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MIL–STD–1390D
19 JANUARY 1993

SUPERSEDING
MIL–STD–1390C(NAVY)
8 JULY 1988

MILITARY STANDARD

LEVEL OF REPAIR ANALYSIS

(LORA)

AMSC NO. N6872

AREA ILSS

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FOREWORD

1. This military standard is approved for use by all departments and agencies of the Department of Defense (DOD) and other government agencies.

2. Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Commanding Officer, Naval Air Warfare Center Aircraft Division Lakehurst, Code SR3, Lakehurst, NJ 08733-5100, by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

3. This military standard establishes the Level of Repair Analysis (LORA) process to implement the requirement contained in DOD Instruction 5000.2, Acquisition and Management of Integrated Logistic Support (ILS) for Systems and Equipment, and MIL-STD-1388-1 Logistic Support Analysis (LSA). The DOD instruction requires that acquisition programs emphasize evaluation of alternative support concepts and techniques to minimize cost and support risks. The military standard requires a LORA be conducted "commensurate with the level of design, operation and support data available." The principal purpose of the LORA process is to determine the most effective maintenance and support structure for a system through iterative evaluations of both economic and noneconomic considerations.

4. The LORA process is an integral part of the LSA process as defined in MIL-STD-1388-1. The LSA process entails the selective application of analytical efforts to influence system design and assist in developing support and other ILS resources. The LORA process is an analytical effort undertaken to influence decisions on system design, maintenance planning, and ILS resources. As a consequence, the LORA process forms an integral part of the LSA process by using results of and feeding results to various LSA tasks and the LSAR. The LORA process should start early in the acquisition effort and then be reiterated as the equipment design becomes more refined.

5. This military standard provides general requirements and descriptions of tasks, which when performed in a logical and iterative nature, comprise the LORA process. In addition to the general requirements and task description sections, this standard contains an application guidance appendix which provides rationale for selection and tailoring of the tasks to meet acquisition program objectives in a cost-effective manner. This document is intentionally structured to discourage indiscriminate blanket applications. Tailoring is forced by requiring that specific tasks be selected and that certain essential information relative to implementation of the selected tasks be provided by the requiring authority.

6. The emphasis that DOD is placing on the evaluation of alternative support concepts has been reinforced by the establishment of a Joint Service Level of Repair Analysis-Working Group (JSLORA-WG). The JSLORA-WG has been chartered by DOD to streamline the LORA process and eliminate duplication of

LORA requirements between the military services. This revision contains several fundamental changes from MIL-STD-1390C as a result of the JSLORA-WG efforts. The following paragraphs highlight four of the key changes made to MIL-STD-1390C.

a. The structure and language of the standard has been changed so that requirements are stated in performance or "what-is-necessary" terms, rather than "how to" perform a task.

b. More detailed application guidance has been provided in the standard and organized into an appendix to provide noncontractual information on when and how to use this standard.

c. The standard now accommodates and reflects the LORA requirements and mathematical equations of all the military services in performing LORA economic evaluations.

d. LORA has been made an integral part of the LSA process.

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APPENDIX

1. SCOPE

1.1 Purpose. This standard establishes general requirements and specific tasks for performance of Level of Repair Analysis (LORA) during the life cycle of systems or equipment.

1.2 Applicability.

1.2.1 Application of standard. This standard applies to all system acquisition programs, major modification programs, and applicable research and development projects through all phases of the system life cycle. This standard is for use by both contractor and government agencies. As used in this standard, the requiring authority is generally a government agency but may be a contractor when LORA requirements are levied on subcontractors. The performing activity may be either a contractor or government agency. The use of the term, contract, in this standard includes any document of agreement between organizations to include a government agency and a contractor, or between contractors.

1.2.2 Application guidance. Application guidance and rationale for selecting LORA tasks and appendices to fit the needs of a particular program are included in appendix A. Appendix A is not contractual and does not establish requirements. Specific tailoring guidance on selected tasks are included under the individual task in the "Details to be specified" portion of the task.

1.2.3 Content of appendices. There are seventeen appendices in this standard. The information contained in each appendix is intended to provide guidance and for compliance. Individual appendices contained in this standard shall be selected by the requiring authority. However, tailoring the requirements in specific appendices is not permitted. The field descriptions are in accordance with appendix P, 30.2.

1.2.4 Tailoring of task descriptions. Individual tasks contained in this standard shall be selected by the requiring authority and the selected task descriptions tailored to specific acquisition program characteristics and life cycle phase. The "Details to be specified" portion under each task lists the specific details, additions, modifications, deletions, or options to the requirements of the task that should be considered by the requiring authority when tailoring the task description to fit program needs and preparing the request for proposal (RFP).

1.2.5 Tailoring suggestions. When preparing a proposal, the performing activity may include additional tasks/appendices, alternative tasks/appendices, or task modifications with supporting rationale.

1.3 Method of reference. This standard, the general requirements section, the specific task description number(s), and the specific appendices shall be included or referenced in the statement of work (SOW). Also, when applicable "Details to be specified" shall be included in the SOW.

1.4 Scope of performance. The performing activity shall comply with the general requirements section, specific task requirements, and specific appendices only to the degree specified in the contract.

2. APPLICABLE DOCUMENTS

2.1 Government documents.

2.1.1 Standards. The following standards form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those listed in the issue of the Department of Defense Index of Specifications and Standards (DODISS) and supplement thereto, cited in the solicitation (see 6.2).

MILITARY STANDARDS

MIL-STD-280	Definitions of Item Levels, Item Exchange-ability, Models and Related Terms
MIL-STD-470	Maintainability Program for Systems and Equip-ment
MIL-STD-721	Definitions of Terms for Reliability and Main-tainability
MIL-STD-785	Reliability Program for Systems and Equipment Development and Production
MIL-STD-1388-1	Logistic Support Analysis
MIL-STD-1388-2	DOD Requirements for a Logistic Support Analysis Record
MIL-STD-1367	Packaging Handling, Storage, and Transport-ability Program Requirements (for Systems and Equipment)
MIL-STD-1521	Technical Reviews and Audits for Systems, Equip-ments, and Computer Software
MIL-STD-1561	Provisioning Procedures, Uniform DOD
MIL-STD-1629	Procedures for Performing a Failure Mode, Effects, and Criticality Analysis

(Unless otherwise indicated, copies of federal and military specifications, standards, and handbooks are available from the DODSSP Standardization Document Order Desk, 700 Robbins Avenue, Bldg. 4D, Philadelphia, PA 19111-5094.)

2.1.2 Other government documents, drawings, and publications. The following other government documents, drawings, and publications form a part of this document to the extent specified herein. Unless otherwise specified, the issues are those cited in the solicitation.

DEPARTMENT OF DEFENSE

DODI 5000.2	Acquisition and Management of Integrated Logistic Support for Systems and Equipment
AR 700-82, AFR 66-45, OPNAVINST 4410.2, MCO 4400.120, DSAR 4100.6	Joint Regulation Governing the Use and Application of Uniform Source Maintenance and Recoverability Codes

(Copies of DOD Instruction 5000.2 are available from the Standardization Document Order Desk, Bldg. 4D, 700 Robbins Avenue, Philadelphia, PA 19120-5094. Copies of AR 700-82, AFR 66-45, OPNAVINST 4410.2, MCO 4400.120, or DSAR 4100.6 are available from U.S. Army Publications Center, 2800 Eastern Boulevard, Baltimore, MD 21220.)

2.2 Non-Government publications. Non-Government standards or other types of non-Government publications do not form a part of this document.

2.3 Order of precedence. In the event of a conflict between the text of this document and the references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

3. DEFINITIONS

3.1 Terms. The definitions of terms used herein are in accordance with (IAW) the definitions in MIL-STD-280, MIL-STD-470, MIL-STD-721, MIL-STD-785, MIL-STD-1388-1 and MIL-STD-1388-2, with the exception and addition of those defined in Appendix B, Glossary; and, Appendix P, LORA Input Data Element Definitions.

3.2 Acronyms. The acronyms used in this standard are defined in the Acronym List, Appendix C.

4. GENERAL REQUIREMENTS

4.1 General. LORA is an integral part of Logistic Support Analysis (MIL-STD-1388-1). LORA decisions influence the logistic support cost, total life cycle cost of ownership, and operational readiness of the hardware system. LORA decisions are based on economic and noneconomic considerations and readiness objectives. Furthermore, LORA recommendations for new material should be made as soon as the equipment preliminary design has been determined and updated as required throughout the life of the system.

4.2 Purpose. The purpose of LORA is to establish the least cost feasible repair level or discard alternative for performing maintenance actions and to influence the equipment design in that direction. The analyses are based on economic and noneconomic considerations and readiness objectives.

4.3 LORA program. The LORA program is established as part of the LSA and called out in the LSAP. The LORA program shall cover the early developmental phases as well as the operational phases. The LORA program shall be planned, integrated, developed, and conducted in conjunction with other design, development, production, and deployment functions to permit the most cost effective achievement of overall acquisition program objectives. The LORA program shall be established consistent with the type of acquisition strategy and the phase of the acquisition program. Procedures shall be established to ensure the LORA program is an integral part of the system engineering process. Interfaces between the LORA program and other related system engineering analyses and design programs shall also be identified. The LORA program shall include the management and technical resources, plans, procedures, schedules, and controls for performance of LORA requirements. The basic objective of the LORA program shall be to analyze support and design alternatives; use the results to influence system design and maintenance planning; and, achieve a maintenance concept which is the most effective compromise between economic and noneconomic factors or characteristics related to the system and its support.

4.4 LORA program interfaces. Maximum use shall be made of analyses and data resulting from other system engineering programs to satisfy LORA input data requirements. Figure 1 provides an illustration of how LORA interfaces with the life cycle model.

4.4.1 LORA, as part of the LSA process, interfaces with Maintenance Planning, Reliability, Source Maintenance and Recoverability (SM&R) coding, and Maintenance Allocation Charting (MAC) in the following ways:

a. Maintenance Planning. LORA identifies the maintenance level and logistic support costs associated with an unscheduled maintenance task.

b. Reliability. The LORA is used to analyze reliability critical items to determine whether they are maintenance significant. LORA may be used as a design tool for conducting tradeoff analyses to determine whether to design an item for repair or discard.

c. MAC. LORA is the analytical basis for development of the MAC.

d. SM&R. LORA is the basis from which the maintenance portion of the SM&R code is obtained and identifies maintenance significant items. The MAC and SM&R code are used to determine the maintenance task distribution and replacement task distribution. SM&R coding is a part of the provisioning process. Provisioning is the process of determining and acquiring the range and quantity of spare and repair parts necessary to operate and maintain an end item of materiel for an initial period of service.

4.4.2 Fielded system. LORA on a fielded system is used to evaluate changes in maintenance policy, support costs, use rates, capabilities, and other factors that may affect the logistic support of a system and require adjustment to the support structure to maintain the system's operational readiness or cost effectiveness.

4.5 LORA program coordination. Tasks and data required by this standard, which are also required by other standards and specifications, shall be coordinated and combined to the maximum extent possible to avoid duplication of effort. LORA input data and information used and provided shall be based upon, and traceable to, other system engineering data and activities where applicable. Maximum use shall be made of LORA data and information resulting from applicable tasks in the LORA program to satisfy the LSA requirements called out in MIL-STD-1388-1 and MIL-STD-1388-2.

4.6 LORA process. The LORA program shall be implemented through a process of systematic and comprehensive LORA evaluations conducted on an iterative basis throughout the life cycle to arrive at a maintenance concept that is effective, yet economical. The process shall integrate design, operation, performance, cost, and logistic support characteristics or constraints to identify and update the maintenance concept for the system. The level of detail of the evaluations and the timing of task performance shall be tailored to each system and shall be responsive to the acquisition program's schedules and milestones. Task applicability guidance by the acquisition program phase is provided in table A-I.

4.6.1 Developmental phases. The LORA program shall be initiated early in the developmental phases and then updated in subsequent phases as the system configuration becomes better defined. The LORA program in the developmental phases shall aid in the evaluation of the design alternatives from a supportability standpoint. Also, the LORA program shall provide a basis for identifying items of the system which should clearly be designed for discard at failure from those that should be designed for repair at failure.

4.6.2 Operational phases. The LORA program during the operational phases is conducted on a reactive basis to evaluate significant changes in supportability factors and recommend modifications in the established maintenance concept of the system. The objective of the LORA program during the operational phases is to:

a. Review, refine, and revise the existing maintenance concept established for the system commensurate with changes in supportability factors (e.g., use rates, cost of repair parts, maintenance policy or capabilities, etc.).

b. Propose enhancements to the maintenance concept as impacted by product improvements or engineering changes to the system.

c. Provide a basis of information on which to build a maintenance concept for a similar system.

4.7 LORA input data. The LORA input data and values shall be established through the use of data from other related system engineering programs or from measured data; and traceable to their specific source (i.e., system specification, contract, regulations, reliability allocation report, maintainability predictions report, etc.). The quality and level of detail of the data evaluated shall be commensurate with the acquisition phase. No classified data will be input to the LORA models.

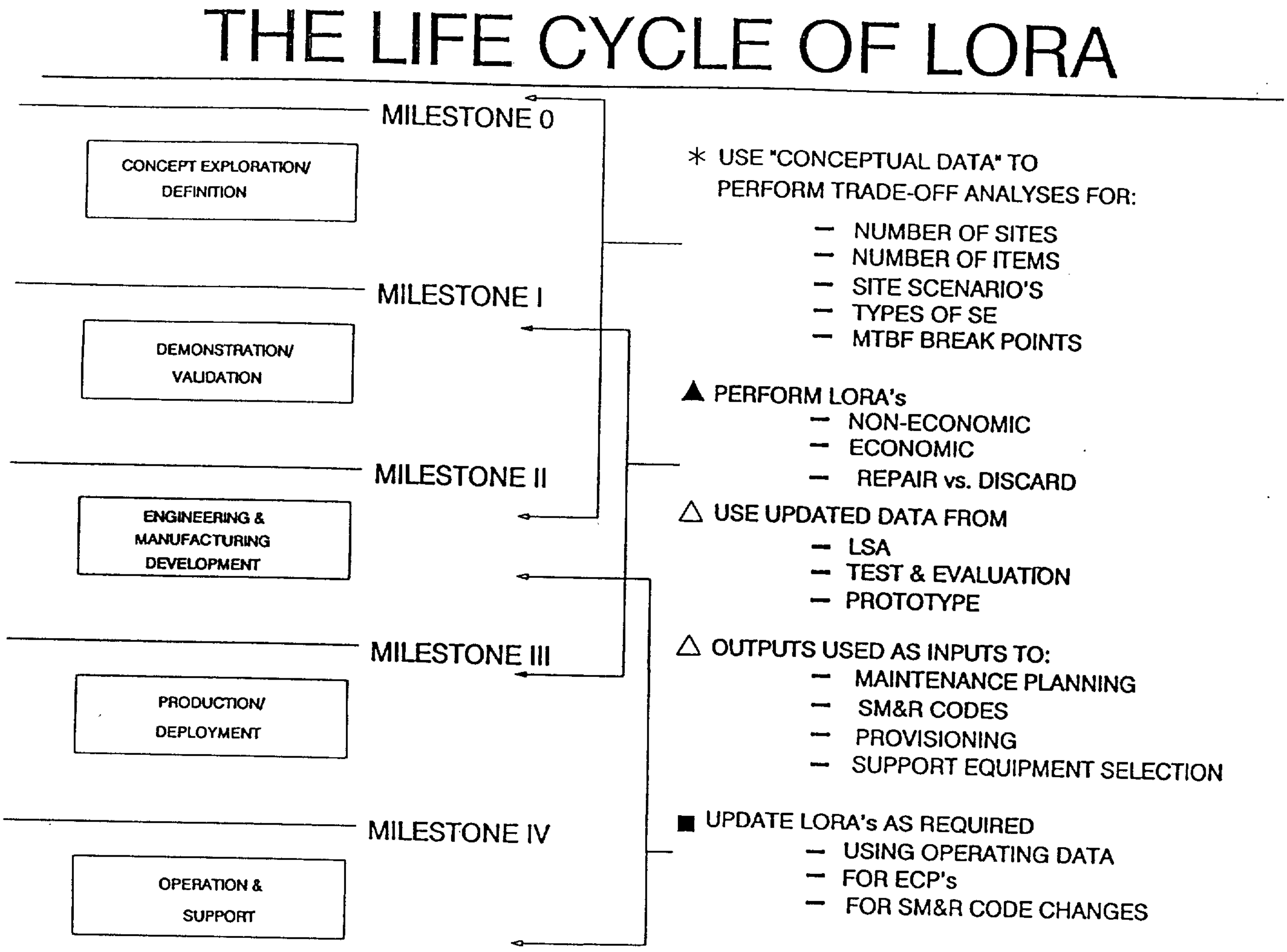


FIGURE 1. The life cycle of LORA.

5. DETAILED REQUIREMENTS

5.1 Task sections. The LORA tasks are divided into the following four general sections: SECTION 100, PROGRAM PLANNING AND CONTROL; SECTION 200, DATA PREPARATION AND MANAGEMENT; SECTION 300, EVALUATIONS; SECTION 400, USE AND IMPLEMENTATION.

5.2 Task structure. Each individual task is divided into the following five subsections.

a. Purpose. The "Purpose" subsection defines the objective of and general reason for performing the task.

b. Task description. The "Task description" subsection provides the detailed tasking statements (subtasks) which comprise the overall task. It is not intended that all tasks and or subtasks be accomplished in the sequence presented (See 5.3 Task selection for further guidance).

c. Task input. The "Task input" subsection identifies the general information required to define the scope of and perform each task. Paragraphs under the "Task input" portion annotated by an "*" indicates information that should be provided by the requiring authority to the performing activity, if available. The requiring authority should identify in the SOW whether the information annotated by an "*" will be provided.

d. Task output. The "Task output" subsection identifies the expected results from performance of the task. When an element of the task input or task output is only applicable to certain subtasks, the applicable subtask numbers are identified in parentheses following the element. Where subtask numbers are not listed, that element is applicable to all subtasks listed under the task description.

e. Details to be specified. The "Details to be specified" subsection provides a list of specific details, additions, modifications, deletions, or options to the task description, task input, and task output parts that should be considered by the requiring authority when tailoring the task description to fit program needs and preparing the RFP. The "Details to be specified" identifies which considerations are required to be specified in the SOW and contract data requirements list (CDRL) by the requiring authority. Paragraphs under the "Details to be specified" portion annotated by an "(R)" are required and shall be specified in the SOW or CDRL by the requiring authority.

5.3 <u>Task selection</u>. It is not intended that all LORA tasks be accomplished in the sequence presented. The sequence of tasks accomplishment should be tailored to the individual acquisition program. Where applicable, the subtasks are organized to correspond with relative timing of performance during the acquisition process. Consequently, for some tasks, all subtasks may not be required to be performed for a given contract period. In these cases, the SOW shall specify the applicable subtask requirements. For additional information on application, refer to appendix A, Application Guidance.

TASK SECTION 100

PROGRAM PLANNING AND CONTROL

TASK 101

PROGRAM STRATEGY AND PLAN

101.1 Purpose. To identify the LORA tasks to be accomplished and develop a LORA Program Plan which details the approach for accomplishing the LORA tasks.

101.2 Task description.

101.2.1 LORA strategy. Identify proposed LORA tasks to be performed; and the activity responsible for each task. Propose any additional tasks and modifications or deletions to tasks or requirements specified in the SOW with supporting rationale for such additions, modifications or deletions. The selection of LORA tasks and the degree of their accomplishment shall be based on the following factors:

a. The probable design, supportability, and operational approaches for the system undergoing LORA.

b. The availability, accuracy, and relevance of LORA input data required to perform the proposed LORA tasks.

c. The potential design impact of LORA recommendations.

d. The LORA requirements specified in the SOW.

e. LORA efforts conducted during previous phases of the acquisition program.

f. Related system engineering analyses planned and completed which are still relevant.

101.2.2 Schedule. Develop a schedule to accomplish the LORA tasks identified and the delivery of LORA products based on the relationship of the LORA program with other Integrated Logistic Support (ILS) program requirements and associated systems engineering activities and programs (e.g., LSA per MIL-STD-1388-1, reliability per MIL-STD-785, maintainability per MIL-STD-470, etc.). Included in the schedule shall be any requirements for program and design reviews identified under task 102.

101.2.3 Manpower estimate. Estimate the man-hours to perform each task identified under subtask 101.2.1 based on the schedule developed under subtask 101.2.2.

101.2.4 LORA candidate list. Develop a list of items for which the LORA program is being established. The list shall include all items covered under, by, or associated with the acquisition program. The LORA Candidates List shall contain a code for each item which represents the hardware breakdown relationship of the items to each other. The list should also include the LSA Control Number (LCN) of each item, if it has been assigned. (R)

(R) Identifies required tasks.
* - Identifies information provided by the requiring authority to the performing authority, if available.

101.2.5 LORA program plan. Prepare a LORA Program Plan which describes how the LORA program will be conducted to meet the program requirements. These descriptions should include a discussion of how LORA results are used in LSA. The LORA Program Plan shall include the following elements of information, with the range and depth of information for each element tailored to the acquisition phase:

a. Identification of each LORA task to be accomplished under the LORA program.

b. A detailed description of how each LORA task will be performed.

c. Identification of the organizational unit with the responsibility for executing each task. This includes identification of key personnel and an organizational structure describing the interrelationship between line, service, staff and policy organizations. This also includes identification and responsibilities of contractors, subcontractors, and vendors.

d. A schedule with estimated start and completion milestones for each LORA program activity or task. The schedule depicts the relative timing of the LORA program tasks in relation to the LSA program.

e. Identification of resources (man-hours and cost) to be expended on each task.

f. Description of how LORA tasks and data will interface with other ILS and system engineering program tasks and data. The description will include analysis and data interfaces with the following programs, as applicable:

(1) Design Program

(2) Reliability Program

(3) Maintainability Program

(4) LSA and LSAR Program

(5) Human Engineering Program

(6) System Safety Program

(7) Maintenance Engineering, Planning, and Analysis Program

(8) Support Equipment Identification Program

(9) Standardization Program

(10) Parts Control Program

(11) Packaging, Handling, Storage and Transportability Program

(12) Initial Provisioning Program

(13) Warranty Program

(14) Test and Evaluation Program

(15) Facilities Program

(16) Technical Publications Program

(17) Survivability and Vulnerability Program

(18) Corrosion Prevention Program.

(19) Other related programs.

g. The method by which the LORA program requirements and data are to be obtained from and disseminated to personnel in all other related program areas.

h. The method by which the LORA program requirements and data are to be obtained from and disseminated to subcontractors, vendors, and the controls levied under such circumstances.

i. Description of the procedures which will be used for collecting, updating, and validating LORA input data and results. These descriptions should include a discussion of how LORA results are used in LSA.

j. The LORA Candidate List.

k. Identification of the LORA model(s) to be used in conducting LORA evaluations. For Army LORA evaluations, the specific computer models and techniques for use in Army programs shall be limited to those models and techniques that have been approved by the Army LORA Support Office.

m. A list of the LORA input data elements required to execute the LORA model(s) identified and sources to provide that data (i.e., government, contractors, subcontractors, vendors, and test agencies).

n. Discussion of the sensitivity evaluation requirements and proposed ranges of particular quantitative data elements so the uncertainty of design and program characteristics can be considered.

o. Identification of major supportability and design tradeoffs or constraints to be evaluated under the LORA program. In particular, describe the support and support equipment alternatives to be evaluated.

p. A list of factors (e.g., safety, security, policies, etc.) which will be examined in the noneconomic evaluation. In particular, describe any factors or characteristics related to the data elements identified which may impact or should be considered in conducting the LORA evaluations.

q. Identification of data that will be used from similar system(s), which will be used to establish a baseline maintenance concept on the system under analysis. This should include identification of the similar system(s) and quantification of any data to be used from the similar system(s).

r. The procedures and methods for identifying, recording, monitoring, and resolving problems associated with the performance of the LORA program.

s. The procedures, methods, and controls for identifying and recording design problems or deficiencies affecting supportability, corrective actions required, and the status of actions taken to resolve the problems.

t. Identification of the requirements or events which, when satisfied or when they occur, will require that the LORA Program Plan be updated and resubmitted for approval by the requiring authority.

101.2.6 LORA program plan updates. Update the LORA Program Plan as required, subject to requiring authority approval, based on analysis results, program schedule modifications, and program decisions.

101.3 Task input.

101.3.1 Previously conducted DOD or Service mission area analyses and LORA evaluations pertinent to the system for which the LORA program is being established. It should be noted this data must not include proprietary data of any contractor.*

101.3.2 Expected mission and functional requirements for the system for which the LORA program is being established.*

101.3.3 LSA strategy outlining the proposed supportability objectives and proposed LSA tasks and subtasks to be performed for each phase of the acquisition program from MIL-STD-1388-1, LSA task 101.*

101.3.4 LSA Program Plan outlining the scheduling of LSA tasks and how each will be performed from MIL-STD-1388-1, LSA task 102.*

101.3.5 Overall system program event and milestone schedule.*

101.3.6 The requirements stated in the SOW and CDRL for the establishment of a LORA program and its accomplishment along with identification of deliverable data items.*

101.3.7 Identification of any specific LORA process indoctrination or training to be provided.*

101.3.8 LORA review procedures, LORA Review Team structure, LORA Guidance Review schedule from task 102.

101.3.9 Program plans for related system engineering analyses which have been accomplished in previous acquisition phases or are to be accomplished in the current acquisition phase.*

* - Identifies information provided by the requiring authority to the performing authority, if available.

101.4 Task output.

101.4.1 LORA Program Plan outlining proposed tasks to be accomplished; how each task is proposed to be accomplished; and, proposed supportability and design tradeoffs or constraints to be evaluated under the LORA program (101.2.5).

101.4.2 LORA Program Plan updates as applicable (101.2.6).

101.5 Details to be specified. Details to be specified by the requiring authority in the SOW shall include the following, as applicable.

101.5.1 DI-ILSS- , LORA Program Plan, applies to this task and shall be specified when required as a deliverable data item.

101.5.2 Identification of each task from this standard to be performed as part of the LORA program. (R)

101.5.3 Identify whether the LORA Program Plan forms a part of the contract when approved by requiring authority.

101.5.4 Applicability of the performing activity proposing any additional tasks and modifications or deletions to tasks or requirements specified in the SOW and CDRL.

101.5.5 Identification of any specific LORA process indoctrination, training, or guidance conference to be provided or required.

101.5.6 Identification of LORA program review requirements. (R)

101.5.7 Identification and information about data items required as deliverables (i.e., DID number; dates, frequency, quantities, distribution, and medium of deliveries; and, locations for distributions). (R)

101.5.8 Duration of the LORA Program Plan to be developed (i.e., indicate the length, period, or event for which the LORA Program Plan is in effect or covers).

101.5.9 Identification of the LORA model(s) specified for use. (R)

101.5.10 Applicability of the LORA Program Plan being integrated into or a separate document from the LSAP. This should be stated in the SOW to ensure that the LSAP and the LORA Program Plan are compatible but non-duplicative.

101.5.11 Identify the significance the LORA program is to have in maintenance planning for the acquisition program (i.e., indicate the requirement for LORA results to directly impact and influence maintenance planning for the acquisition program). (R)

(R) Identifies required tasks.

101.5.12 Identify the system operating environment(s) for which the LORA program is being conducted. In specific, identify whether LORA input data and LORA evaluations are to reflect a wartime, peacetime, or combination of operating environments. (R)

101.5.13 Identify the task input information annotated with an "*" in paragraph 101.3 which will be provided by the requiring authority to the performing activity. (R)

(R) Identifies required tasks.

TASK 102

PROGRAM REVIEWS

102.1 Purpose. To establish a requirement for the performing activity to plan and provide for official and timely reviews of the LORA program and provide the requiring authority with appropriate surveillance and management control of the LORA program through reviews. In addition, the purpose of this task is to ensure the LORA program is proceeding in accordance with the contractual milestones so that the LORA requirements will be achieved.

102.2 Task description.

102.2.1 Review procedures. Establish and document review procedures (where procedures do not already exist) which provide for official review and control of released LORA information and results in a timely and controlled manner. The review procedures shall identify ILS and system engineering program areas along with the contractors, subcontractors, and vendors which will conduct official review, control, and implementation of LORA information and results. These procedures shall define the interfaces and degree of authority that each of the reviewing activities have to accept/reject the LORA information/results.

102.2.2 LORA review team. The LORA program shall be monitored under the auspices of the joint requiring authority/performing activity Integrated Logistics Support Management Team (ILSMT) or LSA Review Team, if either is required by the contract. If an ILSMT or LSA Review Team is not required, establish a joint requiring authority/performing activity LORA Review Team to serve as the primary management vehicle for monitoring the status of the LORA program and implementation of requiring authority approved LORA decisions. The chairperson of the LORA Review Team shall be appointed by the requiring authority with the performing activity acting as co-chairperson. The performing activity shall identify nongovernment members to the LORA Review Team which include management and functional representatives in systems engineering and functional disciplines (i.e., design engineers; operations research specialists; reliability, availability, and maintainability (RAM) engineers; maintenance engineers; human factors engineering; and, provisioning specialists), from prime contractors, and any subcontractors designated by the performing activity. The requiring authority shall identify LORA Review Team members from government organizations. The members of the LORA Review Team serve as a staffing body for LORA input data and evaluation reports and serve as participants in LORA Guidance Conferences and Reviews.

102.2.3 LORA guidance conference. In order to ensure that the performing activity and requiring authority have a mutual understanding of the scope of the effort contractually required, a LORA Guidance Conference shall be held. This conference can be held either separately or as part of other conferences, such as a postaward LSA/LSAR guidance conference, if the conference is required in the contract. When a LORA Guidance Conference is not contractually specified and the performing activity desires a guidance conference, the performing activity shall propose a date, place, and agenda. The proposal shall be submitted within thirty (30) days after contract award.

The specific date and place for the guidance conference will be determined by the requiring authority and performing activity. The guidance provided to the performing activity by the requiring authority may include, but shall not be limited to the following:

a. Performing activity inquiries relative to contractual LORA requirements and changes to the LORA Program Plan, which impact how the LORA effort will be conducted by the performing activity.

b. Clarification of review procedures to be employed.

c. Clarification of procedures for transfer of data between the requiring authority and performing activity.

d. Maintenance concepts to be considered.

e. Baseline operational and logistics data to be used (i.e., deployment life, end item density, washout rate, operating time of end item).

f. Guidance relative to use and application of LORA data and results.

g. Technical features of government supported LORA models to be employed.

102.2.4 LORA reviews. Plan and schedule the LORA program to permit the performing activity and the requiring authority to review program status at specific milestones of the life cycle. The status of the LORA program shall be assessed at LORA reviews scheduled and held, to the maximum extent possible, in conjunction with ILSMT/LSA reviews and major program reviews described in MIL-STD-1521 and specified by the contract. The performing activity shall also schedule LORA reviews with prime contractors, subcontractors, and suppliers, as appropriate, and inform the requiring authority in advance of each review. The requiring authority shall specify in the SOW whether there is a need for prior approval of the agenda and the number of days advance notice required before each scheduled review meeting. The performing activity shall ensure participation of prime contractor and subcontractor personnel, if necessary. The performing activity shall provide administrative support for and participate in the LORA reviews. Administrative support shall include, but not be limited to facilities, office equipment, clerical personnel, technical data, and preparation and distribution of agendas and minutes of the guidance reviews.

102.2.5 Review agendas. LORA reviews shall identify and discuss all pertinent aspects of the LORA program. Agendas shall be developed and coordinated, with the requiring authority, to address at least the following topics as they apply to the program phase activity and the review being conducted.

a. Status of the LORA effort with respect to schedule. (R)

b. LORA candidate list status. (R)

(R) Identifies required tasks.

c. Performing activity assessment of LORA program effectiveness (i.e., design changes or maintenance concept changes that were made or planned as a result of the LORA effort). (R)

d. Design, schedule, or analysis problems affecting the LORA program and corrective actions considered, proposed, or taken, such as: (R)

(1) Changing support alternatives under consideration.

(2) Changing system alternatives under consideration.

(3) Sensitivity evaluation results.

(4) Comparative analysis with existing systems.

(5) Design or redesign actions proposed or taken.

e. Supportability related design recommendations based on LORA results. (R)

f. Findings from staffing LORA input data and reports prior to the meeting. (R)

g. Results from noneconomic, economic, and sensitivity evaluations. (R)

h. Status of action items. (R)

i. Points of special interest occurring since the last review. (R)

j. LORA input data requirements and status. (R)

k. Other topics and issues as deemed appropriate by the requiring authority and performing activity. (R)

102.2.6 Review minutes. The proceedings of each LORA Guidance Review shall be documented and provided to the requiring authority for approval. The performing activity shall participate in and take minutes of the proceedings. The performing activity shall identify and document items requiring action at LORA Guidance Review meetings. These action items shall be submitted as agenda items for the next LORA review. The performing activity shall prepare a summary listing of open action items which identifies the organizational entity assigned responsibility for resolution and the target date for completion of each action item. The minutes of these reviews shall include the status of any supportability related design recommendations, description of design change, whether or not the design change was accepted, and if accepted the rationale (tangible and nontangible) for acceptance.

102.3 Task input.

102.3.1 Overall system program event and milestone schedule.*

(R) Identifies required tasks.
* - Identifies information provided by the requiring authority to the performing authority, if available.

102.3.2 LSA Program Plan, outlining the scheduling of and procedures for LSA Guidance Reviews, from MIL-STD-1388-1, LSA Task 102.*

102.3.3 The specifications and requirements stated in the SOW and CDRL for the LORA program along with identification of deliverable data items.*

102.3.4 Identification of LORA Review Team members from government organizations.*

102.4 Task output.

102.4.1 LORA review procedures which provide for official review and control of released LORA information and results in a timely and controlled manner (between and among performing activity ILS/systems engineering elements, prime contractors, subcontractors, requiring authority, and government organizations) (102.2.1).

102.4.2 Identification of LORA Review Team members (102.2.2).

102.4.3 LORA Guidance Conference proposal (102.2.3).

102.4.4 LORA Guidance Reviews scheduled for input to the LORA Program Plan, task 101 (102.2.4).

102.4.5 Agendas for each LORA Guidance Review (102.2.5).

102.4.6 Documented results of each LORA Guidance Review to include the status of any supportability related design recommendations (102.2.6).

102.5 Details to be specified. Details to be specified by the requiring authority in the contract, specifically the SOW, CDRL and schedule, shall include the following, as applicable.

102.5.1 DI-A-7088, Conference Agenda and DI-A-7089, Conference Minutes apply to this task and shall be specified when agendas and minutes are required as deliverable data items.

102.5.2 Identification and information about data items required as deliverables (i.e., DID number; dates, frequency, quantities, distribution, and medium of deliveries; and, locations for distributions). (R)

102.5.3 Description of the LORA Review Team (i.e., identify whether the team is composed of members from the ILSMT or LSA Review Teams; whether the LORA program will be monitored under other teams; and, identify the LORA Review Team members). (R)

102.5.4 Specify whether review procedures should be included in the LORA Program Plan. (R)

102.5.5 If a LORA Guidance Conference is required, identify when it will be held and what the topics of discussion will be.

(R) Identifies required tasks.
* - Identifies information provided by the requiring authority to the performing authority, if available.

102.5.6 Identification and frequency of LORA reviews required (i.e., specify dates for LORA reviews or indicate that dates shall be as set forth in the approved LORA Program Plan, or that LORA reviews shall be held as deemed appropriate by the requiring authority). (R)

102.5.7 Specify whether there is a need for requiring authority approval of agenda and number of days advance notice required before each scheduled review meeting. (R)

102.5.8 Indicate information (LORA results, reports, and data) is to be forwarded to the review participants by the performing activity. (R)

102.5.9 Indicate whether minutes to meetings/conferences require approval by the requiring authority and whether action items in approved minutes become contractual requirements after submission through the contracting officer. (R)

102.5.10 Specify the relationship (i.e., part of or separate from other reviews) of the LORA Guidance Review meetings with any similar group meetings (i.e., program reviews, design reviews, ILSMT meetings, LSA Review meetings, etc.).

102.5.11 Identify the task input information annotated with an "*" in paragraph 102.3 which will be provided by the requiring authority to the performing activity. (R)

(R) Identifies required tasks.

TASK SECTION 200

DATA PREPARATION AND MANAGEMENT

TASK 201

INPUT DATA COMPILATION

201.1 Purpose. To identify pertinent LORA input data and assemble the data into a manageable form for use in LORA evaluations.

201.2 Task description.

201.2.1 LORA input data for economic evaluations. Identify values for the LORA input data elements specified in the SOW for each item in the LORA Candidates List and the item's associated support alternatives. Identify the specific source from which each data element value was obtained. When multiple values and sources exist for a data element indicate the most current data value and the corresponding source. Perform this subtask by reviewing data contained in requirements documents (contracts, specifications, regulations, etc.) and by examining data produced by other system engineering programs (e.g., LSA/LSAR program, reliability program, maintainability program, etc.). The values for the data elements shall be established, to the maximum extent possible, from existing sources. However, when no source is available for a data element then a realistic range for the value shall be established through the engineering experience and knowledge of the performing activity. All values, as well as changes to requiring authority furnished values, are subject to approval of the requiring authority. The LORA input data elements listed in appendix P translate and quantify an item's design, operation, cost, and support characteristics and are used in conducting LORA economic and sensitivity evaluations. All values related to cost shall be expressed in terms of a particular base year to ensure consistency and cohesiveness.

201.2.2 LORA input data for noneconomic evaluations. Identify specific factors (i.e. constraints, policies, special requirements, human factors, etc.) which affect items in the LORA Candidates List and its associated support alternatives. Relate these factors to the LORA input data elements specified in the SOW. Perform this subtask by: reviewing program and requirements documents; and, examining other related system engineering programs or analyses. Identify the specific source from which the factors and constraints were obtained. All factors identified, as well as changes to any requiring authority furnished factors, are subject to approval of the requiring authority. The identified factors are used in conducting LORA noneconomic evaluations and influences the results of LORA economic and sensitivity evaluations. Some factors are listed in table Q-I; however, this list is not all inclusive and other factors may be identified.

201.2.3 LORA input data report. Prepare a LORA Input Data Report which documents the data and sources identified under task 201.2.1 and 201.2.2.

201.2.4 Updates. Perform updates on subtasks 201.2.1 through 201.2.3 as the system becomes better defined and as more reliable data becomes available. The subtask shall include reexamination of the LORA input data element values and factors identified as the sources of information are updated or as new sources become available. Additional factors shall be identified, as well as applicability of the existing factors during performance of this subtask.

201.3 Task input.

201.3.1 LORA Program Plan from task 101.2.5 containing the LORA Candidates List; LORA input data elements list; proposed sensitivity ranges for particular LORA data elements; factors which have already been identified; and, support alternatives to be evaluated.

201.3.2 The specifications and requirements stated in the SOW and CDRL for the LORA program along with identification of deliverable data items.*

201.3.3 System specifications, requirements documents, contracts, etc. in which LORA input data exists.*

201.3.4 Studies, reports, and documentation available from all system engineering and design programs. For example, reliability, maintainability, FMECA, and transportability documentation and reports developed from MIL-STD-785, MIL-STD-470, MIL-STD-1629, and MIL-STD-1367 requirements, respectively, should be used as input to this task.*

201.3.5 Applicable LORA input data element definitions from appendix P related to the LORA model identified in the LORA Program Plan.

201.3.6 Applicable factors from table II identified in the LORA Program Plan.

201.3.7 Use Study Report containing pertinent supportability factors and quantitative data related to the intended use of the system from MIL-STD-1388-1, LSA task 201.*

201.3.8 Supportability and supportability related design constraints based upon support standardization considerations identified from conduct of MIL-STD-1388-1, LSA task 202.*

201.3.9 Projected supportability data for the baseline comparative system developed from MIL-STD-1388-1, LSA task 203.*

201.3.10 LSAR data and supportability and supportability related design constraints and alternatives for the system developed from MIL-STD-1388-1, LSA task 205.*

201.3.11 Various support concepts and alternatives developed for the various system design alternatives from MIL-STD-1388-1, LSA task 302.*

201.4 Task output.

201.4.1 Values and sources of LORA input data that depicts the design, operation, performance, cost, and support characteristics, factors, and features related to the system and its support alternatives which are used in conducting LORA economic and sensitivity evaluations (201.2.1).

201.4.2 Pertinent factors related to the system and its support which must be considered in conducting LORA noneconomic evaluations (201.2.2).

* - Identifies information provided by the requiring authority to the performing authority, if available.

201.4.3 LORA Input Data Report (201.2.3).

201.4.4 LORA Input Data Report updates as applicable (201.2.4).

201.5 <u>Details to be specified</u>. Details to be specified by the requiring authority in the SOW shall include the following, as applicable.

201.5.1 DI-ILSS- , LORA Input Data Report, applies to this task and shall be specified when required as a deliverable data item. If a LORA Report is required then delivery of a separate LORA Input Data Report is not necessary and should not be included in the SOW. In that case the LORA Report would document the input data used in the evaluations.

201.5.2 Identification of the items from the LORA Candidate List for which data is required to be assembled. (R)

201.5.3 Identification of the LORA input data elements for which information is to be assembled. Identify the specific table of input data elements for the LORA models in appendices D through O, for which the data is required. (R)

201.5.4 Identification of the data elements for which the requiring authority will furnish values or information. Each table in appendices D through O indicates data elements which are potentially requiring authority furnished. Include specific guidance in the SOW on which of those data elements will indeed be supplied by the requiring authority. Also, identify when the values or information for those requiring authority furnished data elements will be furnished to the performing activity. (R)

201.5.5 Identification of the factors for which information is to be assembled and used in the noneconomic analysis. (R)

201.5.6 Specification of the delivery media for the LORA Input Data Report, if delivery is required. (R)

201.5.7 Specification of the format of section II of the LORA Input Data Report. (R)

201.5.8 Identify the task input information annotated with an "*" in paragraph 201.3 which will be provided by the requiring authority to the performing activity. (R)

201.5.9 Specification of the base year in which data elements related to costs are to be expressed. (R)

(R) Identifies required tasks.

TASK SECTION 300

EVALUATIONS

TASK 301

EVALUATION PERFORMANCE, ASSESSMENT, AND DOCUMENTATION

301.1 Purpose. To evaluate maintenance alternatives and determine the optimum level of repair or discard of each LORA candidate based on various economic and noneconomic conditions.

301.2 Task description.

301.2.1 LORA noneconomic evaluation. Use the data identified in subtask 201.2.2 to perform a noneconomic analysis. Identify the maintenance level(s) or support alternative(s) which are affected or restricted. Also provide the factors and rationale for the restriction or constraint imposed. In performing this subtask, evaluate and interpret the results of other related system engineering analyses that have been conducted on the system under analysis. Perform the analysis without regard to cost; however, any LORA recommendation(s) based upon this analysis may include an economic evaluation which will assign some economic value to the noneconomic recommendation. Specific factors to be considered when eliminating support alternatives that are not practical or feasible include, but are not limited to, the following:

a. Safety

b. Constraints on the existing logistics support structure

c. Special transportation factors

d. Deployment mobility

e. Technical feasibility of repair

f. Mission success (criticality and effectiveness)

g. Security

h. Human factors

i. Policy (specifications and regulations pertaining to items)

301.2.2 LORA economic evaluation. Conduct a LORA economic analysis on all items in the LORA candidate list. Specifically, determine and identify the most cost effective maintenance concept for all items in the LORA Candidate List. One or more of the LORA model(s) in appendices D through O shall be used to establish the most cost effective maintenance concept for the item(s) under analysis. For Army LORA economic evaluations, the specific computer models and techniques for use in Army programs shall be limited to those models and techniques that have been approved by the Army LORA Support Office.

301.2.3 LORA sensitivity evaluation. Conduct sensitivity analysis on selected input parameters to assess the impacts on the baseline maintenance concept. Specific parameters subject to sensitivity analysis shall include, but not be limited to: parameters for which engineering values are not available; parameters representing uncertainties in design characteristics; parameters critical to the logistic support and readiness of the system; parameters that have been estimated, calculated, or based on historical data; manpower and personnel skill parameters; parameters which are effected by the environment in which the system is intended to be operated in; resupply time; and, spares budget. The sensitivity analysis consists of the following:

a. Identify or select the specific LORA input data element(s) which will be analyzed during the sensitivity evaluation.

b. Determine and establish a numerical range(s) over which the selected data element(s) are expected to fall within.

c. Execute the LORA model over the established numerical range(s).

d. Assess the impact on the baseline maintenance concept by analyzing the total logistic support cost and the designated level of repair or discard output by the model. Assess the likelihood that the parameter will vary as described in the sensitivity analysis when the system is fielded.

e. Confirm or change the recommended maintenance concept based upon the results of the sensitivity evaluation(s) performed.

301.2.4 Documentation of results. Prepare a LORA report which documents the results of the LORA program. The LORA tasks and evaluations performed, the procedures used to perform the LORA evaluation, and the results of LORA shall be included in the report. Detailed contents of the LORA Report are described in DI-ILSS- . As a minimum, the LORA report should contain the following:

a. A description of the system under analysis including the breakdown structure of how the system was modeled. Also discuss similar systems and their maintenance concepts which were compared against the system under analysis.

b. A description of the LORA performed which includes: operational scenario modeled; assumptions made; maintenance alternatives considered; and, the LORA model used to perform the economic and sensitivity evaluations.

c. A listing of the input data elements titles and their corresponding values. Indicate if any values were calculated or estimated. Include rationale for estimation and confidence level, if applicable.

d. Summary of the results of the noneconomic and economic analysis conducted.

e. A discussion and explanation of the sensitivity analysis performed and the results obtained.

f. The contractor's conclusions and recommendations of the level of repair or discard of each item undergoing the LORA.

g. Formatted input records and the formatted model output reports produced.

301.2.5 Updates. Perform updates on tasks 301.2.1 through 301.2.4 as the system becomes better defined and as better data becomes available. Specifically updates will be required when there are: (a) significant changes in the data elements; (b) significant changes in the support equipment requirements, capabilities, use, costs, etc.; (c) other requirements imposed by the contract; or, (d) changes directed by the requiring authority.

301.3 Task input.

301.3.1 The LORA candidate list developed in task 101.2.4.

301.3.2 Any previous analyses performed on the system or on similar systems. *

301.3.3 The LORA input data compiled during performance of task 201.

301.3.4 The LORA input data report.

301.3.5 The LORA model specified by the requiring authority which will be used to perform the economic and sensitivity evaluations. *

301.3.5 List of support alternatives to be analyzed, if applicable. *

301.3.6 LORA program plan.

301.4 Task output.

301.4.1 The results of the noneconomic analysis (subtask 301.2.1) including identification of the factors affecting the maintenance level.

301.4.3 The results, conclusions, and recommendations established during performance of subtasks 301.2.2 and 301.2.3.

301.4.4 The LORA report (subtask 301.2.4)

301.4.5 The updates performed and the resulting changes, as the system becomes better defined and as more accurate and reliable data is obtained.

301.5 Details to be specified. Details to be specified by the requiring authority in the SOW shall include the following, as applicable:

301.5.1 DI-ILSS-   , LORA Report, applies to this task and shall be specified, when required, as a deliverable data item. (R)

(R) Identifies required tasks.
* - Identifies information provided by the requiring authority to the performing authority, if available.

301.5.2 Identification of the LORA model(s) which will be used in all economic and sensitivity evaluations conducted during performance of subtasks 301.2.2 and 301.2.3. (R)

301.5.3 Identification of specific data element(s) and the numerical range(s) over which sensitivity analysis will be performed. (R)

301.5.4 Specific government constraints imposed on the system under analysis. (R)

(R) Identifies required tasks.

TASK SECTION 400

USE AND IMPLEMENTATION

TASK 401

USING RESULTS

401.1 Purpose. To identify how the results obtained from the LORA are to be implemented and used to influence system design. Also, identify how the results will be used to develop/update/revise the LSA related products.

401.2 Task description.

401.2.1 Recommendations/actions. Prepare a list of recommendations for the equipment designer to influence the design of the system under development.

401.2.2 Incorporating results in LSA products. Use the results obtained in developing LSA related products specified in the contract.

401.2.3 Related analyses. Prepare and identify a list of results which can be incorporated into other LSA related system engineering analyses.

401.2.4 Use of government recommendations. Incorporate the government approved results of the LORA program in development or revision of LSA related products specified in the contract.

401.2.5 Updates. Identify the requirement for further analysis to be performed on the system and update the LORA Program Plan as necessary.

401.3 Task input.

401.3.1 Results of the evaluations performed and the recommendations established during accomplishment of task 301.

401.3.2 The LORA Report developed in task 301.2.4 and the LORA Program Plan.

401.3.3 The requiring authority's determinations and approved results based on review of the contractor's LORA Report. *

401.3.4 The LSA related products.

401.3.5 The results of other LSA related system engineering analyses conducted on the system.

401.4 Task output.

401.4.1 The updated LSA related products specified in the contract.

401.4.2 Identification of the results which shall be incorporated into other related LSA system engineering analyses (subtask 401.2.3)

* - Identifies information provided by the requiring authority to the performing authority, if available.

401.4.3 A list of the proposed actions/recommendations to be provided to the equipment designer to influence the design of the system under analysis.

401.4.4 Identification of the need to perform further analysis and the resulting updates to the LORA Program Plan.

401.5 Details to be specified. Details to be specified by the requiring authority in the SOW shall include the following, as applicable:

401.5.1 Identification of the LSA related products which are to be developed or revised with the results obtained. (R)

401.5.3 Identification of the related LSA system engineering analyses which are to be interfaced with the LORA program.

401.5.3 Identification of the related LSA system engineering analyses which will incorporate the results of the LORA evaluations performed.

6. NOTES

(This section contains information of a general or explanatory nature that may be helpful, but is not mandatory.)

6.1 Intended use. This document is intended to standardize the LORA process throughout the government. This document is intended for incorporation into contracts and for use internally within the government for systems operationally in use or being procured for future use. Every time this standard is used, each of its paragraphs must be considered for applicability by the requiring authority (see 1.2).

6.2 Issue of DODISS. When this standard is used in acquisition, the applicable issue of the DODISS must be cited in the solicitation (see 2.1.1).

6.3 Data requirements. The following DIDs must be listed, as applicable, on the CDRL (DD Form 1423) when this standard is applied on a contract, in order to obtain the data, except where DOD FAR Supplement 27.475-1 exempts the requirement for a DD Form 1423:

Reference Paragraph	DID Number	DID Title	Suggested Tailoring
101.2.5, 101.2.6	DI-ILSS-80645A	LORA Plan	--------
102.2.3, 102.2.5	DI-ADMIN-81249	Conference Agenda	--------
102.2.6	DI-ADMIN-81250	Conference Minutes	--------
201.2.3,	DI-ILSS-80647A	LORA Input Data Report	--------
301.2.4, 301.2.5	DI-ILSS-80646A	LORA Report	--------

(R) Identifies required tasks.

The above DIDs were those cleared as of the date of this standard. The current issue of DOD 5010.12-L, Acquisition Management Systems and Data Requirements Control List (AMSDL), must be researched to ensure that only current, cleared DIDs are cited on the DD Form 1423.

6.4 Tailoring guidance for contractual application. To ensure proper application of this standard, invitations for bids, RFPs, and contractual SOWs should tailor the requirements in sections 4 and 5 of this standard to exclude any unnecessary requirements.

6.5 Security classification. Every effort must be made by the performing activity to limit the need for classifying the data furnished IAW the requirements of this document. No classified or unclassified-sensitive data shall be input to the LORA model(s) described in appendices D through O. If a LORA is required to be performed on a classified system, then security policies for protection of the classified data, usage of this data, and the results obtained shall be governed by the policies, procedures, or directives of the Joint Chiefs of Staff, Defense Intelligence Agency, National Security Agency, Defense Communications Agency, or other Department of Defense directives. In the event of a conflict, the more stringent requirement will take precedence.

6.6 Subject term (key word) listing.

Economic analysis
Integrated Logistic Support (ILS)
Logistic Support Analysis (LSA)
Maintenance planning
Maintenance and support alternatives
Noneconomic analysis
Sensitivity analysis
Source Maintenance and Recoverability (SMR) codes
Support Equipment (SE)
Test Measurement and Diagnostic Equipment (TMDE)
Tradeoff analysis

6.7 Changes from previous issue. Marginal notations are not used in this revision to identify changes with respect to the previous issue due to the extensiveness of the changes.

APPLICATION GUIDANCE FOR IMPLEMENTATION OF LEVEL OF REPAIR ANALYSIS PROGRAM REQUIREMENTS

10. SCOPE

10.1 General. This appendix provides rationale and guidance for the selection and tailoring of LORA tasks of this standard to meet specific program objectives in a cost effective manner. However, it is not to be referenced or implemented in contractual documents. No requirements are contained in this appendix. The users of this appendix may include the DOD contracting activity, government in-house activity, and prime contractor or subcontractor, who wishes to impose LORA tasks upon a supplier.

10.2 How to use this appendix. Section 20 contains a list of documents applicable to this appendix. Section 30 provides information on key terms used in this document. Section 40 provides guidance on how to tailor the LORA task requirements based on: program objectives; type of acquisition strategy; and, the acquisition phase of the life cycle. Section 50 provides detailed guidance on individual LORA tasks.

20. APPLICABLE DOCUMENTS

20.1 Government documents. The following documents form a part of this appendix to the extent specified:

DOD Instruction 5000.2	-	Acquisition and Management of Integrated Logistic Support for Systems and Equipment
ARMY		
AR 700-127	-	Integrated Logistic Support (ILS)
AMC-P 750-1	-	Army Maintenance System
AR 750-1	-	Army Materiel Maintenance Policy and Retail Maintenance Operations
AR 750-2	-	Army Materiel Maintenance Wholesale Operations
AMC-R 700-15	-	Integrated Logistic Support
AMC-R 700-27	-	Level of Repair Analysis Program
AMC-P 700-27	-	Level of Repair Analysis Procedures Guide
AR 725-50	-	Requisitioning, Receipt and Issue System
AR 710-1	-	Centralized Inventory Management of the Army Supply System
AR 710-2	-	Supply Policy Below Wholesale Level
DA Pam 700-1	-	Logistics, Department of Defense Supply Management Reference Book
DA Pam 710-2-1	-	Using Unit Supply System, Manual Procedures
DA Pam 710-2-2	-	Supply Support Activity (SSA) Supply System
MRSA Pam 700-XX	-	Draft Design for Supportablity Primer
NAVY		
OPNAVINST 5000.49A	-	Integrated Logistic Support
NAVAIRINST 4140.3	-	Level of Repair Analysis for Naval Air System Command Materiel

NAVSEAINST 5000.39	-	Acquisition and Management of Integrated Logistic Support for Ships, Systems and Equipment
TL-081-AB-PRO-010/LORA	-	Naval Sea Systems Command Level of Repair Analysis LORA Procedures Manual
MARINE CORPS		
MCO 4856.1B	-	Marine Corps Maintenance Policy
MCO P5000.10B	-	System Acquisition Management Manual
AIR FORCE		
AFR 800-8	-	Integrated Logistic Support Program
AFLCR/AFSCR 800-28	-	Repair Level Analysis (RLA) Program
AFLCP/AFSCP 800-4	-	Repair Level Analysis (RLA) Procedures
FAA		
FAA ORDER 1800.58	-	National Airspace Integrated Logistics Support Policy Order

(Copies of DOD Instruction 5000.2, OPNAVINST 5000.49A, and NAVAIRINST 4140.3 are available from the Commanding Officer, Standardization Document Order Desk, 700 Robbins Avenue, Bldg. 4D, Philadelphia, PA 19120-5094. Copies of AR 700-127, AR 750-1, and AR 750-2 are available from the US Army Publications Center, 2800 Eastern Boulevard, Baltimore, MD 21220. Copies of AMC-R 700-15, AMC-R 700-27, and AMC-P 750-1 are available from the Commander, Letterkenny Army Depot, ATTN: SDSLE-SAAD (Publications Distribution Branch), Chambersburg, PA 17201. Copies of MCO 4856.1B and MCO P5000.10B are available from the Commandant of the Marine Corps, Navy Annex (Code: HQSP-2), Washington, DC 20380. Copies of AFR 800-8, AFLCR/AFSCR 800-28, and AFLCP/AFSCP 800-4 are available from Headquarters, US Air Force, USAF/AADPDQ, Washington, DC 20330-5000. Copies of FAA ORDER 1800.58 may be obtained from FAA Management Standards and Statistics Division, AM5-400, 800 Independence Avenue, Washington, DC 20591.)

30. DEFINITIONS

30.1 General. Key terms used in this standard are defined in Appendix B, Glossary; and Appendix P, LORA Input Data Element Definitions.

40. GENERAL APPLICATION GUIDANCE FOR LORA PROGRAMS

40.1 LORA process. The LORA process involves systematic and comprehensive evaluations conducted on an iterative basis throughout the life cycle of the system. Through the iterative evaluation process, a maintenance and support concept for the system which is effective, yet economical can be established. The process shall integrate design, operations, performance, cost, and logistic support characteristics to assist in identifying and refining the maintenance and support concept for the system.

40.2 Coordination and interface. The success of a LORA program depends on the coordination efforts which provide integration of LORA activities with LSA and other system engineering analyses. Coordination efforts between all organizations/agencies involved should be described in the LORA Program Plan (subtask 101.2.5). The LORA Program Plan should be reviewed to ensure that input and output relationships, responsibilities, and the program milestones are properly addressed and identified to prevent overlap, duplication, omission, or schedule delays.

40.3 Development of LORA requirements.

40.3.1 General. The key to a productive and cost effective LORA effort is the concentration of available resources on activities which will most benefit the overall program. The basic objectives of the LORA program are to: (1) analyze maintenance support alternatives based on economic and noneconomic factors relating to the system; and, (2) use the results of the analysis to influence the design and assist in the maintenance planning process which will achieve the most effective maintenance support structure. The analyses are iterated and refined as the system progresses through the various stages of the life cycle. Development of a LORA strategy involves a large number of variables. Therefore, consideration of significant effects on these variables must be addressed in the tailoring process. The LORA tasks must be tailored and scheduled to meet the project decision milestones. The guidance included in this appendix is designed to assist in tailoring the LORA process.

40.3.2 Task selection and extent of analysis. The scope of the LORA program should be tailored to the size, complexity, and life cycle phase of the individual system program. The detail of the program and the rationale for selection of LORA tasks is dependent upon many factors which may require tailoring, so that a particular program's dollars are used efficiently. The factors listed below in paragraphs a through h will influence the amount of LORA activity administered on a program or restrict the LORA to selective areas (e.g., TPS development, repair versus discard, and item analysis).

a. Type of program. The type of acquisition program can impact objectives and the degree of the LORA effort. For example: (1) Major modifications may require a new approach to some of the LORA already conducted or it may require a reinitiation of the LORA; (2) a minor materiel change might focus on support risks associated with the changed part of the system and opportunities for improvement on the total system through improvements in supportability characteristics; and, (3) in a product improvement program (PIP) a LORA could be performed to determine how the product improvement will affect the maintenance requirements for that system.

b. Amount of design freedom. The amount of design freedom is a key consideration in LORA. Design freedom is related to program considerations, (i.e., phasing, scheduling). One objective of LORA is to influence selection of design characteristics to achieve improvements in supportability (e.g., design for discard). If the design and maintenance policy for a program are generated concurrently until finalized, the LORA is beneficial in developing an optimal system support package. During the post production phase a LORA may be conducted to evaluate the maintenance concept and determine potential benefits to be gained by changing the maintenance concept.

c. Availability of resources. The accomplishment of LORA requires resources in the form of people and money. It is DOD policy to fund readiness and support considerations up front and with sufficient time in system acquisition programs. However, in reality resources are constrained. If program funds are short, the LORA effort may have to be adjusted to compensate for lack of funds. For example, due to funding restrictions all LORA tasks cannot be performed under contract. In this situation it would be logical to have the contractor perform subtask 201.2.3 (Input Data Report) and use in-house capabilities to conduct the evaluations and assessments (Task 301).

d. Schedule constraints. Scheduling constraints (such as those imposed by accelerated programs) tend to reduce the time to accomplish design influence analysis tasks such as LORA.

e. Data availability and relevancy. The availability, accuracy, and relevancy of experience and historical data on similar systems are crucial for accomplishing a LORA early in a program. The effectiveness of the LORA effort is impacted if historical data is unavailable.

f. Acquisition phase of the program. The extent and detail of LORA should be tailored to the life cycle phase of the program. Table A-I identifies the applicability of LORA tasks by phase of development. This table is to be used for guidance only and may require adjustment for specific acquisition programs. The following information should be used to determine the amount of LORA activity which should be administered in each life cycle phase:

(1) Concept and Exploration (CE) phase. A LORA in the CE phase is selectively applicable and requires tailoring. The design is only conceptual and this phase allows the best opportunity for identifying alternatives, conducting tradeoffs, and influencing design from a supportability standpoint. Since the design is conceptual, the extent of the LORA conducted in this phase depends primarily on the availability of data. A CE phase LORA is usually conducted to establish a preliminary maintenance concept based upon engineering studies, evaluations, historical data, and expert opinion. CE phase LORAs should only analyze general concepts.

(2) Demonstration and Validation (DVAL) phase. A LORA is generally applicable in this phase. In this phase performance characteristics of the system are more or less established. The actual design is still flexible. Support, design, and operation alternatives are being investigated through tradeoff analysis. In this phase, a LORA is an excellent method for performing these tradeoffs and influencing the design of the system. When effectively timed and tailored, LORA assists in establishing the maintenance concept; assists in establishing cost effective reliability requirements, and, allocating these system level requirements to lower indenture levels; and, assists in establishing cost effective testability requirements. A DVAL phase LORA is also conducted to identify items which should clearly be designed for discard, instead of repaired.

TABLE A-I. Level of repair analysis task applicability and documentation.

TASK NUMBER AND TITLE	APPLICABILITY by PHASE				APPLICABLE DIDs	REMARKS
	CE	DVAL	FSD	PD		
101 - PROGRAM STRATEGY AND PLAN	S	G	G	C	DI-ILSS- , Level of Repair Analysis Program Plan	
102 - PROGRAM REVIEWS	G(1)	G	G	G(1)	DI-A-7088 Conference Agenda DI-A-7089 Conference Minutes DI-ILSS- , Level of Repair Analysis Program Plan	DI-A-7088 and DI-A-7089 apply to any review. Subtask 102.2.1 only.
201 - INPUT DATA COMPILATION	S	G	G	C	DI-ILSS- , Level of Repair Analysis Input Data Report	DI-ILSS- , is required when the requiring authority is to perform the evaluations.
301 - EVALUATION PERFORMANCE, ASSESSMENT, AND DOCUMENTATION	S	G	G	S	DI-ILSS- , Level of Repair Analysis Report	If a LORA Report is required by contract, then the LORA Input Data Report should not be cited or required.
401 - USING RESULTS	G	G	G	G		

CODE DEFINITIONS:

- S - Selectively applicable.
- G - Generally applicable.
- C - Generally applicable to design changes only.
- (1) - Selectively applicable for equipment level acquisitions.

(3) Engineering and Manufacturing Development (EMD) phase. As in the DVAL phase, a LORA is also generally applicable in the EMD phase. The EMD phase results in a prototype system for test and evaluation, including the

associated support concept. Detailed design engineering, parts selection, and fine tuning of performance are primary activities of this phase. Design influence is limited to items at the subsystem/item level, as well as to details such as, packaging, partitioning, testability, and accessibility. The support system is fairly well defined. The LORA is used to optimize the support system and determine an optimal maintenance concept for the system. LORA, in conjunction with detailed engineering design analyses, can verify the economics and engineering viability of repair level or discard alternatives at the module level; and, built-in-test (BIT) versus automated test equipmentl (ATE) tradeoffs can result in design optimization. LORAs conducted in this phase are usually detailed and consider both the economic and noneconomic factors of the repair level or discard alternatives.

(4) Production and deployment (P/D) phase. In the P/D phase, the design is fixed and there are limited opportunities for tradeoffs or further optimization of the design. A LORA may be applicable if unanticipated circumstances arise that require design changes be made to the system. A LORA may also be conducted for update purposes to adjust LORA decisions based on field experience or evaluations on ECPs and PIPs.

g. Previously performed analyses. Previously conducted analyses can impact tasks selection. These analyses include LORAs, LSA, and other related system engineering analyses; or, work already accomplished. The previous work should be assessed for accuracy, and reliability. If the documented results of the previous work is adequate, the analysis may only require updating as opposed to conducting a new analysis. Program documents may also prescribe objectives or constraints which tend to bound the scope of the LORA effort.

h. Procurement considerations. The requiring authority must specify which LORA tasks will be performed and who is responsible for performing each. Acquisition streamlining is encouraged by the prospective performing activities.

40.4 <u>Task data and documentation of data</u>. The data and documentation resulting from the LORA tasks contained in this standard serve the following purposes:

a. Provide an audit trail of analyses performed assumptions and decisions made affecting the supportability of a system.

b. Provide analysis results for input to follow-on analysis tasks later in the system life cycle.

c. Provide input into materiel acquisition program documents.

d. Help prevent duplication of analyses.

e. Provide valid data for use on future acquisition programs.

40.4.1 <u>Performing activity</u>. The individual analysis tasks performed as part of a system's LORA program may be performed in three ways. The first method is when the performing activity is contractually responsible for the complete

LORA program. This includes input data compilation, evaluation performance, and LORA report preparation. The second method involves a joint effort between the requiring authority and performing activity. In this method the performing activity is responsible for gathering and providing the input data, in the form of a LORA input data report (subtask 201.2.3). This is then used by the requiring authority to conduct LORA evaluations and prepare the LORA report. The third method is when the requiring authority is solely responsible for performing the complete LORA program. The method is chosen at the discretion of the requiring authority. Whatever method chosen, task documentation must be developed to the degree which will allow another activity to use the task results as input to perform other LORA tasks, or as input to conduct the same tasks to a more detailed level in a later acquisition phase. When certain tasks are performed by the requiring authority and others are performed by the performing activity, procedures must be established to provide for the data interchange between the performing activities. Therefore, tasks performed by the requiring authority should be documented equivalently to the applicable DID requirements to ensure compatibility of the documentation.

40.4.2 Identification of requirements. The LORA data and documentation required for delivery to the requiring authority will be specified on the CDRL, DD Form 1423. The CDRL identifies data, information, and documentation which the performing activity will be obligated to deliver under the contract. DIDs are used to define and describe that data required to be furnished by the performing activity. Applicable DIDs that describe the data resulting from performance of LORA tasks contained in this standard are identified in table A-I. These DIDs are structured to identify the maximum range of data which can be documented in a report. The requiring authority can tailor the DIDs by deleting unwanted requirements from Block 10 of the applicable DIDs. Block 16 of the CDRL will specify those requirements of the DIDs that have been deleted.

40.4.3 Cost considerations. The procurement of data and documentation must be carefully scoped to meet program objectives in a cost effective manner.

40.4.3.1 Factors affecting cost. The following factors may affect data and documentation costs:

a. Timing of preparation and delivery. Documentation or reordering of data should coincide with generation of such data in design and analysis sequence in order that such data, at a later date, will not have to be recreated at added expense. Delivery of data should be postponed until actual need date in order to acquire data in its most complete form without repetitive updates.

b. Special formatting requirements.

c. Degree of detailed required.

d. Degree of research required to obtain the data.

e. Accuracy and amount of verification required.

f. Duration of responsibility for data contents.

g. Availability and accuracy of source data from which to construct documentation.

40.4.3.2 Controlling costs. Data and data documentation costs can be effectively controlled by the following methods:

a. Screening requirements prior to preparation of solicitation documents. Each data requirement should be reviewed for data content, end use, formatting needs, scheduled delivery, and estimated cost to eliminate duplication and ensure proper integration/scheduling of requirements.

b. Involve potential bidders in briefings and planning conferences prior to release of a solicitation document. This helps ensure that data and data documentation requirements are realistic and that the maximum use is made of data already available.

50. DETAILED GUIDANCE ON TASK SECTIONS, TASKS, AND SUBTASKS

50.1 General. In the early acquisition phases the system's maintenance alternatives are initially being considered. Therefore, to influence design, the LORA tasks must be completed on time. This includes having available the most up to date documented results of the LORA tasks. Later, as the program progresses through the life cycle phases, and the system becomes better defined, the LORA tasks and associated documented results must be updated to reflect the current status of the system under analysis. This iterative process is continuously performed throughout the system's life cycle and applies to all tasks required to be performed during execution of the LORA program.

50.2 Task section 100 - program planning and control.

50.2.1 General considerations.

a. Program management. Good management of the LORA program requires: (1) planning which identifies all the necessary actions required for program success; (2) scheduling which identifies the timing of each required action and the responsible party for each action; and, (3) execution through timely management. Procedures must be established to ensure the right information is available at the scheduled time so that timely decisions can be made.

b. Timing. Scheduling task accomplishment is critical for the LORA program to achieve its objectives. The criteria that must be applied for proper scheduling of LORA actions is to assure that (1) all required actions are completed and data available when it is needed, and (2) only the required actions are done and only the required data is available to prevent wasting resources and time.

c. Program Execution. Proper program execution is achieved through continuous monitoring of the effort to identify problems as they occur, and having an established procedure to eliminate or minimize problems as they occur. Efficient program execution requires that working arrangements between the LORA program and other system engineering programs be established to identify mutual concerns, maximize the benefits of mutually supporting tasks, and minimize effort overlap.

50.2.2 Program strategy and plan (task 101). This task is the earliest planning activity for a LORA program and is the first step in developing an effective program. While task 101 is pertinent for concept exploration activity, it is also generally applicable prior to preparation of any solicitation documents containing LORA task requirements. The efficient scheduling of tasks and assignment of personnel to perform each task will assure proper execution of the LORA program. Therefore, the program strategy and plan for scheduling of tasks and personnel to perform the tasks must be coordinated with other related system engineering analyses, and with the agencies performing these analyses or similar studies to avoid duplication.

50.2.2.1 LORA program plan (subtask 101.2.5).

a. General. The LORA Program Plan is the basic tool for establishing and executing an effective LORA program. It should effectively document what LORA tasks are to be accomplished, when each task will be accomplished, what organizational units will be responsible for tasks accomplishment, and how the results of each task will be used. The LORA Program Plan is a stand alone document but can be included as part of the LSAP when an LSAP is required. Plans submitted in response to solicitation documents assist the requiring authority: (1) in evaluating the prospective performing activity's approach to performing LORA task(s); (2) in evaluating the performing activities' understanding of the LORA task(s) requirements and the overall process for performing LORA task(s); and, (3) the organizational structure for performing LORA tasks. The LORA Program Plan should be tailored to meet the specified goals of the system under analysis. In developing a tailored LORA Program Plan, time and resource constraints must be considered. However, when a LORA input data report is required, the tailored LORA Program Plan shall state explicitly: (1) what data is to be provided; (2) how data is to be provided (hardcopy, disks, etc.); (3) what items in the LORA candidates list data is to be provided on; (4) the LORA model specified in the contract to which the data will be formatted for; and, (5) when the data is to be provided.

b. Submission and Approval. The LORA Program Plan is generally submitted in response to a solicitation document and generally becomes a part of the SOW when approved by the requiring authority. When requiring a LORA Program Plan, the requiring authority should allow the performing activity to propose additional tasks or task modifications, with supporting rationale to show overall program benefits, to those tasks contained in the solicitation document. The LORA Program Plan should therefore reflect the current program status and planned actions. The LORA Program Plan must be reviewed and approved by the requiring authority and incorporated into the contract.

50.2.3 Program reviews (task 102). This task provides the opportunity for the performing activity and the requiring authority to review the progress of the LORA program and the results at scheduled intervals. Program review is an important management and technical tool of the requiring authority. Program reviews should be specified in SOW's to assure adequate staffing and funding and are typically held periodically during an acquisition program to evaluate overall program progress, consistency, and technical adequacy. If the performing activity conducts internal reviews with contractors, sub-contractors, vendors, or the requiring authority, then the documented results and minutes of these meeting are to be available to the requiring authority upon request.

50.2.3.1 LORA guidance conference (subtask 102.2.3). LORA program reviews should be conducted periodically as specified in the contract (generally semi-annually or quarterly). The initial LORA review should be conducted as a detailed guidance conference and held not later than 90 days after award of the contract. The purpose of this conference is to establish review procedures, provide guidance concerning analysis and data requirements, describe procedures for exchange of data between requiring authority and performing activity, and identify any problems. Subsequent LORA reviews should be conducted at appropriate intervals to ensure accomplishment of the LORA review objectives.

50.2.3.2 LORA review team agenda (subtask 102.2.5). The topics included in a LORA review will vary with the type of development effort, the life cycle phase, and the review technique. However, there are core topics that should be covered during a LORA review in order to ensure the maximum effectiveness of the LORA program. During the review the topics to be discussed include, but are not limited to:

a. Status of action items from previous meetings.

b. Contract modifications and other program issues impacting the LORA effort.

c. Status of the LORA program task and schedule.

d. Summary of LORA results and recommendations.

e. Issues, risks, and action items.

50.3 Task section 200 - data preparation and management.

50.3.1 Input data compilation (task 201). This task identifies the LORA input data which will be used in the LORA evaluations. The tedious task of data collection can be reduced by examining the data obtained from existing documents, comparative systems, historical data bases, and expert knowledge. When values are unobtainable, engineering estimates or calculated values should be used. However, caution should be exercised to ensure that data values are consistent and reliable. The most current data should be used. Elements related to cost must be expressed in the same base year dollars. This will ensure consistency and accuracy. A major key to having an effective LORA program is the use of the data available on similar systems to predict a maintenance concept for the system being analyzed. If design parameters are predicted, then current operational systems which are similar to the system being analyzed must be identified.

50.3.1.2 LORA input data for economic evaluations (subtask 201.2.1). This subtask identifies values corresponding to the data elements contained in appendix P. The values identified are used in the LORA economic and sensitivity evaluations. The algorithms contained in appendices D through O uses the identified data to establish a baseline maintenance concept. The data should be collected on all items listed in the LORA candidate list.

50.3.1.1 LORA input data for noneconomic evaluations (subtask 201.2.2). The data identified in this subtask are constraints, stipulations, special requirements, or other factors which restrict the maintenance concept, or limits the support alternatives available. The data is used to perform a LORA noneconomic analysis. Factors affecting the maintenance concept are listed in appendix Q and defined in appendix B. These factors will directly affect the repair decisions obtained, and should be used in conjunction with the LORA economic and sensitivity evaluations to establish an optimal maintenance concept.

50.3.1.3 LORA input data report (subtask 201.2.3). This subtask is generally invoked when another performing activity is responsible for conducting LORA evaluations described in task 301. LORA input data should be collected on all items in the LORA candidate list.

50.4 Task section 300 - evaluations.

50.4.1 General considerations.

50.4.1.1 Iterations. The subtasks contained in this section are iterative, performed in sequence, and are applicable in each phase of the life cycle. This process is performed to increasingly lower levels of indenture and detail.

50.4.1.2 Timing. The development of alternatives and evaluations should be conducted to a level consistent with the design and operational concept development. In the early phases of the life cycle, alternatives should only be developed to the level required to analyze differences and conduct tradeoffs. More detail can be developed after tradeoffs are made and the range of alternatives is narrowed. Analysis of support alternatives is an inherent feature of models used in the evaluation and tradeoff process.

50.4.2 Evaluation performance, assessment, and documentation (task 301). Optimum benefits are realized when LORA analyses are conducted considering cost, schedule, performance, and supportability before the system design is finalized. The magnitude, scope, and level of detail of the LORA will depend upon both the acquisition phase and the system complexity. As development of the system progresses and the input data become more reliable, LORAs are progressively updated.

a. LORA noneconomic evaluation (subtask 301.2.1). This subtask uses the data identified in subtask 201.2.2 to determine the maintenance levels affected or restricted. The subtask also determines if the support alternatives are limited and explains the rationale for the restrictions or limitations. A noneconomic analysis is included in appendix Q.

b. LORA economic/sensitivity evaluation. The economic analyses of the support alternatives identified are conducted to establish the maintenance concept which is most cost effective. These evaluations are conducted by analyzing different support alternative concepts relating to design, operation, and logistic support resource factors. Appendices D through O contain algorithms that are used to conduct LORA economic and sensitivity evaluations. The algorithms are used to establish a baseline maintenance concept and in performance of the sensitivity analysis. Sensitivity evaluations are conducted to assess the impact on the baseline maintenance concept. The results, including the rationale for selection and rejection of alternatives, assumptions, and risks involved should be documented for subsequent iterations.

c. LORA report (subtask 301.2.4). The LORA report should be periodically updated to reflect the current status of the program. The following list is to be used for guidance on submission of LORA reports. This list should be tailored to fit the goals and objectives of the specific program under analysis.

(1) The first DVAL LORA report is due before LSA task 401.

(2) The second DVAL LORA report is due after completion of Operational Test (OT) I, but before Defense System Acquisition Review Council design review and contract award.

(3) The first EMD LORA report is prepared after the update of the reliability FMECA.

(4) The second EMD LORA report is prepared after the OT II, but before the preparation of initial provision parts list and before the formal provisioning review.

(5) The final P/D LORA report is prepared after the final reliability FMECA is updated and before the performing activity submits a final provisioning parts list (PPL).

Fewer reports may be required when a program's acquisition strategy is shortened. LORA reports conducted on similar systems are analyzed in the conceptual phase. The LORA report includes summary of results of the LORA evaluations, assumptions made, conclusions, and recommendations.

50.5 Task section 400 - use and implementation.

50.5.1 Using results (task 401). This task provides for using results of the evaluations conducted during task 301. From the results of the analysis an optimal maintenance concept will be derived. The results should also be coordinated with other system engineering analyses. In early phases of the life cycle, the LORA results can be used to influence design and assist in development of the maintenance concept. The LORA results are also used to develop LSA related products specified in the contract. The results should also be used to make recommendations for further analyses and to update the LORA. When conducting a LORA on fielded systems, the LORA results should be used to assess the current maintenance concept and to recommend how it may be improved.

GLOSSARY

10. SCOPE. This appendix is to provide definitions of terms for clarity of understanding and completeness of information. As a general rule, the definitions provided are currently accepted and have been extracted verbatim from other directives (regulations, manuals, MIL-STD's, DOD Directives, etc.). This appendix is not a mandatory part of this standard.

20. APPLICABLE DOCUMENTS

20.1 Standards. The standards cited in 2.1 form a part of this appendix to the extent specified under 2.1.1.

20.1.2 Nongovernment publications. Nongovernment standards or other non-government publications do not form a part of this appendix.

30. DEFINITIONS

30.1 Acquisition phases. The acquisition includes the following four phases:

a. Concept and exploration phase. The acquisition period when the alternative solutions or solution concepts to satisfy a validated need are undergoing identification and exploration.

b. Demonstration and validation phase. The acquisition period when the selected candidate solutions are refined through extensive study and analyses; hardware development, if appropriate; test; and, evaluations.

c. Engineering and Manufacturing Development (EMD). The acquisition period when the system and the principal items necessary for its support are designed, fabricated, tested, and evaluated.

d. Production and deployment phase. The acquisition period from production approval until the last system is delivered and accepted.

30.2 Additional publication pages. Number of additional technical publication pages.

30.3 Automatic test equipment (ATE). TMDE which performs a predetermined program to test functional or static parameters for fault isolation of unit malfunctions, including Quality Assurance tests, to evaluate the degree of performance degradation. The decision making control, or evaluation functions are conducted with minimum reliance on human intervention.

30.4 Availability. A measure of system readiness, the degree to which an item is in an operable and committable state at the start of a mission when the mission is called for a random (unknown) time.

30.5 Built-in-test (BIT). A test approach using built-in-test equipment or other hardware and/or integrally designed into a unit under test (UUT) self-test to fault diagnose all or part of that UUT.

30.6 Built-in-test equipment (BITE). Any identifiable removable device which is part of UUT that is used for the express purpose of that UUT.

30.7 Calibration. The comparison of an instrument (measurement standard or item of test, measurement and diagnostic equipment) of unverified accuracy to detect and correct any discrepancy in the accuracy of the unverified instrument.

30.8 Component. A combination of parts mounted together in manufacture, which may be tested, removed, or replaced as a unit, or repaired (for example, starter, generator, fuel pump, and printed circuit board).

30.9 Computer resources. Facilities, hardware, software, and manpower needed to operate and support embedded and standalone computer systems, including post-deployment software support requirements.

30.10 Contractor. Any corporation, company, association, or individual which undertakes performance under the terms of a contract, letter contract, letter of intent or purchase order, project order, or allotment in which this document may be incorporated by reference. For the purpose of the use of this document, the term includes government operated activities undertaking performances under a project order or allotment with the exception of depot maintenance facilities.

30.11 Constraints. Restrictions or key boundary conditions that impact overall capability, priority, and resources in system acquisition.

30.12 Contract data requirements list (CDRL) DD Form 1423. A form used as the sole list of data and information which the contractor will be obligated to deliver under the contract, with the exception of that data specifically required by standard Defense Acquisition Regulation (DAR) clauses.

30.13 Corrective maintenance. All actions performed as a result of failure to restore an item to a specified condition. Corrective maintenance can include any or all of the following steps: Localization, isolation, disassembly, interchange, reassembly, alignment, and checkout.

30.14 Data item description (DID), DD Form 1664. A form used to define and describe the data required to be furnished by the contractor. Completed forms are provided to contractors in support of and, for identification of, each data item listed on the CDRL.

30.15 Depot maintenance. Maintenance performed on material requiring major overhaul or a complete rebuild of parts, assemblies, subassemblies, and end items, including the manufacture of parts, modifications, testing, and reclamation, as required. Depot maintenance serves to support lower categories of maintenance by providing technical assistance an performing the maintenance beyond their responsibility. Depot maintenance provides stocks of serviceable equipment by using more extensive facilities for repair than are available in lower level maintenance activities.

30.16 Discard. A unique maintenance action where no attempt is made to repair a failed item; that item is thrown away (discarded).

30.17 End item. A final combination of end products, component parts, and/or materials which is ready for its intended use; e.g., ship, tank, mobile machine shop, aircraft.

30.18 Engineering support cost. The cost associated with development of a unique repair cost.

30.19 Environment. The aggregate of all external and internal conditions (such as temperature, humidity, radiation, magnetic and electric fields, shock vibration, etc.) either natural or man made, or self-induced, that influences the form, performance, reliability, or survival of an item.

30.20 Facilities. The permanent or semipermanent real property assets specifically required to support the system. This includes facilities for: training and maintenance; storage of equipment, ammunition, mobile shops, POL, and classified material; contractor repair; troop housing, and special requirements (i.e., clean rooms, x-ray inspections, control of temperature and humidity, corrosion control, etc.)

30.21 Fixed cost. A cost independent of the number of repairs.

30.22 Indenture levels. The item levels which identify or describe relative complexity of assembly or function. The levels progress from the more complex (system) to the simpler (part) divisions.

30.23 Integrated logistic support (ILS). A disciplined approach to the activities necessary to: (a) cause support considerations to be integrated into system design; (b) develop support requirements that are consistently related to design and to each other; (c) acquire the required support; and, (d) provide the required support during the operational phase at minimum cost.

30.24 Line replaceable unit (LRU). A unit installed in an item of equipment or system which is replaceable in operational environment (that is, under field or combat conditions). An LRU may be a printed circuit board (PCB), black box, major component, alternator, carburetor, avionics, tank engine, road wheel assembly, installed weapons, etc. This repair by replacement is normally accomplished as far forward as possible by unit (ORG) maintenance personnel.

30.25 Logistic support analysis (LSA). The selective application of scientific and engineering efforts undertaken during the acquisition process, as part of the system engineering and design process, to assist in complying with supportability and other ILS objectives.

30.26 Logistic support analysis record (LSAR). The portion of LSA documentation consisting of detailed data pertaining to the identification of logistic support resource requirements of a system. See MIL-STD-1388-2 for LSAR data element definitions.

30.27 Maintainability. The measure of the ability of an item to be retained in or restored to specified condition when maintenance is performed by personnel having specified skill levels, using prescribed procedures and resources at each prescribed level of maintenance and repair.

30.28 Maintenance levels. The basic levels of maintenance into which all maintenance activity is divided. The scope of maintenance performed within each level must be commensurate with the personnel, equipment, technical data, and facilities provided.

30.29 Maintenance planning. The process conducted to evolve and establish maintenance concepts and requirements for a material system. One of the principal elements of ILS.

30.30 Manpower and personnel. The identification and acquisition of military and civilian personnel with skills and the grade required to operate and support a material system at peacetime and wartime rates.

30.31 Module. All assembly containing a complete self-contained circuit or subcircuit. It may consist of a single PCB, in which case, it is synonymous with a PCB or a module may be comprised of two or more PCBs mechanically attached to one another and removable from the next high assembly as a single unit.

30.32 Operational scenario. An outline projecting a course of action under representative operational conditions for an operational system.

30.33 Optimization models. Models which accurately describe a given system and which can be used, to determine the most efficient and/or most cost effective operation of the system being modeled.

30.34 Overhaul (engines, accessories, equipment). The disassembly of an engine, accessory, or equipage as required to permit inspection of every component part. Component parts that upon inspection will not meet requirements as set forth in applicable specifications are restored or replaced by new parts so that after reassembly and test the engine, accessory, or equipage will meet the requirements, as stated above, set forth in the applicable specifications.

30.35 Packaging, handling, and storage. The resources, techniques, and methods required for preserving, loading and unloading, and storing material systems, their associated support equipment, basic sustaining material (BSM) (i.e., ammunition, batteries, petroleum, oils, and lubricants (POL)), and associated supplies of all classes. This includes the procedures, environmental considerations, and preservation equipment requirements for both short and long term storage.

30.36 Part. An item which cannot be normally be disassembled or repaired, or is of such a design that disassembly or repair is impractical (bracket, gear, resistor, toggle switch).

30.37 Performing activity. The activity (government, contractor, subcontractor, or vendor) which is responsible for performance of LORA tasks as specified in a contract or other formal document of agreement.

30.38 Policy. Military standards, handbooks, bulletins, specifications, regulations, and/or other government publications/documents which prevent/restrict the maintenance level(s) at which repair/discard actions can be performed.

30.39 Printed circuit board (PCB). Consists of printed or etched lines (conductors) to which discrete components, LRUs and/or parts are affixed to form an electric circuit.

30.40 Readiness/mission success. Top level or operational constraints which delineate operational availability and system readiness guidelines for a given system.

30.41 Reliability. (1) The duration or probability of failure-free performance under stated conditions. (2) The probability that an item can perform its intended function for a specified interval under stated conditions. (For nonredundant items, this is equivalent to definition (1). For redundant items, this is equivalent to mission reliability.)

30.42 Requiring authority. The activity (government, contractor, or subcontractor) which levies LORA tasks performance requirements or another activity (performing activity) through a contract or other formal document or agreement.

30.43 Repairable item. An item which can be restored to perform all of its required functions by corrective maintenance.

30.44 Safety. The freedom from or protection against hazardous conditions which have the potential to cause injury, illness, or death to personnel and damage to and/or loss of equipment/property.

30.45 Screening. A process for inspecting items to remove those that are unsatisfactory or those likely to exhibit early failure. Inspection includes visual examination, physical dimension measurement and functional performance measurement under specific environmental conditions.

30.46 Security. Measures adopted/taken to guarantee secure actions, communications, documentation control, and/or technologies. This includes requirements for repair at secure facilities, security clearance of personnel, and storage and transportation of classified material which might affect/restrict the maintenance level(s) where repair/discard can be accomplished.

30.47 Sensitivity analysis. A sensitivity analysis is a means of varying some data elements, in the LORA analysis, to see their effect on the calculated logistic support costs and corresponding LORA recommendations.

30.48 Shop replaceable unit (SRU). A unit installed in an item of equipment or system which is replaceable only in a repair facility (shop environment) designated in the applicable maintenance allocation chart.

30.49 Source, maintenance and recoverability (SMR) codes. Uniform codes assigned to all support items early in the acquisition cycle to convey maintenance and supply instructions to the various support levels and using commands. They are assigned based on the logistic support planned for the end item and its LRUs/components. The uniform code format is composed of three, two character parts; source codes, maintenance codes, and recoverability codes in that order.

30.50 Spares. The support items that are an integral part of the end item or system which are coded as reparable.

30.51 Support equipment. All equipment (mobile or fixed) required to support the operation and maintenance of a system. This includes: associated multi-use end items; ground handling and maintenance equipment; and tools.

30.52 Test, measurement, and diagnostic equipment. A system or device which can be used to evaluate the operational condition of a system/component and identify/isolate any actual/potential malfunction (i.e., diagnostic and prognostic equipment, test equipment (semi-automatic, automatic or special), and calibration equipment). These items can be identified as a separate end item or contained within a system.

30.53 Test program set. The package which enables a line or shop replaceable unit, PCB, or similar item(s) to be diagnosed using automatic test equipment. The package includes appropriate interconnect devices, automated load module tapes, equipment publications, and other necessary articles which allow the ATE operator to perform a diagnostics/screening quality assurance function.

30.54 Training. The processes, procedures, and techniques use to train personnel to operate and support a material system.

30.55 Transportation factors. Factors such as weight, size, or special handling requirements which might preclude the transfer of certain systems from the user to the maintenance activities for repair. Susceptibility to damage, which cannot be suitably controlled by packaging requirements, may affect transportation requirements.

30.56 Transportation and transportability. The requirements, specifications, design considerations, and demonstrations that ensure items are transportable in available or projected military transport assets, both intratheater. This provides for efficient use of air, land, and water transport assets.

30.57 Warranty. An official right provided by a system developer which guarantees the proper performance of a specified product for a given period of time.

ACRONYMS

ADT	Assured Depot Task
AIT	Assured Intermediate Task
AMC	Army Material Command
AMSDL	Acquisition Management Systems and Data Requirements Control List
Ao	Operational Availability
APL	Allowance Parts List
AQ	Attrition Quantity
AR	Army Regulation
ASL	Authorized Stockage List
ASO	Aviation Supply Office
ATE	Automatic/Automated Test Equipment
BCM	Beyond Capability of Maintenance
BCS	Baseline Comparison System
BIT	Built-In-Test
BITE	Built-In-Test Equipment
BSM	Basic Sustainment Material
CCA	Circuit Card Assembly
CDRL	Contract Data Requirements List
CE	Concept and Exploration
CER	Complete Engine Repair
CIRF	Centralized Intermediate Repair Facility
CONUS	Continental U. S.
CV	Aircraft Carrier
DAR	Defense Acquisition Regulation
DED	Data Element Definition

DID	Data Item Description
DOD	Department of Defense
DODISS	Department of Defense Index of Specifications and Standards
DS	Direct Support
DVAL	DEVAL Demonstration and Validation
EC	Essentiality Code
EM	Engine Module
EMD	Engineering and Manufacturing Development (EMD)
FAA	Federal Aviation Administration
FLSIP COSAL	Fleet Logistic Support Improvement Program Coordinated Shipboard Allowance List
FMECA	Failure Mode, Effect and Criticality Analysis
GS	General Support
GTE	Gas Turbine Engine
HC	Holding Cost
IAW	In Accordance With
IBM	International Business Machines
IC	Item Condemnation
ILS	Integrated Logistic Support
ILSMT	Integrated Logistic Support Management Team
IMA	Intermediate Maintenance Activity
IRLA	Item Level Repair Analysis
JSLORA-WG	Joint Service Level of Repair Analysis-Working Group
LB	Land-Based
LCC	Life Cycle Cost
LCN	Level of Repair
LORA	Level of Repair Analysis

LORAPP	Level of Repair Analysis Program Plan
LRU	Line Replaceable Unit
LSA	Logistic Support Analysis
LSAP	Logistic Support Analysis Plan
LSAR	Logistic Support Analysis Record
3M	Maintenance and Material Management
MAC	Maintenance Allocation Chart
MAV	Maintenance Allocation Vector
MCAS	Marine Corps Air Station
MCC	Mission Criticality Code
MCO	Maintenance Criticality Oriented
MOD	Model
MPPT	Maximum Permissible Percentage Time
MTBCT	Mean Time Between Critical Task
MTBF	Mean Time Between Failure
MTTR	Mean Time To Repair
NAS	National Aerospace System
NAS	Naval Air Station
NASLORA	National Aerospace System Level of Repair Analysis
NDI	Nondevelopmental Item
NHA	Next Higher Assembly
NRLA	Network Repair Level Analysis
NSN	National Stock Number
ORG	Organization
OST	Order Ship Time
PCS	Permanent Change of Station
P/D	Production and Deployment

PIMA	Prime Intermediate Maintenance Activity
PIP	Product Improvement Plan
POL	Petroleum, Oils and Lubricants
PSE	Peculiar Support Equipment
PSSE	Peculiar Support of Support Equipment
PVF	Present Value Factor
QCT	Questionable Corrective Task
QTY/EI	Quantity per End Item
RAM	Reliability, Availability, Maintainability
RAQ	Raw Attrition Quantity
RFP	Request for Proposal
RFI	Ready for Issue
RLA	Repair Level Analysis
ROC	Required Operational Capability
RP	Rotatable Pool
RRPQ	Raw Rotatable Pool Quantity
RSC	Retail Stockage Criteria
S&TE	Support and Test Equipment
SEM	Sub-Engine Module
SE	Support Equipment
SIP	Standard Initial Provisioning
SMR	Source, Maintenance and Recoverability
SOW	Statement of Work
SRA	Shop Replaceable Assembly
SRU	Shop Replaceable Unit
SSA	Supply Support Activity
SSEM	Sub-Sub-Engine Module

SSRA	Sub Shop Replaceable Assembly
SSSEM	Sub-Sub-Sub-Engine Module
TM	Technical Manuals
TMDE	Test Measurement and Diagnostic Equipment
TPS	Test Program Set
TOR	Tentative Operational Requirements
UICP	Uniform Inventory Control Program
UUT	Unit Under Test
WRA	Weapon Replaceable Assembly

NAVAIR METHOD 1

AVIONICS, MODEL III

10. SCOPE

10.1 Purpose. This appendix specifies the algorithms for performing LORA for avionic, electrical and mechanical systems or equipment under the cognizance of the Naval Air Systems Command. The model estimates the most economical level of repair by comparing the life cycle costs of several repair scenarios.

