

Project Planning at the Hanford Site for International Atomic Energy Agency (IAEA) Safeguards of Excess Fissile Material

Prepared for the U.S. Department of Energy
Office of Environmental Restoration and
Waste Management



Westinghouse
Hanford Company Richland, Washington

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B. W. Smith
Pacific Northwest Laboratory

L. P. McRae
Westinghouse Hanford Company

A. C. Walker
U.S. Department of Energy
Richland Operations Office

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**Project Planning at the Hanford Site for
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Safeguards of Excess Fissile Material**

Brian W. Smith

Pacific Northwest Laboratory
Richland, Washington

Larry P. McRae

Westinghouse Hanford Company
Richland, Washington

Alan C. Walker

DOE Richland Operation Office
Richland, Washington 99352

ABSTRACT

In his September 1993 address to the United Nations General Assembly, President Clinton proposed several initiatives to promote nuclear nonproliferation. One element of these initiatives was that the United States offered to place excess fissile material under International Atomic Energy Agency (IAEA) safeguards. Three Department of Energy (DOE) facilities were identified as part of a phased approach for initial implementation. This paper describes the planning process used to provide information to assist the DOE in making decisions for the initial offer, outlines tasks to be performed, and develops a budget request. The process consisted of: (1) characterizing the Hanford Site from the perspective of IAEA safeguards; (2) identifying key issues to be resolved; (3) developing budget estimates and schedules; (4) interfacing with other DOE components and the IAEA to clarify expected activities; and (5) initiating additional data collection and preparatory activities to reduce planning uncertainties.

INTRODUCTION

On September 27, 1993, President Clinton addressed the United Nations General Assembly and proposed several initiatives to promote nuclear nonproliferation. To support these initiatives, the United

States offered to place excess fissile material under International Atomic Energy Agency (IAEA) safeguards (White House Fact Sheet, 1993).

The National Security Council tasked the Nuclear Weapons Council (NWC) with determining the amount of material that was excess and available to be placed under IAEA safeguards. The NWC made its initial recommendation on November 15, 1993. The U.S. Department of Energy (DOE) then began the process of identifying specific facilities that could be used in a phased approach to initial implementation of safeguards. Three facilities were identified: the Y-12 plant at Oak Ridge; the Hanford Site, and the Rocky Flats Plant (Cherry 1994). The goal was to begin implementing safeguards at Oak Ridge in September 1994 and at the Hanford Site in December 1994.

Safeguards for excess fissile materials are implemented under the U.S./IAEA Safeguards Agreement (1980). Of note for the initial implementation is Article 3, which specifies that the safeguards in the United States are to be implemented by the same procedures followed by the IAEA in applying safeguards on similar material in similar facilities in non-nuclear-weapons States. For the initial offer, the implication of Article 3 is that material without sensitive nuclear weapons information would be chosen so that traditional IAEA safeguards approaches could be used.

SITE DESCRIPTION

The 560-square-mile (1,450-square-kilometer) Hanford Site is located in southeastern Washington state (Figure 1). The original mission of the Hanford Site was to produce plutonium for the U.S. nuclear weapons program. The current mission of the Hanford Site is environmental cleanup. The Hanford Site also supports research and development programs for other U.S. initiatives, including high-level waste disposal, energy, and environmental monitoring.

The Hanford Site operated nine production reactors and four reprocessing plants for the production of plutonium for the U.S. nuclear weapons program. These facilities have been deactivated, and the spent fuel is stored pending disposal. Associated fuel fabrication and conversion facilities are also located at the Hanford Site. One conversion facility, the Plutonium Finishing Plant (PFP), is now used to stabilize materials for long-term storage. Table 1 shows the plutonium inventory at the Hanford Site (DOE Press Release, 1993).

