

ORNL/TM-10136

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**OAK RIDGE
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LABORATORY**

MARTIN MARIETTA

Instrumentation and Controls Division Maintenance Management Plan

(Revised August 1986)

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INSTRUMENTATION AND CONTROLS DIVISION
MAINTENANCE MANAGEMENT PLAN

(REVISED AUGUST 1986)

Date Published - August 1986

Prepared by the
OAK RIDGE NATIONAL LABORATORY
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ABSTRACT

This report documents the policies and procedures of the Maintenance Management Department in the Instrumentation and Controls Division at Oak Ridge National Laboratory, and identifies applicable DOE guidelines and requirements.

This report also describes a data base program, Maintenance Accountability Jobs and Inventory Control (MAJIC), a work order system developed in-house for the collection of data on work requests, work assignments, work report summaries, equipment records, and manpower and materials control. The MMD MAJIC data base program includes a cost accumulation and reporting system for cost control, information for quantifying performance measurements and improvements, and engineered time standards (as a tool for job planning) to provide more accurate and reliable preventive maintenance and calibration performance measurements.

The MMD policies and procedures described are designed to comply with applicable ORNL programs such as safety, operational safety requirements, quality assurance, reactor personnel qualification and training, emergency preparedness, and maintenance of DOE-owned reactors.

1. INTRODUCTION

The objective of this document is to highlight the organization and key activities of the Maintenance Management Department (MMD) of the ORNL Instrumentation and Controls Division. The MMD provides products and services to divisions throughout ORNL as well as to the three engineering sections within the I&C Division. The Department's purpose is to further the mission of Oak Ridge National Laboratory through operation of an instrument maintenance program that will provide effective maintenance, fabrication, modification, installation, calibration, testing, repair, and operation of instruments and controls.

The Department continuously seeks to improve management systems, reduce costs, improve communications with customers, and provide effective employee training.

The department consists of a Department Head, two General Supervisors, ten specialty groups, each with a craft supervisor, and an information processing group (see functional organization chart in Sect. 5). In 1986, the total Department staff was approximately 130 persons and the gross MMD budget was in excess of \$6 million.

1.1 POLICY STATEMENT

To improve the effectiveness of the Maintenance Management Department in support of the programs and policies of Oak Ridge National Laboratory, MMD establishes, maintains, and upgrades functional specialty groups within the Department as needed. MMD reevaluates the makeup and specialties of these groups periodically to ensure that the needs of the Division and Laboratory are being met in an effective, economical manner. In general, craftsmen are given opportunities for personal and professional growth in order to increase their expertise and provide the best possible service to our customers as well as to develop candidates for promotion to the positions of Engineering Technologist and Supervisor. It is also MMD policy to work closely with the three engineering sections in the Instrumentation and Controls Division to our mutual benefit. Management by objective is endorsed and encouraged. Each employee is encouraged to make daily and long-term

personal work plans in support of the overall mission of the I&C Division and efficient operations.

1.2 POLICY DOCUMENTS

The Maintenance Management Department has the responsibility to perform the activities described in this document under the overall guidance of DOE and ORNL directives.

The primary applicable documents are DOE Order 4330.4, ERHQ-0004, and Contract No. DE-AC05-84OR21400.

Order 4330.4 covers both real property and equipment because current contractor management systems cover maintenance of all property, real or otherwise.

ERHQ-0004 is the DOE Maintenance Managers' Guide developed for those organizations responsible for maintenance and related services required to support DOE's multiprogram laboratories, energy research centers, and specialized program installations. Although not a directive in nature, the guide does represent DOE's view of the basic elements needed to comply with the policies and objectives of DOE.

Contract DE-AC05-84OR21400, "Oak Ridge Operations Award Fee Determination Plan," states under Quality and Maintenance that

- "1. The maintenance management program effectively and efficiently uses the elements outlined in ERDA ERHQ-0004, 'Maintenance Managers' Guide, December 1976,' and
- "3. The maintenance management program meets the requirements of DOE Order 4330.4 and OR Order 4330.4."

In addition to the above, the MMD is guided by the basic requirements of ANSI/ASME NQA-1, the basic quality assurance document as adopted by ORNL.

1.3 APPLICABLE ORNL AND DOE PROGRAMS

1.3.1 Safety

The MMD complies with ORNL safety standards. A copy of the ORNL Safety Manual will be kept in each supervisor's office and in the Department office.

1.3.2 Reactor Personnel Qualification and Training

The MMD complies with DOE Order 5480.1A, Chapter VI, "Safety of Department of Energy-Owned Reactors" to meet qualification and training requirements for maintenance of reactor instrumentation in accordance with ANSI/ANS Standard 3.1. Programs, plans, and records will be kept on file.

1.3.3 Operational Safety Requirements (OSR)

The MMD complies with DOE Order 5480.1A, Chapter V, "Safety of Nonreactor Nuclear Facilities," to meet all instrument maintenance and personnel training requirements for each nuclear facility. Programs, action plans, and records are kept on file in the Department office.

1.3.4 Quality Assurance

The MMD complies with the ORNL Quality Assurance Program, which is based on ANSI/ASME NQA-1-1983. A copy of the ORNL Quality Assurance Manual and a copy of I&C Division Quality Assurance Operating Procedures are kept in each supervisor's office and in the Department office. Forms and records are kept by the I&C Quality Assurance Coordinator.