10.2 General. This economic LORA technique allocates costs to six major categories: (1) inventory, including inventory administration, rotatable pool, attrition, system stock levels, repair material, scrap material, and transportation; (2) support equipment, including hardware, software, and support of SE costs; (3) space required for inventory storage, repair work, and support equipment; (4) labor; (5) training; (6) documentation.

20. APPLICABLE DOCUMENTS

20.1 Requiring documents.

20.1.1 OPNAVINST 5000.49A (integrated logistic support).

20.1.2 NAVAIRINST 4140.3 (level of repair analysis for NAVAIR material).

20.2 User's instruction and guidance.

20.2.1 Mod II/III LORA user's guide.

20.2.2 LORA default data guide.

20.2.3 Mod II/III student lesson guide.

20.3 Software.

20.3.1 MICROLORA PLUS, (PC version).

20.3.2 Mod III, Release 3, (Mainframe version).

30. DEFINITIONS

30.1 Equipment indenture levels. The equipment under analysis may be broken into three indenture levels, Weapon Replaceable Assembly (WRA), Shop Replaceable Assembly (SRA), and Sub Shop Replaceable Assembly (SSRA). LORA recommendations are made for these items based on each items' characteristics, operating location, resources and the relationship of an item to its next higher assembly.

30.2 LORA code assignments. Each item in the analysis may be assigned one of four codes: (1) I (Intermediate Maintenance Activity, afloat or ashore, repair; (2) P (Primary IMA repair); (3) D (Depot repair); or (4) X (Discard).

30.3 Repair definition. Repair of an item is defined as removal and replacement of a failed lower indenture assembly. This includes the resources required to verify the failure, fault isolate to the item, replacement of the lower level item and check and test of the system.

30.3.1 Intermediate repair. Failure removed at an operational site, either afloat or ashore, are repaired at the IMA at the site.

30.3.2 Prime intermediate repair. Failures removed at operational sites are sent to PIMA's for repair. The PIMA may also have operating aircraft.

30.3.3 Depot repair. Failures removed at operational sites are sent to a depot site for repair.

30.4 Discard definition. All verified failures of the item, along with all of its lower level items, are discarded at the appropriate site. The discard action includes the resources required to verify the failure and check & test the replaced item.

30.5 BCM actions (beyond capability of maintenance). Items that are assigned for repair at an IMA or PIMA, but for one reason or another, cannot be repaired at the operating site and must be sent to the PIMA or Depot for the repair.

30.6 Equipment failures occurring at IMA sites. Items that are BCM at an afloat or ashore IMA site are sent to the designated next higher assembly, either a PIMA or Depot.

30.7 Equipment failures occurring at PIMA sites. Items that are BCM at a PIMA site are sent to the designated Depot for repair.

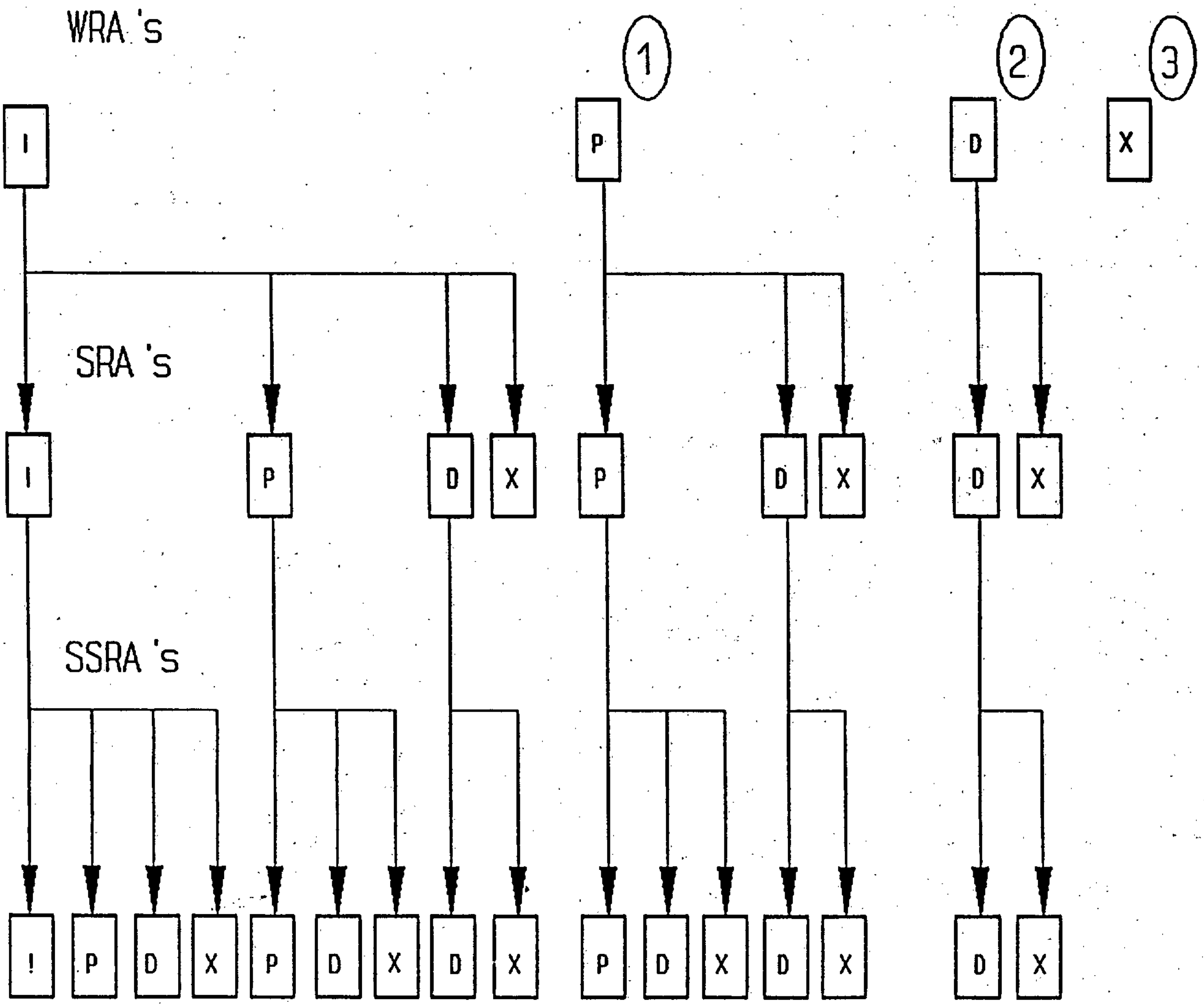
30.8 LORA technique assumptions.

30.8.1 PIMA definition. A PIMA site is a NAS with additional capability for repair of items that are BCM from other operational sites. The PIMA is an IMA that supports local operating aircraft and as a site that BCM items are sent to. The total logistics support cost for performing maintenance on an item at a PIMA is the sum of the costs associated with both the IMA and the PIMA.

30.8.2 Maintenance alternatives. Maintenance alternatives are the various LORA code assignments made by the model for all of the items in the analysis. There are six standard maintenance alternatives plus the optimized or least cost alternative. User specified alternatives can also be analyzed by the model. For a description of how the model determines LORA code assignments, see figure D-1.

30.8.3 Required parameters. Thirteen parameters are utilized within the cost elements equations: (1) discount factors; (2) annual number of items for disposition at a site; (3) annual number of real failures removed at a site; (4) annual number of real failures sent from a site; (5) annual number of items sent from a site; (6) annual number of real failures received by a site; (7) annual number of items received by a site; (8) annual number of items sent from all CV's to a PIMA; (9) annual number of items sent from all NAS's to a PIMA; (10) annual number of items sent from all CV's to a Depot; (11) annual number of items sent from all NAS's to a depot; (12) annual number of items sent from all PIMA's to a depot; (13) annual number of repairs of an item at site.

30.8.4 Discount factors. Discount factors are computed using the discount rate. Discount rate accounts for the time value of money and determines the actual present value of a cost element for the purpose of evaluating different payment schedules. Three discount factors are calculated: (1) the normal discount factor, used with equal payment series starting one year after the life cycle begins and ending one year before the life cycle ends; (2) the present discount factor, used for equal payment series starting at the present and ending on year before the life cycle ends; (3) the reduced discount factor used with equal payment series starting two years hence and terminating at the end of the life cycle.



LORA CODE ASSIGNMENTS

I - IMA REPAIR D - DEPOT REPAIR

P - PIMA REPAIR X - DISCARD

FIGURE D-1. Maintenance alternatives.

Description of LORA Code Assignment Procedure for Selecting Maintenance Alternatives

When the model is making LORA code assignments there are a couple of assumptions the model makes to simplify the process. The first is that the LORA code assigned to an item is independent of the particular lower level part that caused the failure. For example, it is possible a WRA containing two SRA's to have two different LORA codes, it could be discarded if the failure was caused by the first SRA and could be locally repaired if the failure was caused by the second SRA, however the model assigns just one LORA recommendation that is based on the cost, failure characteristics and deployment of the item and not its lower level assemblies.

The second assumption that affects the assignment of LORA codes is the restriction of the flow of repairables. A repairable can only be shipped from lower level to higher level maintenance activities. This prevents an operating site from shipping a WRA to a Depot that removes a SRA and sends it to a PIMA for repair.

While the LORA decision of a lower level item does not effect the decision of a higher level item, the opposite is not true. Because items can only be moved from lower to higher site types and because the model considers WRA's first then SRA's and finally SSRA's, higher level items effect the repair decisions available to the lower items as shown on the previous page. This figure illustrates the importance of telling the model exactly how each item is related to the others.

At marker 1, if the WRA LORA code is P, then its component SRA's are limited to P, D, or X codes. If the WRA LORA code is D (Marker 2) then its component SRA's are limited to D or X codes. This maintenance alternative is often called the "O to D Alternative". Marker 3 shows the WRA LORA code X, which prevents further consideration of the lower level assemblies since all component assemblies are discarded with the WRA.

Logistic support costs calculated for each LORA code assignment differ from one case to another. The logistic support costs will be significantly different if both the SRA and its WRA are locally repaired, than when they are repaired at the Depot. Different costs will result for the other LORA cases.

40. GENERAL REQUIREMENTS

40.1 Algorithms calculated by year.

40.1.1 Normal discount factor. For expenditures occurring as equal payment series starting one year hence and terminating at the end of the life cycle.

$$\left(\begin{matrix}\textit{Normal}\\ \textit{Discount}\\ \textit{Factor}\end{matrix}\right) = \left[\frac{(1.0 + \textit{Discount Rate})^{\left(\begin{matrix}\text{Number of}\\ \text{Years per}\\ \text{Life Cycle}\end{matrix}\right)} - 1.0}{\textit{Discount Rate}\ (1.0 + \textit{Discount Rate})^{\left(\begin{matrix}\text{Number of}\\ \text{Years per}\\ \text{Life Cycle}\end{matrix}\right)}}\right]$$

40.1.2 Present discount factor. For expenditures occurring as equal payment series starting at the present and terminating one year prior to the end of the life cycle.

$$\left(\begin{matrix}\textit{Present}\\ \textit{Discount}\\ \textit{Factor}\end{matrix}\right) = \left[\frac{1.0 + \textit{Discount Rate}^{\left(\begin{matrix}\text{Number of}\\ \text{Years per}\\ \text{Life Cycle}\end{matrix}\right)} - 1.0}{\textit{Discount Rate}\ (1.0 + \textit{Discount Rate})^{\left[\left(\begin{matrix}\text{Number of}\\ \text{Years per}\\ \text{Life Cycle}\end{matrix}\right) - 1.0\right]}}\right]$$

40.1.3 Reduced discount factor. For expenditures occurring as equal payment series starting two years hence and terminating at the end of the life cycle.

$$\left(\begin{matrix}\textit{Reduced}\\ \textit{Discount}\\ \textit{Factor}\end{matrix}\right) = \left[\frac{1.0 + \textit{Discount Rate}^{\left[\left(\begin{matrix}\text{Number of}\\ \text{Years per}\\ \text{Life Cycle}\end{matrix}\right) - 1.0\right]} - 1.0}{\textit{Discount Rate}\ (1.0 + \textit{Discount Rate})^{\left(\begin{matrix}\text{Number of}\\ \text{Years per}\\ \text{Life Cycle}\end{matrix}\right)}}\right]$$

40.1.4 Annual number of items for disposition at a site. The total annual number of removals, including real failures, false removals and less the annual number of detected false removals at each site.

$$\left(\begin{matrix}\textit{Annual Number}\\ \textit{of Items for}\\ \textit{Disposition at}\\ \textit{the a'th Site}\end{matrix}\right)^{t} = \left[\left(\begin{matrix}\textit{Annual Number}\\ \textit{of Real Failures}\\ \textit{Removed at}\\ \textit{the a'th Site}\end{matrix}\right)^{t} + \left(\begin{matrix}\textit{Annual Number}\\ \textit{of Real Failures}\\ \textit{Removed at}\\ \textit{the a'th Site}\end{matrix}\right)\left(\begin{matrix}\textit{Fraction of}\\ \textit{Items Falsely}\\ \textit{Removed}\end{matrix}\right)\right] - \left[\left(\begin{matrix}\textit{Annual Number}\\ \textit{of Real Failures}\\ \textit{Removed at the}\\ \textit{a'th Site}\end{matrix}\right)^{t}\left(\begin{matrix}\textit{Fraction of}\\ \textit{Items Falsely}\\ \textit{Removed}\end{matrix}\right)\left(\begin{matrix}\textit{Fraction of}\\ \textit{False Removals}\\ \textit{Detected as Such}\end{matrix}\right)\right]$$

t = indicates parameters whose values change with the LORA case under consideration

a = the a'th site (either CV, NAS, PIMA, or Depot)

40.1.5 Annual number of real failures removed at a site. The annual number of failed items removed from their next higher assembly at the site. For IMA sites, removals refer to the failed items from the locally operating aircraft. For PIMA and Depot sites, removals of the item are from higher indenture assemblies that were BCM from the sites with operating aircraft and forwarded to the higher level maintenance facility. For computational purposes, it is convenient to consider the PIMA as two separate sites: as an IMA for those items originating from its operating aircraft, and as a PIMA for those BCM items forwarded to it from other sites.

$$\begin{pmatrix}\text{Annual Number *}\\ \text{of Real Failures}\\ \text{Removed at the}\\ \text{a'th Site}\end{pmatrix}^{t} = \left[\frac{\begin{pmatrix}\text{Annual Number of **}\\ \text{Repairs to the Next}\\ \text{Higher Assembly}\\ \text{at the a'th site}\end{pmatrix}^{t}\begin{pmatrix}\text{Predicted Mean}\\ \text{Time Between}\\ \text{Failures of the Next}\\ \text{Higher Assembly}\end{pmatrix}\begin{pmatrix}\text{Number of}\\ \text{Identical Items}\\ \text{per Avionic System}\end{pmatrix}\begin{pmatrix}\text{Item Ratio of}\\ \text{Operating Hours}\\ \text{to Flight Hours}\end{pmatrix}}{\begin{pmatrix}\text{Predicted Mean}\\ \text{Time Between}\\ \text{Failures of the Item}\end{pmatrix}\begin{pmatrix}\text{Number of}\\ \text{Identical Next}\\ \text{Higher Assemblies}\\ \text{per Avionic System}\end{pmatrix}\begin{pmatrix}\text{Ratio of Operating}\\ \text{Hours to Flight Hours}\\ \text{to the Next}\\ \text{Higher Assembly}\end{pmatrix}}\right]$$

** = This equation refers to the SRA or SSRA as applicable to the indenture level under consideration. The corresponding WRA equation is shown later.*

*** = This term refers to repairs from failures orginating at the site if the a'th site is an IMA and to repairs from failures orignating at lower level maintenance facilities if the a'th site is a PIMA or Depot.*

$$\begin{pmatrix}\text{Annual Number **}\\ \text{of Real Failures}\\ \text{Removed at}\\ \text{the a'th Site}\end{pmatrix}^{t} = \left[\frac{\begin{pmatrix}\text{Number of}\\ \text{Identical}\\ \text{WRA's per}\\ \text{Avionic System}\end{pmatrix}\begin{pmatrix}\text{WRA Ratio}\\ \text{of Operating}\\ \text{Hours to}\\ \text{Flight Hours}\end{pmatrix}\begin{pmatrix}\text{12 Months}\\ \text{per}\\ \text{Year}\end{pmatrix}\sum_{b=1}^{c}\left[\begin{pmatrix}\text{Monthly}\\ \text{Flight Hour}\\ \text{Program}\\ \text{at a'th Site}\end{pmatrix}_{b}\begin{pmatrix}\text{Number of}\\ \text{Aircraft at}\\ \text{a'th Site}\end{pmatrix}_{b}\begin{pmatrix}\text{Aircraft Type}\\ \text{Deployment}\\ \text{Factor for}\\ \text{the a'th Site}\end{pmatrix}_{b}\right]}{\begin{pmatrix}\text{Predicted Mean}\\ \text{Time Between}\\ \text{Failures of the Item}\end{pmatrix}\begin{pmatrix}\text{Degradation}\\ \text{Factor}\end{pmatrix}}\right]$$

*** = This equation refers to the WRA's that are always removed at the operating sites.*

b = b/th aircraft type

c = number of different aircraft types

40.1.6 Annual number of real failures sent from a site. The annual number of failures of an item that are BCM at the site and sent to a higher level maintenance facility for repair. Two parameters are defined to account for real failures sent from IMA's and PIMA's.

40.1.6.1 Annual number of real failures sent from an IMA.

$$\begin{pmatrix}\text{Annual Number of}\\ \text{Real Failures Sent}\\ \text{from the d'th IMA}\end{pmatrix}^t = \left[\sum_{e=1}^{f}\begin{pmatrix}\text{Annual Number of Real}\\ \text{Failures Sent from the}\\ \text{d'th IMA to the e'th PIMA}\end{pmatrix}_e^t + \sum_{g=1}^{h}\begin{pmatrix}\text{Annual Number of Real}\\ \text{Failures Sent from the}\\ \text{d'th IMA to the g'th Depot}\end{pmatrix}_g^t\right]$$

WHERE :

$$\begin{pmatrix}\text{Annual Number of Real}\\ \text{Failures Sent from the}\\ \text{d'th IMA to the e'th PIMA}\end{pmatrix}^t = \left[\begin{pmatrix}\text{Annual Number of Real}\\ \text{Failures Removed at}\\ \text{the d'th IMA}\end{pmatrix}^t \begin{pmatrix}\text{BCM Rate of the}\\ \text{Item at the IMA}\end{pmatrix}\begin{pmatrix}\text{Fraction of BCM Items}\\ \text{that are Forwarded}\\ \text{to the e'th PIMA}\end{pmatrix}\right]$$

$$\begin{pmatrix}\text{Annual Number of Real}\\ \text{Failures Sent from the}\\ \text{d'th IMA to the g'th Depot}\end{pmatrix}^t = \left[\begin{pmatrix}\text{Annual Number of Real}\\ \text{Failures Removed at}\\ \text{the d'th IMA}\end{pmatrix}^t \begin{pmatrix}\text{BCM Rate of the}\\ \text{Item at the IMA}\end{pmatrix}\begin{pmatrix}\text{Fraction of BCM Items}\\ \text{that are Forwarded}\\ \text{to the g'th Depot}\end{pmatrix}\right]$$

d = d'th IMA
e = e'th PIMA
f = the total number of PIMA's
g = g'th depot
h = the total number of depots

40.1.6.2 Annual Number of Real Failures Sent from a PIMA.

$$\begin{pmatrix}\text{Annual Number of}\\ \text{Real Failures Sent}\\ \text{From the e'th PIMA}\end{pmatrix}^t = \sum_{g=1}^{h}\left[\begin{pmatrix}\text{Annual Number of}\\ \text{Real Failures Sent}\\ \text{from the e'th PIMA}\\ \text{to the g'th Depot}\end{pmatrix}\right]_g^t$$

WHERE :

$$\begin{pmatrix}\text{Annual Number of}\\ \text{Real Failures Sent}\\ \text{From the e'th PIMA}\\ \text{to the g'th Depot}\end{pmatrix}^t = \left[\begin{pmatrix}\text{Annual Number}\\ \text{of Real Failures}\\ \text{Removed at}\\ \text{the e'th PIMA}\end{pmatrix}^t + \begin{pmatrix}\text{Annual Number}\\ \text{of Real Failures}\\ \text{Received by}\\ \text{the e'th PIMA}\end{pmatrix}^t\right]\begin{pmatrix}\text{BCM Rate of the}\\ \text{Item at the PIMA}\end{pmatrix}\begin{pmatrix}\text{Fraction of BCM Items}\\ \text{that are Forwarded}\\ \text{to the g'th Depot}\end{pmatrix}$$

40.1.7 Annual number of items sent from a site. The annual number of items that are coded for repair at the site but are BCM and sent off-base for repair or the annual number of suspected failures of an item at site where off-base repair is indicated by the LORA code. Two parameters are defined to account for items sent from IMA's and from PIMA's.

40.1.7.1 Annual number of items sent from an IMA.

$$\begin{pmatrix}\text{Annual Number of}\\ \text{Items Sent from}\\ \text{the } d'\text{th IMA}\end{pmatrix}^t = \left[\sum_{e=1}^{f}\begin{pmatrix}\text{Annual Number}\\ \text{of Items Sent}\\ \text{from the } d'\text{th IMA}\\ \text{to the } e'\text{th PIMA}\end{pmatrix}_e^t + \sum_{g=1}^{h}\begin{pmatrix}\text{Annual Number}\\ \text{of Items Sent}\\ \text{from the } d'\text{th IMA}\\ \text{to the } g'\text{th Depot}\end{pmatrix}_g^t\right]$$

WHERE :

$$\begin{pmatrix}\text{Annual Number}\\ \text{of Items Sent}\\ \text{from the } d'\text{th IMA}\\ \text{to the } e'\text{th PIMA}\end{pmatrix}^t = \left[\begin{pmatrix}\text{Annual Number}\\ \text{of Items for}\\ \text{Disposition}\\ \text{at the } d'\text{th IMA}\end{pmatrix}^t \begin{pmatrix}\text{BCM Rate of the}\\ \text{Item at the IMA}\end{pmatrix}\begin{pmatrix}\text{Fraction of BCM Items}\\ \text{that are Forwarded}\\ \text{to the } e'\text{th PIMA}\end{pmatrix}\right]$$

$$\begin{pmatrix}\text{Annual Number}\\ \text{of Items Sent}\\ \text{from the } d'\text{th IMA}\\ \text{to the } g'\text{th Depot}\end{pmatrix}^t = \left[\begin{pmatrix}\text{Annual Number}\\ \text{of Items for}\\ \text{Disposition}\\ \text{at the } d'\text{th IMA}\end{pmatrix}^t \begin{pmatrix}\text{BCM Rate of the}\\ \text{Item at the IMA}\end{pmatrix}\begin{pmatrix}\text{Fraction of BCM Items}\\ \text{that are Forwarded}\\ \text{to the } g'\text{th Depot}\end{pmatrix}\right]$$

40.1.7.2 Annual number of items sent from a PIMA.

$$\begin{pmatrix}\text{Annual Number of}\\ \text{Items Sent from}\\ \text{the } e'\text{th PIMA}\end{pmatrix}^t = \left[\sum_{g=1}^{h}\begin{pmatrix}\text{Annual Number}\\ \text{of Items Sent}\\ \text{from the } e'\text{th PIMA}\\ \text{to the } g'\text{th Depot}\end{pmatrix}_g^t\right]$$

WHERE:

$$\begin{pmatrix}\text{Annual Number}\\ \text{of Items Sent}\\ \text{from the } e'\text{th PIMA}\\ \text{to the } g'\text{th Depot}\end{pmatrix}^t = \left[\begin{pmatrix}\text{Annual Number}\\ \text{of Items for}\\ \text{Disposition}\\ \text{at the } e'\text{th PIMA}\end{pmatrix}^t \begin{pmatrix}\text{BCM Rate of the}\\ \text{Item at the PIMA}\end{pmatrix}\begin{pmatrix}\text{Fraction of BCM Items}\\ \text{that are Forwarded}\\ \text{to the } g'\text{th Depot}\end{pmatrix}\right]$$

40.1.8 Annual number of real failures received by a site. The annual number of failures of an item that are BCM at lower level maintenance facilities and forwarded to the site for repair. Two parameters are defined to account for real failures received by a site: PIMA's receive failures from IMA's while Depots receive failures for IMA's and PIMA's.

40.1.8.1 Annual number of real failures received by a PIMA.

$$\begin{pmatrix}\text{Annual Number of}\\ \text{Real Failures Received}\\ \text{by the } e'\text{th PIMA}\end{pmatrix}^t = \left[\sum_{d=1}^{j}\begin{pmatrix}\text{Annual Number of Real}\\ \text{Failures Sent from the}\\ d'\text{th IMA to the } e'\text{th PIMA}\end{pmatrix}_d^t\right]$$

j = total number of IMA's

40.1.8.2 Annual number of real failures received by a depot.

$$\begin{pmatrix}\text{Annual Number of}\\ \text{Real Failures Received}\\ \text{by the } g'\text{th Depot}\end{pmatrix}^t = \left[\sum_{d=1}^{J}\begin{pmatrix}\text{Annual Number of Real}\\ \text{Failures Sent from the}\\ d'\text{th IMA to the } g'\text{th Depot}\end{pmatrix}_d^t + \sum_{e=1}^{E}\begin{pmatrix}\text{Annual Number of Real}\\ \text{Failures Sent from the}\\ e'\text{th PIMA to the } g'\text{th Depot}\end{pmatrix}_e^t\right]$$

40.1.9 Annual number of items received by a site. The annual number of BCM items or suspected failures sent to the higher level maintenance facility. Two parameters are defined to account for items received by PIMA's and Depot's.

40.1.9.1 Annual number of items received by a PIMA.

$$\begin{pmatrix}\text{Annual Number of}\\ \text{Items Received}\\ \text{by the } e'\text{th PIMA}\end{pmatrix}^t = \left[\sum_{d=1}^{J}\begin{pmatrix}\text{Annual Number}\\ \text{of Items Sent}\\ \text{from the } d'\text{th IMA}\\ \text{to the } e'\text{th PIMA}\end{pmatrix}_d^t\right]$$

40.1.9.2 Annual number of items received by a depot.

$$\begin{pmatrix}\text{Annual Number of}\\ \text{Items Received}\\ \text{by the } g'\text{th Depot}\end{pmatrix}^t = \left[\sum_{d=1}^{J}\begin{pmatrix}\text{Annual Number}\\ \text{of Items Sent}\\ \text{from the } d'\text{th IMA}\\ \text{to the } g'\text{th Depot}\end{pmatrix}_d^t + \sum_{e=1}^{E}\begin{pmatrix}\text{Annual Number}\\ \text{of Items Sent}\\ \text{from the } d'\text{th IMA}\\ \text{to the } g'\text{th Depot}\end{pmatrix}_e^t\right]$$

40.1.9.3 Annual number of items sent from all CV's to a PIMA.

$$\begin{pmatrix}\text{Annual Number}\\ \text{of Items Sent}\\ \text{from all CV's}\\ \text{to the } e'\text{th PIMA}\end{pmatrix}^t = \left[\sum_{k=1}^{L}\begin{pmatrix}\text{Annual Number}\\ \text{of Items Sent}\\ \text{from the } k'\text{th CV}\\ \text{to the } e'\text{th PIMA}\end{pmatrix}_k^t\right]$$

$k = k'\text{th CV}$

$L = \text{the total number of CV's}$

40.1.9.4 Annual number of items sent from all NAS's to a PIMA.

$$\begin{pmatrix}\text{Annual Number}\\ \text{of Items Sent}\\ \text{from all NAS's}\\ \text{to the e'th PIMA}\end{pmatrix}^t = \left[\sum_{m=1}^{n}\begin{pmatrix}\text{Annual Number}\\ \text{of Items Sent}\\ \text{from the m'th NAS}\\ \text{to the e'th PIMA}\end{pmatrix}^t_m\right]$$

m = m'th NAS

n = the total number of NAS's

40.1.9.5 Annual number of items sent from all CV's to a depot.

$$\begin{pmatrix}\text{Annual Number}\\ \text{of Items Sent}\\ \text{from all CV's}\\ \text{to the g'th Depot}\end{pmatrix}^t = \left[\sum_{k=1}^{L}\begin{pmatrix}\text{Annual Number}\\ \text{of Items Sent}\\ \text{from the k'th CV}\\ \text{to the g'th Depot}\end{pmatrix}^t_k\right]$$

40.1.9.6 Annual number of items sent from all NAS's to a depot.

$$\begin{pmatrix}\text{Annual Number}\\ \text{of Items Sent}\\ \text{from all NAS's}\\ \text{to the g'th Depot}\end{pmatrix}^t = \left[\sum_{m=1}^{n}\begin{pmatrix}\text{Annual Number}\\ \text{of Items Sent}\\ \text{from the m'th NAS}\\ \text{to the g'th Depot}\end{pmatrix}^t_m\right]$$

40.1.9.7 Annual number of items sent from all PIMA's to a depot.

$$\begin{pmatrix}\text{Annual Number}\\ \text{of Items Sent}\\ \text{from all PIMA's}\\ \text{to the g'th Depot}\end{pmatrix}^t = \left[\sum_{e=1}^{f}\begin{pmatrix}\text{Annual Number}\\ \text{of Items Sent}\\ \text{from the e'th PIMA}\\ \text{to the g'th Depot}\end{pmatrix}^t_e\right]$$

40.1.10 Annual number of repairs of an item at a site. The annual number of items inducted into the repair process at the site. In the repair process malfunctioning lower level parts are removed and replaced. Three parameters are defined to account for repair of items at IMA's, PIMA's, and Depots.

40.1.10.1 Annual number of repairs of an Item at an IMA.

$$\begin{pmatrix}\text{Annual Number}\\ \text{of Repairs to an}\\ \text{Item at the } d'\text{th IMA}\end{pmatrix}^{t} = \left[\begin{pmatrix}\text{Annual Number}\\ \text{of Real Failures}\\ \text{Removed at}\\ \text{the } d'\text{th IMA}\end{pmatrix}^{t}\left[1.0 - \begin{pmatrix}\text{BCM Rate}\\ \text{of the Item}\\ \text{at the IMA}\end{pmatrix}\right]\left[1.0 - \begin{pmatrix}\text{Fraction of Item}\\ \text{Failures Scrapped}\\ \text{at the IMA}\end{pmatrix}\right]\right]$$

40.1.10.2 Annual number of repairs of an item at a PIMA.

$$\begin{pmatrix}\text{Annual Number}\\ \text{of Repairs}\\ \text{to an Item at}\\ \text{the } e'\text{th PIMA}\end{pmatrix}^{t} = \left[\begin{pmatrix}\text{Annual Number}\\ \text{of Real Failures}\\ \text{Removed at}\\ \text{the } e'\text{th PIMA}\end{pmatrix}^{t} + \begin{pmatrix}\text{Annual Number}\\ \text{of Real Failures}\\ \text{Received by}\\ \text{the } e'\text{th PIMA}\end{pmatrix}^{t}\right]\left[1.0 - \begin{pmatrix}\text{BCM Rate}\\ \text{of the Item}\\ \text{at the PIMA}\end{pmatrix}\right]\left[1.0 - \begin{pmatrix}\text{Fraction of Item}\\ \text{Failures Scrapped}\\ \text{at the PIMA}\end{pmatrix}\right]$$

40.1.10.3 Annual number of repairs of an item at a depot.

$$\begin{pmatrix}\text{Annual Number}\\ \text{of Repairs to an}\\ \text{Item at the } g'\text{th Depot}\end{pmatrix}^{t} = \left[\begin{pmatrix}\text{Annual Number}\\ \text{of Real Failures}\\ \text{Removed at}\\ \text{the } g'\text{th Depot}\end{pmatrix}^{t} + \begin{pmatrix}\text{Annual Number of}\\ \text{Real Failures Received}\\ \text{by the } g'\text{th Depot}\end{pmatrix}^{t}\right]\left[1.0 - \begin{pmatrix}\text{Fraction of Item}\\ \text{Failures Scrapped}\\ \text{at the Depot}\\ \text{Repair Facility}\end{pmatrix}\right]$$

40.2 Cost element equations.

40.2.1 Inventory costs.

40.2.1.1 Inventory administration cost. The cost associated with entering an item into the supply system and retaining it there over its life cycle. The LORA techniques treat the inventory administration cost as proportional to the number of equipment peculiar items entered in the NSN (National Stock Number) system. The cost is a function of three separate costs: item entry, item retention, and field supply administration. Item entry is a one-time cost per peculiar NSN, incurred during the inventory procurement process to establish a NSN for the item. Item retention is a recurring cost per NSN incurred throughout the life cycle. It is a per year cost due to maintaining the item in the NSN system. Field supply administration is a per site cost annually incurred for local management of the item.

40.2.1.1.1 Inventory administration cost for the discard cases. The cost of local management, entry, and retention of the discarded item in the NSN system.

$$\left(\begin{array}{c}\text{Inventory}\\ \text{Administration}\\ \text{Cost for Discard}\end{array}\right)^t = \left(\begin{array}{c}\text{Item}\\ \text{Entry}\\ \text{Cost}\end{array}\right)^* + \left[\left(\begin{array}{c}\text{Item}\\ \text{Retention}\\ \text{Cost}\end{array}\right) + \left(\begin{array}{c}\text{Field Supply}\\ \text{Administration}\\ \text{Cost per Item}\\ \text{per Site per Year}\end{array}\right)\left(\begin{array}{c}\text{Number of}\\ \text{Sites}\\ \text{Discarding}\\ \text{the Item}\end{array}\right)^t\right]\left(\begin{array}{c}\text{Normal}\\ \text{Discount}\\ \text{Factor}\end{array}\right)$$

* = Item refers to either the WRA, SRA or SSRA as applicable to the indenture level under analysis

40.2.1.1.2 Inventory administration cost for the repair cases. The cost of local management, entry, and retention of the repairable item and its peculiar components or pieces parts in the NSN system. The cost equation is comprised of two segments to account for administrative costs associated with each repairable item and with its peculiar components excluding those lower indenture parts under analysis.

$$\left(\begin{array}{c}\text{Inventory}\\ \text{Administration}\\ \text{Cost for Repair}\end{array}\right)^t = \left(\begin{array}{c}\text{Item}\\ \text{Entry}\\ \text{Cost}\end{array}\right) + \left[\left(\begin{array}{c}\text{Item}\\ \text{Retention}\\ \text{Cost}\end{array}\right) + \left(\begin{array}{c}\text{Field Supply}\\ \text{Administration}\\ \text{Cost per Item}\\ \text{per Site per Year}\end{array}\right)\left(\begin{array}{c}\text{Number of}\\ \text{Sites}\\ \text{Discarding}\\ \text{the Item}\end{array}\right)\right]^t\left(\begin{array}{c}\text{Normal}\\ \text{Discount}\\ \text{Factor}\end{array}\right) +$$

$$\left\{\left(\begin{array}{c}\text{Item}\\ \text{Entry}\\ \text{Cost}\end{array}\right) + \left[\left(\begin{array}{c}\text{Item}\\ \text{Retention}\\ \text{Cost}\end{array}\right) + \left(\begin{array}{c}\text{Field Supply}\\ \text{Administration}\\ \text{Cost per Item}\\ \text{per Site per Year}\end{array}\right)\left(\begin{array}{c}\text{Number of}\\ \text{Sites}\\ \text{Discarding}\\ \text{the Item}\end{array}\right)^t\right]\left(\begin{array}{c}\text{Normal}\\ \text{Discount}\\ \text{Factor}\end{array}\right)\right\}\left(\begin{array}{c}\text{Number of Peculiar}\\ \text{Components in the}\\ \text{NSN System}\end{array}\right)^*$$

* = Components refers to the parts which are used to repair the item and are not included in the analysis

40.2.2 Spares inventory costs equations.

40.2.2.1 Inventory quantity for discard. The number of spares required during the systems life cycle to account for discard maintenance actions. The inventory quantity for each item to be discarded is calculated an annual basis by individual site. LB (Land-Based) sites have the demands on the IMA and PIMA, if collocated, added together to calculate the discard quantity.

40.2.2.1.1 Annual inventory quantity for discard at a CV site.

$$\left(\begin{array}{c}\text{Annual Inventory}\\ \text{Quantity for Discard}\\ \text{at the } k'\text{th CV Site}\end{array}\right)^t = \left[\left(\begin{array}{c}\text{Annual Number of}\\ \text{Items for Disposition}\\ \text{at the } k'\text{th CV Site}\end{array}\right)^t\right]$$

40.2.2.1.2 Annual inventory quantity for discard at a LB site.

$$\begin{pmatrix}\text{Annual Inventory}\\ \text{Quantity for Discard}\\ \text{at the } p'\text{th LB Site}\end{pmatrix}^{t} = \left[\begin{pmatrix}\text{Annual Number of}\\ \text{Items for Disposition}\\ \text{at the NAS Located}\\ \text{at the } p'\text{th LB Site}\end{pmatrix}^{t} + \begin{pmatrix}\text{Annual Number of *}\\ \text{Items for Disposition}\\ \text{at the PIMA Located}\\ \text{at the } p'\text{th LB Site}\end{pmatrix}^{t}\right]$$

P = the p'th LB site (NAS's and colocated PIMA's)

** = The term may = 0 as applicable to the site under consideration*

40.2.2.1.3 Annual inventory quantity for discard at a depot site.

$$\begin{pmatrix}\text{Annual Inventory}\\ \text{Quantity for Discard}\\ \text{at the } g'\text{th Depot}\end{pmatrix}^{t} = \left[\begin{pmatrix}\text{Annual Number of}\\ \text{Items for Disposition}\\ \text{at the } g'\text{th Depot}\end{pmatrix}^{t}\right]$$

40.2.2.1.4 Inventory cost for discard.

$$\begin{pmatrix}\text{Annual Cost}\\ \text{for Discard}\\ \text{at the } v'\text{th Site}\end{pmatrix}^{t} = \left[\begin{pmatrix}\text{Unit}\\ \text{Cost of}\\ \text{Item}\end{pmatrix}\begin{pmatrix}\text{Annual Inventory}\\ \text{Quantity for Discard}\\ \text{at the } v'\text{th Site}\end{pmatrix}^{t}\begin{pmatrix}\text{Present}\\ \text{Discount}\\ \text{Factor}\end{pmatrix}\right]$$

v = the v'th site to include CV, LB and Depot sites

40.2.2.2 Repairable inventory quantity. The rotatable pool quantity, attrition quantity, and system stock quantity.

40.2.2.3 Rotatable pool quantity. Items stocked at the site where aircraft operate to allow immediate replacement of items repaired at the site. A rotatable pool quantity is determined for each operational site in accordance with the criteria of figure D-2 and the integerization rules of table D-I. The integerization rules operate on raw or non-integerized rotatable pool quantities calculated for each CV and LB operational site.

40.2.2.3.1 Raw rotatable pool quantity at a CV site.

$$\begin{pmatrix}\text{Raw Rotatable}\\ \text{Pool Quantity}\\ \text{at the } k'\text{th CV Site}\end{pmatrix}^t = \left[\frac{\begin{pmatrix}\text{Annual Number of}\\ \text{Repairs to an Item}\\ \text{at the } k'\text{th CV Site}\end{pmatrix}^t \begin{pmatrix}\text{Repair Cycle Time}\\ \text{at the IMA}\end{pmatrix}}{\begin{pmatrix}\text{365 Days}\\ \text{per}\\ \text{Year}\end{pmatrix}\begin{pmatrix}\text{Carrier}\\ \text{Deployment Factor}\\ \text{for the } k'\text{th CV Site}\end{pmatrix}}\right]$$

WHERE :

$$\begin{pmatrix}\text{Carrier}\\ \text{Deployment Factor}\\ \text{for the } k'\text{th CV Site}\end{pmatrix} = \left[\frac{\sum_{b=1}^{c}\begin{pmatrix}\text{Number of Aircraft}\\ \text{that Deploy to the}\\ k'\text{th Carrier per}\\ \text{Aircraft type}\end{pmatrix}_b \begin{pmatrix}\text{Aircraft type}\\ \text{Deployment Factor}\\ \text{for the } k'\text{th Carrier}\end{pmatrix}_b}{\sum_{b=1}^{c}\begin{pmatrix}\text{Number of Aircraft}\\ \text{that Deploy to the}\\ k'\text{th Carrier per}\\ \text{Aircraft type}\end{pmatrix}_b}\right]$$

40.2.2.3.2 Raw rotatable pool quantity at a LB site.

$$\begin{pmatrix}\text{Raw Rotatable}\\ \text{Pool Quantity}\\ \text{at the } p'\text{th LB Site}\end{pmatrix}^t = \left[\frac{\begin{pmatrix}\text{Annual Number of}\\ \text{Repairs to an Item}\\ \text{at the } p'\text{th LB Site}\end{pmatrix}^t \begin{pmatrix}\text{Repair Cycle Time}\\ \text{at the IMA}\end{pmatrix}}{\begin{pmatrix}\text{365 Days}\\ \text{per}\\ \text{Year}\end{pmatrix}}\right]$$

WHERE :

$$\begin{pmatrix}\text{Annual Number of}\\ \text{Repairs to an}\\ \text{Item Originating}\\ \text{at the } p'\text{th LB Site}\end{pmatrix}^t = \begin{pmatrix}\text{Annual Number of}\\ \text{Repairs to an Item}\\ \text{at the NAS Located}\\ \text{at the } p'\text{th LB Site}\end{pmatrix}^t + \begin{pmatrix}\text{Annual Number of}\\ \text{Real Failures Removed}\\ \text{at the PIMA Located}\\ \text{at the } p'\text{th LB Site}\end{pmatrix}^t \left[1.0 - \begin{pmatrix}\text{Fraction of Item}\\ \text{Failures Scrapped}\\ \text{at the PIMA}\end{pmatrix}\right]\left[1.0 - \begin{pmatrix}\text{BCM Rate}\\ \text{of the Item}\\ \text{at the PIMA}\end{pmatrix}\right]$$

TABLE D-I. Integerization rules for computing rotatable pool quantities.

IF: (RAW ROTABLE POOL QUANTITY PER SITE)	THEN: (ROTABLE POOL QUANTITY PER SITE)
< .10	0
.11 - .59	1
.60 - 1.29	2
1.30 - 2.09	3
2.10 - 2.89	4
2.90 - 3.89	5
≥ 3.90	INT [(RAW ROTABLE POOL QUANTITY PER SITE) + 1.0]

* INT MEANS ROUND OFF TO NEAREST INTEGER.

40.2.2.4 Attrition quantity. The replenishment quantity stocked at the sites where aircraft operate to replace those items not repairable or restorable to an RFI (Ready for Issue) status at the sites. These items are BCM or scrapped and, therefore, not available to the site's supply system. The attrition quantity, computed for the individual sites, is subject to the integerization rules of table D-II and the criteria of figure D-2 which operate on raw or non-integerized attrition quantities.

40.2.2.4.1 Raw attrition quantity for a CV performing local repairs.

$$\begin{pmatrix}\textit{Raw}\\ \textit{Attrition}\\ \textit{Quantity at}\\ \textit{the k'th}\\ \textit{CV Site}\end{pmatrix}^{c} = \left[\frac{\left[\begin{pmatrix}\textit{Annual Number}\\ \textit{of Items for}\\ \textit{Disposition at}\\ \textit{the k'th CV Site}\end{pmatrix}^{c}\begin{pmatrix}\textit{BCM Rate}\\ \textit{of Item at}\\ \textit{the IMA}\end{pmatrix} + \begin{pmatrix}\textit{Annual Number}\\ \textit{of Real Failures}\\ \textit{Removed at the}\\ \textit{k'th CV Site}\end{pmatrix}^{c}\left[1.0 - \begin{pmatrix}\textit{BCM Rate}\\ \textit{of Item at}\\ \textit{the IMA}\end{pmatrix}\right]\begin{pmatrix}\textit{Fraction of}\\ \textit{Item Failures}\\ \textit{Scrapped}\\ \textit{at the IMA}\end{pmatrix}\right]\begin{pmatrix}\textit{Required}\\ \textit{Days of}\\ \textit{Stock at}\\ \textit{the IMA}\end{pmatrix}}{\begin{pmatrix}\textit{365 days}\\ \textit{per}\\ \textit{Year}\end{pmatrix}\begin{pmatrix}\textit{Carrier Deployment}\\ \textit{Factor for the}\\ \textit{k'th CV Site}\end{pmatrix}}\right]$$

40.2.2.4.2 Raw attrition quantity for a CV when off-site repair is indicated.

$$\left(\begin{array}{c}\text{Raw Attrition}\\ \text{Quantity at the}\\ k'\text{th CV Site}\end{array}\right)^t = \left[\frac{\left(\begin{array}{c}\text{Annual Number}\\ \text{of Items for}\\ \text{Disposition at}\\ \text{the } k'\text{th CV Site}\end{array}\right)^t \left(\begin{array}{c}\text{Required}\\ \text{Days of Stock}\\ \text{at the IMA}\end{array}\right)}{\left(\begin{array}{c}\text{365 Days}\\ \text{per}\\ \text{Year}\end{array}\right)\left(\begin{array}{c}\text{Carrier Deployment}\\ \text{Factor for the}\\ k'\text{th CV Site}\end{array}\right)}\right]$$

40.2.2.4.3 Raw attrition quantity for a LB performing local repairs.

$$\left(\begin{array}{c}\text{Raw}\\ \text{Attrition}\\ \text{Quantity at}\\ \text{the } p'\text{th}\\ \text{LB Site}\end{array}\right)^t = \left[\frac{\left\{\left(\begin{array}{c}\text{Annual Number}\\ \text{of Items for}\\ \text{Disposition at the}\\ \text{PIMA Located at}\\ \text{the } p'\text{th LB Site}\end{array}\right)^t + \left(\begin{array}{c}\text{Annual Number}\\ \text{of Real Failures}\\ \text{Received by the}\\ \text{PIMA Located at}\\ \text{the } p'\text{th LB Site}\end{array}\right)^t\right\}\left(\begin{array}{c}\text{BCM Rate}\\ \text{of Item at}\\ \text{the PIMA}\end{array}\right)\left(\begin{array}{c}\text{Required}\\ \text{Days of Stock}\\ \text{at the PIMA}\end{array}\right)}{\left(\begin{array}{c}\text{365 Days}\\ \text{per}\\ \text{Year}\end{array}\right)}\right]$$

$$+\left[\frac{\left\{\left(\begin{array}{c}\text{Annual Number}\\ \text{of Items for}\\ \text{Disposition at}\\ \text{the } p'\text{th LB Site}\end{array}\right)^t\left(\begin{array}{c}\text{BCM Rate}\\ \text{of Item at}\\ \text{the IMA}\end{array}\right) + \left(\begin{array}{c}\text{Annual Number}\\ \text{of Real Failures}\\ \text{Removed at the}\\ p'\text{th LB Site}\end{array}\right)^t\left[1.0 - \left(\begin{array}{c}\text{BCM Rate}\\ \text{of Item at}\\ \text{the IMA}\end{array}\right)\right]\left(\begin{array}{c}\text{Fraction of}\\ \text{Item Failures}\\ \text{Scrapped}\\ \text{at the IMA}\end{array}\right)\right\}\left(\begin{array}{c}\text{Required}\\ \text{Days of}\\ \text{Stock at}\\ \text{the IMA}\end{array}\right)}{\left(\begin{array}{c}\text{365 days}\\ \text{per}\\ \text{Year}\end{array}\right)}\right]$$

$$+\left[\frac{\left\{\left(\begin{array}{c}\text{Annual Number}\\ \text{of Items for}\\ \text{Disposition at the}\\ \text{PIMA Located at}\\ \text{the } p'\text{th LB Site}\end{array}\right)^t + \left(\begin{array}{c}\text{Annual Number}\\ \text{of Real Failures}\\ \text{Received by the}\\ \text{PIMA Located at}\\ \text{the } p'\text{th LB Site}\end{array}\right)^t\right\}\left(\begin{array}{c}\text{BCM Rate}\\ \text{of Item at}\\ \text{the PIMA}\end{array}\right)\left(\begin{array}{c}\text{Required}\\ \text{Days of Stock}\\ \text{at the PIMA}\end{array}\right)}{\left(\begin{array}{c}\text{365 Days}\\ \text{per}\\ \text{Year}\end{array}\right)}\right]$$

40.2.2.4.4 Raw attrition quantity for a LB when off-site repair is indicated.

$$\left(\begin{array}{c}\text{Raw Attrition}\\ \text{Quantity at the}\\ p'\text{th LB Site}\end{array}\right)^t = \left[\frac{\left(\begin{array}{c}\text{Annual Number}\\ \text{of Items for}\\ \text{Disposition at}\\ \text{the NAS Located at}\\ \text{the } p'\text{th LB Site}\end{array}\right)^t \left(\begin{array}{c}\text{Required}\\ \text{Days of Stock}\\ \text{at the IMA}\end{array}\right)}{\left(\begin{array}{c}\text{365 Days}\\ \text{per}\\ \text{Year}\end{array}\right)}\right]$$

TABLE D-II. Integerization rules for computing attrition quantities.

Cost Range Criteria (in dollars)
Recommended Attrition Quantity per Site

RAQ per Site	There is no attrition quantity for raw quantities less than .34				
.34	L $.11 4	$.12 - $1.10 3	$1.11 - $9.80 2	$9.81 - $74 1	G $74.01 1
.35	L .12 4	.13 - 1.20 3	1.21 - 10.80 2	10.81 - 76 1	G 76.01 1
.36	L .15 4	.16 - 1.25 3	1.26 - 10.50 2	10.51 - 78 1	G 78.01 1
.37	L .16 4	.17 - 1.40 3	1.41 - 11.10 2	11.11 - 79 1	G 79 1
.38	L .17 4	.18 - 1.50 3	1.51 - 12 2	12.01 - 81 1	G 81.01 1
.39	L .18 4	.19 - 1.60 3	1.61 - 12.50 2	12.51 - 84 1	G 84.01 1
.40	L .19 4	.20 - 1.70 3	1.71 - 13 2	13.01 - 86 1	G 86.01 1
.42	L .22 4	.23 - 1.90 3	1.91 - 14 2	14.01 - 89 1	G 89.01 1
.44	L .26 4	.27 - 2.10 3	2.11 - 15 2	15.01 - 94 1	G 94.01 1
7.46	L .35 4	.36 - 2.40 3	2.41 - 16 2	16.01 - 96 1	G 96.01 1
.48	L .38 4	.39 - 2.70 3	2.71 - 18 2	18.01 - 98 1	G 98.01 1
.50	L .40 4	.41 - 2.95 3	2.96 - 19 2	19.01 - 100 1	G 100.01 1
.52	L .46 4	.47 - 3.20 3	3.21 - 21 2	21.01 - 100 1	G 100.01 1
.54	L .52 4	.53 - 3.60 3	3.61 - 22 2	22.01 - 100 1	G 100.01 1
.56	L .58 4	.59 - 3.90 3	3.91 - 24 2	24.01 - 100 1	G 100.01 1
.58	L .66 4	.67 - 4.30 3	4.31 - 26 2	26.01 - 100 1	G 100.01 1
.60	L .76 4	.77 - 4.80 3	4.81 - 27 2	27.01 - 100 1	G 100.01 1
.62	L .85 4	.86 - 5 3	5.01 - 28 2	28.01 - 100 1	G 100.01 1

NOTE: L = less than or equal to...
G = greater than or equal to...

EXAMPLE: If an item costs between $11.11 and $29, and has a raw attrition quantity per site of .37, then the recommended attrition quantity per site is 1. This table is applied for CV and LB sites performing either local or off-site repairs. Whether the recommended quantity is stocked at a site depends on the criteria in figure D-2.

TABLE D-II. Integerization rules for computing attrition quantities - Continued.

Cost Range Criteria (in dollars)
Recommended Attrition Quantity per Site

RAQ						
.64	L $.11 5	$.12 - .90 4	$.91 - 5.20 3	$5.20 - 29 2	$29.01 - 100 1	G $100.01 1
.66	L .14 5	.15 - 1.05 4	1.06 - 6.20 3	6.21 - 32 2	32.01 - 100 1	G 100.01 1
.68	L .15 5	.16 - 1.10 4	1.11 - 6.50 3	6.51 - 34 2	34.01 - 100 1	G 100.01 1
.70	L .17 5	.18 - 1.25 4	1.26 - 7 3	7.01 - 36 2	36.01 - 100 1	G 100.01 1
.72	L .19 5	.20 - 1.40 4	1.41 - 7.80 3	7.81 - 38 2	38.01 - 100 1	G 100.01 1
.74	L .22 5	.23 - 1.50 4	1.51 - 8 3	8.01 - 39 2	39.01 - 100 1	G 100.01 1
.76	L .24 5	.25 - 1.65 4	1.66 - 8.50 3	8.51 - 40 2	40.01 - 100 1	G 100.01 1
.78	L .28 5	.29 - 1.80 4	1.81 - 9 3	9.01 - 43 2	43.01 - 100 1	G 100.01 1
.80	L .33 5	.34 - 2 4	2.01 - 10 3	10.01 - 43.50 2	43.51 - 100 1	G 100.01 1
.82	L .37 5	.38 - 2.20 4	2.21 - 10.50 3	10.51 - 44.50 2	44.51 - 100 1	G 100.01 1
.84	L .41 5	.42 - 2.40 4	2.41 - 11.50 3	11.51 - 47 2	47.01 - 100 1	G 100.01 1
.86	L .45 5	.46 - 2.60 4	2.61 - 12.50 3	12.51 - 50 2	50.01 - 100 1	G 100.01 1
.88	L .49 5	.50 - 2.80 4	2.81 - 13 3	13.01 - 53 2	53.01 - 100 1	G 100.01 1
.90	L .52 5	.53 - 3 4	3.01 - 13.50 3	13.51 - 56 2	56.01 - 100 1	G 100.01 1
.92	L .61 5	.62 - 3.25 4	3.26 - 14 3	14.01 - 58 2	58.01 - 100 1	G 100.01 1
.94	L .70 5	.71 - 3.50 4	3.51 - 14.50 3	14.51 - 60 2	60.01 - 100 1	G 100.01 1
.96	L .79 5	.80 - 3.75 4	3.76 - 15 3	15.01 - 62 2	62.01 - 100 1	G 100.01 1
.98	L .86 5	.87 - 4 4	4.01 - 16 3	16.01 - 65 2	65.01 - 100 1	G 100.01 1
.99	L .95 5	.96 - 4.20 4	4.21 - 17.50 3	17.51 - 68 2	68.01 - 100 1	G 100.01 1

EXAMPLE: The raw attrition quantity is rounded to the nearest even hundredth. If an item costs between $1.51 and $8.00 and has a raw quantity per site of .73, then the recommended attrition quantity per site is 3. Whether the recommended quantity is stocked depends on the criteria shown in figure D-2.

TABLE D-II. Integerization rules for computing attrition quantities - Continued.

Cost Range Criteria (in dollars)
Recommended Attrition Quantity per Site

RAQ					
1	L $.15 6	$.16 - .85 5	$.86 - 4.20 4	$4.21 - 17 3	$17.01 - 70 2
1	70.01 - 100 1	G 100.01 1			
2	L .23 8	.24 - .90 7	.91 - 3.10 6	3.11 - 9 5	9.01 - 25 4
2	25.01 - 50 3	50.01 - 100 2	G 100.01 2		
3	L .22 10	.23 - .68 9	.69 - 2 8	2.01 - 5.75 7	5.76 - 13 6
3	13.01 - 27 5	27.01 - 45 4	45.01 - 100 3	G 100.01 3	
4	L .50 13-11*	.51 - 1.40 10	1.41 - 3.20 9	3.21 - 8 8	8.01 - 17 7
4	17.01 - 28 6	28.01 - 44 5	44.01 - 100 4	G 100.01 4	
5	L 1.90 15-11	1.91 - 4.80 10	4.81 - 9.50 9	9.51 - 17 8	17.01 - 28 7
5	28.01 - 40 6	40.01 - 100 5	G 100.01 5		
6	L .11 17-16	.12 - 6 15-11	6.01 - 13 10	13.01 - 19 9	19.01 - 28 8
6	28.01 - 37 7	37.01 - 100 6	G 100.01 6		
7	L .35 18-16	.36 - 13 15-11	13.01 - 19 10	19.01 - 28 9	28.01 - 36 8
7	36.01 - 100 7	G 100.01 7			
8	L 1.00 20-16	1.01 - 20 15-11	20.01 - 27 10	27.01 - 35 9	35.01 - 100 8
8	G 100.01 8				
9	L 2.50 20-16	2.51 - 25 15-11	25.01 - 34 10	34.01 - 100 9	G 100.01 9
10	L .25 23-21	.26 - 6 20-16	6.01 - 31 15-11	31.01 - 100 10	G 100.01 10
11	L .60 24-21	.61 - 10 20-16	10.01 - 100 15-11	G 100.01 11	
12	L 1.30 25-21	1.31 - 15 20-16	15.01 - 100 15-11	G 100.01 12	

EXAMPLE: RAQ's between 1 and 25 are rounded to the nearest whole number. Whether the recommended quantity is stocked or not depends on the criteria of figure D-2.

TABLE D-II. Integerization rules for computing attrition quantities - Continued.

Cost Range Criteria (in dollars)
Recommended Attrition Quantity per Site

RAQ				
13	L $2.70 27-21	$2.71 - 19 20-16	$19.01 - 100 15-11	G $100.01 13
14	L 5.00 28-21	5.01 - 24 20-16	24.01 - 100 15-11	G 100.01 14
15	L 7.50 29-21	7.51 - 28 20-16	28.01 - 100 15-11	G 100.01 15
16	L 11 30-21	11.01 - 100 20-16	G 100.01 16	
17	L .18 33-31	.19 - 14 30-21	14.01 - 100 20-16	G 100.01 17
18	L .40 34-31	.41 - 18 30-21	18.01 - 100 20-16	G 100.01 18
19	L .70 35-31	.71 - 20 30-21	20.01 - 100 20-16	G 100.01 19
20	L 1.20 36-31	1.21 - 22 30-21	22.01 - 100 20-16	G 100.01 20
21	L 2.00 37-31	2.01 - 100 30-21	G 100.01 21	
22	L 3.80 39-31	3.81 - 100 30-21	G 100.01 22	
23	L 5.80 40-31	5.81 - 100 30-21	G 100.01 23	
24	L .15 43-41	.16 - 8 40-31	8.01 - 100 30-21	G 100.01 24

*EXAMPLE: The RAQ is rounded to the nearest whole number. For any item with a rounded RAQ the recommended attrition quantity is determined using linear interpolation of the cost and the attrition quantity range. If an item cost $37.00 and has an RAQ of 16.3, using the interpolation example below, the recommended attrition quantity is 19. The determine this number, 16.3 was rounded to 16, then the appropriate cost range is selected. The cost is interpolated with the quantity range to $17.80 per unit. The expanded cost range with $17.80 steps yields the following:

11.01 - 100 20-16	=>	11.01-28.81 20	28.82-46.61 19	46.62-64.40 18	64.41-82.20 17	82.21-100 16

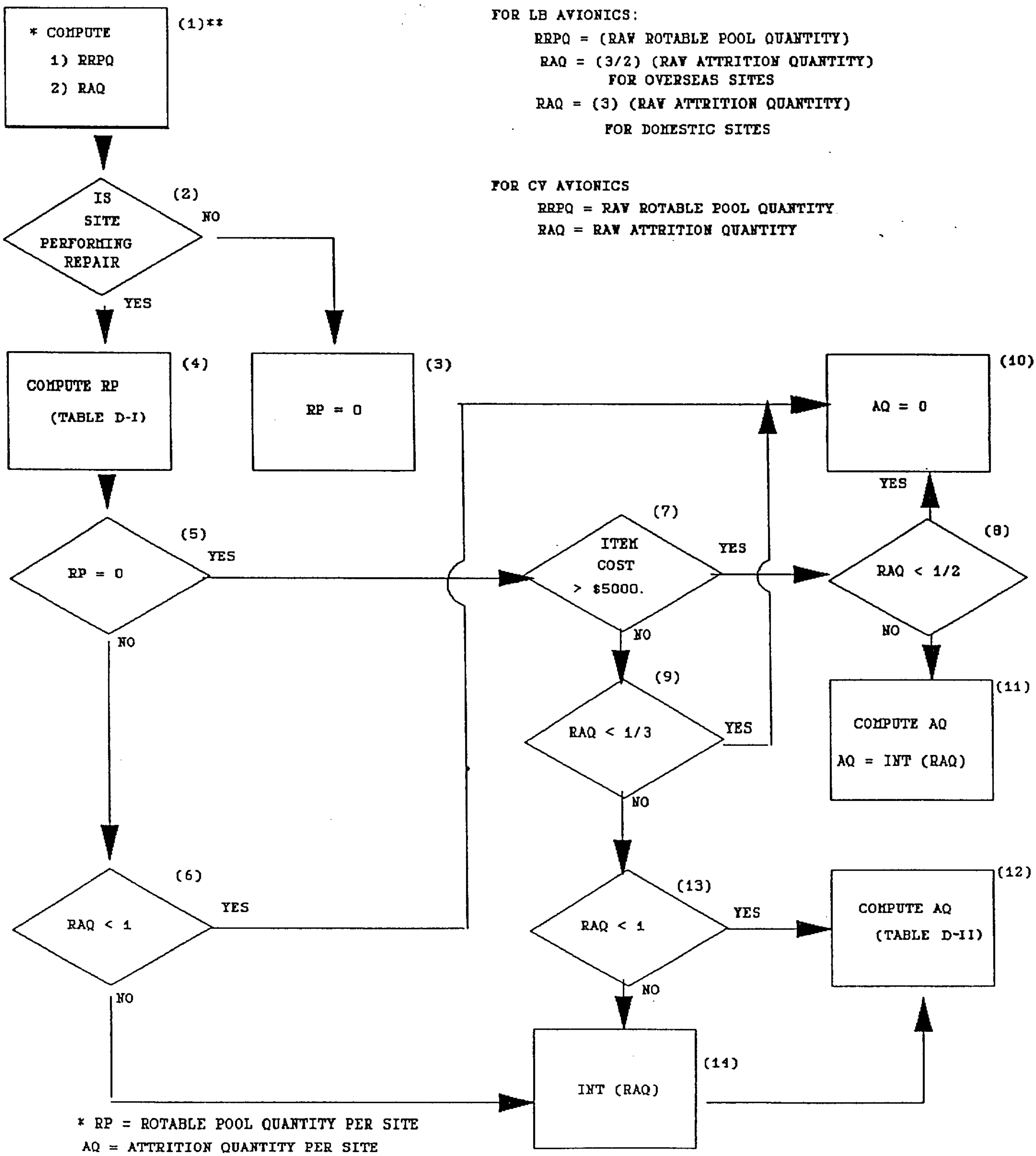
$37 falls in the range 28.82 to 46.61 with a recommended attrition quantity of 19. Whether the recommended quantity is stocked depends on the criteria in figure D-2.

TABLE D-II. Integerization rules for computing attrition quantities - Continued.

Cost Range Criteria (in dollars)
Recommended Attrition Quantity per Site

RAQ				
25	L $.25 45-41	$.26 - 10 40-31	$10.01 - 100 30-21	G $100.01 25
30	L 2.50 50-41	2.51 - 19 40-31	19.01 - 100 30-21	G 100.01 30
35	L .60 75-51	.61 - 9 50-41	9.01 - 100 40-31	G 100.01 35
40	L 5.00 75-51	5.01 - 100 50-41	G 100.01 40	
45	L 9.00 75-51	9.01 - 100 50-41	G 100.01 45	
50	L 14.00 75-51	14.01 - 100 50-41	G 100.01 50	
55	L .40 100-76	.41 - 100 75-51	G 100.01 55	
60	L 1.50 100-76	1.51 - 100 75-51	G 100.01 60	
65	L 5.00 100-76	5.01 - 100 75-51	G 100.01 65	
70	L 7.50 100-76	7.51 - 100 75-51	G 100.01 70	
75	L .20 100	.21 - 12 100-76	12.01 - 100 75-51	G 100.01 75
80	L .70 100	.71 - 100 100-76	G 100.01 80	
85	L 2.50 100	2.51 - 100 100-76	G 100.01 85	
90	L 4.25 100	4.26 - 100 100-76	G 100.01 90	
95	L 7.00 100	7.01 - 100 100-76	G 100.01 95	
Round raw quantities greater than 100 to the nearest whole number. Recommended attrition quantity is equal to the integer.				

EXAMPLE: RAQ's between 25 and 100 are rounded to the nearest whole number evenly divisible by 5. For rounded RAQ's the recommended attrition quantity is found using linear interpolation of the cost and quantity ranges. Whether the recommended quantity is stocked or not depends on the criteria in figure D-2.



* RP = ROTABLE POOL QUANTITY PER SITE
AQ = ATTRITION QUANTITY PER SITE
** CIRCLED NUMBERS ARE DEFINED ON PAGE 42 BY THEIR RESPECTIVE NUMBER

FIGURE D-2. Rotatable pool and attrition quantity computations.

Description of the Rotatable Pool and Attrition Quantity Computations

Figure D-2 presents the criteria used in determining per site RP (Rotatable Pool) and AQ (Attrition Quantity) values. The flow diagram is based on range and quantity criteria derived by the Aviation Supply Office for computing allowance quantities.

A RRPQ (Raw Rotatable Pool Quantity) and a RAQ (Raw Attrition Quantity) are computed using the RAQ equations 40.2.2.3 and 40.2.2.4 (1). Raw or non-integerized quantities for the RP and AQ are calculated for each CV and LB operational site. A criterion for the existence of an RP at a site s is whether the site is authorized to repair the item under analysis (2). If the item is not repairable at the site the RP quantity is zero (3). If the site can repair the item an RP is computed in accordance with the RRPQ integerization rules of table D-I (4). Various criteria may be used to calculate the AQ; the criteria used are dependent on the RP existence (5). For items with a non-zero RP the AQ determination is based on an initial RAQ criterion of 1 (6); for items with a zero RP the AQ determination is based on an initial cost criterion of $5000 (7). If the initial cost criterion is satisfied then a RAQ criterion of 1/2 is applied (8), if not a RAQ criterion of 1/3 is applied (9). Consequently, there is no AQ (10) for items that: (a) have an RP but have an RAQ of less than 1, (b) have no RP, cost more that $5000, and have an RAQ less that 1/2, (c) have no RP, cost less than $5000, and have a RAQ less than 1/3. AQ's are computed for items that do not satisfy the above criterion sequence such that the AQ is equal to the RAQ rounded off to the nearest whole integer for items not meeting the 1/2 criterion (11); the AQ's for the remaining items are computed according to the rules of table D-II (12) which operate only on RAQ's greater that 1/3. RAQ's greater than 1, (6) and (13), are rounded off to the nearest whole integer (14) before inclusion in table D-II, RAQ's less than 1 are not rounded off.

40.2.2.5 <u>System stock quantity</u>. The safety inventory quantity procured to satisfy demands due to anticipated losses during the procurement cycle times exceeding required days of stock. The system stock is stored at designated inventory control resupply points or depots.

$$
\begin{aligned}
\begin{pmatrix}\text{System}\\ \text{Stock}\\ \text{of an}\\ \text{Item}\end{pmatrix} = \text{INT}\Bigg\{ & \left[\begin{pmatrix}\text{Procurement}\\ \text{Lead Time}\\ \text{in Years}\end{pmatrix} + \begin{pmatrix}\text{Safety}\\ \text{Level}\\ \text{in Years}\end{pmatrix}\right]\left[\sum_{d=1}^{j}\begin{pmatrix}\text{Annual Number}\\ \text{of Real Failures}\\ \text{Removed at}\\ \text{the } d'\text{th IMA}\end{pmatrix}_{d}^{t}\left[1.0-\begin{pmatrix}\text{BCM Rate}\\ \text{of Item at}\\ \text{the IMA}\end{pmatrix}\right]\begin{pmatrix}\text{Fraction of Item}\\ \text{Failures Scrapped}\\ \text{at the IMA}\end{pmatrix}\right] \\
& + \sum_{e=1}^{f}\left[\begin{pmatrix}\text{Annual Number}\\ \text{of Real Failures}\\ \text{Removed at}\\ \text{the } e'\text{th PIMA}\end{pmatrix}_{e}^{t} + \begin{pmatrix}\text{Annual Number}\\ \text{of Real Failurs}\\ \text{Received by}\\ \text{the } e'\text{th PIMA}\end{pmatrix}_{e}^{t}\right]\left[1.0-\begin{pmatrix}\text{BCM Rate}\\ \text{of Item at}\\ \text{the PIMA}\end{pmatrix}\right]\begin{pmatrix}\text{Fraction of Item}\\ \text{Failures Scrapped}\\ \text{at the PIMA}\end{pmatrix} \\
& + \sum_{g=1}^{h}\left[\left[\begin{pmatrix}\text{Annual Number}\\ \text{of Real Failures}\\ \text{Removed at}\\ \text{the } g'\text{th Depot}\end{pmatrix}_{g}^{t} + \begin{pmatrix}\text{Annual Number}\\ \text{of Real Failures}\\ \text{Received by}\\ \text{the } g'\text{th Depot}\end{pmatrix}_{g}^{t}\right]\begin{pmatrix}\text{Fraction of Item}\\ \text{Failures Scrapped}\\ \text{at the Depot}\\ \text{Repair Facility}\end{pmatrix}\right]\Bigg] \\
& + \Bigg\{\left[\begin{pmatrix}\text{Repair Cycle}\\ \text{Time the}\\ \text{CV to PIMA}\\ \text{in Years}\end{pmatrix} - \begin{pmatrix}\text{Required}\\ \text{Years}\\ \text{Stock at CV}\end{pmatrix}\right]^{*}\sum_{e=1}^{f}\begin{pmatrix}\text{Annual Number}\\ \text{of Items Sent}\\ \text{from all CV's}\\ \text{to the } e'\text{th PIMA}\end{pmatrix}_{e}^{t}\left[1.0-\begin{pmatrix}\text{BCM Rate}\\ \text{of Item at}\\ \text{the PIMA}\end{pmatrix}\right] \\
& + \left[\begin{pmatrix}\text{Repair Cycle}\\ \text{Time the}\\ \text{NAS to PIMA}\\ \text{in Years}\end{pmatrix} - \begin{pmatrix}\text{Required}\\ \text{Years}\\ \text{Stock at NAS}\end{pmatrix}\right]^{*}\sum_{e=1}^{f}\begin{pmatrix}\text{Annual Number}\\ \text{of Items Sent}\\ \text{from all NAS's}\\ \text{to the } e'\text{th PIMA}\end{pmatrix}_{e}^{t}\left[1.0-\begin{pmatrix}\text{BCM Rate}\\ \text{of Item at}\\ \text{the PIMA}\end{pmatrix}\right] \\
& + \left[\begin{pmatrix}\text{Repair Cycle}\\ \text{Time the}\\ \text{CV to PIMA}\\ \text{in Years}\end{pmatrix} - \begin{pmatrix}\text{Required}\\ \text{Years}\\ \text{Stock at CV}\end{pmatrix}\right]^{*}\sum_{e=1}^{f}\begin{pmatrix}\text{Annual Number}\\ \text{of Items Sent}\\ \text{from all CV's}\\ \text{to the } e'\text{th PIMA}\end{pmatrix}_{e}^{t}\left[1.0-\begin{pmatrix}\text{BCM Rate}\\ \text{of Item at}\\ \text{the PIMA}\end{pmatrix}\right] \\
& + \left[\begin{pmatrix}\text{Repair Cycle}\\ \text{Time the}\\ \text{CV to Depot}\\ \text{in Years}\end{pmatrix} - \begin{pmatrix}\text{Required}\\ \text{Years}\\ \text{Stock at CV}\end{pmatrix}\right]^{*}\sum_{g=1}^{h}\begin{pmatrix}\text{Annual Number}\\ \text{of Items Sent}\\ \text{from all CV's}\\ \text{to the } g'\text{th Depot}\end{pmatrix}_{g}^{t} \\
& + \left[\begin{pmatrix}\text{Repair Cycle}\\ \text{Time the}\\ \text{NAS to Depot}\\ \text{in Years}\end{pmatrix} - \begin{pmatrix}\text{Required}\\ \text{Years}\\ \text{Stock at NAS}\end{pmatrix}\right]^{*}\sum_{g=1}^{h}\begin{pmatrix}\text{Annual Number}\\ \text{of Items Sent}\\ \text{from all NAS's}\\ \text{to the } g'\text{th Depot}\end{pmatrix}_{g}^{t} \\
& + \left[\begin{pmatrix}\text{Repair Cycle}\\ \text{Time the}\\ \text{PIMA to Depot}\\ \text{in Years}\end{pmatrix} - \begin{pmatrix}\text{Required}\\ \text{Years}\\ \text{Stock at NAS}\end{pmatrix}\right]^{*}\sum_{g=1}^{h}\begin{pmatrix}\text{Annual Number}\\ \text{of Items Sent}\\ \text{from all PIMA's}\\ \text{to the } g'\text{th Depot}\end{pmatrix}_{g}^{t}\Bigg\}
\end{aligned}
$$

* *Negative quantities are not allowed; if a term is less than zero, a zero quantity is computed. Yearly parameters for stockage and repair times are input as days and converted to years by the computer model.*

40.2.2.6 <u>Total repairable inventory quantity</u>. The summation of the rotatable pool, attrition, and system stock quantities. Since the rotatable pool and attrition quantities are computed by site, the quantities must be totaled across all sites.

$$\begin{pmatrix}\text{Total}\\\text{Repairable}\\\text{Inventory}\\\text{Quantity}\end{pmatrix} = \sum_{k=1}^{l}\left[\begin{pmatrix}\text{Rotatable}\\\text{Pool Quantity}\\\text{at the }k'\text{th}\\\text{CV Site}\end{pmatrix}_k^t + \begin{pmatrix}\text{Attrition}\\\text{Quantity}\\\text{at the }k'\text{th}\\\text{CV Site}\end{pmatrix}_k^t\right] + \sum_{p=1}^{q}\left[\begin{pmatrix}\text{Rotatable}\\\text{Pool Quantity}\\\text{at the }p'\text{th}\\\text{LB Site}\end{pmatrix}_p^t + \begin{pmatrix}\text{Attrition}\\\text{Quantity}\\\text{at the }p'\text{th}\\\text{LB Site}\end{pmatrix}_p^t\right] + \begin{pmatrix}\text{System}\\\text{Stock of}\\\text{the Item}\end{pmatrix}^t$$

q = total number of LB sites which include NAS's and NAS's collocated with PIMA's

40.2.2.7 Total repairable inventory cost.

$$\begin{pmatrix}\text{Total}\\\text{Repairable}\\\text{Inventory}\\\text{Cost}\end{pmatrix}^t = \left[\begin{pmatrix}\text{Unit}\\\text{Cost of}\\\text{Item}\end{pmatrix}\begin{pmatrix}\text{Total}\\\text{Repairable}\\\text{Inventory}\\\text{Quantity}\end{pmatrix}^t\right]$$

40.2.3 Repair scrap quantity. The inventory procured throughout the life cycle to replenish the system stock quantity. Replenishment of the system stock is necessary to account for losses in the supply system caused by items being scrapped during the repair process. A repair scrap quantity is computed for each repair site.

40.2.3.1 Annual repair scrap quantity at a CV site. This quantity accounts for the contribution to the total repair scrap quantity of losses occurring at each CV site.

$$\begin{pmatrix}\text{Annual Repair}\\\text{Scrap Quantity}\\\text{at the }k'\text{th CV Site}\end{pmatrix}^t = \left[\begin{pmatrix}\text{Annual Number}\\\text{of Real Failures}\\\text{Removed at the}\\k'\text{th CV Site}\end{pmatrix}^t\left[1.0 - \begin{pmatrix}\text{BCM Rate}\\\text{of Item at}\\\text{the IMA}\end{pmatrix}\right]\begin{pmatrix}\text{Fraction of Item}\\\text{Failures Scrapped}\\\text{at the IMA}\end{pmatrix}\right]$$

40.2.3.2 Annual repair scrap quantity at a LB site. This quantity accounts for the contribution to the total repair scrap quantity of losses occurring at each LB site.

$$\begin{pmatrix}\text{Annual Repair}\\\text{Scrap Quantity}\\\text{at the }p'\text{th}\\\text{LB Site}\end{pmatrix}^t = \begin{pmatrix}\text{Annual Number of}\\\text{Real Failures Removed}\\\text{at the NAS Located}\\\text{at the }p'\text{th LB Site}\end{pmatrix}^t\left[1.0 - \begin{pmatrix}\text{BCM Rate}\\\text{of Item at}\\\text{the IMA}\end{pmatrix}\right]\begin{pmatrix}\text{Fraction of Item}\\\text{Failures Scrapped}\\\text{at the IMA}\end{pmatrix}$$
$$\left[\begin{pmatrix}\text{Annual Number}\\\text{of Real Failures}\\\text{Removed at the}\\\text{PIMA Located at}\\\text{the }p'\text{th PIMA Site}\end{pmatrix}^t + \begin{pmatrix}\text{Annual Number}\\\text{of Real Failures}\\\text{Received by the}\\\text{PIMA Located at}\\\text{the }p'\text{th PIMA Site}\end{pmatrix}^t\right]\left[1.0 - \begin{pmatrix}\text{BCM Rate}\\\text{of Item at}\\\text{the PIMA}\end{pmatrix}\right]\begin{pmatrix}\text{Fraction of Item}\\\text{Failures Scrapped}\\\text{at the IMA}\end{pmatrix}$$

40.2.3.3 Annual repair scrap quantity at a depot. This quantity accounts for the contribution to the total repair scrap quantity of losses occurring at each depot site.

$$\begin{pmatrix}\text{Annual Repair}\\ \text{Scrap Quantity}\\ \text{at the } g'\text{th}\\ \text{Depot Site}\end{pmatrix}^t = \left[\begin{pmatrix}\text{Annual Number}\\ \text{of Real Failures}\\ \text{Removed at the}\\ g'\text{th Depot Site}\end{pmatrix}^t + \begin{pmatrix}\text{Annual Number}\\ \text{of Real Failures}\\ \text{Received by the}\\ g'\text{th Depot Site}\end{pmatrix}^t\right]\begin{pmatrix}\text{Fraction of Item}\\ \text{Failures Scrapped}\\ \text{at the Depot}\\ \text{Repair Facility}\end{pmatrix}$$

40.2.3.4 Repair scrap cost.

$$\begin{pmatrix}\text{Repair}\\ \text{Scrap}\\ \text{Cost}\end{pmatrix}^t = \sum_{v=1}^{r}\left[\begin{pmatrix}\text{Annual Repair}\\ \text{Scrap Quantity}\\ \text{at the } v'\text{th Site}\end{pmatrix}_v^t\right]\begin{pmatrix}\text{Unit}\\ \text{Cost of}\\ \text{Item}\end{pmatrix}\begin{pmatrix}\text{Present}\\ \text{Discount}\\ \text{Factor}\end{pmatrix}$$

r = number of repair facilities (IMA's, PIMA's, and Depot's)

40.2.4 Repair material cost. Accounts for the cost of parts required per repair action, excluding those which are included in the analysis. The total repair material cost is the summation of the costs at all sites.

40.2.4.1 Repair material cost at a CV site.

$$\begin{pmatrix}\text{Repair Material}\\ \text{Cost at the}\\ k'\text{th CV Site}\end{pmatrix}^t = \left[\begin{pmatrix}\text{Annual Number of}\\ \text{Repairs to an Item}\\ \text{at the } k'\text{th CV Site}\end{pmatrix}^t\begin{pmatrix}\text{Unit}\\ \text{Cost of}\\ \text{Item}\end{pmatrix}\begin{pmatrix}\text{Repair}\\ \text{Material Rate}\\ \text{at the IMA}\end{pmatrix}\begin{pmatrix}\text{Present}\\ \text{Discount}\\ \text{Factor}\end{pmatrix}\right]$$

40.2.4.2 Repair material cost at a LB site.

$$\begin{pmatrix}\text{Repair Material}\\ \text{Cost at the}\\ p'\text{th LB Site}\end{pmatrix}^t = \left[\begin{pmatrix}\text{Annual Number of}\\ \text{Repairs to an Item}\\ \text{at the NAS Located}\\ \text{at the } p'\text{th LB Site}\end{pmatrix}^t\begin{pmatrix}\text{Repair}\\ \text{Material Rate}\\ \text{at the IMA}\end{pmatrix} + \begin{pmatrix}\text{Annual Number of}\\ \text{Repairs to an Item}\\ \text{at the PIMA Located}\\ \text{at the } p'\text{th LB Site}\end{pmatrix}^t\begin{pmatrix}\text{Repair}\\ \text{Material Rate}\\ \text{at the PIMA}\end{pmatrix}\right]\begin{pmatrix}\text{Unit}\\ \text{Cost of}\\ \text{Item}\end{pmatrix}\begin{pmatrix}\text{Present}\\ \text{Discount}\\ \text{Factor}\end{pmatrix}$$

40.2.4.3 Repair material cost at a depot site.

$$\begin{pmatrix}\text{Repair Material}\\ \text{Cost at the}\\ g'\text{th Depot Site}\end{pmatrix}^t = \left[\begin{pmatrix}\text{Annual Number of}\\ \text{Repairs to an Item}\\ \text{at the } g'\text{th Depot Site}\end{pmatrix}^t\begin{pmatrix}\text{Unit}\\ \text{Cost of}\\ \text{Item}\end{pmatrix}\begin{pmatrix}\text{Repair}\\ \text{Material Rate}\\ \text{at the Depot}\end{pmatrix}\begin{pmatrix}\text{Present}\\ \text{Discount}\\ \text{Factor}\end{pmatrix}\right]$$

40.2.4.4 Total repair material cost.

$$\begin{pmatrix}\text{Repair}\\ \text{Material}\\ \text{Cost}\end{pmatrix}^{t} = \sum_{v=1}^{r}\left[\begin{pmatrix}\text{Repair}\\ \text{Material Cost}\\ \text{at the } v'\text{th Site}\end{pmatrix}_{v}^{t}\right]$$

40.2.5 <u>Transportation costs</u>. The costs of packaging, handling, and transporting for purposes of repair or replenishment, item inventories to and from operational, repair, and resupply sites. The costs are functions of the packaging and handling rates per cubic foot and transportation rates per pound from site to site, and are computed by site.

40.2.5.1 <u>Transportation cost for the discard cases</u>.

$$\begin{pmatrix}\text{Transportation}\\ \text{Cost}\\ \text{for Discard}\end{pmatrix}^{t} = \begin{pmatrix}\text{Normal}\\ \text{Discount}\\ \text{Factor}\end{pmatrix}\left\{\sum_{v=1}^{r}\sum_{s=1}^{T}\left[\begin{pmatrix}\text{Annual Number}\\ \text{of Items for}\\ \text{Disposition at}\\ \text{the } v'\text{th Site}\end{pmatrix}_{v}^{t}\left[\begin{pmatrix}\text{Transportation}\\ \text{Rate per Pound}\\ \text{from the } s'\text{th Site}\\ \text{to the } v'\text{th Site}\end{pmatrix}_{s,v}\begin{pmatrix}\text{Weight}\\ \text{of the}\\ \text{Item}\end{pmatrix}\begin{pmatrix}\text{Fraction of}\\ \text{the } v'\text{th Site}\\ \text{Resupply from}\\ \text{the } s'\text{th Site}\end{pmatrix}_{s,}\right.\right.\right.$$

$$\left.\left.\left. + \begin{pmatrix}\text{Packing and}\\ \text{Handling Rate}\\ \text{per cubic Foot}\end{pmatrix}\begin{pmatrix}\text{Inventory}\\ \text{Storage Space}\\ \text{per Item in}\\ \text{cubic Feet}\end{pmatrix}\right]\right]\right\}$$

WHERE:

$$\begin{pmatrix}\text{Annual Number}\\ \text{of Items for}\\ \text{Disposition at}\\ \text{the } p'\text{th LB Site}\end{pmatrix}^{t} = \left[\begin{pmatrix}\text{Annual Number of}\\ \text{Items for Disposition}\\ \text{at the NAS Located}\\ \text{at the } p'\text{th LB Site}\end{pmatrix}^{t} + \begin{pmatrix}\text{Annual Number of}\\ \text{Items for Disposition}\\ \text{at the PIMA Located}\\ \text{at the } p'\text{th LB Site}\end{pmatrix}^{t}\right]$$

s = the s'th resupply depot

T = number of resupply depots

40.2.5.2 Transportation cost for the repair cases.

$$
\begin{aligned}
&\left(\begin{array}{c}\text{Transportation}\\ \text{Cost}\\ \text{for Repair}\end{array}\right)^{c} = \left(\begin{array}{c}\text{Normal}\\ \text{Discount}\\ \text{Factor}\end{array}\right) \\
&\left\{ 2\sum_{d=1}^{J}\sum_{e=1}^{E}\left[\left(\begin{array}{c}\text{Annual Number of}\\ \text{Items Sent from}\\ \text{the } d'\text{th IMA to}\\ \text{the } e'\text{th PIMA}\end{array}\right)^{c}_{e,d}\left[\left(\begin{array}{c}\text{Transportation}\\ \text{Rate per Pound}\\ \text{from the } d'\text{th IMA}\\ \text{to the } e'\text{th PIMA}\end{array}\right)_{e,d}\left(\begin{array}{c}\text{Weight}\\ \text{of the}\\ \text{Item}\end{array}\right)+\left(\begin{array}{c}\text{Packaging and}\\ \text{Handling Rate}\\ \text{per Cubic Foot}\end{array}\right)\left(\begin{array}{c}\text{Inventory}\\ \text{Storage Space}\\ \text{per Item in}\\ \text{Cubic Feet}\end{array}\right)\right]\right]\right. \\
&+ 2\sum_{d=1}^{J}\sum_{g=1}^{h}\left[\left(\begin{array}{c}\text{Annual Number of}\\ \text{Items Sent from}\\ \text{the } d'\text{th IMA to}\\ \text{the } g'\text{th Depot}\end{array}\right)^{c}_{g,d}\left[\left(\begin{array}{c}\text{Transportation}\\ \text{Rate per Pound}\\ \text{from the } d'\text{th IMA}\\ \text{to the } g'\text{th Depot}\end{array}\right)_{g,d}\left(\begin{array}{c}\text{Weight}\\ \text{of the}\\ \text{Item}\end{array}\right)+\left(\begin{array}{c}\text{Packaging and}\\ \text{Handling Rate}\\ \text{per Cubic Foot}\end{array}\right)\left(\begin{array}{c}\text{Inventory}\\ \text{Storage Space}\\ \text{per Item in}\\ \text{Cubic Feet}\end{array}\right)\right]\right] \\
&+ 2\sum_{e=1}^{E}\sum_{g=1}^{h}\left[\left(\begin{array}{c}\text{Annual Number of}\\ \text{Items Sent from}\\ \text{the } e'\text{th PIMA to}\\ \text{the } g'\text{th Depot}\end{array}\right)^{c}_{g,e}\left[\left(\begin{array}{c}\text{Transportation}\\ \text{Rate per Pound}\\ \text{from the } e'\text{th PIMA}\\ \text{to the } g'\text{th Depot}\end{array}\right)_{g,e}\left(\begin{array}{c}\text{Weight}\\ \text{of the}\\ \text{Item}\end{array}\right)+\left(\begin{array}{c}\text{Packaging and}\\ \text{Handling Rate}\\ \text{per Cubic Foot}\end{array}\right)\left(\begin{array}{c}\text{Inventory}\\ \text{Storage Space}\\ \text{per Item in}\\ \text{Cubic Feet}\end{array}\right)\right]\right] \\
&+ \sum_{k=1}^{L}\sum_{s=1}^{T}\left[\left(\begin{array}{c}\text{Annual Repair}\\ \text{Scrap Quantity}\\ \text{at the } k'\text{th}\\ \text{CV Site}\end{array}\right)^{c}_{k}\left[\left(\begin{array}{c}\text{Transportation}\\ \text{Rate per Pound}\\ \text{from the } s'\text{th Site}\\ \text{to the } k'\text{th CV Site}\end{array}\right)_{s,k}\left(\begin{array}{c}\text{Weight}\\ \text{of the}\\ \text{Item}\end{array}\right)\left(\begin{array}{c}\text{Fraction of}\\ \text{the } k'\text{th CV's}\\ \text{Resupply}\\ \text{from } s'\text{th Site}\end{array}\right)_{s,k}+\left(\begin{array}{c}\text{Packaging and}\\ \text{Handling Rate}\\ \text{per Cubic Foot}\end{array}\right)\left(\begin{array}{c}\text{Inventory}\\ \text{Storage Space}\\ \text{per Item in}\\ \text{Cubic Feet}\end{array}\right)\right]\right] \\
&+ \sum_{p=1}^{q}\sum_{s=1}^{T}\left[\left(\begin{array}{c}\text{Annual Repair}\\ \text{Scrap Quantity}\\ \text{at the } p'\text{th}\\ \text{LB Site}\end{array}\right)^{c}_{p}\left[\left(\begin{array}{c}\text{Transportation}\\ \text{Rate per Pound}\\ \text{from the } s'\text{th Site}\\ \text{to the } p'\text{th LB Site}\end{array}\right)_{s,p}\left(\begin{array}{c}\text{Weight}\\ \text{of the}\\ \text{Item}\end{array}\right)\left(\begin{array}{c}\text{Fraction of}\\ \text{the } p'\text{th LB's}\\ \text{Resupply}\\ \text{from } s'\text{th Site}\end{array}\right)_{s,p}+\left(\begin{array}{c}\text{Packaging and}\\ \text{Handling Rate}\\ \text{per Cubic Foot}\end{array}\right)\left(\begin{array}{c}\text{Inventory}\\ \text{Storage Space}\\ \text{per Item in}\\ \text{Cubic Feet}\end{array}\right)\right]\right] \\
&\left.+ \sum_{g=1}^{h}\sum_{s=1}^{T}\left[\left(\begin{array}{c}\text{Annual Repair}\\ \text{Scrap Quantity}\\ \text{at the } g'\text{th}\\ \text{Depot}\end{array}\right)^{c}_{g}\left[\left(\begin{array}{c}\text{Transportation}\\ \text{Rate per Pound}\\ \text{from the } s'\text{th Site}\\ \text{to the } g'\text{th Depot}\end{array}\right)_{s,g}\left(\begin{array}{c}\text{Weight}\\ \text{of the}\\ \text{Item}\end{array}\right)\left(\begin{array}{c}\text{Fraction of}\\ g'\text{th Depot's}\\ \text{Resupply}\\ \text{from } s'\text{th Site}\end{array}\right)_{s,g}+\left(\begin{array}{c}\text{Packaging and}\\ \text{Handling Rate}\\ \text{per Cubic Foot}\end{array}\right)\left(\begin{array}{c}\text{Inventory}\\ \text{Storage Space}\\ \text{per Item in}\\ \text{Cubic Feet}\end{array}\right)\right]\right]\right\}
\end{aligned}
$$

40.2.6 Support equipment cost. Two types of support equipment are considered in LORA decisions. First, the item may require PSE (Peculiar Support Equipment) for fault isolation or verification. The contractor would design a specific equipment to service the item. Second, the contractor may design an equipment that services a group of items, in which case the equipment is required if at least one member of the group is assigned to some level requiring the equipment.