TABLE 1. PLUTONIUM INVENTORY AT THE HANFORD SITE

Material Type	Plutonium (MT)
N-reactor fuel	4.0
Fast Flux Test Facility Fuel	3.2
Metal, oxide and scrap	3.8
Total	11.0

About 0.6 metric tons (MT) of high-enriched uranium, 4,000 MT of low-enriched uranium, and 1,000 MT of source materials are also stored at the Hanford Site.

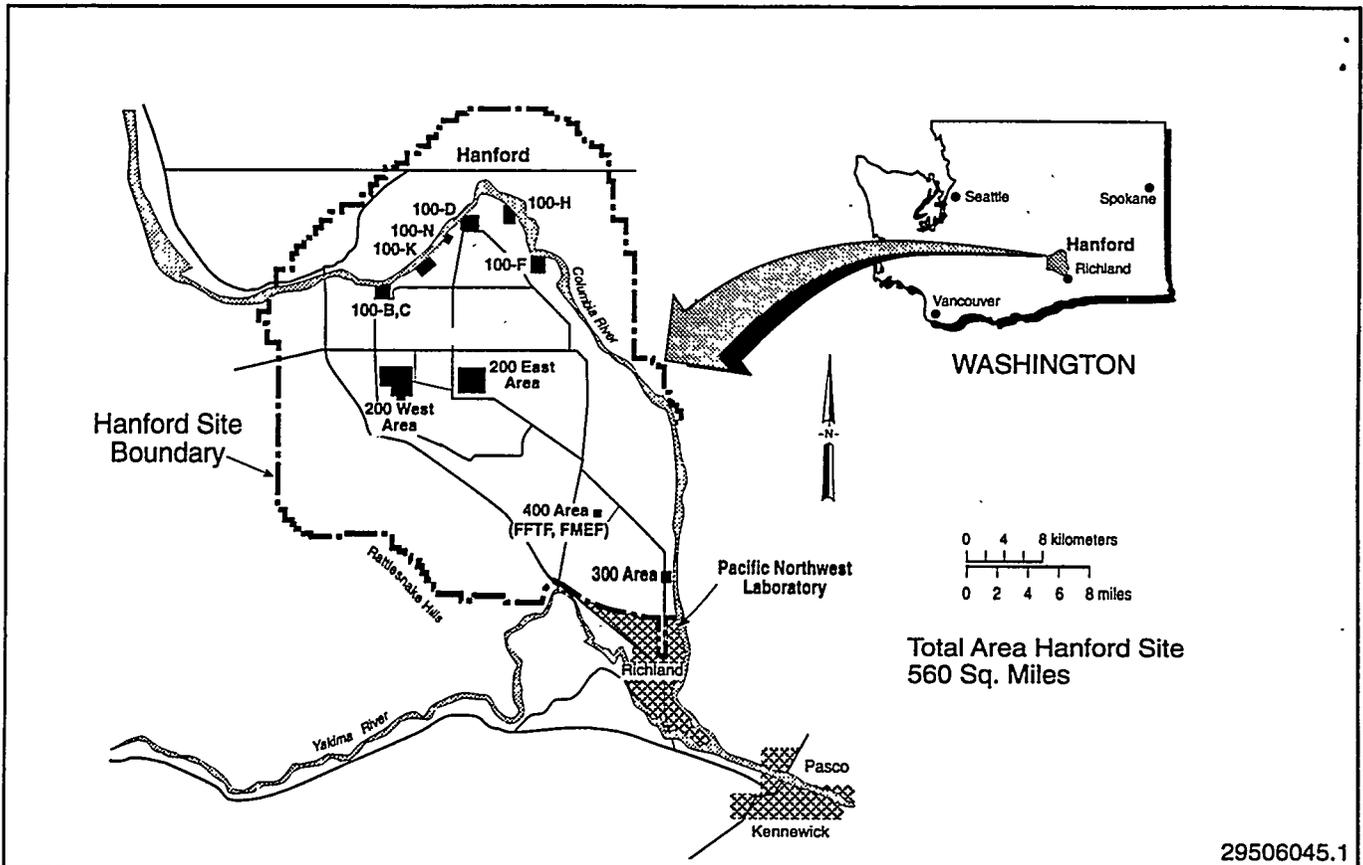


FIGURE 1. HANFORD SITE.

