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UNITED NUCLEAR CORPORATION

NUCLEAR MATERIALS CONTROL SYSTEM
IN A MULTI-ENRICHMENT PROCESSING PLANT

By

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I. INTRODUCTION

Ladies and gentlemen, it is with great pleasure that I stand before you at this 12th Annual Meeting of INMM. As a representative of United Nuclear Corporation, I plan to describe to you the Nuclear Materials Control System currently in effect at the Hematite, Missouri Plant, a facility located approximately thirty miles south of the City of St. Louis.

The Hematite operation is primarily concerned with the conversion of enriched uranium hexafluoride (UF_6) to a variety of uranium compounds, as outlined in Figure 1, for both government and private use. The monthly inventory at Hematite approximates 2,700 kgs. U^{235} or \$30,000,000 in uranium dollar value. Weekly uranium transactions amount to approximately 140 kgs. U^{235} , or \$1,500,000 in uranium dollar value.

FIGURE - 1 -

The organization of the Hematite facility is as shown in Figure 2. The Nuclear Materials Control Group reports to the Hematite Plant Manager through the Quality Control Manager. This organizational arrangement integrates, under the Quality Control Manager, the functions of Nuclear Materials Control, Product Control, and Statistical Control.

I do not plan to discuss Safeguards procedures for uranium materials prior to receipt at or after shipment from United Nuclear. My presentation specifically describes the efforts at Hematite to safeguard uranium materials while on-site. Although tailored directly to our needs, the system we employ is applicable to other facilities concerned with unirradiated high or low enriched uranium moving through various stages of production or held in inventory.

FIGURE 2

II. OBJECTIVES OF THE NUCLEAR MATERIALS CONTROL SYSTEM

The Nuclear Materials Control System at Hematite was designed with the following objectives in mind:

1. Complete compliance with the requirements of Safeguards' Amendment SG-3 to Special Nuclear Material License SNM-33.
2. A broader observance of Fundamental Materials Control as outlined in the FMC Manual for the Hematite facility. The Manual includes all the safeguards requirements of II.1. above, plus additional plant requirements for segregation of individual customer accounts.
3. A system of current, detailed procedures for over-all nuclear materials control, with individual specific materials control sections (Standard Operating Procedures, or SOP's) for each production area.
4. Provisions for rapid translation of uranium activities to dollar values, to permit, within Safeguards' guidelines, the most economic method of handling special nuclear materials.

5. Continued improvements in inventory measurement systems to better identify uranium content of scrap material and equipment holdup.
6. Flexibility of record systems, to adapt to changing industry requirements of both United Nuclear Corporation and the US AEC.

III. DISCUSSION

The Hematite Plant is divided into five Material Balance Areas (MBA's).

These, shown in Figure 3, are described as follows:

MBA 1. A high enriched (over 4% U^{235}) production room, plus an adjacent uranium hexafluoride (UF_6) storage area. Production of all high enriched uranium dioxide (UO_2) and uranium metal is confined, by this arrangement, within a single area. High enriched recovery is also conducted here.

MBA 2. A room limited in use to the preparation of Naval fuel of a single, specific enrichment.

MBA 3. A laboratory, and an incoming storage area for bulk waste awaiting completion of analyses, plus a storage area for wastes, considered uneconomical to recover, which are being held for transfer to off-site burial.

MBA 4. All low enriched production areas (under 4% U^{235}), and, by far the largest area in terms of floor space. The area includes the

M.B.A. Legend

1. Red Room
2. Item
3. Laboratory
4. Oxide, Pellet, Green Room
5. West Vault, South Vault, Yard, Warehouse

FIGURE 3

uranium dioxide (UO_2) production facility, the pellet fabrication facility, and the low enriched recovery process facility.

MBA 5. Four separate storage areas. Two are vault storage bunkers containing 1,800 and 568 shelves, respectively, for storage of high enriched material. A third is a warehouse containing 316 shelves, larger than those in the bunkers, for the storage of low enriched material packaged in 5 and 15 gallon containers. The fourth is a yard area divided by 405 steel-lined grids designed for the holding of 5 and 15 gallon containers.

Each MBA presents an imaginary boundry across which material must not move without accompanying documentation.

Typical inventory levels for the MBA's are as follows:

	<u>~ kgs. U^{235}</u>	<u>~ Value</u>
MBA 1.	240	\$ 3,000,000
MBA 2.	1,250	15,000,000
MBA 3.	10	100,000
MBA 4.	700	6,000,000
MBA 5.	<u>500</u>	<u>6,000,000</u>
Totals	2,700	\$30,000,000

Control procedures for the five MBA's can be outlined as:

1. Each MBA has a Nuclear Materials Control Custodian who is responsible for his particular MBA.
2. Each MBA is assigned transfer tickets, as shown in Figure 4, in a numerical series and color applicable for use by the particular MBA only. As well as the preprinted control number, each ticket bears the required distribution of (1) Accountability Assistant in charge of records, (2) the originator, (3) the receiver, and, (4) the Nuclear Materials Control Custodian. As a minimum, each ticket must also contain the following information:
 - a. date of movement
 - b. job account to be debited
 - c. job account to be credited
 - d. net weight and net uranium moved
 - e. description of material and lot marking
 - f. container size, kind, and number
 - g. the building, department, and reason for movement, as applicable to each of the two MBA's involved.

