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TITLE SAFEGUARDS ISSUES RELEVANT TO GEOLOGIC DISPOSAL OF SPENT NUCLEAR FUELS

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SAFEGUARDS ISSUES RELEVANT TO GEOLOGIC DISPOSAL OF SPENT NUCLEAR FUELS

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I. INTRODUCTION

Two major controversies surrounding the nuclear industry are radioactive waste management and nuclear material safeguards. Both these problems are highlighted in the long-term management of spent nuclear fuels. Until the mid-seventies, reprocessing of spent fuels and recycling of fissile materials were considered worthwhile after a few years of storage of spent fuel assemblies. The United States, Canada, and Sweden have since changed their policies to directly dispose of spent fuels in geologic repositories. However, France, U.K., U.S.S.R., Federal Republic of Germany, India, and Japan have proceeded with large-scale projects for commercial reprocessing of spent fuels and to extend the fuel cycle to reuse plutonium in both fast and thermal reactors. In addition, other countries, such as Argentina, Brazil, China, and Italy are actively pursuing reprocessing of spent fuels as part of the fuel cycle for nuclear power generation.[1,2]

Although the current policy of the U.S. is to dispose of spent fuels from light water reactors (LWRs) in geologic repositories, very few member States of the International Atomic Energy Agency (IAEA) have adopted this policy of burying valuable energy resources in geologic repositories in perpetuity. Most European states that are considering geologic emplacement of spent fuels are only considering it as an interim measure for possible reuse of the resources in the future. In all these cases, safeguarding nuclear materials contained within the spent fuels is important to prevent proliferation and possible diversion of nuclear materials from peaceful uses.

In civilian nuclear fuel cycles, the time between removal of spent nuclear fuels from reactors and the final stages of nuclear waste disposal spans several decades. Safeguarding nuclear materials contained in spent fuels during this period varies with (1) storage modes, (2) packaging and transportation requirements, and (3) treatment of spent fuel for consolidation or recovery of fissile elements. This paper considers some possible diversion scenarios of spent nuclear fuels and identifies actions necessary to evaluate the needs of a comprehensive safeguards system to assure both domestic and international safeguards.

II. DIVERSION POSSIBILITIES

Domestic safeguards concerns should consider, among other things, the following diversion scenarios:

- Removal of spent fuel elements from consignment after they leave the storage areas at reactor sites;
- Removal of fuel during its stay at away-from-reactor storage and consolidation facilities for spent fuels;
- Removal of consolidated fuel elements from storage or shipment or both;
- Removal of fuel elements from interim storages at repository sites;
- Removal of fuel elements from operating repository;
- Removal of spent fuel from a sealed geologic repository.

International safeguards concerns may include the following:

- That a State might attempt diversion of spent nuclear fuels;
- That a State may not declare all the quantities of spent fuels or not declare all facilities involved in spent fuel management; and
- That secret agreements between States may divert spent fuels for clandestine use.

Although some of the States may see these hypotheses as an affront to their commitments to international safeguards, it is important to recognize the relevance of the analysis of potential diversion strategies to the credibility of international safeguards.[3] The U.S. commitments to the Non-Proliferation Treaty (NPT) and international safeguards might require consideration of all these diversion scenarios in designing safeguards systems for spent nuclear fuels to be placed in geologic repositories.[4]

III. SAFEGUARDS SYSTEM REQUIREMENTS

To design credible safeguards systems, it is necessary to analyze diversion scenarios and design scientifically sound approaches to achieve thoroughness in safeguards implementation. Both in domestic and international safeguards, "timely detection" and "deterrence" aspects of safeguards have become prominent and are even seen by some to be the overriding objectives of safeguards. However, the fundamental requirement of international safeguards is the "assurance" that safeguards are effective by the ability to demonstrate the continued presence of nuclear materials within designated boundaries. This requires the establishment of a system of accounting for and control of nuclear materials within spent fuels and thereby enable both the state and international regulatory agencies to verify the safeguards system.

Accomplishing all these safeguards objectives is not an easy task, especially under the present conditions in the U.S. where a variety of options are considered for interim management of spent fuels and numerous options are being explored for fuel consolidation, packaging, storage and disposal. Some of the issues that need to be addressed in the near term are the following:

- The prudence of permanent disposal of spent fuels in geologic repositories;
- The pros and cons of numerous strategies for consolidating spent fuels for geologic disposal;
- The value of fuel element consolidation (as opposed to retaining the integrity of fuel assemblies as items) in the context of accounting for and control of nuclear materials;
- Development of nondestructive assay techniques to accurately measure fissile materials within fuel assemblies and consolidated materials;
- Strategies for monitored retrievable storage of spent fuels with safeguards assurance;
- Methods to assure integrity of fuel canisters during the emplacement and the operational phase of the repository; and
- Development of simple but reliable methods to verify nonintrusion into "sealed" geologic repositories.

For spent fuel management programs, a comprehensive safeguards policy specifying stages of spent fuel management activities and safeguards requirements at each stage is essential to avoid an overwhelming problem for safeguards at some later time.

IV. REFERENCES

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