1.3.5 Emergency Preparedness

The MMD complies with the ORNL Emergency Plan by preparing for emergency situations to minimize material loss and personal injury. A copy of the Local Emergency Manual is kept on file in the Department office.

1.3.6 Supplemental Maintenance Plans

The MMD develops supplemental plans to assist operating divisions and ensure the availability and timely delivery of systematic instrument maintenance services.

1.3.7 Training

The objective of the MMD training program is to provide training for maintenance personnel to keep abreast of changing technologies and techniques by continuously updating the technical, administrative, and

management skills needed to maintain instrumentation and controls throughout Oak Ridge National Laboratory and other areas as assigned. It is the further intent of the training program to provide training and information on procedures and practices as required or beneficial to operation of the MMD.

1.3.8 Reactor Maintenance

To comply with DOE Order 5480.1A, Chapter VI, "Safety of Department of Energy-Owned Reactors" with regard to the maintenance of instrumentation in reactor facilities, the MMD follows a systematic method of maintenance by tracking instrument repair, replacement, calibration, and other maintenance functions and documenting each activity. The MMD coordinates its reactor maintenance functions with the Reactor Systems Section of the I&C Division.

2. RECORDS SYSTEMS

2.1 WORK ORDER SYSTEM

The Maintenance Management Department has established a formal, well-defined interactive job management system to facilitate uniform collection of work request data, assignment of work, preparation of work report summaries, and control of manpower and materials. The system consists of a 1032 data base program, developed in-house, entitled Maintenance Accountability Jobs and Inventory Control (MAJIC). The primary goal of this new system, which came on line in 1986, is to ensure that data are accurate and are collected in a timely manner to provide reliable, traceable maintenance information. MAJIC is an upgraded version of two older, separate data systems. The Maintenance Information System (MAINS) was a Fortran batch inventory system first put on line in 1976. In 1978 a 1022 data base job control system (JCS) was developed and put on line. These earlier systems were state of the art at the time they came on line, but they were not compatible for information sharing. MAJIC combines the best features of each of the older systems and adds the flexibility of relational capability.

The objective of this job management system is to provide a tool that will aid in work planning and scheduling, cost collection, and equipment maintenance history as well as providing a basis for reporting job backlogs, job status, and work performance. Every job requested or scheduled will be described and documented by a work request, which is generated at the shop level by a Technician or a Technologist. A work request normally will be written on a standard form for later entry into the data base, but may be entered directly into the MAJIC system through a local terminal. Each work request must be accompanied by a valid work order. In some cases a blanket or open-end work order will be used to exercise control more efficiently on long-term work.

The MAJIC operating procedures are described in a separate manual entitled "Operating Procedure Manual for I&C Division Maintenance

Management Department." An example of the work request currently used by MMD is included in Sect. 5.

2.2 MATERIAL CONTROL

Another objective of the MMD is to provide documentation for and physical control of material needed in the performance of MMD work. The material control system will assist craft supervisors in inventory management and control over components and purchased parts and assemblies used in the fabrication, modification, installation, calibration, operation, maintenance, and repair of instrumentation at ORNL.

The MMD complies with quality assurance (QA) and operating safety requirements (OSR) of special ORNL programs for critical component identification and inventory control under the supervision of MMD management. Formal job planning includes provision for special inspections; for shipping, handling, and storage; and for compliance with QA requirements associated with materials.

Control of bench stock inventories is typically the responsibility of craft supervisors. The MMD computerized data bases accumulate material costs and maintain up-to-date bench stock inventory and location information.

For many routine material needs the ORNL Stores system permits I&C direct access to information in the ORNL Materials Management System (MMS) data base. Needed parts not available from bench stock or from ORNL Stores will be obtained from outside sources through the Martin Marietta purchasing organization.

2.3 EQUIPMENT RECORDS

Equipment records will be maintained as specified in the MMD Inventory System document using the MAJIC data base program.

The inventory system is designed to enable the Instrumentation and Controls Division to operate at a high level of proficiency and meet the requirements of the QA Program, DOE directives, and ORNL Standard

Practice Procedures. Although the inventory system is used mainly by the I&C Division in its maintenance function, it is available as a service to other ORNL divisions.

All instruments for which I&C has maintenance or administrative responsibility are to be identified with a bar-coded ORNL property or I&C Maintenance number and are subject to inventory system requirements as documented in the Inventory System Document Manual. The primary objectives of the inventory system are (a) to maintain an up-to-date list of instruments, (b) to maintain a history of each instrument including its maintenance and calibration records, (c) to provide systematic recall for calibration and programmed maintenance, (d) to provide scheduled maintenance and recall for special programs or facilities, (e) to identify those instruments that require the most maintenance in a quarter, (f) to identify problem areas and help justify modification or replacement action, and (g) to identify the ten most costly items in the inventory in terms of maintenance costs to assist in management decisions about equipment. The system also provides summarized maintenance information that will improve maintenance efficiency by providing staff with historical data.

3. JOB SCHEDULING AND CONTROL SYSTEMS

3.1 FORMAL JOB PLANNING

Formal job planning in the Maintenance Management Department ranges from executing a maintenance work request for small jobs accepted over the phone to very detailed planning efforts including PERT charts, QA plans, site visits, and checklists for complex jobs.

