HEDL-SA-1965

TECHNICAL INFORMATION PROGRAM SUMMARY

MASTER

SAFEGUARDS FOR SPECIAL NUCLEAR MATERIALS

WESTINGHOUSE HANFORD COMPANY—OPERATING THE HANFORD ENGINEERING DEVELOPMENT LABORATORY FOR THE DEPARTMENT OF ENERGY

DOE Richland, WA

DISCLAIMER

HEDL-SA-1965 SP

SAFEGUARDS FOR SPECIAL NUCLEAR MATERIALS

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BACKUP INFORMATION FOR VARIOUS MEETINGS

Safeguards and Materials Management

HANFORD ENGINEERING DEVELOPMENT LABORATORY
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What Is Safeguards?

Safeguards involves protection and control of nuclear materials. It includes aspects of security, accountability and public protection. The basic idea behind safeguards is to keep track of all nuclear material assigned to a company and to provide methods for preventing inadvertent losses which could endanger workers or the general public. Safeguards also establishes procedures for protecting nuclear material from theft.

What is Accountability?

Accountability is a system of methods and procedures for keeping track of all nuclear material. At Hanford Engineering Development Laboratory (HEDL) this means a computerized record of information relating to the identification, containment, type and location of nuclear material. It includes recording all movement of nuclear materials from place to place or point to point and through the fuel fabrication process. Records are kept of both the product and byproducts such as scrap and waste.

These records are supplemented by a measurement program whereby quantities of special nuclear materials are independently determined at various stages in the process and compared to the book values; and by a physical inventory program where all nuclear materials in particular areas of the plant are identified by a team of workers and compared against the computer listings.

HEDL was a pioneer in the development of computerized nuclear materials accountability. The first system was installed in the Plutonium Fuels Laboratory in 1968. The system utilizes real-time, on-line techniques with the master files in the computer being changed as the operator enters the information at a terminal located near his work station.

Today, HEDL is developing the second generation of this system, utilizing the most advanced techniques and equipment to gather, edit and protect the data. Wherever possible, automated techniques--instruments connected directly to the computer--are used to eliminate the potential of human error, and at the same time achieve a higher level of safeguards protection. These instruments include electronic balances for direct measurement of weight, laser label scanners to identify sealed containers of nuclear materials, and hand geometry devices to positively identify individuals who are entering or requesting data.

Similar accountability systems are being developed by nuclear materials facilities across the nation and throughout the world.

<u>How Do We Measure Nuclear Materials?</u>

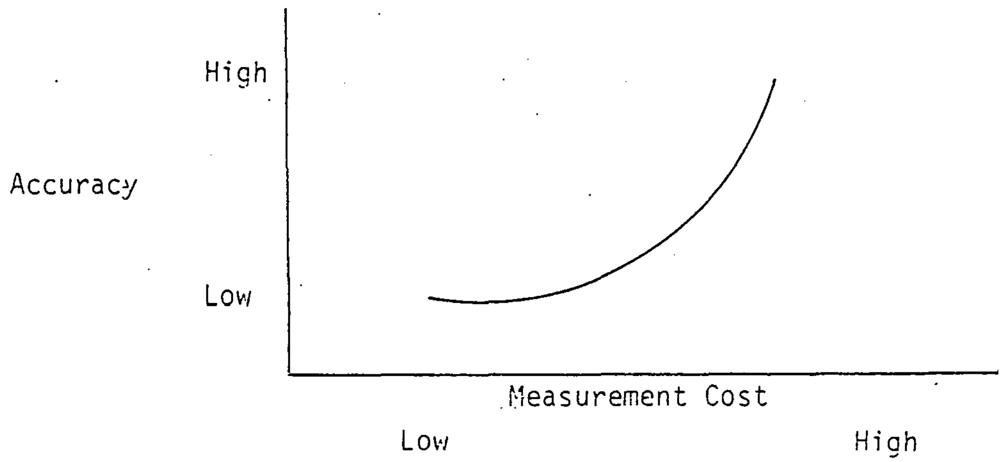
Nuclear materials measurement is a science in itself. At HEDL, and across the nation, scientists are developing new instruments and techniques for more accurate nuclear materials measurement. Two general methods are use: Chemical and nondestructive assay.

