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Engineering and Equipment

AEC RESEARCH AND DEVELOPMENT REPORT

**AN ANALYSIS OF THE REQUEST, PROCUREMENT, AND
DELIVERY OF MATERIALS, SUPPLIES, AND
EQUIPMENT FOR A MAINTENANCE
ORGANIZATION**

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**UNION
CARBIDE**

UNION CARBIDE CORPORATION
NUCLEAR DIVISION

Operating the

- OAK RIDGE GASEOUS DIFFUSION PLANT
- OAK RIDGE Y-12 PLANT
- OAK RIDGE NATIONAL LABORATORY
- PADUCAH GASEOUS DIFFUSION PLANT

*For the Atomic Energy Commission
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AN ANALYSIS OF THE REQUEST; PROCUREMENT, AND DELIVERY OF MATERIALS, SUPPLIES, AND EQUIPMENT FOR A MAINTENANCE ORGANIZATION

D. R. Sampson

This report is based on a study by the author as
partial fulfillment of requirements for the degree
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from The University of Tennessee.

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ABSTRACT

The problem was to analyze and present in simplified form the methods used in obtaining materials, supplies, and equipment for a maintenance organization. The methods employed are presented in a generalized manner to provide a guide to others, if desired, and to provide a graphic presentation to allow for periodic review of the total system.

The author, representing the Maintenance Administrative Services Department, a maintenance staff organization, worked with both the Maintenance Division and Materials Department personnel to analyze and present in simplified form the procedures employed by the Y-12 Maintenance organization for the requisition, delivery, and storage of materials, supplies, and equipment. Various industrial engineering techniques were utilized to analyze these methods and procedures to consolidate the over-all program into a workable system.

The results of these efforts are that the system is depicted in simplified understandable form. This analysis has afforded maintenance management with a summary of the system that allows adequate followup to analyze any deviation from the established procedures. The study is not intended to present the system described as the one best method but as a workable procedure that will incorporate new ideas and modes of operation as soon as they are proved economically sound.

ACKNOWLEDGEMENTS

The author wishes to express his appreciation to the Union Carbide Corporation for which this work was done. The author is particularly indebted to the Y-12 Maintenance Division and the Materials Department for their invaluable assistance and cooperation in the analysis of the system described.

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CHAPTER I

THE SUPPLY PROBLEMS OF MAINTENANCE

I. INTRODUCTION

The concept of production was altered drastically with the Industrial Revolution. Mechanization and automation, aided by rapid growth in technology, have been responsible for increased demands on production machinery, have created the necessity for larger, more specialized material handling equipment, and have raised the power requirements throughout industry.

The changes in production requirements have been accompanied by new demands on maintenance forces. Since in the inanimate world of equipment and materials these objects do not have the ability to repair themselves, as do the creatures of the animate world, "the maintenance function is becoming increasingly important."¹

What is maintenance? The term generally leaves the impression of an occasional handy man with an oil can and monkey wrench, a carpenter repairing a leaky roof, an electrician replacing a relay, or a mechanic tearing down a pump

¹Charles A. Koepke, Plant Production Control (New York: John Wiley and Sons, Inc., 1956), p. 308.

to find the cause of failure.² While these impressions are correct in a sense, there is far more in managing maintenance than simply telling a craftsman to "go fix it."

The importance of controlling labor cost in maintenance cannot be over emphasized. Maintenance craftsmen, as well as production workers, are usually paid an hourly rate and, as such, receive pay regardless of whether or not they are engaged in productive effort. Nevertheless, studies indicate that labor costs contribute only about fifty per cent of the total maintenance costs; the remainder consists of supplies, materials, and equipment costs.³

It is only in recent years that scientific management and industrial engineering principles have been applied to maintenance work.⁴ Thus, when the Maintenance Division in the Y-12 Plant at Oak Ridge, Tennessee,⁵ began searching for methods to improve its operation, there was no one model to use as a guide. It was recognized in the early stages of program development, however, that provisions must be made for easily obtaining the necessary maintenance supplies, materials, and equipment if the work forces were to be utilized properly.

²L. C. Morrow (editor), Maintenance Engineering Handbook (New York: McGraw-Hill Book Co., Inc., 1957), Section 1, pp. 18-19.

³Carrol W. Boyce and Carl G. Wyder, "Where Industry Stands Today in Maintenance Management," Factory Vol. CXIV, No. 9, (September 1958), pp. 90-91.

⁴George Frank, "What's Wrong with Maintenance Management Today?" Factory Vol. CXX, No. 7, (July 1962), pp. 99-101.

⁵The Y-12 Plant is operated by Union Carbide Corporation for the United States Atomic Energy Commission.

II. STATEMENT OF THE PROBLEM

The purpose of this thesis is to analyze and present, in simplified form, the methods used in obtaining supplies, materials, and equipment for the maintenance function in the Y-12 Plant. The analysis involves application of various Industrial Engineering principles, such as:

1. Methods Study - to determine the most logical methods for procurement and delivery of the right materials, in the right place, at the right time, and in the right quantities.⁶
2. Work Simplification - to avoid the unnecessary paperwork usually encountered in most applications throughout industry.
3. Procedures - to establish a uniform method by which maintenance supervisors may obtain the necessary items in advance of job schedule requirements.
4. Flow Charts - to depict, in simplified fashion, the procedures for obtaining supplies, materials, and equipment.
5. Inventory Control - to optimize the amount of expendable materials and supplies retained in the maintenance work areas for general craft use.

⁶Robert A. Pritzker and Robert A. Gring (editors), Modern Approaches to Production Planning and Control (New York: American Management Association, Inc., 1960), p. 111.

6. Functional Analysis - to ascertain that the supplies and materials used in performing maintenance work are standardized where feasible, and that the quality of nonstandard items is in keeping with the requirements of the job.

During the course of analysis using the techniques listed above, which involved close liaison with supervision in the various groups, several changes were adopted which simplified the related procedures under investigation. The resulting procedures and accompanying flow charts are included as an aid to those directly involved with the problem.

III. IMPORTANCE OF THE STUDY

Downtime of equipment or assembly-line processes is becoming more and more critical. In fact, it has been predicted that, eventually, raw materials will enter the production plant on a conveyor belt, move through the process cycle by automated mechanization, and leave the plant untouched by human beings.⁷ With the increasing rate of mechanization throughout industry, there has been an equivalent increase in the emphasis placed on the cost necessary to maintain equipment in all types of plants.⁸

⁷Gerald V. Nadler, Work Design (Homewood, Illinois: Richard D. Irwin, Inc., 1963), pp. 44-47.

⁸Koepke, op. cit., p. 307.

One of the principles in control of maintenance labor is that the necessary supplies, materials, and equipment be available when needed; otherwise, valuable time is spent in nonproductive effort.⁹ The problem of obtaining these articles is quite similar to military logistics, since the supplies must be accumulated from many sources and stored in the most logical places pending actual need for them.

The solution to the problem of supply, in general, hinges upon how well the following basic requirements are met:

1. An established, understandable procedure for procurement,
2. Definite supply points,
3. A way to convey the request,
4. A method for request review and follow up, and
5. A flexible storage facility.¹⁰

This thesis presents the various procedures followed by the Maintenance Division of the Y-12 Plant in Oak Ridge, Tennessee, for meeting the supply problem of maintenance.

⁹Norman N. Barish, Economic Analysis for Engineering and Managerial Decision-Making (New York: McGraw-Hill Book Co., Inc., 1962), p. 3.

¹⁰Jesse C. Jessen, "Eighteen Ways to Low Cost Maintenance," Factory Vol. CXIII, No. 11, (November 1955), pp. 80-81.

IV. DEFINITIONS

Several terms have different meanings to various readers. In order to avoid misinterpretation, the terms below, found throughout this thesis, are defined in the sense as used by the Y-12 Maintenance Division.

Aperture cards - refers to microfilmed reproductions of vendor or Y-12 engineering drawings, mounted on cards of the electronic data processing type.

Bill of materials - refers to an itemized listing, with specifications where necessary, for materials, supplies, and equipment required to accomplish a particular maintenance job.

Customer - refers to the group or individual who requests maintenance service. This includes requests from other plant divisions and interdepartmental requests within the Maintenance Division.

Engineered work order purchase - refers to an order resulting from an authorized engineered analysis of a specific job for the materials, supplies, and equipment required to complete the job.

Programmed maintenance - refers to work of the routine preventive maintenance type, cyclic in nature, performed on predictable frequency, and following standard methods. Schedule requirements for this type of work are determined by long-range estimates, studies, or other means, predicted and submitted on a semiannual basis.

Property number - refers to the "Y" number, a specific number in numerical order assigned to all equipment which must be amortized. (Expendable items are not considered "Property" items.)

Reproducible drawing - refers to a vendor drawing that does not need to be filmed to be reproduced.

Scrap - refers to any item which has a monetary value in basic material content only.

Serviceable equipment and materials - refers to those which have monetary value exceeding basic material content and which can be used for intended purposes through repair or rehabilitation, the cost of which does not exceed sixty-five per cent of the acquisition cost. Repair or rehabilitation costs include labor, materials, and overhead cost.

Shop fabrications - refers to items which are fabricated from subcomponents by plant personnel, and which may be a complete operational unit or a component thereof. The term includes such items as control panels, electrical coils, unique measuring devices, material handling fixtures, and similar items.

Unserviceable equipment and materials - refers to those items which have monetary value exceeding basic material content but which cannot be used for intended purposes due to estimated repair or rehabilitation cost in excess of sixty-five per cent of acquisition cost.

Vendor data - refers to such things as drawings, specifications, equipment manuals, recommended spare parts listings, and others, which are furnished by a manufacturer with all purchases of equipment.

V. SCOPE OF THE STUDY

This study encompasses all phases of activity relating to materials, supplies, and equipment for the Y-12 Maintenance Division. These activities include initial procurement, storage, and ultimate delivery to the point of use, with procedures for each phase. Facilities available in Y-12 to accomplish these activities are discussed.

This study is prepared as an aid to three groups:

1. To supervision, who must constantly be aware of, and be ready to take action on the problem of accomplishing each maintenance job in an economical manner,¹¹
2. To staff personnel, whose activities are guided toward aiding front-line supervision in accomplishing their basic objectives, and
3. To others who may be interested in using this study as a guide for establishing or revising their methods for obtaining maintenance materials, supplies, and equipment.

¹¹H. B. Maynard, Industrial Engineering Handbook (New York: McGraw-Hill Book Co., 1956), Section 1, p. 46.

VI. ORGANIZATION OF THE STUDY

In making this study, the author followed the procedure of isolating and analyzing one function at a time. However, since the functions and facilities are quite interrelated, it is felt that the study should be presented in five basic phases to be of maximum benefit to all concerned.

A generalized discussion of the Y-12 Maintenance Division, its organization and work control concepts, is provided in Chapter II. This discussion is primarily for the purpose of familiarizing the reader with the broad objectives of the Division.

Chapter III gives a detailed description of the facilities and equipment that are available in the plant for obtaining and storing supplies, materials, and equipment.

Procedures and simplified flow charts are contained in Chapter IV. These cover procuring materials from Central Stores, obtaining spare parts from vendor sources, storing materials in Bill of Materials Stores, establishing new Central Stores stock items, replenishing Maintenance Stores stock, and procuring capital equipment.

Specific applications of the functional analysis concept is illustrated in Chapter V, which deals with the process of reclaiming usable items and excessing others which have no further utility in the plant.

Chapter VI summarizes the underlying philosophy of the relative importance of materials, supplies, and equipment to a maintenance organization. The need for a flexible system for procurement, storage, and associated aspects is stressed.

CHAPTER II

Y-12 MAINTENANCE ORGANIZATION AND WORK CONTROL CONCEPT

The Y-12 Plant covers more than one square mile and contains over two hundred building structures. The processes include chemical operations, fabrication activities, and research and development programs. Many different types of equipment are utilized: machine tools, pumps, compressors, refrigeration units, and numerous chemical processing units which are common only to this plant. The maintenance of machine tools, with the exception of the electronics phase, is carried out by specialists in the Operations Unit; maintenance of the remaining facilities—buildings, grounds, and equipment other than machine tools—is the responsibility of the Maintenance Division.

The Maintenance Division employs a force of workers ranging from service-type personnel to skilled craftsmen including welders, pipefitters, mechanics, electrical and electronic technicians, carpenters, and painters. Since a work force of this type represents a considerable expense item, a combined effort has been made to obtain optimum services for the maintenance dollar expenditure.

I. GENERAL ORGANIZATION

Prior to 1956, the Maintenance Division organization was generally of a centralized structure. The work forces had headquarters in limited locations and

were dispatched from these points throughout the plant as the work required.

Figure 1 illustrates the centralized organization concept and shows the general line of authority in the Division.

Studies made in 1956 indicated that some of the maintenance forces might be better utilized by employing an "area maintenance" concept, which was possible due to the geographic location of various plant processes.¹ It also was believed that shop work could be performed more economically in centralized facilities specializing in such phases as electrical or mechanical repair, large-scale painting, major carpenter work, and other types.