Recognizing the benefits to be gained by freeing instrument technicians from detailed job planning to fully utilize their technical skills, and realizing the need for a high degree of flexibility in carrying out responsibilities, the MMD uses shop supervisors, with the assistance of Senior Engineering Technologists and the aid of computer systems, to plan and control maintenance activities.

The techniques and resources developed, implemented, and upgraded have proven both successful and economical from a number of standpoints:

- The maintenance work request is cost effective and flexible as a planning tool for small jobs.
- Status reports are available as an aid to planning daily activities.
- Efficient use of the weekly salaried technician gives the craft supervisor added time to adequately supervise shop activities as well as providing a career opportunity for highly trained and motivated technicians.
- Implementation of the Engineering Support Shop as a new resource of the Maintenance Management Department for large, complex planning efforts is indicative of MMD management's commitment to and support of the effective use of resources. Department management seeks to continually customize and refine its response to an ever-changing work environment.

3.2 JOB SCHEDULING

The work of the MMD is in the areas of electronics and instrument maintenance and is performed primarily by instrument technicians. Typically, requests for services come to the maintenance supervisor, who makes job assignments based on shop workload and the needs of the requestor. Exception reports and status reports can be generated at the

request of supervisors or MMD staff to monitor job status, jobs not yet started, and jobs that are behind schedule or exceed their estimated cost. Based on these reports, the needs of the requestor, and the workload of the maintenance shops, schedules will be modified to provide optimal service to all Maintenance Department customers. If the workload of a particular maintenance shop increases unexpectedly, technicians are shifted temporarily from shop to shop to balance workloads and meet fluctuating demands. Such reassignment of technicians reduces Department overhead, provides cross training for technicians, and results in less downtime for the customer.

For some large jobs, the MMD Engineering Support Shop will coordinate planning with I&C personnel and representatives from other ORNL divisions. Using PERT charts and critical-path scheduling, QA plans, and other planning techniques, the MMD is able to control and monitor the progress and cost of each job, thus ensuring a smooth, continuous flow of work.

3.3 BACKLOG CONTROL

The reliability of instruments affects the level of work accomplished by many staff members throughout ORNL. For this reason, MMD places a high priority on prompt repair of failed instruments and thus keeps the backlog of such jobs to an absolute minimum. The MMD also supports many divisions having critical operations that run continuously and therefore cannot afford to have equipment off-line, even for system checks. An instrument failure might halt a project or experiment, causing scheduling delays or cost overruns and possibly posing an environmental, safety, or security hazard. Maintenance activities are therefore scheduled based on the needs of the various operating divisions or laboratory experiments and known equipment reliability.

The MMD backlog primarily includes preventive maintenance, calibration, and other routine tasks. Smoothing the scheduling of MMD personnel between slack and crisis periods is accomplished, in part, by efficient scheduling of backlog work.

3.4 JOB PRIORITY SYSTEM

The MMD job priority system was established to carry out the assigned tasks of the Maintenance Management Department in an orderly manner. Several factors are considered in assigning job priorities: (1) urgency (consequences of delayed repairs), (2) personnel requirements, and (3) MMD priorities.

The requestor, or the requestor and appropriate MMD staff members, evaluates the effects of delayed repairs on (1) human health and safety, (2) security, (3) programmatic needs, (4) protection of data, and (5) downtime.

The requestor and the MMD supervisor work together to set job priorities. Work requests are categorized as follows:

1. Emergency maintenance: Work required immediately for health, safety, security, programmatic needs, protection of data, or reduction of downtime.
2. Breakdown maintenance: Work required to repair failed equipment.
3. Preventive maintenance: Work scheduled in advance and performed on a routine basis.
4. Calibration maintenance: Calibration work scheduled in advance and performed on a routine basis.
5. Scheduled work: Work scheduled for completion in a timely manner with respect to facility operations or other factors.

Categories are established to facilitate setting priorities on the wide range of MMD work activities. Each work request is monitored until completion. The MMD computerized inventory system is used to schedule preventive maintenance and calibration activities. The MAJIC data base monitors and reports all maintenance activities. Scheduled start and completion dates are monitored to provide exception reports on activities not meeting scheduled start dates or failing to meet completion dates. The maintenance backlog is also monitored. This area of the job control system provides exception reports on maintenance activities by category of work (emergency, breakdown, etc.). Backlogs, due dates, and job priorities are combined to ensure that high-priority

needs are met, that jobs are performed in a reasonable length of time, and that maintenance resources are used in an efficient manner. The success of any priority system depends greatly on the relationship between the requestor and the maintenance organization. The requestor must act responsibly to identify needs and establish deadlines. Setting reasonable, realistic priorities will enable the maintenance supervisor to plan effectively and will reduce unnecessary priority conflicts.

Job priorities are also influenced by Standard Practice Procedures (SSPs) and special programs such as Quality Assurance, Safety, Industrial Safety, Applied Health Physics, Operational Safety Requirements, and Reactor Safety. Some policies and procedures of these programs have a significant effect on the time required to complete a job. Manuals outlining these policies and procedures are used by maintenance personnel as appropriate.

3.5 PREVENTIVE MAINTENANCE AND INSPECTION

Preventive maintenance (PM) is defined as the routine, recurring work required to keep a facility and its equipment in a condition such that it can be used at its original or design specifications or efficiency.