40.2.6.1 Peculiar support equipment cost. When performing an analysis at the item's indenture level, allocatable and/or non-allocatable cost may be incurred. For PSE, peculiar to an individual item, the cost is assigned entirely to the item as an allocatable cost. For PSE designed for a group of items, the cost is assigned to the group of items as non-allocatable cost. Within the following equations, the word item refers to an item that has PSE specifically designed for it or to the items in a group that have PSE designed for the group. In the PSE cost equations that follow the total cost of on PSE is defined to include the initial unit cost and annually recurring support costs.

$$\begin{pmatrix}\text{Unit and}\\ \text{Support}\\ \text{Cost of}\\ \text{a PSE}\end{pmatrix}^{*} = \begin{pmatrix}\text{Unit Cost}\\ \text{of the}\\ \text{PSE}\end{pmatrix}\left[1.0 + \left[\frac{\begin{pmatrix}\text{Support of the}\\ \text{Support Equipment}\\ \text{Rate for the}\\ \text{First Year}\end{pmatrix}}{(1.0 + \text{Discount Rate})}\right] + \begin{pmatrix}\text{Support of}\\ \text{Support Equipment}\\ \text{Rate for the}\\ \text{Succeeding Years}\end{pmatrix}\begin{pmatrix}\text{Reduced}\\ \text{Discount}\\ \text{Factor}\end{pmatrix}\right]$$

** Applicable to repair and discard PGSE as required by the LORA case under consideration*

40.2.6.2 Peculiar support equipment cost for the discard case. Discard or verification PSE may be used at the item level to check and test an item's failure.

$$\begin{pmatrix}\text{Item PSE}\\ \text{Cost for}\\ \text{Dsicard}\end{pmatrix}^{t} = \left[\begin{pmatrix}\text{Unit and Support}\\ \text{Cost per Discard}\\ \text{PSE at CV to}\\ \text{Verify Item}\\ \text{Failure}\end{pmatrix}\begin{pmatrix}\text{Number of*}\\ \text{Discard PSE}\\ \text{Required}\\ \text{per CV}\end{pmatrix}\begin{pmatrix}\text{Number}\\ \text{of}\\ \text{CV's}\end{pmatrix}^{t} + \begin{pmatrix}\text{Unit and Support}\\ \text{Cost per Discard}\\ \text{PSE at NAS to}\\ \text{Verify Item}\\ \text{Failure}\end{pmatrix}\begin{pmatrix}\text{Number of*}\\ \text{Discard PSE}\\ \text{Required}\\ \text{per NAS}\end{pmatrix}\begin{pmatrix}\text{Number of}\\ \text{Non-PIMA}\\ \text{NAS's}\end{pmatrix}^{t}\right.$$

$$\left. + \begin{pmatrix}\text{Unit and Support**}\\ \text{Cost per Discard}\\ \text{PSE at PIMA to}\\ \text{Verify Item}\\ \text{Failure}\end{pmatrix}\begin{pmatrix}\text{Number of}\\ \text{Discard PSE}\\ \text{Required}\\ \text{per PIMA}\end{pmatrix}^{**}\begin{pmatrix}\text{Number}\\ \text{of}\\ \text{PIMA's}\end{pmatrix}^{t} + \begin{pmatrix}\text{Unit and Support**}\\ \text{Cost per Discard}\\ \text{PSE at Depot}\\ \text{to Verify Item}\\ \text{Failure}\end{pmatrix}\begin{pmatrix}\text{Number of*}\\ \text{Discard PSE}\\ \text{Required}\\ \text{per Depot}\end{pmatrix}^{**}\begin{pmatrix}\text{Number of}\\ \text{Depots}\end{pmatrix}^{t}\right]$$

** The term = 0 if the higher assembly is not repaired at the site as applicable to the LORA case under consideration. The determination as to whether CV, non-PIMA, NAS, or PIMA sites require support equipment is dependent upon where the higher assembly is repaired.*

*** The type of support equipment resources, full or back-up, at the PIMA and Depot sites is dependent on the LORA case and workload at the sites. The determination of full or back-up resources is based on the criteria of figures D-3 and D-4.*

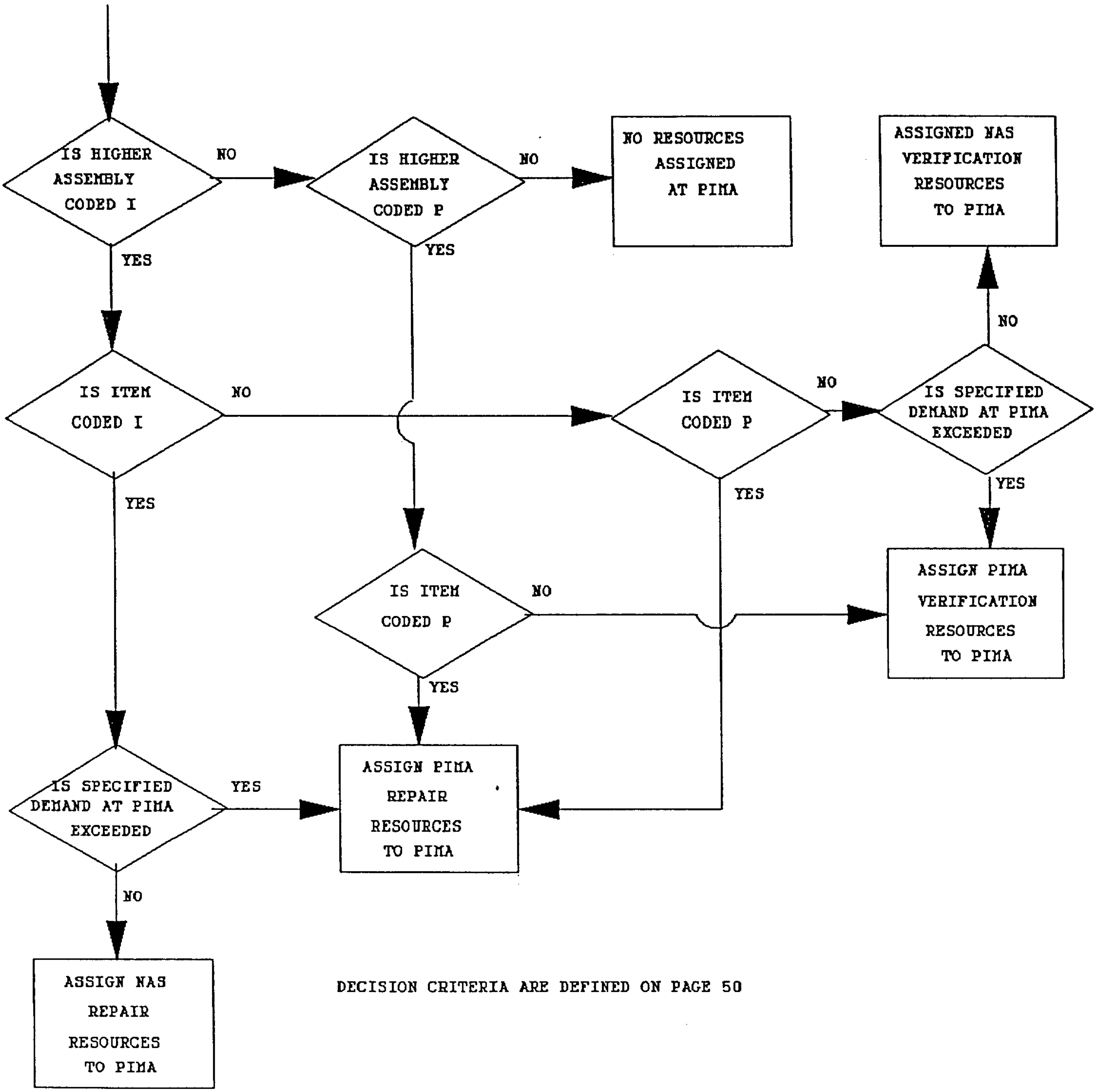
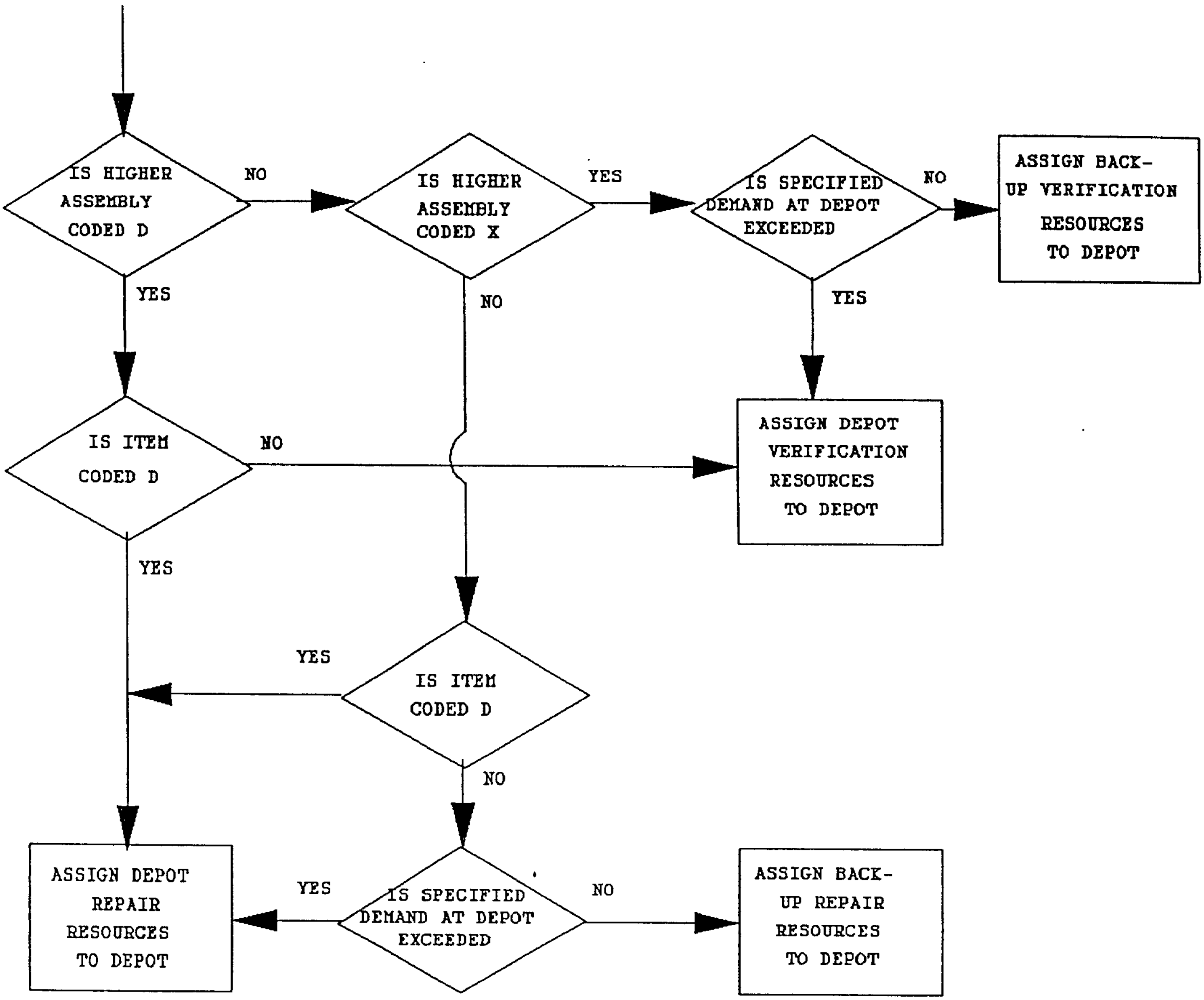


FIGURE D-3. Criteria for full or back-up resources at PIMA sites.

Description of the Criteria for Full or
Back-up Resources at PIMA Sites

The LORA techniques allow one or two types of support resources (support equipment, personnel, documentation, repair work space, equipment space) to be used at PIMA repair facilities. The mode of operation of a PIMA to support the item under analysis depends upon the LORA code assignment of the item. A PIMA services repairables generated at the PIMA due to its local operating aircraft as will as those forwarded to it from other operating sites. Full PIMA resources are always provided for items which are coded PIMA repair, or for higher level assemblies coded PIMA repair; the resource determination for other items depends on the workload experienced at the PIMA. If the workload does not exceed a specified percentage of the locally generated workload the PIMA operates under a reduced mode and back-up NAS resources are provided. If the workload exceeds the specified percentage the PIMA operates under a full mode and full PIMA resources are required. The decision criteria used for determination of full or back-up repair and verification resources for PIMA facilities as a function of the LORA code assignment are given in figure D-3.



DECISION CRITERIA ARE DEFINED ON PAGE 52

FIGURE D-4. Criteria for full or back-up resources at depot sites.

Description of the Criteria for Full or Back-up Resources at Depot Sites

The LORA techniques allow one or two types of support resources (support equipment, personnel, documentation, repair work space, equipment space) to be used at Depot repair facilities. The mode of operation of a Depot to support the item under analysis depends upon the LORA code assignment of the item. A Depot services repairables forwarded to it from other repair sites. Full Depot resources are always provided for items which are coded Depot repair, or for higher level assemblies coded Depot repair; the resource determination for other items depends on the workload experienced at the Depot. If the workload does not exceed a specified percentage then the Depot operates under a limited mode and back-up depot resources are provided. If the workload exceeds the specified percentage the Depot operates under a full mode and full Depot resources are provided. The decision criteria used for determination of full or back-up repair and verification resources at Depot facilities as a function of the LORA code assignment are given in figure D-4.

40.2.6.3 Peculiar support equipment cost for the repair intermediate cases. Repair PSE at intermediate repair facilities can verify the item failure and fault isolate to the next lower assembly. The repair PSE is more complex that its discard counterpart and the complexity is reflected in different costs from the required PSE. The assignment of the PSE cost as allocatable/non-allocatable and the resource type determination are the same as that for discard.

$$\begin{pmatrix}\text{Item PSE}\\ \text{Cost for}\\ \text{Intermediate}\\ \text{Repair}\end{pmatrix} = \left[\begin{pmatrix}\text{Unit and Support*}\\ \text{Cost per Repair}\\ \text{PSE at CV to}\\ \text{Repair Item}\\ \text{Failure}\end{pmatrix}\begin{pmatrix}\text{Number of}\\ \text{Repair PSE}\\ \text{Required}\\ \text{per CV}\end{pmatrix}\begin{pmatrix}\text{Number}\\ \text{of}\\ \text{CV's}\end{pmatrix}^{t} + \begin{pmatrix}\text{Unit and Support}\\ \text{Cost per Repair}\\ \text{PSE at NAS to}\\ \text{Repair Item}\\ \text{Failure}\end{pmatrix}\begin{pmatrix}\text{Number of}\\ \text{Repair PSE}\\ \text{Required}\\ \text{per NAS}\end{pmatrix}\begin{pmatrix}\text{Number of}\\ \text{non-PIMA}\\ \text{NAS's}\end{pmatrix}^{t}\right.$$

$$\left. + \begin{pmatrix}\text{Unit and Support*}\\ \text{Cost per Repair}\\ \text{PSE at PIMA to}\\ \text{Repair Item}\\ \text{Failure}\end{pmatrix}\begin{pmatrix}\text{Number of*}\\ \text{Repair PSE}\\ \text{Required}\\ \text{per PIMA}\end{pmatrix}\begin{pmatrix}\text{Number}\\ \text{of}\\ \text{PIMA's}\end{pmatrix}^{t} + \begin{pmatrix}\text{Unit and Support*}\\ \text{Cost per Repair}\\ \text{PSE at Depot}\\ \text{to Repair Item}\\ \text{Failure}\end{pmatrix}\begin{pmatrix}\text{Number of*}\\ \text{Discard PSE}\\ \text{Required}\\ \text{per Depot}\end{pmatrix}\begin{pmatrix}\text{Number of}\\ \text{Depots}\end{pmatrix}^{t}\right]$$

** The determination of full or back-up resources is based on the criteria of figures D-3 and D-4.

40.2.6.4 Peculiar support equipment cost for repair PIMA cases. Support equipment for fault verification may be required at the operational site if the higher assembly was repaired there. The assignment of the PSE cost as allocatable/non-allocatable is the same as that for the discard and repair intermediate cases.

$$\begin{pmatrix}\text{Item PSE}\\ \text{Cost for}\\ \text{PIMA}\\ \text{Repair}\end{pmatrix}^{t} = \left[\begin{pmatrix}\text{Unit and Support}\\ \text{Cost per Discard}\\ \text{PSE at CV to}\\ \text{Verify Item}\\ \text{Failure}\end{pmatrix}\begin{pmatrix}\text{Number of*}\\ \text{Discard PSE}\\ \text{Required}\\ \text{per CV}\end{pmatrix}\begin{pmatrix}\text{Number}\\ \text{of}\\ \text{CV's}\end{pmatrix}^{t} + \begin{pmatrix}\text{Unit and Support}\\ \text{Cost per Repair}\\ \text{PSE at NAS to}\\ \text{Verify Item}\\ \text{Failure}\end{pmatrix}\begin{pmatrix}\text{Number of*}\\ \text{Discard PSE}\\ \text{Required}\\ \text{per NAS}\end{pmatrix}\begin{pmatrix}\text{Number of}\\ \text{non-PIMA}\\ \text{NAS's}\end{pmatrix}^{t}\right.$$

$$\left. + \begin{pmatrix}\text{Unit and Support}\\ \text{Cost per Discard}\\ \text{PSE at PIMA to}\\ \text{Repair Item}\\ \text{Failure}\end{pmatrix}\begin{pmatrix}\text{Number of}\\ \text{Repair PSE}\\ \text{Required}\\ \text{per PIMA}\end{pmatrix}\begin{pmatrix}\text{Number}\\ \text{of}\\ \text{PIMA's}\end{pmatrix}^{t} + \begin{pmatrix}\text{Unit and Support}\\ \text{Cost per Repair}\\ \text{PSE at Depot}\\ \text{to Repair Item}\\ \text{Failure}\end{pmatrix}\begin{pmatrix}\text{Number of}\\ \text{Discard PSE}\\ \text{Required}\\ \text{per Depot}\end{pmatrix}\begin{pmatrix}\text{Number of}\\ \text{Depots}\end{pmatrix}^{t}\right]$$

* The term = 0 if the higher assembly is not repaired at the site as applicable to the LORA case under consideration

40.2.6.5 Peculiar support equipment cost for repair depot cases. Support equipment for fault verification may be required at the operational site or PIMA if the higher assembly was repaired there. The assignment of the PSE as allocatable/non-allocatable is the same as that for the discard, repair intermediate, and repair PIMA cases.

$$\left(\begin{array}{c}\text{Item PSE}\\\text{Cost for}\\\text{Depot}\\\text{Repair}\end{array}\right)^t = \Bigg[\left(\begin{array}{c}\text{Unit and Support}\\\text{Cost per Discard}\\\text{PSE at CV to}\\\text{Verify Item}\\\text{Failure}\end{array}\right)\left(\begin{array}{c}\text{Number of*}\\\text{Discard PSE}\\\text{Required}\\\text{per CV}\end{array}\right)\left(\begin{array}{c}\text{Number}\\\text{of}\\\text{CV's}\end{array}\right)^t + \left(\begin{array}{c}\text{Unit and Support}\\\text{Cost per Discard}\\\text{PSE at NAS to}\\\text{Verify Item}\\\text{Failure}\end{array}\right)\left(\begin{array}{c}\text{Number of*}\\\text{Discard PSE}\\\text{Required}\\\text{per NAS}\end{array}\right)\left(\begin{array}{c}\text{Number of}\\\text{non-PIMA}\\\text{NAS's}\end{array}\right)$$

$$+ \left(\begin{array}{c}\text{Unit and Support*}\\\text{Cost per Discard}\\\text{PSE at PIMA to}\\\text{Verify Item}\\\text{Failure}\end{array}\right)\left(\begin{array}{c}\text{Number of*}\\\text{Discard PSE}\\\text{Required}\\\text{per PIMA}\end{array}\right)\left(\begin{array}{c}\text{Number}\\\text{of}\\\text{PIMA's}\end{array}\right)^t + \left(\begin{array}{c}\text{Unit and Support}\\\text{Cost per Repair}\\\text{PSE at Depot}\\\text{to Repair Item}\\\text{Failure}\end{array}\right)\left(\begin{array}{c}\text{Number of}\\\text{Discard PSE}\\\text{Required}\\\text{per Depot}\end{array}\right)\left(\begin{array}{c}\text{Number of}\\\text{Depots}\end{array}\right)^t\Bigg]$$

* *The term = 0 if the higher assembly is not repaired at the site as applicable to the LORA case under consideration*

40.2.7 Space cost. For each case, total space is the sum of three separate costs: cost of inventory storage space, cost of support equipment space, and cost of repair work space.

40.2.7.1 Inventory storage space cost. The cost associated with the discard inventory; attrition, rotatable pool, and system stock quantities.

40.2.7.1.1 Inventory storage space cost for discard cases. For carrier based aircraft, the storage quantity is adjusted to account for the fact that failures occur only during the carrier's deployments. This adjustment is carried out though division by the carrier deployment factor.

$$\left(\begin{array}{c}\text{Cost of Inventory}\\\text{Storage Space}\\\text{for Discard}\end{array}\right)^t = \sum_{v=1}^{r}\left[\left(\begin{array}{c}\text{Inventory Reserved}\\\text{for the Required}\\\text{Days of Stock of}\\\text{the v'th Site}\end{array}\right)_v^t\left(\begin{array}{c}\text{Cost of Space per}\\\text{Cubic Foot per Year}\\\text{at the v'th Site}\end{array}\right)_v\right]\left(\begin{array}{c}\text{Inventory}\\\text{Storage Space}\\\text{per Item in}\\\text{Cubic Feet}\end{array}\right)\left(\begin{array}{c}\text{Normal}\\\text{Discount}\\\text{Factor}\end{array}\right)$$

WHERE :

$$\left(\begin{array}{c}\text{Inventory Reserved}\\\text{for the Required}\\\text{Days of Stock of}\\\text{the v'th Site}\end{array}\right)^t = INT\left\{\frac{\left(\begin{array}{c}\text{Annual Inventory}\\\text{Quantity for Discard}\\\text{at the v'th Site}\end{array}\right)^t\left(\begin{array}{c}\text{Required Days}\\\text{of Stock at}\\\text{the v'th Stock}\end{array}\right)}{\left(\begin{array}{c}\text{365 Days}\\\text{per}\\\text{Year}\end{array}\right)\left(\begin{array}{c}\text{Carrier *}\\\text{Deployment}\\\text{Factor}\end{array}\right)}\right\}$$

40.2.7.1.2 Inventory storage space cost for repair cases.

$$\begin{pmatrix}\text{Cost of Inventory}\\ \text{Storage Space}\\ \text{per Item}\\ \text{for Repair}\end{pmatrix}^t = \left\{ \sum_{k=1}^{L}\left[\begin{pmatrix}\text{Rotatable}\\ \text{Pool Quantity}\\ \text{at the k'th}\\ \text{CV Site}\end{pmatrix}_k^t + \begin{pmatrix}\text{Attrition}\\ \text{Quantity}\\ \text{at the k'th}\\ \text{CV Site}\end{pmatrix}_k^t\right]\begin{pmatrix}\text{Cost of Space}\\ \text{per Cubic Foot}\\ \text{per Year for}\\ \text{CV Sites}\end{pmatrix}\right.$$

$$+ \sum_{p=1}^{q}\left[\begin{pmatrix}\text{Rotatable}\\ \text{Pool Quantity}\\ \text{at the p'th}\\ \text{LB Site}\end{pmatrix}_p^t + \begin{pmatrix}\text{Attrition}\\ \text{Quantity}\\ \text{at the p'th}\\ \text{LB Site}\end{pmatrix}_p^t\right]\begin{pmatrix}\text{Cost of Space}\\ \text{per Cubic Foot}\\ \text{per Year for}\\ \text{LB Sites}\end{pmatrix}$$

$$\left. + \begin{pmatrix}\text{System}\\ \text{Stock of}\\ \text{the Item}\end{pmatrix}^t \begin{pmatrix}\text{Cost of Space}\\ \text{per Cubic Foot}\\ \text{per Year for}\\ \text{Depot Sites}\end{pmatrix}\right\} \begin{pmatrix}\text{Inventory Storage}\\ \text{Space per Item}\\ \text{in Cubic Feet}\end{pmatrix}\begin{pmatrix}\text{Normal}\\ \text{Discount}\\ \text{Factor}\end{pmatrix}$$

40.2.7.2 Support equipment space cost. The cost of PSE space allocated to an item or a group of items. It is determined as a function of the number of required PSE, the PSE deck space, and the cost of space at the facility. The deck space includes both the space occupied by the PSE and the working space necessary to operate the equipment. The assignment of the space cost to an item or group of items and the determination of type of resource are the same as that for support equipment. Within the following equations, the word item refers to an item that has PSE specifically designed for it or to the group of items that have PSE designed for the group.

$$\begin{pmatrix}\text{Cost of}\\ \text{PSE Space}\end{pmatrix}^t = \left\{\left[\begin{pmatrix}\text{Number of}\\ \text{PSE Required}\\ \text{per CV Site}\end{pmatrix}^t \begin{pmatrix}\text{Space}\\ \text{Required}\\ \text{per PSE}\end{pmatrix}\begin{pmatrix}\text{Number of}\\ \text{CV Sites}\end{pmatrix}^t \begin{pmatrix}\text{Cost of Space}\\ \text{per Square Foot}\\ \text{per Year for}\\ \text{CV Sites}\end{pmatrix}\right]\right.$$

$$+ \left[\begin{pmatrix}\text{Number of}\\ \text{PSE Required}\\ \text{per NAS}\end{pmatrix}^t \begin{pmatrix}\text{Space}\\ \text{Required}\\ \text{per PSE}\end{pmatrix}\begin{pmatrix}\text{Number of}\\ \text{non-PIMA}\\ \text{NAS's}\end{pmatrix}^t \begin{pmatrix}\text{Cost of Space}\\ \text{per Square Foot}\\ \text{per Year for}\\ \text{LB Sites}\end{pmatrix}\right]$$

$$+ \left[\begin{pmatrix}\text{Number of}\\ \text{PSE Required}\\ \text{per PIMA}\end{pmatrix}^t \begin{pmatrix}\text{Space}\\ \text{Required}\\ \text{per PSE}\end{pmatrix}\begin{pmatrix}\text{Number of}\\ \text{PIMA's}\end{pmatrix}^t \begin{pmatrix}\text{Cost of Space}\\ \text{per Square Foot}\\ \text{per Year for}\\ \text{PIMA Sites}\end{pmatrix}\right]$$

$$\left. + \left[\begin{pmatrix}\text{Number of}\\ \text{PSE Required}\\ \text{per Depot}\end{pmatrix}^t \begin{pmatrix}\text{Space}\\ \text{Required}\\ \text{per PSE}\end{pmatrix}\begin{pmatrix}\text{Number of}\\ \text{Depots}\end{pmatrix}^t \begin{pmatrix}\text{Cost of Space}\\ \text{per Square Foot}\\ \text{per Year for}\\ \text{Depot Sites}\end{pmatrix}\right]\right\}\begin{pmatrix}\text{Normal}\\ \text{Discount}\\ \text{Factor}\end{pmatrix}$$

40.2.7.3 Repair work space cost. Repair work space is defined as the space dedicated solely of maintenance actions of an item or group of items exclusive of the support equipment space. The assignment of the space cost as allocatable/non-allocatable and determination of type of resource is the same as that for support equipment. The word item, in the following equations, refers to the item or the items that uniquely have the space set aside for maintenance actions.

$$\begin{pmatrix}\text{Repair Work}\\ \text{Space Cost}\end{pmatrix}^t = \Bigg\{\Bigg[\begin{pmatrix}\text{Item Repair}\\ \text{Work Space}\\ \text{Required at}\\ \text{the CV Site}\end{pmatrix}^t \begin{pmatrix}\text{Number}\\ \text{of}\\ \text{CV Sites}\end{pmatrix}^t \begin{pmatrix}\text{Cost of Space}\\ \text{per Square Foot}\\ \text{per Year for}\\ \text{CV Sites}\end{pmatrix}\Bigg]$$

$$+ \Bigg[\begin{pmatrix}\text{Item Repair}\\ \text{Work Space}\\ \text{Required at}\\ \text{the NAS Site}\end{pmatrix}^t \begin{pmatrix}\text{Number of}\\ \text{non-PIMA}\\ \text{NAS's Sites}\end{pmatrix}^t \begin{pmatrix}\text{Cost of Space}\\ \text{per Square Foot}\\ \text{per Year for}\\ \text{LB Sites}\end{pmatrix}\Bigg]$$

$$+ \Bigg[\begin{pmatrix}\text{Item Repair}\\ \text{Work Space}\\ \text{Required at}\\ \text{the PIMA}\end{pmatrix}^t \begin{pmatrix}\text{Number}\\ \text{of}\\ \text{PIMA's}\end{pmatrix}^t \begin{pmatrix}\text{Cost of Space}\\ \text{per Square Foot}\\ \text{per Year for}\\ \text{PIMA Sites}\end{pmatrix}\Bigg]$$

$$+ \Bigg[\begin{pmatrix}\text{Item Repair}\\ \text{Work Space}\\ \text{Required at}\\ \text{the Depot}\end{pmatrix}^t \begin{pmatrix}\text{Number}\\ \text{of}\\ \text{Depots}\end{pmatrix}^t \begin{pmatrix}\text{Cost of Space}\\ \text{per Square Foot}\\ \text{per Year for}\\ \text{Depot Sites}\end{pmatrix}\Bigg]\Bigg]\Bigg\} \begin{pmatrix}\text{Normal}\\ \text{Discount}\\ \text{Factor}\end{pmatrix}$$

40.2.7.4 Total space cost. The sum of the inventory, support equipment, and repair work space costs.

$$\begin{pmatrix}\text{Total}\\ \text{Space}\\ \text{Cost}\end{pmatrix}^t = \begin{pmatrix}\text{Inventory}\\ \text{Storage}\\ \text{Space Cost}\end{pmatrix}^t + \begin{pmatrix}\text{Support}\\ \text{Equipment}\\ \text{Space Cost}\end{pmatrix}^t + \begin{pmatrix}\text{Repair}\\ \text{Work}\\ \text{Space Cost}\end{pmatrix}^t$$

40.2.8 Labor cost. The cost incurred for discard and repair actions.

40.2.8.1 Labor cost for the discard case.

$$\begin{pmatrix}\text{Cost of}\\ \text{Labor for}\\ \text{Discard}\end{pmatrix}^t = \Bigg\{\sum_{k=1}^{L}\Bigg[\begin{pmatrix}\text{Annual Number}\\ \text{of Real Failures}\\ \text{Removed at the}\\ \text{k'th CV Site}\end{pmatrix}^t_k \begin{pmatrix}\text{Direct Maintenance}\\ \text{Man Hours at CV}\\ \text{per Discard Action}\end{pmatrix} \begin{pmatrix}\text{Labor Cost}\\ \text{per Hour}\\ \text{at the CV}\end{pmatrix}\Bigg]$$

$$+ \sum_{m=1}^{n}\Bigg[\begin{pmatrix}\text{Annual Number}\\ \text{of Real Failures}\\ \text{Removed at the}\\ \text{m'th NAS Site}\end{pmatrix}^t_m \begin{pmatrix}\text{Direct Maintenance}\\ \text{Man Hours at NAS}\\ \text{per Discard Action}\end{pmatrix} \begin{pmatrix}\text{Labor Cost}\\ \text{per Hour}\\ \text{at the NAS}\end{pmatrix}\Bigg]$$

$$+ \sum_{e=1}^{f}\Bigg[\begin{pmatrix}\text{Annual Number}\\ \text{of Real Failures}\\ \text{Removed at the}\\ \text{e'th PIMA Site}\end{pmatrix}^t_e \begin{pmatrix}\text{Direct Maintenance}\\ \text{Man Hours at PIMA}\\ \text{per Discard Action}\end{pmatrix} \begin{pmatrix}\text{Labor Cost}\\ \text{per Hour}\\ \text{at the PIMA}\end{pmatrix}\Bigg]$$

$$+ \sum_{g=1}^{h}\Bigg[\begin{pmatrix}\text{Annual Number}\\ \text{of Real Failures}\\ \text{Removed at the}\\ \text{g'th Depot Site}\end{pmatrix}^t_g \begin{pmatrix}\text{Direct Maintenance}\\ \text{Man Hours at Depot}\\ \text{per Discard Action}\end{pmatrix} \begin{pmatrix}\text{Labor Cost}\\ \text{per Hour}\\ \text{at the Depot}\end{pmatrix}\Bigg]$$

$$\Bigg[1.0 + \begin{pmatrix}\text{Fraction of}\\ \text{Items Falsely}\\ \text{Removed}\end{pmatrix}\Bigg] \begin{pmatrix}\text{Normal}\\ \text{Discount}\\ \text{Factor}\end{pmatrix}\Bigg\}$$

40.2.8.2 Labor cost for repair intermediate cases.

$$
\begin{aligned}
\begin{pmatrix}\text{Cost of}\\ \text{Labor for}\\ \text{Intermediate}\\ \text{Repair}\end{pmatrix}^{t} = \Bigg[& \sum_{k=1}^{L} \begin{pmatrix}\text{Annual Number}\\ \text{of Real Failures}\\ \text{Removed at the}\\ k'\text{th CV Site}\end{pmatrix}^{t}_{k} \begin{pmatrix}\text{Labor Cost}\\ \text{per Hour}\\ \text{at the CV}\end{pmatrix} \Bigg\{ \begin{pmatrix}\text{Fraction of}\\ \text{Items Falsely}\\ \text{Removed}\end{pmatrix} \begin{pmatrix}\text{Fraction of Item}\\ \text{False Removals}\\ \text{Detected as such}\end{pmatrix} \begin{pmatrix}\text{Direct Maintenance}\\ \text{Man Hours at CV}\\ \text{per Discard Action}\end{pmatrix} \\
& + \Bigg[1.0 + \begin{pmatrix}\text{Fraction of}\\ \text{Items Falsely}\\ \text{Removed}\end{pmatrix} \Bigg] \Bigg[1.0 - \begin{pmatrix}\text{Fraction of Item}\\ \text{False Removals}\\ \text{Detected as such}\end{pmatrix} \Bigg] \Bigg] \begin{pmatrix}\text{Direct Maintenance}\\ \text{Man Hours at CV}\\ \text{per Repair Action}\end{pmatrix} \Bigg\} \\
& + \sum_{m=1}^{n} \begin{pmatrix}\text{Annual Number}\\ \text{of Real Failures}\\ \text{Removed at the}\\ m'\text{th NAS Site}\end{pmatrix}^{t}_{m} \begin{pmatrix}\text{Labor Cost}\\ \text{per Hour}\\ \text{at the NAS}\end{pmatrix} \Bigg\{ \begin{pmatrix}\text{Fraction of}\\ \text{Items Falsely}\\ \text{Removed}\end{pmatrix} \begin{pmatrix}\text{Fraction of Item}\\ \text{False Removals}\\ \text{Detected as such}\end{pmatrix} \begin{pmatrix}\text{Direct Maintenance}\\ \text{Man Hours at NAS}\\ \text{per Discard Action}\end{pmatrix} \\
& + \Bigg[1.0 + \begin{pmatrix}\text{Fraction of}\\ \text{Items Falsely}\\ \text{Removed}\end{pmatrix} \Bigg] \Bigg[1.0 - \begin{pmatrix}\text{Fraction of Item}\\ \text{False Removals}\\ \text{Detected as such}\end{pmatrix} \Bigg] \Bigg] \begin{pmatrix}\text{Direct Maintenance}\\ \text{Man Hours at NAS}\\ \text{per Repair Action}\end{pmatrix} \Bigg\} \\
& + \sum_{e=1}^{f} \begin{pmatrix}\text{Annual Number}\\ \text{of Real Failures}\\ \text{Removed at the}\\ e'\text{th PIMA Site}\end{pmatrix}^{t}_{e} \begin{pmatrix}\text{Labor Cost}\\ \text{per Hour}\\ \text{at the NAS}\end{pmatrix} \Bigg\{ \begin{pmatrix}\text{Fraction of}\\ \text{Items Falsely}\\ \text{Removed}\end{pmatrix} \begin{pmatrix}\text{Fraction of Item}\\ \text{False Removals}\\ \text{Detected as such}\end{pmatrix} \begin{pmatrix}\text{Direct Maintenance}\\ \text{Man Hours at PIMA}\\ \text{per Discard Action}\end{pmatrix} \\
& + \Bigg[1.0 + \begin{pmatrix}\text{Fraction of}\\ \text{Items Falsely}\\ \text{Removed}\end{pmatrix} \Bigg] \Bigg[1.0 - \begin{pmatrix}\text{Fraction of Item}\\ \text{False Removals}\\ \text{Detected as such}\end{pmatrix} \Bigg] \Bigg] \begin{pmatrix}\text{Direct Maintenance}\\ \text{Man Hours at PIMA}\\ \text{per Repair Action}\end{pmatrix} \Bigg\} \\
& + \sum_{g=1}^{h} \begin{pmatrix}\text{Annual Number}\\ \text{of Real Failures}\\ \text{Removed at the}\\ g'\text{th Depot}\end{pmatrix}^{t}_{g} \begin{pmatrix}\text{Labor Cost}\\ \text{per Hour}\\ \text{at the Depot}\end{pmatrix} \Bigg\{ \begin{pmatrix}\text{Fraction of}\\ \text{Items Falsely}\\ \text{Removed}\end{pmatrix} \begin{pmatrix}\text{Fraction of Item}\\ \text{False Removals}\\ \text{Detected as such}\end{pmatrix} \begin{pmatrix}\text{Direct Maintenance}\\ \text{Man Hours at Depot}\\ \text{per Discard Action}\end{pmatrix} \\
& + \Bigg[1.0 + \begin{pmatrix}\text{Fraction of}\\ \text{Items Falsely}\\ \text{Removed}\end{pmatrix} \Bigg] \Bigg[1.0 - \begin{pmatrix}\text{Fraction of Item}\\ \text{False Removals}\\ \text{Detected as such}\end{pmatrix} \Bigg] \Bigg] \begin{pmatrix}\text{Direct Maintenance}\\ \text{Man Hours at Depot}\\ \text{per Repair Action}\end{pmatrix} \Bigg\} \\
& + \sum_{e=1}^{f} \begin{pmatrix}\text{Annual Number}\\ \text{of Items}\\ \text{Received by the}\\ e'\text{th PIMA Site}\end{pmatrix}^{t}_{e} \begin{pmatrix}\text{Direct Maintenance}\\ \text{Man Hours at PIMA}\\ \text{per Repair Action}\end{pmatrix} \\
& + \sum_{g=1}^{h} \begin{pmatrix}\text{Annual Number}\\ \text{of Items}\\ \text{Received by the}\\ g'\text{th Depot}\end{pmatrix}^{t}_{g} \begin{pmatrix}\text{Direct Maintenance}\\ \text{Man Hours at Depot}\\ \text{per Repair Action}\end{pmatrix} \Bigg] \begin{pmatrix}\text{Normal}\\ \text{Discount}\\ \text{Factor}\end{pmatrix}
\end{aligned}
$$

40.2.8.3 Labor cost for repair PIMA cases. Two labor cost equations are presented. One is applicable if the higher assembly is repaired at intermediate level; the other is applicable if the higher assembly is repaired at PIMA level.

40.2.8.4 Labor cost for repair PIMA case if higher assembly is coded intermediate repair.

$$
\begin{pmatrix}\text{Cost of Labor for}\\ \text{PIMA Repair if}\\ \text{Higher Assembly}\\ \text{is Intermediate}\\ \text{Repair}\end{pmatrix}^{t} = \left[\sum_{k=1}^{L}\begin{pmatrix}\text{Annual Number}\\ \text{of Real Failures}\\ \text{Removed at the}\\ k'\text{th CV Site}\end{pmatrix}_{k}^{t}\left[1.0+\begin{pmatrix}\text{Fraction of}\\ \text{Items Falsely}\\ \text{Removed}\end{pmatrix}\right]\begin{pmatrix}\text{Labor Cost}\\ \text{per Hour}\\ \text{at the CV}\end{pmatrix}\begin{pmatrix}\text{Direct Maintenance}\\ \text{Man Hours at CV}\\ \text{per Discard Action}\end{pmatrix}\right.
$$

$$
+\sum_{w=1}^{x}\begin{pmatrix}\text{Annual Number}\\ \text{of Real Failures}\\ \text{Removed at the}\\ w'\text{th NAS Site}\end{pmatrix}_{w}^{t}\left[1.0+\begin{pmatrix}\text{Fraction of}\\ \text{Items Falsely}\\ \text{Removed}\end{pmatrix}\right]\begin{pmatrix}\text{Labor Cost}\\ \text{per Hour}\\ \text{at the NAS}\end{pmatrix}\begin{pmatrix}\text{Direct Maintenance}\\ \text{Man Hours at NAS}\\ \text{per Discard Action}\end{pmatrix}
$$

$$
+\sum_{y=1}^{z}\begin{pmatrix}\text{Annual Number}\\ \text{of Real Failures}\\ \text{Removed at the}\\ y'\text{th NAS Site}\end{pmatrix}_{y}^{t}\begin{pmatrix}\text{Labor Cost}\\ \text{per Hour}\\ \text{at the NAS}\end{pmatrix}\left\{\begin{pmatrix}\text{Fraction of}\\ \text{Items Falsely}\\ \text{Removed}\end{pmatrix}\begin{pmatrix}\text{Fraction of Item}\\ \text{False Removals}\\ \text{Detected as such}\end{pmatrix}\begin{pmatrix}\text{Direct Maintenance}\\ \text{Man Hours at NAS}\\ \text{per Discard Action}\end{pmatrix}\right.
$$

$$
\left.+\left[1.0+\begin{pmatrix}\text{Fraction of}\\ \text{Items Falsely}\\ \text{Removed}\end{pmatrix}\left[1.0-\begin{pmatrix}\text{Fraction of the}\\ \text{False Removals}\\ \text{Detected as such}\end{pmatrix}\right]\right]\begin{pmatrix}\text{Direct Maintenance}\\ \text{Man Hours at NAS}\\ \text{per Repair Action}\end{pmatrix}\right\}
$$

$$
+\sum_{e=1}^{f}\begin{pmatrix}\text{Annual Number}\\ \text{of Real Failures}\\ \text{Removed at the}\\ e'\text{th PIMA Site}\end{pmatrix}_{e}^{t}\begin{pmatrix}\text{Labor Cost}\\ \text{per Hour}\\ \text{at the NAS}\end{pmatrix}\left\{\begin{pmatrix}\text{Fraction of}\\ \text{Items Falsely}\\ \text{Removed}\end{pmatrix}\begin{pmatrix}\text{Fraction of Item}\\ \text{False Removals}\\ \text{Detected as such}\end{pmatrix}\begin{pmatrix}\text{Direct Maintenance}\\ \text{Man Hours at PIMA}\\ \text{per Discard Action}\end{pmatrix}\right.
$$

$$
\left.+\left[1.0+\begin{pmatrix}\text{Fraction of}\\ \text{Items Falsely}\\ \text{Removed}\end{pmatrix}\left[1.0-\begin{pmatrix}\text{Fraction of the}\\ \text{False Removals}\\ \text{Detected as such}\end{pmatrix}\right]\right]\begin{pmatrix}\text{Direct Maintenance}\\ \text{Man Hours at PIMA}\\ \text{per Repair Action}\end{pmatrix}\right\}
$$

$$
+\sum_{g=1}^{h}\begin{pmatrix}\text{Annual Number}\\ \text{of Real Failures}\\ \text{Removed at the}\\ g'\text{th Depot Site}\end{pmatrix}_{g}^{t}\begin{pmatrix}\text{Labor Cost}\\ \text{per Hour}\\ \text{at the Depot}\end{pmatrix}\left\{\begin{pmatrix}\text{Fraction of}\\ \text{Items Falsely}\\ \text{Removed}\end{pmatrix}\begin{pmatrix}\text{Fraction of Item}\\ \text{False Removals}\\ \text{Detected as such}\end{pmatrix}\begin{pmatrix}\text{Direct Maintenance}\\ \text{Man Hours at Depot}\\ \text{per Discard Action}\end{pmatrix}\right.
$$

$$
\left.+\left[1.0+\begin{pmatrix}\text{Fraction of}\\ \text{Items Falsely}\\ \text{Removed}\end{pmatrix}\left[1.0-\begin{pmatrix}\text{Fraction of the}\\ \text{False Removals}\\ \text{Detected as such}\end{pmatrix}\right]\right]\begin{pmatrix}\text{Direct Maintenance}\\ \text{Man Hours at Depot}\\ \text{per Repair Action}\end{pmatrix}\right\}
$$

$$
+\sum_{e=1}^{f}\begin{pmatrix}\text{Annual Number}\\ \text{of Items Received}\\ \text{by the }e'\text{th}\\ \text{PIMA Site}\end{pmatrix}_{e}^{t}\begin{pmatrix}\text{Labor Cost}\\ \text{per Hour}\\ \text{at the NAS}\end{pmatrix}\begin{pmatrix}\text{Direct Maintenance}\\ \text{Man Hours at PIMA}\\ \text{per Repair Action}\end{pmatrix}
$$

$$
\left.+\sum_{g=1}^{h}\begin{pmatrix}\text{Annual Number}\\ \text{of Items Received}\\ \text{by the }g'\text{th}\\ \text{Depot Site}\end{pmatrix}_{g}^{t}\begin{pmatrix}\text{Labor Cost}\\ \text{per Hour}\\ \text{at the Depot}\end{pmatrix}\begin{pmatrix}\text{Direct Maintenance}\\ \text{Man Hours at Depot}\\ \text{per Repair Action}\end{pmatrix}\right]\begin{pmatrix}\text{Normal}\\ \text{Discount}\\ \text{Factor}\end{pmatrix}
$$

WHERE: w = the w'th non-PIMA NAS $\quad$ x = the number of non-PIMA NAS's

y = the y'th PIMA NAS $\quad$ z = the number of PIMA NAS's

40.2.8.5 Labor cost for repair PIMA case if higher assembly is coded PIMA repair.

$$
\begin{pmatrix}\text{Cost of Labor for}\\ \text{PIMA Repair if}\\ \text{Higher Assembly}\\ \text{is PIMA Repair}\end{pmatrix}^{t} =
$$

$$
\Bigg[\sum_{y=1}^{z}\begin{pmatrix}\text{Annual Number}\\ \text{of Real Failures}\\ \text{Removed at the}\\ \text{y'th NAS Site}\end{pmatrix}^{t}_{y}\begin{pmatrix}\text{Labor Cost}\\ \text{per Hour}\\ \text{at the NAS}\end{pmatrix}\Bigg\{\left(\begin{pmatrix}\text{Fraction of}\\ \text{Items Falsely}\\ \text{Removed}\end{pmatrix}\begin{pmatrix}\text{Fraction of Item}\\ \text{False Removals}\\ \text{Detected as such}\end{pmatrix}\right)\begin{pmatrix}\text{Direct Maintenance}\\ \text{Man Hours at NAS}\\ \text{per Discard Action}\end{pmatrix}
$$

$$
+\left[1.0+\begin{pmatrix}\text{Fraction of}\\ \text{Items Falsely}\\ \text{Removed}\end{pmatrix}\left[1.0-\begin{pmatrix}\text{Fraction of the}\\ \text{False Removals}\\ \text{Detected as such}\end{pmatrix}\right]\right]\begin{pmatrix}\text{Direct Maintenance}\\ \text{Man Hours at NAS}\\ \text{per Repair Action}\end{pmatrix}\Bigg\}
$$

$$
+\sum_{e=1}^{f}\begin{pmatrix}\text{Annual Number}\\ \text{of Real Failures}\\ \text{Removed at the}\\ \text{e'th PIMA Site}\end{pmatrix}^{t}_{e}\begin{pmatrix}\text{Labor Cost}\\ \text{per Hour}\\ \text{at the NAS}\end{pmatrix}\Bigg\{\left(\begin{pmatrix}\text{Fraction of}\\ \text{Items Falsely}\\ \text{Removed}\end{pmatrix}\begin{pmatrix}\text{Fraction of Item}\\ \text{False Removals}\\ \text{Detected as such}\end{pmatrix}\right)\begin{pmatrix}\text{Direct Maintenance}\\ \text{Man Hours at PIMA}\\ \text{per Discard Action}\end{pmatrix}
$$

$$
+\left[1.0+\begin{pmatrix}\text{Fraction of}\\ \text{Items Falsely}\\ \text{Removed}\end{pmatrix}\left[1.0-\begin{pmatrix}\text{Fraction of the}\\ \text{False Removals}\\ \text{Detected as such}\end{pmatrix}\right]\right]\begin{pmatrix}\text{Direct Maintenance}\\ \text{Man Hours at PIMA}\\ \text{per Repair Action}\end{pmatrix}\Bigg\}
$$

$$
+\sum_{g=1}^{h}\begin{pmatrix}\text{Annual Number}\\ \text{of Real Failures}\\ \text{Removed at the}\\ \text{g'th Depot Site}\end{pmatrix}^{t}_{g}\begin{pmatrix}\text{Labor Cost}\\ \text{per Hour}\\ \text{at the Depot}\end{pmatrix}\Bigg\{\left(\begin{pmatrix}\text{Fraction of}\\ \text{Items Falsely}\\ \text{Removed}\end{pmatrix}\begin{pmatrix}\text{Fraction of Item}\\ \text{False Removals}\\ \text{Detected as such}\end{pmatrix}\right)\begin{pmatrix}\text{Direct Maintenance}\\ \text{Man Hours at Depot}\\ \text{per Discard Action}\end{pmatrix}
$$

$$
+\left[1.0+\begin{pmatrix}\text{Fraction of}\\ \text{Items Falsely}\\ \text{Removed}\end{pmatrix}\left[1.0-\begin{pmatrix}\text{Fraction of the}\\ \text{False Removals}\\ \text{Detected as such}\end{pmatrix}\right]\right]\begin{pmatrix}\text{Direct Maintenance}\\ \text{Man Hours at Depot}\\ \text{per Repair Action}\end{pmatrix}\Bigg\}
$$

$$
+\sum_{g=1}^{h}\begin{pmatrix}\text{Annual Number}\\ \text{of Items Received}\\ \text{by the g'th}\\ \text{Depot Site}\end{pmatrix}^{t}_{g}\begin{pmatrix}\text{Labor Cost}\\ \text{per Hour}\\ \text{at the Depot}\end{pmatrix}\begin{pmatrix}\text{Direct Maintenance}\\ \text{Man Hours at Depot}\\ \text{per Repair Action}\end{pmatrix}\Bigg]\begin{pmatrix}\text{Normal}\\ \text{Discount}\\ \text{Factor}\end{pmatrix}
$$

40.2.8.6 Labor cost for repair depot cases. Three labor cost equations are presented, one each for the next higher assembly repaired at intermediate, PIMA or depot level.

40.2.8.7 Labor cost for repair depot case if higher assembly is coded intermediate repair.

$$\begin{aligned}
&\begin{pmatrix}\text{Cost of Labor for}\\ \text{Depot Repair if}\\ \text{Higher Assembly}\\ \text{is Intermediate}\\ \text{Repair}\end{pmatrix}^{t} = \left[\left\{\sum_{k=1}^{L}\begin{pmatrix}\text{Annual Number}\\ \text{of Real Failures}\\ \text{Removed at the}\\ k'\text{th CV Site}\end{pmatrix}_{k}^{t}\begin{pmatrix}\text{Labor Cost}\\ \text{per Hour}\\ \text{at the CV}\end{pmatrix}\begin{pmatrix}\text{Direct Maintenance}\\ \text{Man Hours at CV}\\ \text{per Discard Action}\end{pmatrix}\right.\right.\\
&+\sum_{m=1}^{n}\begin{pmatrix}\text{Annual Number}\\ \text{of Real Failures}\\ \text{Removed at the}\\ m'\text{th NAS Site}\end{pmatrix}_{m}^{t}\begin{pmatrix}\text{Labor Cost}\\ \text{per Hour}\\ \text{at the NAS}\end{pmatrix}\begin{pmatrix}\text{Direct Maintenance}\\ \text{Man Hours at NAS}\\ \text{per Discard Action}\end{pmatrix}\\
&\left.+\sum_{e=1}^{f}\begin{pmatrix}\text{Annual Number}\\ \text{of Real Failures}\\ \text{Removed at the}\\ e'\text{th PIMA Site}\end{pmatrix}_{y}^{t}\begin{pmatrix}\text{Labor Cost}\\ \text{per Hour}\\ \text{at the NAS}\end{pmatrix}\begin{pmatrix}\text{Direct Maintenance}\\ \text{Man Hours at PIMA}\\ \text{per Discard Action}\end{pmatrix}\right\}\left[1.0+\begin{pmatrix}\text{Fraction of}\\ \text{Items Falsely}\\ \text{Removed}\end{pmatrix}\right]\\
&+\sum_{g=1}^{h}\begin{pmatrix}\text{Annual Number}\\ \text{of Real Failures}\\ \text{Removed at the}\\ g'\text{th Depot Site}\end{pmatrix}_{g}^{t}\begin{pmatrix}\text{Labor Cost}\\ \text{per Hour}\\ \text{at the Depot}\end{pmatrix}\left\{\left(\begin{pmatrix}\text{Fraction of}\\ \text{Items Falsely}\\ \text{Removed}\end{pmatrix}\begin{pmatrix}\text{Fraction of Item}\\ \text{False Removals}\\ \text{Detected as such}\end{pmatrix}\begin{pmatrix}\text{Direct Maintenance}\\ \text{Man Hours at Depot}\\ \text{per Discard Action}\end{pmatrix}\right.\right.\\
&\left.+\left[1.0+\begin{pmatrix}\text{Fraction of}\\ \text{Items Falsely}\\ \text{Removed}\end{pmatrix}\right]\left[1.0-\begin{pmatrix}\text{Fraction of the}\\ \text{False Removals}\\ \text{Detected as such}\end{pmatrix}\right]\Bigg]\begin{pmatrix}\text{Direct Maintenance}\\ \text{Man Hours at Depot}\\ \text{per Repair Action}\end{pmatrix}\right\}\\
&\left.+\sum_{g=1}^{h}\begin{pmatrix}\text{Annual Number}\\ \text{of Items Received}\\ \text{by the } g'\text{th}\\ \text{Depot Site}\end{pmatrix}_{g}^{t}\begin{pmatrix}\text{Labor Cost}\\ \text{per Hour}\\ \text{at the NAS}\end{pmatrix}\begin{pmatrix}\text{Direct Maintenance}\\ \text{Man Hours at PIMA}\\ \text{per Discard Action}\end{pmatrix}\right]\begin{pmatrix}\text{Normal}\\ \text{Discount}\\ \text{Factor}\end{pmatrix}
\end{aligned}$$

40.2.8.8 Labor cost for repair depot case if higher assembly is coded PIMA repair.

$$\begin{aligned}
&\begin{pmatrix}\text{Cost of Labor for}\\ \text{Depot Repair if}\\ \text{Higher Assembly}\\ \text{is PIMA}\\ \text{Repair}\end{pmatrix}^{t} = \left[\left\{\sum_{y=1}^{z}\begin{pmatrix}\text{Annual Number}\\ \text{of Real Failures}\\ \text{Removed at the}\\ y'\text{th NAS Site}\end{pmatrix}_{y}^{t}\begin{pmatrix}\text{Direct Maintenance}\\ \text{Man Hours at NAS}\\ \text{per Discard Action}\end{pmatrix}\right.\right.\\
&\left.+\sum_{e=1}^{f}\begin{pmatrix}\text{Annual Number}\\ \text{of Real Failures}\\ \text{Removed at the}\\ e'\text{th PIMA Site}\end{pmatrix}_{e}^{t}\begin{pmatrix}\text{Direct Maintenance}\\ \text{Man Hours at PIMA}\\ \text{per Discard Action}\end{pmatrix}\right\}\left[1.0+\begin{pmatrix}\text{Fraction of}\\ \text{Items Falsely}\\ \text{Removed}\end{pmatrix}\right]\begin{pmatrix}\text{Labor Cost}\\ \text{per Hour}\\ \text{at the NAS}\end{pmatrix}\\
&+\sum_{g=1}^{h}\begin{pmatrix}\text{Annual Number}\\ \text{of Real Failures}\\ \text{Removed at the}\\ g'\text{th Depot Site}\end{pmatrix}_{g}^{t}\begin{pmatrix}\text{Labor Cost}\\ \text{per Hour}\\ \text{at the Depot}\end{pmatrix}\left\{\left(\begin{pmatrix}\text{Fraction of}\\ \text{Items Falsely}\\ \text{Removed}\end{pmatrix}\begin{pmatrix}\text{Fraction of Item}\\ \text{False Removals}\\ \text{Detected as such}\end{pmatrix}\begin{pmatrix}\text{Direct Maintenance}\\ \text{Man Hours at Depot}\\ \text{per Discard Action}\end{pmatrix}\right.\right.\\
&\left.+\left[1.0+\begin{pmatrix}\text{Fraction of}\\ \text{Items Falsely}\\ \text{Removed}\end{pmatrix}\right]\left[1.0-\begin{pmatrix}\text{Fraction of the}\\ \text{False Removals}\\ \text{Detected as such}\end{pmatrix}\right]\Bigg]\begin{pmatrix}\text{Direct Maintenance}\\ \text{Man Hours at Depot}\\ \text{per Repair Action}\end{pmatrix}\right\}\\
&\left.+\sum_{g=1}^{h}\begin{pmatrix}\text{Annual Number}\\ \text{of Items Received}\\ \text{by the } g'\text{th}\\ \text{Depot Site}\end{pmatrix}_{g}^{t}\begin{pmatrix}\text{Labor Cost}\\ \text{per Hour}\\ \text{at the Depot}\end{pmatrix}\begin{pmatrix}\text{Direct Maintenance}\\ \text{Man Hours at Depot}\\ \text{per Discard Action}\end{pmatrix}\right]\begin{pmatrix}\text{Normal}\\ \text{Discount}\\ \text{Factor}\end{pmatrix}
\end{aligned}$$

40.2.8.9 Labor cost for repair depot case if higher assembly is coded depot repair.

$$\begin{pmatrix}\text{Cost of Labor for}\\ \text{Depot Repair if}\\ \text{Higher Assembly}\\ \text{is Depot Repair}\end{pmatrix}^{t} = \left[\sum_{g=1}^{h}\begin{pmatrix}\text{Annual Number}\\ \text{of Real Failures}\\ \text{Removed at the}\\ g'\text{th Depot Site}\end{pmatrix}_{g}^{t}\begin{pmatrix}\text{Labor Cost}\\ \text{per Hour}\\ \text{at the Depot}\end{pmatrix}\left\{\begin{pmatrix}\text{Fraction of}\\ \text{Items Falsely}\\ \text{Removed}\end{pmatrix}\begin{pmatrix}\text{Fraction of Item}\\ \text{False Removals}\\ \text{Detected as such}\end{pmatrix}\begin{pmatrix}\text{Direct Maintenance}\\ \text{Man Hours at Depot}\\ \text{per Discard Action}\end{pmatrix}\right.\right.$$

$$\left.\left. + \left[1.0 + \begin{pmatrix}\text{Fraction of}\\ \text{Items Falsely}\\ \text{Removed}\end{pmatrix}\left[1.0 - \begin{pmatrix}\text{Fraction of the}\\ \text{False Removals}\\ \text{Detected as such}\end{pmatrix}\right]\right]\begin{pmatrix}\text{Direct Maintenance}\\ \text{Man Hours at Depot}\\ \text{per Repair Action}\end{pmatrix}\right\}\right]\begin{pmatrix}\text{Normal}\\ \text{Discount}\\ \text{Factor}\end{pmatrix}$$

40.2.9 Training cost.

$$\begin{pmatrix}\text{Cost of}\\ \text{Training}\end{pmatrix}^{t} = \left[\begin{pmatrix}\text{Total Number of}\\ \text{Squadron Men}\\ \text{Trained}\end{pmatrix}^{t}\begin{pmatrix}\text{Training Cost}\\ \text{per}\\ \text{Squadron Man}\end{pmatrix}^{t} + \begin{pmatrix}\text{Total Number}\\ \text{of CV Men}\\ \text{Trained}\end{pmatrix}^{t}\begin{pmatrix}\text{Training Cost}\\ \text{per}\\ \text{CV Man}\end{pmatrix}^{t}\right.$$

$$+ \begin{pmatrix}\text{Total Number of}\\ \text{NAS Men}\\ \text{Trained}\end{pmatrix}^{t}\begin{pmatrix}\text{Training Cost}\\ \text{per}\\ \text{NAS Man}\end{pmatrix}^{*} + \begin{pmatrix}\text{Total Number of}\\ \text{PIMA Men}\\ \text{Trained}\end{pmatrix}^{t}\begin{pmatrix}\text{Training Cost}\\ \text{per}\\ \text{PIMA Man}\end{pmatrix}^{t}\Bigg]\left[1.0 + \begin{pmatrix}\text{Navy}\\ \text{Personnel}\\ \text{Attrition}\\ \text{Rate}\end{pmatrix}\right]\begin{pmatrix}\text{Present}\\ \text{Discount}\\ \text{Factor}\end{pmatrix}$$

$$+ \begin{pmatrix}\text{Total Number of}\\ \text{Depot Men}\\ \text{Trained}\end{pmatrix}^{t}\begin{pmatrix}\text{Training Cost}\\ \text{per}\\ \text{Depot Man}\end{pmatrix}^{*}\left[1.0 + \begin{pmatrix}\text{Depot}\\ \text{Personnel}\\ \text{Attrition}\\ \text{Rate}\end{pmatrix}\right]\begin{pmatrix}\text{Present}\\ \text{Discount}\\ \text{Factor}\end{pmatrix}$$

* - Full or back up resources on the criteria in figures D-3 and D-4.

40.2.9.1 Training cost for intermediate repair cases. The repair cost is incurred for each operational site; for the PIMA and depot repair facilities either full or back-up resources are required based on the criteria of figures D-3 and D-4.

40.2.9.2 Training cost for PIMA repair cases. The repair cost is incurred for each PIMA and depot facility; discard training cost is incurred for each IMA site if the higher assembly is repaired at the IMA site.

40.2.9.3 Training cost for depot repair cases. The repair cost is incurred by the depot and discard training cost are incurred for the sites other than the depots which repair the higher assembly.

40.2.9.4 Training cost for discard cases. The training costs are incurred for the sites which repair the higher assembly. The PIMA and depot sites are subject to the criteria of figures D-3 and D-4.

40.2.10 Documentation cost. A cost value is predetermined for the case under consideration. Documentation includes the following: the drawings and specifications which make up the avionic system technical manual, the LSA (Logistic Support Analysis) preparation, and support equipment requirement sheets, lists software, etc... The determination of applicable costs is the same as that for training.

$$\begin{pmatrix}\text{Cost of}\\ \text{Documentation}\end{pmatrix}^{t} = \begin{pmatrix}\text{Documentation}\\ \text{Cost at IMA}\end{pmatrix} + \begin{pmatrix}\text{Documentation}\\ \text{Cost at PIMA}\end{pmatrix} + \begin{pmatrix}\text{Documentation}\\ \text{Cost at Depot}\end{pmatrix}$$

40.2.11 Combination of cost elements. The cost element equations are combined for each item for the alternative under consideration. The cost of an LORA alternative for an equipment is the sum of the costs associated with the items in the equipment. For an avionic equipment different alternatives may be recommended for the different items; the higher assembly, however, must always be assigned to the same case when evaluating all the next lower assemblies contained in it. When making individual recommendations for a group of items which have non-allocatable costs associated with them, redundant costing must be compensated for. If part of the group requires verification at a site and the remainder requires repair at the same site, the verification cost is deleted since it is assumed that the capability to verify is acquired with the capability to repair. Similarly, back-up cost at a site are ignored if full repair capability is collocated with it.

NAVAIR METHOD 2

SUPPORT EQUIPMENT, MODEL II

10. SCOPE

10.1 Purpose. This appendix specifies the algorithms for performing LORA for support equipment under the cognizance of the Naval Air Systems Command. The model estimates the most economical level of repair by comparing the life cycle costs of several repair scenarios.

10.2 General. This economic LORA technique allocates costs to six major categories: (1) inventory, including inventory administration, rotatable pool, attrition, system stock levels, repair material, scrap material, and transportation; (2) support equipment, including hardware, software, and support of SE costs; (3) space required for inventory storage, repair work, and support equipment; (4) labor; (5) training; (6) documentation.

20. APPLICABLE DOCUMENTS

20.1 Requiring documents.

20.1.1 OPNAVINST 5000.49A, (integrated logistic support).

20.1.2 NAVAIRINST 4140.3, (level of repair analysis for NAVAIR material).

20.2 User's instruction and guidance.

20.2.1 Mod II/III LORA user's guide.

20.2.2 LORA default data guide.

20.2.3 Mod II/III student lesson guide.

20.3 Software.

20.3.1 MICROLORA PLUS, (PC version).

20.3.2 Mod II, Release 1, (Mainframe version).

30. DEFINITIONS

30.1 Equipment indenture levels. The equipment under analysis may be broken into three indenture levels, Weapon Replaceable Assembly (WRA), Shop Replaceable Assembly (SRA), and Sub Shop Replaceable Assembly (SSRA). LORA recommendations are made for these items based on each items' characteristics, operating location, resources and the relationship of an item to its next higher assembly.

30.2 LORA code assignments. Each item in the analysis may be assigned one of three codes: (1) I (Intermediate Maintenance Activity, afloat or ashore, repair; (2) D (Depot repair); or (3) X (Discard).

30.3 Repair definition. Repair of an item is defined as removal and replacement of a failed lower indenture assembly. This includes the resources required to verify the failure, fault isolate to the item, replacement of the lower level item and check and test of the system.

30.3.1 Intermediate repair. Failures removed at an operational site, either afloat or ashore, are repaired at the IMA at the site.

30.3.2 Depot repair. Failures removed at operational sites are sent to a depot site for repair.

30.4 Discard definition. All verified failures of the item, along with all of its lower level items, are discarded at the appropriate site. The discard action includes the resources required to verify the failure and check & test the replaced item.

30.5 BCM actions (beyond capability of maintenance). Items that are assigned for repair at an IMA, but for one reason or another, cannot be repaired at the operating site and must be sent to Depot for the repair.

30.6 Equipment failures occurring at IMA sites. Items that are BCM at an afloat or ashore IMA site are sent to the designated next higher repair site, usually a Depot.

30.7 LORA technique assumptions.

30.7.1 Maintenance alternatives. Maintenance alternatives are the various LORA code assignments made by the model for all of the items in the analysis. There are six standard maintenance alternatives plus the optimized or least cost alternative. User specified alternatives can also be analyzed by the model. For a description of how the model determines LORA code assignments (see figure E-1).

30.7.2 Required parameters. Ten parameters are used within the cost elements equations: (1) discount factors; (2) annual number of items for disposition at a site; (3) annual number of real failures removed at a site; (4) annual number of real failures sent from a site; (5) annual number of items sent from a site; (6) annual number of real failures received by a site; (7) annual number of items received by a site; (8) annual number of items sent from all CV's to a Depot; (9) annual number of items sent from all NAS's to a depot; (10) annual number of repairs of an item at site.

30.7.3 Discount factors. Discount factors are computed using the discount rate. Discount rate accounts for the time value of money and determines the actual present value of a cost element for the purpose of evaluating different payment schedules. Three discount factors are calculated: (1) the normal discount factor, used with equal payment series starting one year after the life cycle begins and ending one year before the life cycle ends; (2) the present discount factor, used for equal payment series starting at the present and ending on year before the life cycle ends; (3) the reduced discount factor used with equal payment series starting two years hence and terminating at the end of the life cycle.

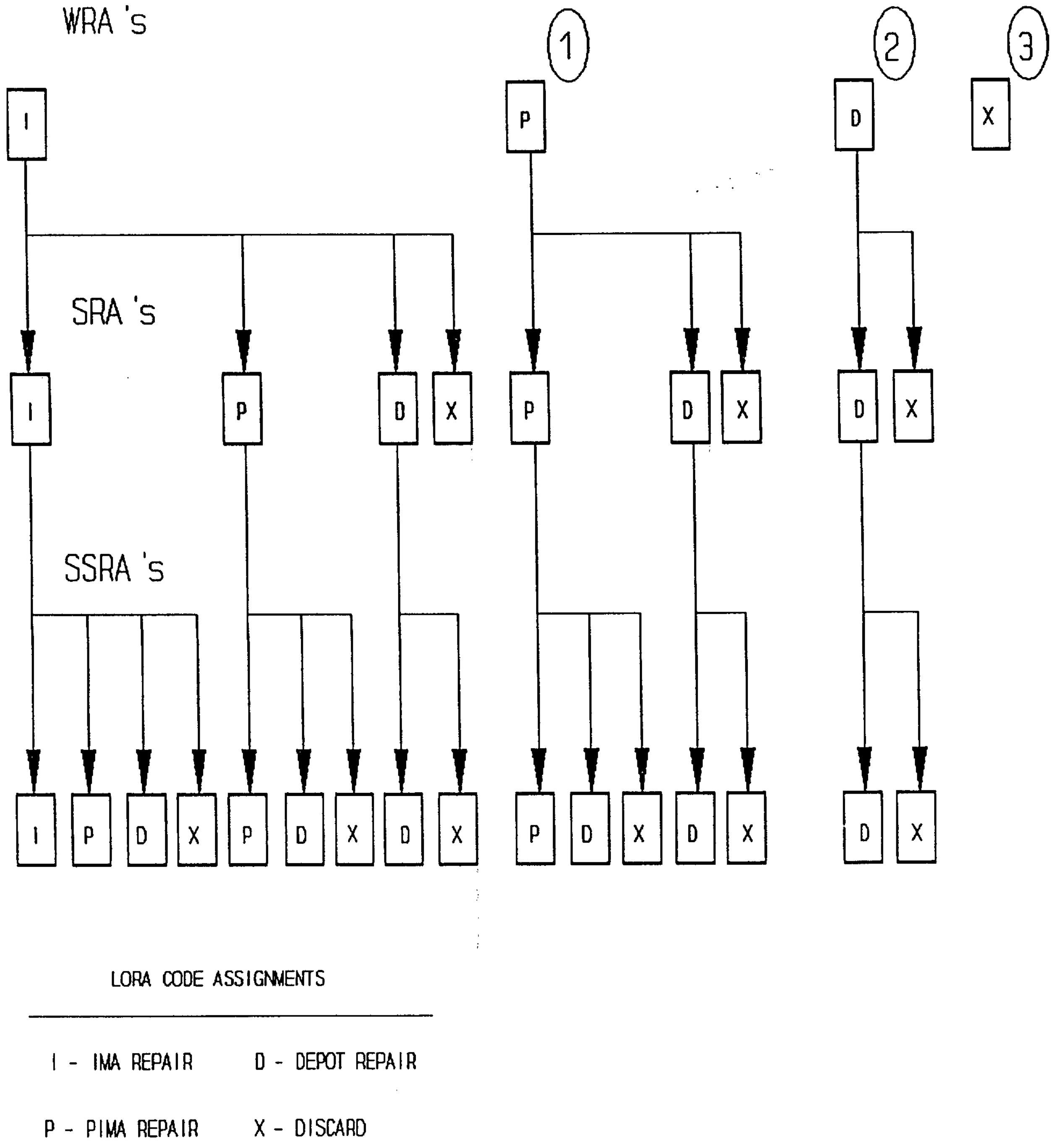


FIGURE E-1. Maintenance alternatives.

Description of LORA Code Assignment Procedure for Selecting Maintenance Alternatives

When the model is making LORA code assignments there are a couple of assumptions the model makes to simplify the process. The first is that the LORA code assigned to an item is independent of the particular lower level part that caused the failure. For example, it is possible a WRA containing two SRA's to have two different LORA codes, it could be discarded if the failure was caused by the first SRA and could be locally repaired if the failure was caused by the second SRA, however the model assigns just one LORA recommendation that is based on the cost, failure characteristics and deployment of the item and not its lower level assemblies.

The second assumption that affects the assignment of LORA codes is the restriction of the flow of repairables. A repairable can only be shipped from lower level to higher level maintenance activities. This prevents an operating site from shipping a WRA to a Depot that removes a SRA and sends it to a PIMA for repair.

While the LORA decision of a lower level item does not effect the decision of a higher level item, the opposite is not true. Because items can only be moved from lower to higher site types and because the model considers WRA's first then SRA's and finally SSRA's, higher level items effect the repair decisions available to the lower items as shown on the previous page. This figure illustrates the importance of telling the model exactly how each item is related to the others.

At marker 1, if the WRA LORA code is P, then its component SRA's are limited to P, D, or X codes. If the WRA LORA code is D (Marker 2) then its component SRA's are limited to D or X codes. This maintenance alternative is often called the "O to D Alternative". Marker 3 shows the WRA LORA code X, which prevents further consideration of the lower level assemblies since all component assemblies are discarded with the WRA.

Logistic support costs calculated for each LORA code assignment differ from one case to another. The logistic support costs will be significantly different if both the SRA and its WRA are locally repaired, than when they are repaired at the Depot. Different costs will result for the other LORA cases.

40. GENERAL REQUIREMENTS

40.1 Algorithms calculated by year.

40.1.1 Normal discount factor. For expenditures occurring as equal payment series starting one year hence and terminating at the end of the life cycle.

$$\begin{pmatrix}\text{Normal}\\ \text{Discount}\\ \text{Factor}\end{pmatrix} = \left[\frac{(1.0 + \text{Discount Rate})^{\begin{pmatrix}\text{Number of}\\ \text{Years per}\\ \text{Life Cycle}\end{pmatrix}} - 1.0}{\text{Discount Rate } (1.0 + \text{Discount Rate})^{\begin{pmatrix}\text{Number of}\\ \text{Years per}\\ \text{Life Cycle}\end{pmatrix}}}\right]$$

40.1.2 Present discount factor. For expenditures occurring as equal payment series starting at the present and terminating one year prior to the end of the life cycle.

$$\begin{pmatrix}\text{Present}\\ \text{Discount}\\ \text{Factor}\end{pmatrix} = \left[\frac{1.0 + \text{Discount Rate}^{\begin{pmatrix}\text{Number of}\\ \text{Years per}\\ \text{Life Cycle}\end{pmatrix}} - 1.0}{\text{Discount Rate } (1.0 + \text{Discount Rate})^{\left[\begin{pmatrix}\text{Number of}\\ \text{Years per}\\ \text{Life Cycle}\end{pmatrix} - 1.0\right]}}\right]$$

40.1.3 Reduced discount factor. For expenditures occurring as equal payment series starting two years hence and terminating at the end of the life cycle.

$$\begin{pmatrix}\text{Reduced}\\ \text{Discount}\\ \text{Factor}\end{pmatrix} = \left[\frac{1.0 + \text{Discount Rate}^{\left[\begin{pmatrix}\text{Number of}\\ \text{Years per}\\ \text{Life Cycle}\end{pmatrix} - 1.0\right]} - 1.0}{\text{Discount Rate } (1.0 + \text{Discount Rate})^{\begin{pmatrix}\text{Number of}\\ \text{Years per}\\ \text{Life Cycle}\end{pmatrix}}}\right]$$

40.1.4 Annual number of items for disposition at a site. The total annual number of removals, including real failures, false removals and less the annual number of detected false removals at each site.

$$\left(\begin{array}{c}\text{Annual Number}\\ \text{of Items for}\\ \text{Disposition at}\\ \text{the } a'\text{th Site}\end{array}\right)^{t} = \left[\left(\begin{array}{c}\text{Annual Number}\\ \text{of Real Failures}\\ \text{Removed at}\\ \text{the } a'\text{th Site}\end{array}\right)^{t} + \left(\begin{array}{c}\text{Annual Number}\\ \text{of Real Failures}\\ \text{Removed at}\\ \text{the } a'\text{th Site}\end{array}\right)\left(\begin{array}{c}\text{Fraction of}\\ \text{Items Falsely}\\ \text{Removed}\end{array}\right)\right] - \left[\left(\begin{array}{c}\text{Annual Number}\\ \text{of Real Failures}\\ \text{Removed at the}\\ a'\text{th Site}\end{array}\right)^{t}\left(\begin{array}{c}\text{Fraction of}\\ \text{Items Falsely}\\ \text{Removed}\end{array}\right)\left(\begin{array}{c}\text{Fraction of}\\ \text{False Removals}\\ \text{Detected as Such}\end{array}\right)\right]$$

t - indicates parameters whose values change with the LORA case under consideration

a - the a'th site (either CV, NAS, or Depot)

40.1.5 <u>Annual number of real failures removed at a site</u>. The annual number of failed items removed from their next higher assembly at the site. For IMA sites, removals refer to the failed items from the locally operating aircraft. For Depot sites, removals of the item are from higher indenture assemblies that were BCM from the sites with operating aircraft and forwarded to the higher level maintenance facility.

$$\left(\begin{array}{c}\text{Annual Number *}\\ \text{of Real Failures}\\ \text{Removed at the}\\ a'\text{th Site}\end{array}\right)^{t} = \left[\frac{\left(\begin{array}{c}\text{Annual Number of **}\\ \text{Repairs to the Next}\\ \text{Higher Assembly}\\ \text{at the } a'\text{th site}\end{array}\right)^{t}\left(\begin{array}{c}\text{Predicted Mean}\\ \text{Time Between}\\ \text{Failures of the Next}\\ \text{Higher Assembly}\end{array}\right)\left(\begin{array}{c}\text{Number of}\\ \text{Identical Items}\\ \text{per Avionic System}\end{array}\right)\left(\begin{array}{c}\text{Item Ratio of}\\ \text{Operating Hours}\\ \text{to Flight Hours}\end{array}\right)}{\left(\begin{array}{c}\text{Predicted Mean}\\ \text{Time Between}\\ \text{Failures of the Item}\end{array}\right)\left(\begin{array}{c}\text{Number of}\\ \text{Identical Next}\\ \text{Higher Assemblies}\\ \text{per Avionic System}\end{array}\right)\left(\begin{array}{c}\text{Ratio of Operating}\\ \text{Hours to Flight Hours}\\ \text{to the Next}\\ \text{Higher Assembly}\end{array}\right)}\right]$$

** - This equation refers to the SRA or SSRA as applicable to the indenture level under consideration. The corresponding WRA equation is shown later.*

*** - This term refers to repairs from failures originating at the site if the a'th site is an IMA and to repairs from failures orignating at lower level maintenance facilities if the a'th site is a Depot.*

$$\left(\begin{array}{c}\text{Annual Number **}\\ \text{of Real Failures}\\ \text{Removed at}\\ \text{the } a'\text{th Site}\end{array}\right)^{t} = \left[\frac{\left(\begin{array}{c}\text{Number of}\\ \text{Identical}\\ \text{WRA's per}\\ \text{Avionic System}\end{array}\right)\left(\begin{array}{c}\text{WRA Ratio}\\ \text{of Operating}\\ \text{Hours to}\\ \text{Flight Hours}\end{array}\right)\left(\begin{array}{c}\text{12 Months}\\ \text{per}\\ \text{Year}\end{array}\right)\sum_{b=1}^{c}\left[\left(\begin{array}{c}\text{Monthly}\\ \text{Flight Hour}\\ \text{Program}\\ \text{at } a'\text{th Site}\end{array}\right)_{b}\left(\begin{array}{c}\text{Number of}\\ \text{Aircraft at}\\ a'\text{th Site}\end{array}\right)_{b}\left(\begin{array}{c}\text{Aircraft Type}\\ \text{Deployment}\\ \text{Factor for}\\ \text{the } a'\text{th Site}\end{array}\right)_{b}\right]}{\left(\begin{array}{c}\text{Predicted Mean}\\ \text{Time Between}\\ \text{Failures of the Item}\end{array}\right)\left(\begin{array}{c}\text{Degradation}\\ \text{Factor}\end{array}\right)}\right]$$

*** - This equation refers to the WRA's that are always removed at the operating sites.*

b - b'th aircraft type

c - number of different aircraft types

40.1.6 Annual number of real failures sent from a site. The annual number of failures of an item that are BCM at the site and sent to a higher level maintenance facility for repair. Two parameters are defined to account for real failures sent from IMA's.

40.1.6.1 Annual number of real failures sent from an IMA.

$$\begin{pmatrix}\text{Annual Number of}\\ \text{Real Failures Sent}\\ \text{from the } d'\text{th IMA}\end{pmatrix}^t = \left[\sum_{g=1}^{h}\begin{pmatrix}\text{Annual Number of Real}\\ \text{Failures Sent from the}\\ d'\text{th IMA to the } g'\text{th Depot}\end{pmatrix}_g^t\right]$$

WHERE :

$$\begin{pmatrix}\text{Annual Number of Real}\\ \text{Failures Sent from the}\\ d'\text{th IMA to the } g'\text{th Depot}\end{pmatrix}^t = \left[\begin{pmatrix}\text{Annual Number of Real}\\ \text{Failures Removed at}\\ \text{the } d'\text{th IMA}\end{pmatrix}^t \begin{pmatrix}\text{BCM Rate of the}\\ \text{Item at the IMA}\end{pmatrix}\begin{pmatrix}\text{Fraction of BCM Items}\\ \text{that are Forwarded}\\ \text{to the } g'\text{th Depot}\end{pmatrix}\right]$$

d = d'th IMA
g = g'th depot
h = the total number of depots

40.1.7 Annual number of items sent from a site. The annual number of items that are coded for repair at the site but are BCM and sent off-base for repair or the annual number of suspected failures of an item at site where off-base repair is indicated by the LORA code. Two parameters are defined to account for items sent from IMA's.

40.1.7.1 Annual number of items sent from an IMA.

$$\begin{pmatrix}\text{Annual Number of}\\ \text{Real Failures Sent}\\ \text{From the } d'\text{th IMA}\end{pmatrix}^t = \sum_{g=1}^{h}\left[\begin{pmatrix}\text{Annual Number of}\\ \text{Real Failures Sent}\\ \text{from the } d'\text{th IMA}\\ \text{to the } g'\text{th Depot}\end{pmatrix}\right]_g^t$$

WHERE :

$$\begin{pmatrix}\text{Annual Number of}\\ \text{Real Failures Sent}\\ \text{From the } d'\text{th IMA}\\ \text{to the } g'\text{th Depot}\end{pmatrix}^t = \left[\begin{pmatrix}\text{Annual Number}\\ \text{of Items For}\\ \text{Disposition}\\ \text{at the } d'\text{th IMA}\end{pmatrix}^t \begin{pmatrix}\text{BCM Rate of the}\\ \text{Item at the IMA}\end{pmatrix}\begin{pmatrix}\text{Fraction of BCM Items}\\ \text{that are Forwarded}\\ \text{to the } g'\text{th Depot}\end{pmatrix}\right]$$

40.1.8 Annual number of real failures received by a site. The annual number of failures of an item that are BCM at lower level maintenance facilities and forwarded to the site for repair. One parameter is defined to account for real failures received by a site: Depots receive failures for IMA's.

40.1.8.1 Annual number of real failures received by a depot.

$$\begin{pmatrix}\text{Annual Number of}\\ \text{Real Failures Received}\\ \text{by the } g'\text{th Depot}\end{pmatrix}^t = \sum_{d=1}^{j}\begin{pmatrix}\text{Annual Number of Real}\\ \text{Failures Sent from the}\\ d'\text{th IMA to the } g'\text{th Depot}\end{pmatrix}_d^t$$

40.1.9 Annual number of items received by a site. The annual number of BCM items or suspected failures sent to the higher level maintenance facility. One parameter is defined to account for items received by Depots.

40.1.9.1 Annual number of items received by a depot.

$$\begin{pmatrix}\text{Annual Number of}\\ \text{Items Received}\\ \text{by the } g'\text{th Depot}\end{pmatrix}^{t} = \sum_{d=1}^{j}\begin{pmatrix}\text{Annual Number}\\ \text{of Items Sent}\\ \text{from the } d'\text{th IMA}\\ \text{to the } g'\text{th Depot}\end{pmatrix}_{d}^{t}$$

40.1.9.2 Annual number of items sent from all CV's to a depot.

$$\begin{pmatrix}\text{Annual Number}\\ \text{of Items Sent}\\ \text{from all CV's}\\ \text{to the } g'\text{th Depot}\end{pmatrix}^{t} = \left[\sum_{k=1}^{L}\begin{pmatrix}\text{Annual Number}\\ \text{of Items Sent}\\ \text{from the } k'\text{th CV}\\ \text{to the } g'\text{th Depot}\end{pmatrix}_{k}^{t}\right]$$

40.1.9.3 Annual number of items sent from all NAS's to a depot.

$$\begin{pmatrix}\text{Annual Number}\\ \text{of Items Sent}\\ \text{from all NAS's}\\ \text{to the } g'\text{th Depot}\end{pmatrix}^{t} = \left[\sum_{m=1}^{n}\begin{pmatrix}\text{Annual Number}\\ \text{of Items Sent}\\ \text{from the } m'\text{th NAS}\\ \text{to the } g'\text{th Depot}\end{pmatrix}_{m}^{t}\right]$$

40.1.10 Annual number of repairs of an item at a site. The annual number of items inducted into the repair process at the site. In the repair process malfunctioning lower level parts are removed and replaced. Three parameters are defined to account for repair of items at IMA's,and Depots.

40.1.10.1 Annual number of repairs of an item at an IMA.

$$\begin{pmatrix}\text{Annual Number}\\ \text{of Repairs to an}\\ \text{Item at the } d'\text{th IMA}\end{pmatrix}^{t} = \left[\begin{pmatrix}\text{Annual Number}\\ \text{of Real Failures}\\ \text{Removed at}\\ \text{the } d'\text{th IMA}\end{pmatrix}^{t}\left[1.0 - \begin{pmatrix}\text{BCM Rate}\\ \text{of the Item}\\ \text{at the IMA}\end{pmatrix}\right]\left[1.0 - \begin{pmatrix}\text{Fraction of Item}\\ \text{Failures Scrapped}\\ \text{at the IMA}\end{pmatrix}\right]\right]$$

40.1.10.2 Annual number of repairs of an item at a depot.

$$\begin{pmatrix}\text{Annual Number}\\ \text{of Repairs to an}\\ \text{Item at the } g'\text{th Depot}\end{pmatrix}^{t} = \left[\begin{pmatrix}\text{Annual Number}\\ \text{of Real Failures}\\ \text{Removed at}\\ \text{the } g'\text{th Depot}\end{pmatrix}^{t} + \begin{pmatrix}\text{Annual Number of}\\ \text{Real Failures Received}\\ \text{by the } g'\text{th Depot}\end{pmatrix}^{t}\right]\left[1.0 - \begin{pmatrix}\text{Fraction of Item}\\ \text{Failures Scrapped}\\ \text{at the Depot}\\ \text{Repair Facility}\end{pmatrix}\right]$$

40.2 Cost element equations.

40.2.1 Inventory costs.

40.2.1.1 Inventory administration cost. The cost associated with entering an item into the supply system and retaining it there over its life cycle. The LORA techniques treat the inventory administration cost as proportional to the number of equipment peculiar items entered in the NSN (National Stock Number) system. The cost is a function of three separate costs: item entry, item retention, and field supply administration. Item entry is a one-time cost per peculiar NSN, incurred during the inventory procurement process to establish a NSN for the item. Item retention is a recurring cost per NSN incurred throughout the life cycle. It is a per year cost due to maintaining the item in the NSN system. Field supply administration is a per site cost annually incurred for local management of the item.

40.2.1.1.1 Inventory administration cost for the discard cases. The cost of local management, entry, and retention of the discarded item in the NSN system.

$$\begin{pmatrix}\text{Inventory}\\ \text{Administration}\\ \text{Cost for Discard}\end{pmatrix}^{t} = \begin{pmatrix}\text{Item}\\ \text{Entry}\\ \text{Cost}\end{pmatrix}^{*} + \left[\begin{pmatrix}\text{Item}\\ \text{Retention}\\ \text{Cost}\end{pmatrix} + \begin{pmatrix}\text{Field Supply}\\ \text{Administration}\\ \text{Cost per Item}\\ \text{per Site per Year}\end{pmatrix}\begin{pmatrix}\text{Number of}\\ \text{Sites}\\ \text{Discarding}\\ \text{the Item}\end{pmatrix}^{t}\right]\begin{pmatrix}\text{Normal}\\ \text{Discount}\\ \text{Factor}\end{pmatrix}$$

* = Item refers to either the WRA, SRA or SSRA as applicable to the indenture level under analysis

40.2.1.1.2 Inventory administration cost for the repair cases. The cost of local management, entry, and retention of the repairable item and its peculiar components or pieces parts in the NSN system. The cost equation is comprised of two segments to account for administrative costs associated with each repairable item and with its peculiar components excluding those lower indenture parts under analysis.

$$\begin{pmatrix}\text{Inventory}\\ \text{Administration}\\ \text{Cost for Repair}\end{pmatrix}^{t} = \begin{pmatrix}\text{Item}\\ \text{Entry}\\ \text{Cost}\end{pmatrix} + \left[\begin{pmatrix}\text{Item}\\ \text{Retention}\\ \text{Cost}\end{pmatrix} + \begin{pmatrix}\text{Field Supply}\\ \text{Administration}\\ \text{Cost per Item}\\ \text{per Site per Year}\end{pmatrix}\begin{pmatrix}\text{Number of}\\ \text{Sites}\\ \text{Discarding}\\ \text{the Item}\end{pmatrix}\right]^{t}\begin{pmatrix}\text{Normal}\\ \text{Discount}\\ \text{Factor}\end{pmatrix} +$$

$$\left\{\begin{pmatrix}\text{Item}\\ \text{Entry}\\ \text{Cost}\end{pmatrix} + \left[\begin{pmatrix}\text{Item}\\ \text{Retention}\\ \text{Cost}\end{pmatrix} + \begin{pmatrix}\text{Field Supply}\\ \text{Administration}\\ \text{Cost per Item}\\ \text{per Site per Year}\end{pmatrix}\begin{pmatrix}\text{Number of}\\ \text{Sites}\\ \text{Discarding}\\ \text{the Item}\end{pmatrix}^{t}\right]\begin{pmatrix}\text{Normal}\\ \text{Discount}\\ \text{Factor}\end{pmatrix}\right\}\begin{pmatrix}\text{Number of Peculiar}\\ \text{Components in the}\\ \text{NSN System}\end{pmatrix}^{*}$$

* = Components refers to the parts which are used to repair the item and are not included in the analysis

40.2.2 Spares inventory costs equations.

40.2.2.1 Inventory quantity for discard. The number of spares required during the systems life cycle to account for discard maintenance actions. The inventory quantity for each item to be discarded is calculated an annual basis by individual site.

40.2.2.1.1 Annual inventory quantity for discard at a CV site.

$$\begin{pmatrix}\text{Annual Inventory}\\ \text{Quantity for Discard}\\ \text{at the } k'\text{th CV Site}\end{pmatrix}^{t} = \left[\begin{pmatrix}\text{Annual Number of}\\ \text{Items for Disposition}\\ \text{at the } k'\text{th CV Site}\end{pmatrix}^{t}\right]$$

40.2.2.1.2 Annual inventory quantity for discard at a LB site.

$$\begin{pmatrix}\text{Annual Inventory}\\ \text{Quantity for Discard}\\ \text{at the } p'\text{th LB Site}\end{pmatrix}^{t} = \begin{pmatrix}\text{Annual Number of}\\ \text{Items for Disposition}\\ \text{at the NAS Located}\\ \text{at the } p'\text{th LB Site}\end{pmatrix}^{t}$$

P = the p'th LB site

** = The term may = 0 as applicable to the site under consideration*

40.2.2.1.3 Annual inventory quantity for discard at a depot site.

$$\begin{pmatrix}\text{Annual Inventory}\\ \text{Quantity for Discard}\\ \text{at the } g'\text{th Depot}\end{pmatrix}^{t} = \left[\begin{pmatrix}\text{Annual Number of}\\ \text{Items for Disposition}\\ \text{at the } g'\text{th Depot}\end{pmatrix}^{t}\right]$$

40.2.2.1.4 Inventory cost for discard.

$$\begin{pmatrix}\text{Annual Cost}\\ \text{for Discard}\\ \text{at the } v'\text{th Site}\end{pmatrix}^{t} = \left[\begin{pmatrix}\text{Unit}\\ \text{Cost of}\\ \text{Item}\end{pmatrix}\begin{pmatrix}\text{Annual Inventory}\\ \text{Quantity for Discard}\\ \text{at the } v'\text{th Site}\end{pmatrix}^{t}\begin{pmatrix}\text{Present}\\ \text{Discount}\\ \text{Factor}\end{pmatrix}\right]$$

v = the v'th site to include CV, LB and Depot sites

40.2.2.2 Repairable inventory quantity. The rotatable pool quantity, attrition quantity, and system stock quantity.

40.2.2.3 Rotatable pool quantity. Items stocked at the site where aircraft operate to allow immediate replacement of items repaired at the site. A rotatable pool quantity is determined for each operational site in accordance with the criteria of figure E-2 and the integerization rules of table E-I. The integerization rules operate on raw or non-integerized rotatable pool quantities calculated for each CV and LB operational site.

40.2.2.3.1 Raw rotatable pool quantity at a CV site.

$$\begin{pmatrix}\text{Raw Rotatable}\\ \text{Pool Quantity}\\ \text{at the } k'\text{th CV Site}\end{pmatrix}^t = \left[\frac{\begin{pmatrix}\text{Annual Number of}\\ \text{Repairs to an Item}\\ \text{at the } k'\text{th CV Site}\end{pmatrix}^t \begin{pmatrix}\text{Repair Cycle Time}\\ \text{at the IMA}\end{pmatrix}}{\begin{pmatrix}\text{365 Days}\\ \text{per}\\ \text{Year}\end{pmatrix}\begin{pmatrix}\text{Carrier}\\ \text{Deployment Factor}\\ \text{for the } k'\text{th CV Site}\end{pmatrix}}\right]$$

WHERE :

$$\begin{pmatrix}\text{Carrier}\\ \text{Deployment Factor}\\ \text{for the } k'\text{th CV Site}\end{pmatrix} = \left[\frac{\sum_{b=1}^{c}\begin{pmatrix}\text{Number of Aircraft}\\ \text{that Deploy to the}\\ k'\text{th Carrier per}\\ \text{Aircraft type}\end{pmatrix}_b \begin{pmatrix}\text{Aircraft type}\\ \text{Deployment Factor}\\ \text{for the } k'\text{th Carrier}\end{pmatrix}_b}{\sum_{b=1}^{c}\begin{pmatrix}\text{Number of Aircraft}\\ \text{that Deploy to the}\\ k'\text{th Carrier per}\\ \text{Aircraft type}\end{pmatrix}_b}\right]$$

40.2.2.3.2 Raw rotatable pool quantity at a LB site.

$$\begin{pmatrix}\text{Raw Rotatable}\\ \text{Pool Quantity}\\ \text{at the } p'\text{th LB Site}\end{pmatrix}^t = \left[\frac{\begin{pmatrix}\text{Annual Number of}\\ \text{Repairs to an Item}\\ \text{at the } p'\text{th LB Site}\end{pmatrix}^t \begin{pmatrix}\text{Repair Cycle Time}\\ \text{at the IMA}\end{pmatrix}}{\begin{pmatrix}\text{365 Days}\\ \text{per}\\ \text{Year}\end{pmatrix}}\right]$$

WHERE :

$$\begin{pmatrix}\text{Annual Number of}\\ \text{Repairs to an}\\ \text{Item Originating}\\ \text{at the } p'\text{th LB Site}\end{pmatrix}^t = \begin{pmatrix}\text{Annual Number of}\\ \text{Repairs to an Item}\\ \text{at the NAS Located}\\ \text{at the } p'\text{th LB Site}\end{pmatrix}^t$$

TABLE E-I. Integerization rules for computing rotatable pool quantities.

IF: (RAW ROTABLE POOL QUANTITY PER SITE)	THEN: (ROTABLE POOL QUANTITY PER SITE)
< .10	0
.11 - .59	1
.60 - 1.29	2
1.30 - 2.09	3
2.10 - 2.89	4
2.90 - 3.89	5
> 3.90	INT [(RAW ROTABLE POOL QUANTITY PER SITE) + 1.0]

* INT MEANS ROUND OFF TO NEAREST INTEGER.

40.2.2.4 Attrition quantity. The replenishment quantity stocked at the sites where aircraft operate to replace those items not repairable or restorable to an RFI (Ready for Issue) status at the sites. These items are BCM or scrapped and, therefore, not available to the site's supply system. The attrition quantity, computed for the individual sites, is subject to the integerization rules of table E-II and the criteria of figure E-2 which operate on raw or non-integerized attrition quantities.

