Institute of Nuclear Materials Management,
11th Annual Meeting, 1970

PREFACE

This report contains the Proceedings of the Eleventh Annual Meeting of the Institute of Nuclear Materials Management.

The three-day meeting, sponsored by the INMM, consisted of formal papers and discussions in the general and specific areas of management, transportation and safeguards of nuclear materials.

The Dinner Speaker was The Honorable Craig Hosmer, Member Joint Committee on Atomic Energy.

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EXHIBITS

A general invitation to nuclear and nuclear-associated industry produced twelve excellent exhibits. The Institute is indebted to the following firms for their cooperation in helping to make our Eleventh Annual Meeting a success.

Argonne National Laboratory
Monsanto Research Corporation, Mound Laboratory
Los Alamos Scientific Laboratory
Gulf General Atomic
Tri-State Motor Transit Company
Ludlum Measurements, Inc., Sweetwater, Texas
Avco, Tulsa, Oklahoma
National Nuclear Corporation, Palo Alto, California
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WELCOMING REMARKS

R. F. Hibbs

Institute of Nuclear Materials Management Conference

May 25, 1970

Gatlinburg, Tennessee

From a personal standpoint--as well as representing Union Carbide Corporation--it is a pleasure to welcome you to this conference. I'm sorry you weren't able to meet in Oak Ridge. However, we Oak Ridgers consider Gatlinburg one of our nicer suburbs!

Seriously, I have taken a great deal of interest in the activities of the Institute. As the operator of four major facilities for the U. S. Atomic Energy Commission, Union Carbide certainly has had its share of problems in the field of nuclear materials management.

While not wanting to appear immodest, I am personally proud of the role members of the Nuclear Division staff have played in the growth and development of the Institute of Nuclear Materials Management. I am particularly pleased by the fact that of the 66 Certified Nuclear Materials Managers, 14 are members of the Nuclear Division staff, and two are retired members of our staff.

The objectives of the organization to promote research, to establish standards, and to disseminate information have been well implemented since the formation of the Institute about twelve years ago. That this is true I think is evidenced by the current international scope of the organization.

It hasn't been too long since I was personally and directly involved in some very real problems of nuclear materials management. In retrospect, I guess that the problem of determining the inventory of a major enriched-uranium processing system is probably one of the most difficult and least-appreciated aspects of our business. I am well aware of the problems in measuring transfers, discards, and shipments but, to my mind, the problem of inventory is much greater. Take equipment holdups, for example. Even in relatively small static systems it is difficult. In large, continuously operating systems with many valves, tanks, decomposers, reactors, and all the interconnecting piping one is almost confronted with an impossibility. I think it is a great tribute to the members of this organization that we do as well as we do.

In reviewing the program for this meeting I notice the heavy emphasis on safeguards and the important part the Institute can play. I think you will agree that my concern for inventory is central to a reasonable safeguards system. Certainly the manipulation of inventories is an old and tested method of fraud. When one considers the difficulty honest people have in measuring inventory, it doesn't stretch the imagination to see the opportunities for dishonest ones. These opportunities will become increasingly numerous as the volume of business and the size of the processing system increase. I think the members of this Institute can make a great contribution to solution of this problem. A considerable amount of thought by many people must be applied to this problem.

In addition to the determination of equipment holdup, such things as representative sampling, good analytical techniques, and the other problems with which you are well aware need attention. I have the feeling that what is needed are some truly ingenious ideas. I'm not sure we have had them yet. Though, again, the program for this meeting argues well for these new ideas.

Recently, in discussing the computer preparation of composition-of-ending-inventory reports with Del Crowson, I made this same point. While I recognize that timely reports are necessary, it is my position that fancy reports turned out in a hurry are worse than no reports at all if the input data are not reliable. I caution against the possible trend of putting the emphasis in the wrong place.

I understand that during your deliberations here you will be acting on an expanded code of ethics for nuclear materials managers which will include the following item:

> Discourage the spreading of untrue or exaggerated claims concerning nuclear materials control systems.

This surely is worthy of the attention of all of us, and it serves to emphasize what I have been saying. In the past we have all been faced with the problem of our lack of creditability regarding our statements about nuclear energy in general. We are all aware of the fact that there has been controversy between organizations as materials have moved back and forth between installations. Who among us hasn't been involved in shipper-receiver discrepancies?

