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Overview of Spent Nuclear Fuel Storage Needs Assessment Tool

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Outline

- Context
- Challenge
- Goal of Tool
- Overview of Tool
- Demonstration and Sample Results
- Discussion

Global Context

- **Used fuel management is a critical issue in the safety, security, and sustainability**
  - **Storage capacity supports reliable fuel service programs**
  - **Economical, proven, safe, secure**

Region	Amount (tHM)
West Europe	**36,100**
East Europe	**27,700**
America	**83,300**
Asia & Africa	**23,900**
World	**171,000**

SNF in Storage Globally by Region

From Fukuda, K., et al. "IAEA Overview of Global Spent Fuel Storage." IAEA-CN-102/60.

Spent nuclear fuel is accumulating in many geographic regions, in decentralized fashion and according to varying standards, a fact that represents a potential threat to global security and hardly coincides with the objectives of nuclear nonproliferation.

-M.I. Solonin, Russian Ministry of Atomic Energy

Technical Cooperation Context

- Used fuel management mentioned as an important issue in each Nuclear Energy Nonproliferation workshop
- Areas of interest related to storage:
  - Capacity
  - Safety
  - Cost
  - Transparency
- Focus on common technical standards and approaches

August 2005 Workshop in Seoul: Selected Topics Identified for Technical Cooperation

- **Evaluation of multilateral fuel cycle service supply concepts**
  - ☑ **Collaboration on issues related to the safe and secure storage of spent nuclear fuel**
  - ☑ **Shareable model and database of future demand for enrichment services and future accumulation of spent nuclear fuel**
- **Technical approaches to reducing proliferation risk**
  - ☑ Improved transparency and data sharing, especially related to safeguards data
  - ☑ Development of near-real-time process monitoring technologies
  - ✓ Strengthening technical capabilities for implementing the Additional Protocol
  - ✓ Collaboration on physical security of nuclear facilities, including vulnerability analysis
  - ✓ Development of new safeguards technologies

Nonproliferation Benefits to Regional Cooperation

- Material protection
  - Prevent loss or theft by non-state actors
- Regional assurance of material control
  - Standards and practices for national spent fuel storage to assure regional states that material is not being diverted or misused (and being managed safely)
- Builds the foundation for the development of fuel cycle service regimes
  - Spent fuel storage is the *sine qua non* of fuel cycle service regimes
  - Reliability of such regimes (GNEP or otherwise) are partially a function of creating an enabling infrastructure
  - Creating infrastructure requires addressing technical challenges

Centralized Spent Fuel Storage Technology Roadmap

- “A structured approach to identifying the broad-scope issues, available technologies to address those issues, and prioritizing them according to standards (such as cost, safety, political acceptance, etc
  - Identify issues, needs and technologies
  - Prioritize issues and technologies
  - Guide research, development and standard development
- Contents:
  - Needs
  - Critical System Requirements
  - Major Functional and Technology Areas
- Draft circulated to participants in 2007. Currently under revision
  - Additional comments welcome!

Challenge

- **Wide range of issues (technical, economic, social, political, etc.)**
- **Wide range of stakeholders**

- **Difficult to identify all issues**
- **Difficult to conduct constructive dialogues**

Concept: Needs Assessment Tool

- Goal: Develop a tool that
  - Could be used by a wide range of stakeholders AND
  - Helped to identify all areas that need to be addressed
  - Helped to identify common understandings and areas of disagreement in a rational manner
- Two modes:
  - Self Assessment: “What are all the things I need to think about?”
  - Stakeholder dialogue
    - How do different stakeholders assess the same set of questions?

Overview (1)

- 8 Types of Users
  - Nuclear Power Plant operator (manager or worker)
  - Spent Nuclear Fuel (SNF) storage-facility operator
  - Academic or industrial researcher
  - Governmental official
  - Member of a regulatory body
  - Member of an International oversight entity
  - Student (college, university, or other higher education)
  - Concerned citizen