The reorganization was started in 1956 under such a plan. A maintenance crew was assigned to each major operating area; each crew included the various types of crafts necessary to perform the routine-type work required to maintain the facilities within its area of maintenance responsibilities. Other craftsmen were assigned to the shops, where they could best provide support for the area maintenance crew through use of specialized skills and equipment. Figure 2 illustrates the "area maintenance" organization principle.

¹J. D. Westbrook, "The Application of Data Processing Techniques to a Maintenance Work Control Program," (Unpublished Master's Thesis, The University of Tennessee, Knoxville, 1963), p. 8.

FIGURE 1
CENTRALIZED TYPE MAINTENANCE ORGANIZATION

FIGURE 2

AREA TYPE MAINTENANCE ORGANIZATION

II. MAINTENANCE PLAN

Although the reorganization appeared to result in more effective utilization of manpower, the basic question of whether or not the work force was operating at optimum effectiveness remained. Since scientific management principles had been used to effect cost reductions in production areas for more than a half century, it seemed logical that the same principles could be applied with resultant gains in the field of maintenance also. A broad investigation was started in 1958 to determine just how these principles could be used most effectively in the following areas of interest:²

1. Work Order System - to define the scope of each job, and to make provisions for job identification.
2. Work Scheduling and Labor Control - to improve methods of estimating work content, labor evaluation, coordination, and scheduling work on a long-range as well as a day-to-day basis.
3. Programmed Maintenance - to establish schedules of highly repetitive routine and service-type functions on a long-range basis, for translation later to a daily routine schedule.
4. Maintenance Materials - to review and streamline the methods of procurement, storage, and delivery of maintenance materials and supplies.

²Ibid., pp. 5-16.

Work Order System

A sound work order system is a prerequisite for effective management of maintenance. In Y-12, work orders are issued as cost collection devices for particular phases of plant operations. There are three basic types of work orders used:

1. Capital Work Orders - initiated for engineering, labor, and/or materials involved with construction projects or purchase and installation of capital equipment.
2. Special Work Orders - initiated for engineering, labor, and/or materials involved with maintenance alterations, or noncapital work which exceeds a specific cost figure.
3. Blanket Work Orders - initiated for engineering, labor, and/or materials over a stipulated period of time, and generally used in connection with routine and repetitive repairs. Individual jobs covered by this type of work order must not exceed a specified cost figure; if so, the Capital or Special Work Order is used.

Of the three types, the Maintenance Division, in most instances, is more involved with the Blanket Work Orders. The Special and Blanket Work Orders are basic departmental cost-collection devices for work performed by Maintenance. All maintenance costs are allocated to the customer on the basis of time worked according to Equation 1.

$$TAC = \left(\frac{CWO}{TWO} \right) (TC) , \quad (1)$$

where:

TAC = total allocated cost to the individual customer,

CWO = time charged to the customer's work orders,

TWO = total time charged to all work orders by the maintenance department, and

TC = total cost of operating the maintenance department; including direct and indirect labor; Maintenance Stores inventory costs; engineering costs; and divisional, general plant, and administrative overhead costs.

A Maintenance Work Request, shown in Figure 3, is used by the customer to request maintenance services or repairs to be performed against a Blanket Work Order. Each Maintenance Work Request has a preprinted job number (lower-left and upper-right corners) which is unique to the particular job, thereby providing a basis for collecting costs around an individual job.

Work Scheduling, Labor Control, Programmed Work, and Maintenance Materials

A very close scrutiny of these activities indicated that the methods employed in one phase were dependent upon methods employed in the other phases for successful application. Accordingly, they were combined with other aspects to form a comprehensive work control program.

III. WORK CONTROL CONCEPT

The work control concept of the Y-12 Maintenance Division is, simply, to manage maintenance so that each job is handled in a reasonable manner consistent

[illegible]

FIGURE 3

MAINTENANCE WORK REQUEST

with the schedule requirements of the plant, making the best possible use of labor and materials. To accomplish this basic objective, the work control program was established to include seven functions, illustrated by Figure 4. The seven functions are:

1. Review the job,
2. Plan the job if necessary,
3. Estimate manpower requirements,
4. Plan materials and shop work,
5. Schedule the job,
6. Supervise the job, and
7. Follow up the job.

These are functions which are basic to any job, whether production, maintenance, or otherwise. These seven steps are flexible enough to allow their use to be fitted to the requirements of the job. The over-all effectiveness of each job is dependent upon the thoroughness of applying each principle to the extent needed, and directly proportional to the judgment factors as applied by work control personnel.

Job Review

This is the first step in any job. The judgment factor enters at this point and is carried throughout the remaining six steps. The review should disclose job content, schedule requirements, as well as indicating any unique considerations

such as safety hazards or special equipment requirements, and should point up the need, if any, for a detailed job plan.

Job Plan

Job plans are invaluable when they can aid the front-line supervisor, such as a need for scheduling operations downtime or when more than one craft or maintenance group is involved. The job plan is a general procedure designed for coordinating the activities of the various personnel to achieve successful completion of the job. Special considerations are spelled out, to call attention in advance of job performance so that the work may proceed smoothly.

Manpower Estimates

Effective scheduling and work performance evaluation are dependent upon an estimate of manpower requirements for each job. In Y-12, the estimate may be either an Engineered Estimate (EE) based upon standard data, or a Non-Engineered Estimate (NEE) based upon the estimator's judgment and previous encounters with similar jobs. It is recognized that a certain amount of work is not practical to estimate; this includes the small percentage of jobs that are of an emergency type or that are of very brief duration. Of the two methods of estimating, the standard data approach provides by far the best basis for work measurement and follow-up evaluation.

Material and Shop Work Plans

This function is critical to the orderly flow of work once the job is started. Every effort is made to have all the necessary materials, supplies, and shop work

items at the job site in advance of requirements. It is essential from an economical standpoint that the quality and quantity of these items be in line with job requirements. (For example, choice lumber should not be used for concrete forms.)

Work Schedule

A work schedule has been defined as "the process of fitting jobs into a logical time table."³ For maintenance application, the words "to meet the customer's requirements" should be added. In Y-12 maintenance, in addition to long-range schedules, a short-range schedule is made out one day in advance, and is generally arranged so that each man is scheduled for slightly more than a full day's work. Thus, when a job is disrupted for any reason other than for emergency work, the craftsmen need not wait for instructions before moving to another job. Emergency work, usually involving critical equipment downtime, is performed on an as-needed, top-priority basis which disrupts the daily schedule to some degree. (Certain scheduled jobs may be carried over to the next day.)

Work Supervision

The first-line supervisor is a key man in any efficient organization. The quality and quantity of work produced is generally in proportion to the supervisor and his ability to handle technical and personnel problems. It is very important that the first-line supervisor spend as much time as practical in supervising his crew.

³Charles A. Koepke, Plant Production Control (New York: John Wiley and Sons, Inc., 1956), p. 453.

Follow Up

It is equally important in a maintenance organization that checks be made to determine whether the job was accomplished economically, that the quality is commensurate with the job requirement, and that the customer is satisfied with the over-all job. Delays encountered due to material shortages, improper planning or coordination, insufficient information, or other reasons should be analyzed and the acquired knowledge be applied to future jobs.

IV. WORK CONTROL CENTERS

The importance of each of the seven basic functions noted in the foregoing discussion should be apparent. It should be apparent also that if each first-line supervisor were to handle each detail of every job, there would be little time left for directly supervising his crew. Since the primary responsibility of the first-line supervisor is to direct his crew toward the most effective performance on the job, he clearly needs assistance in applying the remaining elements of a nonsupervisory nature.⁴

A review of each of the functions gives indication of the kind of assistance that will be most beneficial. For example, a planner-estimator could review, plan, and estimate the job. A material planner could handle the details of procuring the

⁴H. B. Maynard, Industrial Engineering Handbook (First edition; New York: McGraw-Hill Book Co., Inc., 1956), Section 1, p. 46.

materials and supplies necessary for job completion, and higher supervision could aid in the follow-up function. In the formalized work control center concept, the above functions were established upon these precepts to aid the front-line supervisor in his basic function.

Work Control Center Organization

The natural conclusions resulted in the establishment of formalized work control centers as illustrated in Figure 5. Administrative control is provided at the general foreman level or higher, depending upon the area of maintenance responsibility.

Work control centers are, in general, self-sufficient maintenance units oriented to the needs of their particular areas. Planner-estimators, material planners, and clerks serve in essentially a staff capacity, each rendering a specialized service and usually reporting directly to the work control center supervisor. Also, the line organization, or first-line supervisors, usually reports to the work control center supervisors. It should be noted that there are exceptions to the preceding statement, since work control centers are tailored to meet the existing situations in each area.

Work Control Center Activities

The work control center serves as the nucleus around which all maintenance activities in the immediate area revolve. It serves as a central contact for prospective maintenance customers, and also serves as an information gathering center

FIGURE 5

AREA WORK CONTROL CENTER MAIN- TENANCE ORGANIZATION

in the job review, coordination, planning, estimating, and materials procurement stages. Administrative control is localized for more effective action.

V. RETROSPECT

The preceding discussion was offered to acquaint the reader with the concept of work control as viewed by the Y-12 Maintenance Division. The remainder of this study will be devoted exclusively to the materials, supplies, and equipment phase in the work control program of the Y-12 Maintenance Division.

CHAPTER III

FACILITIES AND EQUIPMENT

The Y-12 Plant encompasses a large area of highly complex and automated chemical and fabrication operations, with maintenance forces assigned on an area basis for maintaining the productive facilities and equipment. To obtain and store the materials, supplies, and equipment needed to accomplish this responsibility, the maintenance organization utilizes numerous plant facilities and equipment.

Some of these are:

1. Central Material Stores,
2. Material Substores,
3. Material Tool Cribs,
4. Material Stores Pick-Up and Delivery Stations,
5. Pneumatic Tube Requisition and Delivery Equipment,
6. Datafax Requisition Equipment,
7. Bill of Materials Stores, and
8. Maintenance Stores.

These facilities and equipment will be described in the remaining sections of this chapter.

I. CENTRAL MATERIAL STORES

The Y-12 Central Material Stores personnel do all procurement and warehousing of materials, supplies, and equipment which are carried as stock inventory items. This activity involves approximately eighty-five per cent of all the procurement of materials, supplies, and equipment needed by the maintenance organization. At the present time there are approximately 47,000 material and supply items carried on inventory by Central Material Stores and the outlying facilities. The value of this inventory is in excess of eight million dollars. With proper authorization, any employee of the Y-12 Plant can go to Central Material Stores or one of the outlying facilities for materials and/or supplies needed to accomplish their job.

The physical layout of Central Material Stores and outlying facilities has been designed around two major considerations. These are:

1. The amount and flow of materials and supplies, and
2. The number and flow of people to be served.

These are basic considerations to any industrial engineering layout problem.¹ A general floor plan layout is shown in Figure 6. The floor plan is general in nature but shows specifically designated areas for the service counters handling different types of commodities.

¹H. B. Maynard, Industrial Engineering Handbook (First edition, New York: McGraw-Hill Book Co., Inc., 1956), Section 8, p. 167.

FIGURE 6

GENERAL FLOOR PLAN LAYOUT OF CENTRAL MATERIAL STORES

The stock items carried in Central Material Stores inventory are controlled with an electronic data processing system. The system employs three basic tools.

These tools are:

1. Electronic data processing equipment,
2. Adequate stock records, and
3. Economic order quantity formulas.

The electronic data processing equipment utilized by the Y-12 Plant for inventory control is the International Business Machine (IBM) Company's 7090 and 1401 computers with standard accessories.

The stock records to be maintained have been standardized. Certain minimum information requirements also have been established to be included in the records. These requirements are as follows:

1. Catalog item identification number,
2. Item name and a short description,
3. Date of transaction,
4. Unit of issue,
5. Unit price,
6. Quantities received,
7. Quantities issued or shipped,
8. Quantity balance of stock on hand,
9. Quantities on order,
10. Substitution data,

11. Maximum and minimum levels, and

12. Reorder point amounts.²

Along with the other two basic tools, there are the economic order quantity formulas, similar to standard inventory control formulas. The formulas are being used to permit the purchase before the required materials and supplies are needed rather than on an emergency basis. The basic equations used are:

$$Q = \sqrt{\frac{2RS}{KC}} , \quad (2)$$

where:

Q = economic quantity to purchase,

R = annual usage in suitable units of measurement, such as pieces, pounds, gallons, or others,

S = cost of acquisition, in dollars,

K = cost of possession and/or carrying charge expressed in per cent of investment in the material, and

C = unit cost in dollars per piece, pound, gallon, or other unit of measurement.

$$\frac{PQU + CQU}{TW} = AWU \times LT = FOP , \quad (3)$$

²Inventory Management and Control Handbook (Limited Distribution AEC Manual Appendix 5115, Published by the United States Atomic Energy Commission, Office of the Controller, June 7, 1962), p. 5.

where:

PQU = previous three quarters usage,

CQU = current quarter usage,

TW = approximate total weeks processed,

AWU = average weekly usage,

LT = lead time, and

FOP = floating order point.

$$EOQ + FOP - (QOH + QOO) = CQO, \quad (4)$$

where:

EOQ = amount to order by the EOQ equation,

FOP = floating order point (from Equation 3),

QOH = quantity on hand,

QOO = quantity on order, and

CQO = new calculated quantity to order.