40.2.2.4.1 Raw attrition quantity for a CV performing local repairs.

$$\left(\text{Raw Attrition Quantity at the k'th CV Site}\right)^{c} = \left[\frac{\left[\left(\text{Annual Number of Items for Disposition at the k'th CV Site}\right)^{c}\left(\text{BCM Rate of Item at the IMA}\right) + \left(\text{Annual Number of Real Failures Removed at the k'th CV Site}\right)^{c}\left[1.0 - \left(\text{BCM Rate of Item at the IMA}\right)\right]\left(\text{Fraction of Item Failures Scrapped at the IMA}\right)\right]\left(\text{Required Days of Stock at the IMA}\right)}{\left(\text{365 days per Year}\right)\left(\text{Carrier Deployment Factor for the k'th CV Site}\right)}\right]$$

40.2.2.4.2 Raw attrition quantity for a CV when off-site repair is indicated.

$$\left(\begin{array}{c}\text{Raw Attrition}\\\text{Quantity at the}\\\text{k'th CV Site}\end{array}\right)^{t} = \left[\frac{\left(\begin{array}{c}\text{Annual Number}\\\text{of Items for}\\\text{Disposition at}\\\text{the k'th CV Site}\end{array}\right)^{t}\left(\begin{array}{c}\text{Required}\\\text{Days of Stock}\\\text{at the IMA}\end{array}\right)}{\left(\begin{array}{c}\text{365 Days}\\\text{per}\\\text{Year}\end{array}\right)\left(\begin{array}{c}\text{Carrier Deployment}\\\text{Factor for the}\\\text{k'th CV Site}\end{array}\right)}\right]$$

40.2.2.4.3 Raw attrition quantity for a LB performing local repairs.

$$\left(\begin{array}{c}\text{Raw}\\\text{Attrition}\\\text{Quantity at}\\\text{the p'th}\\\text{LB Site}\end{array}\right)^{t} =$$

$$+\left[\frac{\left\{\left(\begin{array}{c}\text{Annual Number}\\\text{of Items for}\\\text{Disposition at}\\\text{the p'th LB NAS}\end{array}\right)^{t}\left(\begin{array}{c}\text{BCM Rate}\\\text{of Item at}\\\text{the IMA}\end{array}\right) + \left(\begin{array}{c}\text{Annual Number}\\\text{of Real Failures}\\\text{Removed at the}\\\text{p'th LB NAS}\end{array}\right)^{t}\left[1.0 - \left(\begin{array}{c}\text{BCM Rate}\\\text{of Item at}\\\text{the IMA}\end{array}\right)\right]\left(\begin{array}{c}\text{Fraction of}\\\text{Item Failures}\\\text{Scrapped}\\\text{at the IMA}\end{array}\right)\right\}\left(\begin{array}{c}\text{Required}\\\text{Days of}\\\text{Stock at}\\\text{the IMA}\end{array}\right)}{\left(\begin{array}{c}\text{365 days}\\\text{per}\\\text{Year}\end{array}\right)}\right]$$

40.2.2.4.4 Raw attrition quantity for a LB when off-site repair is indicated.

$$\left(\begin{array}{c}\text{Raw Attrition}\\\text{Quantity at the}\\\text{p'th LB Site}\end{array}\right)^{t} = \left[\frac{\left(\begin{array}{c}\text{Annual Number}\\\text{of Items for}\\\text{Disposition at}\\\text{the NAS Located at}\\\text{the p'th LB Site}\end{array}\right)^{t}\left(\begin{array}{c}\text{Required}\\\text{Days of Stock}\\\text{at the IMA}\end{array}\right)}{\left(\begin{array}{c}\text{365 Days}\\\text{per}\\\text{Year}\end{array}\right)}\right]$$

TABLE E-II. Integerization rules for computing attrition quantities.

Cost Range Criteria (in dollars)
Recommended Attrition Quantity per Site

RAQ per Site	There is no attrition quantity for raw quantities less than .34				
.34	L $.11 4	$.12 - $1.10 3	$1.11 - $9.80 2	$9.81 - $74 1	G $74.01 1
.35	L .12 4	.13 - 1.20 3	1.21 - 10.80 2	10.81 - 76 1	G 76.01 1
.36	L .15 4	.16 - 1.25 3	1.26 - 10.50 2	10.51 - 78 1	G 78.01 1
.37	L .16 4	.17 - 1.40 3	1.41 - 11.10 2	11.11 - 79 1	G 79 1
.38	L .17 4	.18 - 1.50 3	1.51 - 12 2	12.01 - 81 1	G 81.01 1
.39	L .18 4	.19 - 1.60 3	1.61 - 12.50 2	12.51 - 84 1	G 84.01 1
.40	L .19 4	.20 - 1.70 3	1.71 - 13 2	13.01 - 86 1	G 86.01 1
.42	L .22 4	.23 - 1.90 3	1.91 - 14 2	14.01 - 89 1	G 89.01 1
.44	L .26 4	.27 - 2.10 3	2.11 - 15 2	15.01 - 94 1	G 94.01 1
7.46	L .35 4	.36 - 2.40 3	2.41 - 16 2	16.01 - 96 1	G 96.01 1
.48	L .38 4	.39 - 2.70 3	2.71 - 18 2	18.01 - 98 1	G 98.01 1
.50	L .40 4	.41 - 2.95 3	2.96 - 19 2	19.01 - 100 1	G 100.01 1
.52	L .46 4	.47 - 3.20 3	3.21 - 21 2	21.01 - 100 1	G 100.01 1
.54	L .52 4	.53 - 3.60 3	3.61 - 22 2	22.01 - 100 1	G 100.01 1
.56	L .58 4	.59 - 3.90 3	3.91 - 24 2	24.01 - 100 1	G 100.01 1
.58	L .66 4	.67 - 4.30 3	4.31 - 26 2	26.01 - 100 1	G 100.01 1
.60	L .76 4	.77 - 4.80 3	4.81 - 27 2	27.01 - 100 1	G 100.01 1
.62	L .85 4	.86 - 5 3	5.01 - 28 2	28.01 - 100 1	G 100.01 1

NOTE: L = less than or equal to...
G = greater than or equal to...

EXAMPLE: If an item costs between $11.11 and $29, and has a raw attrition quantity per site of .37, then the recommended attrition quantity per site is 1. This table is applied for CV and LB sites performing either local or off-site repairs. Whether the recommended quantity is stocked at a site depends on the criteria in figure E-2.

TABLE E-II. Integerization rules for computing attrition quantities - Continued.

Cost Range Criteria (in dollars)
Recommended Attrition Quantity per Site

RAQ						
.64	L $.11 5	$.12 - .90 4	$.91 - 5.20 3	$5.20 - 29 2	$29.01 - 100 1	G $100.01 1
.66	L .14 5	.15 - 1.05 4	1.06 - 6.20 3	6.21 - 32 2	32.01 - 100 1	G 100.01 1
.68	L .15 5	.16 - 1.10 4	1.11 - 6.50 3	6.51 - 34 2	34.01 - 100 1	G 100.01 1
.70	L .17 5	.18 - 1.25 4	1.26 - 7 3	7.01 - 36 2	36.01 - 100 1	G 100.01 1
.72	L .19 5	.20 - 1.40 4	1.41 - 7.80 3	7.81 - 38 2	38.01 - 100 1	G 100.01 1
.74	L .22 5	.23 - 1.50 4	1.51 - 8 3	8.01 - 39 2	39.01 - 100 1	G 100.01 1
.76	L .24 5	.25 - 1.65 4	1.66 - 8.50 3	8.51 - 40 2	40.01 - 100 1	G 100.01 1
.78	L .28 5	.29 - 1.80 4	1.81 - 9 3	9.01 - 43 2	43.01 - 100 1	G 100.01 1
.80	L .33 5	.34 - 2 4	2.01 - 10 3	10.01 - 43.50 2	43.51 - 100 1	G 100.01 1
.82	L .37 5	.38 - 2.20 4	2.21 - 10.50 3	10.51 - 44.50 2	44.51 - 100 1	G 100.01 1
.84	L .41 5	.42 - 2.40 4	2.41 - 11.50 3	11.51 - 47 2	47.01 - 100 1	G 100.01 1
.86	L .45 5	.46 - 2.60 4	2.61 - 12.50 3	12.51 - 50 2	50.01 - 100 1	G 100.01 1
.88	L .49 5	.50 - 2.80 4	2.81 - 13 3	13.01 - 53 2	53.01 - 100 1	G 100.01 1
.90	L .52 5	.53 - 3 4	3.01 - 13.50 3	13.51 - 56 2	56.01 - 100 1	G 100.01 1
.92	L .61 5	.62 - 3.25 4	3.26 - 14 3	14.01 - 58 2	58.01 - 100 1	G 100.01 1
.94	L .70 5	.71 - 3.50 4	3.51 - 14.50 3	14.51 - 60 2	60.01 - 100 1	G 100.01 1
.96	L .79 5	.80 - 3.75 4	3.76 - 15 3	15.01 - 62 2	62.01 - 100 1	G 100.01 1
.98	L .86 5	.87 - 4 4	4.01 - 16 3	16.01 - 65 2	65.01 - 100 1	G 100.01 1
.99	L .95 5	.96 - 4.20 4	4.21 - 17.50 3	17.51 - 68 2	68.01 - 100 1	G 100.01 1

EXAMPLE: The raw attrition quantity is rounded to the nearest even hundredth. If an item costs between $1.51 and $8.00 and has a raw quantity per site of .73, then the recommended attrition quantity per site is 3. Whether the recommended quantity is stocked depends on the criteria shown in figure E-2.

TABLE E-II. Integerization rules for computing attrition quantities - Continued.

Cost Range Criteria (in dollars)
Recommended Attrition Quantity per Site

RAQ					
1	L $.15 6	$.16 - .85 5	$.86 - 4.20 4	$4.21 - 17 3	$17.01 - 70 2
1	70.01 - 100 1	G 100.01 1			
2	L .23 8	.24 - .90 7	.91 - 3.10 6	3.11 - 9 5	9.01 - 25 4
2	25.01 - 50 3	50.01 - 100 2	G 100.01 2		
3	L .22 10	.23 - .68 9	.69 - 2 8	2.01 - 5.75 7	5.76 - 13 6
3	13.01 - 27 5	27.01 - 45 4	45.01 - 100 3	G 100.01 3	
4	L .50 13-11	.51 - 1.40 10	1.41 - 3.20 9	3.21 - 8 8	8.01 - 17 7
4	17.01 - 28 6	28.01 - 44 5	44.01 - 100 4	G 100.01 4	
5	L 1.90 15-11	1.91 - 4.80 10	4.81 - 9.50 9	9.51 - 17 8	17.01 - 28 7
5	28.01 - 40 6	40.01 - 100 5	G 100.01 5		
6	L .11 17-16	.12 - 6 15-11	6.01 - 13 10	13.01 - 19 9	19.01 - 28 8
6	28.01 - 37 7	37.01 - 100 6	G 100.01 6		
7	L .35 18-16	.36 - 13 15-11	13.01 - 19 10	19.01 - 28 9	28.01 - 36 8
7	36.01 - 100 7	G 100.01 7			
8	L 1.00 20-16	1.01 - 20 15-11	20.01 - 27 10	27.01 - 35 9	35.01 - 100 8
8	G 100.01 8				
9	L 2.50 20-16	2.51 - 25 15-11	25.01 - 34 10	34.01 - 100 9	G 100.01 9
10	L .25 23-21	.26 - 6 20-16	6.01 - 31 15-11	31.01 - 100 10	G 100.01 10
11	L .60 24-21	.61 - 10 20-16	10.01 - 100 15-11	G 100.01 11	
12	L 1.30 25-21	1.31 - 15 20-16	15.01 - 100 15-11	G 100.01 12	

EXAMPLE: RAQ's between 1 and 25 are rounded to the nearest whole number. Whether the recommended quantity is stocked or not depends on the criteria of figure E-2.

TABLE E-II. Integerization rules for computing attrition quantities - Continued.

Cost Range Criteria (in dollars)
Recommended Attrition Quantity per Site

RAQ				
13	L $2.70 27-21	$2.71 - 19 20-16	$19.01 - 100 15-11	G $100.01 13
14	L 5.00 28-21	5.01 - 24 20-16	24.01 - 100 15-11	G 100.01 14
15	L 7.50 29-21	7.51 - 28 20-16	28.01 - 100 15-11	G 100.01 15
16	L 11 30-21	11.01 - 100 20-16	G 100.01 16	
17	L .18 33-31	.19 - 14 30-21	14.01 - 100 20-16	G 100.01 17
18	L .40 34-31	.41 - 18 30-21	18.01 - 100 20-16	G 100.01 18
19	L .70 35-31	.71 - 20 30-21	20.01 - 100 20-16	G 100.01 19
20	L 1.20 36-31	1.21 - 22 30-21	22.01 - 100 20-16	G 100.01 20
21	L 2.00 37-31	2.01 - 100 30-21	G 100.01 21	
22	L 3.80 39-31	3.81 - 100 30-21	G 100.01 22	
23	L 5.80 40-31	5.81 - 100 30-21	G 100.01 23	
24	L .15 43-41	.16 - 8 40-31	8.01 - 100 30-21	G 100.01 24

EXAMPLE: The RAQ is rounded to the nearest whole number. For any item with a rounded RAQ the recommended attrition quantity is determined using linear interpolation of the cost and the attrition quantity range. If an item cost $37.00 and has an RAQ of 16.3, using the interpolation example below, the recommended attrition quantity is 19. The determine this number, 16.3 was rounded to 16, then the appropriate cost range is selected. The cost is interpolated with the quantity range to $17.80 per unit. The expanded cost range with $17.80 steps yields the following:

11.01 - 100 20-16	=>	11.01-28.81 20	28.82-46.61 19	46.62-64.40 18	64.41-82.20 17	82.21-100 16

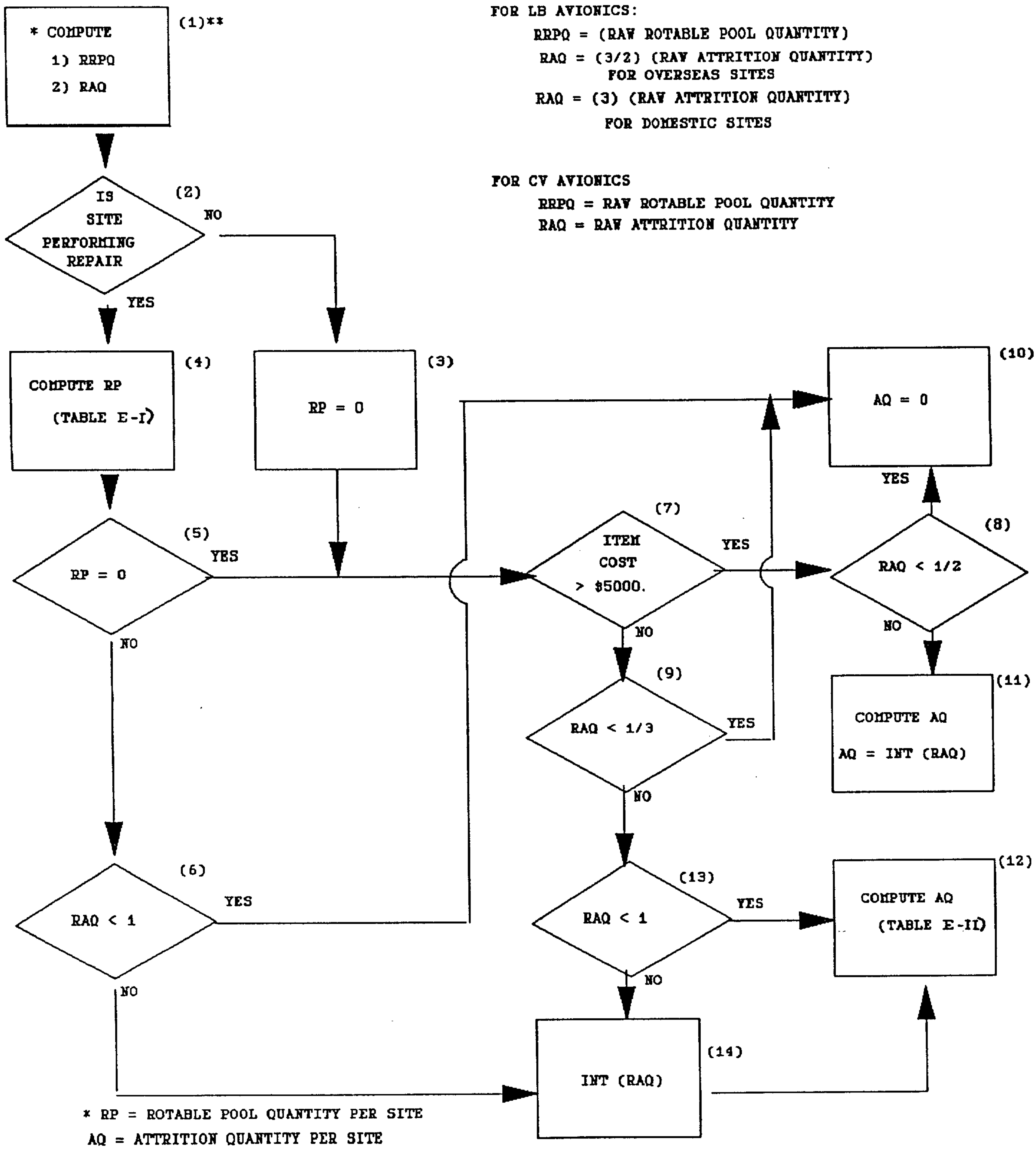
$37 falls in the range 28.82 to 46.61 with a recommended attrition quantity of 19. Whether the recommended quantity is stocked depends on the criteria in figure E-2.

TABLE E-II. Integerization rules for computing attrition quantities - Continued.

Cost Range Criteria (in dollars)
Recommended Attrition Quantity per Site

RAQ				
25	L $.25 45-41	$.26 - 10 40-31	$10.01 - 100 30-21	G $100.01 25
30	L 2.50 50-41	2.51 - 19 40-31	19.01 - 100 30-21	G 100.01 30
35	L .60 75-51	.61 - 9 50-41	9.01 - 100 40-31	G 100.01 35
40	L 5.00 75-51	5.01 - 100 50-41	G 100.01 40	
45	L 9.00 75-51	9.01 - 100 50-41	G 100.01 45	
50	L 14.00 75-51	14.01 - 100 50-41	G 100.01 50	
55	L .40 100-76	.41 - 100 75-51	G 100.01 55	
60	L 1.50 100-76	1.51 - 100 75-51	G 100.01 60	
65	L 5.00 100-76	5.01 - 100 75-51	G 100.01 65	
70	L 7.50 100-76	7.51 - 100 75-51	G 100.01 70	
75	L .20 100	.21 - 12 100-76	12.01 - 100 75-51	G 100.01 75
80	L .70 100	.71 - 100 100-76	G 100.01 80	
85	L 2.50 100	2.51 - 100 100-76	G 100.01 85	
90	L 4.25 100	4.26 - 100 100-76	G 100.01 90	
95	L 7.00 100	7.01 - 100 100-76	G 100.01 95	
Round raw quantities greater than 100 to the nearest whole number. Recommended attrition quantity is equal to the integer.				

EXAMPLE: RAQ's between 25 and 100 are rounded to the nearest whole number evenly divisible by 5. For rounded RAQ's the recommended attrition quantity is found using linear interpolation of the cost and quantity ranges. Whether the recommended quantity is stocked or not depends on the criteria in figure E-2.



* RP = ROTABLE POOL QUANTITY PER SITE
AQ = ATTRITION QUANTITY PER SITE
** CIRCLED NUMBERS ARE DEFINED ON PAGE 42 BY THEIR RESPECTIVE NUMBER

FIGURE E-2. Rotatable pool and attrition quantity computations.

Description of the Rotatable Pool and
Attrition Quantity Computations

Figure E-2 presents the criteria used in determining per site RP (Rotatable Pool) and AQ (Attrition Quantity) values. The flow diagram is based on range and quantity criteria derived by the Aviation Supply Office for computing allowance quantities.

A RRPQ (Raw Rotatable Pool Quantity) and a RAQ (Raw Attrition Quantity) are computed using the RAQ equations 40.2.2.3 and 40.2.2.4 (1). Raw or non-integerized quantities for the RP and AQ are calculated for each CV and LB operational site. A criterion for the existence of an RP at a site is whether the site is authorized to repair the item under analysis (2). If the item is not repairable at the site the RP quantity is zero (3). If the site can repair the item an RP is computed in accordance with the RRPQ integerization rules of table E-I (4). Various criteria may be used to calculate the AQ; the criteria used are dependent on the RP existence (5). For items with a non-zero RP the AQ determination is based on an initial RAQ criterion of 1 (6); for items with a zero RP the AQ determination is based on an initial cost criterion of $5000 (7). If the initial cost criterion is satisfied then a RAQ criterion of 1/2 is applied (8), if not a RAQ criterion of 1/3 is applied (9). Consequently, there is no AQ (10) for items that: (a) have an RP but have an RAQ of less than 1, (b) have no RP, cost more that $5000, and have an RAQ less that 1/2, (c) have no RP, cost less than $5000, and have a RAQ less than 1/3. AQ's are computed for items that do not satisfy the above criterion sequence such that the AQ is equal to the RAQ rounded off to the nearest whole integer for items not meeting the 1/2 criterion (11); the AQ's for the remaining items are computed according to the rules of table E-II (12) which operate only on RAQ's greater that 1/3. RAQ's greater than 1, (6) and (13), are rounded off to the nearest whole integer (14) before inclusion in table E-II, RAQ's less than 1 are not rounded off.

40.2.2.5 System stock quantity. The safety inventory quantity procured to satisfy demands due to anticipated losses during the procurement cycle times exceeding required days of stock. The system stock is stored at designated inventory control resupply points or depots.

$$\begin{pmatrix}\text{System}\\ \text{Stock}\\ \text{of an}\\ \text{Item}\end{pmatrix} = INT\left\{\left[\begin{pmatrix}\text{Procurement}\\ \text{Lead Time}\\ \text{in Years}\end{pmatrix} + \begin{pmatrix}\text{Safety}\\ \text{Level}\\ \text{in Years}\end{pmatrix}\right]\left[\sum_{d=1}^{j}\begin{pmatrix}\text{Annual Number}\\ \text{of Real Failures}\\ \text{Removed at}\\ \text{the } d'\text{th IMA}\end{pmatrix}^{t}_{d}\left[1.0 - \begin{pmatrix}\text{BCM Rate}\\ \text{of Item at}\\ \text{the IMA}\end{pmatrix}\right]\begin{pmatrix}\text{Fraction of Item}\\ \text{Failures Scrapped}\\ \text{at the IMA}\end{pmatrix}\right.\right.$$

$$\left.\left. + \sum_{g=1}^{h}\left[\left[\begin{pmatrix}\text{Annual Number}\\ \text{of Real Failures}\\ \text{Removed at}\\ \text{the } g'\text{th Depot}\end{pmatrix}^{t}_{g} + \begin{pmatrix}\text{Annual Number}\\ \text{of Real Failures}\\ \text{Received by}\\ \text{the } g'\text{th Depot}\end{pmatrix}^{t}_{g}\right]\begin{pmatrix}\text{Fraction of Item}\\ \text{Failures Scrapped}\\ \text{at the Depot}\\ \text{Repair Facility}\end{pmatrix}\right]\right]\right\}$$

$$+ \left[\begin{pmatrix}\text{Repair Cycle}\\ \text{Time the}\\ \text{CV to Depot}\\ \text{in Years}\end{pmatrix} - \begin{pmatrix}\text{Required}\\ \text{Years}\\ \text{Stock at CV}\end{pmatrix}\right]^{*}\sum_{g=1}^{h}\begin{pmatrix}\text{Annual Number}\\ \text{of Items Sent}\\ \text{from all CV's}\\ \text{to the } g'\text{th Depot}\end{pmatrix}^{t}_{g}$$

$$+ \left[\begin{pmatrix}\text{Repair Cycle}\\ \text{Time the}\\ \text{NAS to Depot}\\ \text{in Years}\end{pmatrix} - \begin{pmatrix}\text{Required}\\ \text{Years}\\ \text{Stock at NAS}\end{pmatrix}\right]^{*}\sum_{g=1}^{h}\begin{pmatrix}\text{Annual Number}\\ \text{of Items Sent}\\ \text{from all NAS's}\\ \text{to the } g'\text{th Depot}\end{pmatrix}^{t}_{g}$$

* *Negative quantities are not allowed; if a term is less than zero, a zero quantity is computed. Yearly parameters for stockage and repair times are input as days and converted to years by the computer model.*

40.2.2.6 Total repairable inventory quantity. The summation of the rotatable pool, attrition, and system stock quantities. Since the rotatable pool and attrition quantities are computed by site, the quantities must be totaled across all sites.

$$\begin{pmatrix}\text{Total}\\ \text{Repairable}\\ \text{Inventory}\\ \text{Quantity}\end{pmatrix} = \sum_{k=1}^{l}\left[\begin{pmatrix}\text{Rotatable}\\ \text{Pool Quantity}\\ \text{at the } k'\text{th}\\ \text{CV Site}\end{pmatrix}^{t}_{k} + \begin{pmatrix}\text{Attrition}\\ \text{Quantity}\\ \text{at the } k'\text{th}\\ \text{CV Site}\end{pmatrix}^{t}_{k}\right] + \sum_{p=1}^{q}\left[\begin{pmatrix}\text{Rotatable}\\ \text{Pool Quantity}\\ \text{at the } p'\text{th}\\ \text{LB Site}\end{pmatrix}^{t}_{p} + \begin{pmatrix}\text{Attrition}\\ \text{Quantity}\\ \text{at the } p'\text{th}\\ \text{LB Site}\end{pmatrix}^{t}_{p}\right] + \begin{pmatrix}\text{System}\\ \text{Stock of}\\ \text{the Item}\end{pmatrix}^{t}$$

q = total number of LB sites which include NAS's and NAS's collocated with PIMA's

40.2.2.7 Total repairable inventory cost.

$$\begin{pmatrix}\text{Total}\\ \text{Repairable}\\ \text{Inventory}\\ \text{Cost}\end{pmatrix}^{t} = \left[\begin{pmatrix}\text{Unit}\\ \text{Cost of}\\ \text{Item}\end{pmatrix}\begin{pmatrix}\text{Total}\\ \text{Repairable}\\ \text{Inventory}\\ \text{Quantity}\end{pmatrix}^{t}\right]$$

40.2.3 Repair scrap quantity. The inventory procured throughout the life cycle to replenish the system stock quantity. Replenishment of the system stock is necessary to account for losses in the supply system caused by items being scrapped during the repair process. A repair scrap quantity is computed for each repair site.

40.2.3.1 Annual repair scrap quantity at a CV site. This quantity accounts for the contribution to the total repair scrap quantity of losses occurring at each CV site.

$$\begin{pmatrix}\text{Annual Repair}\\ \text{Scrap Quantity}\\ \text{at the } k'\text{th CV Site}\end{pmatrix}^t = \left[\begin{pmatrix}\text{Annual Number}\\ \text{of Real Failures}\\ \text{Removed at the}\\ k'\text{th CV Site}\end{pmatrix}^t \left[1.0 - \begin{pmatrix}\text{BCM Rate}\\ \text{of Item at}\\ \text{the IMA}\end{pmatrix}\right]\begin{pmatrix}\text{Fraction of Item}\\ \text{Failures Scrapped}\\ \text{at the IMA}\end{pmatrix}\right]$$

40.2.3.2 Annual repair scrap quantity at a LB site. This quantity accounts for the contribution to the total repair scrap quantity of losses occurring at each LB site.

$$\begin{pmatrix}\text{Annual Repair}\\ \text{Scrap Quantity}\\ \text{at the } p'\text{th}\\ \text{LB Site}\end{pmatrix}^t = \begin{pmatrix}\text{Annual Number of}\\ \text{Real Failures Removed}\\ \text{at the NAS Located}\\ \text{at the } p'\text{th LB Site}\end{pmatrix}^t \left[1.0 - \begin{pmatrix}\text{BCM Rate}\\ \text{of Item at}\\ \text{the IMA}\end{pmatrix}\right]\begin{pmatrix}\text{Fraction of Item}\\ \text{Failures Scrapped}\\ \text{at the IMA}\end{pmatrix}$$

40.2.3.3 Annual repair scrap quantity at a depot. This quantity accounts for the contribution to the total repair scrap quantity of losses occurring at each depot site.

$$\begin{pmatrix}\text{Annual Repair}\\ \text{Scrap Quantity}\\ \text{at the } g'\text{th}\\ \text{Depot Site}\end{pmatrix}^t = \left[\begin{pmatrix}\text{Annual Number}\\ \text{of Real Failures}\\ \text{Removed at the}\\ g'\text{th Depot Site}\end{pmatrix}^t + \begin{pmatrix}\text{Annual Number}\\ \text{of Real Failures}\\ \text{Received by the}\\ g'\text{th Depot Site}\end{pmatrix}^t\right]\begin{pmatrix}\text{Fraction of Item}\\ \text{Failures Scrapped}\\ \text{at the Depot}\\ \text{Repair Facility}\end{pmatrix}$$

40.2.3.4 Repair scrap cost.

$$\begin{pmatrix}\text{Repair}\\ \text{Scrap}\\ \text{Cost}\end{pmatrix}^t = \sum_{v=1}^{r}\left[\begin{pmatrix}\text{Annual Repair}\\ \text{Scrap Quantity}\\ \text{at the } v'\text{th Site}\end{pmatrix}^t_v\right]\begin{pmatrix}\text{Unit}\\ \text{Cost of}\\ \text{Item}\end{pmatrix}\begin{pmatrix}\text{Present}\\ \text{Discount}\\ \text{Factor}\end{pmatrix}$$

r = number of repair facilities (IMA's, and Depot's)

40.2.4 Repair material cost. Accounts for the cost of parts required per repair action, excluding those which are included in the analysis. The total repair material cost is the summation of the costs at all sites.

40.2.4.1 Repair material cost at a CV site.

$$\begin{pmatrix}\text{Repair Material}\\ \text{Cost at the}\\ k'\text{th CV Site}\end{pmatrix}^t = \left[\begin{pmatrix}\text{Annual Number of}\\ \text{Repairs to an Item}\\ \text{at the } k'\text{th CV Site}\end{pmatrix}^t \begin{pmatrix}\text{Unit}\\ \text{Cost of}\\ \text{Item}\end{pmatrix}\begin{pmatrix}\text{Repair}\\ \text{Material Rate}\\ \text{at the IMA}\end{pmatrix}\begin{pmatrix}\text{Present}\\ \text{Discount}\\ \text{Factor}\end{pmatrix}\right]$$

40.2.4.2 Repair material cost at a LB site.

$$\begin{pmatrix}\text{Repair Material}\\ \text{Cost at the}\\ p'\text{th LB Site}\end{pmatrix}^t = \begin{pmatrix}\text{Annual Number of}\\ \text{Repairs to an Item}\\ \text{at the NAS Located}\\ \text{at the } p'\text{th LB Site}\end{pmatrix}^t \begin{pmatrix}\text{Repair}\\ \text{Material Rate}\\ \text{at the IMA}\end{pmatrix}\begin{pmatrix}\text{Unit}\\ \text{Cost of}\\ \text{Item}\end{pmatrix}\begin{pmatrix}\text{Present}\\ \text{Discount}\\ \text{Factor}\end{pmatrix}$$

40.2.4.3 Repair material cost at a depot site.

$$\begin{pmatrix}\text{Repair Material}\\ \text{Cost at the}\\ g'\text{th Depot Site}\end{pmatrix}^t = \left[\begin{pmatrix}\text{Annual Number of}\\ \text{Repairs to an Item}\\ \text{at the } g'\text{th Depot Site}\end{pmatrix}^t \begin{pmatrix}\text{Unit}\\ \text{Cost of}\\ \text{Item}\end{pmatrix}\begin{pmatrix}\text{Repair}\\ \text{Material Rate}\\ \text{at the Depot}\end{pmatrix}\begin{pmatrix}\text{Present}\\ \text{Discount}\\ \text{Factor}\end{pmatrix}\right]$$

40.2.4.4 Total repair material cost.

$$\begin{pmatrix}\text{Repair}\\ \text{Material}\\ \text{Cost}\end{pmatrix}^t = \sum_{v=1}^{r}\left[\begin{pmatrix}\text{Repair}\\ \text{Material Cost}\\ \text{at the } v'\text{th Site}\end{pmatrix}^t_v\right]$$

40.2.5 <u>Transportation costs</u>. The costs of packaging, handling, and transporting for purposes of repair or replenishment, item inventories to and from operational, repair, and resupply sites. The costs are functions of the packaging and handling rates per cubic foot and transportation rates per pound from site to site, and are computed by site.

40.2.5.1 <u>Transportation cost for the discard cases</u>.

$$\begin{pmatrix}\text{Transportation}\\ \text{Cost}\\ \text{for Discard}\end{pmatrix}^{t} = \begin{pmatrix}\text{Normal}\\ \text{Discount}\\ \text{Factor}\end{pmatrix} \left\{ \sum_{v=1}^{I} \sum_{s=1}^{T} \left[\begin{pmatrix}\text{Annual Number}\\ \text{of Items for}\\ \text{Disposition at}\\ \text{the } v'\text{th Site}\end{pmatrix}_{v}^{t} \left[\begin{pmatrix}\text{Transportation}\\ \text{Rate per Pound}\\ \text{from the } s'\text{th Site}\\ \text{to the } v'\text{th Site}\end{pmatrix}_{s,v} \begin{pmatrix}\text{Weight}\\ \text{of the}\\ \text{Item}\end{pmatrix} \begin{pmatrix}\text{Fraction of}\\ \text{the } v'\text{th Site}\\ \text{Resupply from}\\ \text{the } s'\text{th Site}\end{pmatrix}_{s,v} + \begin{pmatrix}\text{Packing and}\\ \text{Handling Rate}\\ \text{per cubic Foot}\end{pmatrix} \begin{pmatrix}\text{Inventory}\\ \text{Storage Space}\\ \text{per Item in}\\ \text{cubic Feet}\end{pmatrix} \right] \right] \right\}$$

WHERE:

$$\begin{pmatrix}\text{Annual Number}\\ \text{of Items for}\\ \text{Disposition at}\\ \text{the } p'\text{th LB Site}\end{pmatrix}^{t} = \begin{pmatrix}\text{Annual Number of}\\ \text{Items for Disposition}\\ \text{at the NAS Located}\\ \text{at the } p'\text{th LB Site}\end{pmatrix}^{t}$$

s = the s'th resupply depot

T = number of resupply depots

40.2.5.2 <u>Transportation cost for the repair cases</u>.

$$\begin{pmatrix}\text{Transportation}\\ \text{Cost}\\ \text{for Repair}\end{pmatrix}^{t} = \begin{pmatrix}\text{Normal}\\ \text{Discount}\\ \text{Factor}\end{pmatrix}$$

$$\left\{ 2 \sum_{d=1}^{j} \sum_{g=1}^{h} \left[\begin{pmatrix}\text{Annual Number of}\\ \text{Items Sent from}\\ \text{the } d'\text{th IMA to}\\ \text{the } g'\text{th Depot}\end{pmatrix}_{g,d}^{t} \left[\begin{pmatrix}\text{Transportation}\\ \text{Rate per Pound}\\ \text{from the } d'\text{th IMA}\\ \text{to the } g'\text{th Depot}\end{pmatrix}_{g,d} \begin{pmatrix}\text{Weight}\\ \text{of the}\\ \text{Item}\end{pmatrix} + \begin{pmatrix}\text{Packaging and}\\ \text{Handling Rate}\\ \text{per Cubic Foot}\end{pmatrix} \begin{pmatrix}\text{Inventory}\\ \text{Storage Space}\\ \text{per Item in}\\ \text{Cubic Feet}\end{pmatrix} \right] \right] \right.$$

$$+ \sum_{k=1}^{L} \sum_{s=1}^{T} \left[\begin{pmatrix}\text{Annual Repair}\\ \text{Scrap Quantity}\\ \text{at the } k'\text{th}\\ \text{CV Site}\end{pmatrix}_{k}^{t} \left[\begin{pmatrix}\text{Transportation}\\ \text{Rate per Pound}\\ \text{from the } s'\text{th Site}\\ \text{to the } k'\text{th CV Site}\end{pmatrix}_{s,k} \begin{pmatrix}\text{Weight}\\ \text{of the}\\ \text{Item}\end{pmatrix} \begin{pmatrix}\text{Fraction of}\\ \text{the } k'\text{th CV's}\\ \text{Resupply}\\ \text{from } s'\text{th Site}\end{pmatrix}_{s,k} + \begin{pmatrix}\text{Packaging and}\\ \text{Handling Rate}\\ \text{per Cubic Foot}\end{pmatrix} \begin{pmatrix}\text{Inventory}\\ \text{Storage Space}\\ \text{per Item in}\\ \text{Cubic Feet}\end{pmatrix} \right] \right]$$

$$+ \sum_{p=1}^{q} \sum_{s=1}^{T} \left[\begin{pmatrix}\text{Annual Repair}\\ \text{Scrap Quantity}\\ \text{at the } p'\text{th}\\ \text{LB Site}\end{pmatrix}_{p}^{t} \left[\begin{pmatrix}\text{Transportation}\\ \text{Rate per Pound}\\ \text{from the } s'\text{th Site}\\ \text{to the } p'\text{th LB Site}\end{pmatrix}_{s,p} \begin{pmatrix}\text{Weight}\\ \text{of the}\\ \text{Item}\end{pmatrix} \begin{pmatrix}\text{Fraction of}\\ \text{the } p'\text{th LB's}\\ \text{Resupply}\\ \text{from } s'\text{th Site}\end{pmatrix}_{s,p} + \begin{pmatrix}\text{Packaging and}\\ \text{Handling Rate}\\ \text{per Cubic Foot}\end{pmatrix} \begin{pmatrix}\text{Invertory}\\ \text{Storage Space}\\ \text{per Item in}\\ \text{Cubic Feet}\end{pmatrix} \right] \right]$$

$$\left. + \sum_{g=1}^{h} \sum_{s=1}^{T} \left[\begin{pmatrix}\text{Annual Repair}\\ \text{Scrap Quantity}\\ \text{at the } g'\text{th}\\ \text{Depot}\end{pmatrix}_{g}^{t} \left[\begin{pmatrix}\text{Transportation}\\ \text{Rate per Pound}\\ \text{from the } s'\text{th Site}\\ \text{to the } g'\text{th Depot}\end{pmatrix}_{s,g} \begin{pmatrix}\text{Weight}\\ \text{of the}\\ \text{Item}\end{pmatrix} \begin{pmatrix}\text{Fraction of}\\ g'\text{th Depot's}\\ \text{Resupply}\\ \text{from } s'\text{th Site}\end{pmatrix}_{s,g} + \begin{pmatrix}\text{Packaging and}\\ \text{Handling Rate}\\ \text{per Cubic Foot}\end{pmatrix} \begin{pmatrix}\text{Inventory}\\ \text{Storage Space}\\ \text{per Item in}\\ \text{Cubic Feet}\end{pmatrix} \right] \right] \right\}$$

40.2.6 Support equipment cost. Two types of support equipment are considered in LORA decisions. First, the item may require PSSE (Peculiar Support of Support Equipment) for fault isolation or verification. The contractor would design a specific equipment to service the item. Second, the contractor may design an equipment that services a group of items, in which case the equipment is required if at least one member of the group is assigned to some level requiring the equipment.

40.2.6.1 Peculiar support equipment cost. When performing an analysis at the item's indenture level, allocatable and/or non-allocatable cost may be incurred. For PSSE, peculiar to an individual item, the cost is assigned entirely to the item as an allocatable cost. For PSSE designed for a group of items, the cost is assigned to the group of items as non-allocatable cost. Within the following equations, the word item refers to an item that has PSSE specifically designed for it or to the items in a group that have PSSE designed for the group. In the PSSE cost equations that follow the total cost of on PSSE is defined to include the initial unit cost and annually recurring support costs.

$$\begin{pmatrix}\text{Unit and}\\ \text{Support}\\ \text{Cost of}\\ \text{a PSSE}\end{pmatrix}^{*} = \begin{pmatrix}\text{Unit Cost}\\ \text{of the}\\ \text{PSSE}\end{pmatrix} \left[1.0 + \left[\frac{\begin{pmatrix}\text{Support of the}\\ \text{Support Equipment}\\ \text{Rate for the}\\ \text{First Year}\end{pmatrix}}{(1.0 + \text{Discount Rate})} \right] + \begin{pmatrix}\text{Support of}\\ \text{Support Equipment}\\ \text{Rate for the}\\ \text{Succeeding Years}\end{pmatrix} \begin{pmatrix}\text{Reduced}\\ \text{Discount}\\ \text{Factor}\end{pmatrix} \right]$$

* *Applicable to repair and discard PSSE as required by the LORA case under consideration*

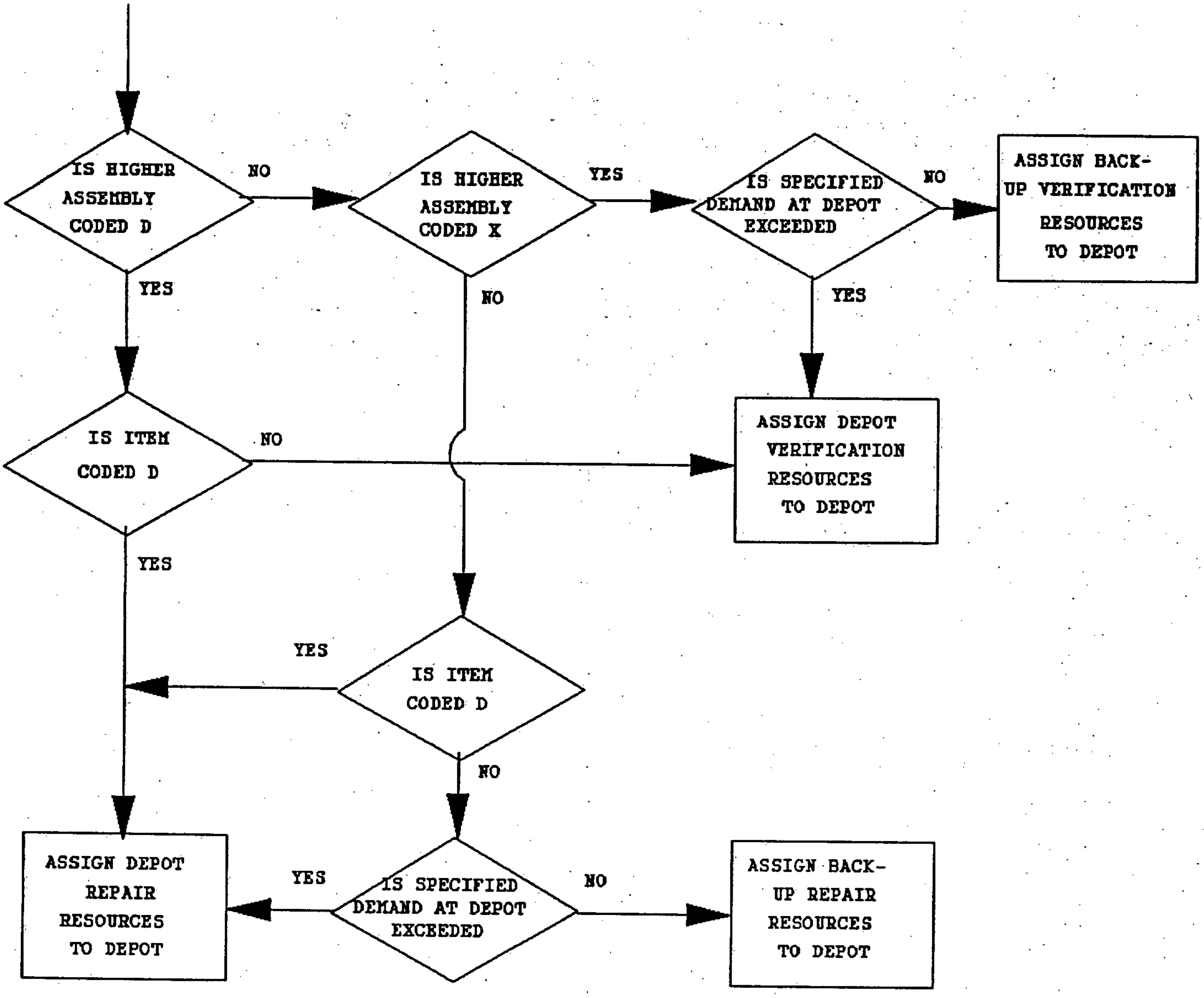
40.2.6.2 Peculiar support equipment cost for the discard case. Discard or verification PSSE may be used at the item level to check and test an item's failure.

$$\begin{pmatrix}\text{Item PSSE}\\ \text{Cost for}\\ \text{Discard}\end{pmatrix}^{t} = \left[\begin{pmatrix}\text{Unit and Support}\\ \text{Cost per Discard}\\ \text{PSSE at CV to}\\ \text{Verify Item}\\ \text{Failure}\end{pmatrix} \begin{pmatrix}\text{Number of*}\\ \text{Discard PSSE}\\ \text{Required}\\ \text{per CV}\end{pmatrix} \begin{pmatrix}\text{Number}\\ \text{of}\\ \text{CV's}\end{pmatrix}^{t} + \begin{pmatrix}\text{Unit and Support}\\ \text{Cost per Discard}\\ \text{PSSE at NAS to}\\ \text{Verify Item}\\ \text{Failure}\end{pmatrix} \begin{pmatrix}\text{Number of*}\\ \text{Discard PSSE}\\ \text{Required}\\ \text{per NAS}\end{pmatrix} \begin{pmatrix}\text{Number of}\\ \text{NAS's}\end{pmatrix}^{t} \right.$$

$$\left. + \begin{pmatrix}\text{Unit and Support**}\\ \text{Cost per Discard}\\ \text{PSSE at Depot to}\\ \text{Verify Item}\\ \text{Failure}\end{pmatrix} \begin{pmatrix}\text{Number of}\\ \text{Discard PSSE}\\ \text{Required}\\ \text{per Depot}\end{pmatrix}^{**} \begin{pmatrix}\text{Number}\\ \text{of}\\ \text{Depots}\end{pmatrix}^{t} \right]$$

* *The term = 0 if the higher assembly is not repaired at the site as applicable to the LORA case under consideration. The determination as to whether CV, or NAS sites require support equipment is dependent upon where the higher assembly is repaired.*

** *The type of support equipment resources, full or back-up, at the Depot sites is dependent on the LORA case and workload at the sites. The determination of full or back-up resources is based on the criteria of figure E-3.*



Decision criteria are described on the following page.

FIGURE E-3. <u>Criteria for full or back-up resources at depot sites.</u>

Description of the Criteria for Full or Back-up Resources at Depot Sites

The LORA techniques allow one or two types of support resources (support equipment, personnel, documentation, repair work space, equipment space) to be used at Depot repair facilities. The mode of operation of a Depot to support the item under analysis depends upon the LORA code assignment of the item. A Depot services repairables forwarded to it from other repair sites. Full Depot resources are always provided for items which are coded Depot repair, or for higher level assemblies coded Depot repair; the resource determination for other items depends on the workload experienced at the Depot. If the workload does not exceed a specified percentage then the Depot operates under a limited mode and back-up depot resources are provided. If the workload exceeds the specified percentage the Depot operates under a full mode and full Depot resources are provided. The decision criteria used for determination of full or back-up repair and verification resources at Depot facilities as a function of the LORA code assignment is given in figure E-3.

40.2.6.3 Peculiar support equipment cost for the repair intermediate cases. Repair PSSE at intermediate repair facilities can verify the item failure and fault isolate to the next lower assembly. The repair PSSE is more complex that its discard counterpart and the complexity is reflected in different costs from the required PSSE. The assignment of the PSSE cost as allocatable/non-allocatable and the resource type determination are the same as that for discard.

$$\begin{pmatrix}\text{Item PSSE}\\\text{Cost for}\\\text{Intermediate}\\\text{Repair}\end{pmatrix} = \left[\begin{pmatrix}\text{Unit and Support*}\\\text{Cost per Repair}\\\text{PSSE at CV to}\\\text{Repair Item}\\\text{Failure}\end{pmatrix}\begin{pmatrix}\text{Number of}\\\text{Repair PSSE}\\\text{Required}\\\text{per CV}\end{pmatrix}\begin{pmatrix}\text{Number}\\\text{of}\\\text{CV's}\end{pmatrix}^{c} + \begin{pmatrix}\text{Unit and Support}\\\text{Cost per Repair}\\\text{PSSE at NAS to}\\\text{Repair Item}\\\text{Failure}\end{pmatrix}\begin{pmatrix}\text{Number of}\\\text{Repair PSSE}\\\text{Required}\\\text{per NAS}\end{pmatrix}\begin{pmatrix}\text{Number of}\\\text{NAS's}\end{pmatrix}^{c}\right.$$
$$\left. + \begin{pmatrix}\text{Unit and Support*}\\\text{Cost per Repair}\\\text{PSSE at Depot}\\\text{to Repair Item}\\\text{Failure}\end{pmatrix}\begin{pmatrix}\text{Number of*}\\\text{Discard PSSE}\\\text{Required}\\\text{per Depot}\end{pmatrix}\begin{pmatrix}\text{Number of}\\\text{Depots}\end{pmatrix}^{c}\right]$$

** The determination of full or back-up resources is based on the criteria of figure E-3

40.2.6.4 Peculiar support equipment cost for repair depot cases. Support equipment for fault verification may be required at the operational site if the higher assembly was repaired there. The assignment of the PSSE as allocatable/non-allocatable is the same as that for the discard, and repair intermediate.

$$\begin{pmatrix}\text{Item PSSE}\\\text{Cost for}\\\text{Depot}\\\text{Repair}\end{pmatrix}^{c} = \left[\begin{pmatrix}\text{Unit and Support}\\\text{Cost per Discard}\\\text{PSSE at CV to}\\\text{Verify Item}\\\text{Failure}\end{pmatrix}\begin{pmatrix}\text{Number of*}\\\text{Discard PSSE}\\\text{Required}\\\text{per CV}\end{pmatrix}\begin{pmatrix}\text{Number}\\\text{of}\\\text{CV's}\end{pmatrix}^{c} + \begin{pmatrix}\text{Unit and Support}\\\text{Cost per Discard}\\\text{PSSE at NAS to}\\\text{Verify Item}\\\text{Failure}\end{pmatrix}\begin{pmatrix}\text{Number of*}\\\text{Discard PSSE}\\\text{Required}\\\text{per NAS}\end{pmatrix}\begin{pmatrix}\text{Number of}\\\text{NAS's}\end{pmatrix}^{c}\right.$$
$$\left. + \begin{pmatrix}\text{Unit and Support}\\\text{Cost per Repair}\\\text{PSSE at Depot}\\\text{to Repair Item}\\\text{Failure}\end{pmatrix}\begin{pmatrix}\text{Number of}\\\text{Discard PSSE}\\\text{Required}\\\text{per Depot}\end{pmatrix}\begin{pmatrix}\text{Number of}\\\text{Depots}\end{pmatrix}^{c}\right]$$

* The term = 0 if the higher assembly is not repaired at the site as applicable to the LORA case under consideration

40.2.7 Space cost. For each case, total space is the sum of three separate costs: cost of inventory storage space, cost of support equipment space, and cost of repair work space.

40.2.7.1 Inventory storage space cost. The cost associated with the discard inventory; attrition, rotatable pool, and system stock quantities.

40.2.7.1.1 Inventory storage space cost for discard cases. For carrier based aircraft, the storage quantity is adjusted to account for the fact that failures occur only during the carrier's deployments. This adjustment is carried out though division by the carrier deployment factor.

$$\begin{pmatrix}\text{Cost of Inventory}\\ \text{Storage Space}\\ \text{for Discard}\end{pmatrix}^t = \sum_{v=1}^{r}\left[\begin{pmatrix}\text{Inventory Reserved}\\ \text{for the Required}\\ \text{Days of Stock of}\\ \text{the } v'\text{th Site}\end{pmatrix}_v^t \begin{pmatrix}\text{Cost of Space per}\\ \text{Cubic Foot per Year}\\ \text{at the } v'\text{th Site}\end{pmatrix}_v\right]\begin{pmatrix}\text{Inventory}\\ \text{Storage Space}\\ \text{per Item in}\\ \text{Cubic Feet}\end{pmatrix}\begin{pmatrix}\text{Normal}\\ \text{Discount}\\ \text{Factor}\end{pmatrix}$$

WHERE :

$$\begin{pmatrix}\text{Inventory Reserved}\\ \text{for the Required}\\ \text{Days of Stock of}\\ \text{the } v'\text{th Site}\end{pmatrix}^t = INT\left\{\frac{\begin{pmatrix}\text{Annual Inventory}\\ \text{Quantity for Discard}\\ \text{at the } v'\text{th Site}\end{pmatrix}^t \begin{pmatrix}\text{Required Days}\\ \text{of Stock at}\\ \text{the } v'\text{th Stock}\end{pmatrix}}{\begin{pmatrix}\text{365 Days}\\ \text{per}\\ \text{Year}\end{pmatrix}\begin{pmatrix}\text{Carrier *}\\ \text{Deployment}\\ \text{Factor}\end{pmatrix}}\right\}$$

40.2.7.1.2 Inventory storage space cost for repair cases.

$$\begin{pmatrix}\text{Cost of Inventory}\\ \text{Storage Space}\\ \text{per Item}\\ \text{for Repair}\end{pmatrix}^t = \left\{\sum_{k=1}^{L}\left[\begin{pmatrix}\text{Rotatable}\\ \text{Pool Quantity}\\ \text{at the } k'\text{th}\\ \text{CV Site}\end{pmatrix}_k^t + \begin{pmatrix}\text{Attrition}\\ \text{Quantity}\\ \text{at the } k'\text{th}\\ \text{CV Site}\end{pmatrix}_k^t\right]\begin{pmatrix}\text{Cost of Space}\\ \text{per Cubic Foot}\\ \text{per Year for}\\ \text{CV Sites}\end{pmatrix}\right.$$

$$+ \sum_{p=1}^{q}\left[\begin{pmatrix}\text{Rotatable}\\ \text{Pool Quantity}\\ \text{at the } p'\text{th}\\ \text{LB Site}\end{pmatrix}_p^t + \begin{pmatrix}\text{Attrition}\\ \text{Quantity}\\ \text{at the } p'\text{th}\\ \text{LB Site}\end{pmatrix}_p^t\right]\begin{pmatrix}\text{Cost of Space}\\ \text{per Cubic Foot}\\ \text{per Year for}\\ \text{LB Sites}\end{pmatrix}$$

$$\left. + \begin{pmatrix}\text{System}\\ \text{Stock of}\\ \text{the Item}\end{pmatrix}^t \begin{pmatrix}\text{Cost of Space}\\ \text{per Cubic Foot}\\ \text{per Year for}\\ \text{Depot Sites}\end{pmatrix}\right\}\begin{pmatrix}\text{Inventory Storage}\\ \text{Space per Item}\\ \text{in Cubic Feet}\end{pmatrix}\begin{pmatrix}\text{Normal}\\ \text{Discount}\\ \text{Factor}\end{pmatrix}$$

40.2.7.2 Support equipment space cost. The cost of PSSE space allocated to an item or a group of items. It is determined as a function of the number of required PSSE, the PSSE deck space, and the cost of space at the facility. The deck space includes both the space occupied by the PSSE and the working space necessary to operate the equipment. The assignment of the space cost to an item or group of items and the determination of type of resource are the same as that for support equipment. Within the following equations, the word item refers to an item that has PSSE specifically designed for it or to the group of items that have PSSE designed for the group.

$$\begin{pmatrix}\text{Cost of}\\ \text{PSSE Space}\end{pmatrix}^t = \Bigg\{\Bigg[\begin{pmatrix}\text{Number of}\\ \text{PSSE Required}\\ \text{per CV Site}\end{pmatrix}^t \begin{pmatrix}\text{Space}\\ \text{Required}\\ \text{per PSSE}\end{pmatrix} \begin{pmatrix}\text{Number of}\\ \text{CV Sites}\end{pmatrix}^t \begin{pmatrix}\text{Cost of Space}\\ \text{per Square Foot}\\ \text{per Year for}\\ \text{CV Sites}\end{pmatrix}\Bigg]$$

$$+ \Bigg[\begin{pmatrix}\text{Number of}\\ \text{PSSE Required}\\ \text{per NAS}\end{pmatrix}^t \begin{pmatrix}\text{Space}\\ \text{Required}\\ \text{per PSSE}\end{pmatrix} \begin{pmatrix}\text{Number of}\\ \text{NAS's}\end{pmatrix}^t \begin{pmatrix}\text{Cost of Space}\\ \text{per Square Foot}\\ \text{per Year for}\\ \text{LB Sites}\end{pmatrix}\Bigg]$$

$$+ \Bigg[\begin{pmatrix}\text{Number of}\\ \text{PSSE Required}\\ \text{per Depot}\end{pmatrix}^t \begin{pmatrix}\text{Space}\\ \text{Required}\\ \text{per PSSE}\end{pmatrix} \begin{pmatrix}\text{Number of}\\ \text{Depots}\end{pmatrix}^t \begin{pmatrix}\text{Cost of Space}\\ \text{per Square Foot}\\ \text{per Year for}\\ \text{Depot Sites}\end{pmatrix}\Bigg]\Bigg\} \begin{pmatrix}\text{Normal}\\ \text{Discount}\\ \text{Factor}\end{pmatrix}$$

40.2.7.3 Repair work space cost. Repair work space is defined as the space dedicated solely of maintenance actions of an item or group of items exclusive of the support equipment space. The assignment of the space cost as allocatable/non-allocatable and determination of type of resource is the same as that for support equipment. The word item, in the following equations, refers to the item or the items that uniquely have the space set aside for maintenance actions.

$$\begin{pmatrix}\text{Repair Work}\\ \text{Space Cost}\end{pmatrix}^t = \Bigg\{\Bigg[\begin{pmatrix}\text{Item Repair}\\ \text{Work Space}\\ \text{Required at}\\ \text{the CV Site}\end{pmatrix}^t \begin{pmatrix}\text{Number}\\ \text{of}\\ \text{CV Sites}\end{pmatrix}^t \begin{pmatrix}\text{Cost of Space}\\ \text{per Square Foot}\\ \text{per Year for}\\ \text{CV Sites}\end{pmatrix}\Bigg]$$

$$+ \Bigg[\begin{pmatrix}\text{Item Repair}\\ \text{Work Space}\\ \text{Required at}\\ \text{the NAS Site}\end{pmatrix}^t \begin{pmatrix}\text{Number of}\\ \text{NAS Sites}\end{pmatrix}^t \begin{pmatrix}\text{Cost of Space}\\ \text{per Square Foot}\\ \text{per Year for}\\ \text{LB Sites}\end{pmatrix}\Bigg]$$

$$+ \Bigg[\begin{pmatrix}\text{Item Repair}\\ \text{Work Space}\\ \text{Required at}\\ \text{the Depot}\end{pmatrix}^t \begin{pmatrix}\text{Number}\\ \text{of}\\ \text{Depots}\end{pmatrix}^t \begin{pmatrix}\text{Cost of Space}\\ \text{per Square Foot}\\ \text{per Year for}\\ \text{Depot Sites}\end{pmatrix}\Bigg]\Bigg\} \begin{pmatrix}\text{Normal}\\ \text{Discount}\\ \text{Factor}\end{pmatrix}$$

40.2.7.4 Total space cost. The sum of the inventory, support equipment, and repair work space costs.

$$\begin{pmatrix}\text{Total}\\ \text{Space}\\ \text{Cost}\end{pmatrix}^t = \begin{pmatrix}\text{Inventory}\\ \text{Storage}\\ \text{Space Cost}\end{pmatrix}^t + \begin{pmatrix}\text{Support}\\ \text{Equipment}\\ \text{Space Cost}\end{pmatrix}^t + \begin{pmatrix}\text{Repair}\\ \text{Work}\\ \text{Space Cost}\end{pmatrix}^t$$

40.2.8 Labor cost. The cost incurred for discard and repair actions.

40.2.8.1 Labor cost for the discard case.

$$\begin{pmatrix}\text{Cost of}\\ \text{Labor for}\\ \text{Discard}\end{pmatrix}^t = \left\{ \sum_{k=1}^{L} \left[\begin{pmatrix}\text{Annual Number}\\ \text{of Real Failures}\\ \text{Removed at the}\\ \text{k'th CV Site}\end{pmatrix}_k^t \begin{pmatrix}\text{Direct Maintenance}\\ \text{Man Hours at CV}\\ \text{per Discard Action}\end{pmatrix} \begin{pmatrix}\text{Labor Cost}\\ \text{per Hour}\\ \text{at the CV}\end{pmatrix} \right] \right.$$

$$+ \sum_{m=1}^{n} \left[\begin{pmatrix}\text{Annual Number}\\ \text{of Real Failures}\\ \text{Removed at the}\\ \text{m'th NAS Site}\end{pmatrix}_m^t \begin{pmatrix}\text{Direct Maintenance}\\ \text{Man Hours at NAS}\\ \text{per Discard Action}\end{pmatrix} \begin{pmatrix}\text{Labor Cost}\\ \text{per Hour}\\ \text{at the NAS}\end{pmatrix} \right]$$

$$+ \sum_{g=1}^{h} \left[\begin{pmatrix}\text{Annual Number}\\ \text{of Real Failures}\\ \text{Removed at the}\\ \text{g'th Depot Site}\end{pmatrix}_g^t \begin{pmatrix}\text{Direct Maintenance}\\ \text{Man Hours at Depot}\\ \text{per Discard Action}\end{pmatrix} \begin{pmatrix}\text{Labor Cost}\\ \text{per Hour}\\ \text{at the Depot}\end{pmatrix} \right]$$

$$\left. \left[1.0 + \begin{pmatrix}\text{Fraction of}\\ \text{Items Falsely}\\ \text{Removed}\end{pmatrix} \right] \begin{pmatrix}\text{Normal}\\ \text{Discount}\\ \text{Factor}\end{pmatrix} \right\}$$

40.2.8.2 Labor cost for repair intermediate cases.

$$\begin{pmatrix}\text{Cost of}\\ \text{Labor for}\\ \text{Intermediate}\\ \text{Repair}\end{pmatrix}^t = \left[\sum_{k=1}^{L} \begin{pmatrix}\text{Annual Number}\\ \text{of Real Failures}\\ \text{Removed at the}\\ \text{k'th CV Site}\end{pmatrix}_k^t \begin{pmatrix}\text{Labor Cost}\\ \text{per Hour}\\ \text{at the CV}\end{pmatrix} \left\{ \begin{pmatrix}\text{Fraction of}\\ \text{Items Falsely}\\ \text{Removed}\end{pmatrix} \begin{pmatrix}\text{Fraction of Item}\\ \text{False Removals}\\ \text{Detected as such}\end{pmatrix} \begin{pmatrix}\text{Direct Maintenance}\\ \text{Man Hours at CV}\\ \text{per Discard Action}\end{pmatrix} \right. \right.$$

$$\left. + \left[1.0 + \begin{pmatrix}\text{Fraction of}\\ \text{Items Falsely}\\ \text{Removed}\end{pmatrix} \right] \left[1.0 - \begin{pmatrix}\text{Fraction of Item}\\ \text{False Removals}\\ \text{Detected as such}\end{pmatrix} \right] \begin{pmatrix}\text{Direct Maintenance}\\ \text{Man Hours at CV}\\ \text{per Repair Action}\end{pmatrix} \right\}$$

$$+ \sum_{m=1}^{n} \begin{pmatrix}\text{Annual Number}\\ \text{of Real Failures}\\ \text{Removed at the}\\ \text{m'th NAS Site}\end{pmatrix}_m^t \begin{pmatrix}\text{Labor Cost}\\ \text{per Hour}\\ \text{at the NAS}\end{pmatrix} \left\{ \begin{pmatrix}\text{Fraction of}\\ \text{Items Falsely}\\ \text{Removed}\end{pmatrix} \begin{pmatrix}\text{Fraction of Item}\\ \text{False Removals}\\ \text{Detected as such}\end{pmatrix} \begin{pmatrix}\text{Direct Maintenance}\\ \text{Man Hours at NAS}\\ \text{per Discard Action}\end{pmatrix} \right.$$

$$\left. + \left[1.0 + \begin{pmatrix}\text{Fraction of}\\ \text{Items Falsely}\\ \text{Removed}\end{pmatrix} \right] \left[1.0 - \begin{pmatrix}\text{Fraction of Item}\\ \text{False Removals}\\ \text{Detected as such}\end{pmatrix} \right] \begin{pmatrix}\text{Direct Maintenance}\\ \text{Man Hours at NAS}\\ \text{per Repair Action}\end{pmatrix} \right\}$$

$$+ \sum_{g=1}^{h} \begin{pmatrix}\text{Annual Number}\\ \text{of Real Failures}\\ \text{Removed at the}\\ \text{g'th Depot}\end{pmatrix}_g^t \begin{pmatrix}\text{Labor Cost}\\ \text{per Hour}\\ \text{at the Depot}\end{pmatrix} \left\{ \begin{pmatrix}\text{Fraction of}\\ \text{Items Falsely}\\ \text{Removed}\end{pmatrix} \begin{pmatrix}\text{Fraction of Item}\\ \text{False Removals}\\ \text{Detected as such}\end{pmatrix} \begin{pmatrix}\text{Direct Maintenance}\\ \text{Man Hours at Depot}\\ \text{per Discard Action}\end{pmatrix} \right.$$

$$\left. + \left[1.0 + \begin{pmatrix}\text{Fraction of}\\ \text{Items Falsely}\\ \text{Removed}\end{pmatrix} \right] \left[1.0 - \begin{pmatrix}\text{Fraction of Item}\\ \text{False Removals}\\ \text{Detected as such}\end{pmatrix} \right] \begin{pmatrix}\text{Direct Maintenance}\\ \text{Man Hours at Depot}\\ \text{per Repair Action}\end{pmatrix} \right\}$$

$$\left. + \sum_{g=1}^{h} \begin{pmatrix}\text{Annual Number}\\ \text{of Items}\\ \text{Received by the}\\ \text{g'th Depot}\end{pmatrix}_g^t \begin{pmatrix}\text{Direct Maintenance}\\ \text{Man Hours at Depot}\\ \text{per Repair Action}\end{pmatrix} \right] \begin{pmatrix}\text{Normal}\\ \text{Discount}\\ \text{Factor}\end{pmatrix}$$

40.2.8.3 Labor cost for repair depot cases. Three labor cost equations are presented, one each for the next higher assembly repaired at intermediate, or depot level.

40.2.8.4 <u>Labor cost for repair depot case if higher assembly is coded intermediate repair</u>.

$$
\begin{aligned}
\begin{pmatrix}\text{Cost of Labor for}\\ \text{Depot Repair if}\\ \text{Higher Assembly}\\ \text{is Intermediate}\\ \text{Repair}\end{pmatrix}^{t} = \Bigg[\Bigg\{ & \sum_{k=1}^{L} \begin{pmatrix}\text{Annual Number}\\ \text{of Real Failures}\\ \text{Removed at the}\\ \text{k'th CV Site}\end{pmatrix}_{k}^{t} \begin{pmatrix}\text{Labor Cost}\\ \text{per Hour}\\ \text{at the CV}\end{pmatrix} \begin{pmatrix}\text{Direct Maintenance}\\ \text{Man Hours at CV}\\ \text{per Discard Action}\end{pmatrix} \\
& + \sum_{m=1}^{n} \begin{pmatrix}\text{Annual Number}\\ \text{of Real Failures}\\ \text{Removed at the}\\ \text{m'th NAS Site}\end{pmatrix}_{m}^{t} \begin{pmatrix}\text{Labor Cost}\\ \text{per Hour}\\ \text{at the NAS}\end{pmatrix} \begin{pmatrix}\text{Direct Maintenance}\\ \text{Man Hours at NAS}\\ \text{per Discard Action}\end{pmatrix} \left[1.0 + \begin{pmatrix}\text{Fraction of}\\ \text{Items Falsely}\\ \text{Removed}\end{pmatrix} \right] \\
& + \sum_{g=1}^{h} \begin{pmatrix}\text{Annual Number}\\ \text{of Real Failures}\\ \text{Removed at the}\\ \text{g'th Depot Site}\end{pmatrix}_{g}^{t} \begin{pmatrix}\text{Labor Cost}\\ \text{per Hour}\\ \text{at the Depot}\end{pmatrix} \Bigg\{ \begin{pmatrix}\text{Fraction of}\\ \text{Items Falsely}\\ \text{Removed}\end{pmatrix} \begin{pmatrix}\text{Fraction of Item}\\ \text{False Removals}\\ \text{Detected as such}\end{pmatrix} \begin{pmatrix}\text{Direct Maintenance}\\ \text{Man Hours at Depot}\\ \text{per Discard Action}\end{pmatrix} \\
& + \left[1.0 + \begin{pmatrix}\text{Fraction of}\\ \text{Items Falsely}\\ \text{Removed}\end{pmatrix} \right] \left[1.0 - \begin{pmatrix}\text{Fraction of the}\\ \text{False Removals}\\ \text{Detected as such}\end{pmatrix} \right] \Bigg] \begin{pmatrix}\text{Direct Maintenance}\\ \text{Man Hours at Depot}\\ \text{per Repair Action}\end{pmatrix} \Bigg\} \\
& + \sum_{g=1}^{h} \begin{pmatrix}\text{Annual Number}\\ \text{of Items Received}\\ \text{by the g'th}\\ \text{Depot Site}\end{pmatrix}_{g}^{t} \begin{pmatrix}\text{Labor Cost}\\ \text{per Hour}\\ \text{at the Depot}\end{pmatrix} \begin{pmatrix}\text{Direct Maintenance}\\ \text{Man Hours at Depot}\\ \text{per Discard Action}\end{pmatrix} \Bigg] \begin{pmatrix}\text{Normal}\\ \text{Discount}\\ \text{Factor}\end{pmatrix}
\end{aligned}
$$

40.2.8.5 <u>Labor cost for repair depot case if higher assembly is coded depot repair</u>.

$$
\begin{aligned}
& \begin{pmatrix}\text{Cost of Labor for}\\ \text{Depot Repair if}\\ \text{Higher Assembly}\\ \text{is Depot Repair}\end{pmatrix}^{t} = \\
& \Bigg[\sum_{g=1}^{h} \begin{pmatrix}\text{Annual Number}\\ \text{of Real Failures}\\ \text{Removed at the}\\ \text{g'th Depot Site}\end{pmatrix}_{g}^{t} \begin{pmatrix}\text{Labor Cost}\\ \text{per Hour}\\ \text{at the Depot}\end{pmatrix} \Bigg\{ \begin{pmatrix}\text{Fraction of}\\ \text{Items Falsely}\\ \text{Removed}\end{pmatrix} \begin{pmatrix}\text{Fraction of Item}\\ \text{False Removals}\\ \text{Detected as such}\end{pmatrix} \begin{pmatrix}\text{Direct Maintenance}\\ \text{Man Hours at Depot}\\ \text{per Discard Action}\end{pmatrix} \\
& + \left[1.0 + \begin{pmatrix}\text{Fraction of}\\ \text{Items Falsely}\\ \text{Removed}\end{pmatrix} \right] \left[1.0 - \begin{pmatrix}\text{Fraction of the}\\ \text{False Removals}\\ \text{Detected as such}\end{pmatrix} \right] \Bigg] \begin{pmatrix}\text{Direct Maintenance}\\ \text{Man Hours at Depot}\\ \text{per Repair Action}\end{pmatrix} \Bigg\} \begin{pmatrix}\text{Normal}\\ \text{Discount}\\ \text{Factor}\end{pmatrix}
\end{aligned}
$$

40.2.9 Training cost.

$$\begin{pmatrix}\text{Cost of}\\ \text{Training}\end{pmatrix}^{t} = \left[\begin{pmatrix}\text{Total Number of}\\ \text{Squadron Men}\\ \text{Trained}\end{pmatrix}^{t}\begin{pmatrix}\text{Training Cost}\\ \text{per}\\ \text{Squadron Man}\end{pmatrix}^{t} + \begin{pmatrix}\text{Total Number}\\ \text{of CV Men}\\ \text{Trained}\end{pmatrix}^{t}\begin{pmatrix}\text{Training Cost}\\ \text{per}\\ \text{CV Man}\end{pmatrix}^{t}\right.$$

$$+ \left.\begin{pmatrix}\text{Total Number of}\\ \text{NAS Men}\\ \text{Trained}\end{pmatrix}^{t}\begin{pmatrix}\text{Training Cost}\\ \text{per}\\ \text{NAS Man}\end{pmatrix}^{*}\right]\left[1.0 + \begin{pmatrix}\text{Navy}\\ \text{Personnel}\\ \text{Attrition}\\ \text{Rate}\end{pmatrix}\right]\begin{pmatrix}\text{Present}\\ \text{Discount}\\ \text{Factor}\end{pmatrix}$$

$$+ \begin{pmatrix}\text{Total Number of}\\ \text{Depot Men}\\ \text{Trained}\end{pmatrix}^{t}\begin{pmatrix}\text{Training Cost}\\ \text{per}\\ \text{Depot Man}\end{pmatrix}^{*}\left[1.0 + \begin{pmatrix}\text{Depot}\\ \text{Personnel}\\ \text{Attrition}\\ \text{Rate}\end{pmatrix}\right]\begin{pmatrix}\text{Present}\\ \text{Discount}\\ \text{Factor}\end{pmatrix}$$

** = Full or back up resources on the criteria in figure E-3 .*

40.2.9.1 Training cost for intermediate repair cases. The repair cost is incurred for each operational site; for the depot repair facilities either full or back-up resources are required based on the criteria of figure E-3.

40.2.9.2 Training cost for depot repair cases. The repair cost is incurred by the depot and discard training cost are incurred for the sites other than the depots which repair the higher assembly.

40.2.9.3 Training cost for discard cases. The training costs are incurred for the sites which repair the higher assembly. The depot sites are subject to the criteria of figure E-3.

40.2.10 Documentation cost. A cost value is predetermined for the case under consideration. Documentation includes the following: the drawings and specifications which make up the avionic system technical manual, the LSA (Logistic Support Analysis) preparation, and support equipment requirement sheets, lists software, etc... The determination of applicable costs is the same as that for training.

$$\begin{pmatrix}\text{Cost of}\\ \text{Documentation}\end{pmatrix}^{t} = \begin{pmatrix}\text{Documentation}\\ \text{Cost at IMA}\end{pmatrix} + \begin{pmatrix}\text{Documentation}\\ \text{Cost at Depot}\end{pmatrix}$$

40.2.11 Combination of cost elements. The cost element equations are combined for each item for the alternative under consideration. The cost of LORA alternative for an equipment is the sum of the costs associated with the items in the equipment. For an avionic equipment different alternatives may be recommended for the different items; the higher assembly, however, must always be assigned to the same case when evaluating all the next lower assemblies contained in it. When making individual recommendations for a group of items which have non-allocatable costs associated with them, redundant costing must be compensated for. If part of the group requires verification at a site and the remainder requires repair at the same site, the verification cost is deleted since it is assumed that the capability to verify is acquired with the capability to repair. Similarly, back-up cost at a site are ignored if full repair capability is collocated with it.

LOR ANALYTICAL TECHNIQUES FOR SPACE AND NAVAL WARFARE SYSTEMS COMMAND (SPAWAR) EQUIPMENTS

10. SCOPE

10.1 Purpose. This appendix specifies the mathematical equations for performing LOR analyses for equipments under the cognizance of the Space and Naval Warfare Systems Command. The equations determine the life cycle logistic support costs associated with the assembly hardware indenture level.

10.2 Methodology. The LOR analysis recommendation for an item is based on the economic impact of four LOR alternatives: (1) Organizational Repair, (2) Intermediate Repair, (3) Depot Repair, and (4) Discard. The economic LOR analytical techniques are based upon six major cost categories: (1) inventory, which includes level of investment, attrition, administration, and storage space; (2) personnel, which includes training and direct labor; (3) support equipment, which includes acquisition, support, and space; (4) repair, which includes material, scrap, and space; (5) documentation; and (6) transportation, which includes packaging and shipping. These cost categories include fifteen cost equations.

In the process of determining life cycle costs, one of seven inventory policies must first be specified by the user. The model will then select one of three reorder level distributions. This information is then combined with two types of parameters: discount factors (of which there are two) and flow rates (of which there are five).

The following pages define the methodologies used with the discount factors, flow rates, reorder level distributions, inventory policies, and finally, cost equations, which incorporate data from the assessment of the four alternatives cited above.

20. APPLICABLE DOCUMENTS

20.1 Other Government documents, drawings and publications. The following other Government documents, drawings and publications form a part of this document to the extent specified herein. Unless otherwise specified, the issues are those cited in the solicitation.

- OPNAVINST 5000.49 (series), Integrated Logistic Support
- SPAWARINST 4700.16, Maintenance Policy Requirements and Procedures
- SPAWARINST 5000.2, Integrated Logistic Support (ILS) Policy and Responsibilities

20.2 Guidance publications. The following guidance publications are applicable:

- NAVSUPPUB 553, Inventory Management
- Mod VI Level of Repair Model User's Guide

30. ALGORITHMS

30.1 Discount factors. Two discount factors are required for use with individual cost equations. These factors calculate the present value of future incurred costs at the end of each year of the operational life span.

The standard formula for the present value of an annuity is used with the "peak program" cost computations. This "peak program" cost estimating method assumes that all equipments under analysis will be operational throughout the stated life span. If, however, the delivery of equipments to operational sites is known, a "phase-in" costing method should be employed. As yearly expenditures will not be identical under this method, the standard present value discounting equation should be used for each year of the life cycle. Results of present values can then be computed.

For peak program (calculate once):

$$\begin{pmatrix}\text{Discount}\\ \text{Factor}\end{pmatrix} = \frac{\left[1.0-\left(\dfrac{1.0}{\left[1.0+\begin{pmatrix}\text{Annual}\\ \text{Interest Rate}\end{pmatrix}\right]^{\text{Life Span}}}\right)\right]}{\begin{pmatrix}\text{Annual}\\ \text{Interest Rate}\end{pmatrix}}$$

For phase-in (calculate for each year of life span):

$$\begin{pmatrix}\text{Discount}\\ \text{Factor}\\ \text{Year } n\end{pmatrix} = \left[\frac{1.0}{\left[1.0+\begin{pmatrix}\text{Annual}\\ \text{Interest Rate}\end{pmatrix}\right]^{(\text{Year } n)}}\right]$$

where n identifies the given year in the life span of the system or component.

30.2 Flow rates. There are five flow rates used in the cost equations. The flow rate is the movement of a repairable item through the maintenance cycle.

30.2.1 Verification rate. Verification refers to the ability of a maintenance technician to fault-isolate and determine that an item has failed. The verification rate is the pace at which that component failure is expected to be detected at a given maintenance echelon for a given LOR case. The actual repair may occur at the same echelon or at a higher echelon.

$$\begin{pmatrix}\text{Verification}\\ \text{Rate}\end{pmatrix} = \begin{pmatrix}1.0 + \begin{matrix}\text{False Removal Rate from}\\ \text{Next Higher Assembly (NHA)}\end{matrix}\end{pmatrix}$$

30.2.2 Repair rate. The repair rate is the frequency with which the component, upon failure, undergoes repair at a given maintenance echelon for a given LOR case. This rate is defined for all three maintenance echelons, but may be zero for one or more according to the LOR case. In particular, it will be zero for all three echelons for LOR cases in which the LOR assignment is discard for the item or any higher assembly.

$$\begin{pmatrix}\text{Repair}\\ \text{Rate}\end{pmatrix} = \left[\left(1.0 + \begin{pmatrix}\text{False Removal}\\ \text{Rate from NHA}\end{pmatrix}\left(1.0 - \begin{pmatrix}\text{False Removal Detection}\\ \text{Rate from NHA}\end{pmatrix}\right)\right)\left(1.0 - \begin{pmatrix}\text{BCM}\\ \text{Rate}\end{pmatrix}\right)\left(1.0 - \begin{pmatrix}\text{Unrepairable}\\ \text{Failure Rate}\end{pmatrix}\right)\right]$$

30.2.3 Scrap rate. The scrap rate is the pace at which a component failure results in the item's being scrapped or discarded at a given maintenance echelon for a given LOR case. The component is assumed to be permanently lost for further use. This rate is defined for all three maintenance echelons, but may be zero for one or more echelons. For example, if the LOR case specifies discard for the item, the scrap rate will be 1.0 for the echelon at which the item is first removed from its next higher assembly (which may be in the equipment) and zero for the other echelons.

$$\begin{pmatrix}\text{Scrap}\\ \text{Rate}\end{pmatrix} = \left[\left(1.0 + \begin{pmatrix}\text{False Removal}\\ \text{Rate from NHA}\end{pmatrix}\left(1.0 - \begin{pmatrix}\text{False Removal}\\ \text{Detection}\\ \text{Rate from NHA}\end{pmatrix}\right)\right)\left(1.0 - \begin{pmatrix}\text{BCM}\\ \text{Rate}\end{pmatrix}\right)\begin{pmatrix}\text{Unrepairable}\\ \text{Failure Rate}\end{pmatrix}\right]$$

30.2.4 BCM-to-IMA rate. The BCM-to-IMA rate is the frequency with which a component failure goes beyond capability of maintenance (BCM) at the organizational level and is sent to the intermediate maintenance activity (IMA) for repair. This rate is defined only for LOR cases that permit organizational level repair of the item.

$$\begin{pmatrix}\text{BCM to}\\ \text{IMA Rate}\end{pmatrix} = \left[\left(1.0 + \begin{pmatrix}\text{False Removal}\\ \text{Rate from NHA}\end{pmatrix}\left(1.0 - \begin{pmatrix}\text{False Removal Detection}\\ \text{Rate from NHA}\end{pmatrix}\right)\right)\begin{pmatrix}\text{BCM}\\ \text{Rate}\end{pmatrix}\begin{pmatrix}\text{\% of Failed Units}\\ \text{Sent to IMA}\end{pmatrix}\right]$$

30.2.5 BCM-to-Depot rate. This rate identifies how often a component failure is beyond capability of maintenance at a lower-level maintenance echelon and is sent to the depot level for repair. This rate is defined for organizational and intermediate maintenance levels, and only for LOR cases that permit repair at these levels.

$$\begin{pmatrix}\text{BCM to}\\ \text{Depot}\\ \text{Rate}\end{pmatrix} = \left[\left(1.0 + \begin{pmatrix}\text{False Removal}\\ \text{Rate from NHA}\end{pmatrix}\left(1.0 - \begin{pmatrix}\text{False Removal Detection}\\ \text{Rate from NHA}\end{pmatrix}\right)\right)\begin{pmatrix}\text{BCM}\\ \text{Rate}\end{pmatrix}\left(1.0 - \begin{pmatrix}\text{\% of Failed Units}\\ \text{Sent to IMA}\end{pmatrix}\right)\right]$$

30.3 Reorder level. The reorder level used by a given inventory policy is calculated for a given mean, variance, and risk factor. There are three types of standard distributions used to perform this calculation: the Poisson, the negative binomial, and the normal. The type of distribution to use depends upon the mean and variance. The selection criteria and computational methodology for each of the three distributions are as follows:

30.3.1 Poisson distribution. This distribution is used whenever the mean is less than 20 and the variance is equal to the mean. The distribution is given by the following formula:

$$\text{Reorder Level} = P(x) = \left(\frac{\text{Mean}^{x}\, e^{-\text{Mean}}}{x!}\right)$$

To obtain a reorder level when using this formula, it is necessary to find the smallest value of x such that the sum of P(x) from that point on is less than the given risk factor. This value is found by a recursive procedure that relies on the fact that

$$P(x) = \frac{(\text{Mean})\, P(x-1)}{x}$$

If $e^{-\text{Mean}} \geq (1.0 - (\text{Risk}))$
then (*Reorder Level*) = 0

30.3.2 Negative binomial. This distribution is used whenever the mean is less than 20 and the variance is greater than the mean. The distribution is given by the following formula:

$$(\text{Reorder Level}) = P(x) = \frac{((K + x-1)!\ (Q-1)^{x})}{((K-1)!\ x!\,(Q)^{(k+x)})}$$

where

$$K = \frac{(\text{Mean})}{(Q-1)}$$

$$Q = \frac{(\text{Variance})}{(\text{Mean})}$$

As in the case of the Poisson distribution, it is necessary to find the smallest value for x such that the sum of P(x) from that point on is less than the given risk factor. Again, this value is found by a recursive procedure based upon the following:

$$P(x) = \left(\frac{(K + x-1)\ (Q-1)}{(x)\ (Q)}\right) P(x-1)$$

If $Q^{-K} \geq (1.0 - \text{Risk})$
then (*Reorder Level*) = 0

30.3.3 Normal distribution. The normal probability distribution is used when the mean is 20 or more, or when the variance is less than the mean. For these parameter values, the normal is used to approximate the Poisson or negative binomial distributions so as to reduce the amount of computations involved. The reorder level is calculated by the following set of formulas (these formulas use a Hasting's approximation of the normal distribution):

Sign = +1

If Risk > .5, *replace Risk with* (1.0 - *Risk*) *and let Sign* = -1

$$Z = \sqrt{-\log_e (Risk)^2}$$

$$T = (Z)\left[\frac{(2.515517 + .802853\,(Z) + .010328\,(Z^2))}{(1 + 1.432788\,(Z) + .189269\,(Z^2) + .0013908\,(Z^3))}\right]$$

$$(Reorder\ Level) = \left((Mean) + (Sign)\,(T)\,\sqrt{(Variance)} \right)$$

30.4 Inventory policies. Alternative inventory policies are used to calculate stock levels for each item at each site for individual support programs. These policies represent rules and procedures used in various segments of the Navy inventory management system. The seven inventory policies are discussed in the following subsections:

30.4.1 FLSIP COSAL
30.4.2 MODFLSIP COSAL
30.4.3 MCO COSAL
30.4.4 ASO Retail
30.4.5 Wholesale Stockage
30.4.6 UICP Wholesale Follow-on
30.4.7 Protection Level

To determine least-cost LOR code assignments, the stock levels are used to calculate several kinds of inventory costs according to LOR case. Basic inventory theory begins with historical demand and demand averages as a primary element. The theory assumes a demand estimate is available.

$$\binom{Number\ of\ Replacements}{per\ Year\ per\ Site} = \left(\binom{Item}{Population} \left(\frac{(8760\ Hours\ per\ Year)}{MTBF} \right) \right) \binom{Equipment}{Population}$$

a. Demand is the number of items to be replaced at a particular level because of items requested by customers in a given time period.

$$(\textit{Demand}) = \left(\begin{matrix}\textit{Number of Replacements}\\ \textit{per Year per Site}\end{matrix}\right)(\textit{Rate})^{*}$$

* *One of the following factors is computed, depending upon maintenance level:*

$$\left(\begin{matrix}\textit{Organizational}\\ \textit{Level Demand Rate}\end{matrix}\right) = \left(\begin{matrix}\textit{Verification}\\ \textit{Rate}\end{matrix}\right)$$

$$\text{or} \left(\begin{matrix}\textit{Intermediate Level}\\ \textit{Demand Rate}\end{matrix}\right) = \left[\left(\begin{matrix}\textit{Verification}\\ \textit{Rate}\end{matrix}\right) + \left(\begin{matrix}\textit{Scrap Rate at}\\ \textit{Organizational}\\ \textit{Level}\end{matrix}\right) + \left(\begin{matrix}\textit{BCM to Depot Rate}\\ \textit{at Organizational}\end{matrix}\right)\right]$$

$$\text{or} \left(\begin{matrix}\textit{Depot Level}\\ \textit{Demand Rate}\end{matrix}\right) = \left[\left(\begin{matrix}\textit{Verification}\\ \textit{Rate}\end{matrix}\right) + \left(\begin{matrix}\textit{Scrap Rate at}\\ \textit{Organizational}\\ \textit{Level}\end{matrix}\right) + \left(\begin{matrix}\textit{Scrap Rate}\\ \textit{at IMA Level}\end{matrix}\right)\right]$$

b. Discard represents the annual number of items lost at a particular maintenance level.

$$(\textit{Discard}) = \left(\begin{matrix}\textit{Number of Replacements}\\ \textit{per Year per Site}\end{matrix}\right)\left(\begin{matrix}\textit{Scrap}\\ \textit{Rate}\end{matrix}\right)$$

c. DSF is the discard fraction of total demand lost to the system at the particular maintenance level.

$$(\textit{DSF}) = \frac{(\textit{Scrap Rate})}{(\textit{Demand Rate})}$$

d. DSS is the discard of total demand lost to the system at the particular level.

$$(\textit{DSS}) = (\textit{Discard})\left(\frac{\left(\begin{matrix}\textit{Number of Equipments}\\ \textit{per Site for Year }(n+2)\end{matrix}\right)}{\left(\begin{matrix}\textit{Number of Equipments}\\ \textit{per Site for Year }(n)\end{matrix}\right)}\right)$$

30.4.1 <u>Fleet logistic support improvement program consolidated shipboard allowance list (FLSIP COSAL)</u>. This formulation uses a demand cutoff of .25 per year (.0625 per quarter) for stockage of insurance items. For demand rates greater than 1, the COSAL level is based on the use of a probability distribution and provides a 10% or less risk of incurring stockouts (90% protection level). If the demand rate is greater than 10, an approximation based on the normal distribution is used with the stock level being calculated with the given formula. The Essentiality Code (EC) is a code used to indicate the degree to which the failure of the part affects the ability of the end item to perform its intended function.

ASSIGNMENTS:

(Demand Rate) = (.25) *(Discard)*
Variance = *Demand Rate*
Risk = 0.10

a. *If (Demand Rate)* < .0625
then (Stock Level) = 0

b. *If* .0625 ≤ *(Demand Rate)* ≤ 1.0
then (Stock Level) = 1.0 *if Essentiality Code* = 1
or
(Stock Level) = 0 *if Essentiality Code* > 1

c. *If* 1.0 < = *(Demand Rate)* ≤ 10

$$\text{then (Stock Level)} = \text{Maximum}^{*} \begin{cases} 2 \\ \text{Reorder} \end{cases}$$

d. *If (Demand Rate)* > (10)

$$\text{then (Stock Level)} = \text{Maximum}^{*} \begin{cases} 2 \\ \text{Demand Rate} + (1.28249)\sqrt{\text{(Demand Rate)}} \end{cases}$$

* *Indicates a choice of either of the two options.*

30.4.2 MOD FLSIP COSAL. This allowance is calculated in the same manner as FLSIP, except that, under MODFLSIP authorized allowances of insurance items vary depending on the level of importance of the mission an item supports and the item's demand rate. It uses the same logic for a demand rate greater than 1. The stock level for a demand rate less than 1 is determined using the Essentiality Code for the item.

ASSIGNMENTS:

(Demand Rate) = (.25) *(Discard)*
Variance = *Demand Rate*
Risk = 0.10

a. *If (Demand Rate)* < .025
then (Stock Level) = 0

b. *If Essentiality Code* = 1 *and*
if .025 ≤ *(Demand Rate)* < .5
then (Stock Level) = 1
or
if .5 ≤ *(Demand Rate)* < 1.0
then (Stock Level) = 2

c. *If Essentiality Code* > 1 *and*
if .025 ≤ *(Demand Rate)* < .0625
then (Stock Level) = 0
or
if .0625 ≤ *(Demand Rate)* < 1.0
then (Stock Level) = 1

d. *If* 1.0 < *(Demand Rate)* ≤ 10

$$\text{then (Stock Level)} = \text{Maximum}^{*} \begin{cases} 2 \\ \text{Reorder} \end{cases}$$

e. *If (Demand Rate)* > 10

$$\text{then (Stock Level)} = \text{Maximum}^{*} \begin{cases} 2 \\ \text{Demand Rate} + (1.28249)\sqrt{\text{(Demand Rate)}} \end{cases}$$

* *Indicates a choice of either of the two options.*

30.4.3 Mission criticality oriented (MCO) COSAL. This formula derives the stock level using the Essentiality Code (EC) of an item. The EC determines a Mission Criticality Code (MCC) for an item, which is then used in the formula. The calculated value is rounded off to the nearest integer. The low limit, high limit, A, B, and C parameters are given as input factors for this policy, with values for the low limit and high limit being given by the EC.

ASSIGNMENTS:

(*Demand Rate*) = (.25)(*Discard*)

Mission Criticality Code = 1 *if Essentiality Code* > 1
or = 4 *if Essentiality Code* = 1

$$(\text{Stock Level}) = ((\text{Demand Rate}) + \text{Risk}(\sqrt{(\text{Demand Rate})}))$$

where

$$\text{Risk} = \text{Maximum} \begin{cases} * \; \text{Low Limit} \\ \text{Minimum} \; * \begin{cases} \text{High Limit} \\ (A - (B(4 - MCC)) - (C \log_e(\text{Unit Cost}) \end{cases} \end{cases}$$

---

* *Indicates a choice of either of the two options.*

30.4.4 Aviation supply office (ASO) retail policy. This model provides a fixed endurance level of support for the ship or station in accordance with the support period authorized by OPNAV.