Keeping an instrument or piece of equipment operating at the lowest possible total maintenance cost while prolonging its life is the objective of the PM program. By definition, PM is performed on a schedule rather than in response to specific failure or defect in instruments or equipment. A careful blend of PM and breakdown maintenance is needed to maintain and operate an instrument or equipment at the lowest possible cost with optimum efficiency and to extend its life.

To qualify as PM, a task must consist of specifically defined work such as cleaning, making minor adjustments, lubricating, testing, measuring, or replacing minor parts.

The PM and inspection program in the MMD has many advantages such as detection of potential instrument or equipment failures and more cost-effective management of materials and parts inventories. The PM

program is a measurable work effort that helps justify timely replacement of instruments or equipment.

Not all instruments or equipment can be included in a PM program. Some questions that should be considered before putting instruments or equipment in a PM program are as follows:

1. Is breakdown maintenance more economical than PM?
2. Is the instrument or equipment vital?
3. If failure occurs, does it result in a safety hazard?
4. Is the instrument or equipment included in a program that requires PM or inspection?
5. Will the instrument or equipment need to be replaced because it is obsolete?
6. Is funding available for PM?
7. How important is prolonging instrument or equipment life?

The instruments and equipment PM program is controlled by the MMD inventory system. Frequency of PM will be determined by vendor specifications, customer programs or need, and feedback from users and/or supervisors. The inventory system will schedule the PM program by preprinting PM requests. Computer printouts of PM will ensure economical use of resources, availability of critical parts, and a well-defined structure for the Maintenance Department and for its relationship with other divisions.

4. MANAGEMENT ANALYSIS AND PLANNING

4.1 INFORMATION COLLECTION AND ANALYSIS*

Every member of the MMD staff is expected to make every effort to ensure that complete and accurate data are collected in a timely manner to achieve the highest possible degree of reliability and traceability of maintenance information.

The Maintenance Information and Job Control System Office collects data and issues computer-generated reports on job scheduling, performance measurements, performance appraisals, and PM schedules and backlog for Department use. That office has access to all I&C Division data bases.

4.2 ENGINEERED TIME STANDARDS

Engineered time standards are being developed by the MMD to establish the average hours required for specific activities of the MMD preventive maintenance and calibration programs. These standards will be established based on data collected by the MAJIC data base. The repetitive nature of preventive maintenance and calibrations, unlike breakdown maintenance, produces data that yield equitable, reliable standards.

These standards will be available to craft supervisors as a dependable tool for formal job planning. As a result, preventive maintenance and calibration performance measurements will be more accurate and therefore more reliable.

4.3 COST IDENTIFICATION AND CONTROL

The MMD data base program MAJIC is an effective cost accumulation and reporting system that collects and stores information required for internal control and performance evaluations. Labor and material costs on each job are accumulated, and monthly reports are reviewed to identify trends or departures from planned expenditures. Trend or

*Entitled "Separate Control Function" in ERGH-0004.

deviation information is forwarded to the craft supervisor directly accountable, who is responsible for taking corrective action.

4.4 PERFORMANCE MEASUREMENT AND IMPROVEMENT

The MMD strives to select and implement effective criteria for measuring individual and group job performance. Individual judgment and experience are important factors in measuring the quality of performance, but they do not quantify work output. The MMD data base program MAJIC contains information with which to systematically quantify the performance of individual maintenance shops. The attributes currently used to measure performance in the MMD are as follows:

