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REAL-TIME PLUTONIUM ACCOUNTABILITY AND INVENTORY CONTROL SYSTEM*

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ABSTRACT

An on-line inventory system for a large storage and processing facility is planned. A terminal system will provide for interactive updating and information retrieval. The data base will contain information on inventory items and transactions, as well as process monitoring information and laboratory bookkeeping data. Access to the terminals, as well as the storage vaults, will be controlled by fingerprint comparison with a personnel identification data base.

Bar code labels attached to each inventory item will be read by a light pen during physical inventories and when materials are transferred. The use of devices to continuously monitor and control storage locations within the vaults is planned.

INTRODUCTION

Before a nuclear materials inventory can be controlled and protected, the contents of the inventory must be known. The items in the inventory must be kept track of and it must be verified that the book inventory is the same as the actual, physical inventory. For a small facility with only a few items, this is not too hard of a job. For a large storage and processing facility, however, just the bookkeeping becomes a major task; and it is even a harder job to verify that the book and physical inventories are the same.

At the Atlantic Richfield Hanford Company we are responsible for one of the largest nuclear materials inventories in the nation. For many years we have used a computer system to account for our inventory. We now have many ideas as to how we can develop a dedicated, real-time computer based system to further control our inventory and improve the safeguards. We are now ironing out the final design of the system and will have a major portion of it running in about a year.

At ARHCO we have thousands of items in our inventory, mostly plutonium. The plutonium can be stored in three forms: as a nitrate, as a metal, or as an oxide. Each of these different forms have correspondingly different containers. Many of our items are contaminated scrap, which are stored in drums as large as 55 gallons. These different containers combine to give us a large, varied inventory, stored in several different types of storage vaults.

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DISCLAIMER

We also have several processing operations and laboratories which involve nuclear materials. The materials in these operations must also be measured and controlled.

To meet our control requirements, we have identified a computer system consisting of four components which we are now working on. These four components are:

1) On-line inventory system
2) Item identification
3) Personnel identification
4) Location identification and surveillance

ON-LINE INVENTORY SYSTEM

For several years we have had an inventory system on a large batch-oriented computer which keeps accounts for all identifiable items of nuclear materials. This data base, which is updated on a weekly basis, contains pertinent information on the inventory items, external shipping and receiving transactions, and internal item control area transactions.

The major effort of developing an on-line inventory system will be to move this existing inventory system to a computer system located within the plutonium processing facility. When the inventory system is on our own computer, we will be able to update it at the time a physical transaction is made or the data generated. This computer, then, will have a completely up-to-date inventory. At any time it will be available to give an accurate accounting of the inventory and will contain the best data available about a particular item.

One addition will be to include inventory information on some of the actual plutonium processing operations. By measuring the process streams and gathering data from chemical analyses, it will be possible to make daily material balance calculations about process areas and calculate the material inbalances. Also, the monitoring of process streams will allow better engineering control of the process.

Another extension of the on-line inventory system will be to automatically generate the input data to the Energy Research and Development Administration's Nuclear Materials Information System (NMIS). On the batch-oriented computer we currently edit and save our NMIS input, as well as generating some Composition of Ending Inventory input. In addition to these functions, we will now be able to automatically generate weekly transaction information to the NMIS shortly after the close of the reporting period.

As part of our current system we keep all the analytical information that is available about our inventory. In the on-line system, this information will be entered into the data base directly by laboratory personnel as soon as an analysis is completed. In addition, a bookkeeping system for the laboratories will be established. This will let the labs know information such as which analyses have yet to be run on which sample, which samples can be discarded and how much work is being done for each end user. This bookkeeping

system will also perform material balance calculations for the laboratories. Eventually, we also plan to tie lab instrumentation and analysis minicomputers directly into our system.

The underlying concept of an on-line inventory system is that data will be entered into the system as soon as it is generated, instead of being written down on a form and entered into the computer later. In order to gather and distribute this data effectively, terminals to the computer must be scattered throughout the operating facility, giving a network as shown in Figure 1.