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High-enriched uranium and separated plutonium, other than laboratory samples, are stored at the PFP in the 200 West Area. The PFP contains 94% of the separated plutonium at the Hanford Site. It is estimated that this plutonium could be prepared for an initial IAEA inspection in about four to six months, with complete safeguards implementation in less than one year.

The PFP was built in 1949 and operations began in 1952. The vaults in the 2736Z building at the PFP became the focus of the initial offer because they contain most of the direct-use material on the Hanford Site. The material is contained in discrete items. The vaults contain a number of cubicles, and each cubicle contains 28 or more well-defined storage locations. The materials are reasonably well characterized. The primary impact of IAEA safeguard implementation at these vaults is expected to be radiation exposure to Hanford Site personnel and IAEA inspectors.

Low-enriched uranium is primarily stored in the 300 Area, and consists primarily of N-Reactor fuel with an enrichment of about 1% ²³⁵U.

Irradiated fuels are stored in 10 locations at the Hanford Site. High-level liquid waste is present in 177 tanks, and buried waste is stored as identifiable items in 25 transuranic storage locations and about 200 low-level storage locations. Transuranic-contaminated soil (cribs, trenches, and ponds) has been identified at 24 locations. The K-Basins contain the largest quantity of irradiated fuel at the Hanford Site, with four metric tons of plutonium contained in approximately 100,000 fuel assemblies.

It was assumed that IAEA safeguards would only address the stored plutonium and uranium inventory, and would not include plutonium or uranium in buried waste, waste tanks, or soil contamination during the initial implementation.

The PFP is the first of the Hanford Site weapons facilities to be considered for IAEA safeguards implementation, but it is not the first Hanford Site facility to be considered. The Fast Flux Test Facility (FFTF), the Fuels and Material Examination Facility (FMEF), and the Pacific Northwest Laboratory (PNL) have been on the IAEA's eligibility list for IAEA safeguards since the early 1980s, but have never been chosen for inspection.

KEY ISSUES

In February 1994, the DOE conducted a tutorial at the Hanford Site on IAEA safeguards. Implementation was described to consist of selection of a facility by the IAEA, negotiation of a Facility Attachment by the United States and IAEA representatives, development of design information and initial inventory declaration by the Hanford Site, IAEA verification of design information and stated inventory, and implementation of a safeguards program including routine inspections (Cherry 1994).

The IAEA safeguards approach was assumed, for the purpose of planning, to consist of a focus on material accounting supplemented by containment and surveillance. It was assumed that published criteria were applicable for estimating inspection effort (Larrimore 1993).

Table 2 shows the results of a preliminary assessment of the impacts of IAEA inspections for the whole Hanford Site. Radiation exposures for IAEA inspections would exceed those for all other activities on the Site. In addition, implementing IAEA safeguards on the entire Hanford Site inventory would have a significant impact on IAEA resources. While there are some economies of scale in whole-site IAEA inspections, the benefit of beginning with a single storage location was that baseline procedures could be developed and options could be identified for increased efficiency. Radiation exposures are highest during the initial inspection, and a phased approach would allow methods to be developed to reduce this exposure. In addition, there were unresolved questions regarding access for measurement and verification activities.

The key issues to be resolved regarding IAEA safeguards implementation included security, health and safety, budgets, shipping plutonium samples, and measurement of complex material types. Some of these issues need to be addressed in the Facility Attachment.

Health and safety issues are focused on radiation exposure, but also include training, respirators, dosimetry, and safety analysis of IAEA equipment. The key personnel that may exceed administrative limits for radiation are those qualified to operate as vault technicians. IAEA inspectors would likely exceed Hanford Site administrative limits for radiation exposure.

Security issues addressed included access procedures for IAEA inspectors, transfer and reporting of inventory data, IAEA security requirements, and receipt of IAEA equipment.