ASSIGNMENTS:

(*Daily Rate*) = ((*Demand*)/365)
Mean = ((*Daily Rate*)(*Repair Cycle*)(1.0 - (*DSF*))
(*Demand Rate*) = ((*Daily Rate*)(*ASO Factor*)(*DSF*))
Variance = *Mean*
Risk = 0.10
Local Repair Cycle Allowance (*Pool*) = *Reorder if Mean* > 0
or = 0 *if Mean* ≤ 0

a. *If* (*Demand Rate*) < .34
then (*Stock Level*) = (*Pool*)

b. *If* (*Unit Cost*) < $5000
and .34≤ (*Demand Rate*) < 1.0
then (*Stock Level*) = (1.0 + (*Pool*))

c. *If* (*Unit Cost*) ≥ $5000
and .34 ≤ (*Demand Rate*) ≤ .5
then (*Stock Level*) = (*Pool*)
or else if .5 < (*Demand Rate*) < 1.0
then (*Stock Level*) = (1.0 + (*Pool*))

d. *If* (*Demand Rate*) ≥ 1.0
then (*Stock Level*) = ((*Demand Rate*) + (*Pool*))

30.4.5 Wholesale stockage.

$$(Losses) = \left(\frac{((DSF)(Production\ Lead\ Time) + (1.0 - (DSF)))(Repair\ Cycle)}{(365)}\right)$$

If DSS < 12.0
then Item Holding Cost (IHC) = ((Holding Cost)(Unit Cost))

$$Shortage\ Cost = (.5)\ Maximum \begin{cases} Item\ Holding\ Cost \\ Shortage\ Cost \end{cases}$$

$$DT = (DSS)/(DSF)$$

$$\begin{pmatrix} Frequency\ of \\ Procurement \end{pmatrix} = Minimum \begin{cases} DSS \\ Minimum \begin{cases} 4.0 \\ Maximum \begin{cases} 0.3 \\ \dfrac{(.5)(DSS)(IHC)}{(C^1p)*} \end{cases} \end{cases} \end{cases}$$

where C^1p is the administrative cost of procurement plus $2.72 receipt cost for stocked items.

$$(Index) = Minimum \begin{cases} 12 \\ DT + 1 \end{cases}$$

$$\begin{pmatrix} Probability \\ of\ No\ Demand \end{pmatrix} = Ptable\ (Index)$$ [The Probability of No Demand in two years.]

$$Economic\ Order\ Quantity\ (EOQ) = \left(\frac{(DSS)}{(Frequency\ of\ Procurement)}\right)$$

$$BUY = (EOQ) + ((DT)((Losses) + (.25)(DSF)))$$

---

* If ((BUY)(Unit Cost)) < (THRESH), $C^1p = C^1pA$;
If ((EOQ)(Unit Cost)) < (THRESH), $C^1p = C^1pB$

The formula used in the wholesale stockage concept, under DODI 4140.42, is based upon the recognition that unimproved engineering deficiencies tend to impede the stockage process. Therefore, the wholesale stockage criteria is used to determine when an item should be managed with or without stock. These criteria are used on all types of items and include variable holding costs (HC), variable procurement costs, implied shortage costs (as defined in DODI 4140.39), and a probability of no-demand function.

The difference in costs is the difference between the cost of stocked items and the cost of non-stocked items.

$$\begin{pmatrix}\text{Difference}\\ \\ \text{in Costs}\\ \\ \text{(COSDIF)}\end{pmatrix} = \Big[(\text{Probability of no demand})\,\big((C^1pA) + (2.0)(IHC)(BUY)\big)\Big] + \Big[(1.0 - \text{Probability of no demand})\big((C^1pB)(\text{Frequency of Procurement}) + (.5)(IHC)\left(\frac{DSS}{\text{Frequency of Procurement}}\right) + DT\left(\frac{IC - C^2p - (\text{Production Lead Times})SC}{365}\right) - \big((1 - F_0|F_d)\big)(C^2p)(F_d) + (DSS)(\text{Unit Cost})(\text{Procurement Cycle})\big)\Big]$$

where

- IC = *Issue Cost*
- C^2p = *Non-stocked fixed procurement cost*
- F_d = *Frequency of demand*
- $F_0|F_d$ = *The probability of no demand, given that the forecasted annual demand frequency is F_d.*

If COSDIF ≤ 0

$$\text{then (Stock Level)} = \text{Maximum}\begin{cases}1\\ (\text{Demand})\big((\text{Losses}) + (.25)(DSF)\big)\end{cases}$$

If COSDIF > 0
then (Stock Level) $= 0$

30.4.6 Uniform inventory control program (UICP) wholesale follow-on. This policy is used by Navy inventory control points to manage supply system inventories. It is based on simplifying assumptions that may or may not accurately reflect the environment in which UICP operates. Such assumptions include a steady state environment, continuous demand, and a continual review of assets and requirements. Procurements are not constrained by funding or other factors.

a. Definitions:

Item Holding Cost (IHC) = ((Unit Cost)((OBS)+(HC)))[HC is the holding cost rate of an item based on obsolescence, storage cost, and interest rate. OBS is the reciprocal of expected item life and is the cost, recognized in advance, of procuring material which is never sold.]

ORDER = (High Limit) + (Manufacturer's Setup Cost)

$$Test = \frac{(8{,}000{,}000)\ (IHC)}{(Unit\ Cost)\left((Lower\ Limit) + \begin{pmatrix} Manufacturer's \\ Setup\ Cost \end{pmatrix}\right)}$$

$$Unit\ Shortage\ Cost = \frac{(IHC)}{(2.0)\ (SC)}$$

(Daily Demand Rate) = (Demand)/365

BDF = (91.25)(DSF)(Demand Rate)[BDF is the expected system losses per quarter during the year's operating period following procurement lead time.]

BCE = (Lead Time)(Demand Rate)(DSF)[BCE is the expected system losses during the procurement lead time.]

B022 = (91.25)(Demand Rate)[B022 is the expected quarterly demand based on a 365 day year.]

B023G = (1.0 - (DSF))(Demand Rate)(Repair Cycle)[B023G is the number of items repaired at the depot during the procurement lead time.]

$Q \geq 1$ [Q is the average quantity of items procured when an item reaches the reorder point.]

Mean = (BCE + B023G)

Variance = Mean

b. If Mean $\leq$ .001
then (Stock Level) = 0

c. If BDF $\leq$ .001

$$then\ (Stock\ Level) = .5 + Maximum \begin{cases} 0.0 \\ (Mean) + .5 \end{cases}$$

OCST = ORDER
where OCST is the fixed order cost for procurement of an item.

If B022 $\leq$ Test
then OCST = ((Low) + (Manufacturer's Setup Costs))

$$\tilde{Q} = \text{Minimum} \begin{cases} \text{Maximum} \begin{cases} (BDF + .5) \\ \sqrt{\dfrac{(8.0)\ (BDF)\ (OCST)}{(IHC)\ +\ .5}} \end{cases} \\ \\ (BDF)\ (OBS) \begin{cases} Risk - Pipeline \\ \text{Maximum} \begin{cases} 25/\text{Unit Cost} \\ 12\ (BDF) \end{cases} \end{cases} \end{cases}$$

$$Risk = \text{Minimum} \begin{cases} .4499 \\ \text{Maximum} \begin{cases} .01 \\ \left(\dfrac{(OMEGA1)}{(OMEGA1) + 1.0} \right) \end{cases} \end{cases}$$

where

$\tilde{Q}$ = Basic Q

$$OMEGA1 = \text{Minimum} \begin{cases} 99 \\ \dfrac{(\text{Unit Shortage Cost})\ (\tilde{Q})}{(BDF)} \end{cases}$$

If Mean > 1.0
Variance = $(1.31)\ (Mean)^{(.72)}$

$$(\text{Stock Level}) = \text{Maximum} \begin{cases} .001 \\ \text{Minimum} \begin{cases} (Reorder) \\ ((BDF)\ (OBS) + (Mean)) - 1.0 \end{cases} \end{cases}$$

$$\hat{Q} = \left[\text{Maximum} \begin{cases} BDF \\ \\ \text{Minimum} \begin{cases} \tilde{Q} \\ (BDF)\ (OBS) - \text{Maximum} \begin{cases} 0.0 \\ (\text{Stock Level}) - (Mean) \end{cases} \end{cases} \end{cases} \right] + .5$$

where

$\hat{Q}$ = Constrained Q

30.4.7 Protection policy. In this policy, the user specifies a level of protection for the items. This level of protection must then be met for all possible demand rates.

ASSIGNMENTS:

$$(Mean) = ((Demand)\ (DSF)\ (Lead\ Time)) + \left(\frac{(1.0 - DSF)\ (Repair\ Cycle)}{(365)}\right)$$

$$Risk = (1.0 - (Protection\ Level))$$

a. *If at Depot Level*
then Variance = Mean

b. *If not at Depot Level*
then $Variance = (1.31)(Mean)^{(.72)}$
(Stock Level) = (Reorder)

30.5 Cost equations. Fifteen cost equations are defined. Some include a separate sub-equation for when the LOR maintenance action is discard rather than repair. In such cases, verification parameters replace repair parameters. For example, in the Direct Labor Cost equation, [(Verification Rate) - (Repair Rate)] is substituted for the Repair Rate. This is because the repair rate is a sub-set of the verification rate, as defined by the Flow Rates descriptions. By subtracting the repair rate from the global verification rate, a verify-only (i.e., without repair) rate is derived; it is then applied to discard-type maintenance actions.

30.5.1 Inventory costs.

30.5.1.1 Level of investment cost. The following cost equation accounts for the level of investment needed to acquire new stock per location. The new stock per location is the current stock level for the preceding year subtracted from the required stock level of the given year. This cost element is calculated when the new stock per location is greater than zero. The stock levels are determined according to the inventory policy used. (For Phase-in discounting, the discount factor in the equation below should be for Year n - 1.)

$$\begin{pmatrix} Inventory \\ Level\ of \\ Investment \\ Cost \end{pmatrix} = \left[(Unit\ Cost)\begin{pmatrix} Number\ of \\ Locations \\ per\ Site \end{pmatrix}\begin{pmatrix} New\ Stock \\ per \\ Location \end{pmatrix}\begin{pmatrix} Discount \\ Factor \end{pmatrix}\begin{pmatrix} Number\ of \\ Operational \\ Sites \end{pmatrix}\right]$$

where

$$\begin{pmatrix} New\ Stock \\ per \\ Location \end{pmatrix} = \left[\begin{pmatrix} Required \\ Stock \\ Level \end{pmatrix} - \begin{pmatrix} Current \\ Stock \\ Level \end{pmatrix}\right]$$

30.5.1.2 Discard attrition cost. The following cost equation accounts for the recurring cost of inventory purchased throughout the life cycle necessary to resupply stock levels due to failed assemblies being scrapped. The failed assemblies are replaced in the equipment with new assemblies. This cost element is calculated when the level of repair option is discard.

$$\begin{pmatrix}\text{Inventory}\\ \text{Discard}\\ \text{Attrition}\\ \text{Cost}\end{pmatrix} = \left[\begin{pmatrix}\text{Number of}\\ \text{Replacements}\\ \text{per Life Cycle}\\ \text{for all Sites}\end{pmatrix}(\text{Unit Cost})\begin{pmatrix}\text{Scrap}\\ \text{Rate}\end{pmatrix}\begin{pmatrix}\text{Discount}\\ \text{Factor}\end{pmatrix}\right]$$

The number of replacements per life cycle for all sites is calculated below. The operating factor represents the fraction of calendar time an equipment is operational at the location during any year.

$$\begin{pmatrix}\text{Number of}\\ \text{Replacements}\\ \text{per Life}\\ \text{Cycle for}\\ \text{all Sites}\end{pmatrix} = \frac{\begin{pmatrix}\text{Quantity of}\\ \text{Identical}\\ \text{Items per Site}\end{pmatrix}\begin{pmatrix}\text{Number of}\\ \text{Operating}\\ \text{Sites}\end{pmatrix}\begin{pmatrix}\text{Life}\\ \text{Span}\end{pmatrix}\begin{pmatrix}\text{Operating}\\ \text{Factor}\end{pmatrix}\begin{pmatrix}\text{Annual}\\ \text{Operating}\\ \text{Requirements}\end{pmatrix}}{(\text{Mean Time Between Failures})}$$

where

$$\begin{pmatrix}\text{Quantity of}\\ \text{Identical}\\ \text{Items per Site}\end{pmatrix} = \left[\begin{pmatrix}\text{Quantity}\\ \text{per End Item}\end{pmatrix}\begin{pmatrix}\text{Quantity}\\ \text{per Location}\end{pmatrix}\begin{pmatrix}\text{Number of}\\ \text{Locations}\\ \text{per Site}\end{pmatrix}\right]$$

30.5.1.3 Inventory administration cost. Inventory administration cost represents the cost of entering the assembly into the supply system and retaining it throughout the life cycle. The LOR analytical technique treats inventory administration cost as proportional to the number of new items entered in the National Stock Number (NSN) system. Specifically, the cost is a function of three separate costs: item entry, item retention, and field supply administration. Item entry is a one-time cost per NSN incurred during the inventory procurement process to establish the new item in the NSN system. Item retention is a recurring cost per NSN incurred throughout the life cycle. It is a per-year cost due to updating of the NSN system. Field supply administration is a per site cost incurred for local management of the item.

30.5.1.3.1 Inventory administration cost equation for the discard alternative. The administrative cost incurred for discard is the cost of local management, entry, and retention of the assembly in the NSN system. Specifically, within the various data elements, the word "item" refers to the assembly.

$$\begin{pmatrix}\textit{Inventory}\\ \textit{Administration}\\ \textit{Cost for Discard}\end{pmatrix} = \left[\begin{pmatrix}\textit{Entry and}\\ \textit{Retention}\\ \textit{Cost}\end{pmatrix} + \begin{pmatrix}\textit{Inventory}\\ \textit{Administration}\\ \textit{Cost per Site}\end{pmatrix}\begin{pmatrix}\textit{Life}\\ \textit{Span}\end{pmatrix}\begin{pmatrix}\textit{Number of}\\ \textit{Operating}\\ \textit{Sites}\end{pmatrix}\begin{pmatrix}\textit{Discount}\\ \textit{Factor}\end{pmatrix}\right]$$

30.5.1.3.2 Inventory administration cost equation for the repair alternative. The administrative cost incurred for repair is the cost of local management, entry, and retention of the assembly and its unique components or piece parts in the NSN system. Specifically, within the data elements, the word "item" refers to the new piece parts. Inclusion of the discard equation accounts for the assembly itself. A common cost element equation is applicable for each of the repair alternatives.

$$\begin{pmatrix}\textit{Inventory}\\ \textit{Administration}\\ \textit{Cost for Repair}\end{pmatrix} = \left[\left(\begin{pmatrix}\textit{Entry and}\\ \textit{Retention}\\ \textit{Cost}\end{pmatrix} + \begin{pmatrix}\textit{Inventory}\\ \textit{Administration}\\ \textit{Cost per Site}\end{pmatrix}\begin{pmatrix}\textit{Life}\\ \textit{Span}\end{pmatrix}\begin{pmatrix}\textit{Number of}\\ \textit{Operating}\\ \textit{Sites}\end{pmatrix}\begin{pmatrix}\textit{Discount}\\ \textit{Factor}\end{pmatrix}\right)\begin{pmatrix}\textit{Number of New}\\ \textit{Parts in NSN}\\ \textit{System per Assembly}\end{pmatrix} + \begin{pmatrix}\textit{Inventory}\\ \textit{Administration}\\ \textit{Cost for Discard}\end{pmatrix}\right]$$

where

$$\begin{pmatrix}\textit{Entry and}\\ \textit{Retention}\\ \textit{Cost}\end{pmatrix} = \left[\left(\begin{pmatrix}\textit{Entry}\\ \textit{Cost per}\\ \textit{Item}\end{pmatrix}\begin{pmatrix}\textit{Discount}\\ \textit{Factor}\\ \textit{Year n-1}\end{pmatrix}\right) + \left(\begin{pmatrix}\textit{Life}\\ \textit{Span}\end{pmatrix}\begin{pmatrix}\textit{Retention}\\ \textit{Cost per Item}\\ \textit{per Year}\end{pmatrix}\begin{pmatrix}\textit{Discount}\\ \textit{Factor}\end{pmatrix}\right)\right]$$

30.5.1.4 Inventory storage space cost. A common cost equation is applicable for discard and each of the possible repair alternatives. The equation computes the cost of storage space for the required stock level.

$$\begin{pmatrix}\textit{Inventory}\\ \textit{Storage Space}\\ \textit{Cost}\end{pmatrix} = \left[\begin{pmatrix}\textit{Unit}\\ \textit{Size}\end{pmatrix}\begin{pmatrix}\textit{Number of}\\ \textit{Locations}\\ \textit{per Site}\end{pmatrix}\begin{pmatrix}\textit{Required}\\ \textit{Stock}\\ \textit{Level}\end{pmatrix}\begin{pmatrix}\textit{Storage}\\ \textit{Cost per}\\ \textit{Cubic Foot}\end{pmatrix}\begin{pmatrix}\textit{Discount}\\ \textit{Factor}\end{pmatrix}\begin{pmatrix}\textit{Number of}\\ \textit{Operating}\\ \textit{Sites}\end{pmatrix}\right]$$

30.5.2 Personnel costs.

30.5.2.1 Training costs. The cost equations are common for discard and repair alternatives. The equation computes the cost of training men for a predicted number of man-hours required. The number of man-hours required is computed as a function of how many men are required for an action and how much time is needed to complete the action. If initial training has already been purchased, it is considered to be an expended cost and is not included in the training cost. Only the attrition training cost is calculated for such a case.

$$\text{(Training Cost)} = \left[\begin{pmatrix}\text{Number of}\\\text{Man-Hours}\\\text{Required}\end{pmatrix}\begin{pmatrix}\text{Amortized}\\\text{Training Cost}\\\text{per Person}\end{pmatrix}\begin{pmatrix}\text{Discount}\\\text{Factor}\end{pmatrix}\right]$$

where

$$\begin{pmatrix}\text{Amortized}\\\text{Training Cost}\\\text{per Person}\end{pmatrix} = \left[\frac{\begin{pmatrix}\text{Training Cost}\\\text{per Person}\end{pmatrix}}{\begin{pmatrix}\text{Available}\\\text{Man-Hours}\\\text{per Year}\end{pmatrix}\begin{pmatrix}\text{Life}\\\text{Span}\end{pmatrix}}\right]$$

$$\begin{pmatrix}\text{Training}\\\text{Time}\end{pmatrix} = \left[\begin{pmatrix}\text{Number of}\\\text{Replacements per}\\\text{Life Cycle}\\\text{for All Sites}\end{pmatrix}\left(\begin{pmatrix}\text{Number of}\\\text{Persons Required}\\\text{for Repair}\end{pmatrix}\begin{pmatrix}\text{Task}\\\text{Time}\end{pmatrix}\begin{pmatrix}\text{Repair}\\\text{Rate}\end{pmatrix}\right)^{*}\right]$$

* *For the discard alternative*

$$\left[\begin{pmatrix}\text{Number of}\\\text{Persons Required}\\\text{for Verification}\end{pmatrix}\begin{pmatrix}\text{Task}\\\text{Duration for}\\\text{Verification}\end{pmatrix}\left(\begin{pmatrix}\text{Verification}\\\text{Rate}\end{pmatrix} - \begin{pmatrix}\text{Repair}\\\text{Rate}\end{pmatrix}\right)\right] \text{ is substituted.}$$

30.5.2.2 <u>Direct labor cost</u>. The cost equations are common for discard and repair alternatives. The equation computes the cost of labor charged directly for the action taken.

$$\begin{pmatrix}\text{Direct}\\\text{Labor}\\\text{Cost}\end{pmatrix} = \left[\begin{pmatrix}\text{Number of}\\\text{Man-Hours}\\\text{Required}\end{pmatrix}\begin{pmatrix}\text{Recurring}\\\text{Hourly}\\\text{Cost}\end{pmatrix}\begin{pmatrix}\text{Discount}\\\text{Factor}\end{pmatrix}\right]$$

*or**

$$\begin{pmatrix}\text{Direct}\\\text{Labor}\\\text{Cost}\end{pmatrix} = \left[\begin{pmatrix}\text{Number of}\\\text{Replacements per}\\\text{Life Cycle}\\\text{for All Sites}\end{pmatrix}\begin{pmatrix}\text{Unit}\\\text{Cost}\end{pmatrix}\left(\begin{pmatrix}\text{Repair}\\\text{Rate}\end{pmatrix}\begin{pmatrix}\text{Personnel}\\\text{Repair}\\\text{Rate}\end{pmatrix}\right)^{**}\begin{pmatrix}\text{Discount}\\\text{Factor}\end{pmatrix}\right]$$

* *Two modes of calculating the cost equations are available; the choice of mode depends on the input data provided.*

** *For the discard alternative*

$$\left[\left(\begin{pmatrix}\text{Verification}\\\text{Rate}\end{pmatrix} - \begin{pmatrix}\text{Repair}\\\text{Rate}\end{pmatrix}\right)\begin{pmatrix}\text{Personnel}\\\text{Verification}\\\text{Rate}\end{pmatrix}\right] \text{ is substituted.}$$

30.5.3 Support equipment cost.

30.5.3.1 Support equipment acquisition cost. This element represents the cost for acquisition of support equipment associated with the electronic system in question. Already available support equipment is considered an expended cost and does not enter the computations.

$$\left(\begin{array}{c}\text{Support}\\\text{Equipment}\\\text{Acquisition}\\\text{Cost}\end{array}\right) = \left[\left(\begin{array}{c}\text{Number of}\\\text{Support}\\\text{Equipment Hours}\\\text{Required}\end{array}\right)\left(\begin{array}{c}\text{Amortized}\\\text{Support}\\\text{Equipment}\\\text{Cost}\end{array}\right)\left(\begin{array}{c}\text{Discount}\\\text{Factor}\end{array}\right)\left(1.0 - \left(\begin{array}{c}\text{Support}\\\text{Equipment}\\\text{Fraction}\end{array}\right)\right)\right]$$

where

$$\left(\begin{array}{c}\text{Number of}\\\text{Support}\\\text{Equipment Hours}\\\text{Required}\end{array}\right) = \left[\left(\begin{array}{c}\text{Number of}\\\text{Replacements per}\\\text{Life Cycle}\\\text{for All Sites}\end{array}\right)\left(\left(\begin{array}{c}\text{Number}\\\text{of Support}\\\text{Equipment}\\\text{Required}\\\text{for Repair}\end{array}\right)\left(\begin{array}{c}\text{Task}\\\text{Time}\end{array}\right)\left(\begin{array}{c}\text{Repair}\\\text{Rate}\end{array}\right)\right)^{*}\right]$$

$$\left(\begin{array}{c}\text{Amortized}\\\text{Support}\\\text{Equipment}\\\text{Cost}\end{array}\right) = \left[\frac{\left(\begin{array}{c}\text{Initial Cost per}\\\text{Support Equipment}\end{array}\right)}{\left(\begin{array}{c}\text{Available}\\\text{Support}\\\text{Equipment Hours}\\\text{per Year}\end{array}\right)\left(\begin{array}{c}\text{Life}\\\text{Span}\end{array}\right)}\right]$$

$$\left(\begin{array}{c}\text{Support}\\\text{Equipment}\\\text{Fraction}\end{array}\right) = \left[\frac{\left(\begin{array}{c}\text{Area per}\\\text{Support}\\\text{Equipment}\end{array}\right)\left(\begin{array}{c}\text{Area Cost}\\\text{per Year}\end{array}\right)\left(\begin{array}{c}\text{Discount}\\\text{Factor}\end{array}\right)}{\left(\begin{array}{c}\text{Support}\\\text{Equipment}\\\text{Procurement}\\\text{Costs}\end{array}\right)\left(\begin{array}{c}\text{Support}\\\text{Equipment}\\\text{Attrition}\end{array}\right) + \left(\begin{array}{c}\text{Area per}\\\text{Support}\\\text{Equipment}\end{array}\right)\left(\begin{array}{c}\text{Area Cost}\\\text{per Year}\end{array}\right)\left(\begin{array}{c}\text{Discount}\\\text{Factor}\end{array}\right)}\right]$$

or**

$$\left(\begin{array}{c}\text{Support}\\\text{Equipment}\\\text{Acquisition}\\\text{Cost}\end{array}\right) = \left[\left(\begin{array}{c}\text{Number of}\\\text{Replacements per}\\\text{Life Cycle}\\\text{for All Sites}\end{array}\right)\left(\begin{array}{c}\text{Unit}\\\text{Cost}\end{array}\right)\left(\begin{array}{c}\text{Support}\\\text{Equipment}\\\text{Cost Rate}\end{array}\right)\left(\begin{array}{c}\text{Repair}\\\text{Rate}\end{array}\right)^{\dagger}\left(\begin{array}{c}\text{Discount}\\\text{Factor}\end{array}\right)\right]$$

---

* For the discard alternative

$$\left[\left(\begin{array}{c}\text{Number of}\\\text{Support}\\\text{Equipment}\\\text{Required for}\\\text{Verification}\end{array}\right)\left(\begin{array}{c}\text{Task}\\\text{Duration for}\\\text{Verification}\end{array}\right)\left(\left(\begin{array}{c}\text{Verification}\\\text{Rate}\end{array}\right) - \left(\begin{array}{c}\text{Repair}\\\text{Rate}\end{array}\right)\right)\right]$$ is substituted.

** Two modes of calculating the cost equations are available; the choice of mode depends on the input data provided.

† For the discard alternative $\left[\left(\begin{array}{c}\text{Verification}\\\text{Rate}\end{array}\right) - \left(\begin{array}{c}\text{Repair}\\\text{Rate}\end{array}\right)\right]$ is substituted.

30.5.3.2 Support equipment support cost. The common cost equation is applicable for discard and each of the repair alternatives. This equation accounts for the recurring cost for support of support equipment.

$$\begin{pmatrix}\text{Support}\\ \text{Equipment}\\ \text{Support Cost}\end{pmatrix} = \left[\begin{pmatrix}\text{Number of}\\ \text{Support Equipment}\\ \text{Hours Required}\end{pmatrix}\begin{pmatrix}\text{Recurring}\\ \text{Hourly}\\ \text{Cost}\end{pmatrix}\begin{pmatrix}\text{Discount}\\ \text{Factor}\end{pmatrix}\right]$$

30.5.3.3 Support equipment area cost. The cost equations are common for discard and each of the repair alternatives. This is the repair work area cost calculated for a predicted number of hours that work area is required for the type of action taken.

$$\begin{pmatrix}\text{Support}\\ \text{Equipment}\\ \text{Area Cost}\end{pmatrix} = \left[\begin{pmatrix}\text{Number of}\\ \text{Support Equipment}\\ \text{Hours Required}\end{pmatrix}\begin{pmatrix}\text{Amortized}\\ \text{Support}\\ \text{Equipment Cost}\end{pmatrix}\begin{pmatrix}\text{Support}\\ \text{Equipment}\\ \text{Fraction}\end{pmatrix}\begin{pmatrix}\text{Discount}\\ \text{Factor}\end{pmatrix}\right]$$

30.5.4 Repair costs.

30.5.4.1 Repair material cost. The repair material cost is the cost of materials (wire, piece parts, etc.) utilized to repair the assemblies that have failed. The repair material cost rate is a percentage of the assembly cost associated with the amount of repair material. Each repair alternative uses the same equation. For the discard alternative, the repair material cost is zero, since no repair parts are required.

$$\begin{pmatrix}\text{Repair}\\ \text{Material}\\ \text{Cost}\end{pmatrix} = \left[\begin{pmatrix}\text{Number of}\\ \text{Replacements per}\\ \text{Life Cycle}\\ \text{for All Sites}\end{pmatrix}\begin{pmatrix}\text{Unit}\\ \text{Cost}\end{pmatrix}\begin{pmatrix}\text{Repair}\\ \text{Material}\\ \text{Cost Rate}\end{pmatrix}\begin{pmatrix}\text{Repair}\\ \text{Rate}\end{pmatrix}\begin{pmatrix}\text{Discount}\\ \text{Factor}\end{pmatrix}\right]$$

30.5.4.2 Repair scrap cost. A common cost equation is applicable for each of the repair alternatives. The repair scrap cost accounts for the recurring cost of inventory purchased throughout the life cycle necessary to resupply stock levels due to failed assemblies being sent to a higher level of repair for restoration. The failed assemblies are replaced in the equipment with new assemblies. This cost element is not calculated when the level of repair option is discard (see Discard Attrition Cost), but rather when the option is repair, and the item must be scrapped anyway.

$$\begin{pmatrix}\text{Repair}\\ \text{Scrap}\\ \text{Cost}\end{pmatrix} = \left[\begin{pmatrix}\text{Number of}\\ \text{Replacements per}\\ \text{Life Cycle}\\ \text{for All Sites}\end{pmatrix}\begin{pmatrix}\text{Unit}\\ \text{Cost}\end{pmatrix}\begin{pmatrix}\text{Scrap}\\ \text{Rate}\end{pmatrix}\begin{pmatrix}\text{Discount}\\ \text{Factor}\end{pmatrix}\right]$$

30.5.4.3 Repair area cost. This is the repair work area cost calculated for a predicted number of hours that the work area is required for the type of action taken.

$$\begin{pmatrix}\text{Repair}\\\text{Area}\\\text{Cost}\end{pmatrix} = \left[\begin{pmatrix}\text{Number of}\\\text{Repair Work Area}\\\text{Hours Required}\end{pmatrix}\left(\begin{pmatrix}\text{Amortized}\\\text{Repair Work}\\\text{Area Cost}\end{pmatrix} + \begin{pmatrix}\text{Recurring}\\\text{Hourly}\\\text{Cost}\end{pmatrix}\right)\begin{pmatrix}\text{Discount}\\\text{Factor}\end{pmatrix}\right]$$

where

$$\begin{pmatrix}\text{Amortized}\\\text{Repair Work}\\\text{Area Cost}\end{pmatrix} = \left[\frac{\begin{pmatrix}\text{Cost for}\\\text{Repair Work Area}\end{pmatrix}}{\begin{pmatrix}\text{Available}\\\text{Repair Work Area}\\\text{Hours per Year}\end{pmatrix}\begin{pmatrix}\text{Life}\\\text{Span}\end{pmatrix}}\right]$$

and

$$\begin{pmatrix}\text{Number of}\\\text{Repair Work}\\\text{Area Hours}\\\text{Required}\end{pmatrix} = \left[\begin{pmatrix}\text{Number of}\\\text{Replacements per}\\\text{Life Cycle}\\\text{for All Sites}\end{pmatrix}\left(\begin{pmatrix}\text{Number of}\\\text{Repair Work}\\\text{Areas Required}\\\text{for Repair}\end{pmatrix}\begin{pmatrix}\text{Task}\\\text{Time}\end{pmatrix}\begin{pmatrix}\text{Repair}\\\text{Rate}\end{pmatrix}\right)^{*}\right]$$

* For the discard alternative

$$\left[\begin{pmatrix}\text{Number of}\\\text{Repair Work}\\\text{Areas Required}\\\text{for Verification}\end{pmatrix}\begin{pmatrix}\text{Task Time for}\\\text{Verification}\end{pmatrix}\left(\begin{pmatrix}\text{Verification}\\\text{Rate}\end{pmatrix} - \begin{pmatrix}\text{Repair}\\\text{Rate}\end{pmatrix}\right)\right]$$ *is substituted.*

30.5.5 Documentation costs. A common cost equation is applicable for discard and repair alternatives. Documentation includes the following elements: the drawings and specifications that make up the electronic system technical manual; the logistic support analysis preparation; and various support equipment requirements sheets, lists, etc.

$$\left(\text{Documentation Cost}\right) = \left[\left(\begin{matrix}\text{Documentation}\\ \text{Hours}\\ \text{Required}\end{matrix}\right)\left(\left(\begin{matrix}\text{Amortized}\\ \text{Documentation}\\ \text{Cost}\end{matrix}\right) + \left(\begin{matrix}\text{Recurring}\\ \text{Hourly}\\ \text{Cost}\end{matrix}\right)\right)\left(\begin{matrix}\text{Discount}\\ \text{Factor}\end{matrix}\right)\right]$$

where

$$\left(\begin{matrix}\text{Documentation}\\ \text{Hours}\\ \text{Required}\end{matrix}\right) = \left[\left(\begin{matrix}\text{Number of}\\ \text{Replacements per}\\ \text{Life Cycle}\\ \text{for All Sites}\end{matrix}\right)\left(\left(\begin{matrix}\text{Pages of}\\ \text{Documentation}\\ \text{Required for}\\ \text{Repair}\end{matrix}\right)\left(\begin{matrix}\text{Task}\\ \text{Time}\end{matrix}\right)\left(\begin{matrix}\text{Repair}\\ \text{Rate}\end{matrix}\right)\right)^{*}\right]$$

and

$$\left(\begin{matrix}\text{Amortized}\\ \text{Documentation}\\ \text{Cost}\end{matrix}\right) = \left[\frac{\left(\begin{matrix}\text{Initial Cost for}\\ \text{Documentation}\end{matrix}\right)}{\left(\begin{matrix}\text{Available}\\ \text{Documentation}\\ \text{Hours per Year}\end{matrix}\right)\left(\begin{matrix}\text{Life}\\ \text{Span}\end{matrix}\right)}\right]$$

*or***

$$\left(\begin{matrix}\text{Documentation}\\ \text{Cost}\end{matrix}\right) = \left[\left(\begin{matrix}\text{Number of}\\ \text{Replacements per}\\ \text{Life Cycle}\\ \text{for All Sites}\end{matrix}\right)\left(\begin{matrix}\text{Unit}\\ \text{Cost}\end{matrix}\right)\left(\begin{matrix}\text{Documentation}\\ \text{Cost Rate}\end{matrix}\right)\left(\begin{matrix}\text{Repair}\\ \text{Rate}\end{matrix}\right)^{\dagger}\left(\begin{matrix}\text{Discount}\\ \text{Factor}\end{matrix}\right)\right]$$

* *For the discard alternative*

$$\left[\left(\begin{matrix}\text{Pages of}\\ \text{Documentation}\\ \text{Required for}\\ \text{Verification}\end{matrix}\right)\left(\begin{matrix}\text{Task Time for}\\ \text{Verification}\end{matrix}\right)\left(\left(\begin{matrix}\text{Verification}\\ \text{Rate}\end{matrix}\right) - \left(\begin{matrix}\text{Repair}\\ \text{Rate}\end{matrix}\right)\right)\right]$$ *is substituted.*

** *Two modes of calculating the cost equations are available; the choice of mode depends on the input data provided.*

† *For the discard alternative* $\left[\left(\begin{matrix}\text{Verification}\\ \text{Rate}\end{matrix}\right) - \left(\begin{matrix}\text{Repair}\\ \text{Rate}\end{matrix}\right)\right]$ *is substituted.*

30.5.6 Transportation costs.

30.5.6.1 Packaging cost. This element includes the costs incurred during the life cycle. It accounts for packaging of assemblies that must be sent to other maintenance sites for further action or are replacements for those that have been lost to the supply system.

$$\begin{pmatrix}\text{Packaging}\\ \text{Cost}\end{pmatrix} = \left[\begin{pmatrix}\text{Number of}\\ \text{Replacements per}\\ \text{Life Cycle for}\\ \text{All Sites}\end{pmatrix}\begin{pmatrix}\text{Unit}\\ \text{Size}\end{pmatrix}\begin{pmatrix}\text{Cost of}\\ \text{Packaging}\end{pmatrix}\begin{pmatrix}\text{Scrap}\\ \text{Rate}\end{pmatrix}^{*}\begin{pmatrix}\text{Discount}\\ \text{Factor}\end{pmatrix}\right]$$

---

* *For items sent to the Intermediate Level* $\begin{pmatrix}\text{BCM}\\ \text{to IMA}\\ \text{Rate}\end{pmatrix}$ *is substituted (refer to flow rates under required parameters).*

For items sent to the Depot Level $\begin{pmatrix}\text{BCM to}\\ \text{Depot}\\ \text{Rate}\end{pmatrix}$ *is substituted (refer to flow rates under required parameters).*

30.5.6.2 Shipping cost. This element includes the costs incurred during the life cycle. It accounts for transportation of assemblies that must be sent to other maintenance sites for further action or are replacements for those that have been lost to the supply system.

$$\begin{pmatrix}\text{Shipping}\\ \text{Cost}\end{pmatrix} = \left[\begin{pmatrix}\text{Number of}\\ \text{Replacements per}\\ \text{Life Cycle}\\ \text{for All Sites}\end{pmatrix}\begin{pmatrix}\text{Unit}\\ \text{Weight}\end{pmatrix}\begin{pmatrix}\text{Cost per lb.}\\ \text{for Shipping}\end{pmatrix}\begin{pmatrix}\text{Scrap}\\ \text{Rate}\end{pmatrix}^{*}\begin{pmatrix}\text{Discount}\\ \text{Factor}\end{pmatrix}\right]$$

---

* *For items sent to the Intermediate Level* $\begin{pmatrix}\text{BCM}\\ \text{to IMA}\\ \text{Rate}\end{pmatrix}$ *is substituted (refer to flow rates under required parameters).*

For items sent to the Depot Level $\begin{pmatrix}\text{BCM to}\\ \text{Depot}\\ \text{Rate}\end{pmatrix}$ *is substituted (refer to flow rates under required parameters).*

30.6 Integer considerations. Quantities involving a number of assemblies are rounded to an integer by the following method. First the quantities are computed as specified in the preceding formulas. After calculating these quantities for all of the assemblies in the system, each quantity is summed for all the assemblies. These total quantities are then operated on in two ways. First, these total quantities, for each level of repair, are compared to a minimum of one per site. If they are less than one per site, they are set equal to one per site. If the total quantities are greater than this minimum, the quantities are rounded to the next higher integer. After these totals are adjusted, they are reapportioned over all the assemblies in the same ratio as they were originally calculated.

30.7 LOR results. For each of the repair categories and discard, the computed values of the various cost equations are summed to determine the most cost-effective level of repair.

30.8 Table of data elements. Table F-I contains the various LOR data elements, the LSA interface, the associated units required, and the data element sources as input to the LOR model for SPAWAR equipments. Definitions for LSA related data elements are found in MIL-STD-1388-2A, Appendix F, and MIL-STD-1388-2B, Appendix E.

TABLE F-I. Level of repair model data elements.

Input Format	Data Element Number	Data Element Name	LSA	Units	Data Sources
A	1	Run Identification		None	Navy
A	2	Date of Last Change		Yr/Mo/Da	Navy/Contractor
A	3	Base Year		Year	Navy
A	4	Life Span	Yes*	Years	Navy
I,J	5	Reference Symbol		None	Contractor
I,J	6	Reference Number		None	Contractor
I	7	Item Indenture	Yes**	None	Contractor
I	8	Part Number/Nomenclature	Yes	None	Contractor
I	9	No. of New Items		None	Contractor
I	10	Unit Weight	Yes	lbs.	Contractor
I	11	Unit Size	Yes	Cu. ft.	Contractor
I	12	Number Per Next Higher Assembly	Yes**	Unit	Contractor
I	13	Unit Cost	Yes	$/Assembly	Contractor
I	14	Source, Maintenance & Recoverability (SM&R) Codes	Yes	None	Navy/Contractor
I	15	Mean Time Between Failures (MTBF)	Yes	Hours	Contractor
I	16	Mean Time to Repair (MTTR)	Yes	Hours	Contractor
I	17	Military Essentiality Code (MEC)	Yes	None	Contractor
I	18	Override Code		Unit	Navy
I	19	Override Amount		Unit	Navy
J	20	Item Operating Factor	Yes*	Hr/Yr	Navy/Contractor
J	21	Order and Shipping Time (O&ST) Organizational		Days	Navy
J	22	O&ST - Intermediate Maintenance Activity		Days	Navy
J	23	Procurement Lead Time		Days	Navy/Contractor
J	24	Repair Cycle - Organization		Days	Navy
J	25	Repair Cycle - IMA		Days	Navy
J	26	Repair Cycle - Depot		Days	Contractor
J	27	Personnel Cost Rate - Verification		Fraction	Navy
J	28	Personnel Cost Rate - Repair		Fraction	Navy
J	29	Material Cost Rate		Fraction	Navy/Contractor
J	30	Support Equipment Cost Rate		Fraction	Navy
J	31	Documentation Cost Rate		Fraction	Navy
J	32	IMA Percentage		Fraction	Navy
J	33	BCM Rate - Organization		Fraction	Navy
J	34	BCM Rate - IMA		Fraction	Navy
J	35	Scrap Rate - Organization		Fraction	Navy
J	36	Scrap Rate - IMA		Fraction	Navy
J	37	Scrap Rate - Depot	Yes	Fraction	Navy
J	38	False Removal Rate - Organizational		Fraction	Navy
J	39	False Removal Rate - IMA		Fraction	Navy
J	40	False Removal Rate - Depot		Fraction	Navy

*Yes for 1388-2B only; not available from 1388-2A.
**LSAR elements must be combined to create comparable LORA element.

TABLE F-I. Level of repair model data elements - Continued.

Input Format	Data Element Number	Data Element Name	LSA	Units	Data Sources
J	41	False Removal Detection Rate - Organization		Fraction	Navy
J	42	False Removal Detection Rate - IMA		Fraction	Navy
J	43	False Removal Detection Rate - Depot		Fraction	Navy
L	44	Site Name		None	Navy
L	45	Location Indenture		None	Navy
L	46	Location Echelon Code		None	Navy
L	47	Lead Time		Days	Navy
L	48	Repair Cycle		Days	Navy (Ship/Shore)
	49	No. of Locations		Unit	Navy (Ship/Shore)
L	50	No. of Equipments		Unit	Navy
L	51	Stockage Policy		None	
L	52	Availability Target (Protection Level)		Percentage	Navy
L	53	No. of Shifts		Unit	Navy
L	54	Site Operating Factor		Fraction	Navy
L	55	Zone		None	Navy (Transportation Cost)
L	56	Delivery Schedule (three deliveries)		No. per yr/mo	Navy
R	57	Resource Type	Yes	None	Contractor
R,T	58	Resource Identification	Yes	None	Contractor
R	59	Resource Description	Yes	None	Contractor
R	60	Facilities/Support Space	Yes	Sq.Ft.	Contractor
R	61	Hourly Cost - Recurring		$/Hr.	Contractor
R	62	Hourly Cost - Amortized		$/Hr.	Contractor
R	63	Procurement/Training Cost	Yes	Follows	Contractor
R	64	Procurement Sunk Cost		Dollars	Contractor
R	65	Attrition/Support Rate - First Year		Fraction	Navy
R	66	Attrition/Support Rate - Subsequent Years	Yes**	Fraction	Navy
R	67	Development Cost		Dollars	Contractor
R	68	Development Sunk Cost	Yes	None	Contractor
R	69	Hours Available Per Shift		Hr/Yr	Contractor
R	70	Availability Fraction		Fraction	Contractor
T	71	Item Number		None	Contractor
T	72	Task Echelon		None	Contractor
T	73	Task Type	Yes**	None	Duration
T	74	Task Duration	Yes**	Hours	Contractor
T	75	Resource Identification for Task (6)		None	Contractor
T	76	No. Required (6)	Yes**	Unit	Contractor

*Yes for 1388-2B only; not available from 1388-2A.
**LSAR elements must be combined to create comparable LORA element.

NAVAL SEA SYSTEMS COMMAND (NAVSEA)
LEVEL OF REPAIR ANALYSIS METHOD

10. PURPOSE. This appendix specifies the methods and algorithms for performing Level of Repair Analysis (LORA) for systems and equipment under the cognizance of the Naval Sea Systems Command (NAVSEA).

20. APPLICABLE DOCUMENTS.

20.1 Requiring documents.

20.1.1 OPNAVINST 5000.49A, integrated logistics support.

20.1.2 NAVSEAINST 5000.2, acquisition and management of integrated logistics support for ships, systems, and equipment.

20.2 NAVSEA technical documents.

20.2.1 NAVSEA LORA procedures manual, TL081-AB-PRO-010/LORA.

30. LEVEL OF REPAIR ANALYSIS (LORA). Level of Repair Analysis (LORA) shall be performed on an iterative basis, in consonance with design maturity. LORA shall be performed initially at the system level to define the corrective repair portion of the maintenance concept. As system design matures, LORA shall be performed at the item level to derive the recommended repair code of each LORA candidate's Source, Maintenance, and Recoverability (SM&R) code.

30.1 NAVSEA LORA method. NAVSEA requires LORA to be performed using a combination of qualitative and quantitative procedures. Qualitative information and data will be assessed first to determine the level of repair decisions. Quantitative procedures (cost analysis) are used for LORA when qualitative procedures are not applicable. The NAVSEA LORA Procedures Manual TL081-AB-PRO-010/LORA provides the procedures and guidance for performing LORA on systems or equipment procured or developed for NAVSEA.

30.2 System level analysis. LORA must be performed early in the development phases to allow cost-effective influence of design and affect maintenance and logistics planning efforts; however, during early pre-production phases, design may not be stable or have progressed to the piece part level. LORAs, performed prior to stable piece part design or selection, will consider information commensurate with design to develop the corrective repair portion of the maintenance concept.

30.2.1 Pre-empting factors. Conduct a system-level analysis to determine if pre-empting factors exist which will affect the design of the system or equipment and its support concept, including the maintenance concept. Identify pre-empting factors to assess any maintenance constraints or special needs pertaining to the system or equipment and its repairable items. Pre-empting factors include, but are not limited to, safety, security, manning levels, transportation factors, host platform maintenance concepts, policy (specifications and regulations), operational availability thresholds, special repair facilities/processes, warranties, calibration requirements, special skills and training, and remove/replace decisions that preclude certain maintenance alternatives.

30.2.2 Comparative analysis. If pre-empting factors do not dictate the corrective repair portion of the maintenance concept, determine a maintenance concept for the system or equipment that implements NAVSEA policy for consideration of three levels of maintenance (organizational, intermediate, and depot). To determine the corrective repair portion of the maintenance concept, assess the effectiveness of a Lead Allowance Parts List (Lead APL) or Baseline Comparison System (BCS) corrective repair maintenance concept. Examine Fleet experience information, including the Maintenance and Material Management (3M) data, of the Lead APL or BCS and evaluate maintenance experience through discussions with Fleet personnel. If no significant Fleet maintenance problems are discovered, the Lead APL equipment or BCS corrective repair maintenance concept shall be adopted for the new system or equipment. If Fleet maintenance problems are discovered that can be rectified by a design that optimizes supportability and maintainability, adopt the Lead APL equipment or BCS corrective repair maintenance concept and propose that the new system or equipment adopt design features that enhance supportability.

30.3 Item level analysis. As system design matures, the LORA shall be performed on each LORA candidate. In most cases, the design of the new system or equipment will have progressed to the piece part selection or piece part design stage for each repairable item (LORA candidate). The information and data for each item will include Logistic Support Analysis (LSA), reliability, and maintainability data. The LORA candidates shall consist of all repairable items and all items requiring an SM&R code.

30.3.1 Pre-empting factors. As system design progresses to the item level, determine if there are pre-empting factors that dictate the maintenance level at which an LORA candidate should be repaired. If pre-empting factors apply, recommend assignment of the repair code of the SM&R code for the LORA candidate (or delete that maintenance level from further assessment if only certain maintenance levels are pre-empted).

30.3.2 Comparative analysis. If pre-empting factors do not indicate the maintenance level, perform comparative analysis on each LORA candidate, as described in section 30.2.2. The comparative analysis will compare Lead APL equipment or BCS data of the comparable item to the LORA candidate's design and support requirements. Recommend repair code assignments for those LORA candidates that are similar in form, fit, function, internal interface, and use to the Lead APL equipment or BCS items that have experienced no Fleet maintenance problems and have not contributed to readiness degradation.

30.4 Final phase analysis. For LORA candidates that were not coded based on pre-empting factors or comparative analysis, conduct a final phase analysis. The analysis shall consist of the following steps as described herein: item level screen, organizational level (O-level) evaluation, intermediate level (I-level) evaluation, depot level (D-level) evaluation, and cost analysis.

30.4.1 Item level screen. Conduct the item level screen to limit the evaluation to only candidates which warrant comprehensive evaluation. Identify LORA candidates that cost $200 or less and, for those items, determine data elements for: 1) the time to repair the item (Mean Time To Repair) and 2) the cost for repair material as a percent of item cost (Repair Material Cost Rate) for each item. Determine a labor rate for O-level. For each candidate, solve the following equation:

Cost Threshold Screen

$$\text{Cost Threshold Screen} = \frac{\text{Mean Time To Repair} * \text{Labor Rate (O-level)}}{1 - \text{Repair Material Cost Rate}}$$

If the actual procurement cost of the LORA candidate is less than the calculated amount (i.e. cost threshold screen value), the LORA candidate shall be recommended for discard at the organizational level. If the LORA candidate's procurement cost is greater than the calculated amount (i.e. cost threshold screen value), continue the evaluation with the next section.

30.4.2 Organizational level (O-level) evaluation. Determine if all resources needed to repair the LORA candidate are available at the O-level. If the O-level possesses the capability to repair the LORA candidate, recommend that the LORA candidate be coded for O-level repair. If the O-level does not possess all resources required for repair of the LORA candidate, identify all additional resources required for repair at O-level (to accommodate cost analysis).

30.4.3 Intermediate level (I-level) evaluation. If the O-level does not possess the all resources required to repair the LORA candidate, determine if all resources needed to perform the repair are available at the I-level. Identify existing I-level capabilities and resources by using the NAVSEA Intermediate Maintenance Activity (IMA) Manual (S9810-AA-GTP-010/IMA) and confirm these capabilities via the requiring activity, who will coordinate with the NAVSEA IMA office and Type Commander (TYCOM) IMA representatives. If the I-level possesses the capability to repair the LORA candidate, recommend that the LORA candidate be coded for I-level repair. If the I-level does not possess all resources required for repair of the LORA candidate, identify all additional resources required for repair at I-level (to accommodate cost analysis).

30.4.4 Depot level (D-level) evaluation. If I-level does not possess the all resources required to repair the LORA candidate, identify all additional resources required for repair at D-level. The information determined from O, I, and D-level evaluation shall be used to perform cost analysis.

30.4.5 Cost analysis. If the capability for repair does not exist at a Fleet maintenance level (O or I-level), conduct a cost analysis to determine the least cost maintenance alternative for repair of the LORA candidate. The resulting decision of the least cost maintenance alternative for the LORA candidate will also indicate the appropriate maintenance level requiring the additional resource. Analyze costs based on annual repair costs and the incremental (i.e. added) cost of supplying the resource at each level. Determine values for the data elements and calculate LORA costs using the equations listed below.

30.4.5.1 System variables. Determine system variable data elements required for cost analysis. Once determined, these data elements should remain constant for each LORA candidate undergoing cost analysis. Use Logistics Support Analysis Record (LSAR) data element values when possible (as indicated in the NAVSEA LORA Data Element Table).

30.4.5.2 Discount factor calculation. The discount factor is calculated from the discount rate and life cycle system variable data elements and is used as the factor in amortizing one-time costs of support resources. Amortizing the one-time costs converts costs which are allocated over the life cycle into an annual basis. Calculate the system discount factor value by using the following equation:

Discount Factor

$$\text{Discount Factor} = \frac{\text{Discount Rate} * \left[1 + \text{Discount Rate}\right]^{\text{Life Cycle}}}{\left[1 + \text{Discount Rate}\right]^{\text{Life Cycle}} - 1}$$

30.4.5.3 Item variables. Determine item variable data elements for each LORA candidate. Use LSAR data element values when possible (as indicated in the NAVSEA LORA Data Element Table).

30.4.5.4 Demand calculations. The demand calculations determine the annual repair actions based on system and item data elements. Calculate system annual demand and fleet annual demand for each LORA candidate by using the following equations:

System Annual Demand

$$\text{System Annual Demand} = \frac{8766 * \text{System Operating Factor} * \text{Item Operating Factor} * \text{Item Population}}{\text{Mean Time Between Failure}}$$

Fleet Annual Demand

$$\text{Fleet Annual Demand} = \text{System Annual Demand} * \text{Fielded Systems}$$

30.4.5.5 Spares pipeline expansion. Normal onboard sparing costs are considered sunk costs for LORA cost analysis. Requirements for the spares pipeline expansion due to differential repair turnaround times (RTATs) is addressed by calculating the number of spares required for the given confidence level (95%). For each LORA candidate, calculate the spares pipeline expansion for each maintenance level by using the following equations:

O-level Spares Pipeline Expansion

$$\text{Spares Pipeline Expansion (O-level)} = \left[\frac{\text{RTAT (O-level)} * 24 * \text{Fielded Systems} * \text{System Operating Factor} * \text{Item Operating Factor} * \text{Item Population}}{\text{Mean Time Between Failure}} \right] +$$

$$\left[\alpha * \left(\frac{\text{RTAT (O-level)} * 24 * \text{Fielded Systems} * \text{System Operating Factor} * \text{Item Operating Factor} * \text{Item Population}}{\text{Mean Time Between Failure}} \right)^{0.5} \right] + \beta$$

I-level Spare Pipeline Expansion

$$\text{Spares Pipeline Expansion (I-level)} = \left[\frac{\text{RTAT (I-level)} * 24 * \text{Fielded Systems} * \text{System Operating Factor} * \text{Item Operating Factor} * \text{Item Population}}{\text{Mean Time Between Failure}} \right] +$$

$$\left[\alpha * \left(\frac{\text{RTAT (I-level)} * 24 * \text{Fielded Systems} * \text{System Operating Factor} * \text{Item Operating Factor} * \text{Item Population}}{\text{Mean Time Between Failure}} \right)^{0.5} \right] + \beta$$

D-level Spares Pipeline Expansion

$$\text{Spares Pipeline Expansion (D-level)} = \left[\frac{\text{RTAT (D-level)} * 24 * \text{Fielded Systems} * \text{System Operating Factor} * \text{Item Operating Factor} * \text{Item Population}}{\text{Mean Time Between Failure}} \right] +$$

$$\left[\alpha * \left(\frac{\text{RTAT (D-level)} * 24 * \text{Fielded Systems} * \text{System Operating Factor} * \text{Item Operating Factor} * \text{Item Population}}{\text{Mean Time Between Failure}} \right)^{0.5} \right] + \beta$$

RTAT = Repair Turnaround Time

α = 1.6649

β = 0.6943

30.4.5.6 Base annual repair cost calculations. The base annual repair cost is the calculated value of the LORA candidate repair cost at each maintenance level before consideration of additional support resource costs. For each LORA candidate, calculate the base annual repair costs at each maintenance level by using the following equations:

O-level Base Annual Repair Costs

$$\text{Base Annual Repair Costs (O-level)} = \left(\left(\left[\text{Labor Rate (O-level)} * \text{Mean Time To Repair} \right] + \left[\text{Repair Material Cost Rate} * \text{Item Cost} \right] \right) * \text{Fleet Annual Demand} \right) + \left(\text{Spares Pipeline Expansion (O-level)} * \text{Item Cost} * \text{Discount Factor} \right)$$

I-level Base Annual Repair Costs

$$\text{Base Annual Repair Costs (I-level)} = \left(\left(\left[\text{Labor Rate (I-level)} * \text{Mean Time To Repair} \right] + \left[\text{Repair Material Cost Rate} * \text{Item Cost} \right] + \left[\text{Weight} * \text{Ship/Pack Cost Rate} \right] \right) * \text{Fleet Annual Demand} \right) + \left(\text{Spares Pipeline Expansion (I-level)} * \text{Item Cost} * \text{Discount Factor} \right)$$

D-level Base Annual Repair Costs

$$\text{Base Annual Repair Costs (D-level)} = \left(\left(\left[\text{Labor Rate (D-level)} * \text{Mean Time To Repair} \right] + \left[\text{Repair Material Cost Rate} * \text{Item Cost} \right] + \left[\text{Weight} * \text{Ship/Pack Cost Rate} * 3 \right] \right) * \text{Fleet Annual Demand} \right) + \left(\text{Spares Pipeline Expansion (D-level)} * \text{Item Cost} * \text{Discount Factor} \right)$$

30.4.5.7 Cost of additional support resources. Each additional support resource requirement will be calculated in one of the following four (4) cost modules. Support resource costs, to be allocated to LORA candidates, shall only consist of incremental (additional) resources and the associated costs. The calculation of support resource costs does not consider currently available or existing resources at the appropriate maintenance levels.

30.4.5.7.1 Support and test equipment annual costs. The Support and Test Equipment (S&TE) annual cost is a summation of all S&TE resource costs allocated to the LORA candidate at each maintenance level. For each LORA candidate, calculate the S&TE annual costs for each resource at each maintenance level. All S&TE resource calculations are summed (at each maintenance level) to determine the allocated costs for the LORA candidate. Calculate S&TE annual costs by using the following equations:

O-level S&TE Annual Costs

$$\text{S\&TE Annual Costs (O-level)} = \left(\left[\text{Discount Factor} * \text{S\&TE Development Cost} \right] + \left[\text{Discount Factor} * \text{S\&TE Procurement Cost} * \text{No. of Operating Locations} \right] + \left[\text{Upkeep Cost Rate} * \text{S\&TE Procurement Cost} * \text{No. of Operating Locations} \right] \right) * \text{Shared Use Rate}$$

I-level S&TE Annual Costs

$$\text{S\&TE Annual Costs (I-level)} = \left(\left[\text{Discount Factor} * \text{S\&TE Development Cost} \right] + \left[\text{Discount Factor} * \text{S\&TE Procurement Cost} * \text{No. of IMAs} \right] + \left[\text{Upkeep Cost Rate} * \text{S\&TE Procurement Cost} * \text{No. of IMAs} \right] \right) * \text{Shared Use Rate}$$

D-level S&TE Annual Costs

$$\text{S\&TE Annual Costs (D-level)} = \left(\left[\text{Discount Factor} * \text{S\&TE Development Cost} \right] + \left[\text{Discount Factor} * \text{S\&TE Procurement Cost} * \text{No. of Depots} \right] + \left[\text{Upkeep Cost Rate} * \text{S\&TE Procurement Cost} * \text{No. of Depots} \right] \right) * \text{Shared Use Rate}$$

30.4.5.7.2 Training annual costs. The training annual cost is a summation of all training resource costs allocated to the LORA candidate at each maintenance level. For each LORA candidate, calculate the training annual costs for each resource at each maintenance level. All resource calculations are summed (at each maintenance level) to determine the allocated costs for the LORA candidate. Calculate training annual costs by using the following equations:

O-level Training Annual Costs

$$\text{Training Annual Costs (O-level)} = \Big(\big[\text{Discount Factor} * \text{Training Development Cost} \big] + \big[\text{Discount Factor} * \text{Training Procurement Cost} \big] + \big[\text{Discount Factor} * \text{Training Aids Cost} \big] + \big[\text{No. of Students Per Year} * \text{Cost For Each Student} \big] + \big[\text{No. of Instructors Per Year} * \text{Cost For Each Instructor} \big] \Big) * \text{Shared Use Rate}$$

I-level Training Annual Costs

$$\text{Training AnnualCosts I-level} = \Big(\big[\text{Discount Factor} * \text{Training Development Cost} \big] + \big[\text{Discount Factor} * \text{Training Procurement Cost} \big] + \big[\text{Discount Factor} * \text{Training Aids Cost} \big] + \big[\text{No. of Students Per Year} * \text{Cost For Each Student} \big] + \big[\text{No. of Instructors Per Year} * \text{Cost For Each Instructor} \big] \Big) * \text{Shared Use Rate}$$

D-level Training Annual Costs

$$\text{Training Annual Costs D-level} = \Big(\big[\text{Discount Factor} * \text{Training Development Cost} \big] + \big[\text{Discount Factor} * \text{Training Procurement Cost} \big] + \big[\text{Discount Factor} * \text{Training Aids Cost} \big] + \big[\text{No. of Students Per Year} * \text{Cost For Each Student} \big] + \big[\text{No. of Instructors Per Year} * \text{Cost For Each Instructor} \big] \Big) * \text{Shared Use Rate}$$

30.4.5.7.3 Test program sets (TPS) annual costs. The test program sets (TPS) annual cost is a summation of all TPS resource costs allocated to the LORA candidate at each maintenance level. For each LORA candidate, calculate the TPS annual costs for each resource at each maintenance level. All resource calculations are summed (at each maintenance level) to determine the allocated costs for the LORA candidate. Calculate TPS annual costs by using the following equations:

O-level TPS Annual Costs

$$\text{TPS Annual Costs (O-level)} = [\text{Discount Factor} * \text{TPS Development Cost}] + [\text{Discount Factor} * \text{TPS Duplication Cost} * \text{No. of Operating Locations}] + [\text{Discount Factor} * \text{ID Procurement Cost} * \text{No. of IDs}]$$

I-level TPS Annual Costs

$$\text{TPS Annual Costs (I-level)} = [\text{Discount Factor} * \text{TPS Development Cost}] + [\text{Discount Factor} * \text{TPS Duplication Cost} * \text{No. of IMAs}] + [\text{Discount Factor} * \text{ID Procurement Cost} * \text{No. of IDs}]$$

D-level TPS Annual Costs

$$\text{TPS Annual Costs (D-level)} = [\text{Discount Factor} * \text{TPS Development Cost}] + [\text{Discount Factor} * \text{TPS Duplication Cost} * \text{No. of Depots}] + [\text{Discount Factor} * \text{ID Procurement Cost} * \text{No. of IDs}]$$

30.4.5.7.4 Documentation annual costs. The documentation annual cost is a summation of all documentation resource costs allocated to the item at each maintenance level. For each item, calculate the documentation annual costs for each resource at each maintenance level. All resource calculations are summed (at each maintenance level) to determine the allocated costs for the item. Calculate documentation annual costs by using the following equations:

O-level Documentation Annual Costs

$$\text{Documentation Annual Costs (O-level)} = \left(\left[\text{Discount Factor} * \text{Documentation Development Cost} \right] + \left[\text{Discount Factor} * \text{Change Page Cost Per Page} * \text{No. of Change Pages} * \text{No. of Operating Locations} \right] + \left[\text{Discount Factor} * \text{Manual Costs} * \text{No. of Operating Locations} \right] \right) * \text{Shared Use Rate}$$

I-level Documentation Annual Costs

$$\text{Documentation Annual Costs (I-level)} = \left(\left[\text{Discount Factor} * \text{Documentation Development Cost} \right] + \left[\text{Discount Factor} * \text{Change Page Cost Per Page} * \text{No. of Change Pages} * \text{No. of IMAs} \right] + \left[\text{Discount Factor} * \text{Manual Costs} * \text{No. of IMAs} \right] \right) * \text{Shared Use Rate}$$

D-level Documentation Annual Costs

$$\text{Documentation Annual Costs (D-level)} = \left(\left[\text{Discount Factor} * \text{Documentation Development Cost} \right] + \left[\text{Discount Factor} * \text{Change Page Cost Per Page} * \text{No. of Change Pages} * \text{No. of Depots} \right] + \left[\text{Discount Factor} * \text{Manual Costs} * \text{No. of Depots} \right] \right) * \text{Shared Use Rate}$$

30.4.5.8 Total annual costs. To determine the total annual maintenance cost for each LORA candidate at each maintenance level, sum the base annual repair costs (from 30.4.5.6) and the support resource costs (from 30.4.5.7.1, 30.4.5.7.2, 30.4.5.7.3, and 30.4.5.7.4) by using the following equations:

O-level Total Annual Costs

$$\begin{matrix} \textit{Total} \\ \textit{Annual Costs} \\ \textit{(O-level)} \end{matrix} = \begin{matrix} \textit{Base Annual} \\ \textit{Repair Costs} \\ \textit{(O-level)} \end{matrix} + \begin{matrix} \textit{S\&TE} \\ \textit{Annual Costs} \\ \textit{(O-level)} \end{matrix} + \begin{matrix} \textit{Training} \\ \textit{Annual Costs} \\ \textit{(O-level)} \end{matrix} + \begin{matrix} \textit{TPS} \\ \textit{Annual Costs} \\ \textit{(O-level)} \end{matrix} + \begin{matrix} \textit{Documentation} \\ \textit{Annual Costs} \\ \textit{(O-level)} \end{matrix}$$

I-level Total Annual Costs

$$\begin{matrix} \textit{Total} \\ \textit{Annual Costs} \\ \textit{(I-level)} \end{matrix} = \begin{matrix} \textit{Base Annual} \\ \textit{Repair Costs} \\ \textit{(I-level)} \end{matrix} + \begin{matrix} \textit{S\&TE} \\ \textit{Annual Costs} \\ \textit{(I-level)} \end{matrix} + \begin{matrix} \textit{Training} \\ \textit{Annual Costs} \\ \textit{(I-level)} \end{matrix} + \begin{matrix} \textit{TPS} \\ \textit{Annual Costs} \\ \textit{(I-level)} \end{matrix} + \begin{matrix} \textit{Documentation} \\ \textit{Annual Costs} \\ \textit{(I-level)} \end{matrix}$$

D-level Total Annual Costs

$$\begin{matrix} \textit{Total} \\ \textit{Annual Costs} \\ \textit{(D-level)} \end{matrix} = \begin{matrix} \textit{Base Annual} \\ \textit{Repair Costs} \\ \textit{(D-level)} \end{matrix} + \begin{matrix} \textit{S\&TE} \\ \textit{Annual Costs} \\ \textit{(D-level)} \end{matrix} + \begin{matrix} \textit{Training} \\ \textit{Annual Costs} \\ \textit{(D-level)} \end{matrix} + \begin{matrix} \textit{TPS} \\ \textit{Annual Costs} \\ \textit{(D-level)} \end{matrix} + \begin{matrix} \textit{Documentation} \\ \textit{Annual Costs} \\ \textit{(D-level)} \end{matrix}$$

30.4.5.9 Discard threshold analysis. Following summation of total annual costs for each LORA candidate at each maintenance level, select the least cost alternative and use this value to compare unit repair cost and the item discard threshold value. When the unit repair cost exceeds the item discard threshold value for the least cost alternative, the LORA candidate shall be recommended as discard vice repair. Calculate the unit repair cost for the appropriate least cost maintenance alternative by using one of the following equations:

O-level Unit Repair Cost

$$\text{Unit Repair Cost (O-level)} = \frac{\text{Total Annual Cost (O-level)}}{\text{Fleet Annual Demand}}$$

I-level Unit Repair Cost

$$\text{Unit Repair Cost (I-level)} = \frac{\text{Total Annual Cost (I-level)}}{\text{Fleet Annual Demand}}$$

D-level Unit Repair Cost

$$\text{Unit Repair Cost (D-level)} = \frac{\text{Total Annual Cost (D-level)}}{\text{Fleet Annual Demand}}$$

The discard threshold value is calculated as a percentage of the item cost at 100, 100, and 75% (1.00, 1.00, and 0.75) for O, I, and D-level, respectively. The discard threshold value is compared to the unit repair cost for the least cost alternative. If the unit repair cost exceeds the calculated discard threshold value for the LORA candidate, the LORA candidate shall be recommended for discard. If the unit repair cost does not exceed the discard threshold value, then the LORA candidate shall be recommended for repair at the least cost alternative. Calculate, for each LORA candidate, the discard threshold value for the appropriate least cost maintenance alternative by using one of the following equations:

O-level Discard Threshold Value

$$\begin{matrix}\textit{Discard} \\ \textit{Threshold} \\ \textit{(O-level)}\end{matrix} = \begin{matrix}\textit{Item} \\ \textit{Cost}\end{matrix} * 1.00$$

I-level Discard Threshold Value

$$\begin{matrix}\textit{Discard} \\ \textit{Threshold} \\ \textit{(I-level)}\end{matrix} = \begin{matrix}\textit{Item} \\ \textit{Cost}\end{matrix} * 1.00$$

D-level Discard Threshold Value

$$\begin{matrix}\textit{Discard} \\ \textit{Threshold} \\ \textit{(D-level)}\end{matrix} = \begin{matrix}\textit{Item} \\ \textit{Cost}\end{matrix} * 0.75$$

30.4.5.10 Analysis reporting. Prepare a report documenting the results of the LORA. The report shall include identification of all LORA candidates assessed, the results of the LORA, and the recommended repair code of the SM&R code. LORA results shall include: (a) identification and justification of pre-empting factors that affect the repair code recommendation; (b) identification of LORA candidates that were coded as a result of comparative analysis based on the Lead APL equipment or BCS; (c) description of organizational, intermediate, and depot level maintenance capabilities that were compared to resources required to accomplish repair and the identification of additional resources required; and (d) cost analysis results. The cost analysis results shall identify values used for system variables, item variables, and support resource variables data elements; and calculated values of each equation for each LORA candidate undergoing costs analysis (i.e. cost threshold screen, discount factor, system annual demand, fleet annual demand, spares pipeline expansion, base annual repair costs, S&TE annual costs, training annual costs, TPS annual costs, documentation annual costs, and total annual costs) by maintenance alternative. The cost analysis results shall also identify the unit repair cost for the least cost alternative, the discard threshold value, and the repair or discard decision for each LORA candidate.

TABLE G-I. Data element.

INPUT DATA ELEMENT NAME	FIELD DESCRIPTOR	UNITS	APPENDIX P		LSAR Y/N	RECOMMENDED DATA SOURCE
			NAME	CONV FACTOR		
System Nomenclature	10 X L –	None	End Item Acronym Code	None	Y	
Hardware Breakdown Number (LCN)	18 X L –	None	LCN	None	Y	
Fielded Systems	6 N R –	Number	Total Systems Supported	None	Y	
Number of Operating Locations	4 N R –	Number	Number of Operating Locations	None	Y	
Operating Factor	3 N R 2	Decimal	Annual Operating Requirements (AOR)	AOR(hrs)/8766	Y	
Discount Rate	3 N R 2	Decimal	Discount Rate	None	Y	Government
Shipping & Packaging Cost Rate	7 N R 2	Dollars per Pound	1. Transportation Cost 2. Packaging Cost	Transportation Cost + Packaging Cost ($/lb)	N	
Number of IMAs	2 N R –	Number	Number of Shops	I-Level Locations	Y	
Number of Depots	2 N R –	Number	Number of Shops	D-Level Locations	Y	
Life Cycle	2 N R –	Years	Operation Life	None	Y	Government
Labor Rate (O-Level)	4 N R 2	Dollars per Hour	Labor Rate	O-Level	Y	
Labor Rate (I-Level)	4 N R 2	Dollars per Hour	Labor Rate	I-Level	Y	
Labor Rate (D-Level)	4 N R 2	Dollars per Hour	Labor Rate	D-Level	Y	
Item Nomenclature	19 X L –	None	Item Name	None	Y	

TABLE G-I. Data element - continued.

INPUT DATA ELEMENT NAME	FIELD DESCRIPTOR	UNITS	APPENDIX P		LSAR Y/N	RECOMMENDED DATA SOURCE
			NAME	CONV FACTOR		
Item Cost	10 N R –	Dollars	Unit Price	None	N	
MTTR	5 N R 2	Hours	MTTR	None	Y	
Repair Material Cost Rate	3 N R 2	Decimal	Repair Material Rate	None	N	
Item Operating Factor	3 N R 2	Decimal	Conversion Factor	Item hrs./System hrs.	Y	
Population in System	5 N R –	Number	Quantity Per End Item	None	Y	
MTBF	10 D – –	Hours	MTBF	Hrs.	Y	
Weight	5 N R 1	Pounds	Unit Weight	None	Y	
Repair Turnaround Time (O-Level)	3 N R –	Days	Repair Cycle Time	O-Level	Y	
Repair Turnaround Time (I-Level)	3 N R –	Days	Repair Cycle Time	I-Level	Y	
Repair Turnaround Time (D-Level)	3 N R –	Days	Repair Cycle Time	D-Level	Y	
Development Cost (S&TE)	10 N R –	Dollars	Support Equipment	No TPS Costs	N	
Procurement Cost (S&TE)	10 N R –	Dollars	Unit Price	S&TE (No TPS Costs)	N	
Upkeep Cost Rate (S&TE)	3 N R 2	Decimal	Support of Support Equipment Cost Factor	2nd Subfield (No TPS Costs)	Y	
Shared Use Rate (S&TE)	3 N R 2	Decimal	Support Equip. Util. Rate	None	N	

TABLE G-I. Data element. - continued

INPUT DATA ELEMENT NAME	FIELD DESCRIPTOR	UNITS	APPENDIX P		LSAR Y/N	RECOMMENDED DATA SOURCE
			NAME	CONV FACTOR		
Development Cost (Training)	10 N R –	Dollars	Training Pkg. Dev. Cost	None	N	
Procurement Cost for all Sites (Training)	10 N R –	Dollars	Training Activation Cost	None	N	
No. of Students Per Year	6 N R –	Number	Number Trained	None	N	
Cost for Each Student	7 N R –	Dollars	Training Cost	Annual Cost	Y	
Training Aids Cost for all Sites	8 N R –	Dollars	Training Aids Cost	None	N	
No. of Instructors Per Year	4 N R –	Number	Number of Instructors	None	N	
Cost for Each Instructor	6 N R 2	Dollars	Instructor Cost	None	N	
Shared Use Rate (Training)	3 N R 2	Decimal	Training Use Rate	None	N	
Development Cost (TPS)	10 N R –	Dollars	Support Equip. Dev. Price	TPS Only	N	
Duplication Cost (TPS)	10 N R –	Dollars	Unit Price	None	N	
ID Procurement Cost per Set	10 N R –	Dollars	Unit Price	None	N	

** Not appropriate at this time.

TABLE G-I. Data element - continued.

INPUT DATA ELEMENT NAME	FIELD DESCRIPTOR	UNITS	APPENDIX P NAME	APPENDIX P CONV FACTOR	LSAR Y/N	RECOMMENDED DATA SOURCE
No. of ID Applications	7 N R –	Number	Number of Support Equipment	TPS IDs	N	
Development Cost (Documentation)	10 N R –	Dollars	Documentation Development Cost	None	N	
Change Page Cost per Page	7 N R –	Dollars/ Page	Documentation Reproduction Cost	None	N	
No. of Change Pages	6 N R –	Number	Documentation Change Pages	None	N	
Manual Costs	10 N R –	Dollars	Unit Price	Documentation	N	
Shared Use Rate (Documentation)	3 N R 2	Decimal	Documentation Use Rate	None	N	

LEVEL OF REPAIR ANALYTICAL TECHNIQUES FOR MARINE CORPS EQUIPMENT

30. SCOPE

30.1 Purpose. This task provides the mathematical equations for performing level of repair (LOR) analyses on electronic, electrical, mechanical, and ordnance equipment under Marine Corps cognizance. Selected applications of these equations permits computation of logistic support costs at designated indenture levels of the equipment being analyzed.

30.2 General. Military maintenance functions are normally performed at three levels: organizational, intermediate, and depot. For Marine Corps operations however, a five-echelon hierarchy usually exists within these three maintenance levels as follows:

Organizational Maintenance	- 1st and 2nd Echelons
Intermediate Maintenance	- 3rd and 4th Echelons
Depot Maintenance	- 5th Echelon

30.2.1 LOR composition. Within this hierarchy, the LOR analytical techniques determine the lowest life cycle cost alternative to maintaining a failed hardware item, i.e., should it be discarded (washed out) or repaired, and at what maintenance level should the work be performed. Life cycle maintenance costs are produced for three designated equipment indentures. In decreasing order of complexity these indentures are unit, assembly, and lowest replacement item (LRI). Within each indenture level the LOR analysis technique allocates costs to 6 major categories covering a total of 12 cost elements:

Cost Category	Cost Element
Inventory	Item Entry and Retention Cost
	Inventory Cost
	Repair Material Cost
	Packaging and Transportation Cost
Support	Support Equipment Cost
	Support of Support Equipment Cost
Space	Inventory Storage Space Cost
	Support Equipment Space Cost
	Repair Work Space Cost
Labor	Labor Cost
Training	Training Cost
Documentation	Documentation Cost

Summing the costs for each cost element thus provides the total cost of the LOR alternative being analyzed.

30.2.2 Maintenance definitions. Maintenance is divided into two classes: discard and repair. Discard maintenance is a policy where a failed item is discarded (washed out) and replaced with a new item from stock. The discard maintenance policy may be designed for execution at any maintenance level. Repair maintenance is a more comprehensive procedure. It generally consists of maintaining a failed item by isolating and removing a defective lower level component and installing a new one in its place. For example, a failed unit could be repaired by installing a new assembly. A defective LRI could be repaired by isolating and replacing a faulty piece part within the LRI. Repairs are attempted and/or performed initially at a designated maintenance level. For those failures that cannot be corrected there, the discrepant item is generally sent to higher level maintenance echelons for additional trouble-shooting and repair. Under certain conditions a maintenance echelon may be authorized to discard a failed item if it is beyond economical or practical repair.

30.2.3 Required parameters. There are three parameters derived from input data that are used in most element equations, namely, annual number of item failures, item daily demand rate (number of item failures per day), and discount factor.

30.2.3.1 Annual number of item failures. The annual number of item failures represents the expected frequency of repair actions. It is the key initiator of all maintenance events. For purposes of this standard, all item removals are defined as failures, i.e., there are no false removals.

$$\begin{pmatrix}\text{Annual}\\\text{Number}\\\text{of Item}\\\text{Failures}\end{pmatrix} = \frac{\begin{pmatrix}\text{Number of}\\\text{Operating}\\\text{End Items}\end{pmatrix}\begin{pmatrix}\text{Annual Operating}\\\text{Time Per End Item}\\\text{Per Year}\end{pmatrix}}{(\text{MTBF*})}$$

* Mean time between failure (MTBF) can be based on operating hours, mileage, rounds fired, cycles, or whatever term is appropriate to use in describing failure (or repair) frequency.

30.2.3.2 Daily demand rate. The daily demand rate is the average number of item failures occurring daily at the operational sites. For the discard alternative it represents the number of spares consumed each day. For the repair alternative the daily demand rate describes the number of daily maintenance events for a given repairable item.

$$\begin{pmatrix}\text{Daily}\\\text{Demand}\\\text{Rate}\end{pmatrix} = \left[\frac{(\text{Annual Number of Item Failures})}{(\text{365 Days Per Year})}\right]$$

30.2.3.3 Discount factor. The discount factor employs a finite discount rate (other than zero) and a stated period of time to determine the present value of future money. It is used to determine the amount of money that would have to be placed in an interest-bearing account now in order to pay for future costs incurred during the equipment life cycle. It is assumed that these expenditures will occur as equal annual payments made at the beginning of each year of the life cycle.

$$\left(\begin{matrix} Discount* \\ Factor \end{matrix} \right) = \left[\frac{(1.0 + Discount\ Rate)^{\left(\begin{matrix} Number\ of \\ Years\ in \\ Life\ Cycle \end{matrix}\right)} - 1.0}{(Discount\ Rate)(1.0 + Discount\ Rate)^{\left[\left(\begin{matrix} Number\ of \\ Years\ in \\ Life\ Cycle \end{matrix}\right) - 1.0\right]}} \right]$$

* This term breaks down mathematically if the discount rate is zero. If zero discount rate is used, set discount factor equal to the life cycle.

30.3 <u>Cost category and cost element equations</u>. The following paragraphs provide descriptions and mathematical equations for the cost categories and/or cost elements which form the basis for the LOR analysis technique. Separate equations are given for the discard and repair maintenance alternatives. In addition, two forms of repair alternative equations are shown. The first form addresses equipment repair where a single level maintenance policy exists, e.g., organizational level repair of a failed item and organizational level discard of the item if it cannot be fixed. The second repair alternative, multiple level repair, treats situations where more than one maintenance level is involved, e.g., organizational level repair followed by depot repair of those items which are beyond the maintenance capability of the organizational level. If the item subsequently cannot be repaired at the depot, it is washed out.

30.3.1 <u>Inventory costs</u>. Inventory costs are the sum of the expenses associated with inventory administration, i.e., item entry and retention in the supply system, inventory stock, repair material, packaging for shipment, and transportation.

30.3.1.1 <u>Item entry and retention cost</u>. This cost is the sum of two cost segments: item entry and cost and item retention cost. Item entry cost is a one-time cost incurred in establishing a new item and assigning it a national stock number (NSN) in the supply system. Item retention cost is the annual administrative expense of keeping the item in the supply system.

30.3.1.1.1 <u>Item entry and retention cost equation</u>. The item entry and retention cost equations for the discard and repair alternatives are identical. However, the number of new NSN required in the supply system may vary depending on the maintenance alternative. Generally, if an item is discarded at failure, only the NSN covering that item would be necessary. If the item is capable of being repaired, those parts unique to it and not currently residing in the supply system inventory will require NSN assignments. Multiple use NSNs, i.e., those NSNs used in two or more different items are not considered to be unique NSNs.

$$\left(\begin{matrix} Item\ Entry \\ and \\ Retention \\ Cost \end{matrix} \right) = \left[\left(\begin{matrix} Item \\ Entry \\ Cost \end{matrix} \right) + \left(\begin{matrix} Annual \\ Item \\ Retention \\ Cost \end{matrix} \right) \left(\begin{matrix} Discount \\ Factor \end{matrix} \right) \right] \left(\begin{matrix} Number\ of \\ New\ NSN \end{matrix} \right)$$

30.3.1.2 Inventory stock cost. This cost element accounts for the cost of spares required for maintenance during the equipment life cycle.

30.3.1.2.1 Inventory stock cost for the discard alternative. For the discard alternative, inventory stock cost consists of the cost of spare items needed to remain self-sufficient for a stated period, and the cost of system stock required during the item's life cycle to replace items discarded at failure. The item spares quantity is the number of spares required to meet an input target probability against stock-out (PASO) for the specified Required Days of Stock (RDS) using the Poisson probability distribution. This is, enough items are spared so that the probability of exhausting the available stock during the RDS is lower than a particular threshold given as 1-PASO.

30.3.1.2.2 Inventory stock cost equation for the discard alternative.

$$\begin{pmatrix}\text{Inventory}\\ \text{Stock}\\ \text{Cost}\end{pmatrix} = \begin{pmatrix}\text{Item Spares}\\ \text{Quantity at a}^{th}\\ \text{Maintenance}\\ \text{Level}\end{pmatrix}\begin{pmatrix}\text{Cost}\\ \text{per}\\ \text{Item}\end{pmatrix} + \begin{pmatrix}\text{Annual System}\\ \text{Stock Quantity at}\\ \text{a}^{th}\text{ Maintenance}\\ \text{Level}\end{pmatrix}\begin{pmatrix}\text{Cost}\\ \text{per}\\ \text{Item}\end{pmatrix}\begin{pmatrix}\text{Discount}\\ \text{Factor}\end{pmatrix}$$

where

$$\begin{pmatrix}\text{Item Spares}\\ \text{Quantity at a}^{th}\\ \text{Maintenance}\\ \text{Level}\end{pmatrix} = N,\ \text{where } N \text{ is smallest integer such that}$$

$$\begin{pmatrix}\text{Probability}\\ \text{Against}\\ \text{Stock-Out}\\ \text{with } N\\ \text{Spares}\end{pmatrix} = \sum_{i=0}^{N} \frac{\lambda^{i}}{i!} e^{-\lambda} \geq \begin{pmatrix}\text{Target}\\ \text{Probability}\\ \text{Against}\\ \text{Stock-Out}\end{pmatrix}$$

where

$$\lambda = \begin{pmatrix}\text{Daily}\\ \text{Demand}\\ \text{Rate}\end{pmatrix}\begin{pmatrix}\text{Required Days of Stock}\\ \text{at a}^{th}\text{ Maintenance Level}\end{pmatrix}$$

and

$$\begin{pmatrix}\text{Annual}\\ \text{SystemStock}\\ \text{at a}^{th}\\ \text{Maintenance}\\ \text{Level}\end{pmatrix} = \begin{pmatrix}\text{Daily}\\ \text{Demand}\\ \text{Rate}\end{pmatrix}\begin{pmatrix}\text{365 Days}\\ \text{Per Year}\end{pmatrix}$$

30.3.1.2.3 Inventory stock cost for the repair alternative. For the repair alternative the inventory stock cost is composed of the cost of the maintenance float (rotatable pool), spares, and system stock. The maintenance float and spares quantities are located at a particular maintenance level. In order to achieve a specified level of confidence against having an item stock-out, a confidence quantity will be maintained at this particular level. This confidence quantity will be the number of spares required to meet an input target probability against stock-out using the Poisson distribution. It will be sufficient to cover both the maintenance float and item spares quantities.

30.3.1.2.3.1 Maintenance float. The maintenance float is a rotating inventory of items stocked at a maintenance echelon to provide on-site replacements of failed items. The maintenance float quantity is a function of the percentage of failed items which can be repaired at the maintenance echelon and the repair cycle time (RCT) required to effect maintenance. When a failed item cannot be repaired immediately, a replacement item is taken from the maintenance float and used to return the discrepant equipment to service. When the failed item is repaired, it joins the float. When an item is subject to multiple level repair a maintenance float at successively higher maintenance echelons may be required if maintenance pipeline delays are excessive. These delays occur when the RCT at the next higher maintenance echelon exceeds the RDS at the lower maintenance echelon.

30.3.1.2.3.2 Spares quantity. The spares quantity is an inventory used to replace failed items which cannot be repaired on-site. These items are either sent to a higher maintenance echelon for repair, i.e., beyond capability of maintenance (BCM), or discarded. BCM items occur when: (a) the site is not authorized to repair the item, (b) the site is restricted to a discrete but not complete set of repair actions and must send the item to a higher maintenance echelon for additional repairs, and/or (c) the site is not authorized to discard the failed item and must send it to another maintenance echelon for final disposition or condemnation. Items are discarded when they are not economically repairable and the site is authorized to condemn and dispose of them. This action is usually performed at the highest maintenance level where complete repair of the item is authorized. BCM and discard items both affect spares quantity because they are local inventory losses which must be recovered in order for the site to remain self-sufficient for the specified period.

30.3.1.2.3.3 System stock is the quantity of items procured during the life cycle to replace BCM (wash out) losses.

30.3.1.2.4 Inventory stock cost equation for single level repair alternative.

$$\left(\begin{array}{c}\text{Inventory}\\ \text{Stock}\\ \text{Cost}\end{array}\right) = \left(\begin{array}{c}\text{Confidence}\\ \text{Quantity}\\ \text{at a}^{th}\\ \text{Maintenance}\\ \text{Level}\end{array}\right)\left(\begin{array}{c}\text{Cost}\\ \text{Per}\\ \text{Item}\end{array}\right) + \left(\begin{array}{c}\text{Annual System}\\ \text{Stock Quantity}\\ \text{at a}^{th}\\ \text{Maintenance}\\ \text{Level}\end{array}\right)\left(\begin{array}{c}\text{Cost}\\ \text{Per}\\ \text{Item}\end{array}\right)\left(\begin{array}{c}\text{Discount}\\ \text{Factor}\end{array}\right)$$

where

$$\left(\begin{array}{c}\text{Confidence}\\ \text{Quantity}\\ \text{at a}^{th}\\ \text{Maintenance}\\ \text{Level}\end{array}\right) = N, \text{ where } N \text{ is smallest integer such that}$$

$$\left(\begin{array}{c}\text{Probability}\\ \text{Against}\\ \text{Stock-Out}\\ \text{with } N\\ \text{Spares}\end{array}\right) = \sum_{i=0}^{N} \frac{\lambda^i}{i!} e^{-\lambda} \geq \left(\begin{array}{c}\text{Target}\\ \text{Probability}\\ \text{Against}\\ \text{Stock-Out}\end{array}\right)$$

$$\text{where } \lambda = \begin{pmatrix}\text{Item}\\ \text{Daily}\\ \text{Demand}\\ \text{Rate}\end{pmatrix}\left[1.0 - \begin{pmatrix}\text{Item BCM}\\ \text{Rate at a}^{th}\\ \text{Maintenance}\\ \text{Level}\end{pmatrix}\right]\begin{pmatrix}\text{Repair Cycle}\\ \text{Time in Days at}\\ \text{a}^{th}\text{ Maintenance}\\ \text{Level}\end{pmatrix} + \begin{pmatrix}\text{Item}\\ \text{Daily}\\ \text{Demand}\\ \text{Rate}\end{pmatrix}\begin{pmatrix}\text{Item BCM}\\ \text{Rate at a}^{th}\\ \text{Maintenance}\\ \text{Level}\end{pmatrix}\begin{pmatrix}\text{Required Days}\\ \text{of Stock at a}^{th}\\ \text{Maintenance}\\ \text{Level}\end{pmatrix}$$

$$\begin{pmatrix}\text{Annual}\\ \text{System Stock}\\ \text{Quantity at a}^{th}\\ \text{Maintenance}\\ \text{Level}\end{pmatrix} = \begin{pmatrix}\text{Item}\\ \text{Daily}\\ \text{Demand}\\ \text{Rate}\end{pmatrix}\begin{pmatrix}\text{Item BCM}\\ \text{Rate at a}^{th}\\ \text{Maintenance}\\ \text{Level}\end{pmatrix}\begin{pmatrix}\text{365 Days}\\ \text{Per Year}\end{pmatrix}$$

and, a = an index denoting the first maintenance level in the alternative being evaluated.

30.3.1.2.5 Inventory stock cost equation for the multiple level repair alternative.

$$\begin{pmatrix}\text{Inventory}\\ \text{Stock}\\ \text{Cost}\end{pmatrix} = \left[\begin{pmatrix}\text{Confidence}\\ \text{Quantity at}\\ \text{a}^{th}\text{ Maintenance}\\ \text{Level}\end{pmatrix} + \begin{pmatrix}\text{Confidence}\\ \text{Quantity at}\\ \text{b}^{th}\text{ Maintenance}\\ \text{Level}\end{pmatrix} + \ldots + \begin{pmatrix}\text{Confidence}\\ \text{Quantity at}\\ \text{n}^{th}\text{ Maintenance}\\ \text{Level}\end{pmatrix}\right]\begin{pmatrix}\text{Cost}\\ \text{Per}\\ \text{Item}\end{pmatrix} + \begin{pmatrix}\text{Annual System}\\ \text{Stock Quantity at}\\ \text{n}^{th}\text{ Maintenance}\\ \text{Level}\end{pmatrix}\begin{pmatrix}\text{Cost}\\ \text{Per}\\ \text{Item}\end{pmatrix}\begin{pmatrix}\text{Discount}\\ \text{Factor}\end{pmatrix}$$

where

$$\begin{pmatrix}\text{Confidence}\\ \text{Quantity at}\\ \text{a}^{th}\text{ Maintenance}\\ \text{Level}\end{pmatrix} = N, \text{ where } N \text{ is smallest integer such that}$$

$$\begin{pmatrix}\text{Probability}\\ \text{Against}\\ \text{Stock-Out}\\ \text{with N}\\ \text{Spares}\end{pmatrix} = \sum_{i=0}^{N} \frac{\lambda^i}{i!} e^{-\lambda} \geq \begin{pmatrix}\text{Target}\\ \text{Probability}\\ \text{Against}\\ \text{Stock-Out}\end{pmatrix}$$

$$\text{where } \lambda_3 = \begin{pmatrix}\text{Item}\\ \text{Daily}\\ \text{Demand}\\ \text{Rate}\end{pmatrix}\left[1.0 - \begin{pmatrix}\text{Item BCM}\\ \text{Rate at a}^{th}\\ \text{Maintenance}\\ \text{Level}\end{pmatrix}\right]\begin{pmatrix}\text{Repair Cycle}\\ \text{Time in Days at}\\ \text{a}^{th}\text{ Maintenance}\\ \text{Level}\end{pmatrix} + \begin{pmatrix}\text{Item}\\ \text{Daily}\\ \text{Demand}\\ \text{Rate}\end{pmatrix}\begin{pmatrix}\text{Item BCM}\\ \text{Rate at a}^{th}\\ \text{Maintenance}\\ \text{Level}\end{pmatrix}\begin{pmatrix}\text{Required Days}\\ \text{of Stock at a}^{th}\\ \text{Maintenance}\\ \text{Level}\end{pmatrix}$$

$$\begin{pmatrix}\text{Confidence}\\ \text{Quantity at}\\ \text{b}^{th}\text{ Maintenance}\\ \text{Level}\end{pmatrix} = N_b, \text{ where } N_b \text{ is smallest integer such that}$$

$$\begin{pmatrix}\text{Probability}\\ \text{Against}\\ \text{Stock-Out}\\ \text{with}N_b\\ \text{Spares}\end{pmatrix} = \sum_{i=0}^{N} \frac{\lambda^i}{i!} e^{-\lambda} \geq \begin{pmatrix}\text{Target}\\ \text{Probability}\\ \text{Against}\\ \text{Stock-Out}\end{pmatrix}$$

$$\text{where}\ \lambda_3 = \begin{pmatrix}\text{Item}\\ \text{Daily}\\ \text{Demand}\\ \text{Rate}\end{pmatrix}\begin{pmatrix}\text{Item BCM}\\ \text{Rate at a}^{th}\\ \text{Maintenance}\\ \text{Level}\end{pmatrix}\left[1.0 - \begin{pmatrix}\text{Item BCM}\\ \text{Rate at b}^{th}\\ \text{Maintenance}\\ \text{Level}\end{pmatrix}\right]\left[\begin{pmatrix}\text{Repair Cycle}\\ \text{Time in Days at}\\ \text{b}^{th}\ \text{Maintenance}\\ \text{Level}\end{pmatrix} - \begin{pmatrix}\text{Required Days}\\ \text{of Stock at a}^{th}\\ \text{Maintenance}\\ \text{Level}\end{pmatrix}\right]$$

$$+ \begin{pmatrix}\text{Item}\\ \text{Daily}\\ \text{Demand}\\ \text{Rate}\end{pmatrix}\begin{pmatrix}\text{Item BCM}\\ \text{Rate at a}^{th}\\ \text{Maintenance}\\ \text{Level}\end{pmatrix}\begin{pmatrix}\text{Item BCM}\\ \text{Rate at b}^{th}\\ \text{Maintenance}\\ \text{Level}\end{pmatrix}\begin{pmatrix}\text{Required Days}\\ \text{of Stock at}\\ \text{b}^{th}\ \text{Maintenance}\\ \text{Level}\end{pmatrix}$$

$$\begin{pmatrix}\text{Confidence}\\ \text{Quantity at}\\ \text{n}^{th}\ \text{Maintenance}\\ \text{Level}\end{pmatrix} = N_b,\ \text{where}\ N_b\ \text{is smallest integer such that}$$

$$\begin{pmatrix}\text{Probability}\\ \text{Against}\\ \text{Stock-Out}\\ \text{with}N_b\\ \text{Spares}\end{pmatrix} = \sum_{i=0}^{N} \frac{\lambda^i}{i!} e^{-\lambda} \geq \begin{pmatrix}\text{Target}\\ \text{Probability}\\ \text{Against}\\ \text{Stock-Out}\end{pmatrix}$$

$$\text{where}\ \lambda = \begin{pmatrix}\text{Item}\\ \text{Daily}\\ \text{Demand}\\ \text{Rate}\end{pmatrix}\begin{pmatrix}\text{ItemBCM}\\ \text{Rateata}^{th}\\ \text{Maintenance}\\ \text{Level}\end{pmatrix}\begin{pmatrix}\text{ItemBCM}\\ \text{Rateatb}^{th}\\ \text{Maintenance}\\ \text{Level}\end{pmatrix}\cdots\begin{pmatrix}\text{ItemBCM}\\ \text{Rateat}(n-1)^{th}\\ \text{Maintenance}\\ \text{Level}\end{pmatrix}\left[1.0 - \begin{pmatrix}\text{ItemBCM}\\ \text{Rateatn}^{th}\\ \text{Maintenance}\\ \text{Level}\end{pmatrix}\right]$$

$$\left[\begin{pmatrix}\text{Repair Cycle}\\ \text{TimeinDays at}\\ \text{b}^{th}\text{Maintenance}\\ \text{Level}\end{pmatrix} - \begin{pmatrix}\text{Required Days}\\ \text{of Stock at a}^{th}\\ \text{Maintenance}\\ \text{Level}\end{pmatrix}\right] + \begin{pmatrix}\text{Item}\\ \text{Daily}\\ \text{Demand}\\ \text{Rate}\end{pmatrix}\begin{pmatrix}\text{Item BCM}\\ \text{Rateata}^{th}\\ \text{Maintenance}\\ \text{Level}\end{pmatrix}\begin{pmatrix}\text{Item BCM}\\ \text{Rateatb}^{th}\\ \text{Maintenance}\\ \text{Level}\end{pmatrix}\cdots\begin{pmatrix}\text{ItemBCM}\\ \text{Rateatn}^{th}\\ \text{Maintenance}\\ \text{Level}\end{pmatrix}$$

and

$$\begin{pmatrix}\text{Annual}\\ \text{System Stock}\\ \text{Quantityat n}^{th}\\ \text{Maintenance}\\ \text{Level}\end{pmatrix} = \begin{pmatrix}\text{Item}\\ \text{Daily}\\ \text{Demand}\\ \text{Rate}\end{pmatrix}\begin{pmatrix}\text{ItemBCM}\\ \text{Rateat a}^{th}\\ \text{Maintenance}\\ \text{Level}\end{pmatrix}\begin{pmatrix}\text{ItemBCM}\\ \text{Rateat b}^{th}\\ \text{Maintenance}\\ \text{Level}\end{pmatrix}\cdots\begin{pmatrix}\text{ItemBCM}\\ \text{Rateat n}^{th}\\ \text{Maintenance}\\ \text{Level}\end{pmatrix}\begin{pmatrix}\text{365 Days}\\ \text{Per Year}\end{pmatrix}$$

and

b = an index denoting the second maintenance level.
n = an index denoting the highest maintenance level.
n-1 = an index denoting the maintenance level immediately preceding the highest maintenance level.