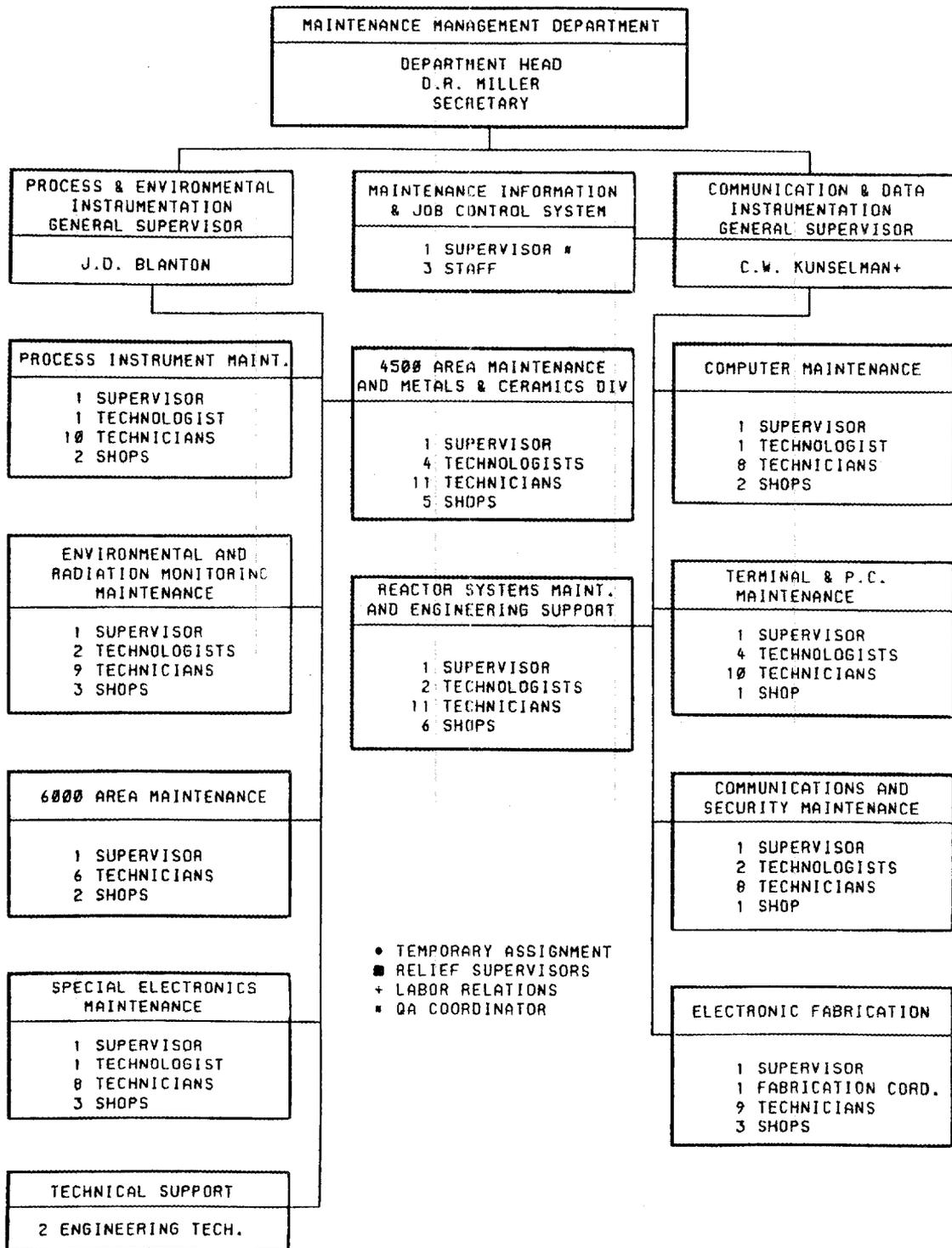
1. Percent of jobs completed by due date
2. Percent of jobs completed within cost estimate
3. Percent of jobs started by scheduled start date
4. Percent of scheduled jobs awaiting materials
5. Percent of jobs not completed on time due to material delays
6. Individual instruments requiring excessive maintenance
7. Customer feedback

Performance indicators cannot by themselves improve maintenance effectiveness. They can only point to areas that should be examined, enabling MMD staff to quantitatively track progress toward established goals. By comparing current performance to goals, MMD determines the actions required to streamline work methods, maintain a sufficient flow of work planned in advance, and reduce delay and coordination problems.

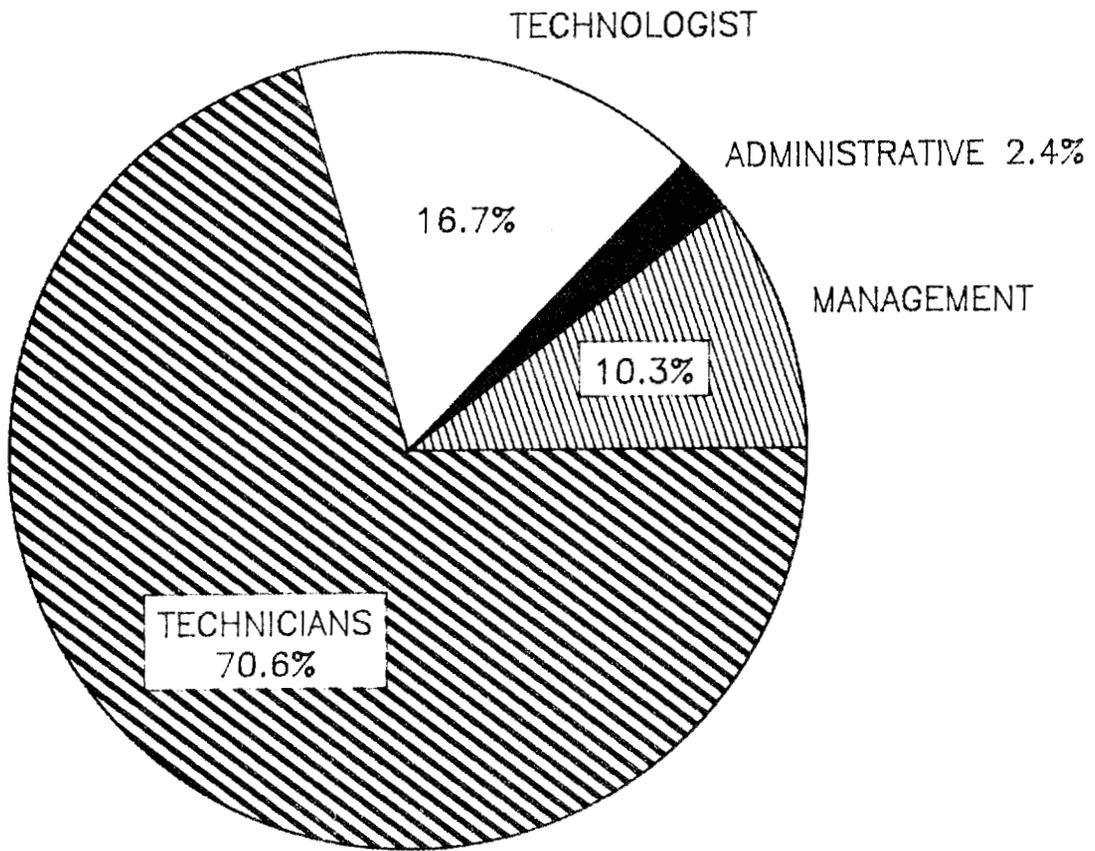
The qualitative aspects of performance must be considered along with quantitative performance measures. A customer appraisal form (see Sect. 5) is used to monitor customer satisfaction and improve customer relations. This questionnaire is given to a random sampling of customers at regular intervals to request feedback representing all shops. The feedback is analyzed and the results reviewed by MMD staff to improve both compliance with customer needs and the overall quality of the maintenance effort.