In a way, the situation is ironic. The opponents of nuclear energy have mastered the art of spreading information which is untrue, or exaggerated, or both! While most of us in the nuclear industry have been shocked at the nature of the attacks leveled at us, in a sense we have been guilty of the same thing.

I really did not intend to philosophize. I do feel that your organization has made an important contribution to nuclear materials management. I am confident that you will continue to make even more meaningful contributions in the future, and you can rely on our continued cooperation.

THANK YOU.

THE FIRST YEAR OF PRIVATE OWNERSHIP EXPERIENCE

Harold McAlduff

U. S. Atomic Energy Commission

Oak Ridge Operations Office

Paper not available at time of publication

AN ACCOUNTABILITY AND SAFEGUARDS SYSTEM FOR THE REACTOR OPERATOR

BY

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PRESENTED AT THE ELEVENTH ANNUAL MEETING
OF THE
INSTITUTE OF NUCLEAR MATERIALS MANAGEMENT

Held in Gatlinburg, Tennessee
May 25 - 26 - 27, 1970

It is a pleasure for me to have an opportunity to address you this morning. A review of the attendance list of last year's meeting at Las Vegas shows that there were only a few representatives from the electric utility industry present at the meeting. Being a utility employee, my first reaction to this fact is that Las Vegas must be off limits to electric utility employees. However, upon further contemplation it is obvious that there are several good reasons why electric power companies have not exhibited wholesale interest in safeguards and accountability for special nuclear materials.

Currently, there are only a limited number of nuclear power reactors in commercial operation, and most electric utilities have not yet drawn down their inventories of special nuclear materials. Also, of the reactors in commercial operation, only a few have experience in the control of nuclear fuel inventories in all phases of the nuclear fuel cycle and are cognizant of the numerous factors involved in the control of special nuclear material. Secondly, there are those within the nuclear industry who believe that there are no accountability or safeguards problems for the reactor operator. The basis for this line of thinking is that the nuclear fuel used in today's water reactors is initially low enriched uranium which is of little value as weapons material. Additionally, the fuel is enclosed in assemblies which are located inside a reactor vessel during most of their lives at the nuclear power plant, and upon their discharge from the reactor, when plutonium has been produced, the assemblies are radioactive. This combination of factors eliminates the safeguards problem of the reactor operator. In my opinion, this reasoning does not consider the serious responsibilities which utility managers have in the receiving, handling, shipping, recording and securing of nuclear fuel.

This morning I would like to tell you what we, at Yankee Atomic Electric Company consider these responsibilities to be, and something about the methods we have developed to account for, and safeguard our inventory of special nuclear materials.

Yankee Organization

Before reviewing the procedures we have developed to control nuclear fuel inventories, I would like to take a few minutes to explain the Yankee organizational structure to you. Yankee is substantially different from a conventional electric utility operating company, and I believe that an explanation of this structure will be helpful in understanding the basis of our special nuclear material inventory control procedures.

Yankee Atomic Electric Company was organized by ten New England utilities to construct and operate the Rowe Nucléar Power Station. Construction of the plant was completed in 1960 and the reactor went into commercial operation on July 1, 1961. The reactor has produced nearly 11 billion kwhs of electricity which is more than any other privately owned nuclear power reactor in the world. In 1969, the cost of power from the Yankee plant was 8.97 mills per kwh, and it is important to note that this figure is based on a depreciated life of twenty years which is at least 10 years shorter than most conventional power plants. One of the main goals in organizing Yankee was to develop a cadre of personnel trained in all aspects of nuclear power plants. This goal was achieved in 1968 when Yankee organized, under its corporate structure, a Nuclear Services Division which consists of some sixty engineers. This Division is responsible for all phases of engineering for the Yankee Rowe nuclear power station and the Connecticut Yankee nuclear power station, which are in commercial operation. The Vermont Yankee plant and the Maine Yankee plant, currently under construction, are also under the direction of the Services Division. In addition, the Services Division of Yankee provides accountability and safeguards services for all of these nuclear facilities. The accountability and safeguards function is closely related to the nuclear engineering and fuel cycle management sections of the Services Division, in that these are the sections that calculate burnup depletion and plutonium productions for the Yankee reactors. The in-house capability to perform these nuclear engineering computations has influenced the methods which we have adopted to fully account and properly safeguard our special nuclear material. Also influencing our procedures is the fact that in 1964 Yankee Rowe became the first United States commercial nuclear power station to come under international safeguards. Because we are committed to I.A.E.A. safeguards requirements, we must undergo periodic inspections and submit reports to the International Atomic Energy Agency.