At the center of the network will be our computer. We have envisioned a computer with 96K of core, disks and magnetic tapes for information storage, and a card reader and lineprinter for input and output.

There will be a terminal to the nuclear materials control group for their input and information retrieval. There will be another terminal in the analytical lab, for their use in entering analytic data and getting bookkeeping information. Another terminal will be located at the engineering group, for their use in receiving analytical information and process data.

There will also be several terminals located in the operations group, for their use in entering process and transaction data. These terminals will be located in positions such that wherever data is generated it will be easily entered into the computer.

ITEM IDENTIFICATION

In order to control the inventory, there must be some way by which the computer can identify the individual items in the inventory. We plan on identifying each item by putting a bar code label on it, similar to the labels which you now find on grocery items. By scanning a pen across the labels, the identification of the item is sent to the computer.

We plan to initially use this system for taking physical inventories of our storage vaults. This should make the inventory faster with less exposure to the operators, and should also make the physical inventory more accurate.

Eventually, we plan to use this system to record transfers in and out of the vaults. We will have one of these light pen systems at the entryway to each vault and as an item goes in or out its number would be entered over the light pen into the computer.

PERSONNEL IDENTIFICATION

In order to safeguard an inventory, the computer must be able to determine who is making a transfer and whether he is authorized to do so. To do this, the computer must be able to uniquely identify each person. Code numbers and magnetic badges are conventional ways of identifying personnel, but these are easily lost or stolen. A more secure concept which is now being worked on is a fingerprint reader.

To identify himself, a person will have to place his finger on one of the fingerprint readers and enter his code number. The computer will then decide if he is really who he says he is, ~~or not, and take the appropriate action.~~

One of these fingerprint readers will be outside each vault. Before the vault door is opened, the people will have to be checked to see if they are authorized to enter. And even if they are authorized to enter, the computer will keep a record of how long they were in the vault and what transactions took place while they were in the vault.

We also plan to put fingerprint readers by the data entry terminals of the inventory system. This will serve a twofold purpose. First, sensitive data on the data base can be protected via fingerprint verification and access control. Secondly, we will only let authorized people alter the data base, and the fingerprint reader will be used by the computer to identify and keep a permanent record of each individual making a modification to the data base.

LOCATION IDENTIFICATION AND SURVEILLANCE

To verify that an item is never removed from its storage location without being authorized, the computer should have some way of insuring the integrity of each storage location.

Sandia Labs in Albuquerque is looking at several concepts of location control and are planning to install a prototype vault at ARHCO.

There are several concepts of surveillance equipment which could be used to monitor the vaults. These include radiation detectors, thermocouples, and strain guages, as well as radio transponsders on each can; however, the concept being most seriously considered by Sandia is putting each of the cans in a cylindrical carousel, which is shaped in such a way that only one container can be accessed through its door at one time. A computer would then control the carousel and know if any item had been removed. In fact, to have access to an item, the computer would have to be told what item is desired. Only then would it turn the carousel so that the requested item could be removed.

SUMMARY

All four of the components have been mentioned as separate systems, but they will not be developed as such. Instead, they will be totally integrated into one system.

To summarize how the interactions among the components will work, take the case of an item being transferred from a storage vault to a processing facility. Before the transfer can take place, it must be authorized over one of the data entry terminals by one or more people who will identify themselves with fingerprints. The two people who are authorized to make the transfer will then go to the vault and identify themselves with the fingerprint reader, which will cause the door to open. The two people will go into the vault and remove the item which has been authorized, from the location selected by the computer. The two people will then take the item out of the vault and pass it

across the light pen reader, which will ensure it is the right item. If desired, the computer will then set a time limit as to when the item should arrive at the processing facility. When the item does arrive at the processing facility, its entry into the process will be recorded over the data entry terminal and the transaction closed. Throughout this transaction, the computer will be keeping a running record of everything that happens.

We feel that the current status of this inventory system will substantially reduce the required time to verify the location of nuclear material in case the inventory status must be quickly confirmed. The checks inherent in this proposed system should greatly reduce the chance of material disappearing and thus improve ARHCO's safeguards ability.