The tools employed by the electronic data processing system are being used to fulfill four basic requirements. These requirements are:

1. A definition of what items are to be controlled,
2. A method of knowing what and how much to reorder,
3. An exact procedure for controlling inventory stock levels, and
4. A means of identifying each item and its exact location.³

³Tom Mostyn, "The Easy Way to Stores Control, " Plant Engineering Vol. CXIV, No. 11, (November 1958), pp. 91-92.

Central Material Stores Substores

There are four Central Material Stores Substores located in outlying areas within the Y-12 Plant. These substores have been established to fulfill five basic requirements. These requirements are:

1. To expedite the delivery of materials, supplies, and equipment to isolated or remote areas of the plant where usage is high,
2. To serve user emergencies,
3. To provide economy in transportation,
4. To reduce shop and site stock where practical, and
5. To provide assistance to operations, construction, and maintenance personnel in obtaining materials, supplies, and equipment normally stocked in Stores.⁴

The stock inventories stored for issue in these substores are treated as Central Material Stores inventory for control and reporting purposes. The stock records of these substores are integrated with Central Material Stores stock records so that the total amounts of the same items on hand at all locations are brought together. Generally, all records are controlled under the electronic data processing system.

⁴Inventory Management and Control Handbook (Limited Distribution AEC Manual Appendix 5115, Published by the United States Atomic Energy Commission, Office of the Controller, June 7, 1962), p. 6.

Central Material Stores Tool Cribs

Four tool cribs have been established in areas where a concentrated need for loan tools exists. These tool cribs, also controlled by Central Material Stores, have not been established for maintenance personnel alone; but their locations make them readily accessible to maintenance employees for the withdrawal of tools needed to carry out maintenance work. The tools carried as inventory in these tool cribs are special items such as hand tools, drills, measuring tapes, drawing instruments, and other similar items. The items stocked are withdrawn on a temporary or permanent-loan basis. Temporary-loan items are returned to the tool cribs upon completion of the job requirements. Permanent-loan tools are assigned to an individual, and he then becomes accountable for the tools. A periodic report on permanent-loan tools is issued, which lists tools to each individual on record; the individual verifies the listing and accounts for the location and condition of the tools loaned to him.

Pickup and Delivery Stations

In cooperation with the Maintenance Division, Central Material Stores has established a regular schedule for the delivery of materials, supplies, and equipment to the maintenance forces, and for the pickup of routine requests for such items. This schedule is set up on five pickup and deliveries per day with approximately two hours floating time between each trip. An alternate schedule has been established that will, in effect, reduce the pickups and deliveries from five to four

per day if and when conditions warrant such action. The regular and alternate schedules are illustrated in Table I.

The pickup and delivery stations have been established in approximately thirty-four buildings with from one to three specific points in each building. Figure 7 shows a view of a pickup and delivery station. Each station has complete catalogues of those materials, supplies, and equipment that are stocked in Central Material Stores, order pads, and various pertinent vendor catalogues. This material furnishes a fairly complete reference for the material planners and front-line supervision. A view of these additional facilities is shown in Figure 8.

Pickup boxes are another facility that has been established to augment the functionability of the pickup and delivery stations. There are approximately fifty-five of these boxes located in the Y-12 Plant. Figure 9 shows one of these boxes. The box is designed to give first-line supervision a place to leave a request for materials and/or supplies that are not of an emergency type; he can fill out a request for the item and drop it in a pickup box. Central Material Stores pickup and delivery personnel check each box on their scheduled trips. They will deliver the requested item on their next trip to the specified delivery station. Table II shows the number of requests for materials, supplies, and equipment received by the Central Material Stores for a six-month period through these facilities, reflected by the number of requests handled on each route covered by the stores delivery men.

TABLE I
MAINTENANCE DELIVERY AREA SCHEDULES

Stores Route	Start Time				
	Trip 1	Trip 2	Trip 3	Trip 4	Trip 5
<u>Regular Schedule</u>					
A	8:00 A.M.	10:00 A.M.	12:30 P.M.	2:00 P.M.	3:30 P.M.
B	8:00 A.M.	9:30 A.M.	11:00 A.M.	1:00 P.M.	3:00 P.M.
C	8:00 A.M.	9:30 A.M.	11:00 A.M.	1:00 P.M.	3:00 P.M.
D	8:00 A.M.	10:00 A.M.	12:00 Noon	2:00 P.M.	3:30 P.M.
E	8:00 A.M.	10:00 A.M.	12:00 Noon	2:00 P.M.	3:30 P.M.
F	8:00 A.M.	9:30 A.M.	11:00 A.M.	1:00 P.M.	3:00 P.M.
<u>Alternate Schedule</u>					
A	8:30 A.M.	10:00 A.M.	12:30 P.M.	2:00 P.M.	
B	8:00 A.M.	9:30 A.M.	11:00 A.M.	3:00 P.M.	
C	8:00 A.M.	9:30 A.M.	1:00 P.M.	3:00 P.M.	
D	8:00 A.M.	10:00 A.M.	12:00 Noon	2:00 P.M.	
E	10:00 A.M.	12:00 Noon	2:00 P.M.	3:30 P.M.	
F	8:00 A.M.	11:00 A.M.	1:00 P.M.	3:00 P.M.

FIGURE 7

MAINTENANCE PICKUP AND DELIVERY STATION

FIGURE 8

MATERIAL CATALOGUES, ORDER PADS, AND VENDOR CATALOGUES, LOCATED AT MAINTENANCE PICKUP AND DELIVERY STATIONS

FIGURE 9

MATERIAL REQUISITION PICKUP BOX

TABLE II
PICKUP BOX REQUEST

Route	Number of Requests Per Month					
	December 1963	January 1964	February 1964	March 1964	April 1964	May 1964
A	413	478	491	502	415	428
B	2,588	3,748	2,483	2,567	2,392	1,836
C	2,023	3,233	2,436	2,414	2,455	2,183
D	1,504	2,459	1,734	1,769	1,758	1,707
E	515	678	549	579	536	379
F	1,107	1,008	1,107	1,135	1,074	707
Totals	8,150	11,604	8,800	8,966	8,630	7,240

Datafax Requisition Equipment⁵

Another type of equipment utilized by the Maintenance Division to request materials, supplies, and equipment is the facsimile transmitter (Datafax) unit. This unit allows the transmission of a complete request form to Central Material Stores. Figure 10 shows a sample Datafax transmission for materials and/or supplies from maintenance personnel to Central Material Stores.

There are eight transmission units located in heavily populated maintenance areas of the Y-12 complex. The location of all the units being used for the requisition of materials, supplies, and equipment for maintenance is given in Table III.

The installation of these units has permitted the receipt of materials, supplies, and equipment in the desired location in less than two hours when delivered routinely. The two receiver units installed in Central Material Stores are placed near the shipping dock. Figure 11 shows a view of the receivers located in Stores.

This system was initially installed for the major purpose of decreasing the time required to get a request for materials, supplies, and equipment to Stores. Particularly if the requests were of an emergency nature, the other methods

⁵While there are several types of facsimile transmission equipment, Datafax is perhaps the most well known and is used herein to indicate a general class of equipment rather than a specific type.

REQUEST FOR MATERIAL FROM STORES					
AUTHORIZED BY	DATE	DEPT.	BADGE NO.	DELIVER TO BLDG.	STOREKEEPER
John Doe	4-29-63	9000	00001		
CATALOG NUMBER	UNIT OF ISSUE	QUANTITY	CHARGE OR WORK ORDER	DESCRIPTION	
07-226-2870	Ft.	00	S-123	Pipe, 1/2" Sched. 40, Steel	
07-253-3340	Ea.	00	"	Elb., 1/2" Sched. 40, Steel	
07-254-2250	"	00	"	Reducer, 1/2" X 1/2" Sched. 40, Steel	
07-254-3990	"	00	"	Tee, 1/2" Sched. 40 Steel	
07-262-4206	"	00	"	Valve 1/2" Gate, 600# Steel,	
				Sched. 40	

SAMPLE COPY

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 (1226 10-61)

FIGURE 10

SAMPLE DATAFAX TRANSMISSION REQUEST FOR MATERIALS, SUPPLIES, AND EQUIPMENT

TABLE III
DATAFAX UNIT LOCATIONS

Unit Location	Number of Units	Type of Unit	Unit Code Letter
Work Control Center 1	1	Transmission	A
Work Control Center 10	1	Transmission	B
Work Control Center 2	1	Transmission	C
Work Control Center 8	1	Transmission	D
Work Control Center 6	1	Transmission	E
Work Control Center 7	1	Transmission	F
Work Control Center 4	1	Transmission	G
Work Control Center 11	1	Transmission	H
Central Materials Stores	2	Receiver	1 and 2

FIGURE 11

DATAFAX RECEIVERS 1 AND 2 LOCATED IN
CENTRAL MATERIAL STORES

consumed too much time; therefore, the only course of action remaining was to send a maintenance man to Stores to pick up the required materials, supplies, and/or equipment. This caused the improper and uneconomical use of a craftsman.

When the system was initially installed it was analyzed to uncover and correct any problems in the operation of the network. The main problem encountered was inadequate utilization of the equipment. The original installation established three basic networks; each network consisted of a transmission unit or units connected to a receiver unit located in Central Material Stores. Two of the networks had three transmission units, and the third had only two units. The transmitters on the three-unit networks were allowed to operate twenty minutes out of each hour. This schedule caused the transmission of requests to be bunched and, in turn, caused the Central Material Stores personnel to have a peaked work load rather than a load of normal distribution. In practice, it meant that any portion of a transmission unit's twenty minutes could not be utilized by another transmitter even though the transmitter was not in use. Since the other unit operators had no way of knowing when the network was being used, they would not cut in on the network except at their designated times. This time-sharing method required the operators to be at their transmitters during a specific time which made it inconvenient, if not impossible, for them to leave the area to perform any other job of an extended time requirement. Not only did this situation cause inadequate utilization of equipment, but it also caused inadequate utilization of manpower.

After troubles encountered with the time-sharing network control were analyzed, a new system of control was developed and installed. The operational control of this new arrangement was made the responsibility of the Central Material Stores personnel through a central control panel. The arrangement of the number of transmitters sharing a receiver was revamped and the number of receivers reduced from three to two. Transmitters A, B, C, and D share one unit, while Transmitters E, F, G, and H share the other receiver under this new arrangement. At each transmitting station a read-out meter was installed. These meters have a scale marked alphabetically to show each station on that network. When Station A is transmitting, the meter pointer will be on "A", or when Station C is sending, the pointer will be on "C". When the network is idle (available for use), the meter pointer will be in a green area on the scale marked "ready." Figure 12 gives a close-up picture of this meter, showing that the network is in use. A Datafax transmitter is shown in Figure 13. Appendix A gives the general guidelines established for the operation of a transmitter.

Each of the transmitters are connected to the main electronic control in Central Material Stores by a leased telephone cable pair. The control equipment tie in uses the same cable pair as the facsimile signal so that no extra cable pairs are needed. The main electronic control in Central Material Stores has lights to show which station is sending. It also has switches to place any transmitter in a "hold" position with lights to show any station that is on "hold." A view of this electronic control in Central Material Stores is shown in Figure 14.

FIGURE 12
NETWORK CONTROL METER

FIGURE 13
DATAFAX TRANSMITTER

FIGURE 14

NETWORK CONTROL UNIT LOCATED IN CENTRAL MATERIAL STORES

In addition to the control facilities, this new method of timing for the transmission of the request for materials, supplies, and equipment has leveled the Stores personnel work load and freed the transmitter operators for the accomplishment of other duties. Table IV gives the number of requests received for a six-month period using the new timing arrangement and control features of the system. These data are shown for only five of the transmitter units, since the usage of three of the units decreased to the point where it was not economically sound to keep them in their locations. This decrease in usage was due to better planning and scheduling for the work needed materials, supplies, and equipment, and by better utilization of the pickup and delivery stations.

Like all facilities and procedures being used by the maintenance organization, this equipment is under periodic reviewal by the Maintenance Administrative Services Department to eliminate problems and unnecessary cost. The equipment, facilities, and procedures utilized by the plant are flexible enough to be adapted to meet any and all requirements.