Responsibilities

What are the electric utility manager's areas of responsibility for special nuclear material? I believe that the responsibilities of management fall into the following three major categories.

1. The utility must comply with the reporting and safeguards requirements of the United States Atomic Energy Commission and the International Atomic Energy Agency.
2. The utility manager must initiate prudent procedures to reduce to a practical minimum any possibility of diversion of special nuclear material in his possession.
3. The dollars (approximately 20 - 25 million) which the reactor operator has invested in nuclear fuel must be safeguarded and accounted for.

The fulfillment of these responsibilities is greatly complicated because the reactor operator's special nuclear material inventory is distributed throughout the nuclear fuel cycle - from conversion, fabrication, and plant to the recovery of enriched uranium and plutonium. This distribution of the reactor operator's fuel inventory can be emphasized by reviewing a recent Yankee Rowe situation which showed the following:

Enriched UF_6 had been drawn down on our lease by a convertor as the initial step in the fabrication of a new core. The fabricating subcontractor already had a portion of our inventory as UO_2 in the pelletization and fabrication process.

In our possession at the plant were four new fuel assemblies located in the new fuel vault. A fully loaded core of 76 assemblies was in the reactor. One region of 36 irradiated assemblies was in the spent fuel cooling pit. Another region of depleted fuel containing enriched uranium and plutonium was awaiting reprocessing at the Nuclear Fuel Services facility. Recovered plutonium nitrate was in storage at the ASDA facility in West Valley, New York, and because we had already contracted for the sale of a portion of this plutonium to Germany, the inventory at ASDA was subdivided into a portion which was subject to I.A.E.A. safeguards and a portion for which the U.S. A.E.C. had provided substitution and was therefore no longer under I.A.E.A. supervision.

Accountability

In order to fulfill our responsibilities for the control of special nuclear material, we at Yankee, keep detailed records on all aspects of the fuel inventory. To gather the information necessary to maintain these records, we require that whenever our material is transferred from one subcontractor to another, a copy of the 388 material transfer document be forwarded to us. From the information shown on the 388's we are able to accumulate the data required to identify all of the special nuclear material held by our subcontractors.

For fuel assemblies in the reactor, burnup depletion and plutonium production figures are calculated for each assembly. The assembly information is essential in the preparation of reports, shipping documents for spent fuel shipments, insurance valuation, and the financial adjustments of reprocessed batches. The burnup quantities are compiled and applied separately to enriched uranium which is leased from the A.E.C., and enriched uranium which is privately owned. This breakdown became essential on February 1st of this year, when Yankee, through the "In Situ" process, transferred to private ownership 25 of the total of 76 fuel assemblies in the reactor.

Our records are also subdivided to identify the type of special nucl ar material in our reactors, either enriched uranium or plutonium. It is also advantageous to identify each batch of fuel that is drawn down, by the core number in which it will be used. The core number is further subdivided for identification purposes into regions. This information is of importance because different regions usually are of varying enrichments, and therefore have different values and are processed individually. Finally, a utility which is responsible for the operation of several reactors should maintain all of this information separately for each reactor.

Because of the numerous variables which are possible, the recording of this data requires a substantial amount of record keeping. In order to maintain all of the information, without getting bogged down in a maze of paper work, computer programs have been developed which have proved to be extremely valuable in streamlining the record keeping requirements. By using the facility reporting identification symbols, and coding of the - core number, the region number, the type of special nuclear material, the ownership category (A.E.C. leased or owned), and the applicable reactor, we are able to call for a computer listing of the inventory totals at each of our subcontractors' facilities for any combination of the above factors. The computer listings show the date of each transaction, the applicable document number, the facility from which material was transferred, the facility into which material was transferred, and the quantities of element and isotope together with their related isotopic percentage. Cumulative totals and their related isotopic percentages are also shown for each lisitng (exhibit A). The computer also enables us to easily obtain fuel assembly listings by storage location at the reactor site, that is, in the new fuel vault, in reactor, in the spent fuel pit, together with the respective inventory content of the individual assemblies. Inventory contents of each fuel assembly are updated at the end of each refueling by the automatic transfer of uranium burnup and plutonium production data from the nuclear engineering section codes to the safeguards and accountability section codes. Additionally, by feeding the computer