5. SUPPLEMENTARY MATERIALS

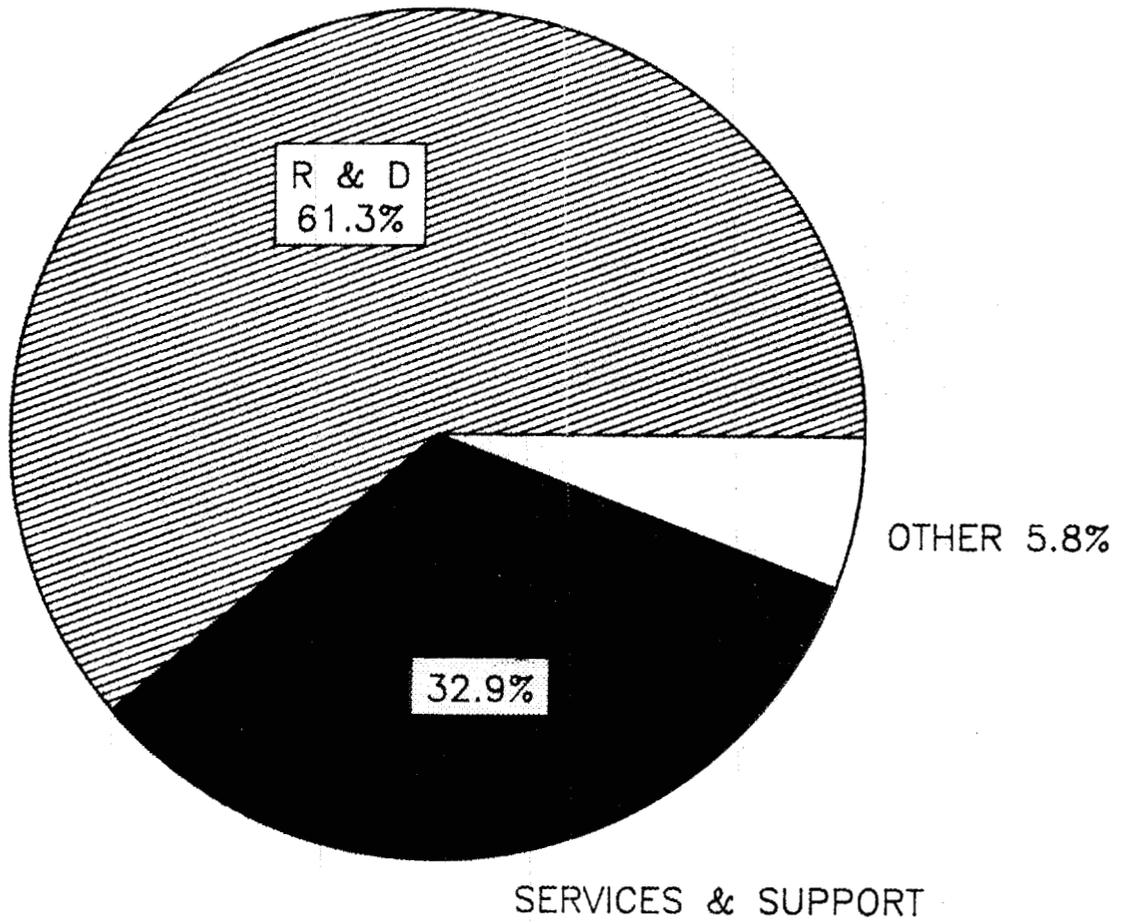
5.1 ORGANIZATION CHART BY FUNCTION



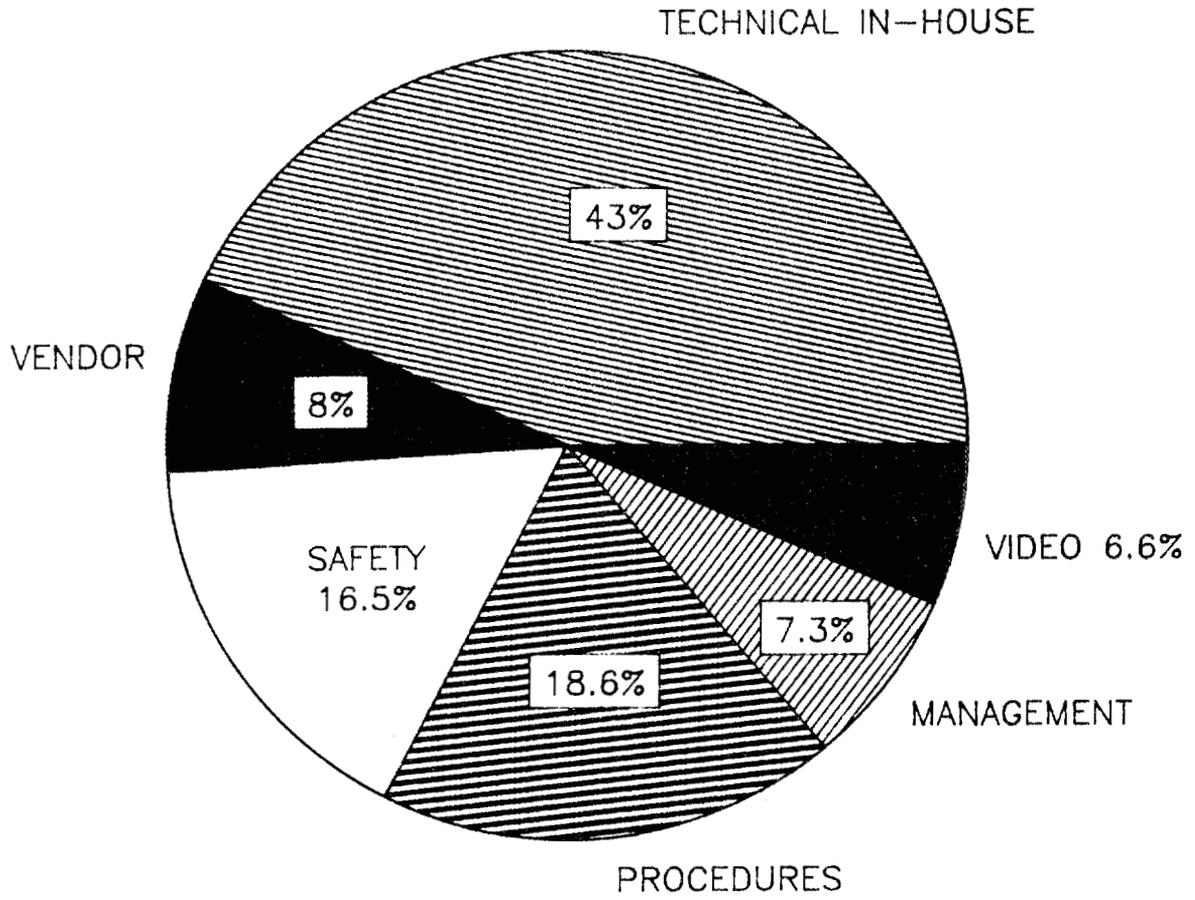
5.2 MANPOWER DISTRIBUTION



5.3 TYPICAL FUNDING SOURCES

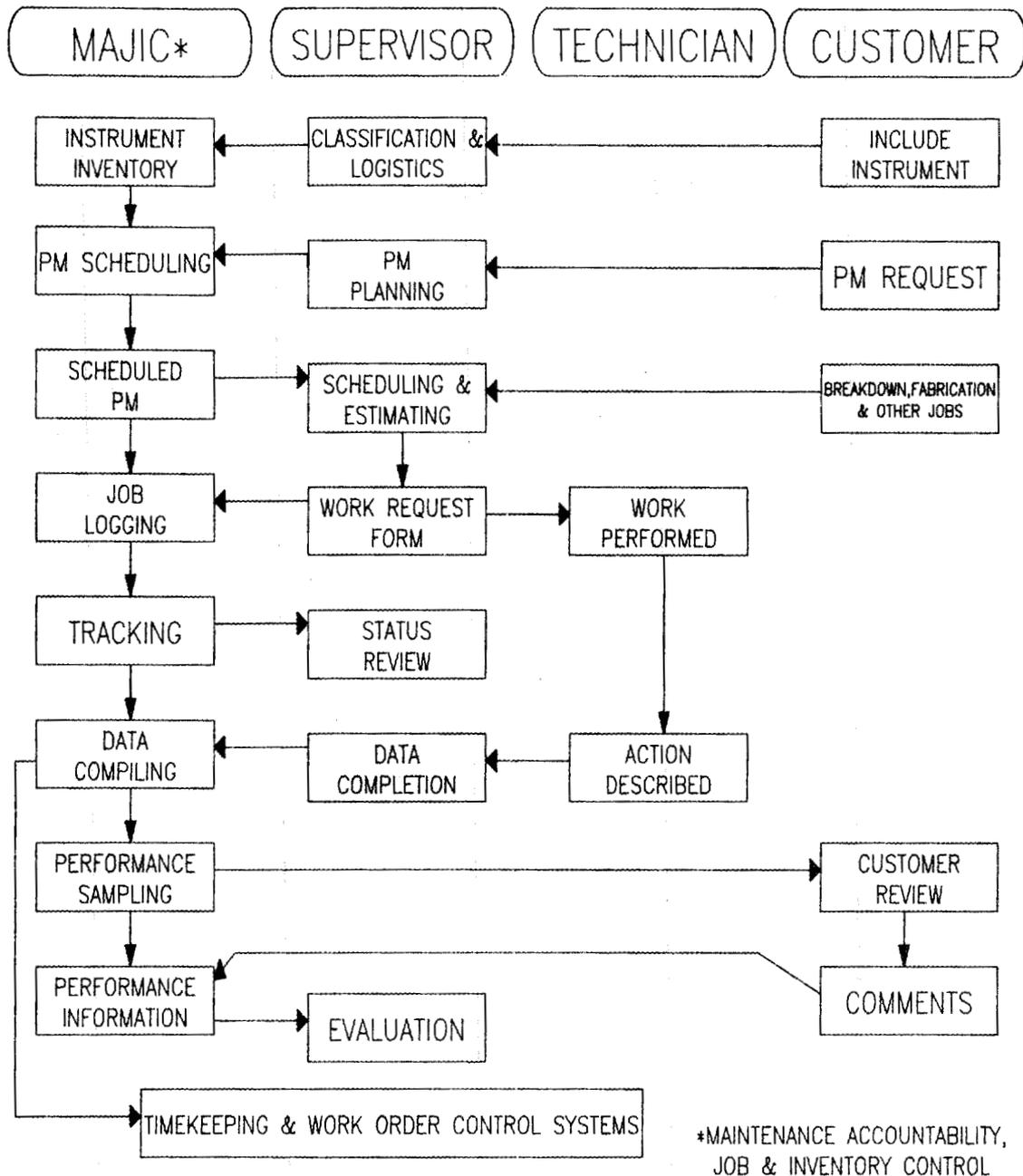


5.4 TYPES OF TRAINING



PERCENT OF TRAINING HOURS

5.5 JOB CONTROL INTERACTIVE FLOW



5.6 SAMPLE INSTRUMENT INVENTORY FORM

| I & C INSTRUMENT INVENTORY | | | | | | | | | | |
|--|-----------|-------------|-----------|---------------------|---------------------|-----------|----------|-------|--|--|
| <input type="checkbox"/> CHECK IF REVISION | | | | | Date: _____ | | | | | |
| I.D. NO. | | Description | | | | | | | | |
| Mfr. Code | Model No. | | | | Classification Code | | | F. P. | | |
| Purchase Order | | Cost New | Year | Division | ST. | Cat. | | | | |
| Serial No. | | | | Service Designation | | | | | | |
| Maint. Document No. | | ADP | | | OSR | | | | | |
| Range From | | To | Units | CB Freq. | PM Freq. | Start Mo. | Est. Hr. | | | |
| Bldg. | Room | | Custodian | | | | | | | |
| Remarks | | | | | | | | | | |
| Remarks CB/ PM | | | | | | | | | | |