Pneumatic Tube Requisition and Delivery Equipment

A pneumatic-tube system has been installed in the Maintenance Division's Electrical Department for the requisition and delivery of materials and/or supplies. This tube system consists of two main stations. The first station is located in the Department's work control center office, and the other station is located approximately 750 feet away in the Central Material Stores building at the electrical material and supply counter. There is also a secondary gravity-drop

TABLE IV
FACSIMILE TRANSMITTER USAGE

WCC	December 1963	January 1964	February 1964	March 1964	April 1964	May 1964
11	1,245	1,233	1,589	1,576	1,611	1,337
10	192	103	103	97	66	119
6	658	856	486	529	474	876
7	454	450	563	441	577	534
1	830	914	934	845	973	844
Totals	3,379	3,556	3,675	3,488	3,701	3,710

station on the first level directly under the main station in the maintenance work control center office. The two main stations are connected by a six-inch, fourteen-gauge aluminum alloy supply tube that is supported at ten-foot intervals by metal support brackets. The transportation power is furnished by a five-horsepower blower. The radius bends in the tube are at a minimum of five feet.

The pneumatic-tube system utilizes material and supply carriers that are constructed of fourteen-gauge aluminum alloy tubing tipped on both ends with felt and leather bushings. The inside dimensions of the carriers are four and one-half inches in diameter and sixteen inches in length. There are seven of these carriers being utilized. A net load of approximately twelve pounds can be transported in one of the carriers in this tube system. Essentially, any item can be handled that weighs up to twelve pounds and will fit in the carrier's dimensions, such as small tools, batteries, relays, and electronic tubes. These items are packed in foam rubber for added protection.

The controls for the pneumatic tube system are simple and are arranged so that the carrier is slowed just prior to the receipt of the carrier at the tube station. This slowing effect makes a gentle landing possible; therefore, it allows the transporting of relatively delicate electronic components. Also incorporated in the controls are "inuse," "carrier received," and "reset" signal lights and/or control switches. Direct voice communications between the two main stations was not initially planned; however, an extra wire pair in the control cable allowed the addition of this very useful feature.

The approximate time required for a carrier to travel from one of the main stations to the other varies from twenty-two to twenty-four seconds. The total time required from the transmission of a request to the receipt of the desired electrical material or supply is approximately five minutes. The time lapse between the request and the receipt of a hardware or tool item is approximately fifteen minutes since these latter items are located in another section of the Central Material Stores building which is about 250 feet from the Store's pneumatic tube station. Thus, the additional distance to be traveled by the Store's stockkeeper accounts for the major portion of the time difference between the request and receipt of electronic materials and supply items and the hardware and tool items. The number of requests for hardware and tool items by the Electrical Department is quite small; therefore, the economics of extending the tube system to the hardware and tools sections of the Central Material Stores is not justified under the present conditions. The pneumatic-tube receiving station that is located in the Central Material Stores building is shown in Figure 15. Figure 16 shows the main-tube station located in the Electrical Department's work control center.

There are approximately ninety requests for materials and/or supply items initiated per day by the Electrical Department with the pneumatic-tube system. Out of the ninety requests initiated, approximately eighty are delivered through the tube system. The remaining ten are too large or heavy to be delivered by the tube system. These materials, and/or supply items are normally received via truck at

FIGURE 15

PNEUMATIC TUBE STATION LOCATED IN
CENTRAL MATERIAL STORES

FIGURE 16

PNEUMATIC TUBE STATION LOCATED IN THE MAINTENANCE
ELECTRICAL DEPARTMENT'S WORK CONTROL CENTER

the regularly scheduled delivery times, or a Stores, material and parts man delivers the item on an emergency basis.

Prior to the installation of the pneumatic-tube system, the Electrical Department was served by a Central Material Stores Substore and a full-time stockkeeper. Although over 1,600 separate catalogue items were stocked, repairs were constantly delayed pending delivery from Central Material Stores of those items which could not be stocked due to space limitations. Further investigation showed that the most practical solution was to close the substore and draw directly from the Central Material Store's warehouse.

In addition to the economic justification, there were two major considerations affecting the choice of equipment to give a direct delivery line from Central Material Stores. The considerations were:

1. Complete enclosure and protection of sensitive items such as electronic tubes and components, and
2. Prompt delivery of the required material and/or supply items.

It was decided that an enclosed belt conveyor or pneumatic-tube system was the only economical answer to the major factors. A pneumatic tube was chosen. A few of the advantages realized from the installation of the system are:

1. Adequate stock inventory available,
2. Less nonproductive time spent waiting for materials and/or supplies,
3. Better control of stock items,
4. Repairs handled more promptly,

5. General service much better, and
6. Material stock inventory cost reduced.

The cost reductions realized from this investment have proven it to be an economical investment.

II. BILL OF MATERIALS STORES (B/M)

The Bill of Materials Stores is the designated location for the receipt and temporary storage of materials, supplies, and equipment on certain jobs until required by maintenance forces, cost-plus-fixed-fee (CPFF), or lump-sum subcontractor (LSSC) contractors. These materials, supplies, and equipment can originate from any of the following sources:

1. Engineered work order purchases, including bill of materials, job specifications, drawings, and engineering transmittals,
2. Regular procurement requests,
3. Shop fabrications,
4. Transfers from other locations, or
5. Central Material Stores and outlying facilities inventory stock items.

The Bill of Materials Stores is not intended to be used for storing small quantities of common stores inventory stock items such as pipe fittings, commonly used electrical wire, short pieces of lumber, conduit, and brick glass. Items of this type are drawn from Central Material Stores through regular channels whenever needed at the job site. Also, Bill of Materials Stores is not intended to be used as

a collection agency for small jobs with the total required material content being composed of regular stores stock items.

The Materials Department has the responsibility of operating the warehouse and maintaining records. Another of the Material Department's responsibilities is to aid in the disposal of excess Central Material Stores' inventory stock items that are stored in Bill of Materials Stores.

The Project Engineering Department is responsible for formulating bills of materials and for having the materials, supplies, and equipment stored for work to be performed by cost-plus-fixed-fee (CPFF) and lump-sum subcontractor (LSSC) contractors.

The Maintenance Division is responsible for having materials, supplies, and equipment procured and stored for maintenance and certain alteration work to be performed by Carbide employees.

The Bill of Materials Stores floor plan has been designed to handle the storage of all materials, supplies, and equipment that are required for a specific work order job in one place. There is also space allotted for heavy equipment and miscellaneous storage. A general floor-plan layout is shown in Figure 17.

III. MAINTENANCE STORES (POINT-OF-USE STORES)

The Maintenance Division of the Y-12 Plant has established Point-of-Use Stores (Maintenance Stores) in various work control centers throughout the plant. The type and number of individual stock items stored in each of these stores are

FIGURE 17

GENERAL FLOOR-PLAN LAYOUT OF BILL OF MATERIALS STORES

based upon the needs and use of the materials, supplies, and equipment that are commonly required to perform the maintenance work requested by all customers of the work control center's maintenance forces. Generally, this results in each store being of a different size and having a variation in the type of items stocked. The type of stock is particularly varied between shop locations and field installations.

The principal reasons for establishing these self-service stores are:

1. To eliminate the cost of a maintenance employee having to wait for the receipt of regularly used items, and
2. To provide an easily accessible storage space for such general purpose items as nuts, bolts, welding rods, wire, and other similar materials and supplies which are needed frequently in the area served by the work control center.

The material and supply stock items in these Point-of-Use Stores may be withdrawn (with the exception of highly sensitive items such as vacuum tubes) by any of the maintenance work control center employees. The sensitive items are kept under close supervisory control. In actual practice these materials and supplies are generally used on breakdown or programmed-type maintenance jobs. Other required materials and supplies for maintenance jobs can be obtained through Central Material Stores or by one of the regular procurement procedures. This type of procurement is charged directly to the customer, or originator of the job request.

Accordingly, the material and supply stock items in these stores are "free issue." This term means that no forms are required to withdraw the items.

The Y-12 Maintenance Division has established three basic criteria for placing a material or supply stock item in the various stores. These criteria are:

1. The material and/or supply stock item must have a general use over the area served by that work control center's Maintenance Store,
2. Each type of material and/or supply stock item usually should not cost more than three dollars per unit, and
3. The usage of an individual material and/or supply stock item must be at least five units per month.

The items stocked in each of these Maintenance Stores are under periodic reviewal by the Maintenance Administrative Services Department to determine if these three basic criteria are being met. If an item does not meet these criteria, then there is storage space being taken without justification, and the item is removed from the store. (The item will still be carried as a stock item by the Central Material Stores, however, if it has a use in the Y-12 Plant.) Table V gives the turnover of the different Maintenance Stores materials and supply stock items. This table shows the number of different catalogue stock items replaced on a per-month basis for a six-month period.

This type of point-of-use storage facility has been utilized by production line organizations for a number of years. The February 1959 issue of Factory lists

TABLE V
MAINTENANCE STORES STOCK TURNOVER

WCC	December 1963	January 1964	February 1964	March 1964	April 1964	May 1964
2	154	200	103	99	95	107
1	337	364	183	241	185	224
41	414	346	197	221	215	204
42	397	497	303	329	361	356
5	228	324	163	147	165	149
11	224	256	86	114	103	97
8	633	698	326	311	349	363
9	350	422	140	159	145	161
Totals	2,737	3,116	1,501	1,621	1,618	1,661

a few of the advantages realized from this type of facility.⁶ The advantages are generally the same ones that the Y-12 Maintenance Division realizes. These general advantages are:

1. The utilization of idle space,
2. The decrease in cost by cutting the paper work required to obtain general-use materials and/or supply items,
3. The elimination of the delivery of materials and/or supplies to the wrong place, and
4. The cost savings realized from decreasing the time required between request and receipt of the required materials and/or supplies.

Physical Layout of Maintenance Stores

The Maintenance Stores vary in size due to the fact that each one is designed to fulfill a specific function. That function is to provide a point-of-use storage for the material and/or supply items needed by maintenance personnel under the specific control of the work control center in which the store is located.

An average Maintenance Stores installation consists of approximately thirty bins. These bins are about three feet wide and eighteen inches high. All of the bins are located within a steel mesh enclosure that can be locked during the

⁶"Newest Trend for Job Shops is Point-of-Use Storage," Factory Vol. CXV, No. 2, (February 1959), pp. 143-150.

off-shift periods if necessary. Two typical bins are shown in Figures 18 and 19. Generally, twenty individual bins are used for regular Central Material Stores stock items, while other bins are available for items stocked by Maintenance on direct purchase.

In general, the bin arrangements consist of shelves on nine-inch centers, with spaces on six-inch centers. This can and does vary to handle different types and sizes of materials and/or supplies. The wider spaces are provided for such items as wire, gasket material, and welding rods. Drawer space is provided for nuts, bolts, and screws. Locked cabinets are available for the storage of sensitive items such as vacuum tubes. In the establishment of these Maintenance Stores, the two bottom rows of shelves were left empty for future expansion if needed. Attached to the front of each bin is a printed card which gives the material and/or supply description, Central Material Stores catalogue number, and the minimum quantity of the stocked material and/or supply to be maintained in that bin.

Maintenance Stores Inventory Usage Cost Distribution

The Maintenance Stores inventory usage cost is generally charged to the maintenance department in which the store is located except where a specific customer can be isolated.

Equation 1 in Chapter II gives the general formula for total cost allocation to a specific customer of the maintenance department concerned. As pointed out in that chapter, the cost collection and control is formulated around the direct labor charged to the work order and individual job number on the maintenance work

FIGURE 18

VIEW OF MAINTENANCE STORES' OPEN BINS

FIGURE 19

VIEW OF MAINTENANCE STORES' CLOSED DRAWER BINS

request (MWR). Like the decentralization of the labor and management concept, costs are similarly collected under a decentralized policy. (The actual cost-collection mechanics are carried out in Central Accounting, but they are allocated to a decentralized location.) This method affords a clear picture of where and by whom the operational expenses are incurred.

For the allocation of the Maintenance Stores' usage cost to the customer, a specific part of the total maintenance department cost must be studied. In actual practice the inventory usage cost is not a separate cost item, but for clarification of the inventory usage cost distribution it is assumed here to be a separate item. The equation for determining this cost is:

$$MAC = \left(\frac{CWO}{TWO} \right) (SRC) , \quad (5)$$

where:

MAC = allocated cost of the Maintenance Stores' inventory stock replenishment,

CWO = time charged to customer's work order for the month,

TWO = total time charged to all customers' blanket work orders in the department for the month, and

SRC = total Maintenance Stores' stock replenishment cost.

By the use of the fractional ratio of the manhours charged to a specific customer's work orders compared to the manhours spent on all customer's work orders, it is felt that this is a method of cost allocation that is realistic and practical. An example of the application of this equation is shown in Table VI.

TABLE VI
COMPARATIVE APPLICATION OF MAINTENANCE STORES
INVENTORY USAGE ALLOCATION

Customer A		Customer B	
CWO	300 Hours	CWO	100 Hours
TWO	6,000 Hours	TWO	6,000 Hours
SRC	\$4,000	SRC	\$4,000
$\text{MAC} = \left(\frac{300}{6,000} \right) (\$4,000)$		$\text{MAC} = \left(\frac{100}{6,000} \right) (\$4,000)$	
= \$200		= \$66.67	

\$200.00 is the total cost allocated to Customer A for Maintenance Stores inventory usage.

\$66.67 is the total cost allocated to Customer B for Maintenance Stores inventory usage.