Notes: 1. For the purpose of this standard, integerization quantity criteria for Annual System Stock, i.e., rounding to the next higher integer, are not applicable.
2. Negative quantities are not allowed. If term is less than zero, use zero.
3. BCM rate at highest maintenance level is a discard (washout) rate.

30.3.1.2.6 Inventory stock cost for the multiple level subitem repair alternative. A slightly different procedure is required for determining inventory stock quantities when a repairable item contains repairable sub-items. For example, a repairable item at the unit level of complexity may contain subitems, i.e., assemblies, which are also repairable. Further, these subitems may be repaired at the maintenance level where they are removed and replaced or they may require repair at one or more higher level maintenance echelons.

30.3.1.2.6.1 Consider the maintenance sequence of a repairable item containing repairable subitems as diagrammed and described below in figure H-1. Item repair is permitted at the organizational and 4th echelon maintenance levels but subitem repair can be effected only at the 4th echelon.

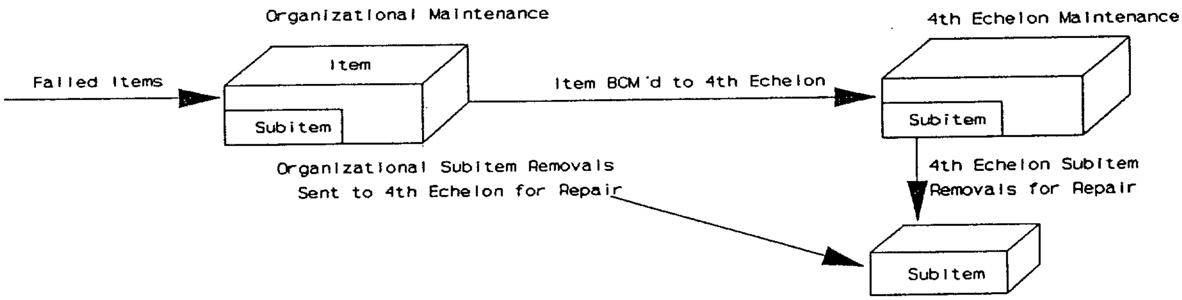


FIGURE H-1. Repairable item maintenance sequence.

Defective subitems removed at the organizational level must be sent to the 4th echelon for repair. Also, same items which are beyond the capability of organizational level maintenance are sent to the 4th echelon for additional repair and they can contain failed subitems which are 4th echelon-repairable. Therefore, the total number of 4th echelon subitem repairs is a function of the number of subitems sent from the organizational level to the 4th echelon for directed repair and the number of subitem failures detected in items repaired at the 4th echelon.

30.3.1.2.6.2 This situation is replicated as more maintenance levels are employed. (Also, this sequence of events can be extended to include sub-items, i.e., LRI's, contained in subitems). When such an indentured structure equipment is subjected to an LOR analysis, the following equations should be used, as necessary, to determine inventory stock cost and maintenance float, spares, and system stock quantities.

30.3.1.2.7 <u>Inventory stock cost equation for the multiple level subitem repair alternative</u>.

where

$$\begin{pmatrix}\text{Subitem}\\\text{Inventory}\\\text{Stock}\\\text{Cost}\end{pmatrix} = \left[\begin{pmatrix}\text{Subitem}\\\text{Confidence}\\\text{Quantity at a}^{th}\\\text{Maintenance}\\\text{Level}\end{pmatrix} + \begin{pmatrix}\text{Subitem}\\\text{Confidence}\\\text{Quantity at b}^{th}\\\text{Maintenance}\\\text{Level}\end{pmatrix} + \ldots + \begin{pmatrix}\text{Subitem}\\\text{Confidence}\\\text{Quantity at n}^{th}\\\text{Maintenance}\\\text{Level}\end{pmatrix}\right]\begin{pmatrix}\text{Cost}\\\text{Per}\\\text{Item}\end{pmatrix} + \begin{pmatrix}\text{Annual Subitem}\\\text{System Stock}\\\text{Quantity at n}^{th}\\\text{Maintenance}\\\text{Level}\end{pmatrix}\begin{pmatrix}\text{Cost}\\\text{Per}\\\text{Item}\end{pmatrix}\begin{pmatrix}\text{Discount}\\\text{Factor}\end{pmatrix}$$

$$\begin{pmatrix}\text{Subitem}\\\text{Confidence}\\\text{Quantity at a}^{th}\\\text{Maintenance}\\\text{Level}\end{pmatrix} = N_a,\ \text{where } N_a \text{ is smallest integer such that}$$

$$\begin{pmatrix}\text{Probability}\\\text{Against}\\\text{Stock-Out}\\\text{with } N_a\\\text{Spares}\end{pmatrix} = \sum_{i=0}^{N} \frac{\lambda^i}{i!} e^{-\lambda} \ge \begin{pmatrix}\text{Target}\\\text{Probability}\\\text{Against}\\\text{Stock-Out}\end{pmatrix}$$

where

$$\lambda_a = \begin{pmatrix}\text{Subitem}\\\text{Failures}\\\text{Detected at a}^{th}\\\text{Maintenance}\\\text{Level}\end{pmatrix}\left[1.0 - \begin{pmatrix}\text{Subitem}\\\text{BCM Rate}\\\text{at a}^{th}\\\text{Maintenance}\\\text{Level}\end{pmatrix}\right]\begin{pmatrix}\text{Repair}\\\text{Time in Days}\\\text{at a}^{th}\\\text{Maintenance}\\\text{Level}\end{pmatrix} + \begin{pmatrix}\text{Item}\\\text{Daily}\\\text{Demand}\\\text{Rate}\end{pmatrix}\left[1.0 - \begin{pmatrix}\text{Item}\\\text{BCM Rate}\\\text{at a}\\\text{Maintenance}\\\text{Level}\end{pmatrix}\right]\left(\frac{\text{Item MTBF}}{\text{Subitem MTBF}}\right)\begin{pmatrix}\text{Subitem}\\\text{BCM Rate}\\\text{at a}^{th}\\\text{Maintenance}\\\text{Level}\end{pmatrix}\begin{pmatrix}\text{Required}\\\text{Days of Stock}\\\text{at a}^{th}\\\text{Maintenance}\\\text{Level}\end{pmatrix}$$

and

$$\begin{pmatrix}\text{Subitem}\\\text{Failures}\\\text{Detected at a}^{th}\\\text{Maintenance}\\\text{Level}\end{pmatrix} = \begin{pmatrix}\text{Item}\\\text{Daily}\\\text{Demand}\\\text{Rate}\end{pmatrix}\left[1.0 - \begin{pmatrix}\text{Item}\\\text{BCM Rate}\\\text{at a}^{th}\\\text{Maintenance}\\\text{Level}\end{pmatrix}\right]\left(\frac{\text{Item MTBF}}{\text{Subitem MTBF}}\right)$$

$$\begin{pmatrix}\text{Subitem}\\\text{Confidence}\\\text{Quantity at b}^{th}\\\text{Maintenance}\\\text{Level}\end{pmatrix} = N_b,\ \text{where } N_b \text{ is smallest integer such that}$$

$$\begin{pmatrix}\text{Probability}\\\text{Against}\\\text{Stock-Out}\\\text{with } N_b\\\text{Spares}\end{pmatrix} = \sum_{i=0}^{N_b} \frac{\lambda^i}{i!} e^{-\lambda} \ge \begin{pmatrix}\text{Target}\\\text{Probability}\\\text{Against}\\\text{Stock-Out}\end{pmatrix}$$

$$\text{where}\ \lambda_b = \left[\begin{pmatrix}\text{Subitem}\\ \text{Failures}\\ \text{Sent From } a^{th} \text{ to}\\ b^{th}\ \text{Maintenance}\\ \text{Level}\end{pmatrix} + \begin{pmatrix}\text{Subitem}\\ \text{Failures}\\ \text{Detected at } b^{th}\\ \text{Maintenance}\\ \text{Level}\end{pmatrix}\right]\left[1.0 - \begin{pmatrix}\text{Subitem}\\ \text{BCM Rate}\\ \text{at } n^{th}\\ \text{Maintenance}\\ \text{Level}\end{pmatrix}\right]\left[\begin{pmatrix}\text{Repair Cycle}\\ \text{Time in Days}\\ \text{at } b^{th}\\ \text{Maintenance}\\ \text{Level}\end{pmatrix} - \begin{pmatrix}\text{Required}\\ \text{Days of Stock}\\ \text{at } a^{th}\\ \text{Maintenance}\\ \text{Level}\end{pmatrix}\right]$$

$$+ \left\{\begin{pmatrix}\text{Item}\\ \text{Daily}\\ \text{Demand}\\ \text{Rate}\end{pmatrix}\left[1.0 - \begin{pmatrix}\text{Item}\\ \text{BCM Rate}\\ \text{at } a^{th}\\ \text{Maintenance}\\ \text{Level}\end{pmatrix}\right]\left(\frac{\text{Item MTBF}}{\text{Subitem MTBF}}\right)\begin{pmatrix}\text{Subitem}\\ \text{BCM Rate}\\ \text{at } a^{th}\\ \text{Maintenance}\\ \text{Level}\end{pmatrix} + \begin{pmatrix}\text{Item}\\ \text{Daily}\\ \text{Demand}\\ \text{Rate}\end{pmatrix}\begin{pmatrix}\text{Item}\\ \text{BCM Rate}\\ \text{at } a^{th}\\ \text{Maintenance}\\ \text{Level}\end{pmatrix}\left[1.0 - \begin{pmatrix}\text{Item}\\ \text{BCM Rate}\\ \text{at } b^{th}\\ \text{Maintenance}\\ \text{Level}\end{pmatrix}\right]\left(\frac{\text{Item MTBF}}{\text{Subitem MTBF}}\right)\right\}$$

$$\begin{pmatrix}\text{Subitem}\\ \text{BCM Rate}\\ \text{at } b^{th}\\ \text{Maintenance}\\ \text{Level}\end{pmatrix}\begin{pmatrix}\text{Required}\\ \text{Days of Stock}\\ \text{at } b^{th}\\ \text{Maintenance}\\ \text{Level}\end{pmatrix}$$

and

$$\begin{pmatrix}\text{Subitem}\\ \text{Failures}\\ \text{Sent From } a^{th} \text{ to}\\ b^{th}\ \text{Maintenance}\\ \text{Level}\end{pmatrix} = \begin{pmatrix}\text{Item}\\ \text{Daily}\\ \text{Demand}\\ \text{Rate}\end{pmatrix}\left[1.0 - \begin{pmatrix}\text{Item}\\ \text{BCM Rate}\\ \text{at } a^{th}\\ \text{Maintenance}\\ \text{Level}\end{pmatrix}\right]\left(\frac{\text{Item MTBF}}{\text{Subitem MTBF}}\right)\begin{pmatrix}\text{Subitem}\\ \text{BCM Rate}\\ \text{at } a^{th}\\ \text{Maintenance}\\ \text{Level}\end{pmatrix}$$

$$\begin{pmatrix}\text{Subitem}\\ \text{Failures}\\ \text{Detected at}\\ b^{th}\ \text{Maintenance}\\ \text{Level}\end{pmatrix} = \begin{pmatrix}\text{Item}\\ \text{Daily}\\ \text{Demand}\\ \text{Rate}\end{pmatrix}\begin{pmatrix}\text{Item}\\ \text{BCM Rate}\\ \text{at } a^{th}\\ \text{Maintenance}\\ \text{Level}\end{pmatrix}\left[1.0 - \begin{pmatrix}\text{Item}\\ \text{BCM Rate}\\ \text{at } b^{th}\\ \text{Maintenance}\\ \text{Level}\end{pmatrix}\right]\left(\frac{\text{Item MTBF}}{\text{Subitem MTBF}}\right)$$

$$\begin{pmatrix}\text{Subitem}\\ \text{Confidence}\\ \text{Quantity at } n^{th}\\ \text{Maintenance}\\ \text{Level}\end{pmatrix} = N_n,\ \text{where } N_n \text{ is smallest integer such that}$$

$$\begin{pmatrix}\text{Probability}\\ \text{Against}\\ \text{Stock-Out}\\ \text{with } N_n\\ \text{Spares}\end{pmatrix} = \sum_{i=0}^{N_n} \frac{\lambda_n^{i}}{i!} e^{-\lambda_n} \geq \begin{pmatrix}\text{Target}\\ \text{Probability}\\ \text{Against}\\ \text{Stock-Out}\end{pmatrix}$$

$$\text{where}\ \lambda_n = \left[\begin{pmatrix}\text{Subitem}\\ \text{Failures Sent}\\ \text{From } (n-1)^{th} \text{ to}\\ n^{th}\ \text{Maintenance}\\ \text{Level}\end{pmatrix} + \begin{pmatrix}\text{Subitem}\\ \text{Failures}\\ \text{Detected at}\\ n^{th}\ \text{Maintenance}\\ \text{Level}\end{pmatrix}\right]\left[1.0 - \begin{pmatrix}\text{Subitem}\\ \text{BCM Rate}\\ \text{at } b^{th}\\ \text{Maintenance}\\ \text{Level}\end{pmatrix}\right]\left[\begin{pmatrix}\text{Repair Cycle}\\ \text{Time in Days}\\ \text{at } n^{th}\\ \text{Maintenance}\\ \text{Level}\end{pmatrix} - \begin{pmatrix}\text{Required}\\ \text{Days of Stock}\\ \text{at } (n-1)^{th}\\ \text{Maintenance}\\ \text{Level}\end{pmatrix}\right]$$

$$+\left[\left\{\left\{\begin{pmatrix}\text{Item}\\\text{Daily}\\\text{Demand}\\\text{Rate}\end{pmatrix}\left[1.0-\begin{pmatrix}\text{Item}\\\text{BCMRate}\\\text{at a}^{th}\\\text{Maintenance}\\\text{Level}\end{pmatrix}\right]\right]\left(\frac{\text{Item MTBF}}{\text{Subitem MTBF}}\right)\begin{pmatrix}\text{Subitem}\\\text{BCMRate}\\\text{at a}^{th}\\\text{Maintenance}\\\text{Level}\end{pmatrix}\right.\right.$$

$$+\begin{pmatrix}\text{Item}\\\text{Daily}\\\text{Demand}\\\text{Rate}\end{pmatrix}\begin{pmatrix}\text{Item}\\\text{BCMRate}\\\text{at a}^{th}\\\text{Maintenance}\\\text{Level}\end{pmatrix}\left[1.0-\begin{pmatrix}\text{Item}\\\text{BCMRate}\\\text{at b}^{th}\\\text{Maintenance}\\\text{Level}\end{pmatrix}\right]\left[\left(\frac{\text{Item MTBF}}{\text{Subitem MTBF}}\right)\right]\right\}\begin{pmatrix}\text{Subitem}\\\text{BCMRate}\\\text{at n}^{th}\\\text{Maintenance}\\\text{Level}\end{pmatrix}+\ldots+\Bigg\}$$

$$+\begin{pmatrix}\text{Item}\\\text{Daily}\\\text{Demand}\\\text{Rate}\end{pmatrix}\begin{pmatrix}\text{Item}\\\text{BCMRate}\\\text{at a}^{th}\\\text{Maintenance}\\\text{Level}\end{pmatrix}\begin{pmatrix}\text{Item}\\\text{BCMRate}\\\text{at b}^{th}\\\text{Maintenance}\\\text{Level}\end{pmatrix}\ldots\begin{pmatrix}\text{Item}\\\text{BCMRate}\\\text{at (n-1)}^{th}\\\text{Maintenance}\\\text{Level}\end{pmatrix}\left[1.0-\begin{pmatrix}\text{Item}\\\text{BCMRate}\\\text{at n}^{th}\\\text{Maintenance}\\\text{Level}\end{pmatrix}\right]\left[\left(\frac{\text{Item MTBF}}{\text{Subitem MTBF}}\right)\right]$$

$$\begin{pmatrix}\text{Subitem}\\\text{BCMRate}\\\text{at n}^{th}\\\text{Maintenance}\\\text{Level}\end{pmatrix}\begin{pmatrix}\text{Required}\\\text{Days of Stock}\\\text{at n}^{th}\\\text{Maintenance}\\\text{Level}\end{pmatrix}$$

$$\begin{pmatrix}\text{Subitem Failures}\\\text{Sent From (n-1)}^{th}\text{ to}\\\text{n}^{th}\text{ Maintenance}\\\text{Level}\end{pmatrix}=\left\{\left[\left[\begin{pmatrix}\text{Item}\\\text{Daily}\\\text{Demand}\\\text{Rate}\end{pmatrix}\left[1.0-\begin{pmatrix}\text{Item BCM}\\\text{Rate at a}^{th}\\\text{Maintenance}\\\text{Level}\end{pmatrix}\right]\right]\left(\frac{\text{Item MTBF}}{\text{Subitem MTBF}}\right)\begin{pmatrix}\text{Subitem}\\\text{BCMRate at}\\\text{a}^{th}\text{ Maintenance}\\\text{Level}\end{pmatrix}\right.\right.$$

$$+\begin{pmatrix}\text{Item}\\\text{Daily}\\\text{Demand}\\\text{Rate}\end{pmatrix}\begin{pmatrix}\text{Item BCM}\\\text{Rate at a}^{th}\\\text{Maintenance}\\\text{Level}\end{pmatrix}\left[1.0-\begin{pmatrix}\text{Item BCM}\\\text{Rate at a}^{th}\\\text{Maintenance}\\\text{Level}\end{pmatrix}\right]\left[\left(\frac{\text{Item MTBF}}{\text{Subitem MTBF}}\right)\right]\Bigg]\Bigg\}\begin{pmatrix}\text{Subitem}\\\text{BCMRate at}\\\text{b}^{th}\text{ Maintenance}\\\text{Level}\end{pmatrix}+\ldots+\Bigg\}$$

$$\begin{pmatrix}\text{Subitem}\\\text{Failures}\\\text{Detected at n}^{th}\\\text{Maintenance}\\\text{Level}\end{pmatrix}=\begin{pmatrix}\text{Item}\\\text{Daily}\\\text{Demand}\\\text{Rate}\end{pmatrix}\begin{pmatrix}\text{Item BCM}\\\text{Rate at a}^{th}\\\text{Maintenance}\\\text{Level}\end{pmatrix}\begin{pmatrix}\text{Item BCM}\\\text{Rate at b}^{th}\\\text{Maintenance}\\\text{Level}\end{pmatrix}\ldots\begin{pmatrix}\text{Item BCM}\\\text{Rate at (n-1)}^{th}\\\text{Maintenance}\\\text{Level}\end{pmatrix}\left[1.0-\begin{pmatrix}\text{Item BCM}\\\text{Rate at n}^{th}\\\text{Maintenance}\\\text{Level}\end{pmatrix}\right]\left(\frac{\text{Item MTBF}}{\text{Subitem MTBF}}\right)$$

$$\begin{pmatrix}\text{Annual Subitem}\\\text{System Stock}\\\text{Quantity at n}^{th}\\\text{Maintenance}\\\text{Level}\end{pmatrix}=\begin{pmatrix}\text{Subitem}\\\text{Daily}\\\text{Demand}\\\text{Rate}\end{pmatrix}\begin{pmatrix}\text{Subitem}\\\text{BCMRate at}\\\text{a}^{th}\text{ Maintenance}\\\text{Level}\end{pmatrix}\begin{pmatrix}\text{Subitem}\\\text{BCMRate at}\\\text{b}^{th}\text{ Maintenance}\\\text{Level}\end{pmatrix}\ldots\begin{pmatrix}\text{Subitem}\\\text{BCMRate at}\\\text{n}^{th}\text{ Maintenance}\\\text{Level}\end{pmatrix}\begin{pmatrix}\text{365 Days}\\\text{Per Year}\end{pmatrix}$$

30.3.1.3 Repair material cost. Repair material cost accounts for the parts and/or supplies required to fix a failed hardware item. A repair material cost factor (the ratio of the average yearly cost of repair material per failure to the item's unit cost) is used to predict costs in this LOR category.

30.3.1.3.1 Repair material cost for the discard alternative. Material cost is zero for the discard alternative because repair parts and/or supplies are not required.

30.3.1.3.2 Repair material cost equation for the single level repair alternative.

$$\begin{pmatrix}\text{Item Repair}\\ \text{Material}\\ \text{Cost}\end{pmatrix} = \begin{pmatrix}\text{Annual}\\ \text{Number of}\\ \text{Item}\\ \text{Failures}\end{pmatrix}\left[1.0 - \begin{pmatrix}\text{Item BCM*}\\ \text{Rate at a}^{th}\\ \text{Maintenance}\\ \text{Level}\end{pmatrix}\right]\begin{pmatrix}\text{Cost}\\ \text{Per}\\ \text{Item}\end{pmatrix}\begin{pmatrix}\text{Item Repair}\\ \text{Material}\\ \text{Cost Factor}\end{pmatrix}\begin{pmatrix}\text{Discount}\\ \text{Factor}\end{pmatrix}$$

30.3.1.3.3 Repair material cost equation for the multiple level repair alternative.

$$\begin{pmatrix}\text{Item Repair}\\ \text{Material Cost}\end{pmatrix} = \left[\begin{pmatrix}\text{Item Repair}\\ \text{Material Cost at}\\ \text{a}^{th}\text{ Maintenance}\\ \text{Level}\end{pmatrix} + \begin{pmatrix}\text{Item Repair}\\ \text{Material Cost at}\\ \text{b}^{th}\text{ Maintenance}\\ \text{Level}\end{pmatrix} + \dots + \begin{pmatrix}\text{Item Repair}\\ \text{Material Cost at}\\ \text{n}^{th}\text{ Maintenance}\\ \text{Level}\end{pmatrix}\right]\begin{pmatrix}\text{Discount}\\ \text{Factor}\end{pmatrix}$$

where

$$\begin{pmatrix}\text{Item Repair}\\ \text{Material Cost at}\\ 1^{th}\text{ Maintenance}\\ \text{Level}\end{pmatrix} = \begin{pmatrix}\text{Annual}\\ \text{Number of}\\ \text{Item}\\ \text{Failures}\end{pmatrix}\left[1.0 - \begin{pmatrix}\text{Item BCM}\\ \text{Rate at a}^{th}\\ \text{Maintenance}\\ \text{Level}\end{pmatrix}\right]\begin{pmatrix}\text{Cost}\\ \text{Per}\\ \text{Item}\end{pmatrix}\begin{pmatrix}\text{Item Repair}\\ \text{Material}\\ \text{Cost Factor}\end{pmatrix}$$

$$\begin{pmatrix}\text{Item Repair}\\ \text{Material Cost at}\\ \text{a}^{th}\text{ Maintenance}\\ \text{Level}\end{pmatrix} = \begin{pmatrix}\text{Annual}\\ \text{Number of}\\ \text{Item}\\ \text{Failures}\end{pmatrix}\begin{pmatrix}\text{Item BCM}\\ \text{Rate at a}^{th}\\ \text{Maintenance}\\ \text{Level}\end{pmatrix}\left[1.0 - \begin{pmatrix}\text{Item BCM}\\ \text{Rate at b}^{th}\\ \text{Maintenance}\\ \text{Level}\end{pmatrix}\right]\begin{pmatrix}\text{Cost}\\ \text{Per}\\ \text{Item}\end{pmatrix}\begin{pmatrix}\text{Item Repair}\\ \text{Material}\\ \text{Cost Factor}\end{pmatrix}$$

$$\begin{pmatrix}\text{Item Repair}\\ \text{Material Cost at}\\ \text{n}^{th}\text{ Maintenance}\\ \text{Level}\end{pmatrix} = \begin{pmatrix}\text{Annual}\\ \text{Number of}\\ \text{Item}\\ \text{Failures}\end{pmatrix}\begin{pmatrix}\text{Item BCM}\\ \text{Rate at a}^{th}\\ \text{Maintenance}\\ \text{Level}\end{pmatrix}\begin{pmatrix}\text{Item BCM}\\ \text{Rate at b}^{th}\\ \text{Maintenance}\\ \text{Level}\end{pmatrix}\dots\left[1.0 - \begin{pmatrix}\text{Item BCM}\\ \text{Rate at n}^{th}\\ \text{Maintenance}\\ \text{Level}\end{pmatrix}\right]\begin{pmatrix}\text{Cost}\\ \text{Per}\\ \text{Item}\end{pmatrix}\begin{pmatrix}\text{Item Repair}\\ \text{Material}\\ \text{Cost Factor}\end{pmatrix}$$

* This is a washout rate when applied to a single level repair alternative.

30.3.1.4 Transportation cost. Costs in this category cover the expenses incurred in packaging and shipping inventory items between the maintenance echelons for the purposes of supply or repair. These costs are functions of the type of commodity item, its size and weight, and the cost of transporting it.

30.3.1.4.1 Transportation cost for the discard alternative. This cost is the one-way cost of shipping a new item from a supply point to the maintenance echelon which requisitioned the item as a replacement for the discarded item.

30.3.1.4.2 Transportation cost equation for the discard alternative.

$$\begin{pmatrix}\text{Transportation}\\\text{Cost}\end{pmatrix}=\begin{pmatrix}\text{Annual}\\\text{Number of}\\\text{Item}\\\text{Failures}\end{pmatrix}\left[\begin{pmatrix}\text{Item}\\\text{Packaging}\\\text{Cost}\end{pmatrix}+\begin{pmatrix}\text{Item}\\\text{Transportation Cost}\\\text{From Supply Point to}\\n^{th}\text{ Maintenance}\\\text{Level}\end{pmatrix}\right]\begin{pmatrix}\text{Discount}\\\text{Factor}\end{pmatrix}$$

30.3.1.4.3 Transportation cost for the single level repair alternative. This cost is the sum of two similar but unique cost factors. The first involves the packaging cost and the round-trip cost of transporting a failed item between the failure site and the maintenance echelon responsible for its repair. In some cases the cost of transporting the item is negligible because the failure site and the maintenance activity are collocated or the proximity of these facilities precludes significant cost accrual. The second factor is the cost of packaging and transporting an item from a supply point to the maintenance echelon. This supply item is a replacement for the one drawn from the echelon's spares stock to replace an item washed out during maintenance. This form of discard occurs when (a) the item is beyond the repair capability of the maintenance echelon, and (b) the echelon is authorized to discard the item when it is beyond economical and/or practical repair.

30.3.1.4.4 Transportation cost equation for the single level repair alternative.

$$\begin{pmatrix}\text{Transporation}\\\text{Cost}\end{pmatrix}=\left[\begin{pmatrix}\text{Annual}\\\text{Number of}\\\text{Item}\\\text{Failures}\end{pmatrix}\left\{\left[\begin{pmatrix}\text{Item}\\\text{Packaging}\\\text{Cost}\end{pmatrix}+\begin{pmatrix}\text{Item Transportation}\\\text{Cost; Failure Site}\\\text{to a }^{th}\text{ Maintenance}\\\text{Level}\end{pmatrix}\right](2)\begin{pmatrix}\text{Collocation}\\\text{Factor}\end{pmatrix}\right\}\right.$$

$$\left.+\begin{pmatrix}\text{Annual}\\\text{Number of}\\\text{Item}\\\text{Failures}\end{pmatrix}\begin{pmatrix}\text{Item BCM}\\\text{Rate at a }^{th}\\\text{Maintenance}\\\text{Level}\end{pmatrix}\left[\begin{pmatrix}\text{Item}\\\text{Packaging}\\\text{Cost}\end{pmatrix}+\begin{pmatrix}\text{Item Transportation}\\\text{Cost, Supply Point}\\\text{to a }^{th}\text{ Maintenance}\\\text{Level}\end{pmatrix}\right]\right]\begin{pmatrix}\text{Discount}\\\text{Factor}\end{pmatrix}$$

and

Collocation Factor = zero when maintenance levels are collocated and 1.0 when maintenance levels are not collocated.

30.3.1.4.5 Transportation cost for the multiple level repair alternative. For this repair alternative the cost includes packaging and transporting the failed item from its point of failure to and from the maintenance echelon initially responsible for its repair. It also includes subsequent costs for transporting items beyond that echelon's maintenance capability to higher level maintenance activities. In those situations where one or more maintenance echelons are collocated, transportation costs may be negligible. A separate transportation cost factor is provided for the case where a replacement for a failed item is obtained from a designated supply point other than a depot.

30.3.1.4.6 Transportation cost equation for the multiple level repair alternative.

$$\begin{pmatrix}\text{Transportation}\\ \text{Cost}\end{pmatrix} = \left[\begin{pmatrix}\text{Annual}\\ \text{Number of}\\ \text{Item}\\ \text{Failures}\end{pmatrix}\left[\begin{pmatrix}\text{Item}\\ \text{Packaging}\\ \text{Cost}\end{pmatrix} + \begin{pmatrix}\text{Item Transportation}\\ \text{Cost, Failure Site}\\ \text{to a}^{\text{th}}\text{ Maintenance}\\ \text{Level}\end{pmatrix}\right](2)\begin{pmatrix}\text{Collocation}\\ \text{Factor}\end{pmatrix}\right.$$

$$+\begin{pmatrix}\text{Annual}\\ \text{Number of}\\ \text{Item}\\ \text{Failures}\end{pmatrix}\begin{pmatrix}\text{Item BCM}\\ \text{Rate at a}^{\text{th}}\\ \text{Maintenance}\\ \text{Level}\end{pmatrix}\left[\begin{pmatrix}\text{Item}\\ \text{Packaging}\\ \text{Cost}\end{pmatrix} + \begin{pmatrix}\text{Item Transportation}\\ \text{Cost, a}^{\text{th}}\text{ Maintenance}\\ \text{Level to b}^{\text{th}}\\ \text{Maintenance Level}\end{pmatrix}\right](2)\begin{pmatrix}\text{Collocation}\\ \text{Factor}\end{pmatrix}$$

$$+\begin{pmatrix}\text{Annual}\\ \text{Number of}\\ \text{Item}\\ \text{Failures}\end{pmatrix}\begin{pmatrix}\text{Item BCM}\\ \text{Rate at a}^{\text{th}}\\ \text{Maintenance}\\ \text{Level}\end{pmatrix}\begin{pmatrix}\text{Item BCM}\\ \text{Rate at b}^{\text{th}}\\ \text{Maintenance}\\ \text{Level}\end{pmatrix}\left[\begin{pmatrix}\text{Item}\\ \text{Packaging}\\ \text{Cost}\end{pmatrix} + \begin{pmatrix}\text{Cost Transportation}\\ \text{Cost, b}^{\text{th}}\text{ Maintenance}\\ \text{Level to n}^{\text{th}}\\ \text{Maintenance Level}\end{pmatrix}\right](2)\begin{pmatrix}\text{Collocation}\\ \text{Factor}\end{pmatrix}$$

$$+\ldots+\begin{pmatrix}\text{Annual}\\ \text{Number of}\\ \text{Item}\\ \text{Failures}\end{pmatrix}\begin{pmatrix}\text{Item BCM}\\ \text{Rate at a}^{\text{th}}\\ \text{Maintenance}\\ \text{Level}\end{pmatrix}\begin{pmatrix}\text{Item BCM}\\ \text{Rate at b}^{\text{th}}\\ \text{Maintenance}\\ \text{Level}\end{pmatrix}\cdots\begin{pmatrix}\text{Item BCM}\\ \text{Rate at n}^{\text{th}}\\ \text{Maintenance}\\ \text{Level}\end{pmatrix}$$

$$\left.\left[\begin{pmatrix}\text{Item}\\ \text{Packaging}\\ \text{Cost}\end{pmatrix} + \begin{pmatrix}\text{Item Transportation}\\ \text{Cost, Supply Point}\\ \text{to n}^{\text{th}}\text{ Maintenance}\\ \text{Level}\end{pmatrix}\right]\begin{pmatrix}\text{Supply}\\ \text{Point}\\ \text{Factor}\end{pmatrix}\right]\begin{pmatrix}\text{Discount}\\ \text{Factor}\end{pmatrix}$$

and

Supply Point Factor = zero when item supply point and depot are the same and one when item supply count is note the depot.

30.3.2 Support cost. This cost category is composed of two cost elements: support equipment cost and support equipment of support cost. The first cost element accounts for the acquisition cost of the support equipment. The second element covers the long-term expenses accrued in supporting and/or maintaining support equipment during the life cycle of the prime equipment.

30.3.2.1 Support equipment cost. Two types of support equipment, peculiar support equipment (PSE) and common support equipment (CSE), are included in an LOR analysis. Both PSE and CSE can be employed for discard and repair actions. For discard, support equipment may be required to confirm a failure or to demilitarize the item.

30.3.2.1.1 PSE and CSE application. PSE is unique to and generally designed for use with a specific equipment or equipment family. CSE is designed for a wide range of applications and usually exists in the normal support equipment inventory. However, a new equipment entering the operational environment may require either CSE not in the inventory at specific maintenance echelons or additional CSE at a repair site because of the increase in maintenance activity generated by the new equipment. For the purpose of this LOR, CSE cost is intended to cover the acquisition of additional CSE for these situations. The development cost of CSE is a sunk cost. However, the development cost of PSE is included in the overall cost of support equipment as a separate cost element.

30.3.2.1.2 PSE and CSE cost allocation. PSE and CSE costs are allocated costs. PSE and CSE cost allocation factors are used in apportioning support equipment costs among only those items which require the support equipment. The allocation technique is based on the ratio of the item's failure rate to the total failure rate of all items in the equipment which share the support equipment. A discount factor is not applied to support equipment cost since it is a one-time purchase, but the cost of supporting support equipment during the life cycle is adjusted with the discount factor.

30.3.2.1.3 Support equipment cost equation for the discard alternative.

$$\begin{pmatrix}\text{Support}\\ \text{Equipment}\\ \text{Cost}\end{pmatrix} = \sum_{i=1}^{n}\left[\begin{pmatrix} i^{th}\,\text{PSE}\\ \text{Development}\\ \text{Cost}\end{pmatrix} + \begin{pmatrix}\text{Number of } i^{th}\\ \text{PSE at a}^{th}\\ \text{Maintenance}\\ \text{Level}\end{pmatrix}\begin{pmatrix} i^{th}\\ \text{PSE}\\ \text{Unit Cost}\end{pmatrix}\right]\begin{pmatrix}\text{PSE Cost}\\ \text{Allocation}\\ \text{Factor}\end{pmatrix}$$

$$+\sum_{i=1}^{n}\begin{pmatrix}\text{Number of } i^{th}\\ \text{Additional}\\ \text{CSE at a}^{th}\\ \text{Maintenance}\\ \text{Level}\end{pmatrix}\begin{pmatrix} i^{th}\,\text{Additional}\\ \text{CSE Unit}\\ \text{Cost}\end{pmatrix}\begin{pmatrix}\text{CSE Cost}\\ \text{Allocation}\\ \text{Factor}\end{pmatrix}$$

30.3.2.1.4 Support equipment cost equation for the single level repair alternative.

$$\begin{pmatrix}\text{Support}\\ \text{Equipment}\\ \text{Cost}\end{pmatrix} = \sum_{i=1}^{n}\left[\begin{pmatrix} i^{th}\,\text{PSE}\\ \text{Development}\\ \text{Cost}\end{pmatrix} + \begin{pmatrix}\text{Number of } i^{th}\\ \text{PSE at a}^{th}\\ \text{Maintenance}\\ \text{Level}\end{pmatrix}\begin{pmatrix} i^{th}\,\text{PSE}\\ \text{Unit Cost}\end{pmatrix}\right]\begin{pmatrix}\text{PSE Cost}\\ \text{Allocation}\\ \text{Factor}\end{pmatrix}$$

$$+\sum_{i=1}^{n}\begin{pmatrix}\text{Number of } i^{th}\\ \text{Additional}\\ \text{CSE at a}^{th}\\ \text{Maintenance}\\ \text{Level}\end{pmatrix}\begin{pmatrix} i^{th}\,\text{Additional}\\ \text{CSE Unit}\\ \text{Cost}\end{pmatrix}\begin{pmatrix}\text{CSE Cost}\\ \text{Allocation}\\ \text{Factor}\end{pmatrix}$$

30.3.2.1.5 Support equipment cost equation for the multiple level repair alternative.

$$\begin{pmatrix}\text{Support}\\\text{Equipment}\\\text{Cost}\end{pmatrix} = \sum_{i=1}^{n}\left[\begin{pmatrix}i^{th}\,\text{PSE}\\\text{Development}\\\text{Cost}\end{pmatrix} + \begin{pmatrix}\text{Number of } i^{th}\\\text{PSE at a}^{th}\\\text{Maintenance}\\\text{Level}\end{pmatrix}\begin{pmatrix}\text{PSE Cost}\\\text{Allocation}\\\text{Factor}\end{pmatrix} + \begin{pmatrix}\text{Number of } i^{th}\\\text{PSE at b}^{th}\\\text{Maintenance}\\\text{Center}\end{pmatrix}\begin{pmatrix}\text{PSE Cost}\\\text{Allocation}\\\text{Factor}\end{pmatrix}\right.$$

$$\left. + \dots + \begin{pmatrix}\text{Number of } i^{th}\\\text{PSE at n}^{th}\\\text{Maintenance}\\\text{Level}\end{pmatrix}\begin{pmatrix}\text{PSE Cost}\\\text{Allocation}\\\text{Factor}\end{pmatrix}\right]\begin{pmatrix}i^{th}\,\text{PSE}\\\text{Unit Cost}\end{pmatrix}$$

$$+ \sum_{i=1}^{n}\left[\begin{pmatrix}\text{Number of } i^{th}\\\text{Additional}\\\text{CSE at a}^{th}\\\text{Maintenance}\\\text{Level}\end{pmatrix}\begin{pmatrix}\text{CSE Cost}\\\text{Allocation}\\\text{Factor}\end{pmatrix} + \begin{pmatrix}\text{Number of } i^{th}\\\text{Additional}\\\text{CSE at b}^{th}\\\text{Maintenance}\\\text{Level}\end{pmatrix}\begin{pmatrix}\text{CSE Cost}\\\text{Allocation}\\\text{Factor}\end{pmatrix}\right.$$

$$\left. + \dots + \begin{pmatrix}\text{Number of } i^{th}\\\text{Additional}\\\text{CSE at a}^{th}\\\text{Maintenance}\\\text{Level}\end{pmatrix}\begin{pmatrix}\text{CSE Cost}\\\text{Allocation}\\\text{Factor}\end{pmatrix}\right]\begin{pmatrix}i^{th}\\\text{Additional}\\\text{CSE Unit}\\\text{Cost}\end{pmatrix}$$

30.3.2.2 Support equipment support cost. It is necessary to include the cost of maintaining support equipment during the life cycle of the equipment it supports. A support equipment support factor is used in predicting this cost. This factor is the ratio of the average annual support equipment maintenance cost to total cost of the support equipment.

30.3.2.2.1 Support equipment support cost equation for the discard alternative.

$$\begin{pmatrix}\text{Support Equipment}\\\text{Support Cost}\end{pmatrix} = \left[\sum_{i=1}^{n}\begin{pmatrix}\text{Number of } i^{th}\\\text{PSE at a}^{th}\\\text{Maintenance}\\\text{Level}\end{pmatrix}\begin{pmatrix}i^{th}\,\text{PSE}\\\text{Unit}\\\text{Cost}\end{pmatrix}\begin{pmatrix}\text{PSE Cost}\\\text{Allocation}\\\text{Factor}\end{pmatrix}\right.$$

$$\left. + \sum_{i=1}^{n}\begin{pmatrix}\text{Number of } i^{th}\\\text{Additional}\\\text{CSE at a}^{th}\\\text{Maintenance}\\\text{Level}\end{pmatrix}\begin{pmatrix}i^{th}\,\text{Additional}\\\text{CSE Unit}\\\text{Cost}\end{pmatrix}\begin{pmatrix}\text{CSE Cost}\\\text{Allocation}\\\text{Factor}\end{pmatrix}\right]\begin{pmatrix}\text{Support Equipment}\\\text{Support Factor}\end{pmatrix}\begin{pmatrix}\text{Discount}\\\text{Factor}\end{pmatrix}$$

30.3.2.2.2 <u>Support equipment support cost equation for the single level repair alternative</u>.

$$\begin{pmatrix}\text{Support Equipment}\\ \text{Support Cost}\end{pmatrix} = \Bigg[\sum_{i=1}^{n} \begin{pmatrix}\text{Number of } i^{th}\\ \text{PSE at a}^{th}\\ \text{Maintenance}\\ \text{Level}\end{pmatrix} \begin{pmatrix} i^{th}\text{ PSE}\\ \text{Unit}\\ \text{Cost}\end{pmatrix} \begin{pmatrix}\text{PSE Cost}\\ \text{Allocation}\\ \text{Factor}\end{pmatrix}$$

$$+ \sum_{i=1}^{n} \begin{pmatrix}\text{Number of}\\ \text{Additional}\\ \text{CSE at a}^{th}\\ \text{Maintenance}\\ \text{Level}\end{pmatrix} \begin{pmatrix} i^{th}\text{ Additional}\\ \text{CSE Unit}\\ \text{Cost}\end{pmatrix} \begin{pmatrix}\text{CSE Cost}\\ \text{Allocation}\\ \text{Factor}\end{pmatrix} \Bigg] \begin{pmatrix}\text{Support Equipment}\\ \text{Support Factor}\end{pmatrix} \begin{pmatrix}\text{Discount}\\ \text{Factor}\end{pmatrix}$$

30.3.2.2.3 <u>Support equipment support cost equation for the multiple level repair alternative</u>.

$$\begin{pmatrix}\text{Support Equipment}\\ \text{Support Cost}\end{pmatrix} = \Bigg[\sum_{i=1}^{n} \Bigg[\begin{pmatrix}\text{Number of } i^{th}\\ \text{PSE at a}^{th}\\ \text{Maintenance}\\ \text{Level}\end{pmatrix} \begin{pmatrix}\text{PSE Cost}\\ \text{Allocation}\\ \text{Factor}\end{pmatrix} + \begin{pmatrix}\text{Number of } i^{th}\\ \text{PSE at b}^{th}\\ \text{Maintenance}\\ \text{Level}\end{pmatrix} \begin{pmatrix}\text{PSE Cost}\\ \text{Allocation}\\ \text{Factor}\end{pmatrix}$$

$$+ \ldots + \begin{pmatrix}\text{Number of } i^{th}\\ \text{PSE at n}^{th}\\ \text{Maintenance}\\ \text{Level}\end{pmatrix} \begin{pmatrix}\text{PSE Cost}\\ \text{Allocation}\\ \text{Factor}\end{pmatrix} \Bigg] \begin{pmatrix} i^{th}\text{ PSE}\\ \text{Unit Cost}\end{pmatrix}$$

$$+ \sum_{i=1}^{n} \Bigg[\begin{pmatrix}\text{Number of}\\ \text{Additional}\\ \text{CSE at a}^{th}\\ \text{Maintenance Level}\end{pmatrix} \begin{pmatrix}\text{CSE Cost}\\ \text{Allocation}\\ \text{Factor}\end{pmatrix} + \begin{pmatrix}\text{Number of}\\ \text{Additional}\\ \text{CSE at b}^{th}\\ \text{Maintenance Level}\end{pmatrix} \begin{pmatrix}\text{CSE Cost}\\ \text{Allocation}\\ \text{Factor}\end{pmatrix}$$

$$+ \ldots + \begin{pmatrix}\text{Number of}\\ \text{Additional}\\ \text{CSE at n}^{th}\\ \text{Maintenance Level}\end{pmatrix} \begin{pmatrix}\text{CSE Cost}\\ \text{Allocation}\\ \text{Factor}\end{pmatrix} \Bigg] \begin{pmatrix} i^{th}\\ \text{Additional}\\ \text{CSE Unit}\\ \text{Cost}\end{pmatrix} \Bigg] \begin{pmatrix}\text{Support Equipment}\\ \text{Support Factor}\end{pmatrix} \begin{pmatrix}\text{Discount}\\ \text{Factor}\end{pmatrix}$$

30.3.3 <u>Space cost</u>. The total space cost is the sum of three costs: inventory storage space cost, support equipment space cost, and repair work space cost.

30.3.3.1 <u>Inventory storage space cost</u>. For the discard alternative this is the cost of storing the spares quantities and system stock on hand. For the repair alternative this is the cost of storing the maintenance float, spares quantities, and system stock on hand. It is assumed that on the average, one half of the annual system stock is on hand at any one time.

30.3.3.1.1 Inventory storage space cost equation for the discard alternative.

$$\begin{pmatrix}\text{Inventory}\\\text{Storage}\\\text{Space Cost}\end{pmatrix}=\left[\begin{pmatrix}\text{Item Spares}\\\text{Quantity at}\\a^{\text{th}}\text{Maintenance}\\\text{Level}\end{pmatrix}+\frac{\begin{pmatrix}\text{Annual}\\\text{System Stock}\\\text{Quantity at}\\a^{\text{th}}\text{Maintenance}\\\text{Level}\end{pmatrix}}{(2)}\right]\begin{pmatrix}\text{Inventory}\\\text{Storage}\\\text{Space in}\\\text{Cubic Feet}\\\text{Per Item}\end{pmatrix}\begin{pmatrix}\text{Inventory}\\\text{Storage}\\\text{Space Cost}\\\text{Per Cubic Foot}\\\text{Per Month}\end{pmatrix}\begin{pmatrix}\text{12 Months}\\\text{Per Year}\end{pmatrix}\begin{pmatrix}\text{Discount}\\\text{Factor}\end{pmatrix}$$

30.3.3.1.2 Inventory storage space cost equation for the single level repair alternative.

$$\begin{pmatrix}\text{Inventory}\\\text{Storage}\\\text{Space Cost}\end{pmatrix}=\left[\begin{pmatrix}\text{Item}\\\text{Maintenance}\\\text{Float}\\\text{Quantity at }a^{\text{th}}\\\text{Maintenance Level}\end{pmatrix}+\begin{pmatrix}\text{Item Spares}\\\text{Quantity at}\\a^{\text{th}}\text{Maintenance}\\\text{Level}\end{pmatrix}+\frac{\begin{pmatrix}\text{Annual}\\\text{System Stock}\\\text{Quantity at}\\a^{\text{th}}\text{Maintenance}\\\text{Level}\end{pmatrix}}{(2)}\right]\begin{pmatrix}\text{Inventory}\\\text{Storage}\\\text{Space in}\\\text{Cubic Feet}\\\text{Per Item}\end{pmatrix}\begin{pmatrix}\text{Inventory}\\\text{Storage Space}\\\text{Cost Per}\\\text{Cubic Foot}\\\text{Per Month}\end{pmatrix}\begin{pmatrix}\text{12 Months}\\\text{Per Year}\end{pmatrix}\begin{pmatrix}\text{Discount}\\\text{Factor}\end{pmatrix}$$

30.3.3.1.3 Inventory storage space cost equation for the multiple level repair alternative.

$$\begin{pmatrix}\text{Inventory}\\\text{Storage}\\\text{Space Cost}\end{pmatrix}=\left[\begin{pmatrix}\text{Item}\\\text{Maintenance}\\\text{Float}\\\text{Quantity at }a^{\text{th}}\\\text{Maintenance Level}\end{pmatrix}+\begin{pmatrix}\text{Item Spares}\\\text{Quantity at}\\a^{\text{th}}\text{Maintenance}\\\text{Level}\end{pmatrix}+\begin{pmatrix}\text{Item}\\\text{Maintenance}\\\text{Float}\\\text{Quantity at }b^{\text{th}}\\\text{Maintenance Level}\end{pmatrix}+\begin{pmatrix}\text{Item Spares}\\\text{Quantity at}\\b^{\text{th}}\text{Maintenance}\\\text{Level}\end{pmatrix}+\dots+\begin{pmatrix}\text{Item}\\\text{Maintenance}\\\text{Float}\\\text{Quantity at }n^{\text{th}}\\\text{Maintenance Level}\end{pmatrix}\right.$$

$$\left.+\begin{pmatrix}\text{Item Spares}\\\text{Quantity at}\\n^{\text{th}}\text{Maintenance}\\\text{Level}\end{pmatrix}+\frac{\begin{pmatrix}\text{Annual}\\\text{System Stock}\\\text{Quantity at}\\n^{\text{th}}\text{Maintenance}\\\text{Level}\end{pmatrix}}{(2)}\right]\begin{pmatrix}\text{Inventory}\\\text{Storage}\\\text{Space in}\\\text{Cubic Feet}\\\text{Per Item}\end{pmatrix}\begin{pmatrix}\text{Inventory}\\\text{Storage Space}\\\text{Cost Per}\\\text{Cubic Foot}\\\text{Per Month}\end{pmatrix}\begin{pmatrix}\text{12 Months}\\\text{Per Year}\end{pmatrix}\begin{pmatrix}\text{Discount}\\\text{Factor}\end{pmatrix}$$

30.3.3.2 Support equipment space cost. This cost element accounts for the cost of peculiar support equipment (PSE) and additional common support equipment (CSE) floor space for discard and/or repair alternatives. PSE and CSE cost allocation factors are applied to prorate the cost of support equipment space among those items which require its use during maintenance.

30.3.3.2.1 Support equipment space cost equation for the discard alternative.

$$\begin{pmatrix}\text{Support Equipment}\\ \text{Space Cost}\end{pmatrix} = \left[\sum_{i=1}^{n}\begin{pmatrix}\text{Number of } i^{th}\\ \text{PSE at a}^{th}\\ \text{Maintenance}\\ \text{Level}\end{pmatrix}\begin{pmatrix}i^{th}\text{ PSE}\\ \text{Space in}\\ \text{Square Feet}\\ \text{Per PSE}\end{pmatrix}\begin{pmatrix}i^{th}\text{ PSE Space}\\ \text{Cost in Dollars}\\ \text{Per Square}\\ \text{Foot Per}\\ \text{Month}\end{pmatrix}\begin{pmatrix}\text{PSE Cost}\\ \text{Allocation}\\ \text{Factor}\end{pmatrix}\right.$$

$$\left.+\sum_{i=1}^{n}\begin{pmatrix}\text{Number of } i^{th}\\ \text{Additional}\\ \text{CSE at a}^{th}\\ \text{Maintenance}\\ \text{Level}\end{pmatrix}\begin{pmatrix}i^{th}\text{ Additional}\\ \text{CSE Space in}\\ \text{Square Feet}\\ \text{Per CSE}\end{pmatrix}\begin{pmatrix}i^{th}\text{ Additional}\\ \text{CSE Space}\\ \text{Cost in Dollars}\\ \text{Per Square Foot}\\ \text{Per Month}\end{pmatrix}\begin{pmatrix}\text{CSE Cost}\\ \text{Allocation}\\ \text{Factor}\end{pmatrix}\right]\begin{pmatrix}\text{12 Months}\\ \text{Per Year}\end{pmatrix}\begin{pmatrix}\text{Discount}\\ \text{Rate}\end{pmatrix}$$

30.3.3.2.2 Support equipment space cost equation for the multiple level repair alternative.

$$\begin{pmatrix}\text{Support Equipment}\\ \text{Space Cost}\end{pmatrix} = \left[\sum_{i=1}^{n}\left[\begin{pmatrix}\text{Number of } i^{th}\\ \text{PSE at a}^{th}\\ \text{Maintenance}\\ \text{Level}\end{pmatrix}\begin{pmatrix}\text{PSE Cost}\\ \text{Allocation}\\ \text{Factor}\end{pmatrix} + \begin{pmatrix}\text{Number of } i^{th}\\ \text{PSE at b}^{th}\\ \text{Maintenance}\\ \text{Level}\end{pmatrix}\begin{pmatrix}\text{PSE Cost}\\ \text{Allocation}\\ \text{Factor}\end{pmatrix}\right.\right.$$

$$\left.+\ldots+\begin{pmatrix}\text{Number of } i^{th}\\ \text{PSE at n}^{th}\\ \text{Maintenance}\\ \text{Level}\end{pmatrix}\begin{pmatrix}\text{PSE Cost}\\ \text{Allocation}\\ \text{Factor}\end{pmatrix}\right]\begin{pmatrix}i^{th}\text{ PSE}\\ \text{Space in}\\ \text{Square Feet}\\ \text{Per PSE}\end{pmatrix}\begin{pmatrix}i^{th}\text{ PSE Space}\\ \text{Cost in Dollars}\\ \text{Per Square}\\ \text{Foot Per}\\ \text{Month}\end{pmatrix}$$

$$+\sum_{i=1}^{n}\left[\begin{pmatrix}\text{Number of } i^{th}\\ \text{Additional}\\ \text{CSE at a}^{th}\\ \text{Maintenance Level}\end{pmatrix}\begin{pmatrix}\text{CSE Cost}\\ \text{Allocation}\\ \text{Factor}\end{pmatrix} + \begin{pmatrix}\text{Number of } i^{th}\\ \text{Additional}\\ \text{CSE at b}^{th}\\ \text{Maintenance Level}\end{pmatrix}\begin{pmatrix}\text{CSE Cost}\\ \text{Allocation}\\ \text{Factor}\end{pmatrix}\right.$$

$$\left.\left.+\ldots+\begin{pmatrix}\text{Number of } i^{th}\\ \text{Additional}\\ \text{CSE at a}^{th}\\ \text{Maintenance Level}\end{pmatrix}\begin{pmatrix}\text{CSE Cost}\\ \text{Allocation}\\ \text{Factor}\end{pmatrix}\right]\begin{pmatrix}i^{th}\text{ Additional}\\ \text{CSE Space in}\\ \text{Square Feet}\\ \text{Per CSE}\end{pmatrix}\begin{pmatrix}i^{th}\text{ Additional}\\ \text{CSE Space}\\ \text{Cost in Dollars}\\ \text{Per Square Foot}\\ \text{Per Month}\end{pmatrix}\right]\begin{pmatrix}\text{12 Months}\\ \text{Per Year}\end{pmatrix}\begin{pmatrix}\text{Discount}\\ \text{Factor}\end{pmatrix}$$

30.3.3.2.3 <u>Support equipment space cost equation for the single level repair alternative</u>.

$$\begin{pmatrix}\text{Support Equipment}\\ \text{Space Cost}\end{pmatrix} = \left[\sum_{i=1}^{n}\begin{pmatrix}\text{Number of } i^{th}\\ \text{PSE at a }^{th}\\ \text{Maintenance}\\ \text{Level}\end{pmatrix}\begin{pmatrix}i^{th}\text{ PSE}\\ \text{PSE at a }^{th}\\ \text{Square Feet}\\ \text{Per PSE}\end{pmatrix}\begin{pmatrix}i^{th}\text{ PSE Space}\\ \text{Cost in Dollars}\\ \text{Per Square}\\ \text{Foot Per}\\ \text{Month}\end{pmatrix}\begin{pmatrix}\text{PSE Cost}\\ \text{Allocation}\\ \text{Factor}\end{pmatrix}\right.$$

$$\left.+\sum_{i=1}^{n}\begin{pmatrix}\text{Number of } i^{th}\\ \text{Additional}\\ \text{CSE at a }^{th}\\ \text{Maintenance}\\ \text{Level}\end{pmatrix}\begin{pmatrix}i^{th}\text{ Additional}\\ \text{CSE Space in}\\ \text{Square Feet}\\ \text{Per CSE}\end{pmatrix}\begin{pmatrix}i^{th}\text{ Additional}\\ \text{CSE Space}\\ \text{Cost in Dollars}\\ \text{Per Square Foot}\\ \text{Per Month}\end{pmatrix}\begin{pmatrix}\text{CSE Cost}\\ \text{Allocation}\\ \text{Factor}\end{pmatrix}\right]\begin{pmatrix}\text{12 Months}\\ \text{Per Year}\end{pmatrix}\begin{pmatrix}\text{Discount}\\ \text{Rate}\end{pmatrix}$$

30.3.3.3 <u>Repair work space cost</u>. Repair work space cost covers the cost of floor space (excluding support equipment space) required for the repair of failed items. This cost is apportioned across all items which are repaired in this work space. For the discard alternative repair work space is non-existent; any space required for discard is considered to be included in support equipment space cost.

$$\begin{pmatrix}\text{Repair Work}\\ \text{Space Cost}\end{pmatrix} = \begin{pmatrix}\text{Total Repair}\\ \text{Work Space}\\ \text{in Square Feet}\\ \text{at a }^{th}\text{ Maintenance}\\ \text{Level}\end{pmatrix}\begin{pmatrix}\text{Repair Work}\\ \text{Space Apportionment}\\ \text{Factor at a }^{th}\\ \text{Maintenance}\\ \text{Level}\end{pmatrix}\begin{pmatrix}\text{Repair Work}\\ \text{Space Cost}\\ \text{in Dollars}\\ \text{Per Square Foot}\\ \text{Per Month}\end{pmatrix}\begin{pmatrix}\text{12 Months}\\ \text{Per Year}\end{pmatrix}\begin{pmatrix}\text{Discount}\\ \text{Factor}\end{pmatrix}$$

where

$$\begin{pmatrix}\text{Repair Work}\\ \text{Space Apportionment}\\ \text{Factor at a }^{th}\\ \text{Maintenance}\\ \text{Level}\end{pmatrix} = \frac{\begin{pmatrix}\text{Number of Item Repairs}\\ \text{at a }^{th}\text{ Maintenance Level}\end{pmatrix}}{\sum_{i=1}^{n}\begin{pmatrix}\text{Number of } i^{th}\text{ Item Repairs}\\ \text{at a }^{th}\text{ Maintenance Level}\end{pmatrix}}$$

30.3.3.3.1 Repair work space cost equation for the multiple level repair alternative.

$$\begin{pmatrix}\text{Repair Work}\\ \text{Space Cost}\end{pmatrix} = \left[\begin{pmatrix}\text{Total}\\ \text{Repair Work}\\ \text{Space in Square Feet}\\ \text{at a}^{th}\text{ Maintenance}\\ \text{Level}\end{pmatrix}\begin{pmatrix}\text{Repair Work}\\ \text{Space Apportionment}\\ \text{Factor at a}^{th}\\ \text{Maintenance}\\ \text{Level}\end{pmatrix}\begin{pmatrix}\text{Repair Work}\\ \text{Space Cost}\\ \text{in Dollars}\\ \text{Per Square Foot}\\ \text{Per Month}\end{pmatrix} + \begin{pmatrix}\text{Repair Work}\\ \text{Space in}\\ \text{Square Feet}\\ \text{at b}^{th}\text{ Maintenance}\\ \text{Level}\end{pmatrix}\begin{pmatrix}\text{Repair Work}\\ \text{Space Apportionment}\\ \text{Factor at b}^{th}\\ \text{Maintenance}\\ \text{Level}\end{pmatrix}\right.$$

$$\left.\begin{pmatrix}\text{Repair Work}\\ \text{Space Cost in}\\ \text{Dollars Per}\\ \text{Square Foot}\\ \text{Per Month}\end{pmatrix} + \ldots + \begin{pmatrix}\text{Total Repair}\\ \text{Work Space in}\\ \text{Square Feet at}\\ \text{n}^{th}\text{ Maintenance}\\ \text{Level}\end{pmatrix}\begin{pmatrix}\text{Repair Work}\\ \text{Apportionment}\\ \text{Factor at n}^{th}\\ \text{Maintenance}\\ \text{Level}\end{pmatrix}\begin{pmatrix}\text{Repair Work}\\ \text{Space Cost in}\\ \text{Dollars per}\\ \text{Square Foot}\\ \text{Per Month}\end{pmatrix}\right]\begin{pmatrix}\text{12 Months}\\ \text{Per Year}\end{pmatrix}\begin{pmatrix}\text{Discount}\\ \text{Factor}\end{pmatrix}$$

where

$$\begin{pmatrix}\text{Repair Work}\\ \text{Space Apportionment}\\ \text{Factor at b}^{th}\\ \text{Maintenance}\\ \text{Level}\end{pmatrix} = \frac{\begin{pmatrix}\text{Number of Item Repairs}\\ \text{at b}^{th}\text{ Maintenance Level}\end{pmatrix}}{\sum_{i=1}^{n}\begin{pmatrix}\text{Number of i}^{th}\text{ Item Repairs}\\ \text{at b}^{th}\text{ Maintenance Level}\end{pmatrix}} \qquad \begin{pmatrix}\text{Repair Work}\\ \text{Space Apportionment}\\ \text{Factor at n}^{th}\\ \text{Maintenance}\\ \text{Level}\end{pmatrix} = \frac{\begin{pmatrix}\text{Number of Item Repairs}\\ \text{at n}^{th}\text{ Maintenance Level}\end{pmatrix}}{\sum_{i=1}^{n}\begin{pmatrix}\text{Number of i}^{th}\text{ Item Repairs}\\ \text{at n}^{th}\text{ Maintenance Level}\end{pmatrix}}$$

30.3.4 Labor cost. This category encompasses labor expenditures associated with both discard and repair actions. It accounts for the time in manhours spent by each labor category (military occupational specialty, MOS) involved in the maintenance event and the labor cost in these labor categories.

30.3.4.1 Labor cost equation for the discard alternative.

$$\begin{pmatrix}\text{Labor}\\ \text{Cost}\end{pmatrix} = \begin{pmatrix}\text{Annual Number}\\ \text{of Item}\\ \text{Failures}\end{pmatrix}\left[\sum_{i=1}^{n}\begin{pmatrix}\text{Number of Maintenance}\\ \text{Manhours for}\\ \text{Discard, i}^{th}\text{ Skill}\\ \text{Level MOS at a}^{th}\\ \text{Maintenance Level}\end{pmatrix}\begin{pmatrix}\text{i}^{th}\text{ Skill}\\ \text{Level MOS}\\ \text{Labor Rate}\end{pmatrix}\right]\begin{pmatrix}\text{Discount}\\ \text{Factor}\end{pmatrix}$$

30.3.4.2 Labor cost equation for the single level repair alternatives.

$$\begin{pmatrix}\text{Labor}\\ \text{Cost}\end{pmatrix} = \begin{pmatrix}\text{Annual Number}\\ \text{of Item}\\ \text{Failures}\end{pmatrix}\left[\sum_{i=1}^{n}\begin{pmatrix}\text{Number of Maintenance}\\ \text{Manhours for}\\ \text{Repair, i}^{th}\text{ Skill}\\ \text{Level MOS at a}^{th}\\ \text{Maintenance Level}\end{pmatrix}\begin{pmatrix}\text{i}^{th}\text{ Skill}\\ \text{Level MOS}\\ \text{Labor Rate}\end{pmatrix}\right]\begin{pmatrix}\text{Discount}\\ \text{Factor}\end{pmatrix}$$

30.3.4.3 Labor cost equation for the multiple level repair alternative.

$$\begin{pmatrix}\text{Labor}\\\text{Cost}\end{pmatrix}=\left\{\begin{pmatrix}\text{Annual Number}\\\text{of Item}\\\text{Failures}\end{pmatrix}\left[\sum_{i=1}^{n}\begin{pmatrix}\text{Number of Maintenance}\\\text{Manhours for}\\\text{Repair, } i^{th}\text{ Skill}\\\text{Level MOS at a}^{th}\\\text{Maintenance Level}\end{pmatrix}\begin{pmatrix}i^{th}\text{ Skill}\\\text{Level MOS}\\\text{Labor Rate}\end{pmatrix}\right]+\begin{pmatrix}\text{Annual Number}\\\text{of Item}\\\text{Failures}\end{pmatrix}\begin{pmatrix}\text{BCM Rate at}\\a^{th}\text{ Maintenance}\\\text{Level}\end{pmatrix}\right.$$

$$\left[\sum_{i=1}^{n}\begin{pmatrix}\text{Number of Maintenance}\\\text{Manhours for Repair,}\\i^{th}\text{ Skill Specialty Code}\\\text{at a}^{th}\text{ Maintenance Level}\end{pmatrix}\begin{pmatrix}\text{Hourly Labor}\\\text{Rate Per}\\\text{Skill Specialty}\\\text{Code}\end{pmatrix}\right]+\ldots+\begin{pmatrix}\text{Annual Number}\\\text{of Item Failures}\end{pmatrix}\begin{pmatrix}\text{BCM Rate at}\\a^{th}\text{ Maintenance}\\\text{Level}\end{pmatrix}\begin{pmatrix}\text{BCM Rate at}\\b^{th}\text{ Maintenance}\\\text{Level}\end{pmatrix}$$

$$\left.\ldots\begin{pmatrix}\text{BCM Rate at}\\(n-1)^{th}\text{ Maintenance}\\\text{Level}\end{pmatrix}\left[\sum_{i=1}^{n}\begin{pmatrix}\text{Number of Maintenance}\\\text{Manhours for Repair,}\\i^{th}\text{ Skill Specialty Code}\\\text{at n}^{th}\text{ Maintenance Level}\end{pmatrix}\begin{pmatrix}\text{Hourly Labor}\\\text{Rate Per Skill}\\\text{Specialty Code}\end{pmatrix}\right]\right\}\begin{pmatrix}\text{Discount}\\\text{Factor}\end{pmatrix}$$

30.3.5 Training cost. This category includes the life cycle cost of training personnel required to maintain the equipment and replacing previously trained personnel lost through attrition.

30.3.5.1 Training cost equation for the discard alternative.

$$\begin{pmatrix}\text{Training}\\\text{Cost}\end{pmatrix}=\left[\sum_{i=1}^{n}\begin{pmatrix}\text{Number of }i^{th}\\\text{Skill Specialty Code}\\\text{at a}^{th}\text{ Maintenance}\\\text{Level}\end{pmatrix}\begin{pmatrix}\text{Cost of Discard}\\\text{Training Number of}\\i^{th}\text{ Persons Per}\\\text{Skill Specialty Code}\end{pmatrix}\right]\left[1+\begin{pmatrix}\text{Skill Specialty}\\\text{Code Attrition Rate}\end{pmatrix}\begin{pmatrix}\text{Discount}\\\text{Factor}\end{pmatrix}\right]$$

30.3.5.2 Training cost equation for the single level repair alternative.

$$\begin{pmatrix}\text{Training}\\\text{Cost}\end{pmatrix}=\left[\sum_{i=1}^{n}\begin{pmatrix}\text{Number of }i^{th}\\\text{Skill Specialty Code}\\\text{at a}^{th}\text{ Maintenance}\\\text{Level}\end{pmatrix}\begin{pmatrix}\text{Cost of Repair}\\\text{Training Per Number of}\\i^{th}\text{ Persons Per}\\\text{Skill Specialty Code}\end{pmatrix}\right]\left[1+\begin{pmatrix}\text{Skill Specialty Code}\\\text{Attrition Rate}\end{pmatrix}\begin{pmatrix}\text{Discount}\\\text{Factor}\end{pmatrix}\right]$$

30.3.5.3 Training cost equation for the multiple level repair alternative.

$$\begin{pmatrix}\text{Training}\\ \text{Cost}\end{pmatrix}=\left[\sum_{i=1}^{n}\begin{pmatrix}\text{Number of } i^{th}\\ \text{Skill Specialty Code}\\ \text{at a}^{th}\text{ Maintenance Level}\end{pmatrix}\begin{pmatrix}\text{Cost of Repair}\\ \text{Training Per Number}\\ \text{of } i^{th}\text{ Persons}\\ \text{Per Skill Specialty Code}\end{pmatrix}+\sum_{i=1}^{n}\begin{pmatrix}\text{Number of } i^{th}\\ \text{Skill Specialty Code}\\ \text{at b}^{th}\text{ Maintenance Level}\end{pmatrix}\begin{pmatrix}\text{Cost of Repair}\\ \text{Training Per Number}\\ \text{of } i^{th}\text{ Persons}\\ \text{Per Skill Specialty Code}\end{pmatrix}\right.$$

$$\left.+\dots+\sum_{i=1}^{n}\begin{pmatrix}\text{Number of } i^{th}\\ \text{Skill Specialty Code}\\ \text{at n}^{th}\text{ Maintenance}\\ \text{Level}\end{pmatrix}\begin{pmatrix}\text{Cost of Repair}\\ \text{Training Number of } i^{th}\\ \text{Persons Per Skill}\\ \text{Specialty Code}\end{pmatrix}\right]\left[1+\begin{pmatrix}\text{Skill Specialty}\\ \text{Code Attrition}\\ \text{Rate}\end{pmatrix}\begin{pmatrix}\text{Discount}\\ \text{Factor}\end{pmatrix}\right]$$

30.3.6 Documentation cost. This cost element covers the expenses associated with PSE technical manuals. It assumes that the major factor affecting technical documentation is its development cost. Production cost of technical manuals is considered negligible. Documentation cost is allocated among those equipment items which share the use of these manuals. Documentation development cost for CSE is a sunk cost. Additional CSE documentation costs are negligible. A common documentation cost equation is applicable to both discard and repair maintenance alternatives.

30.3.6.1 Documentation cost equation for the discard and repair alternatives.

$$\begin{pmatrix}\text{Documentation}\\ \text{Cost}\end{pmatrix}=\sum_{i=1}^{n}\begin{pmatrix}i^{th}\text{ PSE}\\ \text{Technical}\\ \text{Manual}\\ \text{Development}\\ \text{Cost}\end{pmatrix}\begin{pmatrix}\text{PSE Cost}\\ \text{Allocation}\\ \text{Factor}\end{pmatrix}$$

30.4 LOR alternatives. A total of 19 different LOR alternatives exists in the Marine Corps maintenance hierarchy. These alternatives are shown in table H-I where, for example, maintenance alternative 11 describes a sequence of events beginning with repair of a failed item at the Organizational level. If repair is unsuccessful, i.e., BCM at this level, the item is sent to the 4th echelon for further maintenance. If the 4th echelon cannot fix the faulty item it is shipped to the depot. At the depot the item is either repaired or washed out. Table H-I also identifies the washout point for each maintenance alternative. The washout point is the lowest maintenance level authorized to condemn or dispose an unserviceable item. An item may become unserviceable because it is BCM or it is not economically feasible to repair. In either case the item is washed out.

30.5 Combination of cost elements. The total life cycle LOR cost is the sum of the cost elements for the maintenance alternative being evaluated. The LOR discard alternative requires the inclusion of 10 cost elements. (Repair material cost and repair work space cost are not included in the LOR discard alternative). The LOR repair alternative, however, encompasses all 12 cost elements.

30.5.1 Total life cycle LOR cost for the discard alternative.

$$\begin{pmatrix}\text{Total Life}\\ \text{Cycle Level}\\ \text{of Repair Cost}\\ \text{for the Discard}\\ \text{Alternative}\end{pmatrix} = \begin{pmatrix}\text{Item Entry}\\ \text{and Retention}\\ \text{Cost}\end{pmatrix} + \begin{pmatrix}\text{Inventory}\\ \text{Stock Cost}\end{pmatrix} + \begin{pmatrix}\text{Transportation}\\ \text{Cost}\end{pmatrix} + \begin{pmatrix}\text{Support}\\ \text{Equipment}\\ \text{Cost}\end{pmatrix} + \begin{pmatrix}\text{Support}\\ \text{Equipment}\\ \text{Support Cost}\end{pmatrix}$$

$$+ \begin{pmatrix}\text{Inventory}\\ \text{Storage}\\ \text{Space Cost}\end{pmatrix} + \begin{pmatrix}\text{Support}\\ \text{Equipment}\\ \text{Space Cost}\end{pmatrix} + \begin{pmatrix}\text{Labor}\\ \text{Cost}\end{pmatrix} + \begin{pmatrix}\text{Training}\\ \text{Cost}\end{pmatrix} + \begin{pmatrix}\text{Documentation}\\ \text{Cost}\end{pmatrix}$$

30.5.2 Total life cycle cost for the repair alternative.

$$\begin{pmatrix}\text{Total Life}\\ \text{Cycle Level}\\ \text{of Repair Cost}\\ \text{for the Discard}\\ \text{Alternative}\end{pmatrix} = \begin{pmatrix}\text{Item Entry}\\ \text{and Retention}\\ \text{Cost}\end{pmatrix} + \begin{pmatrix}\text{Inventory}\\ \text{Stock Cost}\end{pmatrix} + \begin{pmatrix}\text{Repair}\\ \text{Material Cost}\end{pmatrix} + \begin{pmatrix}\text{Transportation}\\ \text{Cost}\end{pmatrix} + \begin{pmatrix}\text{Support}\\ \text{Equipment}\\ \text{Cost}\end{pmatrix} + \begin{pmatrix}\text{Support}\\ \text{Equipment}\\ \text{Support Cost}\end{pmatrix}$$

$$+ \begin{pmatrix}\text{Inventory}\\ \text{Storage}\\ \text{Space Cost}\end{pmatrix} + \begin{pmatrix}\text{Support}\\ \text{Equipment}\\ \text{Space Cost}\end{pmatrix} + \begin{pmatrix}\text{Repair Work}\\ \text{Space Cost}\end{pmatrix} + \begin{pmatrix}\text{Labor}\\ \text{Cost}\end{pmatrix} + \begin{pmatrix}\text{Training}\\ \text{Cost}\end{pmatrix} + \begin{pmatrix}\text{Documentation}\\ \text{Cost}\end{pmatrix}$$

30.6 Table of data elements. Table H-II provides a list of the data elements required to perform an LOR analysis. Also, identified in the table is Logistic Support Analysis (LSA) compatibility and data element units, sources, field descriptors, and the compatibility with appendix P.

30.7 LOR computer program. Computer programs have been developed by the Marine Corps for machine processing LOR data and performing LOR calculations. These programs provide the capability, (a) to perform LOR analyses for any or all of the 19 LOR alternatives, and, (b) to find the optimum (least cost) LOR solution for a given set of input data. An additional program feature is a sensitivity analysis routine which permits varying any input parameter over a range of values to assess its impact on the LOR alternative.

TABLE H-I. LOR maintenance alternatives.

Alternative Number	Discard	Repair				
		Lowest Repair Level	Next Higher Repair Level	Next Higher Repair Level	Next Higher Repair Level	Wash-out Point
1	0*					
2	3*					
3	4*					
4	D*					
5		0				0
6		0	3			3
7		0	3	4		4
8		0	3	4	D	D
9		0	3	D		D
10		0	4			4
11		0	4	D		D
12		0	D			D
13		3				3
14		3	4			4
15		3	4	D		D
16		3	D			D
17		4				4
18		4	D			D
19		D				D

*0 - Organizational Level, 1st and 2nd Echelons Combined
3 - Intermediate Level, 3rd Echelon
4 - Intermediate Level, 4th Echelon
D - Depot, 5th Echelon

TABLE H-II. Data element.

INPUT DATA ELEMENT NAME	FIELD DESCRIPTOR	UNITS	APPENDIX P		LSAR Y/N	RECOMMENDED DATA SOURCE
			NAME	CONV FACTOR		
Total Systems Supported	XXXXX.XX	Number	Same	-	No	USMC
Annual Operating Time	XXXX.	Hours	Annual Oper. Requirements	-	Yes 024	USMC
No. Years in Lifecycle	XX.	Number of Years	Operation Life	-	No	USMC
Discount Rate	X.XX	Decimal	Same	-	Yes 078	USMC
Item Entry Cost	XXXX.XX	Dollars	Initial Cat. Cost	-	No	USMC
Item Retention Cost	XXXX.XX	Dollars	Recurring Cat. Cost	-	No	USMC
Support of Suprt. Equp. Cost Factor	X.XX	Decimal	Same	-	Yes 370	Contractor
Training Cost	XXXXX.XX	Dollars	Same	-	Yes 404	Contractor
Marine Corps Attrition Rate	X.XX	Decimal	Repairman Turnover Rate	Subdiv. Mil/Civ	No	USMC
Depot Attrition Rate	X.XX	Decimal	Repairman Turnover Rate	Subcat. 2 See above	No	USMC

TABLE H-II. Data element - continued.

INPUT DATA ELEMENT NAME	FIELD DESCRIPTOR	UNITS	APPENDIX P		LSAR Y/N	RECOMMENDED DATA SOURCE
			NAME	CONV FACTOR		
Peculiar Support Equipment	XXXX.	Number			No	Contractor
PSE Unit Cost	XXXXXXXX.XX	Dollars		Same	No	Contractor
PSE Space	XXXX.XX	Sq. ft.	Repair Work Space Avail.	Incl. w/in overall maintenance floorspace	No	Contractor
PSE Space Cost	XX.XX	Dollars per sq. ft. per month	Repair Work Space Cost	SE included in overall space costs	No	USMC
PSE Tech Manual Development Cost	XXXXXX.XX	Dollars			No	Contractor
Common Support Equipment	XXXX.	Number			No	Contractor
CSE Unit Cost	XXXXXXXX.XX	Dollars		-	No	Contractor

TABLE H-II. Data element - continued.

INPUT DATA ELEMENT NAME	FIELD DESCRIPTOR	UNITS	APPENDIX P		LSAR Y/N	RECOMMENDED DATA SOURCE
			NAME	CONV FACTOR		
CSE Space	XXXX.XX	Sq. ft.	Repair Work Space Avail.	Included w/in overall work space costs	No	Contractor
CSE Space Costs	XX.XX	Dollars per sq. ft. per month	Repair Work Space Cost	SE included in overal space costs	No	USMC
PSE Development Cost	XXXXXXXX.XX	Dollars	SE Development Prior	-	No	Contractor
Required Days of Stock	XXX.	Days	Operation Level	-	Yes 319	USMC
Repair Work Space	XXXX.XX	Sq. ft.	Repair Work Space Avail.	-	No	Contractor
Repair Work Space Cost	XX.XX	Dollars per sq. ft. per month	Repair Work Space Cost		Yes 314	USMC
Repair Cycle Time	XXXX.	Days	Repair Cycle Time	-	Yes 312	USMC
No. of Identical Items in System	XXX.XX	Number	Quantity per End Item			Contractor

TABLE H-II. Data element - continued.

INPUT DATA ELEMENT NAME	FIELD DESCRIPTOR	UNITS	APPENDIX P		LSAR Y/N	RECOMMENDED DATA SOURCE
			NAME	CONV FACTOR		
Mean Time Between Failures	XXXXXXXXX.	Number	Same	-	No	Contractor
Item Cost	XXXXXXX.XX	Dollars	Unit Price	Same	No	Contractor
Number of Unique New NSNs	XXX.	Number	No. of Parts Needing NSN	-	No	Contractor
Inventory Storage Space Cost	XX.XX	Dollars per cu. ft. per month	Inventory Storage Cost Rate	-	Yes 158	USMC
Inventory Storage Space	XXXX.XX	Cu. ft.	Inventory Storage Space Avail.	-	No	Contractor
Item Packaging Cost	XXXX.XX	Dollars	Packaging Cost by Volume	Also divided into dollars per pound	No	USMC
Beyond Capability of Maintenance Rate	X.XX	Decimal	Maintenance Task Distribution	-	No	Contractor

TABLE H-II. Data element - continued.

INPUT DATA ELEMENT NAME	FIELD DESCRIPTOR	UNITS	APPENDIX P		LSAR Y/N	RECOMMENDED DATA SOURCE
			NAME	CONV FACTOR		
Target Probability Against Stockout	X.XXXX	Decimal	Stockage Confidence Level	-	No	USMC
Item Repair Mat'l Cost Factor	X.XXXX	Decimal	Repair Material Rate	-	No	Contractor
Item Transportation Cost	XXXX.XX	Dollars	Transportation Cost	-	No	Contractor
Special Support Equipment Cost	XXXXXXX.XX	Dollars		-	No	Contractor
Number of Persons per Skill Specialty Code	XX.	Number	Number of Repairmen	-	Yes 233	Contractor
Mean Manhours	XXX.XX	Manhours per MOS	Repairman Time Used	-	Yes 200	Contractor
Hourly Labor Rate Skill Specialty Code	XXXXXX.XX	Dollars per hour	Labor Rate	-	Yes 144	USMC
PSE Usage Indicators	X	Zero or One	SE Utilization Rate	-	No	Contractor
CSE Usage Indicators	X	Zero or One	SE Utilization Rate	-	No	Contractor

ARMY METHOD 1

10. SCOPE

10.1 Purpose. This appendix implements the basic mathematical requirements pertaining to the development of Level of Repair Analysis (LORA) economic evaluations for the item indenture level of a system under the cognizance of the Army. This method provides a means of conducting early LORA economic evaluations to assist design engineers in evaluating supportability and design related characteristics of an item. The objective of this method is to determine whether it is more economically desirable to design for repair at failure or discard at failure of an item.

10.2 General. In early LORA, the decision to repair or discard a failed item is based on the cost to repair an item versus the cost to discard an item. An item is defined as any entity in the hardware hierarchy, except those entities at the lowest level of a specific branch. The item can be the end item itself, line replaceable unit (LRU), shop replaceable unit (SRU), but not the parts that make up the item. The items to be analyzed should be selected by the contractor through the LSA candidate selection process. LSA candidates shall be defined as those assemblies, subassemblies, or items/components which are designated as repairable items or maintenance significant items.

This method provides two breakeven analysis options (breakeven cost and breakeven reliability) which allows the analyst to best determine the repair/discard decision. The breakeven cost option provides breakeven cost outputs, based on an analyst input reliability, which the analyst can then compare with the actual cost of the item under analysis. If the item cost is less than the breakeven cost, the item should be discarded upon failure. If the item cost is greater than the breakeven cost, the item should be repaired.

The breakeven reliability analysis provides breakeven reliability outputs based on an analyst input cost of the item under analysis. The breakeven reliability is compared with the estimated reliability of the item. If the estimated item reliability is less than the breakeven reliability, the item should be repaired. If the estimated item reliability is greater than the breakeven reliability, the item should be discarded upon failure.

Breakeven points for both analysis options are determined by setting the life cycle cost of repairing the item equal to the life cycle cost of discarding the item and solving for the desired output (cost or reliability).

This method considers the following cost areas: repair cost; testing cost; repair training and information cost; supply cost; assembly replacement cost; and, initial provisioning cost, and procurement costs. This method is based on total item failure.

This method consists of the following levels of supply: (a) equipment/repairable exchange; (b) maintenance level supply; and (c) depot supply. The repairable exchange program is usually located at the Direct Support (DS) or General Support (GS) maintenance echelon but can be at the Unit/Organization. The maintenance level can be at the DS, GS, or depot but is usually found at the corps or theatre supply.

20. APPLICABLE DOCUMENTS

20.1 Government documents.

20.1.1 Specifications, standards, and handbooks. The specifications, standards, and handbooks, cited in 2.1, form a part of this appendix to the extent specified under 2.1.1.

20.1.2 Nongovernment publications. Nongovernment standards, or other types of nongovernment publications, do not form a part of this appendix.

30. ITEM LORA MATHEMATICS

30.1 This section contains general equations illustrating the top-down approach for calculating the cost element categories for repair/discard LORA economic evaluations on Army systems at the item level. An explanation of the variable definitions can be found in appendix P. Definitions not found in appendix P can be found in the glossary. 30.2 contains the equations that form the repair policy. 30.3 contains the equations that form the discard policy.

30.2 Repair policy. This section contains the mathematical equations that form the repair policy for LORA economic evaluation on Army systems at the item level. The repair of an item is the product of the total number of item failures during operation and total cost per item replaced in the supply system. The item failures during operation is the product of the failures per item and the number of items.

30.2.1 This equation represents the total number of item failures.

```
Total Number of
Item Failures
During Operation =  [((1/(Mean Time Between Failure)) *
                    (Operation Life) *
                    (8760) *
                    (Annual Operating Requirements) *
                    (Quantity per End Item) *
                    (Total Systems Supported)]
```

30.2.2 The following equation represents the total cost per item replaced in the supply system:

```
Total Cost Per
Item Replaced in
Supply System  =  [(Repair Cost)      +
                  (Testing Cost)      +
                  (Repair Training
                   and Information
                   Cost)              +
                  (Supply Cost)       +
                  (Assembly
                   Replacement Cost) +
                  (Initial
                   Provisioning Cost)]
```

The equations for calculating each cost element in this section are provided at 30.2.2.1 through 30.2.2.6. The definitions of the cost element variables within the equations are contained in appendix P.

30.2.2.1 Repair Costs = [(Repair Labor Cost] + (Parts Cost) + (Requisition Cost) + (Maintenance Facility Cost)]

Repair Labor Cost = [(Labor Rate)(Mean Time to Repair)* (Percent Failures Repaired)(1 + Loading Factor)]/ [(Productivity Factor)]

Parts Cost = [(Repair Material Cost)(Percent Failures Repaired)]

Requisition Cost = [(Cost per Requisition)(Percent Failures Repaired)

Maintenance Facility Cost = [(Facility Operating Cost)(Mean Time to Repair)* (Percent Failures Repaired)]

30.2.2.2 Testing Cost = [(Test Equipment Development Cost) + (Test Equipment Procurement Cost) + (Test Equipment Maintenance Cost) + (Test Facilities Development Cost) + (Test Facilities Procurement Cost) + (Test Facilities Maintenance Cost)

Test Equipment Development Cost = [(Support Equipment Development Cost)/ (Total Number Item Failures)]

Test Equipment Procurement Cost = [(Unit Price)/(Total Number Item Failures)]

Test Equipment Maintenance Cost = [(Unit Price)(Support of Support Equipment Cost Factor)(Operation Life)]/ [(Total Number Item Failures)]

Facilities Development Cost = [(Facilities Development Cost)/ (Total Number Item Failures)]

Facilities Procurement Cost = [(Unit Price)/(Total Number Item Failures)]

Facilities Maintenance Cost = [(Unit Price)(Support of Support Facility Cost Factor)(Operation Life)]/ [(Total Number Item Failures)]

30.2.2.3 Repair Training and Information Cost = [(Repair Training Cost) + (Technical Instruction Manual Cost)]

Repair Training Cost = [[(Number Trained) *
(Training Time) *
(Labor Rate) *
(Operation Life)]*
[1 + Loading Factor]/
[(Productivity Factor)]]/
[Total Number Item Failures]

Technical Instruction Manual Cost = [(Technical Documentation cost) *
(Additional Publication Pages)]/
[(Total Number Item Failures)]

30.2.2.4 Supply Costs = [(Transportation Cost) +
(Repair Parts Inventory Holding Cost) +
(Administrative and Engineering Support Cost for Procurement of Unique Repair Parts) +
(NSN cost)

Transportation Cost = Cost of Transportation

Repair Parts Inventory Holding Cost = [(Repair Material Cost) *
(Holding Cost Percentage) *
(Percent Failures Repaired)]

Administrative and Engineering Support Cost for Procurement of Unique Repair Parts = [(Recurring Bin Cost) *
(Engineering Support Cost) *
(Number Parts Needing NSNs) *
(Operation Life)]/ *
[(Total Number Item Failures)]

Cost to Obtain and Maintain Unique NSN's Per Item = [[(Initial Cataloging Cost) *
(Number Parts Needing NSN)] +
[(Recurring Cataloging Cost) *
(Number Parts Needing NSN) *
(Operation Life)]]/
[(Total Number Item Failures)]

30.2.2.5 Item Replacement Cost = [(Cost to Replace a Nonrepairable Assembly)]+
[(Cost to Replace a Scrapped Failed Assembly)]

= [(Percent Failures Repaired) *
(Washout Rate) *
(Unit Cost of New Items)] +
[(1-Percent Failurs Repaired)*
(Unit Cost of New Items)]

30.2.2.6 Initial Provisioning for this method involves determining the quantity of pipeline spares that are to be unit issued for repair and supply. For this method, provisioning is a function of demand , safety stock, and time to resupply. The amount of stockage needed at the repairable exchange, equipment exchange, maintenance level supply, and depot level is determined based on the demand, time to resupply, and safety stock at each level. The demand is a function of expected item failures, years end item deployed, fraction of assemblies returned and received at repair facility, fraction not repaired, and the safety stock coefficient. The time to resupply is a function of the order and ship times and depends on the type of demand.

The amount of stockage needed for repair parts is a function of the non-standard parts demand and the order and ship time in days for parts to be obtained by the maintenance facility. Nonstandard repair parts are those repair parts that requires new national stock numbers.

30.3 Discard policy. This section contains the mathematical equations that form the discard policy for LORA economic evaluations on Army systems at the item level. The discard cost of an item is the product of the item failures during operation and the cost to purchase a new item.

30.3.1 The following equation represents the discard cost of an item:

Item Discard Cost = [(1/(Mean Time Between Failure)) *
(Operation Life) *
(8760) *
(Annual Operating Requirements) *
(Quantity per End Item) *
(Total Systems Supported)]*
[(Unit Cost to Purchase New Item)]

40. ARMY SPECIFIC ASPECT OF REPAIR ANALYSIS CLASS OF MODELS. Because this method is conducted to specifically analyze repair versus discard, it is categorized as a specific aspects of repair level analysis model. The Army approved computer model for conducting repair/discard analysis is the Palman model. AMC-R-700-27, LORA Program provides policy regarding the use of specific models/techniques to conduct Army LORA evaluations.

The following data element table cross-references the definitions of appendix P with the data element categories of the Palman model.

TABLE I-I. Data element.

INPUT DATA ELEMENT NAME	FIELD DESCRIPTION	UNITS	APPENDIX P		LSAR INTERFACE	DATA SOURCES
			APPENDIX P NAME	CONVERSION FROM APPENDIX P		
Safety stock coefficient	8NR2	Decimal				Government
System or assembly Name	16X	None	Item Name		YES	Government Contractor
Test equipment development cost	8NR2	Dollars	Support equipment development cost			Contractor
Facilities development cost	8NR2	Dollars	Facilities development cost			Contractor
Test equipment procurement cost	8NR2	Dollars	Unit price			Contractor
Facilities procurement cost	8NR2	Dollars	Unit price			Contractor
Cost as a fraction of inventory value	8NR2	Decimal	Holding cost percentage			Government
Labor cost per hour	8NR2	Dollars/ Hour	Labor rate		YES	Government
Maintenance facilities cost per direct labor hour	8NR2	Dollars/ Hour	Facility operating cost			Government
Repair parts requisition cost	8NR2	Dollars/ Requisition	Cost per requisition	Do not include spare parts cost		Government
Average cost per repair part	8NR2	Dollars/ Rpr Part	Repair material cost		YES	Contractor

TABLE I-I. Data element - continued.

INPUT DATA ELEMENT NAME	FIELD DESCRIPTION	UNITS	APPENDIX P		LSAR INTERFACE	DATA SOURCES
			APPENDIX P NAME	CONVERSION FROM APPENDIX P		
Transportation and handling cost/assembly	8NR2	Dollars/ Assembly	Transportation cost	Add handling cost to include cost for packaging, document-ing, and transport-ing unservice-able assembly to repair facility	YES	Contractor
Repairable exchange locations	8NR-	Number	Number of shops			Government
End items in use	8NR-	Number	Total systems supported			Government
Assembly failure rate during operation	8NR2	Failures Per Million Hours Operation	Mean time between failure (MTBF)	1/MTBF		Contractor
Fraction of time assembly operated	8NR2	Hours/Year	Annual operating require-ments			Government

TABLE I-I. Data element - continued.

INPUT DATA ELEMENT NAME	FIELD DESCRIPTION	UNITS	APPENDIX P		LSAR INTERFACE	DATA SOURCES
			APPENDIX P NAME	CONVERSION FROM APPENDIX P		
Cost to enter national stock number	8NR2	Dollars	Initial cataloging cost			Government
Yearly cost to manage NSN	8NR2	Dollars/ Year	Recurring cataloging cost			Government
Additional training time	8NR2	Hours	Training time			Contractor Government
Minimum days of initial provisioning for assemblies	8NR2	Days of stock	Operation level			Government
Minimum days of initial provisioning for parts	8NR2	Days of stock	Operation level			Government
Number of maintenance level supply locations	8NR-	Number	Number of shops			Government
Order and ship (OST) days repairable exchange (RX) to equipment	8NR-	Days	Ship time			Government
OST RX to Maintenance level supply (MLS)	8NR-	Days	Ship time			Government
OST MLS to depot supply	8NR-	Days	Ship time			Government
OST between Depot and factory	8NR-	Days	Ship time			Government
OST parts for maintenance	8NR-	Days	Ship time			Government

TABLE I-I. Data element - continued.