| ULN-10598 (3-5-66) | | | | | | | | | | |

5.7 SAMPLE WORK REQUEST FORM

| I & C MAINTENANCE WORK REQUEST | | | | | | | | | |
|--|------------|-----------------------|----------------------|----------------------|-------|--------------------|--|------------|--|
| Date: _____ | | UCN-14783 (3-4-66) | | | | NO. K-09003 | | | |
| Requester | | | Bldg. | Room | Phone | SIC | BL | Work Order | |
| Description | | | | MFR | Model | OSR | Document No. | | |
| Sch. Start | Sch. Comp. | Est. Labor | Act. Service Desig. | Work Permit Required | | | <input type="checkbox"/> Electrical <input type="checkbox"/> Other (Specify) | | |
| Act. Start | Act. Comp. | Est. Material | Act. QA Instructions | AC ID | | | HRS | Material | |
| Request | | | | | | | | \$ | |
| | | | | | | | | \$ | |
| | | | | | | | | \$ | |
| | | | | | | | | \$ | |
| Comment | | | | | | | | \$ | |
| | | | | Badge No. | HR | Date | ACTIVITY CODE | | |
| | | | | | | | 1 Installation | | |
| | | | | | | | 2 Alteration | | |
| | | | | | | | 3 Breakdown Maint. | | |
| | | | | | | | 4 Programmed Maint. | | |
| | | | | | | | 5 Calibration | | |