Note: These examples are used only for clarity and are not to be related to any actual figures.

CHAPTER IV

PROCEDURES FOR OBTAINING MATERIALS, SUPPLIES, AND EQUIPMENT

The preceding chapter described the facilities and equipment that Y-12 Maintenance has available for its use in obtaining and storing the necessary materials, supplies, and equipment required to carry out a maintenance request. This chapter will explain the general procedures followed for obtaining the necessary materials, supplies, and equipment. It will also show, by the use of simplified flow diagrams, each step the request must go through before the materials, supplies, and equipment are delivered to the requester. The procedures set forth in this chapter will pertain to the following:

1. Requisition and delivery of plant inventory stock,
2. Replenishment of Central Material Stores stock,
3. Requisition and storage of material, supplies, and equipment in Bill of Materials Stores,
4. Replenishment of Maintenance Stores stock,
5. Spare parts and new Central Material Stores stock requisition and delivery, and
6. Requisition and delivery of "B" property equipment.

It should be emphasized that these procedures are used only as general guides and are not set rules. Due to the requirement of retaining flexibility, variations of these procedures are sometimes used.

I. REQUISITION AND DELIVERY OF MATERIAL, SUPPLY, AND EQUIPMENT STOCK ITEMS

To obtain materials, supplies, and/or equipment which are carried as stock inventory within the Y-12 complex, an employee (requester) must fill out a request for material from stores (Form UCN-3140). This form is shown in Appendix B, Figure 29, and a generalized flow is shown in Figure 20.

On this form must be listed the following information:

1. The catalogue number of the needed items,
2. The unit of issue,
3. The quantity desired,
4. The work order number for which the items are being procured,
5. A description of the items,
6. The date,
7. The requester's department and badge number,
8. The location to which the items are to be delivered, and
9. An authorized signature.

The requester can send or carry, through one of the facilities available, the request to Central Material Stores, one of the substores, or tool cribs. (An

FIGURE 20

PLANT INVENTORY STOCK REQUISITION AND DELIVERY FLOW

exception to the necessity of this form is in obtaining stock items from the Maintenance Stores as explained in Chapter III. The requester does not need a request form to obtain items from these locations.) The majority of the requests for stock items is handled through the regularly scheduled deliveries by Stores personnel. (For an emergency request received via transmitter, or telephone, "emergency" or "rush" is printed on the form and an immediate delivery will be received by the requester.)

II. REPLENISHMENT OF CENTRAL MATERIAL STORES' STOCK

The major portion of the inventory stock of Central Material Stores is replenished by using an electronic data processing system. The quantities to be replenished are calculated by the use of the economic order quantity equations. (The electronic data processing system and the economic order quantity formulas are explained in Chapter III.)

Central Material Stores

As each item is withdrawn from stock, a prepunched IBM card is withdrawn and forwarded to Materials Control.

Materials Control

Materials Control is responsible for maintaining the stock inventory levels. They collect all inventory usage cards, sort them, and forward them to the Data Processing Section.

Data Processing Section

The Data Processing Section enters the prepunched cards into the computer equipment. The inventory-replenishment-program memory tapes are activated and an Order Point Report is printed out. This report is forwarded to Central Purchasing.

Central Purchasing

Central Purchasing takes the stock quantity requirements from the report and after due consideration initiates a purchase requisition to procure the items. The purchase requisition is sent to the appropriate vendor.

Vendor

The vendor supplies the required items and delivers them to the Receiving Department along with a copy of the purchase requisition.

Receiving Department

The Receiving Department checks the quantities, quality, and condition of the requested materials, supplies, and/or equipment. They then prepare the required copies of a receiving report. This report and one copy of the purchase requisition is forwarded to the Accounts Payable Department; a second copy is forwarded to Materials Control. The stock items are then transported to Central Material Stores, where the stock is placed in the inventory bins. Figure 21 shows the flow for the procurement and delivery of stock replenishment items.

FIGURE 21

CENTRAL MATERIAL STORES' INVENTORY STOCK REPLENISHMENT FLOW

III. REQUISITION AND STORAGE OF MATERIALS, SUPPLIES, AND EQUIPMENT IN BILL OF MATERIALS STORES

A request for materials, supplies, and equipment to be stored in Bill of Materials Stores must be within the limits of the basic criteria, as explained in Chapter III, for the types of materials, supplies, and equipment that can be stored in the Bill of Materials Stores.

Requester

The requester for materials, supplies, and equipment to be stored in the Bill of Materials Stores for use by Maintenance can be any authorized person operating under the jurisdiction of the requesting maintenance department. Requests are made using appropriate forms submitted to other groups as follows:

If the request is for a nonstock item that must be purchased a purchase requisition and telephone release (Form UCN-3324) is initiated and forwarded directly to the Purchasing Department. This form is shown in Appendix B, Figure 30. As explained in Chapters I and II, the transmittal for an engineered work order authorizes the procurement of materials, supplies, and equipment needed to complete the job that is requested. Therefore, the requester can forward the request with other pertinent information directly to the Purchasing Department.

If the request is for a Central Material Stores stock inventory item, the requester sends the material request directly to the Central Material Stores.

When the request is for an item that must be fabricated in one of the maintenance shops, a maintenance work request is sent, with drawings and specification, if required, to the appropriate shop for fabrication.

Maintenance Shops

Upon receipt of a maintenance work request and/or drawings and specifications describing what is to be done, the maintenance shop fabricates the requested item and sends it to the requester in care of the Bill of Materials Stores for composite storage.

Central Material Stores

When Central Materials Stores personnel receive a bill-of-materials request, the request is filled from stock and forwarded to the requester in care of the Bill of Materials Stores for composite storage.

Purchasing Department

The Purchasing Department notifies Materials Control of the requisition by sending a copy of the requisition. The order is forwarded to the vendor.

Vendor

The vendor supplies the requested materials, supplies, and/or equipment and delivers same to the Y-12 Receiving Department.

Receiving Department

The Receiving Department receives and checks the requested materials, supplies, and/or equipment against the specifications on the request, then initiates the receiving reports and forwards a copy, if needed, to the Property Department

for the assignment of a property "Y" number (see property number definition Chapter I). A copy of the receiving report is also forwarded to the Materials Control Department. The materials, supplies, and equipment are then forwarded to the requester in care of the Bill of Materials Stores along with a copy of the receiving report.

Bill of Materials Stores

Upon receipt of materials, supplies, and/or equipment in the Bill of Materials Stores, a withdrawal card (Form UCN-774) is prepared. The card, as shown in Figure 22, indicates the work order number, bill-of-materials item number, identification number, a brief description, and the purchase order number when applicable. One copy of this withdrawal card (yellow) is forwarded to the requester with a copy of the receiving report, when purchased from outside sources, or a copy of the bill of materials, when transferred from Stores stock; the second copy (pink) is forwarded to Materials Control for use in compiling reports; and the third copy (green) is retained in the Bill of Materials Stores' files.

Three types of reports are generated from Bill of Materials Stores:

1. Open Work Order Report - indicates active jobs and the materials stores for the specific job,
2. Closed Work Order Reports - indicates closed jobs for which some materials are being held. The items appearing on this report are held for the requester for sixty days after job closure. If no disposition is made by the requester within sixty days, the items are made available for general use,

05-07854					
GROUP	NUMBER				
RECEIVED IN B/M STOCK		COMMODITY GROUP	NUMBER		
BY:					
DATE:	IDENTIFICATION NUMBER		UNIT	QUANTITY	UNIT VALUE

FIELD ENGINEER	05-07854					
GROUP	NUMBER					
RECEIVED IN B/M STOCK		COMMODITY GROUP	NUMBER			
BY:						
DATE:	IDENTIFICATION NUMBER		UNIT	QUANTITY	UNIT VALUE	

BY:	FIELD ENGINEER	05-07854					
DATE:	GROUP	NUMBER					
RECEIVED IN B/M STOCK		COMMODITY GROUP	NUMBER				
BILL	BY:						
DATE:	IDENTIFICATION NUMBER		UNIT	QUANTITY	UNIT VALUE		
UCN-77 (2-8)	BY:						
DATE:	FIELD ENGINEER:						
BILL	SECTION	BIN	B.M. ITEM NUMBER		DESCRIPTION		
UCN-77 (2-8)	LOCATION		LETTER	NUMBER	CLASS SUB-CLASS ITEM NO.		
BY:	ISSUED FROM B/M STOCK						
DATE:	WORK ORDER NUMBER		PURCHASE ORDER NO. R.R. NO. (ORI STORES CATALOG NO.)				
BILL OF MATERIAL TRANSACTION CARD		RECEIVED BY:					
UCN-774 (2-8-59) EAC 8986		DEPARTMENT	BADGE NUMBER	NAME			
		PINK - RECEIPT COPY GREEN - ISSUE COPY YELLOW - REQUESTOR COPY					

FIGURE 22

BILL OF MATERIALS STORES' WITHDRAWAL CARD

3. Commodity Listings - show those materials that are available for general use.

The Bill of Materials Stores' group forwards a complete set of reports, with the receiving reports, to the Maintenance Administrative Services Department who reviews and forwards the reports to the maintenance work control centers. Five copies of the commodity listings are also forwarded to the Engineering Design Department.

Requester

The requester is responsible for the withdrawal card until the material, supply, or equipment is needed that has been stored in Bill of Materials Stores. This card must be presented to obtain the stored items. A general simplified flow of Bill of Materials Stores is shown in Figure 23.

IV. REPLENISHING MAINTENANCE STORES' STOCK

The Maintenance Stores' stock is established and replenished following the basic criteria that were described in Chapter III. The user can withdraw the stock items in these stores without having to fill out a form. A stockkeeper from Central Material Stores goes through each maintenance store about once a week and visually checks the bins for adequacy of stock based on minimum stock quantities established by Maintenance. The bins are replenished as required and the materials and supplies are charged to the account applicable to the particular store.

FIGURE 23

BILL OF MATERIALS STORES' FLOW

If it is desired to make an addition to or remove an item from stock in a maintenance store, the department responsible for that store forwards a memorandum to that effect to the Maintenance Administrative Services Department who has the responsibility for administrative control of these stores as explained in Chapter III. This memorandum, with other pertinent information, is received and the changes are posted to a master record of all items stocked in the maintenance stores. Form TY-3465, which is shown in Appendix B, Figure 31, is prepared and forwarded to Central Material Stores, where the change is carried out. Figure 24 gives a generalized flow for the replenishment and change of stock in the Maintenance Stores.

V. SPARE PARTS AND NEW CENTRAL MATERIAL STORES'

STOCK REQUISITIONS AND DELIVERY

In view of the vast number of different equipment items for which Maintenance is responsible, spare parts pose a high-cost problem which must be kept under tight supervisory control. If a person (requester) in the Maintenance Division has a need to request spare parts or other new Stores' stock items that must be purchased, he initiates a spare parts recommendation request (Form UCN-2451), shown in Appendix B, Figure 32. This form is then forwarded to his work control center supervisor in the particular maintenance department. (This form originates from Engineering Services personnel when a new piece of equipment for which Maintenance is responsible is received by the Y-12 Plant. When this form is originated

FIGURE 24

REPLENISHMENT AND CHANGE IN MAIN-
TENANCE STORES' STOCK FLOW

from Engineering Services it is forwarded to the appropriate maintenance department and from there follows the same procedure as a request originated in the field.) A generalized flow for this procedure is shown in Figure 25.

Maintenance Work Control Center (WCC) Supervisor

The Work Control Center Supervisor reviews the request, the function of the stock to be established, and the criticality of this stock to the continuity of the operation. The form is then forwarded to the Material Coordinator. If the request is received from Engineering Services, a review is made of the manufacturers' data, equipment, function, and criticality to the continuity of operation. Form UCN-2451 is then completed showing the recommended spare parts and quantities to be stocked. These quantities should be anticipated for a six-month usage. If spare parts are not required, a note is made to that effect on the form and the completed form is forwarded to the Department Superintendent. If spare parts are required, the request is forwarded to the Material Coordinator.

Material Coordinator

The Material Coordinator reviews the request, and approves or suggests alternative stock items to be used in lieu of the request. The request is then forwarded to the Department Superintendent.

Department Superintendent

The Department Superintendent reviews Form UCN-2451 and all pertinent information. If spare parts are not required at the present time, the request is filed or, if originated from Engineering Services, "no spare parts required" is recorded

FIGURE 25

SPARE PARTS AND CENTRAL MATERIAL STORES' REQUISITION AND DELIVERY FLOW

and the request is forwarded to the Maintenance Division Superintendent.

Maintenance Division Superintendent

The Division Superintendent reviews the request and, if the requested items are needed, the form is approved and forwarded to Engineering Services.

Engineering Services

Engineering Services personnel maintain a master file of all vendor data, including either one set of reproducible drawings, aperture cards, and drawings applicable to the microfilm service, or three sets of data when reproducibles are not available. Two copies of the manufacturers' data are forwarded to the shop if shop personnel are responsible for maintaining the equipment. (This is usually encountered for very specialized equipment which can be more economically maintained by one group serving the entire plant.)