INPUT DATA ELEMENT NAME	FIELD DESCRIPTION	UNITS	APPENDIX P: APPENDIX P NAME	APPENDIX P: CONVERSION FROM APPENDIX P	LSAR INTERFACE	DATA SOURCES
Non-operational failure rate	8NR2	Decimal	MTBF degradation factor	Decimal percent of failure rate		Contractor
Administration and engineering cost per NSN	8NR2	Dollars/ unique part/yr				Government
Personnel trained per year	8NR-	Number of repairmen trained per year	Number trained			Government
Technical manual per page cost	8NR2	Dollars/ page	Technical documentation cost			Contractor/ Government
Assemblies per end item	8NR-	Number	Quantity per end item		YES	Contractor
Repair time	8NR2	Hours	Mean time to repair		YES	Contractor
Fraction not repairable	8NR2	Decimal	Washout rate			Government/ Contractor
Additional publication pages	8NR-	Number of pages				Contractor

TABLE I-I. Data element - continued.

INPUT DATA ELEMENT NAME	FIELD DESCRIPTION	UNITS	APPENDIX P		LSAR INTERFACE	DATA SOURCES
			APPENDIX P NAME	CONVERSION FROM APPENDIX P		
Fraction of assemblies returned and received at repair facility	8NR2	Decimal	Percent failures repaired			Contractor
Non-standard part repair	8NR2	Decimal				Contractor
Turnaround time for maintenance	8NR-	Days	Repair cycle time			Government
Test equipment maint-enance cost as a frac-tion of procurement cost	8NR2	Decimal	Support of support equip-ment cost factor			Contractor
Facilities maintenance cost as a fraction of procurement cost	8NR2	Decimal	Support of support facility cost factor			Contractor
Number of repair parts added to federal supply system per assembly	8NR-	Quantity per assembly	Number of parts needing NSNs	Include repair parts only		Contractor
Years of life/analysis	8NR-	Number of years	Operation life		YES	Government
Input Data File		None				Contractor
Output Data File		None				Contractor

ARMY METHOD 2

10. SCOPE

10.1 Purpose. This appendix implements the basic mathematical requirements pertaining to the development of LORA economic evaluations for the subsystem/item indenture level of a system under the cognizance of the Army. This method provides a means of examining all feasible support alternatives for Army subsystems/items within the constraints of existing Army maintenance policies. The objective of this method is to determine the most economical support alternative for an item.

10.2 General. This method incorporates the following factors to establish the most economical support alternative: (a) failure rate of the item/sub-item; (b) indenture level for discard, remove/replace, and repair actions; (c) the minimum level of maintenance that has the capabilities to perform repair; and, (d) support equipment required. This method allocates the support alternatives into six major categories: (1) inventory supply related costs (transportation, bin, cataloging, requisition, etc.); (2) spares cost (consumption and initial); (3) support equipment (Test Program Sets (TPS), Test, Measurement, and Diagnostic Equipment (TMDE)/Automatic Test Equipment (ATE), and other equipment) costs which includes: hardware (development and procurement) and the annual maintenance cost of the support equipment; (4) personnel (labor and training); (5) documentation; and (6) facilities. The LORA economic recommendations for an subsystem/item is based on the economic impact of the following four basic support alternatives: (a) discard at failure with no screening (can be performed at all levels); (b) discard with screening at Direct Support (DS), General Support (GS), and Depot (organizational (ORG) level cannot screen item); (c) repair (all levels); and (d) repair by the contractor.

20. APPLICABLE DOCUMENTS

20.1 Government documents.

20.1.1 Specifications, standards, and handbooks. The specifications, standards, and handbooks, cited in 2.1, form a part of this appendix to the extent specified under 2.1.1.

20.2. Nongovernment publications. Nongovernment standards, or other types of nongovernment publications, do not form a part of this appendix.

30. ITEM LORA MATHEMATICS. This section explains the general mathematical equations used to perform a LORA on Army systems at the item level. Item analysis is conducted to analyze specific components of an end item. The general cost equations are explained in section 40. The cost equations relating to specific support alternatives are discussed in section 50.

30.1 Present value factor. The present value factor (PVF) is used to convert annual recurring costs to a present value. The following PVF equation assumes payments are expended at midyear:

$$PVF_t = [1/(\text{Discount Rate} + 1)]^{(t-1/2)}$$

Where: "t" is the number of years in the future from which the dollar is being converted to the present value amount. This equation represents the PVF in year "t"; therefore, to obtain the present value of a recurring annual cost this value must be summed from year one to year "n" which is the last year in which the recurring annual cost will be incurred.

$$PVF = \sum_{t=1}^{n} PVF_t$$

30.2 General required parameters. These paragraphs show the equations used to compute the following general parameters: (a) common labor rate at an echelon; (b) adjusted order ship time; and, (c) adjusted turnaround time.

30.2.1 Common labor rate factor. The hourly rate of a common repairman at each echelon. It is based on the following three factors: (a) labor rate; (b) loading factor; and, (c) productivity factor.

Common Labor Rate Factor
= (Labor Rate) * (1 + Loading Factor)/(Productivity Factor)

30.2.2 Adjusted order ship time. The adjusted order ship time accounts for the administrative lead time for ordering a part at the depot and is used to calculate the initial spares required for all alternatives.

Adjusted Order Ship Time
= (Ship Time) + [1 - (Stockage Confidence Level)]
* (Procurement Lead Time)

30.2.3 Adjusted turnaround time. This is the repair cycle time at an echelon plus the ship time.

Adjusted Turnaround Time = (Turnaround Time) + (Ship Time)

30.3 Calculation of the unit failures per year. The average annual number of failures is used to compute the spares required to support the item and is based on total operating time of the system, unit's lifetime failures, and the operation life.

30.3.1 Total system operating hours. The total time the end item will be operated during the operation life.

Total Operating Time of the System
=(Number of Systems Supported)*(Annual Operating Requirements per system)*(Operation Life)

30.3.2 Total lifetime failures of the unit. This calculation involves the mean time between failure, quantity of the unit per end item, and total operating time of the system.

Total Lifetime Failures
= (Total Operating Time)*(Quantity per End Item)
/(Mean Time between Failures)

30.3.3 Unit failures per year. The is simply the average number of failures that occur each year. This value is used to calculate the number of spares required.

Unit Failures Per Year = (Total Lifetime Failures)/(Operation Life)

30.4 Annual replenishment. This is based on the unit failures per year and the false removal rate. The false removal rate accounts for units that are removed when they are really operational.

Annual Replenishment
= (Number of Unit Failures Per Year)*(1 + (False Removal Rate))

After this computation, the following four values are calculated at each level of maintenance: (a) units returned; (b) units washed out; (c) units returned after screening; and (d) units repaired. Paragraphs 30.4.1 through 30.4.4 explain the equations used to compute these values.

30.4.1 Units returned. The number of failed units that are actually shipped back for repair, excluding the failed units that are repairable, but are lost or misplaced during shipping.

Units Returned
= (Unserviceable Return Rate)*(Annual Replenishment)

30.4.2 Units washed out. The number of units returned which are nonreparable because of physical damage, loss, etc.

Units Washed Out = (Units Returned) * (Washout Rate)

30.4.3 Units returned after screening. The number of units returned to the supply system which accounts for units that have been falsely removed, and upon screening, are determined to be fully operational.

Units Returned After Screening
= (Unserviceable Return Rate)*(Unit Failures Per Year)
(False Removal Rate)(Screening Detection Fraction)

30.4.4 Number of units repaired. This number represents the actual number of units that are repaired and is used to calculate the cost per repair (labor cost, cost of materials/repair parts, etc.).

Number of Units Repaired
= (Units Returned) - (Units Washed out)
- (Units Returned After Screening)

30.5 Equations used to determine initial spares. Initial spares should be computed according to current Army policy on "sparing to availability."

30.5.1 Inputs. The calculations utilize the following inputs for retail echelons only: (a) retail stockage criteria (RSC); and, (b) operation level; The calculations utilize the following inputs for retail echelons and the depot: (1) stockage confidence level; (2) number of shops; (3) adjusted order ship time; (4) adjusted turnaround time for repair; (5) turnaround time for screening; (6) annual new demand rate; (7) annual units repaired; and, (8) annual units returned after screening.

30.5.2 Average annual demand rates.

30.5.2.1 Annual total demand.

a. Organization. The annual total demand at the organizational (ORG) maintenance level is equal to the annual replenishment.

b. Echelons above Organization. This equation is used to compute the annual total demand at all maintenance levels above ORG.

Annual Total Demand
= (Annual Total Demand at the Next Lower Level)
- (Annual Units Repaired at the Next Lower Level)
- (Annual Units Returned after Screening at the Next Lower Level)

30.5.2.2 Annual new demand. This value is computed at each level of maintenance by the following equation:

Annual New Demand at a Level
= (Annual Total Demand at a Level)
- (Annual Units Repaired at a Level)
- (Annual Units Returned after Screening at a Level)

30.5.2.3 Annual pipeline demand per site.

Annual Pipeline Demand per Site at a Level
= (Annual New Demand at the Level)/(Number of Shops at the Level)

30.5.3 Minimum average stockage per site. The following equations are used to calculate the stock that must be on hand in order to meet the average daily demand rate:

a. Minimum Average Stockage per Site at a Level not Performing Repair/Screening

= (Annual New Demand at a Level)*(Adjusted Order Ship Time) /(365) * (Number of Shops)

b. Minimum Average Stockage per Site at a Level Performing Screening

= [(New Annual Demand Rate)*(Adjusted Order Ship Time)
+ (Annual Units Returned After Screening at a Level)
* (Turnaround Time for Screening)]/(365)*(Number of Shops)

c. Minimum Average Stockage per Site at a Level Performing Repair

= [(Annual New Demand at a Level)*(Adjusted Order Ship Time)
+ (Annual Units Repaired at a Level)*(Turnaround Time for Repair)
+ (Annual Units Returned After Screening at a Level)
* (Turnaround Time for Screening)]/(365) * (Number of Shops)

30.5.4 Minimum pipeline spares.

30.5.4.1 Depot. The minimum pipeline spares at the depot is set equal to the Minimum Average Stockage per Site.

30.5.4.2 Retail echelons.

a. If the annual pipeline demand per site is less than the RSC, then the minimum pipeline spares at a level is set to the Minimum Average Stockage per site.

b. If the annual pipeline demand per site equals or exceeds the RSC, the following equation is used:

Minimum Pipeline Spares
= (Minimum Average Stockage per Site at a Level)
+ (Annual Pipeline Demand Rate)*(Operation Level)/(365)

30.5.5 Determination of whether to use the Poisson distribution or the normal approximation. This is based on the Minimum Average Stockage per Site. If it is less than 25 the Poisson distribution is used to compute the quantity of initial spares. Otherwise the normal distribution is used to approximate the Poisson. In both cases the input values to the distributions are: (a) Minimum Average stockage per site; and, (b) stockage confidence level.

30.6 Annual replenishment spares. The following equation calculates the number of consumption spares required per year at each level of maintenance.

Annual Replenishment Spares
= (Annual Replenishment) - (Annual Units Repaired)
- (Annual Units Returned After Screening)

40. COST ELEMENT EQUATIONS. This section describes the general mathematical equations used to calculate the total logistics costs.

40.1 Cost of a bin. The total bin cost is based on the setup cost, annual maintenance cost of maintaining a bin, and the number of stocking locations. The bin setup cost is the cost of adding a line item to an authorized stockage list (ASL). The annual bin cost is the annual administrative expense of stocking an item at an echelon. The summation of these two costs is the total cost of a bin. The following equations are used to calculate the total bin cost:

Bin Setup Cost = (Initial Bin Cost) * (Number of Shops)
Total Recurring Bin Cost = (Recurring Bin Cost) * (Number of Shops) * (PVF)
Total Bin Cost = (Bin Setup Cost) + (Total Recurring Bin Cost)

40.2 Cataloging costs. The onetime and annual cost of obtaining a National Stock Number (NSN) for a new part. The cost is based on the total number of new items/parts that are entering the supply system. The basic equation is:

Total Cataloging Cost
= (Initial Cataloging Cost) + (Recurring Cataloging Cost) * (PVF)

The number of new parts is based on whether the item will be stocked. This results in two possible cases. The first is when a item is discarded at failure and the second when the item is repaired.

40.2.1 Catalog cost for discard case. When an assembly is discarded at failure, its piece parts are not stocked. Therefore, only the assembly will incur a cataloging cost, if an NSN is required. However, if the item already has an NSN, no cataloging cost would be incurred.

Catalog Cost (Discard Case)
= (Number of discarded items requiring an NSN)*(Total Cataloging Cost)

40.2.2 Catalog cost for the repair case. The repair case's catalog cost is based on the number of parts needing an NSN and is computed by the equation listed below:

Catalog Cost (Repair Case)
= (Number of Parts Needing a NSN) * (Total Cataloging Cost)

40.3 Cost of transporting items. The cost to transport items between echelons is based on weight, distance between echelons, transportation rate, and the number of units transported. This is an annual cost, and therefore, must be put in terms of present value.

Cost of Transporting Items
= (Unit Pack Weight) * (Transportation Rate) * (Distance)
* (Units Transported) * (PVF)

The total units transported is based on which alternative is under analysis. The following equations shows the computation for units transported.

a. Discard Case: The number of units transported is the annual replenishment.

b. Discard with Screening at DS, GS, depot

Units Transported
= (Units Returned) + (Annual New Demand)
+ (Units Returned After Screening)

c. DS, GS, or depot repair with common TMDE/other equipment:

Units Transported
= (Units Returned) + (Annual New Demand)
+ (Units Returned After Screening) + (Units Repaired)

d. Contractor Repair:

Units Transported = (Units Returned) + (Annual Replenishment)

40.4 Cost of technical documentation. The cost of developing and procuring the technical manuals that are associated with repair of the item. It is based on the average cost per page and the number of pages required for the repair action.

Cost of Technical Documentation
= (Technical Documentation Cost) * (Technical Documentation Pages)

40.5 Support equipment cost. Support equipment costs include: procurement; development; installation; replacement; and, annual maintenance costs. The first four are nonrecurring costs associated with acquisition/reprocurement of the support equipment. Support equipment includes any tools, equipment, TPS, interface connection device (ICD), etc.

40.5.1 Nonrecurring cost of support equipment. These are the onetime costs associated with development, procurement, installation, and replacement of the support equipment.

40.5.1.1 Cost of installation. The onetime cost of installing and setting up a piece of equipment at an echelon. This value is either an input or calculated as a percentage of the unit price. When it is based on unit price, it is equal to the unit price times the installation cost factor.

Support Equipment Installation Cost
= (Unit price) * (Support Equipment Installation Cost Factor)

40.5.1.2 Replacement cost. The cost of replacing a piece of support equipment when its life span is less than the operation life of the system. This cost is based on the number of pieces of support equipment that must be procured over the operation life of the system. The required number of support equipment is obtained by dividing the operation life by the life span. The equation is written as:

Pieces of Support Equipment Required per Operation Life
= (Operation Life)/(Life Span)

The cost of the first piece of support equipment will be equal to the unit price. The cost of each replacement piece will equal the unit price multiplied by the discount factor for the year of replacement (t). The following equation takes into account that the support equipment will be replaced either in the year t or year (t+1).

Replacement Cost of Support Equipment
= (Unit Price) * $(PVF_t + PVF_{t+1})/2$

40.5.2 Maintenance cost of the support equipment. The maintenance cost is associated with maintaining an individual piece of support equipment. It is based on a percentage of the support equipment unit price (procurement cost). The mathematical equation is expressed as (in present value):

Maintenance Cost of Support Equipment
= (Unit Price) * (Support of Support Equipment Cost Factor) * (PVF)

40.5.3 Total cost of support equipment. The total cost of support equipment is the sum of all individual associated costs.

Total Cost of Support Equipment
= (Unit Price) + (Support Equipment Development Cost)
+ (Support Equipment Installation Cost)
+ (Replacement Cost) + (Maintenance Cost of Support Equipment)

The above equation calculates cost of support equipment over the life span. Since repair/screening times are usually in hours, this cost must be divided by the total hours the support equipment is available to obtain a cost per hour for support equipment.

Cost of Support Equipment per Hour
= (Total Cost of Support Equipment)
/(Support Equipment Available Hours)

40.5.4 Cost of test program set (TPS). The cost of a TPS includes development, procurement, and annual maintenance costs.

a. Development cost is usually associated with software development; however, if an ICD is used solely for screening and repair of one item then the ICD's development cost should also be included.

b. The procurement cost is the unit price of the ICD. However, an ICD will need to be procured at each maintenance shop; therefore, the total procurement cost would be the product of the unit price of the ICD times the number of shops.

Procurement Cost = (Unit Price) * (Number of Shops)

c. The maintenance cost associated with a TPS is the product of the development cost times the support of support equipment cost factor (SSECF). This is a recurring cost and must be brought back to the present using the PVF.

Maintenance Cost = (Development Cost) * (SSECF) * (PVF)

40.5.4.1 Total cost of TPS. The total cost of TPS is the sum of the development, procurement, and recurring maintenance costs. This cost will be incurred only when an item's repair/screening tasks requires the use of a TPS.

Cost of TPS
= (Procurement Cost) + (Development Cost) + (Maintenance Cost)

40.6 Initial spares cost. The initial spares cost is based on the unit price and the required number of initial spares. The equation is written as:

Initial Spares Cost
= (Unit Price) * (Number of Initial Spares Required)

40.7 Replenishment spares cost. The number of consumption spares to support the item over the operation life times the unit price.

Replenishment Spares Cost
= (Unit Price) * (Annual Replenishment Spares) * (PVF)

40.8 Requisition cost. The cost of preparing and submitting a requisition for replenishment spares/repair parts. The equation is based on the number of requisitions and the cost per requisition.

Requisition Cost
= (Cost per Requisition) * (Number of Annual Requisitions) * (PVF)

Where the number of annual requisitions is peculiar to the alternative under consideration. The number of annual requisitions for each alternative is listed below.

Number of Annual Requisitions

$$= \sum_{K=1}^{4} \text{Minimum Value ((Annual New Demand), (Number of Shops)K *(12))}$$

The "K" represents the maintenance level (ORG, DS, GS, or depot) under consideration. The following is an example: An item is discarded at the DS level; therefore, K goes from 2 to 4 (DS rate or number of shops times 12; GS rate; etc.)

40.9 Inventory holding cost. The costs incurred for storage, loss, obsolescence, etc. as a result of maintaining inventory. The general equation is based on the number of initial spares, holding cost factor, and unit price. There are two equations used to compute this cost and are based on which alternative is under analysis.

40.9.1 Inventory holding cost for discard. The mathematical equation for this case is:

Inventory Holding Cost (Discard)
= (Number of Initial Spares Required) * (Holding Cost Percentage)
* (Unit Price) * (PVF)

This equation is also used to calculate the inventory holding cost for the contractor repair alternative.

40.9.2 Inventory holding cost for repair. The inventory holding cost for the repair case is computed by the following equation:

Inventory Holding Cost (Repair)
= (Unit Price) * (Number of Initial Spares Required)
* (Holding Cost Percentage) * [1+ (Repair Material Rate)]
* (PVF)

40.10 Cost of screening. The cost to screen an item is based on the number of units screened, required screening time, labor rate factor, and cost of support equipment per hour.

Cost of Screening
= (Units Screened) * (Screening Time) * [(Common Labor Rate Factor)
+ (Cost of Support Equipment per Hour)]

40.11 Cost of repair. The cost of repair is based on whether the government performs repair or the contractor. The cost calculated by these equations includes the cost of labor and support equipment. The next two paragraphs describe the equations for both cases.

40.11.1 Cost of repair (Government). The cost of repairing an item is based on the number of units repaired, required repair time, labor rate factor, cost of support equipment per hour, and the cost of repair parts.

Cost of Repair
= (Units Repaired) * {(Cost of Repair Parts)
+ (Mean Time to Repair) * [(Common Labor Rate Factor)
+ (Cost of Support Equipment per Hour)]}

Where:

Cost of Repair Parts = (Unit Price) * (Repair Material Rate)

40.11.2 Cost of repair (contractor). The cost of repairing an item at the contractor's facility is based on the units repaired, unit price, and the unit repair contract percentage rate.

Cost of Repair (Contractor)
= (Unit Price) * (Units Repaired) * (Contractor Repair Cost Factor)

50. SUPPORT ALTERNATIVE COST. This paragraph contains the equations that compute the logistics cost for a each support alternative. The values of specific cost equations from section 40 are summed together to determine the cost of a support alternative. The resulting cost of each support alternative is compared and the most economical (least cost) support alternative is selected as the LORA economic evaluation recommendation.

50.1 Discard alternative. This is when a failed unit is discarded at failure and replaced with one from stock. In this alternative, no labor/support equipment costs are incurred. The total cost is the sum of the nonrecurring costs and recurring costs.

Discard Alternative Costs
= (Initial Spares Cost) + (Total Cataloging Cost) + (Total Bin Cost)
+ (Requisition Cost) + (Cost of Transporting Items)
+ (Inventory Holding Cost) + (Consumption Spares Cost)

50.2 Discard with screening alternative. This case is the same as for discard except there is added costs of the repairmen and support equipment associated with screening the item.

Discard with Screening
= (Initial Spares Cost) + (Total Cataloging Cost) + (Total Bin Cost)
+ (Requisition Cost) + (Cost of Screening) + (Cost of TPS)
+ (Cost of Transporting Items) + (Inventory Holding Cost)
+ (Consumption Spares Cost) + (Cost of Technical Documentation)

The cost of labor and support equipment is included in the cost of screening, as discussed in paragraph 40.10.

50.3 Repair alternative. The repair alternative is the same as for the discard with screening case, except there are associated repair costs. This equation is applicable to government repair.

Repair Alternative
= (Initial Spares Cost) + (Total Cataloging Cost) + (Total Bin Cost)
+ (Requisition Cost) + (Cost of Screening) + (Cost of TPS)
+ (Cost of Transporting Items) + (Inventory Holding Cost)
+ (Consumption Spares Cost) + (Cost of Technical Documentation)
+ (Cost of Repair)

The cost of labor and support equipment is included in the cost of screening and the cost of repair as discussed in paragraphs 40.10 and 40.11.

50.4 Contractor repair alternative. The cost of contractor repair is based on initial and consumption spares cost, transportation cost, requisition costs, inventory holding costs, and the initial and recurring cost of the contractor's program.

Cost of Contractor Repair
= (Initial Spares Cost) + (Total Cataloging Cost) + (Total Bin Cost)
+ (Requisition Cost) + (Cost of Transporting Items)
+ (Inventory Holding Cost) + (Consumption Spares Cost)
+ (Initial Contractor Repair Program Cost)
+ (Cost of Repair (Contractor))
+ (Recurring Contractor Repair Program Cost) * (PVF)
+ (Unit Price) * (Units Returned After Screening)
* (Contractor Repair Quality Factor) * (PVF)

60. SUBSYSTEM/ITEM CLASS OF MODELS. Presently, the Army does not have an approved subsystem/item level analysis model. An item level analysis automated model is in the early developmental phase.

The following data element table cross-references the definitions of appendix P with the data element categories of this method.

TABLE J-I. Data element.

INPUT DATA ELEMENT NAME	FIELD DESCRIPTION	UNITS	APPENDIX P NAME	APPENDIX P CONVERSION FACTOR	LSAR INTERFACE	RECOMMENDED DATA SOURCES
Average Cost of Interfacing Connecting Device (ICD)	9NR-	Dollars	Unit Price		No	Contractor
Annual Decay Factor for TPS Problems	5NR2	Decimal	TPS Problem Decay Factor		No	Government/ Contractor
Average Number of Pages of Technical Documentation	9N--	Number	Technical Documentation Pages		No	Government/ Contractor
Average Number of Parts Needed to Repair the Unit	7N--	Number	Average Number of Parts		Yes	Contractor/ Government
Average Repair Time	9NR2	Hours	Mean Time to Repair		Yes	Government
Average Screening TAT(GS)	7N--	Days	Repair Cycle Time		Yes	Government
Average Unit Weight	7NR2	Pounds	Unit Pack Weight		Yes	Contractor
Backorder Delay Time (Depot)	7N--	Days	Procurement Lead Time	Multiply (7)	Yes	Contractor
Base Year	5N--	Fiscal Year	Base Year		Yes	Government
Contractor Good Unit Return Percentage	6NR2	Decimal	Contractor Repair Quality Factor		No	Contractor
Contractor Repair Cost per part	6NR2	Decimal	Contractor Repair Cost Factor		No	Contractor
Contractor Repair Program Initial Cost	8N--	Dollars	Initial Contractor Repair Program Cost		No	Contractor
Contractor Repair Program Recurring Cost	8N--	Dollars	Recurring Contractor Repair Program Cost		No	Contractor
Diagnostic TPS Development Cost	9N--	Dollars	Support Equipment Development Cost		Yes	Contractor

TABLE J-I. Data element - continued.

INPUT DATA ELEMENT NAME	FIELD DESCRIPTION	UNITS	APPENDIX P NAME	APPENDIX P CONVERSION FACTOR	LSAR INTERFACE	RECOMMENDED DATA SOURCES
Discount Rate	5NR2	Decimal	Discount Rate		Yes	Government
End-to-End TPS Development Cost	9N--	Dollars	Support Equipment Development Cost		Yes	Contractor
Factors Input Filename	10XL-	None			No	
Failure Rate	9NR3	Failures/ Million Hrs	Mean Time Between Failure	1/MTBF	Yes	Contractor
False Pull Rate	6NR2	Decimal	False Removal Rate		No	Contractor
Holding Cost Percentage	5NR2	Decimal	Holding Cost Percentage		Yes	Government
Inflation Rate	5NR3	Decimal			No	Government
Initial Bin Cost	7NR2	Dollars	Initial Bin Cost		Yes	Government
Initial Cataloging Cost	7NR2	Dollars	Initial Cataloging Cost		Yes	Government
Initial Cost of Test Equipment (TE)	9N--	Dollars	Unit Price		Yes	Government/ Contractor
Labor Rate per Hour	9NR2	Dollars	Labor Rate		Yes	Government
Number of General Support (GS) and Depot Sites	8N--	Number	Number of Shops		Yes	Government
Number of Parts (NSN)	5N--	Number	Number of Parts Needing NSN		No	Contractor
Number of Systems Deployed	8N--	Number	Total Systems Supported		Yes	Government
Operating Level at GS	7N--	Days	Operation Level		Yes	Government
Order Ship Time at GS	7N--	Days	Ship Time		Yes	Government

TABLE J-I. Data element - continued.

INPUT DATA ELEMENT NAME	FIELD DESCRIPTION	UNITS	APPENDIX P NAME	APPENDIX P CONVERSION FACTOR	LSAR INTERFACE	RECOMMENDED DATA SOURCES
Output Filename	10XL-	None			No	
Quantity per System	7N--	Number	Quantity Per End Item		Yes	Contractor
Recurring Bin Cost	7NR2	Dollars	Recurring Bin Cost		No	Government
Recurring Cataloging Cost	7NR2	Dollars	Recurring Cataloging Cost		No	Government
Retail Stockage Criterion	7N--	Demands/Yr	Retail Stockage Criteria		No	Government
Repairmen Overhead Rate	9NR2	Decimal	Loading Factor		No	Government
Repairmen Productivity Rate	9NR2	Decimal	Productivity Factor		No	Government
Requisition Cost	7NR2	Dollars	Cost per Requisition		No	Government
Screening Time	9NR2	Hours	Screening Time		Yes	Government
Shipping Distance From DS	9N--	Miles	Distance		Yes	Government
Stockage Confidence Level	9NR2	Decimal	Stockage Confidence Level		No	Government
Successful Screening Rate	5NR2	Decimal	False Removal Detection Fraction		Yes	Contractor
Support Equipment Installation Factor	9NR2	Decimal	Support Equipment Installation Cost Factor		No	Contractor
Support Equipment Recurring Maintenance Factor	9NR2	Decimal	Support of Support Equipment Cost Factor		No	Contractor
System CCA Cost Adjustment Factor (optional input)	6NR2	Fractional Number			No	

TABLE J-I. Data element - continued.

INPUT DATA ELEMENT NAME	FIELD DESCRIPTION	UNITS	APPENDIX P NAME	APPENDIX P CONVERSION FACTOR	LSAR INTERFACE	RECOMMENDED DATA SOURCES
System Failure Adjustment Factor (optional input)	6NR2	Fractional Number			No	
System Life	8N--	Years	Operation Life		Yes	Government
System Name	10AL-	None	End Item Acronym Code		Yes	Government
System Input Filename	10XL-	None			No	
System Operating Hours	8N--	Hours/YR	Annual Operating Requirements		Yes	Government
Technical Documentation Cost per Page	7NR2	Dollars	Technical Documentation Cost		No	Contractor/ Government
Test Equipment Hours Available at GS and Depot	9N--	Hours	Support Equipment Available Hours		Yes	Government
Test Equipment (TE) Life	9N--	Years	Life Span		Yes	Government
TPS Cost Adjustment Factor (optional input)	6ND2	Fractional Number			No	
TPS Initial Problem percent	5NR2	Decimal	TPS Problem Factor		No	Contractor
TPS Modification Cost Factor	5NR2	Decimal	Support of Support Equipment Cost Factor		No	Contractor
TPS Software Correction Cost Factor	5NR2	Decimal	Support of Support Equipment Cost Factor		No	Contractor
Transportation Cost per pound-mile	7NR4	Dollars/ lb-mi	Transportation Rate		No	Government
Turnaround Time (TAT)	9N--	Days	Repair Cycle Time		Yes	Government

TABLE J-I. Data element - continued.

INPUT DATA ELEMENT NAME	FIELD DESCRIPTION	UNITS	APPENDIX P		LSAR INTERFACE	RECOMMENDED DATA SOURCES
			NAME	CONVERSION FACTOR		
Unit Cost	7N--	Dollars	Unit Price		Yes	Contractor
Unit Complexity	1NL-	None	Circuit Card Assembly Classification		No	Contractor
Unit ICD Cost	7N--	Dollars	Unit Price		Yes	Contractor
Unit Name	13XL-	None	Item Name		Yes	Government
Unit Number	10XL-	None	LSA Control Number		Yes	Contractor
Unit Repair Part Cost Rate	9NR2	Decimal	Repair Material Rate		No	Contractor
Unit Washout Rate	9NR2	Decimal	Washout Rate		No	Government
User Return Rate	9NR2	Decimal	Unserviceable Return Rate		No	Government
User Return Ship Time	9N--	Days	Ship Time		No	Government
Unit Type	1AL-	None	Circuit Card Assembly Classification		No	Contractor

ARMY METHOD 3

10. SCOPE

10.1 Purpose. This appendix implements the basic mathematical requirements pertaining to the development of Level of Repair Analysis (LORA) economic evaluations on the system/end item under the cognizance of the Army. This method provides a means of examining all feasible support alternatives for Army System/End Item within the constraints of existing Army maintenance policies. The objective of this method is to determine the most economical support alternative for an end item.

10.2 General. A system/end item LORA is conducted to determine the maintenance policies for the entire system and all indenture levels below the system. A system/end item LORA is especially necessary where line replacement units (LRU) and shop replacement units (SRU) are sharing test, measurement and diagnostic equipment (TMDE), and repairmen. The cost associated with the TMDE and repairmen is a significant portion of the system's cost.

10.2.1 Applicabilities and considerations. A system/end item LORA is applicable throughout all phases of a system's life cycle and consists of an iterative process to determine level of repair/discard alternative(s) based on economic considerations.

10.2.2 Capabilities. A system/end item LORA program is an integral part of the logistic support analysis (LSA) program defined in MIL-STD-1388-1A, Logistic Support Analysis, subtask 303.2.7, Repair Level Analyses. Thus, the system/end item LORA integrates design, operations, and logistic support characteristics/constraints to establish the maintenance level at which an item will be replaced, repaired, or discarded. Therefore, an Army system/end item LORA, should include the following capabilities:

10.2.2.1 Capabilities of analyzing different maintenance structures. The model should have the capability to analyze up to four levels of maintenance. If not all four levels are applicable, the model should also have the ability to screen out or eliminate those levels which are not used. The model should also have the ability to evaluate contractor versus organic repair.

10.2.2.2 Flexible. The model should have the capability to be tailored, so that for each item, maintenance levels that are not feasible because of noneconomic considerations (i.e., safety, security, skill level, etc.) will be eliminated from consideration.

10.2.2.3 Capable to simultaneously optimize supply and maintenance policies while achieving an operational availability (Ao) goal. That is, a system/end item LORA determines which echelon each maintenance function should be performed, or whether the item should be discard, while also determining optimal spares by echelon to achieve an Ao goal at minimum cost.

10.2.2.4 To consider both special TMDE and repairmen in support of a desired maintenance policy. TMDE and repairmen are to be used with any one of the repair actions. In addition, a piece of TMDE or a repairman is to be treated as either common or peculiar at a particular echelon. If a piece of TMDE or a repairman is treated as common at a particular echelon, only the fractional part of time the TMDE/repairman works on the system will get charged to the system. If a piece of TMDE or a repairman is treated as peculiar, the entire cost of that TMDE/repairman will be charged to the system, regardless of the fraction of time it/he is actually used on the system.

10.2.2.5 To perform tradeoff among different repair methods. When there are numerous available test equipment sets and numerous ways of accomplishing a repair, tradeoffs analyses should applied to minimize the repair costs and maximize the repair efficiency. The logistics costs may depend on repair alternatives, test program sets (TPS), documentation, and common labor. Often, it is a tradeoff between more expensive test equipment and lower logistics costs.

10.2.2.6 To screen the false removals. A system/end item LORA should have the capability to verify a removed item, is indeed failed before it is sent back for repair or to be discarded.

10.2.3 Hardware breakdown. In order to do a LORA, a hardware breakdown structure has to be defined, and the standard inputs needed for each level have to be identified. The hardware breakdown starts with end item, LRU (component), SRU (module), and piece part. The following is a list of inputs needed for each indenture:

End Item	Mean time between failure (MTBF), mean time to repair (MTTR), end item life time, annual operating hours, target availability, false removal rate, turnaround time (TAT), number of repair alternatives, and test equipment/repairman.
LRU	MTBF, MTTR, LRU unit price, false removal rate, washout rate, packing shipping weight, TAT, number of repair alternatives, test equipment/repairman, diagnostic time, number of pages of technical documentation, TPS development cost.
SRU	MTBF, MTTR, SRU unit price, false removal rate, washout rate, packing shipping weight, TAT, number of repair alternatives, test equipment/repairman, diagnostic time, number of pages of technical documentation, TPS development cost.
Piece Part	Total MTBF, price of parts used in average repair action, false removal rate, washout rate, weight of parts used in average repair action, total number of parts.

20. APPLICABLE DOCUMENTS

20.1 Government documents.

20.1.1 Specifications, standards, and handbooks. The specifications, standards, and handbooks cited in 2.1 form a part of this appendix to the extent specified under 2.1.1.

20.1.2 Other government documents, drawings, and publications.

USAIRO-TR-87/2	Optimum Supply and Maintenance Model Technical Documentation
TR 80 - 2	Mathematics for SESAME Model
User's Guide	Optimum Supply and Maintenance Model, Release 2.0
AMC-P 700-27	Logistics Level of Repair Analysis (LORA) Procedure Guide

20.2 Nongovernment publications. Nongovernment standards or other types of nongovernment publications do not form a part of this appendix.

30. SYSTEM/END ITEM MATHEMATICS. 30.1 explains the general mathematical equations used to perform a LORA on Army system at the system/end item level. An explanation of variable definitions can be found in appendix P. Definitions not found in appendix P can be found in appendix B. The data element matrix contained in the section crossreferences the definitions of appendix P with the data element categories used in the automated model. The cost equations relating to basic costs are discussed in 30.2. The equations used in tradeoffs of test equipments and repair alternatives are provided in 30.3; and, the Ao in 30.4.

30.1 General mathematical equations. The equations used to compute present value factor, common labor rate factor, failures, and removals are explained below:

30.1.1 Present value factor. The present value factor (PVF) is used to convert annual recurring costs to a present value. The PVF for the n-th year payment expended at midyear is $\{1/[1 + (\text{Discount Rate})/100]\}^{n-1/2}$. The following PVF equation assumes payments are uniform and expended at midyear:

$$\text{Present Value Factor} = \sum_{t=1}^{\text{Operation Life}} \{1/[1 + (\text{Discount Rate})/100]\}^{t-1/2}$$

30.1.2 Common labor rate. The common labor rate is the hourly rate of a common repairman at each echelon and is based on the following three factors: (a) labor rate; (b) loading factor; and, (c) productivity factor. The mathematical expression is:

$$\text{Common Labor Rate} = (\text{Labor Rate})*(1 + \text{Loading Factor})/(\text{Productivity Factor})$$

30.1.3 Failures and removals. The failure rate and removals are required elements to compute logistical costs. The failure rate for an LRU or SRU is the sum over all failure modes in which it is involved. In general, it is assumed that those LRU failures, which result in washouts, do not generate SRU failures.

30.1.3.1 Failures of I-LRU. The following equations are used to compute the I-LRU failure rates caused by the failures of a J-SRU:

I-LRU Failure Rate = Sum over all failures caused by the failures of a J-SRU in the I-LRU

That is, $$\text{Failure(I)} = \sum_{J} \text{Failure(IJ)}$$

30.1.3.2 Removals for I-LRU. The removals for an LRU includes the failures of the LRU and removals of nonfailed LRUs. The removals of nonfailed LRUs or SRUs are called False Removals. The equation to compute I-LRU removals is:

I-LRU Removals
= (I-LRU Failures) + (I-LRU False Removals)
= (I-LRU Failures)*[1 + (I-LRU False Removal Rate)].

Where a false removal of a nonfailed LRU or SRU is due to an error or ambiguity in diagnosis. The false removals are computed as (I-LRU Failures)* (I-LRU False Removal Rate). The false removal rates may vary for different LRUs and SRUs.

30.1.3.3 I-LRU removals caused by J-SRU failures. The removal of I-LRU is the sum of I-LRU failures caused by J-SRU failures and I-LRU false removals.

I-LRU Removals caused by J-SRU Failures
= Failure(I)*[1 + False Removal Rate of I-LRU]

30.1.3.4 J-SRU failures. The J-SRU's failures and removals are adjusted downward to reflect LRUs that are washed out or discarded. The distinction is that discards are a matter of repair policy and occur before the attempt to repair is made, while washouts occur during repair.

J-SRU Failures

$$= \sum_{I} \text{(Total J-SRU related I-LRUs Failures)*[1 - (J-SRU related I-LRU Discard Rate)]*[1 - (I-LRU Washout Rate)]}$$

30.1.3.5 J-SRU removals. The number of removals includes number of failures and number of false removals. That is,

J-SRU Removals = (J-SRU Failures) + (J-SRU False Removals)

A maintenance policy impacts removal rates. If a maintenance policy is to discard an LRU rather than repair it, the demand for the SRUs used to repair that LRU will be eliminated. An inherent washout rate is a certain percentage of removals which cannot be fixed regardless of the maintenance policies chosen. When a discard policy is selected, the washout rate is 100 percent.

30.2 Basic costs. In order to perform LORA thoroughly, it is essential to include cost elements that affect the repair level decision. The basic costs categories are: supply related costs; repair related costs; and, screening costs. The following provides the mathematical equations related to each of these three cost categories.

30.2.1 Supply related costs. This cost category includes discard costs, stockage costs, backorders, bin costs, requisition costs, and transportation costs.

30.2.1.1 Discard costs. Discard Cost is the cost of reoccurring items to maintain a certain level of spares in the supply system. Discard costs for a certain I-LRU and J-SRU are computed as follows:

I-LRU Discard Costs = (Cost of I-LRU)*(Failures of I-LRU + False Removal of I-LRU)*(Washout rate of I-LRU)*PVF

J-SRU Discard Costs = (Cost of J-SRU)*(Failures of J-SRU + False Removal of J-SRU)*(Washout rate of J-SRU)*PVF

30.2.1.2 Stockage costs. The stockage costs are affected by LRU or SRU unit prices, number of stocking units at K-maintenance echelon, and the maximum permissible percentage of time (MPPT) that a system is down because of the unavailability of an LRU or SRU. In order to achieve the minimal stockage costs with the constraint MPPT, the following terms are defined:

Stock(K,I) Number of I-LRU or I-SRU stocked at an K-maintenance echelon.

N(K) Number of stocking units at the K-maintenance echelon.

UP(I) Unit Price of I-LRU or I-SRU.

Expected Backorder(K,I) = Expected amount of I-LRU or I-SRU backordered at K-maintenance echelon.

RTD(K,I) Replacement task distribution percent, a standard Army provisioning element indicating the numeric percent of I-LRU or I-SRU is removed and replaced at K-maintenance echelon.

Backorder Penalty Cost(I) = Cost for backordered I-LRU or I-SRU.

Stockm(K,I) is selected to minimize the total stockage costs (including the backorders penalty) defined in the following mathematical expression:

$$\sum_{I} \sum_{K} \text{Stock}(K,I) * N(K) * UP(I)$$

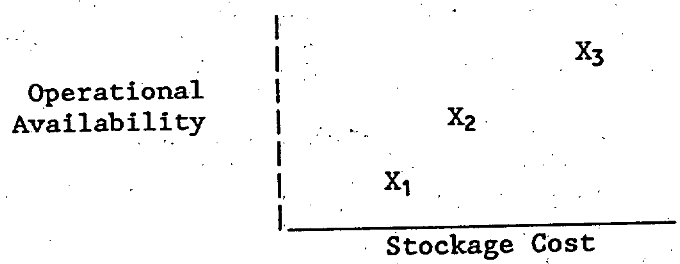
$$+ \sum_{I} \sum_{K} \text{Expected Backorders}(K,I) * RTD(K,I) * N(K) * \text{Backorder Penalty Cost}(I)$$

Then the Stockage Cost is $\sum_{I} \sum_{K} \text{Stock}_m(K,I) * N(K) * UP(I)$.

30.2.1.2.1 Expected backorders. Backorders depend on the demand rate at user level, stockage at user level, repair turn around time if the item (i.e., LRU or SRU) is repairable at user level, and order and ship time to get the item from the user's supplier at the next maintenance echelon. The order and ship time depends on transportation times and on whether the next echelon supplying the unit is in stock. Backorder calculations work from the top maintenance echelon downward. That is, if the support structure consists of organization (ORG), direct support (DS), and depot (DEP, wholesale), for example, then DEP performance is to be determined first. This result is needed to calculate the order and ship times the DS will experience. Next DS supply performance is calculated to determine the order and ship times the ORG will experience and, finally, calculate user backorders.

The Expected backorders are computed for one item at a time. The negative binomial distribution is used to compute the expected backorders.

30.2.1.2.2 Backorder penalty depends on whether or not the item is an LRU. The backorder penalty for all LRUs is the same since unavailability of any LRU has the same effect: it downs a system. The penalty cost is called the "CURPAR". For a particular penalty cost, CURPAR, there is a solution for stockage units, a total inventory investment, and total expected backorders. Since it is an optimum solution, it is known that no other pattern of stocking costing less could result in fewer expected backorders. There may be a least cost solution, but the expected backorders may not correspond to the target Ao. If the backorders are too high, the CURPAR will be raised to get another solution. The new solution will spend more on stockage, since each backorder avoided now reduces cost by a greater amount, the higher CURPAR. The figure below corresponds to the solutions found with successively higher CURPARs.



From the curve, the CURPAR needed to achieve the Ao is found. The backorder penalty for a non-LRU depends on the cost of its next higher assembly and the CURPAR. When the average number of backorders for a non-LRU is increased by one, at least one additional next higher assembly must be invested to compensate for the additional assembly lying unused somewhere awaiting the non-LRU so it can be fixed.

30.2.1.3 Bin costs. Bin costs are those management and holding costs which vary as a function of the range of items stocked rather than the dollar value or quantities stocked. The bin cost parameter is the cost per national stock number (NSN) per stockage location for each LRU or SRU. Therefore, the bin costs depend on the number of stockage locations and where the LRUs or SRUs are. The bin cost parameter is the sum of the initial cost of opening a bin and the annual recurring cost to maintain a bin. The bin costs are computed as below:

Bin Cost Parameter = (Initial Bin Cost)
+ (Present Value Factor)*(Recurring Bin Cost)

BIN COSTS = (Bin Cost Parameter)*(Number of stocking Locations)

30.2.1.4 Requisition costs. Requisition cost is the administrative cost to process a requisition. For each maintenance location, one-for-one requisitioning, is assumed up to 12 requisitions a year for 1 item.

REQUISITION COSTS = (Cost per Requisition)*(Present Value Factor)
*(Number of Total Requisitions)

30.2.1.5 Transportation costs. The transportation costs include the costs to supply the user and the costs to retrograde unserviceables. Placing repair closer to the user reduces distance traveled both ways. However, placing LRU repair forward (forward movement: from DEP to general support (GS) to DS to ORG), can increase transportation costs for the SRUs needed for the repair. Once the costs per pound-mile between DEP-GS, GS-DS, and DS-ORG are given, the retrograde costs are assumed to be the same as costs of forward movement. If there are no GSs, for example, there will be only two costs input: DEP-DS and DS-ORG. It may be, however, that there are GSs for repair but the DS requisitions directly from the DEP when an item cannot be repaired in theater. In this case the DEP-GS cost is used for forward movement, even though the functioning item is going directly to the DS, but the GS-DS cost is used for the movement of unserviceables from DS to GS, and back, after they are repaired. Finally, in computing retrograde costs it is assumed washouts are moved to a repair facility before being discarded (unless there is a 100 percent discard policy for the item). If the item is repaired at two or more different maintenance echelons (split maintenance policy), it is assumed the washouts are discarded at each maintenance echelon in proportion to the amount of repair done there. The transportation cost between maintenance echelons is computed as below:

Transportation Cost between Maintenance Echelons
= (Transportation Cost Rate between Maintenance Echelons)
(Distance between Maintenance Echelons)(Weight of items)

30.2.2 Repair related costs. Repair related costs include labor, parts, cost of developing manuals, test equipment costs, cost of developing diagnostic software to be used with automated test equipment, and cataloging costs. There are two types of labors: common and special skills. Specially skilled personnel are more costly, and they may not be fully used.

30.2.2.1 Common labor. Common labor uses the average hours of labor to repair each LRU or SRU and a common labor rate. The common labor also includes the specified diagnostic time for each false removal and washout which passes through a repair facility, is not repaired, but is diagnosed. Because of differences in pay scales and working hours by maintenance echelon, the same job will incur a different cost depending on the K-maintenance echelon at which it is done. The cost adjustment factor induced by this differences is REPMUL(K), the constant given to K-maintenance echelon to compensate the repair cost differences among the maintenance echelons.

30.2.2.1.1 Total cost to repair I-LRU due to J-SRU failure. The following equations are used to compute the total repair cost, per end item, for an I-LRU failure, induced by a J-SRU failure. Such failure is represented by (IJ)-Failure.

Cost, per end item, to diagnose an I-LRU only and not repair
= (Diagnostic Time)*(Cost to Repair a (IJ)-Failure)
*(Number of (IJ)-Failures)
*[1+(I-LRU False Removal Rate)]

Cost, per end item, to repair a (IJ)-Failure
= (Cost to Repair a (IJ)-Failure)*(Number of (IJ)-Failures)
*[1 - (I-LRU Washout Rate)]

Total Cost, per end item, to repair a (IJ)-Failure
= (Cost, per end item, to diagnose an I-LRU only and not repair)
+ (Cost, per end item, to repair a (IJ)-Failure)

The following equations are to compute the total repair cost for all (IJ)-Failures:

The total cost to repair (IJ)-Failures
= (Total Cost, per end item, to repair a (IJ)-Failure)
(World wide Density)(Present Value Factor)
[$\sum_{K}^{4}$ REPMUL(K)(Fraction of (IJ)-failures being induced
into K-maintenance echelon for repair)]

30.2.2.1.2 Total cost to repair J-SRU failures. The computation total repair costs for the J-SRU failure (represented by J-Failure) is very similar to that of (IJ)-Failure.

Cost, per end item, to diagnose a J-SRU only and not repair
= (Diagnostic Time)*(Cost to Repair a J-Failure)
*(Number of J-Failures)
*[1+(J-SRU False Removal Rate)]

Cost, per end item, to repair a J-Failure
= (Cost to Repair a J-Failure)*(Number of J-Failures)
*[1 - J-SRU Washout Rate]

Total Cost, per end item, to repair a J-Failure
= (Cost, per end item, to diagnose a J-SRU only and not repair)
+ (Cost, per end item, to repair a J-Failure)

The following equations are to compute the total repair cost for J-Failure:

The total Cost to repair J-Failure
= (Total Cost, per end item, to repair a J-Failure)
(World-wide Density)(PVF)
[$\sum_{K}^{4}$ REPMUL(K)(Fraction of J-Failures being inducted into K-maintenance echelon for repair)]

30.2.2.2 TPS and documentation cost. TPS costs consist of the development cost of diagnostic software and interconnection devices. They are used with automated test equipment. A TPS is always associated with an LRU or a SRU, and a repair alternative. Therefore, the total TPS costs for I-LRU or J-SRU and with IA-repair alternative, represented by TPS(I,IA), is computed as follows:

TPS(I,IA) = (Development costs for TPS to diagnose I-LRU (or I-SRU) with IA-repair alternative) + (Present value factor) *(Annual maintenance cost for TPS),

where,

Annual maintenance cost for TPS
= (Development costs for TPS to diagnose I-LRU (or I-SRU) with IA-repair alternative)*(Annual maintenance cost factor for TPS)

Cost of Documentation to repair with repair alternative IA for I-LRU (or I-SRU) or application, represented by DOC(I,IA), is calculated as follows:

DOC(I,IA)
= (Cost of technical documentation per page)*(Number of pages)

30.2.2.3 Parts cost. For each J-SRU, an average part cost, APARTCST(J), is estimated to represent all parts used in repairing the J-SRU. The number N(J) of demands on a part is estimated as the total demand for the J-SRU, minus the number of J-SRU washouts (because the washed out SRUs do not need parts for repairing). Once APARTCST(J) and N(J) are determined, the stockage and all logistics costs (discard, requisitioning, and bin costs) can be calculated as stated before. The holding cost, consumption part cost, and part cost for J-SRU, PARTCOST(J) are calculated as follows:

Holding Cost = (Initial Parts Cost) * (Holding Cost Fraction) *(Present Value Factor)

Consumption Part Cost = APARTCST(J)*N(J)*PVF, and

PARTCOST(J) = (Initial Parts Cost) + (Consumption Parts Cost) + (Holding Cost) + (Requisitioning Cost) + (Bin Cost),

30.2.2.4 Catalog costs. When a new item, LRU, SRU, or piece part, is introduced to the system, each item needs to be coded. A new item requires cataloging. The catalog costs include initial cost of cataloging each item and the recurring annual cost to maintain the cataloging information for the item. The costs are computed as follows:

Catalog Costs = ((Initial Cataloging Cost per item)
+ (Annual recurring Cost per item)*(Present Value Factor))
*(Number of new items)

30.2.2.5 Test equipment and special manpower costs. The test equipment costs include: (a) costs of all types of test equipments for all K-maintenance echelons; (b) annual recurring maintenance costs which is expressed as a percentage of test equipment purchase price; (c) costs of replacing the test equipment when the test equipment life is less than the weapon system's life; and, (d) test equipment installation costs. The special manpower costs consist of the costs for a repairmen's salary and the cost of training for all K-maintenance echelons.

The Costs for Test Equipment at K-maintenance echelon
= (Test Equipment Unit Price at K-maintenance echelon) + (Annual maintenance cost factor for test equipment at K-maintenance echelon)*(Test Equipment Unit Price at K-maintenance echelon)
(Present Value Factor)(Number of Units Procured)
+ (Test Equipment installation cost at K-maintenance echelon)
+ (Test Equipment Replacement Cost),

where,

Test Equipment Replacement Cost
= (Test Equipment Unit Price at K-maintenance echelon)
(Present Value Factor of Test Equipment at K-maintenance echelon)
(Number of Units Procured)

The repairman Costs at K-maintenance echelon
= {(The repairman's annual salary at K-maintenance echelon)*[1 + (the repairman's salary loading factor at K-maintenance echelon)]
+ (Training cost for repairman at K-maintenance echelon)/(Turnover period for repairman at K-maintenance echelon)}*(Number of Repairmen Needed)
*(Present Value Factor)

30.2.3 Screening costs. The purpose of screening is to detect false removals at or near the maintenance echelon where they are removed. This will ensure that the false removals are not discarded. Screening could reduce initial spares. Thus screening can reduce inventory in transit, and hence also reduce transportation and requisition costs. To track total screening cost, it requires common labor costs, test equipment, and special repairman work load associated with screening. The following terms are used to compute the cost of screening:

$scr_i(K,M)$ Decision variable denoting the percent of i item's removals which are screened at K-maintenance echelon and are sent to M-maintenance echelon for repair if not good. Where K = 1 (ORG), 2 (DS), 3 (GS), or, 4 (DEP); and, M = 1 (ORG), 2 (DS), 3 (GS), 4 (DEP), or 5 (WASHOUT).

MTD(K,I) Maintenance task distribution for I-LRU at K-maintenance echelon. It is a percentage breakout of the repair of I-LRU at K-maintenance echelon.

MTDS(K,I) Maintenance task distribution percentage adjusted by screening.

RTD(K,I)	Replacement task distribution for I-LRU at K-maintenance echelon. It is a percentage breakout of the replacement of I-LRU at K-maintenance echelon.
ADJSC	Adjustment of screening cost is the maximum percentage MTD attributable to screening.
ERRATE(i)	Erroneous removal rate of i item, i.e., the ratio of false removals to failures.
DET(i)	Detection rate, i.e, the fraction of false removals which will be found if i item is screened.
WASH(i)	Washout rate if repair of i items is attempted.
REPR(i)	Replenishment rate of i item.
REPRS(i)	Adjusted replenishment rate of i item because of screening.
SCREXP(i)	Screening cost of i item.
REPSAV(i)	Repair saving because of screening i item.
OUPS	Operational units of program, i.e., the worldwide density of end items supported.
REPC(i,2)	Repair cost of i item without screening.
REPMUL(K)	The constant given to K-maintenance echelon to compensate the repair cost differences among the maintenance echelons.
TATSCR(K,I)	Turnaround time for screening I-LRU at K-maintenance echelon. It is an input element.
LOGSAV(i)	Logistics saving because of screening i item.

The screening processes may be considered as a "shift forward" of the maintenance task distribution (MTD) in terms of repair of good I-LRUs/SRUs. The stockage implications of this adjustment to the repair pipeline can be assessed. The equations, used to compute the adjusted MTD, screening costs, and repair savings because of screening are provided as follows:

$$ADJSC = ERRATE(i)*DET(i)*[\ 1 - WASH(i)]/(\ 1 + ERRATE(i))$$

The numerator of the above equation is the maximum potential for repairing good items, i.e., the percent detected (DET) of those erroneously removed (ERRATE) of those that would not be washed out (1-WASH). The denominator is the total removal stream for the i item. Hence ADJSC is the maximum percentage of MTD attributable to screening; and, the following equations are to compute the percentages which can be appended to corresponding maintenance echelons' MTDs because of screening. Each MTD is based on the percentage (+scr) of the removal stream which is screened at that maintenance echelon, or the percentage (-scr) of the removals which do not reach that maintenance echelon for repairs because of lower level screening. REPRS(i) is the reduced replenishment rate because of capture of the good items which, without screening, would have been discarded.

$$MTDS(1,i) = MTD(1,i)$$

$$MTDS(2,i) = MTD(2,i) + ADJSC*[scr_i(2,3) + scr_i(2,4) + scr_i(2,5)]$$

$$MTDS(3,i) = MTD(3,i) + ADJSC*[scr_i(3,4) - scr_i(2,3) + scr_i(3,5)]$$

$$MTDS(4,i) = MTD(4,i) - ADJSC*[scr_i(2,4) + scr_i(3,4) - scr_i(4,5)]$$

$$REPRS(i) = REPR(i) - ADJSC*[scr_i(2,5) + scr_i(3,5) + scr_i(4,5)]$$

The screening cost of item i, is the product of two parts. The first part of the product is the total cost of one screening action for item i. The second part of the product is the total removal stream of the item for a system density OUPS. That is,

$$SCREXP(i) = [\sum_K \sum_M scr_i(K,M)*REPMUL(K)]* [(1 + ERRATE(i))*FAIL(i)*OUPS*REPC(i,2)]$$

The repair savings are the same as the total repair costs avoided because of screening. The total repair savings is calculated as follows:

$$REPSAV(i) = [\sum_K \sum_M scr_i(K,M)*REPMUL(K)]*[ERRATE(i)*DET(i)*OUPS*REPC(i,2)] *[1 - WASH(i)]$$

Another savings attributed to screening is the logistics costs, LOGSAV. To calculate the logistics savings first, MTD, REPR, TAT, and other required factors are used to compute logistics costs, such as: discard, bin, stockage, transportation, and requisition costs. Then, determine the adjusted MTD, REPR, TAT, and other required factors to obtain the adjusted logistics costs. The LOGSAV, the saving in logistics cost due to screening, is the difference between unadjusted logistics cost and the adjusted logistics cost. The adjusted turnaround time, TATS(K,I), is required to compute the adjusted logistics cost. The following equation is used to calculate TATS(K,I):

$$TATS(K,I) = [MTD(K,I)/MTDS(K,I)]*TAT(K,I) + [1 - MTD(K,I)/MTDS(K,I)]*TATSCR(K,I)$$

Where the expression, MTD(K,I)/MTDS(K,I), represents the portion of maintenance at K-maintenance echelon is for repair only, not screening, and $MTD(K,I)/MTDS(K,I) <= 1$.

If $MTD(K,I)/MTDS(K,I) > 1$, then $TATS(K,I) = TAT(K,I)$; i.e., the higher maintenance echelons are considered repair only.

30.3 Tradeoffs of test equipment and repair alternatives. In order to minimize the repair costs and maximize the repair efficiency, different ways of accomplishing repair and test equipment sets are compared for tradeoff analyses. The logistics costs depend on repair alternatives, TPSs, documentation, and common labor. Often, it is a tradeoff between more expensive test equipment and lower logistics costs. In order to perform tradeoff analyses effectively, it is strongly recommended that a mathematical process called Mixed Integer Programming (MIP) should be used. To explain the reasons for using MIP, consider the maintenance echelons consisting of ORG, DS, GS, DEP, and Discard; and, consider there are three indentures: End Item Repair, LRU Repair, and SRU Repair. There are many maintenance policies which can be derived from these five maintenance echelons and three indentures. For true optimization capability, policies may vary by failure mode.

The derivation of a different maintenance policy and repair alternative will induce different logistics costs for each failure. A set of repair alternatives may have the least logistics costs, but the implementation of this set could require some costly test equipment and special repair skills.

On the other hand, some policies may minimize test equipment costs; however, the logistics costs could be very excessive. If each piece of test equipment was used for just one failure mode, the test equipment cost could be included with logistics costs in choosing the policy alternative for that mode. When a test equipment has many uses, selection of the policy is no longer for one failure mode independent of the policies chosen for other failure modes. LORA should provide optimum stockage for a given Ao, and a LORA model should be able to examine many (more than two) maintenance echelons simultaneously. Furthermore, LORA should be able to relate the maintenance policies to the quantity and location of a test equipment required. As in many cases, maintenance policies for different failure modes must be coordinated not only to reduce the number of locations for test equipment, but the quantity per location. A MIP is an approach which can minimize the total cost of equipment and overall logistics costs.

30.4 Evaluation of operational availability (Ao). The Ao of the weapon system is considered in selecting the maintenance policies to minimize the total repair costs. The Ao is estimated as follows:

Ao = MCTBF/(MCTBF + MTTR + MOST + MLDT), where

MCTBF Mean calendar time between failures.

= [Calender hours per year (8760)]/(Average number of failures per year)
= (8760 hours)/[(Annual operating hours)/MTBF]

MTTR Mean time to repair (MTTR) the weapon system if all resources are available.

MOST Mean order ship time (OST). This is a function of the repair level decisions. If the system is always repaired at ORG level with ORG personnel and equipment then MOST is 0; otherwise, MOST is the average OSTs.

MLDT Mean logistics down time.

40. SYSTEM/END ITEM ANALYSIS CLASS OF MODELS. System/End Item Analysis Class of models. This method is categorized as system/end item class of LORA. The Army approved automated models for conducting system/end item LORA are the Logistics Analysis Model (LOGAM) and the Optimum Supply and Maintenance Model (OSAMM). AMC-R-700-27, LORA Program provides policy regarding the use of specific models/techniques to conduct Army LORA evaluations.

The following data element table cross-references the definitions of appendix P with the data element categories of this method.

TABLE K-I. Data element.

INPUT DATA ELEMENT NAME	FIELD DESCRIPTION	UNITS	APPENDIX P		LSAR INTERFACE	RECOMMENDED DATA SOURCES
			NAME	CONV FACTOR		
End Item Identification	10X-	No	End Item Acronym Code		No	Contractor
LRU or SRU Name	10X-	No	Item Name		No	Contractor
End Item Unit Price	10ND-	Dollars	Unit Price		Yes	Contractor
Price of Parts used in Average Repair Action	7ND-	Dollars	Repair Material Cost		No	Contractor
Life	3N--	Years	Operation Life		Yes	Contractor
Test Equipment Life	4N--	Years	Life Span		No	Contractor
End Item Mean Time to	5ND2	Hours	Mean Time to Repair		Yes	Contractor
Diagnostic Time	5ND2	Hours	Diagnostic Time		No	Contractor
Screening Time	5ND3	Hours	Screening Time		No	Contractor
Turnaround Time	3ND-	Days	Repair Cycle Time		No	Contractor
Operational Availability	3ND3	No	Operational Availability		No	Contractor
Retail Stockage Criterion	1N--	No	Retail Stockage Criteria		Yes	Government
Supply System	1A--	No	Type of Supply System Code		No	Government
Discount Rate	2ND2	No	Discount Rate		Yes	Government
Number of Shops at	4ND-	No	Number of Shops		Yes	Government

TABLE K-I. Data element - continued.

INPUT DATA ELEMENT NAME	FIELD DESCRIPTION	UNITS	APPENDIX P		LSAR INTERFACE	RECOMMENDED DATA SOURCES
			NAME	CONV FACTOR		
Density	6ND-	No	Total System Supported		No	Government
Order Ship Time	4ND-	Days	Ship Time		Yes	Government
Procurement Lead Time (days)	4ND-	Days	Procurement Lead Time (weeks)	x 7days/wk	No	Government
Contact Team Delay Time (days)	4ND-	Days	Contact Team Delay Time (hours)	-24hrs/days	Yes	Government
Operating Level	4ND-	Days	Operation Level		Yes	Government
Distance Between	5ND-	Miles	Distance		Yes	Contractor
Packed Shipping Weight	6ND2	Pounds	Unit Pack Weight		No	Contractor
Transportation Cost per Pound per Mile	7ND5	Dollars	Transportation Rate		No	Government
Initial Cataloging Cost	6ND2	Dollars	Initial Cataloging Cost		Yes	Government
Recurring Cataloging Cost	6ND2	Dollars	Recurring Cataloging Cost		Yes	Government
Initial Bin Cost	6ND2	Dollars	Initial Bin Cost		Yes	Government
Recurring Bin Cost	6ND2	Dollars	Recurring Bin Cost		Yes	Government
Requisition Cost	6ND2	Dollars	Cost per Requisition		Yes	Government

TABLE K-I. Data element - continued.

INPUT DATA ELEMENT NAME	FIELD DESCRIPTION	UNITS	APPENDIX P		LSAR INTERFACE	RECOMMENDED DATA SOURCES
			NAME	CONV FACTOR		
Cost of Technical Documentation per Page	6ND2	Dollars	Technical Documentation Cost		No	Contractor
Number of Pages of Technical Documentation	4ND-	No	Technical Documentation Pages		No	Contractor
Equipment/Repairman Identification Number	10X-	No	Support Equipment Full Item Name		No	Contractor
Annual Maintenance Factor	3ND3	No	Support of Support Equipment Cost Factor		No	Government if Common
Annual TPS Maintenance Cost Factor	2ND2	No	Support of Support Equipment Cost Factor		No	Contractor
Available Man/Test Hours per Year	3ND2	Hours	Repairman Available Hours		No	Government if Common
One Time Development Cost	10ND-	Dollars	Support Equipment Development Price		No	Contractor
Test Program Set Development Cost	10ND-	Dollars	Support Equipment Development Price		No	Contractor
Time Used	5ND2	Hours	Support Equipment Time Used		No	Contractor
One Time Installation	7ND-	Dollars	Support Equipment Installation Cost		No	Government if Common

TABLE K-I. Data element - continued.

INPUT DATA ELEMENT NAME	FIELD DESCRIPTION	UNITS	APPENDIX P		LSAR INTERFACE	RECOMMENDED DATA SOURCES
			NAME	CONV FACTOR		
Highest Echelon at which Peculiar	1N--	No	Repairman Highest Maintenance Level Peculiar		No	Government
Lowest Echelon Allowed	1N-	No	Repairman Lowest Maintenance Level Allowed		No	Contractor
Military/Civilian Indicator	1N-	No	Military or Civilian Indicator			Contractor
Turnover (years)	3ND2	Years	Repairman Turnover Rate (percent/year)	100% -	No	Government
Annual Salary	5ND-	Dollars	Personnel Annual Salary		No	Government
Unloaded Labor Hourly Rate	4ND2	Dollars	Labor Rate by Repairman		No	Government
Common Labor Rate Loading Factor	2ND2	No	Loading Factor		No	Government
Salary Loading Factor	2ND2	No	Loading Factor		No	Government
Productivity Factor	2ND2	No	Productivity Factor		No	Government
Training Cost	5ND-	Dollars	Training Cost		No	Government
Total Number of Parts	5N--	No	Total Number of Parts		No	Government

TABLE K-I. Data element - continued.

INPUT DATA ELEMENT NAME	FIELD DESCRIPTION	UNITS	APPENDIX P		LSAR INTERFACE	RECOMMENDED DATA SOURCES
			NAME	CONV FACTOR		
Number of Parts Needing NSNs	5N--	No	Number of Parts Needing NSN		No	Contractor
Number of Piece Parts Needing NSNs	5N--	No	Number of Parts Needing NSN		No	Contractor
Does the LRU have an NSN	1N--	No	National Stock Number Needed		No	Contractor
Essentiality Code	1N--	No	Essentiality Code		Yes	Contractor
Washout Rate	4ND3	No	Washout Rate		No	Contractor
False Removal Rate	2ND2	No	False Removal Rate		No	Contractor
Can the LRU be Screened	1N--	No	Screened Item Code		No	Contractor
Screening Detection Fraction	2ND2	No	False Removal Detection Fraction		No	Contractor
Alternative Name	4X--	No	Support Alternative Name		No	Contractor
Test Equipment Identification Number	2N--	No	Resource Identification Number		No	Contractor
LRU or SRU Identification	4X--	No	Logistic Support Analysis Control Number		No	Contractor

TABLE K-I. Data element - continued.

INPUT DATA ELEMENT NAME	FIELD DESCRIPTION	UNITS	APPENDIX P		LSAR INTERFACE	RECOMMENDED DATA SOURCES
			NAME	CONV FACTOR		
Holding Cost Fraction	2ND2	No			No	Contractor
Screening Detection Default	3ND2	No			No	Contractor
False Removal Rate Default	2ND2	No			No	Contractor
Test Equipment Unit Price	7ND-	Dollars			No	Government if Common
Number of Repair Alternatives	1N-	No			No	Contractor
Identification of Specific LRU	4X--	No			No	Contractor
LRU Identification on Application	4X--	No			No	Contractor
SRU Identification on Application	4X--	No			No	Contractor
Indicator for Fix Only Equipment	2X--	No			No	Government if Common
Run Mode Indicator	1N--	No			No	Contractor
Policy Indicator	1N--	No			No	Contractor

TABLE K-I. Data element - continued.

INPUT DATA ELEMENT NAME	FIELD DESCRIPTION	UNITS	APPENDIX P		LSAR INTERFACE	RECOMMENDED DATA SOURCES
			NAME	CONV FACTOR		
Indicator for Screening of	1N--	No			No	Contractor
End Item Mean Time Between Failures	7ND-	Hours			Yes	Contractor
Mean Time to Repair	5ND2	Hours			No	Contractor
Number of Repair Alternatives	1N--	No			No	Contractor
Number of End Item Repair Alternatives	1N--	No			No	Contractor
End Item Annual Operating Hours	7ND-	Hours			Yes	Government
Continuation Indicator	1X--	No			No	Contractor
Default Repair Turnaround Time	3ND-	Days			No	Contractor
Default Screening Tournaround Time	3ND-	Days			No	Contractor
LRU or SRU's MTBF	10ND-	Hours			No	Contractor
LRU or SRU's Unit Cost	7ND-	Dollars			Yes	Contractor
MTBF Multiplier	5ND2	No			No	Contractor

NETWORK REPAIR LEVEL ANALYSIS

10. SCOPE. This appendix describes the Network Repair Level Analysis (NRLA) model and provides information on obtaining the computer model.

20. APPLICABLE DOCUMENTS

20.1 Government documents. The specifications, standards, and handbooks cited in 2.1 form a part of this appendix to the extent specified under 2.1.

20.2 Nongovernment publications. Nongovernment standards or other types of nongovernment publications do not form a part of this appendix.

30. MODEL DESCRIPTION

30.1 Overview. NRLA is the Air Force's preferred method of conducting Level of Repair Analysis (LORA). It makes LORA decisions which are optimized for a system or subsystem as a whole, rather than for each individual item separately. This is especially important if shared Support Equipment (SE) is a significant portion of the system cost. NRLA considers the relationship of each piece of SE to all the items on which it is used.

30.2 Characteristics. Following are some of the key characteristics of the NRLA model.

30.2.1 NRLA handles two levels of indenture for items under analysis. Items are identified in the model as Line Replaceable Units (LRUs) and Shop Replaceable Units (SRUs). In general, an LRU is removed and replaced on an end-item or major assembly. An SRU is removed and replaced on an LRU and, thus, is a subcomponent of that LRU.

30.2.2 NRLA will handle split level repair decisions for LRUs. That is, the model may make one repair level decision for an item if it experiences one type of failure and a different repair level decision for the same item if it experiences another type of failure. NRLA does not handle split level repair decisions for SRUs.

30.2.3 NRLA currently considers three maintenance alternatives - scrap, depot repair, and intermediate repair. Organizational level repair is assumed to exist. However, costs associated with repair-in-place maintenance and LRU removal from an end-item are not included in the model, because they are incurred regardless of the off-equipment repair level decision.

30.2.4 As currently structured, NRLA cannot simultaneously handle a Centralized Intermediate Repair Facility (CIRF) option along with the scrap, depot, and intermediate options. However, a CIRF can be handled if it is considered as a pseudo-base. NRLA is then run with the data structured to provide the CIRF, depot, scrap options for one analysis and the intermediate, depot, and scrap options for another analysis. The two may then be compared to determine whether CIRF or intermediate repair should be selected.

30.2.5 NRLA uses an average base concept. This means that each intermediate location is assumed to support the same number of operating systems, have the same number of operating hours, have the same maintenance and supply system characteristics, etc. Distinctions are made, however, between CONUS and overseas bases for several of the data inputs.

30.2.6 NRLA does not allocate the cost of shared resources (specifically SE) to individual items. Allocation can lead to incorrect decisions, since the interactions between all shared resources and all LRUs and SRUs are not considered.

30.2.7 NRLA considers only the economic factors affecting repair level decisions. Thus, the repair level recommendations made by the model must be used in conjunction with noneconomic factors when making final repair level decisions.

30.2.8 In the model, the economic analysis of repair level decisions is based on specific life cycle costs associated with each repair level option. However, NRLA is not a comprehensive life cycle cost (LCC) model, because it does not attempt to include all life cycle cost elements. It includes only those costs which directly impact the repair level decisions.

40. METHOD DESCRIPTION

40.1 Overview. The NRLA model derives its name from the solution procedure. A network is mathematically constructed by the computer to structurally tie all LRUs and SRUs to the SE used. The network formulation allows the rapid solution of the LORA problem while considering shared SE resources and associated costs. The program uses a special algorithm called max-flow min-cut to solve the network.

40.2 Illustration. The technical details of the NRLA model are addressed in the NRLA User's Guide (see para 50.). However, the following is a brief explanation of how the method works.

40.2.1 If a system consists of three LRUs, it would be possible to enumerate every combination of LRU/SRU assignments to depot repair, intermediate repair, or scrap. Table L-1 shows some of the 27 possible ways such assignments could be made if the system had three LRUs only.

40.2.2 For each of the 27 combinations, it would be possible to exactly determine the SE that would be required at intermediate and at depot. The cost of the SE together with the cost of all other logistic factors could be priced out and entered into the cost column. It would then be possible to select the minimum cost combination by comparing the costs in the cost column. This shows that it is possible to select the best repair levels for the system with no proration of SE costs.

40.2.3 For a system containing large numbers of LRUs and SRUs, the number of such combinations to be examined would become tremendously large. Therefore, using the exhaustive enumeration approach described would be very time consuming.

40.2.4 By structuring the problem as a network, it is possible to solve the problem by implicitly doing the enumeration. The implicit enumeration technique, called max-flow min-cut, solves the problem by examining only a few of the many combinations. It always retains the minimum cost solution while discarding large numbers of the alternatives that are proven nonoptimal. Finally, all but the optimal solution are discarded.

40.3 Sensitivity analysis.

40.3.1 Purpose. Sensitivity analysis has two purposes: (1) to aid the designer, and (2) to aid the user. Early in a program, many of the input factors may be estimates, sometimes crude ones. By performing sensitivity analysis, the designer can determine whether the repair level selected is firm or marginal. As an example, if varying one or more factors over the 50-200% range causes no repair level decision changes, then the designer can be reasonably sure that the repair level selected is firm. If, however, a small change in a factor causes the repair level decision to change, the designer should be prepared for such an event. Sensitivity analysis tests the stability of the system under varying conditions and the effect of poor data.

40.3.2 NRLA approach. The NRLA computer program has the capability to do sensitivity analysis on one item at a time for LRU Mean Time Between Failure (MTBF), and LRU and SRU cost. However, depending on the number of items being analyzed, this may take excessive computer output. Therefore, NRLA sensitivity may be performed by simultaneously varying all LRU costs, all LRU MTBFs, or all SE costs by fixed percentages. Alternately, a list of individual items, generally the highest cost LRUs and SE, and the items with the lowest MTBF, may be varied for sensitivity analysis on a one-at-a-time basis. The NRLA program has simple procedures to do this sensitivity, and the NRLA User's Guide provides complete details. Other factors, such as number of bases, equivalent weapons systems per base, and system operating hours per month, which either the Government or the contractor consider important should also be investigated. The NRLA program does not do these automatically, but such sensitivities can be easily accomplished in individual computer runs.

40.4 Screening procedures. Screening methods described in appendix N may be performed in conjunction with NRLA, especially in the early stages before all data are available. However, it is necessary to account for any resources used by screened items if they interrelate with items included in a NRLA analysis. One method of accounting for those resources is to include them directly in the NRLA analysis. The other method is to implicitly account for any resources used by the screened items. For example, reduce the operating hours available on a piece of SE by the amount used by screened LRUs and SRUs. This accounts for the screened items' use of SE without explicitly including these items in the analysis.

50. COMPUTER PROGRAM AND DOCUMENTATION. An approved computer program exists in both a mainframe and a PC version for implementation of the NRLA model. The model is written in FORTRAN and is available to contractors and government agencies for use on their computers. The NRLA model, along with documentation in the form of a User's Guide and a Programmer's Guide, is available at no cost from ALD/LSS Wright-Patterson AFB OH 45433-5000.

TABLE L-I. Exhaustive enumeration example.

Alternative Number	Scrap	Intermediate Repair	Depot Repair	Cost
1	LRU 1, LRU 2	LRU 3		$ ALT 1
2	LRU 1, LRU 2		LRU 3	$ ALT 2
3	LRU 3	LRU 1, LRU 2		$ ALT 3
4		LRU 1, LRU 2	LRU 3	$ ALT 4
5	LRU 3		LRU 1, LRU 2	$ ALT 5
6		LRU 3	LRU 1, LRU 2	$ ALT 6
7	LRU 1, LRU 3	LRU 2		$ ALT 7
8	LRU 1, LRU 3		LRU 2	$ ALT 8
. . . .	. . . .	. . . .	. . . .	. . . .
26	LRU 1	LRU 3	LRU 2	$ ALT 26
27	LRU 1	LRU 2	LRU 3	$ ALT 27

ITEM REPAIR LEVEL ANALYSIS

10. SCOPE. This appendix describes the Item Repair Level Analysis (IRLA) method and provides the relevant equations along with a detailed example.

20. APPLICABLE DOCUMENTS

20.1 Government documents. The specifications, standards, and handbooks cited in 2.1 form a part of this appendix to the extent specified under 2.1.

20.2 Nongovernment publications. Nongovernment standards or other types of nongovernment publications do not form a part of this appendix.

30. METHOD DESCRIPTION

30.1 Overview. IRLA is performed by pricing three options: (1) scrap, (2) repair at depot, and (3) repair at intermediate shop. These options are computed, by item, using the equations in this appendix (see para 50.), and the option with the minimum cost is selected. The item under analysis may be a Line Replaceable Unit (LRU), a Shop Replaceable Unit (SRU), or some lower level component. In general, an LRU is removed and replaced on an end-item or major assembly. An SRU is removed and replaced on an LRU and, thus, is a subcomponent of that LRU.

30.2 Characteristics. Following are some of the key characteristics of the IRLA method.

30.2.1. Since it is an item by item computation, IRLA requires that Support Equipment (SE) costs be prorated to individual items. Problems arise in determining exactly how to perform this proration. Also, since LRUs and SRUs are examined on a one-at-a-time basis, contradictory results may occur. An example would be the assignment of an LRU to depot repair or scrap and one of its SRUs to intermediate repair. Despite these problems, IRLA may be used when SE is a relatively small portion of the total cost of the system or when there is very little sharing of SE among items being analyzed.

30.2.2. IRLA deals only with the economic factors affecting the repair level decisions. Thus, the repair level recommendations made by this method must be used in conjunction with noneconomic factors when making final repair level decisions.

30.2.3. In this method, the economic analysis of repair level decisions is based on specific life cycle costs associated with each repair level option. However, IRLA is not a comprehensive life cycle cost (LCC) method, because it does not attempt to include all life cycle cost elements. It includes only those costs which directly impact the repair level decisions.

30.2.4. IRLA uses an average base concept. This means that each intermediate location is assumed to support the same number of operating systems, have the same number of operating hours, have the same maintenance and supply system characteristics, etc. Distinctions are made, however, between CONUS and overseas bases for several of the data inputs.

30.3 Preliminary considerations.

30.3.1 Starting point. Before beginning the analysis, a starting point must be determined. One method would be to start with an item that is obviously scrap, and proceed upward to higher indenture levels. Another method is to arbitrarily select some higher level where a repair requirement is apparent and work down to the scrap level. A combination method is to review the lower level items for obvious scrap items, and then work down from the higher level to the lower level on the remaining items. Using such an approach allows as many items as possible to be eliminated from further repair level considerations.

For remaining items, beginning at the top and working down through the indenture levels avoids inconsistencies such as having an LRU repaired at depot and a component SRU repaired at intermediate. If an LRU is selected for depot repair, it is immediately known that component SRUs must be depot repair or scrap. Furthermore, we would expect decisions with respect to higher level components to dominate those at lower levels. By definition, LRUs cost more and have worse MTBFs than component SRUs. We would therefore ordinarily expect LRU decisions to dominate SRU decisions.

Notwithstanding the above suggestions, the requiring authority leaves the specific method to the performing activity. However, the method must be consistent for any given configuration item.

30.3.2 Proration of SE costs. If an item of SE is fully dedicated to the LRU, SRU, or other component being analyzed, then there is no proration of the SE costs. Where several items share use of SE, proration of SE costs to individual items becomes necessary in the IRLA process. The detailed equations in this appendix (see para 50.) include calculations that can be used to establish this proration. These should be modified as necessary to fit varying conditions which may occur, with modifications being justified by the user.

30.4 Sensitivity analysis. Sensitivity analysis has two purposes: (1) to aid the designer, and (2) to aid the user. Early in a program, many of the input factors may be estimates, sometimes crude ones. By performing sensitivity analysis, the designer can determine whether the repair level selected is firm or marginal. As an example, if varying one or more factors over the 50-200% range causes no repair level decision changes, then the designer can be reasonably sure that the repair level selected is firm. If, however, a small change in a factor causes the repair level decision to change, the designer should be prepared for such an event. Sensitivity analysis tests the stability of the system under varying conditions and the effect of poor data. By necessity, IRLA sensitivity is performed on one item at a time.

40. REPAIR LEVEL SELECTION WITHOUT PRORATION. In some repair level problems, the user is primarily concerned with two levels of indenture only, LRUs and SRUs. When this is true, six special cases should be costed out in addition to using the proration procedures already described. See table M-I below on the following page.

TABLE M-I.

Case	All LRUs	All SRUs
1	Inter	Inter
2	Inter	Depot
3	Inter	Scrap
4	Depot	Depot
5	Depot	Scrap
6	Scrap	Scrap

These cases may be easily costed out without proration. All repair level costs may be divided into two groups: SE-related costs not readily allocated to individual LRUs and SRUs, and all other costs. The other costs are termed pipeline costs. Let us consider a sample case with two LRUs and four SRUs. The following equations show how the costs for these special situations may be computed without proration:

1. L1I + L2I + S1I + S2I + S3I + S4I + SE1I = T1

2. L1I + L2I + S1D + S2D + S3D + S4D + SE2I + SE2D = T2

3. L1I + L2I + S1S + S2S + S3S + S4S + SE3I = T3

4. L1D + L2D + S1D + S2D + S3D + S4D + SE4D = T4

5. L1D + L2D + S1S + S2S + S3S + S4S + SE5D = T5

6. L1S + L2S + S1S + S2S + S3S + S4S = T6

Here, L1I represents the pipeline cost of repairing LRU 1 at intermediate. SE1I represents the cost of all SE (one or more kinds) to repair the LRUs and SRUs at intermediate. T1 represents the total cost of case 1. Thus, the first six terms of equation 1 represent the total pipeline cost of case 1. The seventh term SE1I represents the SE cost of case 1 without proration. T1 then represents the total of case 1 without proration. Similarly, the first two terms of equation 2 represent the pipeline costs of all LRUs at intermediate. Terms 3 through 6 represent the pipeline cost of depot repair of the SRUs. The seventh and eighth terms represent the SE cost for the required intermediate and depot repairs. T2 represents the total cost of case 2 without proration. Cases 3 through 6 are similarly costed out without proration for these variants. In this example, scrapping an item requires no SE; therefore, none is shown in cases 5 and 6 for the scrap alternatives.

The scrap, depot, and intermediate pipeline costs required for input to the above equations may be calculated using the equations in Para 50. of this appendix. When detailed data is unknown, the required cost categories (such as Training or Technical Data) may be estimated. The SE costs required for input to the above computations would include installation costs, development costs, unit costs, maintenance costs for the SE, and software costs associated with the SE. The SE and software cost equations in Para 50. may be used as a guide, but no proration factors will be required.

The minimum cost of the alternatives in table M-I, T = min (T1, T2, T3, T4, T5, T6), should be compared to the lowest cost alternative found using proration. If the difference between these two costs is relatively small, then use of the non-prorated solution may be preferred. For example, if all LRUs and SRUs were repaired at depot, design of the item and the required repair facilities would be simpler. The simplicity of a single repair level for all LRUs and SRUs may be worth a slight increase in cost.

50. IRLA EQUATIONS. Following are the detailed equations which comprise the IRLA method. These equations are not currently automated for use on a personal computer. However, their use in conjunction with an electronic spreadsheet program would be ideal. These equations resemble, as nearly as possible, the equations used in the Network Repair Level Analysis (NRLA) model, which is the Air Force's preferred method of conducting Level of Repair Analysis (LORA). The purpose is to maintain consistency among the analytical methods and the data used. The primary difference between these equations and those used in the NRLA model lies in the treatment of support equipment (SE). NRLA does not require the user to prorate SE costs, whereas IRLA, being an item by item computation, requires proration of SE costs to individual items. IRLA is not recommended for use when SE costs are significant or when there is a significant amount of SE sharing among items being analyzed.

NOTE: When computing costs for a Line Replaceable Unit (LRU), set the failure mode ratio for the item (FAILP(i)) equal to 1 in all the following equations. When computing costs for a Shop Replaceable Unit (SRU), which is a subcomponent of an LRU, set FAILP(i) equal to the fraction of the time this SRU is responsible for the LRU failure.

The following calculations apply to all three repair options: Scrap, Depot and Intermediate.

MTBCT = Mean time between corrective tasks for the item
= MTBF/[UF * (1 - RIP)]
MTBF/(Item oper hr/system hr)(1-RIP)

where MTBF = Mean operating time between failures for the LRU in hours
UF = Ratio of item operating hours to end-item operating hrs
RIP = Fraction of failures repaired in place

PGMB = Monthly end-item use hours at an intr location
= UEBASE * UR
= (syst/base)(hr/syst/mo)

where UEBASE = Number of end-items at each intr location
UR = End-item use rate

TQCTGMi = Total questionable corrective tasks generated monthly for an item at an intermediate location
= PGMB * QTY/MTBCT
(oper hr/mo/intr location)(No. items)/(hr/failure)

where QTY = Number of occurrences of this item on the end-item or system; quantity per assembly

TLCD = Total life cycle demands for an item at an intr location
= TQCTGMi * PIUP * 12 * M
(tasks/mo/intr location)(yr/LC)(mo/yr)(no. intr locations)
where PIUP = Program inventory usage period in years
M = Number of operating locations

PSRC = Packaging and shipping cost for CONUS
= PCC + (PWRC * SRC)
($/lb) + (ratio)($/lb)
where PCC = CONUS packaging cost, including labor & materials
PWRC = Packed to unpacked weight ratio for CONUS shipments
SRC = Shipping rate to CONUS locations

PSRO = Packaging and shipping cost for overseas
= PCO + (PWRO * SRO)
($/lb) + (ratio)($/lb)
where PCO = Overseas packaging cost, including labor & materials
PWRO = Packed to unpacked weight ratio for overseas shipments
SRO = Shipping rate to overseas locations

WPSR = Weighted packaging and shipping rate
= [(1 - OS) * PSRC] + [OS * PSRO]
(fraction CONUS)($/lb) + (fraction OS)($/lb)
where OS = Overseas deployment fraction

SCRAP OPTION

The scrap option will include the following cost categories: Replacement Spares, Packaging & Shipping, and Base Spares Quantity.

REPLACEMENT SPARES (C1S)

C1S = TLCD * FAILP(i) * UCI
(repairs/LC)(ratio)($/item)
where FAILP(i) = Failure mode ratio; frequency of occurrence of the SRU failure as a fraction of all parent LRU failures
UCI = Unit cost of the item

PACKAGING AND SHIPPING (C2S)

C2S = TLCD * FAILP(i) * WGTI * WPSR
(tasks/LC)(ratio)(lb/package)($/lb)
where WGTI = Weight of the item in pounds

BASE SPARES QUANTITY (C3S)

WOST = Weighted order and ship time
= [OS * OSTO] + [(1 - OS) * OSTC]
where OSTO = Order and shipping time, in months, to overseas locations
OSTC = Order and shipping time, in months, to CONUS locations

OSTPL = Order and ship time pipeline
= FAILP(i) * TQCTGMi * WOST
(ratio)(tasks/month/intr location)(mo)

OSTSL = Order and ship time stock level
= OSTPL + $\sqrt{3 * \text{OSTPL}}$

NOTE: If OSTSL has a fractional value when computed, then set OSTSL = the next higher integer. For example, if OSTSL is computed to be 11.4, then set OSTSL = 12.

C3S = OSTSL * UCI * M
(No. items)($/item)(No. intr locations)

TOTAL SCRAP COST = C1S + C2S + C3S

DEPOT OPTION

The depot option will include the following cost categories: Repair Material, Packaging & Shipping, Base Spares Quantity, Depot Spares Quantity, Repair Labor,

Item Entry, Technical Data Acquisition, Maintenance Training, Support Equipment (SE), Software, and Facilities.

REPAIR MATERIAL (C1D)

C1D = TLCD * FAILP(i) * UCPP
(tasks/LC)(ratio)($/fail)
where UCPP = Cost of non-repairable assys and/or pieceparts per repair

PACKAGING AND SHIPPING (C2D)

C2D = 2 * TLCD * FAILP(i) * WGTI * WPSR
(directions/trip)(tasks/LC)(ratio)(lb/package)($/lb packaging & shipping rate)
where WGTI = Weight of the item in pounds

BASE SPARES QUANTITY (C3D)

C3D = C3S (same as scrap calculation)

DEPOT SPARES QUANTITY (C4D)

WDRCT = Weighted depot repair cycle time
= (DRCTO * OS) + (DRCTC * (1 - OS))
(mo OS)(fraction) + (mo CONUS)(fraction)
where DRCTO = Depot repair cycle time, in months, for overseas locations
DRCTC = Depot repair cycle time, in months, for CONUS locations

DRCTPL = Depot repair cycle time pipeline
= FAILP(i) * TQCTGMi * WDRCT * M
(ratio)(tasks/mo)(mo)(no. intr locations)

DRCTSL = Depot repair cycle time stock level
= DRCTPL + \/ 3 * DRCTPL
items in pipeline + safety level

NOTE: If DRCTSL has a fractional value when computed, then set DRCTSL = the next higher integer. For example, if DRCTSL is computed to be 20.5, then set DRCTSL = 21.

C4D = DRCTSL * UCI
(No. items)($/item)

REPAIR LABOR (C5D)

C5D = TLCD * FAILP(i) * DMMH * DLR
(tasks/LC)(ratio)(hr/task)($/hr)
where DMMH = Depot level maint man-hours required for repair
DLR = Depot labor wage rate

ITEM ENTRY (C6D)

RIIMC = Recurring + initial item management cost
= (PIUP * RMC) + IMC
(yr/LC)($/yr) + ($/part intro)
where RMC = Annual item management cost
IMC = Initial cost for introducing an item into the wholesale level inventory system
C6D = NPPA * RIIMC
(No. items)($/item)
where NPPA = Number of new piece-parts and assemblies required for repair

TECHNICAL DATA ACQUISITION (C8D)

C8D = NTDP * TD
(no. pages)($/page)
where NTDP = Number of tech data pages required for repair of item
TD = Cost per original page of tech data from the contractor

MAINTENANCE TRAINING (C9D)

TFD = Training factor at depot
= 1 + [TRD * (PIUP - 1)]
1 + [(turnover/yr)(yr/LC - 1)]
where TRD = Annual turnover rate for depot personnel

C9D = TFD * NUMTD * TRW * [TRC + (40 * DLR)]
(ratio)(No. men)(wk/man) [$/wk + (hr/wk)($/hr)]
where NUMTD = Number of people trained at depot
TRW = Amount of time, in weeks, required for training
TRC = Expected training cost per week for instruction and material

SUPPORT EQUIPMENT (C10D)

NOTE: These computations must be accomplished for each applicable type of SE.

DSE1 = Total no. of hours per month the SE is actually used
= ≥ (TQCTGMi * FAILP(i) * SEHRi) for i = 1,...,Q
where SEHRi = Support equipment time, in hours, used on an item
Q = Number of items which use this piece of SE

DSE2 = Hours/month the item under analysis will require the SE
= TQCTGMi * FAILP(i) * SEHRi

DSE3 = Proportion of SE costs charged to the item under analysis
= DSE2/DSE1

NSE = Number of a particular type of SE at the depot.

If NSE is known, go to DSE4.

NSE = (M * DSE1)/(SEAVAIL/12)
(no. of intr locations)(SE hours used/mo)/(hours avail/mo)
where SEAVAIL = No. of hours the SE is available annually at a maintenance level

NOTE: If NSE has a fractional value when computed, then set NSE = the next higher integer. For example, if NSE is 3 computed to be 3.28, then set NSE = 4.

DSE4 = Depot SE cost charged to the item
= DSE3 * [(UCSE * NSE) + SEINST + HDEVP]
where UCSE = Unit cost of the SE
SEINST = SE installation cost at a maintenance level
HDEVP = Hardware development price

DSE5 = Depot SE maintenance cost
= SSECF * PIUP * DSE4
where SSECF = Support of SE cost factor

C10D = DSE4 + DSE5

SOFTWARE COST (C11D)

NOTE: These computations must be accomplished for each applicable Test program Set (TPS).

TPSDEV = TPS software development cost for the item

DSW1 = Depot software maintenance cost
= TPSMAINT * (PIUP - 1) * TPSDEV
where TPSMAINT = Support of SE cost factor for TPS

C11D = TPSDEV + DSW1

FACILITIES (C12D)

C12D = Cost of new depot facilities
C12D = FACDEV + UC + (FACOP * 12 * PIUP)
where FACDEV = Development cost for facilities
UC = Unit cost of the facilities
FACOP = Operating cost for the facilities

TOTAL DEPOT COST = C1D + C2D + C3D + C4D + C5D + C6D + C8D + C9D + C10D + C11D + C12D

INTERMEDIATE OPTION

The intermediate option will include the following cost categories: Repair Material, Packaging & Shipping, Base Spares Quantity, Repair Labor, Item Entry, Supply Administration, Technical Data Acquisition, Maintenance Training, Support Equipment (SE), Software, and Facilities.

REPAIR MATERIAL (C1B)

C1B = C1D (same as depot calculation)

PACKAGING AND SHIPPING (C2B)

C2B = TLCD * FAILP(i) * WTPP * WPSR
(tasks/LC)(ratio)(lb parts/task)($/lb)
where WTPP = the weight, in pounds, of repair parts and/or assys
WPSR = Weighted packaging and shipping rate; WPSR was calculated under the depot option

BASE SPARES QUANTITY (C3B)

A = Annual cost of non-repairable assys and/or pieceparts for item
= UCPP * FAILP(i) * TQCTGMi * 12
($)(ratio)(tasks/mo)(mo/yr)
where UCPP = Cost of non-repairable assys and/or pieceparts per repair

EOQ = $5.9 \sqrt{A}$
where the value 5.9 is derived from the classical EOQ formula

NOTE: The value for EOQ should reflect a cost no greater than the annual cost (A) and no less than the monthly cost (A/12). Therefore, if EOQ > A, set EOQ = A. If EOQ < A/12, set EOQ = A/12.