In chemical methods, materials are changed or combined with other chemicals in such a manner that they are no longer suitable for nuclear fuel fabrication. Therefore, the method is termed "destructive" and can be used only on samples of the nuclear material. Examples of these methods for safeguards include isotopic dilution, mass spectroscopy, chemical titration (Davis-Gray, amperometric, coulometric). Examples of destructive measurements in other fields include strength testing of steel, and purity analysis of food.

Nondestructive assay techniques use some physical attribute of the nuclear material to provide the measurement. As the name implies, the usefulness of the material is not impaired by the measurement. If desired, all of a quantity of nuclear material can be measured nondestructively. Heat generation is used for calorimetry (counting the calories or heat given off). Radiation emanating from the nuclear material is used in neutron counting and gamma scanning techniques. The ability of nuclear material to respond to monochromatic (radiation of a single wavelength) x-ray radiation is used in x-ray fluorescence and densitometry absorption techniques.

How Accurately Can We Measure Nuclear Materials?

Chemical methods are highly accurate, measuring nuclear material to within a few tenths of 1% of the element weight. These are also the methods that are traceable to the National Bureau of Standards. Nondestructive assay accuacy ranges from a few tenths of 1% to 10 to 15% depending upon the method, the types, and the quantities of the nuclear material being measured. In general, measurement error and the cost of the measurement are related as shown in the following diagram.



Thus, low cost measurements have low accuracy, and highly accurate measurements are expensive. The same is true of other fields of measurement. For example, distance measurement with laser techniques is more accurate and more expensive than measurement of that same distance with a yardstick.

Nuclear material accounting is based upon several types of unit measurement, depending on the value, state of manufacture and level of radiation of the material. For example, natural uranium is measured in kilograms, plutonium is measured in grams, and californium is measured in micrograms.

HEDL's measurement program places emphasis on establishing a very accurate assay of incoming nuclear material using chemical measurement. Once the received material has been characterized, other procedures are used to trace and account for the material as it moves through the various processing steps. The material is kept in sealed containers of known weight and identification.

The computer system maintains the records on the location and quantity of material throughout the processing line.

Inventory differences (ID) are simply the differences in amount of material between what the accounting records show are charged to a facility or process and what a physical inventory shows to be on hand. The entries to the accounting record and the physical inventory are each based on measurements having some degree of uncertainty. ID are, therefore, normal and expected in any processing operation. The occurrences of ID are usually due to measurement imprecisions, nuclear material holdup in equipment, erroneous estimates on material in unmeasurable form at the time of inventory or error in data recording.

Nuclear fuel processing is something like baking a cake. When you place all of the ingredients in the mixing bowl and stir them up, very small quantities stick to the side of the bowl and thus do not end up in the cake. Because the measurement techniques for radioactive materials are so accurate, these "in process" quantities become part of the ID.

Individual and cumulative ID are constantly evaluated by contractor and DOE Safegaurds staff to ensure that the ID are within control limits established for each process or facility. Stringent physical security and material control procedures are a vital part of an integrated safeguards system designed to complement the ID analysis and to assure that ID are not caused by theft or diversion of nuclear material.

What Precautions Are Taken to Insure That The Computer Data Is Correct?

Since some of the data are classified, special procedures must be taken to protect the information at all times, including the time that it is stored in computers. This means that unauthorized persons must not be allowed access to classified data, that data are not lost or destroyed, and that records are not falsified. The computer is located in a locked room and access is granted only by key card. Access at the remote terminal is only granted after the individual is identified as an authorized user. Currently a password system is in use, although HEDL is investigating the use of identification devices that measure some physical attribute of an individual such as finger print scan or hand geometry. Entry of data is very rigidly controlled through functions that are limited to a person's authorization level. All of the data necessary to perform a function are gathered by the computer and edited against the data base before the computer records are changed. This eliminates incomplete data entry and the edits insure that the data are correct.