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TRANSFER DATE 6/3/71		DEBIT L51	CREDIT L51	TRANSFER TICKET FORM 39 REV. 5-66		No. 79055	
WEIGHT & UNIT 74 grams 65 grams U			CODE	ITEM 93% Samples (UO ₂)			
			NO. CONT. 2	SIZE Sample	KIND Bottles	LOT MARK X01 & X02L51	
TO	BLDG. 240-2	DEPT. R.R.	JOB/ACCT. L51	PRODUCT OR ACCOUNT Consolidation			
	FROM	BLDG. 252	DEPT. S.V.	JOB/ACCT. L51	PRODUCT OR ACCOUNT Storage		
DELIVER BY		DATE	ORIGINATED BY	DATE	FILLED BY	DATE	RECEIVED BY
			David Spindler	6/3/71	David Spindler	6/3/71	B. Dunn. 6/3/71

1 - ACCOUNTABILITY, 2 - ORIGINATOR; 3 - NMC GROUP; 4 - RECEIVER

PINK - MBA1

YELLOW - MBA2

GREEN - MBA3

BLUE - MBA4

GOLD - MBA5

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489/23197 X02 Comp. 11.0

FIGURE 4

h. the signature (not initials) and date signed, of the originator, the transporter, and the receiver.

3. The supplies of unused transfer tickets for all MBA's are held by the Nuclear Materials Control group, and distributed to each MBA in quantities according to need. A frequent audit is conducted.

4. Once distributed to an MBA, a supply of tickets becomes the responsibility of Production, and a record is maintained by production personnel in the MBA'S to provide a perpetual inventory of tickets received, used, and on hand. Each production foreman is responsible for completion and distribution of tickets at the time of material movement.

5. The Nuclear Materials Control Group audits all tickets for completeness and accuracy of information. All voided tickets are returned to the Nuclear Materials Control Group for recording in the Ticket Control Journal.

6. Each active MBA, or active part thereof, is inventoried monthly, and the inventory total, divided by job, is compared, at least six times

each year, with the Uranium General Ledger. The loss (Measured Discards plus Material Unaccounted For), as revealed by the monthly MBA inventory, is compared monthly to the loss expected for the active MBA's. MBA 5 (storage area) and MBA 3 (laboratory) are not considered production loss areas, and any Material Unaccounted For (MUF) experienced in these areas is reflected in the loss comparisons of the active MBA's 1, 2, and 4. Any loss exceeding the expected loss is immediately investigated and reported as provided for in the Safeguards' Amendment. Reports of the results of the investigation are also reported as required.

The MBA control system, as it operates for a typical receipt and shipment, can be outlined as follows:

1. High enriched uranium hexafluoride (UF_6) gas is received at Shipping-Receiving (part of Warehouse area, MBA 5). A gold color transfer ticket is written identifying the uranium hexafluoride (UF_6) by job symbol and providing for the movement of the material to the high enriched production area (MBA 1).

2. The material is entered on the MBA 1 book, and conversion to product (e.g. uranium dioxide - UO_2) is begun.
3. Production of the uranium dioxide (UO_2) product is completed, the material is packaged, and returned, on a Pink colored transfer ticket, to Shipping-Receiving. The amount of the movement is removed from the MBA 1 book.
4. The difference in uranium content, between the input to MBA 1 and the output from the MBA, for this particular transaction, is handled as follows:
 - a. All discards and burials are reported on Pink transfer tickets listing movement from the MBA to either an on-site lagoon (liquids) or off-site burial (solids). The amounts are removed from the MBA book.
 - b. Stack effluent and laundry water discharge losses are pro rated to the job on the basis of the job's percentage of total production for the month. The amounts are removed from the MBA book.

c. Any remaining difference between the input and the output is Material Unaccounted For (MUF), and, as such, is removed from the MBA book and added to the Measured Discards to obtain total loss which is compared to the expected loss.

5. As mentioned previously, movements of samples to and returns from the laboratory are adjusted in order to permit Material Unaccounted For in connection therewith to appear on the active MBA book. It will be remembered, also, that high enriched scrap recovery is one of the functions of MBA 1, and, therefore, the scrap from the exhibit work was recovered to Uranium dioxide (UO_2) and shipped as product.

IV. CONCLUDING REMARKS

Lastly, since the beach is waiting, I should like to pass briefly over some additional facets of Nuclear Materials Control at Hematite.

Monthly inventories are religiously conducted regardless of the status of production operations and the crudeness of estimates on system holdup.

Even with the Plant operating at full capacity, the repetitive monthly inventories, under the MBA system, have attained sufficient sophistication so that even minor materials control problems are detected.

As aides in conducting the monthly inventories, such items as the Gamma Scintillation Counter, and Isotopic Source Assay System (ISAS) - which will be discussed in later presentations at this meeting, have greatly elucidated the elusive uranium content of scrap.

Improved programs of effluent control and monitoring, with reports of measurement data, by the Nuclear and Industrial Safety Group to Nuclear Materials Control, has resulted in greater knowledge of measured losses and lowering of the portion of the total loss assigned to Material Unaccounted For.

Along with these improved measurement techniques, a program of statistical evaluation has been in effect for over a year aimed at developing limits of error for all measurements.

Limits of error have been established on all shipments from Hematite, all uranium measurements conducted on-site, and for the scale and balance program.

Further developmental work is in progress to establish limits of error on inventories, uranium hexafluoride receipts, and Material Unaccounted For.

Only through increased knowledge of known losses, and their associated limits of error, can Material Unaccounted For be minimized and action taken to reduce all losses to their lowest limit.

In summary, the MBA system of control which I have described, is not at the level of perfection for which we strive, but has been both physically and mentally rewarding to date, and gives an indication of the direction to be pursued in the attempt to isolate and conquer the problems of Nuclear Materials Control.

V. ACKNOWLEDGMENT

In closing, I should like to acknowledge the interest and assistance of Mr. G. O. Amy, the Hematite Plant Manager, and of Mr. D. E. Bouchein, the Hematite Quality Control Manager, in the operation of the Nuclear Materials Control System at Hematite, and their concurrence in the presentation of this paper.