Shipping plutonium samples was an unknown, because the Hanford Site did not have procedures for shipping plutonium to a foreign country, and the IAEA uses air shipments, which is not a common practice in the United States. Sea shipments, although not meeting the IAEA timeliness goals, were also considered as an option to ensure that samples could be shipped to the IAEA for analysis.

In addition, there were considerations of indirect impacts on staffing at the PFP.

To address these key issues, four focus groups were established to review the conditions and identify options. The groups addressed:

- Plutonium shipping and sampling
- Radiation exposure and ALARA

- Equipment and instrumentation
- Alternative safeguards approaches.

The membership of these working groups consisted of staff from DOE, PNL, and WHC. Membership included experience in plant operations, technical aspects of the topic, regulatory compliance, and oversight. Initially, the focus groups identified issues to be discussed with the IAEA. As the IAEA's safeguards approach for the Hanford Site was clarified, then the focus groups identified options to streamline the process and enhance the health and safety of Hanford Site workers and IAEA inspectors. Each focus group produced a position paper identifying the key issues and proposing options.

In addition to those activities needed if only a single Hanford Site location is offered for safeguards implementation, there are other activities that should be initiated as soon as possible for other locations that would be offered at a later date. For example, the K-Basins need modification of the nuclear material accounting and control system if that area is selected

TABLE 2. PRELIMINARY ASSESSMENT OF IMPACTS OF IAEA SAFEGUARDS ON THE HANFORD SITE ACTIVE INVENTORY.

Facility	Material Significance		Hanford Impacts			IAEA Resources (insp-days)
	Material	Quantity*		Radiation	Cost	
All of Hanford	All Types	1,930 SQ	Initial	25-110 Rem	\$6M	350
			Routine	3-80 Rem/yr	\$3M	300
100-K Area	Spent Fuel	700 SQ	Initial	10-30 Rem	\$2M	185
			Routine	2-10 Rem/yr	\$1M	150
200 West Area	All Types (94% of Direct Use Material)	625 SQ	Initial	15-80 Rem	\$2M	100
			Routine	10-80 Rem/yr	\$1M	70
200 East Area	All Types	5 SQ	Initial	<0.5 Rem	\$0.5M	17
			Routine	<0.5 Rem/yr	\$0.2M	6
300 Area WHC Facilities	Low Enriched Uranium Fuel; Scrap; Samples	250 SQ	Initial	<0.5 Rem	\$0.5M	12
			Routine	<0.5 Rem/yr	\$0.2M	10
Fast Flux Test Facility	Irradiated and Fresh Fuel	350 SQ	Initial	<0.5 Rem	\$0.5M	26
			Routine	<0.5 Rem/yr	\$0.2M	20
PNL Laboratories	Samples and Spent Fuel	4 SQ	Initial	<0.5 Rem	\$0.5M	17
			Routine	<0.5 Rem/yr	\$0.2M	8

* IAEA defines significant quantity as 8 kilograms of plutonium, 25 kilograms of ²³⁵U in high enriched uranium, 75 kilograms of ²³⁵U in low enriched uranium, or 20 metric tonnes of source material.

now or in the future. All items need to be measured as they are encapsulated. Provisions must be made for attaching a unique identifier and some type of tamper-indicator to each container. Additionally, options must be developed to upgrade the fuel containers in the K West Basin that have already been encapsulated.

BUDGET ESTIMATES AND SCHEDULES

Once key issues were identified, a detailed work plan was developed as the basis to request budgeting. The work plan identified over 100 tasks in two general areas:

- IAEA implementation
 - support to DOE headquarters in making offer
 - preparing required documentation
 - support to IAEA safeguards approach
 - support IAEA safeguards initiation
- Hanford Site preparations
 - resolution of key issues
 - prepare plant procedures and training
 - prepare materials and facilities
 - administrative and technical support

The direct cost for preparing for IAEA safeguards at the PFP was initially estimated to be about \$2,000,000. For the whole of the Hanford Site active inventory, the time for initial preparations was estimated to be greater than one year and the cost on the order of \$6,000,000. A major source of uncertainty is the cost of estimating and verifying the inventory in the K-Basins. If buried waste, tank wastes, and contaminated soil are to be included, the time for initial implementation will be greater than five years, and the implementation cost will be in the tens of millions of dollars.