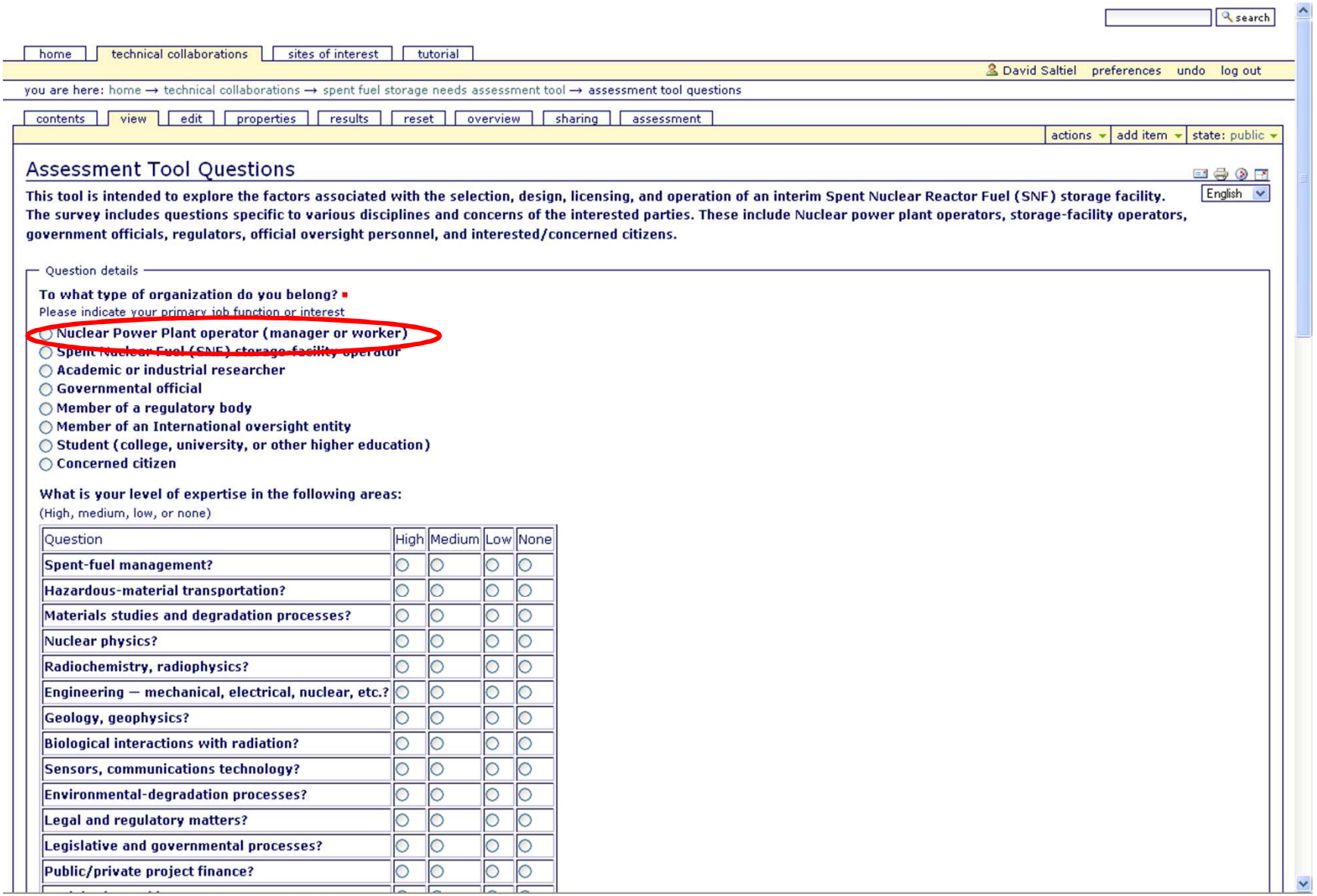
Overview (2)

- **Types of Questions:**
  - **Objective (example):**
    - **What is the age range of the fuel to be sent to interim storage?**
  - **Objective free response (example):**
    - **Describe the transportation paths along which spent fuel would travel to proposed storage sites?**
  - **Subjective (example):**
    - **If an interim storage facility were built in your country, which issues concern you the most (please rank)**

Overview (3)

- Types of output
  - Textual output (verbatim responses to questions)
    - Provides constructive way to conduct stakeholder dialogues and review issues
  - Statistical output (selected questions)
    - Will allow a group of users to understand range of attitudes and concerns
  - Assessment output
    - Uses responses to identify key areas of concern and to suggest resources

Demonstration (1)



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Assessment Tool Questions

English

This tool is intended to explore the factors associated with the selection, design, licensing, and operation of an interim Spent Nuclear Reactor Fuel (SNF) storage facility. The survey includes questions specific to various disciplines and concerns of the interested parties. These include Nuclear power plant operators, storage-facility operators, government officials, regulators, official oversight personnel, and interested/concerned citizens.