Frequent physical inventories are taken to compare the computer records against the actual location and quantities to detect any errors that may be present.

System Failure

If the computer fails, a combination of manual and semi-automated techniques is used to track the nuclear materials inventory. Snapshots of the computer files, which are taken on a daily basis, are stored in the form of inventory listings on paper and a magnetic tape of the inventory conditions at the end of day. If the system fails, the paper records are manually changed to reflect changes in inventory until the computer is returned to service. Once the computer is repaired, the magnetic tape is used to generate the inventory at the last checkpoint before the system failed and the files are updated to reflect the current condition.

How Timely Are The Data?

HEDL operates a real-time system. This means that the computer files are changed as soon as the data entry for a transaction (nuclear materials movement) is complete. Those data are then immediately available anywhere in the system. The speed of the line printer is the limiting factor in report generation. Current capability is 1,000 lines of data per minute, or one page of information every three seconds.

Meticulous records are kept on all nuclear material. Conditions under which the fuel processing occured, complete chemistry of all samples, history of all movements, codes and dates of all inspections, and photograph numbers for x-ray inspections are examples of the type and complexity of the data maintained for all nculear material. This information services not only safeguards, but quality assurance, fuels fabrication, fuels development, and provides a data bank for future research. Although the data are maintained both manually and on a number of computer systems, they can be assembled rapidly into a complete package. In a recent test of this system, the Department of Energy requested a complete history on a given fuel pin for the Fast Flux Test Facility (FFTF). The response was given to DOE within six hours. The majority of that time was spent in reproduction and proofing to ensure that the data package was completed.

Measures Taken to Physically Protect Nuclear Material

Nuclear material is stored in vaults or in vault-type rooms. Within these vaults, the nuclear material is maintained in doubly-sealed canisters (a can within a can) which are locked into bins. The canisters, the bins, and sometimes the vaults are closed with tamper-indicating seals that are uniquely numbered and recorded. Evidence of any unauthorized entry would therefore be available. Entrances to the vault areas all have alarms which would indicate presence of an intruder, and closed-circuit TV is used to monitor the area. In addition, the guard force patrols the perimeter of the area during the off-shifts.

Access to nuclear material is currently controlled through a combination of administrative procedures. Two persons must be present when handling nuclear materials to meet safety and safeguards requirements. Entrance into a protected area--where nuclear material is processed or stored--is controlled through an entry portal system. Up to three independent checks of a person's identification and authroity for access are conducted by the guard force. In addition, personnel are electronically searched for weapons and nuclear material both upon entrance to and exit from protected areas.

Qualtifications for Handling Nuclear Materials

Laboratory personnel obtain, through the government, a "Q" security clearance which is equivalent to the Department of Defense "Secret" clearance.

This normally takes a minimum of six months and involves a complete investigation of the person's background by the FBI.

Laboratory personnel must attend an intensive training course to become qualified nuclear materials handlers. The course involves aspects of safety, safeguards, and security.

ATTACHMENT I

UNCLASSIFIED INVENTORY DIFFERENCES DATA

FY-1971-1978

Contractor	U-235 in 20% and Greater Uranium*								Plutonium*							
	71	77	73	74	75	76	77	78	71	72	73	74	75	76	77	78
HEDL	.2	-	-	.4	.9	1.9	1.5	7.3	.2	.1	.1	(3.1)**	(.8)	(6.7)	.6	.1
ARHCO/Rockwell	-	-	-	-	-	-	-	-	.9	40.6	49.1	(21.2)	(3.4)	.9	NA	NA
UNI	-	-	-	-	-	-	-	-	-	19.3	.2	(.1)	-	(.1)	NA	NA
PNL	-	-	(.7)**	5.6	(4.[illegible])	(.4)	NA	NA	5.3	9.5	2.0	(.4)	1.0	1.5	NA	NA

* All values are in kilograms

** Figures in brackets ( ) indicate an inventory gain