When adequate manufacturers' data have been received, a spare parts recommendation request is prepared and forwarded to the Maintenance group that maintains the equipment.

Upon receipt of the completed spare parts recommendation request from the Maintenance Division Superintendent, the accuracy of the description for each item listed is checked, all pertinent information is entered on the master file, and the completed form is forwarded to the Materials Control Department. When a request denoting "no spare parts required" is received from the Department Superintendent, it is filed for a six-month period.

Materials Control

The Materials Control Department reviews the approved Form UCN-2451 and checks the accuracy of the description for each item listed. A determination is made whether or not any items are interchangeable with items already stocked, such as bearings and V-belts. A consolidated stores catalogue transmittal form (UCN-3) is prepared, shown in Appendix B, Figure 33, for the recommended spare parts. When catalogue numbers have been assigned, a copy of this form is forwarded, indicating the assigned catalogue numbers, to the appropriate Maintenance Department Material Coordinator. A purchase requisition, Form UCN-3324, is then initiated and forwarded to the Purchasing Department. (The purchasing and vendor phase of this procedure is similar to the functions performed by the same groups in the Bill of Materials Stores procedure.)

Receiving Department

The Receiving Department receives and checks the requested materials, supplies, and/or equipment against the specifications on the request and initiates the receiving report and forwards a copy, if needed, to the Property Department for the assignment of a property "Y" number. The received materials, supplies, and equipment are forwarded to Central Material Stores where they are established as a stock inventory item.

VI. REQUISITION AND DELIVERY OF "B" PROPERTY EQUIPMENT

The Y-12 Maintenance Division has the responsibility for requisitioning all "B" property equipment utilized by Maintenance forces. The term "B" property equipment is used in Y-12 to designate capital equipment. All "B" property equipment has a "Y" number. A generalized flow for the requisition and delivery of "B" property equipment is shown in Figure 26.

The Maintenance Division also has the responsibility for requisitioning all vehicles used by the Y-12 Plant. The procedure for the requisition and delivery of vehicles is the same as the procedure for requisitioning "B" property with two exceptions. These exceptions are:

1. The initial requisition is on Form AEC-90, as shown in Appendix B, Figure 34, instead of Form UCN-3324, and
2. Actions taken by the United States Atomic Energy Commission in the procurement of vehicles vary from actions taken in procurement of "B" property. The AEC Purchasing Department procures vehicles through the Government Services Agency (GSA).

With the two exceptions noted, the procedure for vehicles follows the same flow as shown in Figure 26.

Requester

The requester for a "B" property piece of equipment sends a memorandum reflecting the request to Maintenance Administrative Services in care of the

FIGURE 26

"B" PROPERTY EQUIPMENT REQUEST AND DELIVERY FLOW

Equipment Coordinator. This memorandum lists all pertinent information.

Equipment Coordinator

The Equipment Coordinator checks the usage and need of the requested item then checks the service life for the possible retirement of old equipment. Form UCN-3324 is initiated for the purchase of "B" property equipment. Copies of this form are forwarded to the Maintenance Division Superintendent.

Maintenance Division Superintendent

The Maintenance Division Superintendent verifies the requisition and files the requisitioner's file copy then approves and forwards the other copies to the Property Department. If the cost of the requested items is in excess of a specified amount, the requisition is forwarded to a review committee and the Y-12 Plant Superintendent's office where it is verified, approved, and forwarded to the Property Department.

Property Department

The Property Department records the requisition and checks with the Accounts Payable Department to see if funds are available to the requester for the purchase of the requested items. The Property copy of the requisition is filed and the remaining copies are forwarded to the Atomic Energy Commission's (AEC) Oak Ridge headquarters.

Atomic Energy Commission

The Atomic Energy Commission verifies the request for "B" property equipment and checks to see if the required equipment is in stock at one of the other AEC

facilities in the United States. If the equipment is in stock, a notation is made to this effect on the requisition and it is forwarded to the Union Carbide's Oak Ridge Purchasing Department. The Purchasing phase is handled generally in the same manner for these purchases as it is handled for all others.

Y-12 Plant Receiving Department

The Receiving Department receives the requested equipment and initiates the receiving reports. A copy of the receiving report is forwarded to the Property Department where a "Y" number is assigned to the items. The equipment and copies of the receiving reports are forwarded to the Equipment Coordinator.

Equipment Coordinator

The Equipment Coordinator files the requisitioner's comeback copy of the requisition and a copy of the receiving report and records the equipment "Y" number on his master listing. The equipment is then forwarded to the requester.

CHAPTER V

DISPOSAL OF EXCESS USED MATERIALS, SUPPLIES, AND EQUIPMENT

A procedure has been established to direct the flow of excess used materials, supplies, and equipment in an economical manner. This involves screening these items for possible reuse in the plant, or segregation of the items for maximum resale value.

This procedure is a general guide line for the routine unclassified collection of excess materials, supplies, equipment, and scrap. There are exceptions to this procedure, of course, and it is emphasized to the reader that this in no way should be construed to be the exact rule.

I. DISPOSAL OF EXCESS SERVICEABLE MATERIALS, SUPPLIES, AND EQUIPMENT

Chapter I defines serviceable materials, supplies, and equipment. This procedure will explain the disposal of this type of materials, supplies, and equipment. A general flow for this procedure is shown in Figure 27.

Using Department

The Using Department determines the security classification and appropriate strategic importance of the items involved. Arrangement is also made to have the excess materials, supplies, and equipment inspected by the Radiation Safety Department. If property items are involved, a property transfer record (Form UCN-541),

FIGURE 27

DISPOSAL OF SERVICEABLE MATERIALS, SUPPLIES,
AND EQUIPMENT FLOW

shown in Appendix C, Figure 35, is initiated to transfer the items to the Materials Department. If the materials, supplies, and equipment are excess to the user's immediate needs, but the user has a foreseeable need, the items may be stored for possible future use provided such handling is stipulated.

Radiation Safety Department

The Radiation Safety Department provides services upon request by a responsible department. The services include a contamination check, affixing proper tags, and recommending further disposition of the items in question. Further steps to be taken are also recommended if the items require decontamination.

Chemical Department

The Chemical Department provides general decontamination services as requested by the using department. If the items require special handling such as major disassembly, application of protective coatings, or other treatment, the Area Maintenance Department performs these functions.

Materials Department

The Materials Department makes arrangements for storing items until such time as a use for the items exists within the plant or the items are declared excess to plant needs. Excess lists are prepared for review by the Material and Equipment Coordinators. This group also maintains control over the items until removed from the plant by authorized personnel, and advice is also given to others concerning material problems.

Material and Equipment Coordinators

The Material and Equipment Coordinators are representatives from major using departments who are familiar with the various commodity groups and serve as members of the Catalogue Review Committee. The Coordinators act for this committee to see that proper using and design groups are utilized in the review of catalogue information. Excessing materials, supplies, and equipment is also approved by them to insure that needed items are retained in the plant for future work. An effort is also made to encourage better utilization of used materials, supplies, and equipment where practical.

Used Stores

A Used Stores facility has been established to store used materials, supplies, and/or nonstock items that are excess to job requirements in Bill of Materials Stores. Every effort is made to utilize these used materials, supplies, and equipment any of which may be withdrawn without further charge by contacting the stockkeeper at Used Stores. The Maintenance Division stocks one of the Maintenance Stores completely from the Used Stores; supplementary stock goes to the other Maintenance Stores.

Equipment Pools

Another facility established and utilized in the Y-12 Plant is a group of Equipment Pools. These pools are stocked with items which appear on the equipment lists but which have further use by other Maintenance, Engineering, or Operating personnel. This provision eliminates the need for purchasing new

equipment when usable equipment is available. Pools for such items as electric motors, instruments, and pumps have been established, with others planned. In addition to the Equipment Pools, the Materials Department stores serviceable items that do not fit into an existing pool until the items are released for disposal by the equipment coordinators.

Excess Disposal by Sale

This function has been established to recover the maximum value from materials, supplies, and equipment that are no longer of use in the operation of the Y-12 Plant.

II. DISPOSAL OF EXCESS UNSERVICEABLE MATERIALS, SUPPLIES, EQUIPMENT, AND SCRAP

The using department arranges for the Radiation Safety Department to inspect and tag all materials, supplies, and equipment with proper safety tags, then initiates a material and equipment disposal form (Form UCN-2996), shown in Appendix C, Figure 36. Figure 28 shows a generalized flow for this procedure. This form is forwarded to the Salvage Department.

In reference to the handling of scrap, the generating department does the following:

1. Keeps clean scrap segregated from contaminated scrap,
2. Keeps combustibles such as paper, scrap wood, plastics, and similar items separated from scrap metal,

FIGURE 28

DISPOSAL OF UNSERVICEABLE MATERIALS, SUPPLIES, EQUIPMENT,
AND SCRAP FLOW

3. Keeps ferrous scrap metal separate from nonferrous scrap and, where volumes are large enough to be economically practical, keeps non-ferrous scrap metals separate,
4. Places all scrap in the proper color-coded receptacles provided at designated scrap pickup stations for routine handling. Special or extra pick ups can be arranged by notifying the Salvage Department.

Salvage Department

The Salvage Department assists in establishing routine scrap pickup stations where feasible. Scrap is picked up at designated locations and transported to the appropriate storage facility. Unserviceable materials, supplies, and equipment are also picked up when requested by the using department. The Salvage Department disposes of all items which cannot be sold through established plant procedures by limited sale, burning, or burying.

CHAPTER VI

SUMMARY

As explained in Chapter I, maintenance is fast becoming a major contributor to total production cost. With the rapid change in technology and the implementation of highly mechanized production line equipment, the role of maintenance has grown by leaps and bounds. Not only does the inanimate machine need repair, but there are many service functions other than repair—such as the installation of certain power supplies and facilities—that are being performed by maintenance. With the total cost and the increase in this total cost being attributed to maintenance, management must recognize and find ways of controlling these costs.

The cost of maintenance is composed primarily of labor cost and the cost of materials, supplies, and equipment. Studies have indicated that these two factors share equally in the composition of the total maintenance cost; therefore, it is very important that the procurement and handling of the materials, supplies, and equipment be kept under close control.

This thesis describes the organizational concepts, facilities, and simplified procedures employed at the Y-12 Plant to control the inanimate phase of maintenance. The author recognizes that the two phases of maintenance, labor and materials, are highly interrelated and, therefore, a very complex problem is presented when an attempt is made to analyze one phase without going into great detail in the other phase. To counteract this complexity, the author has devoted a

complete chapter, Chapter II, to describe the concepts and methods employed to control the manpower phase of maintenance expense.

Chapter III has gone into detail to describe the facilities and equipment utilized for the procurement, delivery, and storage of the required items. Although this chapter has described these facilities and equipment as separated from the whole system, the analysis was carried out with a view to the over-all system.

Chapter IV has described the detailed procedures employed with the use of simplified flows to depict the detailed step-by-step procedure. With the use of this flow analysis the author has been able to analyze the total system from the viewpoint of continuity of goals and material flow. The flow diagrams of the procedures have been an outstanding aid in the process of making each individual associated in the procurement of materials, supplies, and equipment, conscious of the importance he plays in the system. These pictures have also provided a readily available followup to find and correct any breakdowns in the system from the realization of a need for materials, supplies, and equipment to the fulfillment of that need.

Chapter V describes procedures for the collection and disposal of excess materials, supplies, and equipment. This chapter also emphasizes the economy of utilization of all used materials, supplies, and equipment by plant personnel. If a used item no longer has utility within the plant, it should be disposed of in the most economical manner to eliminate unnecessary storage cost.

The author's role was primarily of an investigative nature. It is believed that contributions to the system have been made as a result of charting existing

situations and questioning those phases that seemed fertile for improvement. The approach was partially responsible for discontinuing the use of several forms and for streamlining the flow of communications in various phases. This thesis describes the present system, providing a one-volume guide, not previously available, to those who are involved constantly with the problem.

It is recognized in an operation as complex as the operation of the Y-12 Plant at Oak Ridge that there is a real need to maintain a large degree of flexibility in certain modes of operation. One of the areas requiring flexibility is in the procurement of materials, supplies, and equipment. Here the plant must be able to take advantage of market conditions and changes in the state of the art in manufacturing and distribution of the items required for maintenance work. It is felt by the author and his associates in this analysis that the system described in this thesis has accomplished the required degree of flexibility and also allowed adequate followup to evaluate any deviation from the established procedures with the aim in mind of not staying within the status quo. It is not the intention of the author to imply that the over-all system described in this thesis is the one best method, but is a workable method that will incorporate new ideas and modes of operation as soon as they are proved economically sound.

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APPENDIX A

REMARKS FOR GUIDANCE OF TRANSMITTER OPERATORS

Before 8:00 A.M., your meter pointer will be downscale at the bottom of the red area, indicating that the Datafax control at Central Material Stores is off. At 8:00 A.M., or sometime before, Central Material Stores personnel will turn the control and receivers on and your meter pointer will move to the green area at the top of the scale. Allow about one minute for the receivers and control to warm up before sending copy.