Question details

To what type of organization do you belong? ■

Please indicate your primary job function or interest

- ○ **Nuclear Power Plant operator (manager or worker)**
- ○ **Spent Nuclear Fuel (SNF) storage facility operator**
- ○ **Academic or industrial researcher**
- ○ **Governmental official**
- ○ **Member of a regulatory body**
- ○ **Member of an International oversight entity**
- ○ **Student (college, university, or other higher education)**
- ○ **Concerned citizen**

What is your level of expertise in the following areas:

(High, medium, low, or none)

Question	High	Medium	Low	None
Spent-fuel management?	○	○	○	○
Hazardous-material transportation?	○	○	○	○
Materials studies and degradation processes?	○	○	○	○
Nuclear physics?	○	○	○	○
Radiochemistry, radiophysics?	○	○	○	○
Engineering — mechanical, electrical, nuclear, etc.?	○	○	○	○
Geology, geophysics?	○	○	○	○
Biological interactions with radiation?	○	○	○	○
Sensors, communications technology?	○	○	○	○
Environmental-degradation processes?	○	○	○	○
Legal and regulatory matters?	○	○	○	○
Legislative and governmental processes?	○	○	○	○
Public/private project finance?	○	○	○	○

Demonstration (2)

- **How many nuclear power plants (NPPs) operate in your country? (Required)**
  You may either count NPP facilities or the total number of reactors at all NPPs
  - ○ Do not know
  - ○ None
  - ○ 1
  - ● Between 2 and 10
  - ○ More than 10

- **What fraction of your country's electricity supply comes from nuclear generation? (Required)**
  - ○ Do not know
  - ○ Less than 10%
  - ● Between 10% and 40%
  - ○ More than 40%

- **What is the urgency of establishing an interim SNF storage system? (Required)**
  - ○ Do not know
  - ○ Near-term (within 1 to 3 years)
  - ● Intermediate (5 to 10 years)
  - ○ Long-term (more than 10 years)

- **What is the nature of the urgency to establish an interim SNF storage facility? (Required)**
  - ○ No urgency
  - ● Existing storage capacity is filling up
  - ○ Current storage facilities are not safe or secure
  - ○ Economic pressures impacting current operations
  - ○ National or international pressure to act
  - ○ Other

- **Describe the urgency, if appropriate Please provide additional information regarding the urgency of your needs.**

- **Is there a site in your country that is being considered for interim SNF storage?**
  - ○ Do not know
  - ● Yes
  - ○ No

Demonstration (3)

- **How many nuclear reactors at your facility would send SNF to an interim storage site?**
  - ○ Do not know
  - ○ 1
  - ● 2 to 5
  - ○ More than 5
- **What types of SNF are being considered for storage?**
  - ○ Do not know
  - ● PWR
  - ○ BWR
  - ○ CANDU
  - ○ Other
- **What is the range of burnups for the various fuels?**
  - ○ Do not know
  - ○ < 15 GWd/MTU
  - ○ 15-25 GWd/MTU
  - ● 25-45 GWd/MTU
  - ○ > 45 GWd/MTU
- **What is the age range of the SNF to be sent to interim storage**
  - ○ Do not know
  - ○ less than 10 years out of reactor
  - ● 10-20 years out of reactor
  - ○ more than 20 years out of reactor
- **What is the storage configuration of the SNF at your reactors that is ready to be sent to interim storage?**
  - ○ Do not know
  - ● SNF is stored in pools
  - ○ SNF has been transferred to on-site dry storage

Demonstration (4)

- **Is any of the SNF that will be included in amounts to be stored at the interim site known to be damaged?**
  - ○ Do not know
  - ● Yes
  - ○ No

- **Have standards for waste acceptance been developed? For example, amount of SNF per canister, thermal output per canister, moderator exclusion, burnup credit, etc.**
  - ○ Do not know
  - ○ Yes
  - ● No

- What is the distance from your NPP to the SNF interim storage site under consideration?
  - ○ Do not know
  - ○ < 25 km
  - ○ 20-50 km
  - ● 100 km

- **What are the transportation options for moving SNF to the site under consideration? Select all that may apply.**
  - ○ Do not know
  - ○ Road
  - ○ Ship
  - ● Rail
  - ○ Air

- **Would any transportation paths require passage of SNF through or near areas with large populations?**
  - ○ Do not know
  - ○ Yes
  - ● No

- **Are there any choke points along the transportation path from the NPPs to the site under consideration? Choke points are areas of restricted ability to respond to accidents, off-normal events, or any other threat.**
  - ○ Do not know
  - ○ No choke points
  - ● Tunnels
  - ○ Bridges

Demonstration (5)

- If a SNF interim storage facility were to be built in your country which issues concern you the most?
  - No concerns
  - Operational safety
  - Threat of terrorism
  - Environmental damage

- How would the cost of the SNF interim storage system affect your interest in supporting the implementation?
  - Cost would have no effect on my decision
  - There is a maximum cost that I would consider reasonable
  - Cost is one of many important factors

Self Assessment Results

- Example responses based on input:
  - Identifies approximate size of facility needed
  - Identifies areas of potential concern
    - Transportation routes
  - Offers references to facilities developed in similar time frames
  - Offers references to information on the storage and handling of damaged fuel
  - Offers references to waste acceptance standards

Questions

- Is this useful?
- What other stakeholders should be included?
- How should assessment function work?
- How technical should the tool be?