The schedule was divided into two aspects: United States Government activities and Hanford Site activities. The United States Government schedule provided the framework for Hanford Site planning activities and included revision of the facility eligibility list and submittal to the Congress, Congressional review, and Facility Attachment negotiations.

When it was determined that no new funding would be available, budgets had to be worked throughout the process, and are still an issue. One result of the budget difficulties was schedule compression. With the DOE committed to reducing its budget over the next five

years, each activity is being reviewed for impact on site missions and to minimize funding and schedule impacts.

TECHNICAL VISITS

Preliminary consultations were held with the IAEA to discuss safeguards approaches, schedules, resources, radiation exposure, measurement methods, and containment and surveillance approaches. These visits included facility tours. The IAEA visits assisted Hanford Site personnel in identifying needed procedure changes and system modifications, planning personnel training, and analyzing safety for IAEA activities.

ACTUAL EXPERIENCE

The first IAEA inspection began at PFP Vault 3 in late November 1994 and continued through December 13, 1994. The inspection team worked 10- to 12-hour days; that, combined with the nearly one-hour drive out to the PFP facility, provided for very long days. Throughout the process, issues had to be continually resolved. The inspections stressed the system, not only in the new procedures being performed, but also in the level of activity. More items were moved in the first week of the inspection than had been moved in the previous two years. A number of procedures were revised and staff trained in their use. Operating records, called supporting documents in the IAEA's vernacular, were in several locations. Some had been sent to storage, and some had been transferred to other locations for other DOE programs. The building had limited hours of access, and the inspections expanded those hours.

Compliance with health and safety procedures was an issue throughout the inspection. The primary impact was in the time required for procedural compliance activities. For example, the material was stored in one room, samples were taken in a glovebox in another room, items were repackaged after sampling in a third room, Hanford Site accountability measurements after repackaging were performed in a fourth room, and the IAEA's verification equipment was set up in a fifth room. Each room had sign-in procedures, and each had radiological survey procedures to be performed when exiting. Some confusion occurred when the IAEA activities transitioned from being a familiarization tour to actually conducting activities, specifically regarding dress.

Containment proved troublesome in that the initial planning had not fully recognized the IAEA needs. Initial assessments of containment options were based on personnel protection and material controls, and didn't fully recognize the IAEA's viewpoint. For example, Hanford Site ventilation ducts have bars inside them to prevent access through the ducts, and other physical protection measures are used to detect tampering. The IAEA's position was that they could not duplicate the Hanford Site's physical protection system to include tamper detection, and that sealing technologies were not available for this type of problem. The paper seals routinely used by the IAEA each night during the week are only considered valid for 24 hours, and therefore other methods of interim sealing were needed for the weekend.

Plutonium samples were shipped to the IAEA using the PAT-2 shipping container. Arrangements, including documentation and approvals, were made in advance with the countries to which the samples were sent.

To benefit sites such as Hanford, whose older facilities were not designed with IAEA safeguards in mind, several potential future development activities are being investigated. These include: new seal technologies for individual items, remote monitoring to reduce radiation exposures, and improved measurement technologies, including use of calorimetry.

SUMMARY

The first IAEA inspection at the Hanford Site began in December 1994 as scheduled. A planning process had been used to involve all functional aspects of the site at an early phase of the preparation. While budget difficulties resulted in schedule compression, and in some cases deletion of tasks, the planning process had established a baseline to ensure that all critical tasks were performed. The implementation exercise validated the planning process and highlighted several areas for future development. These include new containment and surveillance technologies and improved measurement methods for scrap.

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