Since all operators will probably have orders accumulated from the previous evening, some sequence of starting time is necessary. To take care of this Central Material Stores has assigned 10 minutes at the beginning of the shift to each operator and the sequence of transmission will be A, B, C, D on one net and E, F, G, H on the other net. Station A will start at 8:00 A.M. and transmit for 10 minutes, then Station B will transmit for 10 minutes and so on through the net. After the initial 10 minutes available for each operator, the net is free to use any time the meter pointer is in the green area.

Always leave the switch on your meter panel down and light off when not transmitting. This action is necessary because no one else in the net can transmit as long as your meter switch is up and your light is on. If you leave your meter switch up for an extended time without sending copy, Central Material Stores personnel will put you on "hold" and remove your station from the net. In this case, when you return and throw the meter switch down, the meter pointer will

move to the orange section of the scale marked "hold." It will then be necessary for you to call Central Material Stores and ask them to return your station to the net. "Hold" may also be used for telephone line trouble or other transmitter malfunction. If your station is put on "hold," Central Material Stores personnel will try to contact you and explain why.

To transmit a requisition, first note your meter pointer indication. If another station is sending, wait until the pointer moves to the green "ready" area, then throw your meter switch down. The meter pointer will go to the red "send" area and the meter panel light will burn. You will then have locked out all other transmitters on the net and the other station operators will know that you are sending by the indication of their meter pointers. Balance your transmitter and send copy as you did before the electronic control network was installed.

If you have several requisitions to send, space the sending time in small groups of about four or five requisitions, if practical, so that other stations may send small groups between. If you do transmit for an extended time and another operator has a few urgent requisitions, he should call you and ask to break into the net to send the few requisitions. Remember that you have the net tied up, whether your transmitter is on or off, as long as your meter panel light is on. Therefore, be sure when you are through transmitting to turn the meter panel switch off.

Present usage indicates that ample transmitting time will be available for all stations. Send your requisitions through as you receive them to prevent

accumulation. This procedure spreads the work load at Central Material Stores, allows you more operating freedom, and results in better receiver operation since the receiver paper has less time to dry out.

Requests for maintenance on any of the Datafax equipment should be made to the Maintenance Electrical Department's work control center.