| | | | | | | | 6 Adjustment | | |
| | | | | | | | 7 Operational Check | | |
| | | | | | | | 8 Removal | | |
| | | | | | | | 9 User Assistance | | |
| | | | | | | | 10 Scheduled Maint. | | |
| | | | | | | | 11 Fabrication | | |
| | | | | | | | 12 Logistics | | |
| BACKLOG CODES: B1 Breakdown Maint. B2 Scheduled Work B3 Emergency Service B4 Awaiting Material | | | | | | | | | |

5.8 SAMPLE CUSTOMER APPRAISAL FORM

APPRAISAL OF I&C DIVISION SERVICES

Job No.:
 To: W.O. No.:
 Bldg.: Division:
 IC Number:
 Job Title:

 YOUR SATISFACTION IS OUR GOAL. MAY WE HAVE YOUR
 RATING OF OUR SERVICES ON THIS RECENTLY COMPLETED JOB?

Supervisor

CUSTOMER'S APPRAISAL OF SERVICES

| | VERY GOOD | SATISFACTORY | UNSATISFACTORY |
|------------------------|-----------|--------------|----------------|
| RESPONSE TIME | | | |
| DOWN TIME | | | |
| COMPLIANCE TO REQUEST | | | |
| FUNCTIONAL OPERATION | | | |
| QUALITY OF WORKMANSHIP | | | |
| HOURS | | | |

CUSTOMER COMMENTS:

I&C SUPERVISOR ACTIONS:

| | |
|-----------|------|
| Signature | DATE |
|-----------|------|

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