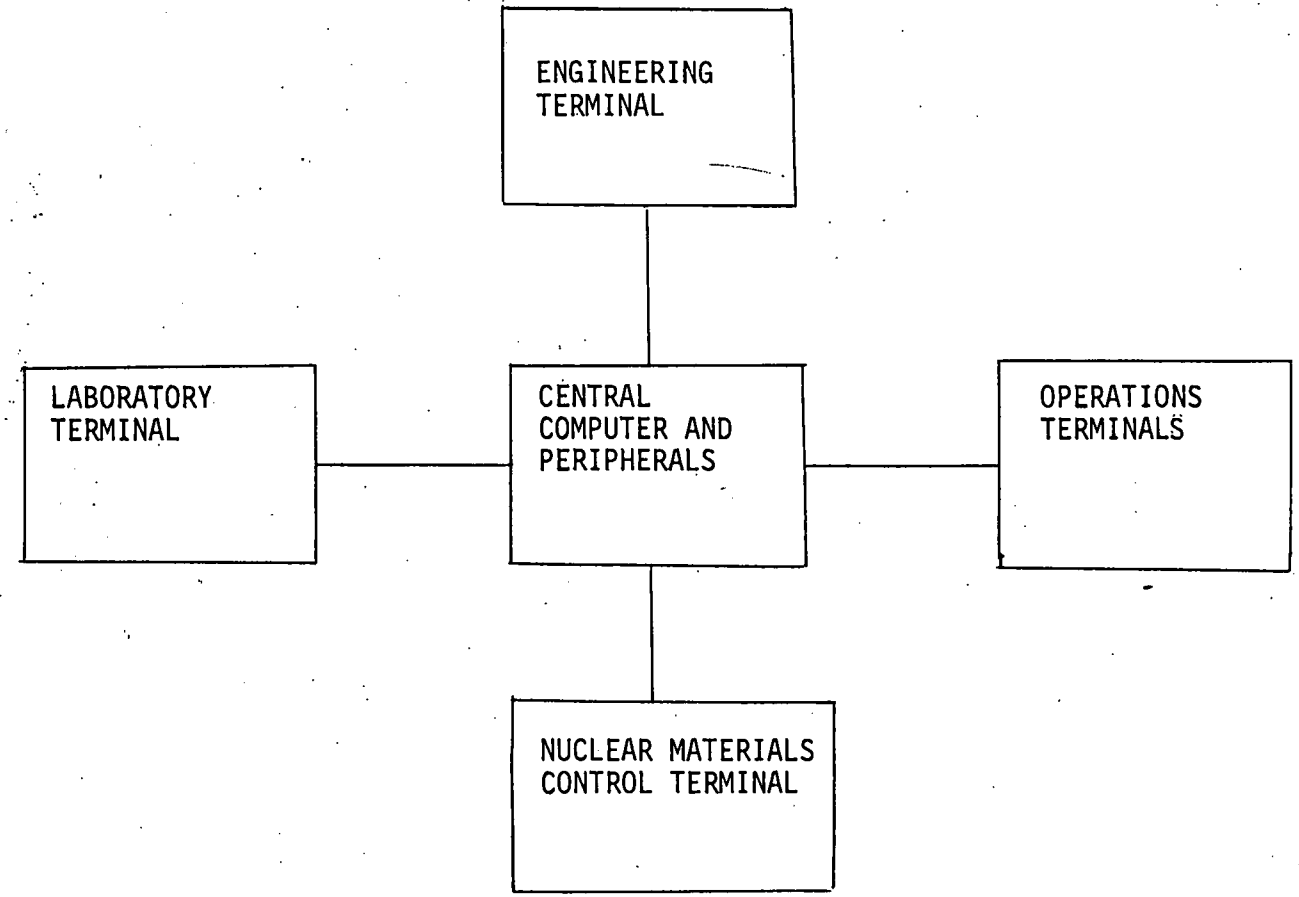

FIGURE 1

BLOCK DIAGRAM OF ON-LINE INVENTORY SYSTEM