APPENDIX B

<div style="display: flex; justify-content: space-between; align-items: center;"> <div style="text-align: left;"> UNION CARBIDE NUCLEAR COMPANY Post Office Box M Oak Ridge, Tennessee Acting Under U.S. Government Contract W7405 eng 26 With the U.S. Atomic Energy Commission </div> <div style="text-align: right;"> PURCHASE REQUISITION AND TELEPHONE RELEASE </div> </div>									
REQUISITION NO.	DELIVER BY	WANTED BY	BUYER	PLANT	ORDER NUMBER	RELEASE NO.	CH. NO.	DATE	A.R. NO.
SHIP TO: U.S. ATOMIC ENERGY COMMISSION, c/o UNION CARBIDE NUCLEAR COMPANY						1. DESTINATION 2. SHIPPING POINT 3. SHIPPING POINT-FRT. ALLOWED			
MARK ALL PACKAGES WITH PLANT AND ORDER NUMBER AND CONSIGN: 1. SOUTHERN RAILWAY TO BLAIR, TENNESSEE 2. LOUISVILLE AND NASHVILLE RAILWAY TO OAK RIDGE, TENNESSEE POST OFFICE BOX OAK RIDGE, TENN.						TRANSPORTATION TERMS (As Coded) 1. ACCOUNT OF GOVERNMENT DO NOT INSURE, DECLARE VALUE SO AS TO OBTAIN LOWEST POSSIBLE TRAIL PORTATION RATE. 2. ACCOUNT OF SELLER-Prepaid. 3. OTHER (See Below)			
Motor Freight, Air Express, or Railway Express to Oak Ridge, Tennessee; Air Freight to Knoxville, Tennessee VENDOR CODE						SHIP VIA (As Coded) A. MOTOR FREIGHT B. RAIL FREIGHT C. RAIL EXPRESS D. AIR FREIGHT E. AIR EXPRESS F. PARCEL POST G. AIR PARCEL POST H. SELLER'S TRUCK I. SELLER'S OPTION J. LOCAL PICK-UP K. BUS L. 45 TONN M. COMPANY VEHICLE N. 500+ PARCEL POST OVER 45+INT. FRT.			
SUGGESTED VENDORS						PAYMENT TERMS (As Coded) 1. 10% 10 DAYS 2. 10% 15 DAYS 3. 10% 20 DAYS 4. 10% 25 DAYS 5. 10% 30 DAYS 6. 10% 35 DAYS 7. 10% 40 DAYS 8. 10% 45 DAYS 9. 10% 50 DAYS 10. 10% 55 DAYS 11. 10% 60 DAYS 12. 10% 65 DAYS 13. 10% 70 DAYS 14. 10% 75 DAYS 15. 10% 80 DAYS 16. 10% 85 DAYS 17. 10% 90 DAYS 18. 10% 95 DAYS 19. 10% 100 DAYS 20. 10% 105 DAYS 21. 10% 110 DAYS 22. 10% 115 DAYS 23. 10% 120 DAYS 24. 10% 125 DAYS 25. 10% 130 DAYS 26. 10% 135 DAYS 27. 10% 140 DAYS 28. 10% 145 DAYS 29. 10% 150 DAYS 30. 10% 155 DAYS 31. 10% 160 DAYS 32. 10% 165 DAYS 33. 10% 170 DAYS 34. 10% 175 DAYS 35. 10% 180 DAYS 36. 10% 185 DAYS 37. 10% 190 DAYS 38. 10% 195 DAYS 39. 10% 200 DAYS 40. 10% 205 DAYS 41. 10% 210 DAYS 42. 10% 215 DAYS 43. 10% 220 DAYS 44. 10% 225 DAYS 45. 10% 230 DAYS 46. 10% 235 DAYS 47. 10% 240 DAYS 48. 10% 245 DAYS 49. 10% 250 DAYS 50. 10% 255 DAYS 51. 10% 260 DAYS 52. 10% 265 DAYS 53. 10% 270 DAYS 54. 10% 275 DAYS 55. 10% 280 DAYS 56. 10% 285 DAYS 57. 10% 290 DAYS 58. 10% 295 DAYS 59. 10% 300 DAYS 60. 10% 305 DAYS 61. 10% 310 DAYS 62. 10% 315 DAYS 63. 10% 320 DAYS 64. 10% 325 DAYS 65. 10% 330 DAYS 66. 10% 335 DAYS 67. 10% 340 DAYS 68. 10% 345 DAYS 69. 10% 350 DAYS 70. 10% 355 DAYS 71. 10% 360 DAYS 72. 10% 365 DAYS 73. 10% 370 DAYS 74. 10% 375 DAYS 75. 10% 380 DAYS 76. 10% 385 DAYS 77. 10% 390 DAYS 78. 10% 395 DAYS 79. 10% 400 DAYS 80. 10% 405 DAYS 81. 10% 410 DAYS 82. 10% 415 DAYS 83. 10% 420 DAYS 84. 10% 425 DAYS 85. 10% 430 DAYS 86. 10% 435 DAYS 87. 10% 440 DAYS 88. 10% 445 DAYS 89. 10% 450 DAYS 90. 10% 455 DAYS 91. 10% 460 DAYS 92. 10% 465 DAYS 93. 10% 470 DAYS 94. 10% 475 DAYS 95. 10% 480 DAYS 96. 10% 485 DAYS 97. 10% 490 DAYS 98. 10% 495 DAYS 99. 10% 500 DAYS 100. 10% 505 DAYS 101. 10% 510 DAYS 102. 10% 515 DAYS 103. 10% 520 DAYS 104. 10% 525 DAYS 105. 10% 530 DAYS 106. 10% 535 DAYS 107. 10% 540 DAYS 108. 10% 545 DAYS 109. 10% 550 DAYS 110. 10% 555 DAYS 111. 10% 560 DAYS 112. 10% 565 DAYS 113. 10% 570 DAYS 114. 10% 575 DAYS 115. 10% 580 DAYS 116. 10% 585 DAYS 117. 10% 590 DAYS 118. 10% 595 DAYS 119. 10% 600 DAYS 120. 10% 605 DAYS 121. 10% 610 DAYS 122. 10% 615 DAYS 123. 10% 620 DAYS 124. 10% 625 DAYS 125. 10% 630 DAYS 126. 10% 635 DAYS 127. 10% 640 DAYS 128. 10% 645 DAYS 129. 10% 650 DAYS 130. 10% 655 DAYS 131. 10% 660 DAYS 132. 10% 665 DAYS 133. 10% 670 DAYS 134. 10% 675 DAYS 135. 10% 680 DAYS 136. 10% 685 DAYS 137. 10% 690 DAYS 138. 10% 695 DAYS 139. 10% 700 DAYS 140. 10% 705 DAYS 141. 10% 710 DAYS 142. 10% 715 DAYS 143. 10% 720 DAYS 144. 10% 725 DAYS 145. 10% 730 DAYS 146. 10% 735 DAYS 147. 10% 740 DAYS 148. 10% 745 DAYS 149. 10% 750 DAYS 150. 10% 755 DAYS 151. 10% 760 DAYS 152. 10% 765 DAYS 153. 10% 770 DAYS 154. 10% 775 DAYS 155. 10% 780 DAYS 156. 10% 785 DAYS 157. 10% 790 DAYS 158. 10% 795 DAYS 159. 10% 800 DAYS 160. 10% 805 DAYS 161. 10% 810 DAYS 162. 10% 815 DAYS 163. 10% 820 DAYS 164. 10% 825 DAYS 165. 10% 830 DAYS 166. 10% 835 DAYS 167. 10% 840 DAYS 168. 10% 845 DAYS 169. 10% 850 DAYS 170. 10% 855 DAYS 171. 10% 860 DAYS 172. 10% 865 DAYS 173. 10% 870 DAYS 174. 10% 875 DAYS 175. 10% 880 DAYS 176. 10% 885 DAYS 177. 10% 890 DAYS 178. 10% 895 DAYS 179. 10% 900 DAYS 180. 10% 905 DAYS 181. 10% 910 DAYS 182. 10% 915 DAYS 183. 10% 920 DAYS 184. 10% 925 DAYS 185. 10% 930 DAYS 186. 10% 935 DAYS 187. 10% 940 DAYS 188. 10% 945 DAYS 189. 10% 950 DAYS 190. 10% 955 DAYS 191. 10% 960 DAYS 192. 10% 965 DAYS 193. 10% 970 DAYS 194. 10% 975 DAYS 195. 10% 980 DAYS 196. 10% 985 DAYS 197. 10% 990 DAYS 198. 10% 995 DAYS 199. 10% 1000 DAYS 200. 10% 1005 DAYS 201. 10% 1010 DAYS 202. 10% 1015 DAYS 203. 10% 1020 DAYS 204. 10% 1025 DAYS 205. 10% 1030 DAYS 206. 10% 1035 DAYS 207. 10% 1040 DAYS 208. 10% 1045 DAYS 209. 10% 1050 DAYS 210. 10% 1055 DAYS 211. 10% 1060 DAYS 212. 10% 1065 DAYS 213. 10% 1070 DAYS 214. 10% 1075 DAYS 215. 10% 1080 DAYS 216. 10% 1085 DAYS 217. 10% 1090 DAYS 218. 10% 1095 DAYS 219. 10% 1100 DAYS 220. 10% 1105 DAYS 221. 10% 1110 DAYS 222. 10% 1115 DAYS 223. 10% 1120 DAYS 224. 10% 1125 DAYS 225. 10% 1130 DAYS 226. 10% 1135 DAYS 227. 10% 1140 DAYS 228. 10% 1145 DAYS 229. 10% 1150 DAYS 230. 10% 1155 DAYS 231. 10% 1160 DAYS 232. 10% 1165 DAYS 233. 10% 1170 DAYS 234. 10% 1175 DAYS 235. 10% 1180 DAYS 236. 10% 1185 DAYS 237. 10% 1190 DAYS 238. 10% 1195 DAYS 239. 10% 1200 DAYS 240. 10% 1205 DAYS 241. 10% 1210 DAYS 242. 10% 1215 DAYS 243. 10% 1220 DAYS 244. 10% 1225 DAYS 245. 10% 1230 DAYS 246. 10% 1235 DAYS 247. 10% 1240 DAYS 248. 10% 1245 DAYS 249. 10% 1250 DAYS 250. 10% 1255 DAYS 251. 10% 1260 DAYS 252. 10% 1265 DAYS 253. 10% 1270 DAYS 254. 10% 1275 DAYS 255. 10% 1280 DAYS 256. 10% 1285 DAYS 257. 10% 1290 DAYS 258. 10% 1295 DAYS 259. 10% 1300 DAYS 260. 10% 1305 DAYS 261. 10% 1310 DAYS 262. 10% 1315 DAYS 263. 10% 1320 DAYS 264. 10% 1325 DAYS 265. 10% 1330 DAYS 266. 10% 1335 DAYS 267. 10% 1340 DAYS 268. 10% 1345 DAYS 269. 10% 1350 DAYS 270. 10% 1355 DAYS 271. 10% 1360 DAYS 272. 10% 1365 DAYS 273. 10% 1370 DAYS 274. 10% 1375 DAYS 275. 10% 1380 DAYS 276. 10% 1385 DAYS 277. 10% 1390 DAYS 278. 10% 1395 DAYS 279. 10% 1400 DAYS 280. 10% 1405 DAYS 281. 10% 1410 DAYS 282. 10% 1415 DAYS 283. 10% 1420 DAYS 284. 10% 1425 DAYS 285. 10% 1430 DAYS 286. 10% 1435 DAYS 287. 10% 1440 DAYS 288. 10% 1445 DAYS 289. 10% 1450 DAYS 290. 10% 1455 DAYS 291. 10% 1460 DAYS 292. 10% 1465 DAYS 293. 10% 1470 DAYS 294. 10% 1475 DAYS 295. 10% 1480 DAYS 296. 10% 1485 DAYS 297. 10% 1490 DAYS 298. 10% 1495 DAYS 299. 10% 1500 DAYS 300. 10% 1505 DAYS 301. 10% 1510 DAYS 302. 10% 1515 DAYS 303. 10% 1520 DAYS 304. 10% 1525 DAYS 305. 10% 1530 DAYS 306. 10% 1535 DAYS 307. 10% 1540 DAYS 308. 10% 1545 DAYS 309. 10% 1550 DAYS 310. 10% 1555 DAYS 311. 10% 1560 DAYS 312. 10% 1565 DAYS 313. 10% 1570 DAYS 314. 10% 1575 DAYS 315. 10% 1580 DAYS 316. 10% 1585 DAYS 317. 10% 1590 DAYS 318. 10% 1595 DAYS 319. 10% 1600 DAYS 320. 10% 1605 DAYS 321. 10% 1610 DAYS 322. 10% 1615 DAYS 323. 10% 1620 DAYS 324. 10% 1625 DAYS 325. 10% 1630 DAYS 326. 10% 1635 DAYS 327. 10% 1640 DAYS 328. 10% 1645 DAYS 329. 10% 1650 DAYS 330. 10% 1655 DAYS 331. 10% 1660 DAYS 332. 10% 1665 DAYS 333. 10% 1670 DAYS 334. 10% 1675 DAYS 335. 10% 1680 DAYS 336. 10% 1685 DAYS 337. 10% 1690 DAYS 338. 10% 1695 DAYS 339. 10% 1700 DAYS 340. 10% 1705 DAYS 341. 10% 1710 DAYS 342. 10% 1715 DAYS 343. 10% 1720 DAYS 344. 10% 1725 DAYS 345. 10% 1730 DAYS 346. 10% 1735 DAYS 347. 10% 1740 DAYS 348. 10% 1745 DAYS 349. 10% 1750 DAYS 350. 10% 1755 DAYS 351. 10% 1760 DAYS 352. 10% 1765 DAYS 353. 10% 1770 DAYS 354. 10% 1775 DAYS 355. 10% 1780 DAYS 356. 10% 1785 DAYS 357. 10% 1790 DAYS 358. 10% 1795 DAYS 359. 10% 1800 DAYS 360. 10% 1805 DAYS 361. 10% 1810 DAYS 362. 10% 1815 DAYS 363. 10% 1820 DAYS 364. 10% 1825 DAYS 365. 10% 1830 DAYS 366. 10% 1835 DAYS 367. 10% 1840 DAYS 368. 10% 1845 DAYS 369. 10% 1850 DAYS 370. 10% 1855 DAYS 371. 10% 1860 DAYS 372. 10% 1865 DAYS 373. 10% 1870 DAYS 374. 10% 1875 DAYS 375. 10% 1880 DAYS 376. 10% 1885 DAYS 377. 10% 1890 DAYS 378. 10% 1895 DAYS 379. 10% 1900 DAYS 380. 10% 1905 DAYS 381. 10% 1910 DAYS 382. 10% 1915 DAYS 383. 10% 1920 DAYS 384. 10% 1925 DAYS 385. 10% 1930 DAYS 386. 10% 1935 DAYS 387. 10% 1940 DAYS 388. 10% 1945 DAYS 389. 10% 1950 DAYS 390. 10% 1955 DAYS 391. 10% 1960 DAYS 392. 10% 1965 DAYS 393. 10% 1970 DAYS 394. 10% 1975 DAYS 395. 10% 1980 DAYS 396. 10% 1985 DAYS 397. 10% 1990 DAYS 398. 10% 1995 DAYS 399. 10% 2000 DAYS 400. 10% 2005 DAYS 401. 10% 2010 DAYS 402. 10% 2015 DAYS 403. 10% 2020 DAYS 404. 10% 2025 DAYS 405. 10% 2030 DAYS 406. 10% 2035 DAYS 407. 10% 2040 DAYS 408. 10% 2045 DAYS 409. 10% 2050 DAYS 410. 10% 2055 DAYS 411. 10% 2060 DAYS 412. 10% 2065 DAYS 413. 10% 2070 DAYS 414. 10% 2075 DAYS 415. 10% 2080 DAYS 416. 10% 2085 DAYS 417. 10% 2090 DAYS 418. 10% 2095 DAYS 419. 10% 2100 DAYS 420. 10% 2105 DAYS 421. 10% 2110 DAYS 422. 10% 2115 DAYS 423. 10% 2120 DAYS 424. 10% 2125 DAYS 425. 10% 2130 DAYS 426. 10% 2135 DAYS 427. 10% 2140 DAYS 428. 10% 2145 DAYS 429. 10% 2150 DAYS 430. 10% 2155 DAYS 431. 10% 2160 DAYS 432. 10% 2165 DAYS 433. 10% 2170 DAYS 434. 10% 2175 DAYS 435. 10% 2180 DAYS 436. 10% 2185 DAYS 437. 10% 2190 DAYS 438. 10% 2195 DAYS 439. 10% 2200 DAYS 440. 10% 2205 DAYS 441. 10% 2210 DAYS 442. 10% 2215 DAYS 443. 10% 2220 DAYS 444. 10% 2225 DAYS 445. 10% 2230 DAYS 446. 10% 2235 DAYS 447. 10% 2240 DAYS 448. 10% 2245 DAYS 449. 10% 2250 DAYS 450. 10% 2255 DAYS 451. 10% 2260 DAYS 452. 10% 2265 DAYS 453. 10% 2270 DAYS 454. 10% 2275 DAYS 455. 10% 2280 DAYS 456. 10% 2285 DAYS 457. 10% 2290 DAYS 458. 10% 2295 DAYS 459. 10% 2300 DAYS 460. 10% 2305 DAYS 461. 10% 2310 DAYS 462. 10% 2315 DAYS 463. 10% 2320 DAYS 464. 10% 2325 DAYS 465. 10% 2330 DAYS 466. 10% 2335 DAYS 467. 10% 2340 DAYS 468. 10% 2345 DAYS 469. 10% 2350 DAYS 470. 10% 2355 DAYS 471. 10% 2360 DAYS 472. 10% 2365 DAYS 473. 10% 2370 DAYS 474. 10% 2375 DAYS 475. 10% 2380 DAYS 476. 10% 2385 DAYS 477. 10% 2390 DAYS 478. 10% 2395 DAYS 479. 10% 2400 DAYS 480. 10% 2405 DAYS 481. 10% 2410 DAYS 482. 10% 2415 DAYS 483. 10% 2420 DAYS 484. 10% 2425 DAYS 485. 10% 2430 DAYS 486. 10% 2435 DAYS 487. 10% 2440 DAYS 488. 10% 2445 DAYS 489. 10% 2450 DAYS 490. 10% 2455 DAYS 491. 10% 2460 DAYS 492. 10% 2465 DAYS 493. 10% 2470 DAYS 494. 10% 2475 DAYS 495. 10% 2480 DAYS 496. 10% 2485 DAYS 497. 10% 2490 DAYS 498. 10% 2495 DAYS 499. 10% 2500 DAYS 500. 10% 2505 DAYS 501. 10% 2510 DAYS 502. 10% 2515 DAYS 503. 10% 2520 DAYS 504. 10% 2525 DAYS 505. 10% 2530 DAYS 506. 10% 2535 DAYS 507. 10% 2540 DAYS 508. 10% 2545 DAYS 509. 10% 2550 DAYS 510. 10% 2555 DAYS 511. 10% 2560 DAYS 512. 10% 2565 DAYS 513. 10% 2570 DAYS 514. 10% 2575 DAYS 515. 10% 2580 DAYS 516. 10% 2585 DAYS 517. 10% 2590 DAYS 518. 10% 2595 DAYS 519. 10% 2600 DAYS 520. 10% 2605 DAYS 521. 10% 2610 DAYS 522. 10% 2615 DAYS 523. 10% 2620 DAYS 524. 10% 2625 DAYS 525. 10% 2630 DAYS 526. 10% 2635 DAYS 527. 10% 2640 DAYS 528. 10% 2645 DAYS 529. 10% 2650 DAYS 530. 10% 2655 DAYS 531. 10% 2660 DAYS 532. 10% 2665 DAYS 533. 10% 2670 DAYS 534. 10% 2675 DAYS 535. 10% 2680 DAYS 536. 10% 2685 DAYS 537. 10% 2690 DAYS 538. 10% 2695 DAYS 539. 10% 2700 DAYS 540. 10% 2705 DAYS 541. 10% 2710 DAYS 542. 10% 2715 DAYS 543. 10% 2720 DAYS 544. 10% 2725 DAYS 545. 10% 2730 DAYS 546. 10% 2735 DAYS 547. 10% 2740 DAYS 548. 10% 2745 DAYS 549. 10% 2750 DAYS 550. 10% 2755 DAYS 551. 10% 2760 DAYS 552. 10% 2765 DAYS 553. 10% 2770 DAYS 554. 10% 2775 DAYS 555. 10% 2780 DAYS 556. 10% 2785 DAYS 557. 10% 2790 DAYS 558. 10% 2795 DAYS 559. 10% 2800 DAYS 560. 10% 2805 DAYS 561. 10% 2810 DAYS 562. 10% 2815 DAYS 563. 10% 2820 DAYS 564. 10% 2825 DAYS 565. 10% 2830 DAYS 566. 10% 2835 DAYS 567. 10% 2840 DAYS 568. 10% 2845 DAYS 569. 10% 2850 DAYS 570. 10% 2855 DAYS 571. 10% 2860 DAYS 572. 10% 2865 DAYS 573. 10% 2870 DAYS 574. 10% 2875 DAYS 575. 10% 2880 DAYS 576. 10% 2885 DAYS 577. 10% 2890 DAYS 578. 10% 2895 DAYS 579. 10% 2900 DAYS 580. 10% 2905 DAYS 581. 10% 2910 DAYS 582. 10% 2915 DAYS 583. 10% 2920 DAYS 584. 10% 2925 DAYS 585. 10% 2930 DAYS 586. 10% 2935 DAYS 587. 10% 2940 DAYS 588. 10% 2945 DAYS 589. 10% 2950 DAYS 590. 10% 2955 DAYS 591. 10% 2960 DAYS 592. 10% 2965 DAYS 593. 10% 2970 DAYS 594. 10% 2975 DAYS 595. 10% 2980 DAYS 596. 10% 2985 DAYS 597. 10% 2990 DAYS 598. 10% 2995 DAYS 599. 10% 3000 DAYS 600. 10% 3005 DAYS 601. 10% 3010 DAYS 602. 10% 3015 DAYS 603. 10% 3020 DAYS 604. 10% 3025 DAYS 605. 10% 3030 DAYS 606. 10% 3035 DAYS 607. 10% 3040 DAYS 608. 10% 3045 DAYS 609. 10% 3050 DAYS 610. 10% 3055 DAYS 611. 10% 3060 DAYS 612. 10% 3065 DAYS 613. 10% 3070 DAYS 614. 10% 3075 DAYS 615. 10% 3080 DAYS 616. 10% 3085 DAYS 617. 10% 3090 DAYS 618. 10% 3095 DAYS 619. 10% 3100 DAYS 620. 10% 3105 DAYS 621. 10% 3110 DAYS 622. 10% 3115 DAYS 			

U. S. ATOMIC ENERGY COMMISSION REQUISITION (AEC-90)

APPENDIX C

PROPERTY TRANSFER RECORD						No. 82156	
	PLANT	BUILDING	ROOM	ACCOUNT NUMBER	WORK ORDER	OTHER	FROM TO
FROM						DECONTAM.	☐ ☐
						REPAIRS	☐ ☐
						STORAGE	☐ ☐
TO						SALVAGE	☐ ☐
DESCRIPTION							PROPERTY NUMBER

SENDER	DATE	RECEIVER	DATE
UCN-541 (2-68)			

FIGURE 35

PROPERTY TRANSFER RECORD (UCN-541)

[illegible]

FIGURE 36

MATERIAL AND EQUIPMENT DISPOSAL (UCN-2996)