BRCTP = Intr repair cycle time pipeline
= FAILP(i) * TQCTGMi * BRCT
(ratio)(tasks/mo)(mo)
where BRCT = Intr repair cycle time in months

BRCTSL = Intr repair cycle time stock level
= BRCTP + $\sqrt{3}$ * BRCTP
items in pipeline + safety level

NOTE: If BRCTSL has a fractional value when computed, then set BRCTSL = the next higher integer. For example, if BRCTSL is computed to be 5.6, then set BRCTSL = 6.

C3B = [(BRCTSL * UCI) + EOQ] * M
[(No. items/intr location)($/item) + EOQ$] (No intr locations)
where UCI = Unit cost of the item

REPAIR LABOR (C5B)

C5B = TLCD * FAILP(i) * BMMH * BLR
(tasks/LC)(ratio)(hr/task)($/hr)
where BMMH = the base level maint man-hours required for repair
BLR = the base labor wage rate

ITEM ENTRY (C6B)

C6B = C6D (same as depot calculation)

SUPPLY ADMINISTRATION (C7B)

C7B = PIUP * SA * (NPPA + NAB) * M
(yr/LC)($/item/yr)(No. new parts + No. new parts at intr location)(No. intr locations)
where SA = the annual cost to manage one item in base supply system
NPPA = the number of new items
NAB = the number of items which will be new at intr level

TECHNICAL DATA ACQUISITION (C8B)

C8B = C8D (same as depot calculation)

MAINTENANCE TRAINING (C9B)

TFB = Training factor for intr level
= 1 + [TRB * (PIUP - 1)]
1 + [(turnover/yr)(yr/LC - 1)]
where TRB = Annual turnover rate for base personnel

C9B = TFB * NUMTB * TRW * [TRC + (40 * BLR)] * M
(ratio)(No. men/intr location)(wk/man)[($/wk + (hr/wk)($/hr)]
(No. intr locations)
where NUMTB = Number of people trained at an intr location
TRW = Amount of time, in weeks, required for training
TRC = Expected training cost per week for instruction and material

SUPPORT EQUIPMENT (C10B)

NOTE: These computations must be accomplished for each applicable type of SE.

ISE1 = Total no. of hours the SE is actually used
= Σ (TQCTGMi * FAILP(i) * SEHRi) for i = 1,...,Q
where SEHRi = Support equipment time, in hours, used on an item
Q = Number of items which use this piece of SE

ISE2 = Hours/month the item under analysis will require the SE
= TQCTGMi * FAILP(i) * SEHRi

ISE3 = Proportion of SE cost charged to the item under analysis
= ISE2/ISE1

NSE = Number of a particular type of SE at intermediate level.

If NSE is known, go to ISE4.

TEMP = Minimum number of SE required at one intr location
= ISE1/(SEAVAIL/12)
(SE hours used)/(hours avail/mo)
where SEAVAIL = No. of hours the SE is available annually at a maintenance level

NOTE: If TEMP has a fractional value when computed, then set TEMP = the next higher integer. For example, if TEMP is computed to be 3.28, then set TEMP = 4.

NSE = M * TEMP
(no. of intr locations)(no. of SE per location)

ISE4 = Intr shop SE cost charged to the item
= ISE3 * [(UCSE * NSE) + SEINST + HDEVP]
where UCSE = Unit cost of the SE
SEINST = SE installation cost at a maintenance level
HDEVP = Hardware development price

ISE5 = Intr shop SE maintenance cost
= SSECF * PIUP * ISE4
where SSECF = Support of SE cost factor

C10B = ISE4 + ISE5

SOFTWARE COST (C11B)

NOTE: These computations must be accomplished for each applicable Test Program Set (TPS).

TPSDEV = TPS software development cost for the item

ISW1 = Intr shop software maintenance
= TPSMAINT * (PIUP - 1) * TPSDEV
where TPSMAINT = Support of SE cost factor for TPS

C11B = TPSDEV + ISW1

FACILITIES (C12B)

C12B = Cost of intr repair facilities unique to repair task
C12B = FACDEV + [UC + (FACOP * 12 * PIUP)] * M
where FACDEV = Development cost for facilities
UC = Unit cost of the facilities
FACOP = Operating cost for the facilities

TOTAL INTERMEDIATE COSTCOST = C1B + C2B + C3B + C5B + C6B + C7B + C8B + C9B + C10B + C11B + C12B

60. IRLA SAMPLE PROBLEM DETAIL

60.1 Overview. The following problem portrays the logic that would be applied in making repair level decisions. Off-equipment repair at either intermediate or depot level, and scrap will be considered. The sample problem addresses the question of whether it is most economical to: (a) discard the particular item and maintain replacement stockage in base supply; (b) repair the item in the base shop (intermediate level maintenance) and maintain a stockage of spares and repair parts on base; or (c) return the item to the depot for repair and maintain a stockage of spares in base supply.

Weapon system data. The weapon system being developed is a tactical fighter planned for individual squadron deployment. Acquisition planning is for 9 squadrons (M = 9), each with 47 aircraft (UEBASE = 47). The operational and basing concept calls for 60 percent of the fleet to be based in overseas locations (OS = .6) with organizational and intermediate maintenance capability. The remainder of the fleet will be based in the US. All depot level repair, including overhaul, will be performed within CONUS. Aircraft use rate is planned for 35 hours per month (UR = 35) when fully operational. The planned inventory usage period or economic life for each aircraft is 20 years (PIUP = 20), and all aircraft assigned to a given squadron will be delivered and placed in operational status concurrently. All cost trade-offs will be conducted on the basis of each squadron continuously possessing and operating its 47 aircraft over the full 20 year period.

Item related data. The item being evaluated is an Input/Output (I/O) SRU on a Data Flight Control Computer LRU.

(1) There is one occurrence of the SRU on the LRU (QTY = 1). This SRU has a MTBF of 375 hours and is responsible for 25.1% of the total LRU failures. (MTBF = 375, (FAILP(i) = .251)

(2) The item unit price is estimated at $5,128. (UCI = $5,128)

(3) The average time to repair this item is 6 hours and the intermediate labor rate is $31.55 per hour while the depot rate is $45.94 per hour. (BMMH = 6, DMMH = 6, BLR = 31.55, DLR = 45.94)

(4) Support equipment (SE) costs are addressed in the applicable portion of the sample problem; more than one piece of SE is required for this item and the calculations must be accomplished for each piece.

(5) The average cost of repair parts per repair action is estimated at $512. (UCPP = $512)

(6) The item weight is 1.33 pounds and the weight of repair parts per repair is .4 pounds. (WGTI = 1.33, WTPP = .4)

(7) The description of the repair action and testing will require 35 pages of technical data at a cost of $752 per page. (NTDP = 35, TD = $752)

(8) Repair of this item will require 20 new piece parts and/or assemblies to the Air Force inventory; no new piece parts/assemblies from the existing AF inventory will be required at the intermediate level. (NPPA = 20, NAB = 0)

(9) Maintenance personnel will require training to do the repair work on this item. The contractor will provide special cadre training at $1855 per man-week for instruction and training material (TRC = $1855). The planned course duration is 1.1 weeks (TRW = 1.1). It's estimated that one technician from each squadron and/or one depot technician will require training (NUMTB = 1, NUMTD = 1). Follow-on training is estimated at the same as that for initial cadre.

(10) The TPS software development cost for the item is $150,000 (TPSDEV = $150,000) and the TPS maintenance cost factor is estimated to be .075 (TPSMAINT = .075).

(11) We assume that repair of this item will require the addition of a small building to existing facilities for both depot and base. The development cost for facilities is $10,000 (FACDEV = $10,000), the unit cost for facilities is $225,000 (UC = $225,000), and the operating cost is $1,000 per month (FACOP = $1,000). Table M-II summarizes this data.

TABLE M-II.

BLR	$31.55	NUMTD	1	SRO	$1.28
BMMH (Hrs)	6	OS	.6	SSECF	.1
BRCT (Mos)	.23	OSTC (Mos)	.4	TD	$752
DLR	45.94	OSTO (Mos)	.55	TPSDEV	$150000
DMMH (Hrs)	6	PCC	$2.78	TPSMAINT	.075
DRCTO (Mos)	1.93	PCO	$2.78	TRB	.128
DRCTC (Mos)	1.70	PIUP	20	TRC	$1855
FACDEV	$10000	PWRC	$1.94	TRW (Wks)	1.1
FACOP	$1000	PWRO	$1.94	UC	$225000
FAILP(i)	.251	QTY	1	UCI	$5128
HDEVP	$62893	RIP	0	UCPP	$512
IMC	$1641	RMC	$234.38	UCSE	$4316
M	9	SA	$2.69	UEBASE	47
MTBF	375	SEAVAIL	3480	UF	1
NAB	0	SEHR	5	UR (Hrs)	30
NPPA	20	SEINST	$226	WGTI (Lbs)	1.33
NTDP	35	SRC	$.61	WTPP (Lbs)	.4
NUMTB	1				

60.2 <u>Calculations</u>. To begin, we need to calculate some factors which will be used in several of the equations below.

The Mean Time Between Critical Tasks (MTBCT)

MTBCT = MTBF/[UF * (1-RIP)]
= 375/[1 * (1-0)]
= 375

The Monthly End Item Use Hours per Base (PGMB)

PGMB = UEBASE * UR
= 47 * 30
= 1410

The Total Questionable Corrective Tasks Generated Monthly (TQCTGM)

TQCTGM = PGMB * QTY/MTBCT
= 1410 * 1/375
= 3.76

The Total Life Cycle Demands (TLCD)

TLCD = TQCTGM * PIUP * 12 * M
= 3.76 * 20 * 12 * 9
= 8121.6

The Weighted Packaging and Shipping Rate (WPSR)

WPSR = (1-OS)(PSRC) + (OS)(PSRO)

Where

PSRC = PCC + (PWRC * SRC)
= 2.78 + (1.94 * .61)
= 3.9634

And

PSRO = PCO + (PWRO * SRO)
= 2.78 + (1.94 * 1.28)
= 5.2632

$$= 2.78 + (1.94 * 1.28)$$
$$= 5.2632$$

So

$$WPSR = (1-.6)(3.9634) + (.6)(5.2632)$$
$$= 4.74328$$

SCRAP OPTION

The Replacement Spares portion (C1S) of the scrap option can now be determined.

$$C1S = FAILP(i) * TLCD * UCI$$
$$= .251 * 8121.6 * 5128$$
$$= \$10,453,538$$

The Packaging and Shipping portion (C2S) of the scrap option can also be determined.

$$C2S = FAILP(i) * TLCD * WGTI * WPSR$$
$$= .251 * 8121.6 * 1.33 * 4.74328$$
$$= 12,860.14$$

To calculate the Intermediate Spares portion (C3S), we must first calculate the Weighted Order and Ship Time (WOST).

$$WOST = [OS * OSTO] + [(1 - OS) * OSTC]$$
$$= [.6 * .55] + [(1-.6) * .4]$$
$$= .49$$

Then we must calculate the spares pipeline requirements (OSTPL).

$$OSTPL = FAILP(i) * TQCTGM * WOST$$
$$= .251 * 3.76 * .49$$
$$= .46244$$

$$OSTSL = OSTPL + \sqrt{3 * OSTPL}$$
$$= .46244 + \sqrt{3 * .46244}$$
$$= 1.6403$$

Since OSTSL has a fractional value, we set OSTSL = next higher integer. Thus, OSTSL = 2.

$$C3S = OSTSL * UCI * M$$
$$= 2 * 5128 * 9$$
$$= 92,304$$

So the total cost of the Scrap Option becomes C1S + C2S + C3S or 10,453,538 + 12,860.14 + 92,304 = 10,558,702.14.

DEPOT OPTION

The Repair Materials (C1D) of the depot option can now be determined.

$$
\begin{aligned}
C1D &= TLCD * FAILP(i) * UCPP \\
&= 8121.6 * .251 * 512 \\
&= 1{,}043{,}723
\end{aligned}
$$

To calculate the Packaging and Shipping portion (C2D) of the depot option, we must use the WPSR calculated in the scrap option. (WPSR = 4.54328). Then

$$
\begin{aligned}
C2D &= 2 * FAILP(i) * TLCD * WGTI * WPSR \\
&= 2 * .251 * 8121.6 * 1.33 * 4.74328 \\
&= 25{,}720.28
\end{aligned}
$$

The Base Spares Quantity portion of the depot option (C3D) is the same as the Base Spares Quantity of the scrap option (C3S).

$$
\begin{aligned}
C3D &= OSTSL * UCI * M \\
&= 2 * 5128 * 9 \\
&= 92{,}304
\end{aligned}
$$

To calculate the Depot Spares Quantity portion of the depot option (C4D), a Weighted Depot Repair Cycle Time (WDRCT) must first be calculated.

$$
\begin{aligned}
WDRCT &= (DRCTO * OS) + [DRCTC * (1 - OS)] \\
&= (1.93 * .6) + [1.7 * (1 - .6)] \\
&= 1.838
\end{aligned}
$$

Then the Depot Repair Cycle Time Pipeline (DRCTPL) requirements are calculated as

$$
\begin{aligned}
DRCTPL &= FAILP(i) * TQCTGM * WDRCT * M \\
&= .251 * 3.76 * 1.838 * 9 \\
&= 15.611677
\end{aligned}
$$

And

$$
\begin{aligned}
DRCTSL &= DRCTPL + \sqrt{3 * DRCTPL} \\
&= 15.611677 + \sqrt{3 * 15.611677} \\
&= 22.4552
\end{aligned}
$$

Since DRCTSL has a fractional value, we set DRCTSL = next higher integer. Thus, DRCTSL = 23.

So

$$
\begin{aligned}
C4D &= DRCTSL * UCI \\
&= 23 * 5128 \\
&= 117{,}944
\end{aligned}
$$

The Repair Labor Portion (C5D) of the depot option is calculated below.

C5D = TLCD * FAILP(i) * DMMH * DLR
= 8121.6 * .251 * 6 * 45.94
= 561,898.06

To calculate the Item Entry Portion (C6D), we need to calculate the recurring and initial management cost (RIIMC).

RIIMC = (PIUP * RMC) + IMC
= (20 * 234.38) + 1641
= 6328.60

Then

C6D = NPPA * RIIMC
= 20 * 6328.6
= 126,572

The Technical Data Acquisition Cost (C8D)

C8D = NTDP * TD
= 35 * 752
= 26,320

The Maintenance Training Cost (C9D)

C9D = TFD * NUMTD * TRW [TRC + (40 * DLR)]

Where

TFD = 1 + [TRD * (PIUP - 1)]
= 1 + [.061 * (20 - 1)]
= 2.159

So

C9D = 2.159 * 1 * 1.1 * [1855 + (40 * 45.94)]
= 8,769.55

Cost of Support Equipment (C10D)

To calculate the cost of support equipment (SE) for this item, the total number of hours per month the SE is actually used must be determined. For this item, two different pieces of SE are required. The first piece is used on 2 items (Q = 2) of the weapon system and has 3480 hours available per year (SEAVAIL = 3480). The second item using this piece has TQCTGM = 2.54, FAILP(i) = .13, and SEHR = 4. The unit cost of the SE is $4,316, the installation cost is $226 and the hardware development price is $62,893. (UCSE = 4316, SEINST = 226, HDEVP = 62893) The cost of SE maintenance is projected at 10% of the cost of the SE so SSECF = .1. Calculations for the first piece of SE are below:

DSE1 = $\bar{\geq}$ (TQCTGMi* FAILP(i) * SEHRi for i = 1,...,Q
= [3.76 * .251 * 5] + [2.54 * .13 * 4]
= 6.0396

DSE2 = TQCTGMi * FAILP(i) * SEHRi
= 3.76 * .251 * 5
= 4.7188

DSE3 = DSE2/DSE1
= 4.7188/6.0396
= .7813

Since we're assuming that NSE is unknown, the following calculation is required:

NSE = (M * DSE1)/(SEAVAIL/12)
= (9 * 6.0396)/(3480/12)
= .1874358

Since NSE is fractional, it will be rounded up to the next higher integer and NSE = 1 is used.

DSE4 = DSE3 * [(UCSE * NSE) + SEINST + HDEVP]
= .7813 * [(4316 * 1) + 226 + 62893]
= 52686.96

DSE5 = SSECF * PIUP * DSE4
= .1 * 20 * 52686.96
= 105373.92

Finally, for the first piece of SE,

C10D = DSE4 + DSE5
= 52686.96 + 105373.92
= 158060.84

The second piece of SE is peculiar to this item. Therefore Q = 1 and SEAVAIL = 3480. The unit cost of the SE is $6,245, the installation cost is $1,006 and the hardware development price is $300,423. (UCSE = 6245, SEINST = 1006, HDEVP = 300423) The cost of SE maintenance is projected at 10% of the cost of the SE so SSECF = .1. Calculations for the second piece of SE are below:

DSE1 = TQCTGM * FAILP(i) * SEHR
= 3.76 * .251 * 5
= 4.7188

DSE2 = TQCTGM * FAILP(i) * SEHR
= 3.76 * .251 * 5
= 4.7188

DSE3 = DSE2/DSE1
= 1

Since we're assuming that NSE is unknown, the following calculation is required:

NSE = (M * DSE1)/(SEAVAIL/12)
= (9 * 4.7188)/(3480/12)
= .1464455

Since NSE is fractional, it will be rounded up to the next higher integer and NSE = 1 is used.

DSE4 = DSE3 * [(UCSE * NSE) + SEINST + HDEVP]
= 1 * [(6245 * 1) + 1006 + 300423]
= 307674

DSE5 = SSECF * PIUP * DSE
= .1 * 20 * 307674
= 615348

Finally, for the second piece of SE,

C10D = DSE4 + DSE5
= 307674 + 615348
= 923022

Since there are two pieces of support equipment involved, the total cost for support equipment is the sum of the C10Ds = $1,081,082.84.

Software Cost (C11D)

To determine the cost of software, the depot software maintenance cost (DSW1) must first be determined.

$$
\begin{aligned}
DSW1 &= TPSMAINT * (PIUP - 1) * TPSDEV \\
&= .075 * (20 - 1) * 150000 \\
&= 213750
\end{aligned}
$$

So

$$
\begin{aligned}
C11D &= TPSDEV + DSW1 \\
&= 150000 + 213750 \\
&= 363750
\end{aligned}
$$

Facilities Cost (C12D) Repair of this item would require the addition of a small building to the existing depot facility.

$$
\begin{aligned}
C12D &= FACDEV + UC + (FACOP * 12 * PIUP) \\
&= 10000 + 225000 + (1000 * 12 * 20) \\
&= 475{,}000
\end{aligned}
$$

So the total cost for the depot option is the sum of C1D through C12D = 1,043,723 + 25,720.28 + 92,304 + 117,944 + 561,898.06 + 126,572 + 26,320 + 8,769.55 + 1,081,082.84 + 363,750 + 475,000 = $3,923,083.7.

INTERMEDIATE OPTION

The Repair Materials (C1B) of the intermediate option can now be determined.

$$
\begin{aligned}
C1B &= TLCD * FAILP(i) * UCPP \\
&= 8121.6 * .251 * 512 \\
&= 1{,}043{,}723
\end{aligned}
$$

To calculate the Packaging and Shipping portion (C2B) of the intermediate option, we must use the WPSR calculated in the scrap option. (WSPR = 4.74328). Then

$$
\begin{aligned}
C2B &= FAILP(i) * TLCD * WTPP * WPSR \\
&= .251 * 8121.6 * .4 * 4.74328 \\
&= 3{,}867.71
\end{aligned}
$$

The Base Spares Quantity portion of the intermediate option (C3B) is calculated by first determining the annual cost of piece parts for the item (A) and then determining an EOQ.

A = UCPP * FAILP(i) * TQCTGM * 12
= 512 * .251 * 3.76 * 12
= 5798.4614

$EOQ = 5.9 * \sqrt{5798.4614}$
= 449.271

A/12 = 483.205

According to the criteria set forth in the equations, EOQ must not be less than A/12. Therefore, since EOQ = 449.271 and A/12 = 483.205, we set EOQ = A/12 = 483.205.

C3B = [(BRCTSL * UCI) + EOQ] * M

Where

BRCTP = FAILP(i) * TQCTGM * BRCT
= .251 * 3.76 * .23
= .2170648

$BRCTSL = BRCTP + \sqrt{3 * BRCTP}$
$= .2170648 + \sqrt{3 * .2170648}$
= 1.0240309

Since BRCTSL has a fractional value, we set BRCTSL = the next higher integer. Thus, BRCTSL = 2.

So

C3B = [(2 * 5128) + 483.205] * 9
= 96,652.84

The Repair Labor Portion (C5B) of the intermediate option is calculated below.

C5B = TLCD * FAILP(i) * BMMH * BLR
= 8121.6 * .251 * 6 * 31.55
= 385,892.13

The Item Entry Portion (C6B) is calculated in the same manner as for the depot and the same RIIMC (6328.6) is used.

C6B = NPPA * RIIMC
= 20 * 6328.6
= 126,572

The Supply Administration Portion (C7B)

C7B = PIUP * SA * (NPPA + NAB) * M
= 20 * 2.69 * (20 + 0) * 9
= 9684

The Technical Data Acquisition Cost (C8B)

C8B = NTDP * TD
= 35 * 752
= 26,320

The Maintenance Training Cost (C9B)

C9B = TFB * NUMTB * TRW [TRC + (40 * BLR)] * M

Where

TFB = 1 + [TRB * (PIUP - 1)]
= 1 + [.128 * (20 - 1)]
= 3.432

So

C9B = 3.432 * 1 * 1.1 * [1855 + (40 * 31.55)] * 9
= 105,905.69

Cost of Support Equipment (C10B)

The same pieces of support equipment (SE) and assumptions set forth in the C10D calculation are used to determine the cost of SE at each intermediate location. Calculations for the first piece of SE are below:

ISE1 = $\overline{\geq}$ (TQCTGMi* FAILP(i) * SEHRi for i = 1,...,Q
= [3.76 * .251 * 5] + [2.54 * .13 * 4]
= 6.0396

ISE2 = TQCTGMi * FAILP(i) * SEHR
= 3.76 * .251 * 5
= 4.7188

ISE3 = ISE2/ISE1
= 4.7188/6.0396
= .7813

Since we're assuming that NSE is unknown, the following calculation is required:

TEMP = (ISE1)/(SEAVAIL/12)
= (6.0396)/(3480/12)
= .0208

Since TEMP is fractional, it will be rounded up to the next higher integer and TEMP = 1 is used.

NSE = M * TEMP = 9 * 1 = 9

ISE4 = ISE3 * [(UCSE * NSE) + SEINST + HDEVP]
= .7813 * [(4316 * 9) + 226 + 62893]
= 79663.69

ISE5 = SSECF * PIUP * ISE4
= .1 * 20 * 79663.69
= 159327.38

Finally, for the first piece of SE,

```
C10B = ISE4 + ISE5
     = 79663.69 + 159327.38
     = 238991.07
```

Calculations for the second piece of SE are below:

```
ISE1 = TQCTGM * FAILP(i) * SEHR
     = 3.76 * .251 * 5
     = 4.7188

ISE2 = TQCTGM * FAILP(i) * SEHR
     = 3.76 * .251 * 5
     = 4.7188

ISE3 = ISE2/ISE1
     = 1
```

Since we're assuming that NSE is unknown, the following calculation is required:

```
TEMP = (ISE1)/(SEAVAIL/12)
     = (4.7188)/290
     = .0163
```

Since TEMP is fractional, it will be rounded up to the next higher integer and TEMP = 1 is used.

```
NSE = M * TEMP = 9 * 1 = 9

ISE4 = ISE3 * [(UCSE * NSE) + SEINST + HDEVP]
     = 1 * [(6245 * 9) + 1006 + 300423]
     = 357634

ISE5 = SSECF * PIUP * ISE4
     = .1 * 20 * 357634
     = 715268
```

Finally, for the second piece of SE,

```
C10B = ISE4 + ISE5
     = 357634 + 715268
     = 1072902
```

Since there are two pieces of support equipment involved, the total cost for support equipment is the sum of the C10Bs = $238,991.07 + $1,072,902 = $1,311,893.

Software Cost (C11B)

To determine the cost of software, the intermediate software maintenance cost (ISW1) must first be determined.

ISW1 = TPSMAINT * (PIUP - 1) * TPSDEV
= .075 * (20 -1) * 150000
= 213750

So

C11B = TPSDEV + ISW1
= 150000 + 213750
= 363750

Facilities Cost (C12B)

C12B = FACDEV + [UC + (FACOP *12 * PIUP)] * M
= 10000 + [225000 + (1000 * 12 * 20)] * 9
= 4,195,000

So the total cost for the intermediate option is the sum of C1B through C12B = 1,043,723 + 3,867.71 + 96,652.84 + 385,892.13 + 126,572 + 9,684 + 26,320 + 105,905.69 + 1,311,893.1 + 363,750 + 4,195,000 = $7,669,260.50.

Summary of IRLA problem: With the calculations completed, a comparison of totals shows the most economic repair level for this item. If this item is scrapped, the total calculated cost is $10,558,702.14. If this item is repaired at the depot level, the total calculated cost is $3,923,083.70. If this item is repaired at the intermediate level, the total calculated cost is $7,669,260.50. Therefore, the most economic way to maintain this item is to repair it at the depot level.

60.3 Sensitivity analysis. Since many of the variables on which the repair level decision was based are of a preliminary nature, it is necessary to examine the effect of variation in certain critical factors on the decision itself. Table M-III shows the result of accomplishing sensitivity analysis on two factors, unit cost and MTBF, in our sample problem. These two factors were selected because they can potentially have major impacts on the final decision. Computations were again performed using the equations from Para 50.

TABLE M-III. Sensitivity analysis - total IRLA costs.

Factor	Value	Scrap	Depot	Intermediate
Unit Cost	$3,000	6,182,425	3,835,836	7,630,956
	$5,128	10,558,702	3,923,083	7,669,260
	$8,000	16,465,033	4,040,836	7,721,136
MTBF	275	14,410,818	4,608,135	8,206,911
	375	10,558,702	3,923,083	7,669,260
	500	7,942,103	3,478,870	7,247,655

We first varied the unit cost while keeping the MTBF constant at 375 hours. The bottom line cost of repair level decisions for each option changed, as you would expect. However, the recommended repair level decision remained at depot in all cases. This indicates that the repair level decision for this item is not particularly sensitive to changes in unit cost. We then varied the MTBF while keeping the unit cost constant at $5128. The bottom line costs for each option again changed, but the recommended repair level decision remained at depot. This indicates that the repair level decision for this item is not sensitive to changes in MTBF within this range.

The above sensitivity analysis varied only one parameter while holding the others constant. It is quite possible that two or more parameters could change. For example, if the unit cost increased to $6500 and the MTBF increased to 1000 hours, then the costs of the various options would be as follows:

OPTION	COST
SCRAP	$ 6,748,625
DEPOT	3,070,302
INTERMEDIATE	6,874,341

Note that, while the recommended decision is still depot level repair, the scrap and intermediate options have switched position. It is now cheaper to scrap the item than to repair it at intermediate level. Various sensitivities could be accomplished to account for other input factor changes; we have only demonstrated a couple of examples.

SCREENING

10. SCOPE. This appendix describes the processes and procedures associated with screening items in preparation for accomplishing Level of Repair Analysis (LORA).

20. APPLICABLE DOCUMENTS

20.1 Government documents. The specifications, standards, and handbooks cited in 2.1 form a part of this appendix to the extent specified under 2.1.

20.2 Nongovernment publications. Nongovernment standards or other types of nongovernment publications do not form a part of this appendix.

30. OVERVIEW

30.1 Definition. Screening procedures are the methods used to arrive at a decision with limited but selected data. These procedures are especially valuable in early stages of a program when limited data are available. They can also be used at various stages in the LORA process to make preliminary decisions without collecting the complete data. In some cases, final decisions can be arrived at using the screening rules. It is important to recognize that it may be necessary to include screened items in later LORA efforts or to make allowances for those screened items where LORA decisions among items interact.

30.2 Illustration. Screening methods are essentially dominance techniques. They depend on selecting certain limited but dominating information and making the decision based on that information. For example, assume that you want to buy a car and that you know the price of a stripped car for several competing models. If the stripped cars all have similar prices, it may be necessary to price out the options before making the selection. However, if one model is priced 25 percent below the others and the options are nearly identically priced, then the decision may be made on the prices of the stripped cars alone. It isn't necessary to determine the exact price of the options because the stripped car's price dominates this situation.

30.3 Terms. Analysis should be conducted to evaluate the off-equipment corrective maintenance alternatives of scrap, depot level repair, and intermediate level repair in relation to the hardware hierarchy. The breakout of the analysis will assign corrective tasks resulting from a particular failure mode on each item analyzed to one of the following categories: item condemnation (IC), assured intermediate task (AIT), assured depot task (ADT), or questionable corrective task (QCT). These terms are defined below. The rationale for assignment of each required corrective task will be documented.

30.3.1 Item condemnation (IC). This category includes items which will be scrapped rather than repaired at intermediate or depot level. Assignments to this category are made for the following reasons:

30.3.1.a. The particular failure mode results in a technically infeasible repair task as determined by historical experience on similar items.

30.3.1.b. It is not economic to perform the required repair, and the item should therefore be designed to facilitate discard-at-failure maintenance. That is, it should be designed for increased reliability and simplicity rather than ease of repair.

NOTE: When deciding to discard-at-failure, on an economic basis, all ramifications should be considered. Will volume be sufficient to warrant economic manufacture of the discard candidate? Will noncompetitive conditions exist later in the program so that the discard decision, though economic under current conditions, is in fact noneconomic under future competitive conditions?

30.3.2 Assured depot tasks (ADT). These are repair tasks that will be performed at a depot level facility. Assignments to this category are made on the basis that the item is determined as reparable and repairs should be performed at depot level for any of the following reasons:

30.3.2.a. Task is of a technically complex nature and requires sophisticated facilities, support equipment (SE), and/or highly skilled personnel available only at the depot level.

30.3.2.b. Task assignment to intermediate level repair would have an unacceptable impact on specified system operational requirements (such as mobility).

30.3.3 Assured intermediate tasks (AID). These are repair tasks that will be performed at intermediate shop level. Assignments to this category are made on the basis that the item is determined as reparable and repairs should be performed at intermediate level for any of the following reasons:

30.3.3.a. Task can be performed with no significant increase in SE, technical data, facilities, or skills. These resources either already exist or have been economically justified for intermediate repair decisions on other items.

30.3.3.b. Task is sufficiently simple, and SE and special tooling so inexpensive, that an intermediate repair level decision is obvious.

30.3.3.c. Task assignment is required to support specified system operational requirements that are not subject to economic analysis.

30.3.3.d. Task can be performed using the same SE (no increase in quantity or function) required for organizational maintenance.

30.3.4. Questionable Corrective Tasks (QCT). Any task that can't be assigned to one of the above categories should be treated as a questionable corrective task and carefully analyzed to determine level of repair. These tasks must be treated on an individual or aggregate basis with regard to making a repair level decision. Later analysis of these tasks will yield a recommendation of intermediate repair, depot repair, or scrap.

40. METHODS. There are two screening methods: cursory discard equations and equal cost curves.

40.1 Cursory discard equations.

40.1.1 Overview. Cursory discard equations focus on the major elements of repair cost and compare them to the cost of replacement. If this partial list of repair costs is greater than the cost of replacement, then the complete cost of repair must be greater than the cost of replacement. A decision to scrap the item rather than repair it can safely be made. Cursory discard criteria should be established early in the development cycle when initial design specifications are being prepared. These criteria should be used to provide general guidance to engineering design on the advisability of optimizing the design configuration to support a planned discard-at-failure or repair maintenance policy. The basic requirement is for a relevant amount of historical information to exist so that valid cost-estimating relationships can be developed as the basis for these early, but extremely important, repair level decisions.

40.1.2 Application. In order to apply the cursory discard criteria, we must first calculate the replacement cost and the repair cost.

TQCTGMi = Total questionable corrective tasks generated monthly for an item at an intermediate location
= UEBASE * UR * QTY/MTBF
= (syst/base)(hr/syst/mo)(no. of items)/(hr/failure)

where UEBASE = Number of end-items at each intr location
UR = End-item use rate
QTY = Number of occurrences of this item on the end-item or system; quantity per assembly
MTBF = Mean operating time between failures for the item in hours

Now, Replacement Cost = (TQCTGMi)(PIUP)(12) x (UCI)
= Life Cycle Failures x Unit Cost

where PIUP = Program inventory usage period in years
UCI = Unit cost of the item

And, Repair Cost = (SE Cost) + (Repair Labor and Material Cost) + (Minimum Investment in Spares)

where SE Cost = Cost of SE necessary to perform repair function. The contractor or analyst may estimate this on the basis of the generic family of items under consideration (dollars/hour SE operation time, dollars/dollar reparable assembly price, etc.).

Repair Labor and Material Cost = Cost of labor and materials to perform repair over weapon life cycle. The contractor or analyst may make a parametric estimate (average time to repair, percentage of assembly price, etc.).

Investment Spares Cost = Cost of minimum number of items in stockage and pipeline to support repair decision. In lieu of specific guidance, use the cost of 45 days worth at the failure rate being estimated (estimated failures/month x 1.5 months).

Now, we apply the cursory discard criteria to compare the replacement cost to the repair cost.

If: Replacement Cost ≤ Repair Cost

Then: Discard

40.1.3 Benefits. The major economic benefits of a discard-at-failure maintenance policy can be realized only by the early identification of items not subject to repair. This precludes the development and acquisition of principal support resources and gives benefits such as:

1. Reduced and simplified requirements for intermediate level support and test equipment.
2. Reduction of technical data and manuals.
3. Elimination of repair parts (bits and pieces, not spares).
4. Reduced training requirements.
5. Reduction in quantity and skill level of base maintenance personnel.
6. Improved unit mobility and deployment capability.
7. Reduced system downtime and turnaround time.

40.1.4 Risks. There are certain risks involved in making early repair level decisions when only limited design information is available. For example, an early decision to discard an item carries the risk of increased spares costs if the decision proves incorrect. Another risk is the inherent fluctuation in pipeline resupply when there is no repair capability. Of course, an early design decision for discard is not irreversible. It is, however, costly and time consuming if the redesign, development and acquisition of support resources must be done at a later date. In the same way, an item originally designed for repair can be reassigned to discard. In this case many of the benefits of a discard policy are lost, and unnecessary development effort will have been used to define the support resources necessary for a repair decision. See the note in 30.3 for certain cautions with respect to the discard-at-failure decision.

40.2. Equal cost curves.

40.2.1 Overview. The equal cost curves screening method requires extensive historical information and cost-estimating relationships to develop a set of curves for a family of items with essentially the same characteristics. These curves are generated by calculating the cost of repair and the cost of discard and then determining where these costs are equal. By setting the appropriate cost equations equal to each other and expressing them as a function of only two variables (usually MTBF and unit cost), we can plot the set of equal cost curves for our family of items as these variables change. These curves are the set of points, defined by specific values of the selected variables, at which the cost of one alternative is equal to another. As such, they define boundaries and separate the graph into areas relating to the discard or repair alternatives. The curves may be used to determine the sensitivity of the repair level decision to changes in unit cost or MTBF. They may also be used to screen repair level decisions for similar items.

Figure N-1 on the following page shows a set of "typical" equal cost curves. We will consider three possible alternatives, which gives three different cost curves: (1) Scrap = Intermediate, (2) Scrap = Depot, and (3) Depot = Intermediate. The intersection of the equal cost curves defines various decision regions on the graph. For example, in the ideal case of low unit cost and high MTBF, the decision region (S < D < I) in figure N-1 indicates that Scrap is the recommended decision. The specific shape of the equal cost curves depends on the equations used to derive them. For example, the locations of the Scrap = Depot and Depot = Intermediate curves might be reversed.

Due to the method of generating these curves on the assumption of average item characteristics and average support costs, only those decisions that clearly fall into a specific category should be made. A confidence interval should be established for these curves based on the expected variations in the basic variables. The borderline cases should be deferred for an item-by-item analysis if possible, or a preliminary decision made in favor of repair.

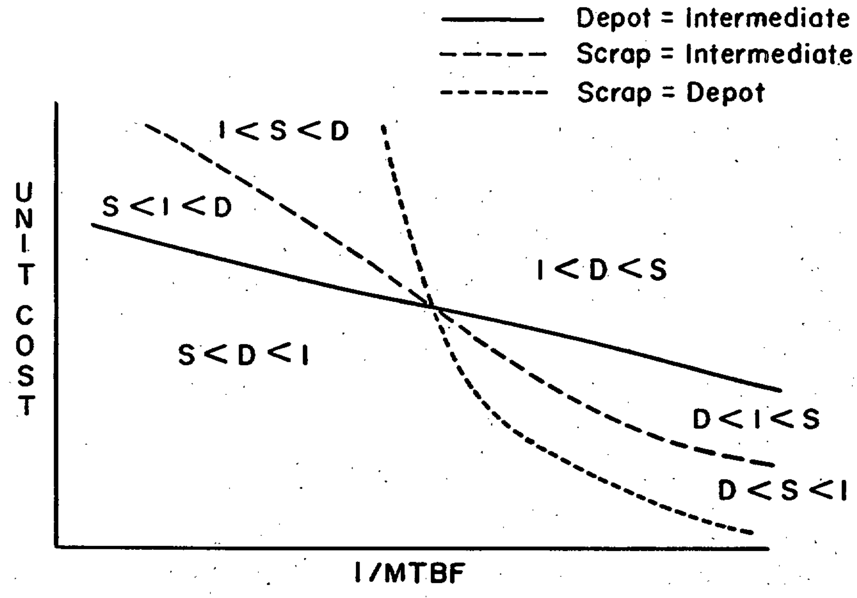


FIGURE N-1. Typical equation cost curve.

40.2.2 Application. In order to apply the equal cost curves method, we must first decide the cost elements to be considered in the scrap, depot, and intermediate level decisions. Next, we must determine how these elements will be calculated. Early in a program, it may be difficult to determine all the input data required to accurately compute many of the cost elements. In this case, the associated cost elements may be directly estimated. For instance, the total cost of technical data acquisition may be estimated, even though the exact number of pages of technical data to be purchased is uncertain. Similarly, the total cost of entering items into inventory may be estimated, even though the exact number of new piece parts and assemblies is currently unknown. Standards for similar items may also be used as an estimate until item specific values are available.

40.2.2.1 Equations. The following equations detail the major cost elements normally included in calculating the total cost of repair level decisions. These equations are grouped by repair level option, and their use is more fully explained in para. 40.2.2.2, Equal cost curves sample.

NOTE: The "average" item under analysis may be a Line Replaceable Unit (LRU) a Shop Replaceable Unit (SRU), or some lower level component. In general, an LRU is removed and replaced on an end-item or major assembly. An SRU is removed and replaced on an LRU and, thus, is a subcomponent of that LRU. When computing costs for an LRU, set FAILP(i) = 1 in all the following equations. When computing costs for an SRU, which is a subcomponent of an LRU, set FAILP(i) = fraction of the time this SRU is responsible for the LRU failure.

The following calculations apply to all three repair options: Scrap, Depot and Intermediate.

MTBCT = Mean time between corrective tasks for the item
= MTBF/[UF * (1 - RIP)]
MTBF/(Item oper hr/system hr)(1-RIP)
where MTBF = Mean operating time between failures for the LRU in hours
UF = Ratio of item operating hours to end-item operating hrs
RIP = Fraction of failures repaired in place

PGMB = Monthly end-item use hours at an intr location
= UEBASE * UR
= (syst/base)(hr/syst/mo)
where UEBASE = Number of end-items at each intr location
UR = End-item use rate

TQCTGMi = Total questionable corrective tasks generated monthly for an item at an intermediate location
= PGMB * QTY/MTBCT
(oper hr/mo/intr location)(No. items)/(hr/failure)
where QTY = Number of occurrences of this item on the end-item or system; quantity per assembly

TLCD = Total life cycle demands for an item at an intr location
= TQCTGMi * PIUP * 12 * M
(tasks/mo/intr location)(yr/LC)(mo/yr)(no. intr locations)
where PIUP = Program inventory usage period in years
M = Number of operating locations

PSRC = Packaging and shipping cost for CONUS
= PCC + (PWRC * SRC)
($/lb) + (ratio)($/lb)
where PCC = CONUS packaging cost, including labor & materials
PWRC = Packed to unpacked weight ratio for CONUS shipments
SRC = Shipping rate to CONUS locations

PSRO = Packaging and shipping cost for overseas
= PCO + (PWRO * SRO)
($/lb) + (ratio)($/lb)
where PCO = Overseas packaging cost, including labor & materials
PWRO = Packed to unpacked weight ratio for overseas shipments
SRO = Shipping rate to overseas locations

WPSR = Weighted packaging and shipping rate
= [(1 - OS) * PSRC] + [OS * PSRO]
(fraction CONUS)($/lb) + (fraction OS)($/lb)
where OS = Overseas deployment fraction

SCRAP OPTION

The scrap option will include the following cost categories: Replacement Spares, Packaging & Shipping, and Base Spares Quantity.

REPLACEMENT SPARES (C1S)

C1S = TLCD * FAILP(i) * UCI
(repairs/LC)(ratio)($/item)

where FAILP(i) = Failure mode ratio; frequency of occurrence of the SRU failure as a fraction of all parent LRU failures
UCI = Unit cost of the item

PACKAGING AND SHIPPING (C2S))

C2S = TLCD * FAILP(i) * WGTI * WPSR
(tasks/LC)(ratio)(lb/package)($/lb)

where WGTI = Weight of the item in pounds

BASE SPARES QUANTITY (C3S)

WOST = Weighted order and ship time
= [OS * OSTO] + [(1 - OS) * OSTC]

where OSTO = Order and shipping time, in months, to overseas locations
OSTC = Order and shipping time, in months, to CONUS locations

OSTPL = Order and ship time pipeline
= FAILP(i) * TQCTGMi * WOST
(ratio)(tasks/month/intr location)(mo)

OSTSL = Order and ship time stock level
= OSTPL + \/ 3 * OSTPL

NOTE: If OSTSL has a fractional value when computed, then set OSTSL = the next higher integer. For example, if OSTSL is computed to be 11.4, then set OSTSL = 12.

C3S = OSTSL * UCI * M
(No. items)($/item)(No. intr locations)

TOTAL SCRAP COST = C1S + C2S + C3S

DEPOT OPTION

The depot option will include the following cost categories: Repair Material, Packaging & Shipping, Base Spares Quantity, Depot Spares Quantity, Repair Labor, Item Entry, Technical Data Acquisition, Maintenance Training, Support Equipment (SE), Software, and Facilities.

REPAIR MATERIAL (C1D)

C1D = TLCD * FAILP(i) * UCPP
(tasks/LC)(ratio)($/fail)

where UCPP = Cost of non-repairable assys and/or pieceparts per repair

PACKAGING AND SHIPPING (C2D)

C2D = 2 * TLCD * FAILP(i) * WGTI * WPSR
(directions/trip)(tasks/LC)(ratio)(lb/package)($/lb packaging & shipping rate)
where WGTI = Weight of the item in pounds

BASE SPARES QUANTITY (C3D)

C3D = C3S (same as scrap calculation)

DEPOT SPARES QUANTITY (C4D)

WDRCT = Weighted depot repair cycle time
= (DRCTO * OS) + (DRCTC * (1 - OS))
(mo OS)(fraction) + (mo CONUS)(fraction)
where DRCTO = Depot repair cycle time, in months, for overseas locations
DRCTC = Depot repair cycle time, in months, for CONUS locations

DRCTPL = Depot repair cycle time pipeline
= FAILP(i) * TQCTGMi * WDRCT * M
(ratio)(tasks/mo)(mo)(no. intr locations)

DRCTSL = Depot repair cycle time stock level
= DRCTPL + $\sqrt{3 * DRCTPL}$
items in pipeline + safety level

NOTE: If DRCTSL has a fractional value when computed, then set DRCTSL = the next higher integer. For example, if DRCTSL is computed to be 20.5, then set DRCTSL = 21.

C4D = DRCTSL * UCI
(No. items)($/item)

REPAIR LABOR (C5D)

C5D = TLCD * FAILP(i) * DMMH * DLR
(tasks/LC)(ratio)(hr/task)($/hr)
where DMMH = Depot level maint man-hours required for repair
DLR = Depot labor wage rate

ITEM ENTRY (C6D)

RIIMC = Recurring + initial item management cost
= (PIUP * RMC) + IMC
(yr/LC)($/yr) + ($/part intro)
where RMC = Annual item management cost
IMC = Initial cost for introducing an item into the wholesale level inventory system

C6D = NPPA * RIIMC
(No. items)($/item)
where NPPA = Number of new piece-parts and assemblies required for repair

TECHNICAL DATA ACQUISITION (C8D)

C8D = NTDP * TD
(no. pages)($/page)
where NTDP = Number of tech data pages required for repair of item
TD = Cost per original page of tech data from the contractor

MAINTENANCE TRAINING (C9D)

TFD = Training factor at depot
= 1 + [TRD * (PIUP - 1)]
1 + [(turnover/yr)(yr/LC - 1)]
where TRD = Annual turnover rate for depot personnel

C9D = TFD * NUMTD * TRW * [TRC + (40 * DLR)]
(ratio)(No. men)(wk/man) [$/wk + (hr/wk)($/hr)]
where NUMTD = Number of people trained at depot
TRW = Amount of time, in weeks, required for training
TRC = Expected training cost per week for instruction and material

SUPPORT EQUIPMENT (C10D)

NOTE: These computations must be accomplished for each applicable type of SE.

DSE1 = Total no. of hours per month the SE is actually used
= ≥ (TQCTGMi * FAILP(i) * SEHRi) for i = 1,...,Q
where SEHRi = Support equipment time, in hours, used on an item
Q = Number of items which use this piece of SE

DSE2 = Hours/month the item under analysis will require the SE
= TQCTGMi * FAILP(i) * SEHRi

DSE3 = Proportion of SE costs charged to the item under analysis
= DSE2/DSE1

NSE = Number of a particular type of SE at the depot.

If NSE is known, go to DSE4.

NSE = (M * DSE1)/(SEAVAIL/12)
(no. of intr locations)(SE hours used/mo)/(hours avail/mo)
where SEAVAIL = No. of hours the SE is available annually at a maintenance level

NOTE: If NSE has a fractional value when computed, then set NSE = the next higher integer. For example, if NSE is computed to be 3.28, then set NSE = 4.

DSE4 = Depot SE cost charged to the item
= DSE3 * [(UCSE * NSE) + SEINST + HDEVP]
where UCSE = Unit cost of the SE
SEINST = SE installation cost at a maintenance level
HDEVP = Hardware development price

DSE5 = Depot SE maintenance cost
= SSECF * PIUP * DSE4
where SSECF = Support of SE cost factor

C10D = DSE4 + DSE5

SOFTWARE COST (C11D)

NOTE: These computations must be accomplished for each applicable Test Program Set (TPS).

TPSDEV = TPS software development cost for the item

DSW1 = Depot software maintenance cost
= TPSMAINT * (PIUP - 1) * TPSDEV

where TPSMAINT = Support of SE cost factor for TPS
C11D = TPSDEV + DSW1

FACILITIES (C12D)

C12D = Cost of new depot facilities
C12D = FACDEV + UC + (FACOP * 12 * PIUP)
where FACDEV = Development cost for facilities
UC = Unit cost of the facilities
FACOP = Operating cost for the facilities

TOTAL DEPOT COST = C1D + C2D + C3D + C4D + C5D + C6D + C8D + C9D + C10D + C11D + C12D

INTERMEDIATE OPTION

The intermediate option will include the following cost categories: Repair Material, Packaging & Shipping, Base Spares Quantity, Repair Labor, Item Entry, Supply Administration, Technical Data Acquisition, Maintenance Training, Support Equipment (SE), Software, and Facilities.

REPAIR MATERIAL (C1B)

C1B = C1D (same as depot calculation)

PACKAGING AND SHIPPING (C2B)

C2B = TLCD * FAILP(i) * WTPP * WPSR
(tasks/LC)(ratio)(lb parts/task)($/lb)
where WTPP = the weight, in pounds, of repair parts and/or assys
WPSR = Weighted packaging and shipping rate; WPSR was calculated under the depot option

BASE SPARES QUANTITY (C3B)

A = Annual cost of non-repairable assys and/or pieceparts for item
= UCPP * FAILP(i) * TQCTGMi * 12
($)(ratio)(tasks/mo)(mo/yr)
where UCPP = Cost of non-repairable assys and/or pieceparts per repair

$EOQ = 5.9 \sqrt{A}$
where the value 5.9 is derived from the classical EOQ formula

NOTE: The value for EOQ should reflect a cost no greater than the annual cost (A) and no less than the monthly cost (A/12). Therefore, if EOQ > A, set EOQ = A. If EOQ < A/12, set EOQ = A/12.

BRCTP = Intr repair cycle time pipeline
= FAILP(i) * TQCTGMi * BRCT
(ratio)(tasks/mo)(mo)
where BRCT = Intr repair cycle time in months

BRCTSL = Intr repair cycle time stock level
= BRCTP + $\sqrt{3}$ * BRCTP
items in pipeline + safety level

NOTE: If BRCTSL has a fractional value when computed, then set BRCTSL = the next higher integer. For example, if BRCTSL is computed to be 5.6, then set BRCTSL = 6.

C3B = [(BRCTSL * UCI) + EOQ] * M
[(No. items/intr location)($/item) + EOQ$] (No intr locations)
where UCI = Unit cost of the item

REPAIR LABOR (C5B)

C5B = TLCD * FAILP(i) * BMMH * BLR
(tasks/LC)(ratio)(hr/task)($/hr)
where BMMH = the base level maint man-hours required for repair
BLR = the base labor wage rate

ITEM ENTRY (C6B)

C6B = C6D (same as depot calculation)

SUPPLY ADMINISTRATION (C7B)

C7B = PIUP * SA * (NPPA + NAB) * M
(yr/LC)($/item/yr)(No. new parts + No. new parts at intr location)(No. intr locations)

where SA = the annual cost to manage one item in base supply system
NPPA = the number of new items
NAB = the number of items which will be new at intr level

TECHNICAL DATA ACQUISITION (C8B)

C8B = C8D (same as depot calculation)

MAINTENANCE TRAINING (C9B)

TFB = Training factor for intr level
= 1 + [TRB * (PIUP - 1)]
1 + [(turnover/yr)(yr/LC - 1)]

where TRB = Annual turnover rate for base personnel

C9B = TFB * NUMTB * TRW * [TRC + (40 * BLR)] * M
(ratio)(No. men/intr location)(wk/man)[($/wk + (hr/wk)($/hr)]
(No. intr locations)

where NUMTB = Number of people trained at an intr location
TRW = Amount of time, in weeks, required for training
TRC = Expected training cost per week for instruction and material

SUPPORT EQUIPMENT (C10B)

NOTE: These computations must be accomplished for each applicable type of SE.

ISE1 = Total no. of hours the SE is actually used
= ≥ (TQCTGMi * FAILP(i) * SEHRi) for i = 1,...,Q

where SEHRi = Support equipment time, in hours, used on an item
Q = Number of items which use this piece of SE

ISE2 = Hours/month the item under analysis will require the SE
= TQCTGMi * FAILP(i) * SEHRi

ISE3 = Proportion of SE time charged to the item under analysis
= ISE2/ISE1

NSE = Number of a particular type of SE at intermediate level.

If NSE is known, go to ISE4.

TEMP = Minimum number of SE required at one intr location
= ISE1/(SEAVAIL/12)
(SE hours used)/(hours avail/mo)

where SEAVAIL = No. of hours the SE is available annually at a maintenance level

NOTE: If TEMP has a fractional value when computed, then set TEMP = the next higher integer. For example, if TEMP is computed to be 3.28, then set TEMP = 4.

NSE = M * TEMP
(no. of intr locations)(no. of SE per location)

ISE4 = Intr shop SE cost charged to the item
= ISE3 * [(UCSE * NSE) + SEINST + HDEVP]
where UCSE = Unit cost of the SE
SEINST = SE installation cost at a maintenance level
HDEVP = Hardware development price

ISE5 = Intr shop SE maintenance cost
= SSECF * PIUP * ISE4
where SSECF = Support of SE cost factor

C10B = ISE4 + ISE5

SOFTWARE COST (C11B)

NOTE: These computations must be accomplished for each applicable Test Program Set (TPS).

TPSDEV = TPS software development cost for the item

ISW1 = Intr shop software maintenance
= TPSMAINT * (PIUP - 1) * TPSDEV
where TPSMAINT = Support of SE cost factor for TPS

C11B = TPSDEV + ISW1

FACILITIES (C12B)

C12B = Cost of intr repair facilities unique to repair task
C12B = FACDEV + [UC + (FACOP * 12 * PIUP)] * M
where FACDEV = Development cost for facilities
UC = Unit cost of the facilities
FACOP = Operating cost for the facilities

TOTAL INTERMEDIATE COST = C1B + C2B + C3B + C5B + C6B + C7B + C8B + C9B + C10B + C11B + C12B

40.2.2.2 Equal cost curves sample. The following sample will illustrate the use of the equal cost curves screening method. Table N-I summarizes the detailed data to be used in the sample.

TABLE N-I.

BLR	$31.55	NUMTB	1	SRC	$.61
BMMH (Hrs)	6	NUMTD	1	SRO	$1.28
BRCT (Mos)	.23	OS	.6	SSECF	.1
DLR	45.94	OSTC (Mos)	.4	TD	$752
DMMH (Hrs)	6	OSTO (Mos)	.55	TPSDEV	$150000
DRCTO (Mos)	1.9	PCC	$2.78	TPSMAINT	.075
DRCTC (Mos)	1.70	PCO	$2.78	TRB	.128
FACDEV	$10000	PIUP	20	TRC	$1855
FACOP	$1000	PWRC	$1.94	TRW (Wks)	1.1
FAILP(i)	.25	PWRO	$1.94	UC	$225000
HDEVP	$62000	QTY	1	UCPP	$512
IMC	$1641	RIP	0	UCSE	$4300
M	9	RMC	$234.38	UEBASE	47
MTBF	375	SA	$2.69	UF	1
NAB	0	SEAVAIL	3480	UR (Hrs)	30
NPPA	20	SEHR	5	WGTI (Lbs)	1.33
NTDP	35	SEINST	$226	WTPP (Lbs)	.4

As explained in 40.2.1, equal cost curves are graphic representations of the specific cases when the costs of various repair options are set equal. Using the equations in 40.2.2.1, we set Total Scrap Cost = Total Depot Cost, Total Scrap Cost = Total Intermediate Cost, and Total Depot Cost = Total Intermediate Cost, respectively. We choose to focus on unit cost and MTBF as our two variables, and we solve the resulting equations in terms of unit cost. We now show you the details of these calculations.

40.2.2.2.1 Simplification. First, we simplify the expressions for Total Scrap Cost, Total Depot Cost, and Total Intermediate Cost. The logic is as follows: (1) partition out the term for unit cost wherever it appears, (2) specifically list any expressions which depend on MTBF, and (3) consolidate all other expressions into a constant value.

Simplification of Total Scrap Cost:

Total Scrap Cost = C1S + C2S + C3S

The only term of this equation which does not depend on the unit cost is C2S. It does, however, depend on MTBF, so we cannot "roll it up" into a constant. This term remains as C2S. The scrap total in terms of unit cost then becomes:

Total Scrap Cost = [TQCTGM * FAILP(i) * PIUP * 12 * M * UCI] + C2S + [OSTSL * M * UCI]

Simplification of Total Depot Cost:

Total Depot Cost = C1D + C2D + C3D + C4D + C5D + C6D + C8D + C9D + C10D + C11D + C12D

The terms C6D, C8D, C9D, C11D, and C12D do not depend on either unit cost or MTBF. Therefore, we compute their values using the equations in Para 40.2.2.1 and the data in table N-I. Then we add these values together and set the Depot Constant (DC) equal to that sum.

DC = C6D + C8D + C9D + C11D + C12D
= 126,572 + 26,320 + 8,769 + 363,750 + 475,000
= 1,000,411

Now, the terms C1D, C2D, C5D, and C10D do not depend on unit cost, but they do depend on MTBF. Therefore, they will remain as is in our simplified equation. The depot total in terms of unit cost then becomes:

Total Depot Cost = C1D + C2D + (OSTSL * UCI * M) + (DRCTSL * UCI) + C5D + C10D + DC

Simplification of Total Intermediate Cost:

Total Intermediate Cost = C1B + C2B + C3B + C5B + C6B + C7B + C8B + C9B + C10B + C11B + C12B

The terms C6B, C7B, C8B, C9B, C11B, and C12B do not depend on either unit cost or MTBF. Therefore, we compute their values using the equations in Para 40.2.2.1 and the data in table N-I. Then we add these values together and set the Intermediate Constant (IC) equal to that sum.

IC = C6B + C7B + C8B + C9B + C11B + C12B
= 126,572 + 9,684 + 26,320 + 105,905 + 363,750 + 4,195,000
= 4,827,231

Now, the terms C1B, C2B, C5B, C10B do not depend on unit cost, but they do depend on MTBF. Therefore, they will remain as is in our simplified equation. The intermediate total in terms of unit cost becomes:

Total Intermediate Cost = C1B + C2B + {[(BRCTSL * UCI) + EOQ] * M} + C5B + C10B + IC

40.2.2.2.2 Equal cost curve relationships. We now use these simplified equations to express the relationships Scrap ≤ Depot, Scrap ≤ Intermediate, and Intermediate ≤ Depot in terms of unit cost. Notice that we are using the "less than or equal to" relationship, rather than simply "equal to". This will help us to define the various regions of our graph once the equal cost curves are plotted. As stated before, the equal cost curves themselves represent the points at which the options are exactly equal.

Scrap ≤ Depot:

[TQCTGMi * FAILP(i) * PIUP * 12 * M * UCI] + C2S + [OSTSL * M * UCI] ≤ C1D + C2D + [OSTSL * M * UCI] + [DRCTSL * UCI] + C5D + C10D + DC

When similar terms are combined,

$$UCI \leq \frac{C1D + C2D + C5D + C10D + DC - C2S}{[TQCTGM * FAILP(i) * PIUP * 12 * M] - DRCTSL}$$

To generate this curve, various values for MTBF must be selected and the TQCTGM, DRCTSL, C1D, C2D, C5D, C10D and C2S must be recalculated for each value. The above equation yields the corresponding unit cost for a particular MTBF. The plot of this relationship defines the equal cost curve. Table N-II shows the resulting calculations for five different values of the MTBF. Normally, five data points will not be sufficient to generate a good equal cost curve. The more data points you calculate, the more defined the curve will be. Note that, as in figure N-1, you will actually be plotting the inverse of the MTBF (that is, 1/MTBF) on the horizontal axis and the unit cost on the vertical axis. Once plotted, this curve will define a decision making region. Since we started with the relationship Scrap ≤ Depot, the area below the curve is the region where the Scrap decision is cheaper than the Depot decision.

TABLE N-II.

MTBF	TQCTGM	DRCTSL	C1D	C2D	C5D	C10D	C2S	UCI
50	28.20	136	7827923	192891	4214236	212478	96451	881
100	14.10	72	3913961	96445	2107118	199578	48223	960
200	7.05	39	1956981	48223	1053559	199578	24113	1119
375	3.76	23	1043723	25719	561898	199578	12859	1398
500	2.82	18	782792	19289	421424	199578	9645	1598

Scrap ≤ Intermediate:

$$[TQCTGM * FAILP(i) * PIUP * 12 * M * UCI] + C2S + [OSTSL * M * UCI] \leq C1B + C2B + ([(BRCTSL * UCI) + EOQ] * M) + C5B + C10B + IC$$

When similar terms are combined,

$$UCI \leq \frac{C1B + C2B + C5B + C10B + IC - C2S - (M * EOQ)}{M * [(TQCTGM * FAILP(i) * PIUP * 12) + OSTSL - BRCTSL]}$$

To generate this curve, we select the same values of MTBF as before and recalculate the BRCTSL, EOQ, C1B, C2B, C5B, C10B, and C2S for each value. The above equation yields the corresponding unit cost for each MTBF. Table N-III shows the results; previously computed values which do not change (such as TQCTGM) are not listed. Once plotted, this curve will define another decision making region. Since we started with the relationship Scrap ≤ Intermediate, the area below the curve is the region where the Scrap decision is cheaper than the Intermediate decision.

TABLE N-III.

MTBF	OSTSL	BRCTSL	EOQ	C1B	C2B	C5B	C10B	UCI
50	7	4	3624	7827923	29006	2894191	302778	1028
100	5	3	1812	3913961	14503	1447096	302778	1363
200	3	2	906	1956981	7252	723548	302778	2032
375	2	2	483	1043723	3867	385892	302778	3211
500	2	1	389	782792	2901	289419	302778	4026

Depot ≤ Intermediate:

$$C1D + C2D + [OSTSL * M * UCI] + [DRCTSL * UCI] + C5D + C10D + DC \leq C1B + C2B + ([(BRCTSL * UCI) + EOQ] * M) + C5B + C10B + IC$$

When similar terms are combined,

$$UCI \leq \frac{C1B + C2B + C5B + C10B + IC - C1D - C2D - C5D - C10D - DC - (M * EOQ)}{M * [\ OSTSL - BRCTSL\ ] + DRCTSL}$$

To plot the curve, we select the same values of MTBF as before, and the above equation yields the corresponding unit cost for each particular MTBF. Table N-IV shows the results; previously computed values which do not change are not listed. Once plotted, this curve will define another decision making region. Since we started with the relationship Depot ≤ Intermediate, the area below the curve is the region where the Depot decision is cheaper than the Intermediate decision.

TABLE N-IV.

MTBF	UCI
50	14727
100	35242
275	73977
375	162079
500	139931

40.2.2.2.3 Screening an item. Now, given the unit cost and MTBF of an item with similar characteristics to the one(s) used in developing the equal cost curves, we may make a repair level screening decision. To do this, we would plot the point determined by that MTBF and unit cost on our equal cost curves graph. The decision region containing this point suggests the repair level decision. The six possible regions and their associated decisions are listed below. Recall that, given the shape of the particular equal cost curves, all of these regions may not be applicable to every graph.

REGION	DECISION
(1) I ≤ D ≤ S	Intermediate
(2) I ≤ S ≤ D	Intermediate
(3) D ≤ I ≤ S	Depot
(4) D ≤ S ≤ I	Depot
(5) S ≤ I ≤ D	Scrap
(6) S ≤ D ≤ I	Scrap

Note that the unit cost and MTBF of the item you wish to screen should fall within the range of the equal cost curve graph. Otherwise, the screening decision may not be valid. If the point is significantly outside the range of the graph, this could mean the item is not "similar enough" to the one(s) used to generate the equal cost curves in the first place. Also, if the plotted point is very close to the boundary between different regions, you may want to defer any decision on the item until more current/accurate data is available.

FEDERAL AVIATION ADMINISTRATION METHOD

10. SCOPE. This appendix provides the theory, methodology and approach comprising the Federal Aviation Administration (FAA) National Airspace System Level of Repair Analysis (NASLORA) model.

20. APPLICABLE DOCUMENTS

20.1 Government documents. The specifications, standards, and handbooks cited in 2.1 form a part of this appendix to the extent specified under 2.1.

20.2 Nongovernment publications. Non government standards or other types of nongovernment publications do not form a part of this appendix.

30. MODEL DESCRIPTION

30.1 Introduction. The NASLORA model is the FAA's required method of conducting a LORA. Use of any other model will be permitted only with prior approval from the FAA LORA Program Office. Requests for deviation from this policy must be submitted in writing to the address in paragraph 30.2. The model is automated and runs on IBM AT/XT compatible personal computers.

30.2 Model availability. The NASLORA model may be obtained by sending a written request to Department of Transportation, Federal Aviation Administration, Mike Monroney Aeronautical Center, ATTN: AAC-412, P.O. Box 25082, Oklahoma City, OK 73125. The request must include the users name, organization, mailing address, the program the model is to be used to support, and the type of computer hardware on which the model is to be installed.

30.3 Characteristics. The model constructs a network based on individual failure modes of each line replaceable unit (LRU), since a given LRU can fail in multiple ways. Each failure mode of an LRU may be attributed to the failure of one or more shop replaceable units (SRUs). Using this information in addition to personnel and training requirements, parts and tools and test equipment (whether shared or dedicated), a representative network is constructed. The network is then solved using maximum flow/minimum cut algorithms.

30.3.1 Approach. The NASLORA solves the LORA problem for both LRUs and SRUs. It solves the problem by failure mode, recognizing that an LRU may fail in more than one way.

Individual failure modes are treated as part of the overall problem. NASLORA successfully treats shared support equipment by avoiding support equipment cost prorating techniques used in some other models. This is handled by including support equipment costs in network paths for those items and failure modes to which they apply.

30.3.2 Level of repair decision alternatives. Working within FAA maintenance policy requires making level of repair decisions based on the alternatives of depot repair, site-repair (repair in place) and discard at failure (scrap). There are however, cases involving repairs of greater detail, being done at the site or an off-site facility. To effectively model resources required by these repairs, they are treated as intermediate level repairs in the LORA process.

30.3.3 Considerations. The NASLORA model deals only with economic factors involved in making repair level decisions. Therefore, the recommendations made by the model must be used in conjunction with noneconomic factors to formulate the final decision. The economic analysis within the model is based on the cost of repair level decisions which in turn are based on specific life cycle cost associated with each repair level option. However, NASLORA should not be considered a LCC model since it does not consider life cycle costs which do not influence repair level decisions.

40. METHODOLOGY

40.1 Overview. The NASLORA model is an automated analytical technique to be used as an aid in making repair level decisions. The model recognizes indenture level relationships between LRUs and SRUs, and uses these interrelationships to preclude inconsistent repair level decisions. A network is constructed mathematically by the model. This network allows for the portrayal of all possible combinations of depot repair, work center repair, and scrap for each LRU and/or SRU while allowing for sharing of support equipment. All decisions are considered simultaneously for all failure modes and all LRUs/SRUs. This method allows optimization of the complete support plan for an end item rather than treating LRUs/SRUs individually.

40.2 Assumptions. The NASLORA model utilizes a number of assumptions to allow for more efficient and specific treatment of repair level decisions while holding user input to a minimum.

The assumptions take FAA maintenance practices for both current and future equipment into account. The following assumptions apply:

a. The maintenance network within the FAA is composed of work centers, which serve as intermediate maintenance shops, and one centrally located depot repair facility, the FAA Logistics Center. The user specifies the number of intermediate locations which will support the end item under analysis, and the level of end item utilization (operating time per month) at the intermediate location (assumed to be equal for all intermediate locations). The number of depot repair facilities, though known to be one, is irrelevant since it is assumed that a given LRU or SRU, if repaired at depot, would always be sent to the same depot repair facility.

b. Intermediate level maintenance data such as available work time per man, labor rate, and turnover rate, are assumed to be equal for all intermediate locations and all types of repair tasks. Corresponding depot level factors are constant for all types of tasks.

c. Supply system factors are assumed to be constant for all LRUs and SRUs being analyzed. The order and shipping time from depot to each work center within the continental U.S. is a constant for every item. Similarly, the order and shipping time from the depot to each overseas intermediate location is a constant.

d. Only one set of technical data is purchased from the contractor. Duplication and distribution costs for additional sets of data are minor and are ignored.

e. Scheduled maintenance actions are not specifically considered by the model. When they exist, they may be included by designating an additional failure mode for the affected items and appropriately modifying the LRU failure rate. These tasks need to be taken into account only when they are not applicable for all level of repair decisions.

f. The model explicitly evaluates each LRU failure mode for a repair level decision; however, a simplifying assumption is made for SRUs. It is assumed that the different failure modes of an SRU are sufficiently similar that explicitly evaluating the principal SRU failure mode is adequate.

g. Depot stock of SRUs is computed to satisfy intermediate level demands for SRUs, that is to resupply the intermediate locations when they send SRUs to depot for repair. This SRU stock supports intermediate level LRU repair, by removing and replacing a failed SRU, but not depot level LRU repair.

40.3 Treatment of support equipment. The NASLORA treats support equipment costs differently than many other LORA systems. The difference is that NASLORA does not prorate support equipment costs. The costs for support equipment are simply treated as additional obstacles in the network. These costs are then included in calculations for any support alternative that employs the particular piece of support equipment. Once a single item of the support equipment is saturated with use at a given location, additional items are charged to that alternative. This approach prevents situations often arising from prorating support equipment costs among LRUs/SRUs requiring them, by optimizing the overall outcome rather than one instance at a time. For example, if an end item is made up of six LRUs that all share a piece of automatic test equipment, we might first try prorating the cost of the ATE to each LRU based on its usage rate for the support equipment. However, if we find that the first of the six LRUs cannot justify its portion of the cost of the ATE, that LRU may be scrapped. This decision leaves the total ATE cost to be prorated among the five remaining LRUs, which may cause another or two to be scrapped. Obviously this could go on until all the LRU's were determined to be scrapped rather than repaired. On the other hand, NASLORA looks at the entire situation to determine if it is more economical to go ahead with repair of some combination of the LRUs than it would be to scrap them all. This is a major benefit of using a network analysis approach.

50. MAXIMUM FLOW MINIMUM CUT ALGORITHM

50.1 Overview. The NASLORA model uses a max-flow/min-cut algorithm to determine repair level decisions. As an example, consider the sample network shown in figure O-1.

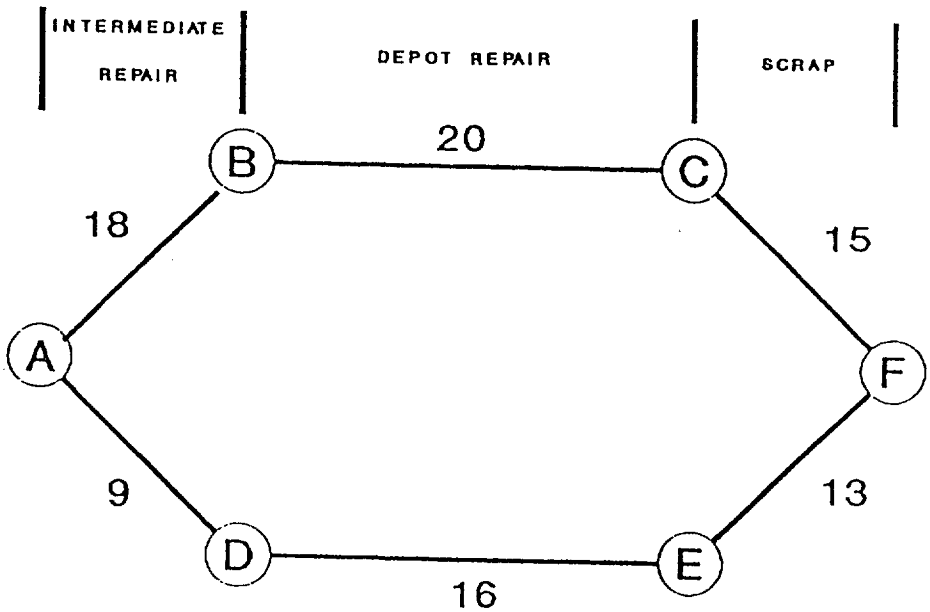


FIGURE O-1. Sample network.

Only the minimum cut logic will be discussed here, since LORA is a means of determining minimum cost level of repair decisions while working within non-quantitative constraints such as personnel availability, agency policy, etc. To visualize the use of minimum cut algorithm logic, consider the above figure as follows: Each of the two paths A-B-C-F and A-D-E-F represents an individual LRU or SRU involved. Imagine drawing a line from top to bottom of the figure, crossing (cutting) each path while forcing the line to cross those segments which will collectively produce the least total cost. For our small example, it is simple to determine that a line crossing the segment between nodes C and F on the upper path and the segment between nodes A and D on the lower path would provide the lowest total life cycle cost for repairs. From the figure, this represents scrapping (discarding at failure) the LRU represented by the upper path and intermediate (using ATE in a back room at the site) repair of the LRU represented by the lower path. When the process is complicated by ATE sharing, test program sets, special tools, etc; the number of nodes and segments increase greatly for each LRU. The more complicated networks which would describe ATE sharing would make it all but impossible to manually optimize level of repair decisions for each LRU, based on all other LRUs. Automation of this algorithm, however, makes this optimization possible in a matter of minutes or less, once data collection and entry are accomplished.

50.2 Mathematical calculations. The NASLORA users guide provides detailed listings of all cost equations used in the model. For this reason, together with the fact that the FAA does not intend or desire to promote the development of models with the same capabilities as NASLORA, the formulas for mathematical computations within NASLORA were not included in this document.

50.3 Data elements. The following is a discussion of the data elements used as input data for the NASLORA model. For the most part, these data elements can be directly associated with specific data elements in the appendix P. However, there are some cases requiring conversion of a data element to bring a data element conforming to the standard definition in line with the data input requirements of the NASLORA model. There are some cases where NASLORA peculiar data elements do not appear in appendix P. In these cases, the definitions are provided in the NASLORA user's guide. Table O-I provides a listing of all NASLORA input data elements (other than those used to control the actual execution of the model), field description, corresponding appendix P name, conversion factor, recommended data source (FAA or Contractor), and whether the data element is available from the LSAR.

50.4 Program output. The output of NASLORA includes data input, intermediate results, supplementary information, the optimal solution, and sensitivity analysis results. Options have been built into the model to allow the user to eliminate portions of the output if so desired. This feature was added to preclude voluminous output reports for those instances where only specific information is desired.

TABLE O-I. Data element.

DATA ELEMENT NAME	FIELD DESCRIPTOR	UNITS	APPENDIX P DATA ELEMENT NAME	APPENDIX P CONVERSION	LSAR	RECOMMENDED DATA SOURCE
AVAILABLE TIME	3 N R -	HRS/MO	SE AVAILABLE HOURS	1/12	NO	GOV/CON
END ITEM NAME	13 X L		END ITEM ACRONYM CODE		YES	GOV
CURRENT USAGE	3 N R -	HRS/MO			NO	GOV/CON
DEPOT LABOR RATE	4 N R 2	$/HR	LABOR RATE		2B	GOV
DEPOT MAINTENANCE HOURS	4 N R 1	HOURS	MEAN TIME TO REPAIR		NO	CON
DEPOT REPAIR CYCLE TIME (CONUS)	4 N R 2	MONTHS	REPAIR CYCLE TIME	1/30	NO	GOV
DEPOT REPAIR CYCLE TIME (OVERSEAS)	4 N R 2	MONTHS	REPAIR CYCLE TIME	1/30	NO	GOV
DEPOT SHOP MANHOURS	4 N R 2	MN-HR /MO	REPAIRMAN AVAIL. HOURS	1/12	NO	GOV
DEPOT TURNOVER RATE	4 N R 3	RATIO	REPMN TURNOVER RATE		2B	GOV
FACILITIES COST	8 N R -	$			NO	CON
FAILURE MODE NAME	8 X L -				YES	CON
FAILURE MODE RATIO	3 N R 2		FAILURE MODE RATIO		YES	CON
INITIAL MANAGEMENT COST	5 N R 2	$/ITEM	INITIAL CATALOGING COST		YES	CON
LRU COST	10 N R 2	$/UNIT	UNIT OF ISSUE PRICE		YES	CON
LRU NAME	19 X L -		ITEM NAME		YES	CON

TABLE O-I. Data element - continued.

DATA ELEMENT NAME	FIELD DESCRIPTOR	UNITS	APPENDIX P		LSAR	RECOMMENDED DATA SOURCE
			DATA ELEMENT NAME	CONVERSION		
MAINTENANCE TRAINING REQUIRED	4 N R 2	WEEKS	TRAINING TIME		NO	CON
MEAN TIME BETWEEN FAILURES	6 N R -	HOURS	MEAN TIME BETWEEN FAILURES		YES	CON
NUMBER OF GPSE TYPES REQUIRED	3 N R -				NO	CON
NUMBER OF NEW PARTS	3 N R -		NUMBER OF PARTS NEEDING NSN		NO	CON
NUMBER OF PERSONS TRAINED (DEPOT)	3 N R -				NO	CON
NUMBER OF PERSONS TRAINED (WORK CENTER)	3 N R -				NO	CON
NUMBER OF STANDARD PARTS	3 N R -		NUMBER PARTS WITH NSN		NO	CON
NUMBER OF SUPPORT EQUIPMENT	2 N R -		NUMBER OF SUPPORT EQUIPMENT		YES	CON
NUMBER OF WORK CENTERS	3 N R -		NUMBER OF OPERATING LOC.		NO	GOV
NUMBER SPSE REQUIRED	3 N R -				NO	CON
OPERATING RATIO	4 N R 2	RATIO	CONVERSION FACTOR		NO	CON
ORDER & SHIP TIME (CONUS)	4 N R 3	MONTHS	SHIP TIME	1/30	NO	CON

TABLE O-I. Data element - continued.

DATA ELEMENT NAME	FIELD DESCRIPTOR	UNITS	APPENDIX P DATA ELEMENT NAME	APPENDIX P CONVERSION	LSAR	RECOMMENDED DATA SOURCE
ORDER & SHIP TIME (OVERSEAS)	4 N R 3	MONTHS	SHIP TIME	1/30	2B	GOV
OVERSEAS EQUIPMENT RATIO	3 N R 2	RATIO	RATIO OF FORCE OVERSEAS		NO	GOV
PACKED WEIGHT RATIO (CONUS)	4 N R 2	RATIO			2B	CON
PACKING COST (CONUS)	4 N R 2	$/LB	PACKING COST		2B	GOV
PACKING COST (OVERSEAS)	4 N R 2	$/LB	PACKING COST		2B	GOV
PLANNED SYSTEM LIFE	2 N R -	YEARS	OPERATION LIFE		2B	GOV
QUANTITY PER END ITEM	3 N R -		QUANTITY PER END ITEM		YES	CON
RECURRING MANAGEMENT COST	5 N R 2	$/ITEM /YEAR	REC. CATALOGING COST		2B	GOV
REPAIR IN PLACE PERCENT	5 N R 2	PERCNT	MAINTENANCE TASK DISTRIBUTION		2B	GOV
REPAIR PARTS COST	5 N R -	$	REPAIR PARTS COST		YES	CON
SHIPPING RATE (CONUS)	4 N R 2	$/LB	TRANSPORTATION COST		2B	GOV
SHIPPING RATE (OVERSEAS)	4 N R 2	$/LB	TRANSPORTATION COST		2B	GOV
SUPPORT EQUIPMENT COST	8 N R -	$/UNIT	UNIT OF ISSUE PRICE		YES	CON

TABLE O-I. Data element - continued.

DATA ELEMENT NAME	FIELD DESCRIPTOR	UNITS	APPENDIX P DATA ELEMENT NAME	APPENDIX P CONVERSION	LSAR	RECOMMENDED DATA SOURCE
SE DEVELOPMENT COST	7 N R -	$1,000	HARDWARE DEVELOPMENT PRICE		YES	CON
SE HOURS PER REPAIR	4 N R 1	HR/REP	SE TIME USED		NO	CON
SE NAME	12 X L -		ITEM NAME		NO	CON
SE O&M COST	5 N R -	$/YR	OPERATING & SUPPORT COST		YES	GOV/CON
SYSTEM OPERATING HOURS PER MONTH	3 N R -	HR/MO	ANNUAL OPERATING TIME		YES	GOV/CON
SYSTEMS PER WORK CENTER	4 N R -		NUMBER OF SYSTEMS SUPPORTED		NO	GOV/CON
TECHNICAL DATA PAGES	3 N R -	PG/REP	TECH DOCUMENTS PAGES		NO	CON
TECHNICAL DATA COST	4 N R -	$/PAGE	TECH DOCUMENTATION COST		2B	GOV
TRAINING COST	5 N R -	$/ (PRSN *WEEK)	TRAINING COST		NO	CON
WEIGHT	5 N R 1	LBS	UNIT WEIGHT		YES	CON
WEIGHT OF PIECE PARTS	4 N R -	LBS	UNIT WEIGHT		YES	CON
WORK CENTER LABOR RATE	4 N R 2	$/HR	LABOR RATE		2B	GOV
WORK CENTER MAINTENANCE MAN HOURS	4 N R 1	HRS	MEAN TIME TO REPAIR		NO	CON

TABLE O-I. Data element - continued.

DATA ELEMENT NAME	FIELD DESCRIPTOR	UNITS	APPENDIX P DATA ELEMENT NAME	APPENDIX P CONVERSION	LSAR	RECOMMENDED DATA SOURCE
WORK CENTER MAN HOURS	3 N R 2	MAN-HR /MON	REPAIRMAN AVAILABLE HOURS	1/12	NO	GOV/CON
WORK CENTER REPAIR CYCLE TIME	4 N R 2	MON	REPAIR CYCLE TIME	1/30	NO	CON
WORK CENTER SUPPLY MANAGEMENT COST	4 N R 2	$/ (ITEM *YR	RECURRING BIN COST		2B	GOV
WORK CENTER TURNOVER RATE	4 N R 3	PRS/ (YR *POS)	REPAIRMAN TURNOVER RATE		2B	GOV

LORA INPUT DATA ELEMENT DEFINITIONS

10. SCOPE. This appendix is a mandatory part of this standard. The information contained herein is intended for compliance. This appendix establishes definitions and units of measure for LORA input data elements associated with each of the mathematical methods contained in appendices D through O. Although the definitions in this appendix are standardized among the services, the units of measure for some of the data elements have not been standardized among the mathematical methods. Thus, it will be necessary to convert certain data elements to different units of measure for input into a particular mathematical method. The data elements requiring conversion, along with necessary conversion factors, are identified in the corresponding appendices (appendices D through O). No classified data should be used as input to the models.

20. APPLICABLE DOCUMENTS

20.1 Government documents. The specifications, standards, and handbooks cited in form a part of this appendix to the extent specified under 2.1.

20.2 Nongovernment publications. Nongovernment standards or other types of nongovernment publications do not form a part of this appendix.

30. DATA ELEMENT DEFINITIONS (DEDs)

30.1 General. The following DEDs (30.3.1 through 30.3.147) are the quantitative data elements corresponding to the mathematical methods in appendices D through O. Some of the DEDs are similar to DEDs found in MIL-STD-1388-2B. These DEDs are annotated with an asterisk "*".

30.2 Format. The general format for the DED is as follows:

DED ## Data Element Title (Units of Measure)
Data Element Definition

The field format descriptions consist of a code that specifies the length, type, positional justification, and decimal placement of the data element or subfields thereof described by the following:

a. Length. The number of characters positions in the data element. In the event the length is variable, the maximum length is specified.

b. Type. A specification of the character type, wherein:

"A" specifies that all characters of the data entry are alphabetical.

"N" specifies that all characters of the data entry are numerical.

"X" specifies that characters of the data entry are alphabetical, numerical, special, or any combination thereof.

c. Justification. A specification of which side of the field the data element characters are entered.

"L" specifies that characters are justified to the left.

"R" specifies that characters are justified to the right.

"F" specifies that characters occupy the entire field and are fixed.

"-" specifies that column is not applicable.

d. Decimal Placement. Specifies the number of character positions to the right of the assumed decimal point when the data element is numeric in all character positions. A dash (-) is used if this column is not applicable. AS means "As Specified" and the detailed instructions will indicate the location of decimal points.

30.3 Definitions.

30.3.1 Aircraft/equipment type. An alpha-numeric six character string that identifies the end item under analysis. The end item is defined as the deployed system, (example tank, aircraft, ship) from which the items under analysis are removed.

30.3.2 Annual operating requirements (measurement base/year)*. The estimated or required yearly rate of usage of an item. Usage is expressed in terms of a measurement base code taken from those listed under the data element titled, Measurement Base.

30.3.3 Average number of parts (number). The average number of parts required to repair an item.

30.3.4 Base year (fiscal year). The fiscal year in which all quantitative data elements related to costs are to be adjusted against and expressed.

30.3.5 Circuit card assembly (CCA) classification. A code which identifies the type of parts which are assembled on the CCA and the number of parts or complexity of how the CCA is assembled. For example, a CCA which has three layers of printed circuit boards with both analog and digital components is much more expensive and difficult to repair than a CCA which has only one printed circuit board and digital components.

a. First subfield.
Code A - Indicates the CCA is designed with only analog parts.
Code D - Indicates the CCA is designed with only digital parts.
Code H - Indicates the CCA is designed with analog and digital parts.

b. Second subfield.
Code 1 - Indicates the CCA has few parts and is of low complexity.
Code 2 - Indicates the CCA has more parts but of moderate complexity.
Code 3 - Indicates the CCA has high number of parts with the highest degree of complexity.

30.3.6 Contact team delay time (hours)*. The time (in hours) required for a contact team to travel from the intermediate maintenance location to the organizational location.

30.3.7 Contractor repair cost factor (decimal). A factor which is used to account for the cost incurred each time an item is sent for repair by a contractor (direct labor and repair parts). The factor is a fraction, expressed as a decimal, of the Unit Price for the item.

30.3.8 Contractor repair quality factor (decimal). A factor which is used to represent the fraction, expressed as a decimal, of items sent to a contractor for repair which are operational when returned to the supply system.

30.3.9 Conversion factor (decimal)*. A factor used to convert the Annual Operating Requirements of the system/equipment to the Annual Operating Requirements of the item under analysis. The factor is obtained by dividing the rate of usage of the item under analysis (expressed in cycles, miles, rounds, hours, or any other appropriate Measurement Base) by the rate of usage of the system/equipment (also expressed in the same Measurement Base). The conversion factor is expressed in decimal form.

30.3.10 Cost per requisition (dollars)*. The administrative cost in dollars and cents to prepare and submit a requisition for a replenishment spare/repair part.

30.3.11 Deployment schedule (number). The number of end items under analysis introduced into the support system by year.

30.3.12 Diagnostic time (hours). The time required, in hours, to isolate a failure within an item. This time does not include time to correct the failure or screening time, only the time to isolate or diagnose the failure.

30.3.13 Discount rate (decimal)*. The interest rate used to discount or calculate future costs and benefits so as to arrive at their present value per DODI 7041.3). The discount rate includes an adjustment for inflation.

30.3.14 Distance (miles)*. The geographical distance between two points.

30.3.15 Documentation change pages (number). The number of pages added to and/or updated in an existing manual to document maintenance procedures on an item.

30.3.16 Documentation development cost (dollars). The cost, in whole dollars, to develop technical manuals and change pages to existing manuals for documenting maintenance procedures of an item.

30.3.17 Documentation reproduction cost (dollars/page). The cost, in dollars per page, to reproduce and distribute updated pages to existing technical manuals on maintenance procedures of an item.

30.3.18 Documentation use rate (decimal). A factor used to identify the portion or fractional rate, expressed in decimal form, of a particular documentation package which is dedicated to maintenance procedures of a specified item.

30.3.19 End item acronym code*. A code which uniquely identifies the system/end item under analysis. This code will be assigned by the requiring authority. It will remain constant throughout the item's life cycle.

30.3.20 Essentiality code*. A code to indicate the degree to which the failure of the part affects the ability of the end item to perform its intended operation. The codes are as follows:

Code 1 - Indicates failure of this part will render the end item inoperable.
Code 3 - Indicates failure of this part will not render the end item inoperable.
Code 5 - Indicates the item does not qualify for the assignment of code 1, but is needed for personnel safety.
Code 6 - Indicates the item does not qualify for assignment of code 1, but is needed for legal, climatic, or other requirements peculiar to the planned operational environment of the end item.
Code 7 - Indicates the item does not qualify for the assignment of code 1, but is needed to prevent impairment of or the temporary reduction of operational effectiveness of the end item.

30.3.21 Facilities development cost (dollars). The estimated cost, in dollars, to develop a facility which is not currently available. This cost does not include the Unit Price of the facility if more than one of a particular facility is to be built or procured.

30.3.22 Facility floorspace (square feet). The amount of floorspace, in square feet, necessary for performing maintenance on items and space required for support equipment usage and storage.

a. First subfield. The amount of floorspace occupied by one unit of a particular support equipment at a maintenance facility.

b. Second subfield. The unique amount of floorspace required (beyond that required by the support equipment) at a maintenance facility to perform a specific maintenance task on an item. This includes only the amount of workspace dedicated to the specific maintenance task. If the space is used for maintenance actions on other items only apply it once.

30.3.23 Facility operating cost (dollars/hour). The cost, in dollars per hour, for utilizing a facility to perform maintenance actions on an item. The dollar per hour cost is computed by considering the costs associated with operating and maintaining a facility which include: indirect labor; indirect supplies and materials; and, utilities.

30.3.24 Failure mode ratio (decimal)*. The fraction of the Failure Rate of the part, related to the particular failure mode under consideration. The Failure Mode Ratio is the probability expressed as a decimal fraction that the part or item will fail in the identified mode.

30.3.25 False removal detection fraction (decimal). The fraction, expressed in decimal form, of false removals (removals that are really operational items) that are detected by screening the item. For example, if there is a total of 110 removals including 10 false removals, then a detection fraction of 0.80 would mean that 8 of the 10 false removals would be detected during screening. Therefore, these 8 items would be returned to stock, and the remaining 102 items would be sent on for repair.

30.3.26 False removal rate (decimal). The fraction, expressed in decimal form, of removals that are really operational items.

30.3.27 Holding cost percentage (decimal)*. A percentage of inventory value to account for storage, loss, obsolescence, and interest cost incurred as a result of maintaining inventory.

30.3.28 Initial bin cost (dollars/item/site)*. The initial cost in whole dollars of entering an item into the retail supply system. This includes the administrative cost of setting up a bin for the item at the wholesale supply point.

30.3.29 Initial cataloging cost (dollars)*. The initial cost, in whole dollars, of entering a new item into the wholesale supply system. This is generally considered to be the cost of screening the item and assigning a national stock number.

30.3.30 Initial contractor repair program cost (dollars). The one time cost, in whole dollars, incurred for setting up a contractor repair program on an item.

30.3.31 Instructor cost (dollars/year). The estimated cost, in dollars per year, for an instructor. This cost includes base pay, overhead, benefits, permanent change of station (PCS) moves, hazardous duty pay, etc. for the instructor.

30.3.32 Inventory storage cost rate (dollars/cubic feet). The cost for inventory storage space at a designated maintenance facility. This cost is expressed in dollars per cubic foot per month.

30.3.33 Inventory storage space available (cubic feet). The total amount of space, expressed in cubic feet, allocated for storage of spare items at a particular site.

30.3.34 Item name.* An identifying noun with appropriate adjective modifier as contained in Federal Item Name Directory for Supply Cataloging, H6-1. Item Names contained in Federal Item Name Directory for Supply Cataloging, H6-1, cannot be abbreviated unless approved by the requiring authority. When abbreviation is approved by the requiring authority, the nonapproved item names can be abbreviated in accordance with MIL-STD-12. If item names have not been established IAW H6-1 or MIL-STD-12 then descriptive item names may be used.

30.3.35 Item number. A code assigned to each reparable assembly that identifies the item uniquely. There are three subfields as follows:

a. Subfield a - a three character alpha-numeric code
b. Subfield b - a ten character code (made up of five two character fields) that identify the item to the model.
c. Subfield c - a three character alpha-numeric code that identifies the item's next higher assembly.

30.3.36 Item task code. A code which indicates the maintenance action associated with a particular item. The codes are as follows:

Code V - Indicates the maintenance action will be to verify or screen a particular failed item to ensure it has failed before the item and its components are discarded.
Code R or RP - Indicates the maintenance action will be to repair the item. Repair of the item would includes: (1) fault verify; (2) fault isolate; (3) remove and replace; and, (4) check and test.
Code DI - Indicates the maintenance action will be to discard the item.
Code RR - Indicates the maintenance action will be to remove and replace the item only.
Code RT - Indicates the maintenance action will be to retire the item (which is different from discarding the item).

30.3.37 Labor rate (dollars/hour)*. The average direct labor rate per hour for an Operations/Maintenance Level. The labor rate is expressed in units of dollars and cents.

30.3.38 Labor rate by repairman (dollars/hour). The loaded basic labor rate, expressed in dollars and cents per hour, for a particular type of repairman. This rate includes base pay, overhead, benefits, PCS moves, hazardous duty pay, etc.

30.3.39 Labor rate loaded (dollars/hour). The average loaded labor rate, expressed in dollars and cents per hour, for a repairman at a maintenance level. The loaded labor rate includes direct hourly pay (labor) rate, overhead, benefits, PCS moves, hazardous duty pay, etc.

30.3.40 Life span (years)*. The estimated useful life, in years, of the support/test equipment.

30.3.41 Loading factor (decimal)*. A factor which is applied to the hourly and annual manpower costs to account for overhead, benefits, hazardous duty, PCS moves, etc.

30.3.42 Logistic support analysis control number (LCN)*. A code that represents a hardware generation breakdown/disassembly sequence of the system under analysis. A code is assigned for each item in the system under analysis and represents the hardware breakdown relationship of the items to each other. If LCNs have not been established then another code sequence which would accomplish the same function may be used as agreed to by the requiring authority until LCNs become available.

30.3.43 Maintenance task distribution (decimal)*. The percentage of a reparable item expected to be repaired and returned to stock by a specified maintenance level. This data element is divided into the following subfields:

a. First subfield. Maintenance Task Distribution at Organizational/On-Equipment/Unit-Organizational maintenance level.
b. Second subfield. Maintenance Task Distribution at Intermediate/Direct Support/Afloat/Third Echelon/Off Equipment/Intermediate-Forward maintenance level.
c. Third subfield. Maintenance Task Distribution at Intermediate/General Support/Ashore/Fourth Echelon/Intermediate-Rear maintenance level.
d. Fourth subfield. Maintenance Task Distribution at Specialized Repair Activity maintenance level.
e. Fifth subfield. Maintenance Task Distribution at Depot/Shipyards maintenance level.

30.3.44 Mean time between failures (MTBF) (measurement base)*. The total functioning life of a population of an item, divided by the total number of failures within the population during the measurement interval. The definition holds for time, rounds, miles, events, or other measure of life units (i.e., Measurement Base). The MTBF is expressed as a technical MTBF (inherent reliability of an item). The Measurement Base utilized with MTBF must be consistent with the Measurement Base used with the data elements titled, Annual Operating Requirements, Mean Time Between Maintenance, and Conversion Factor.

30.3.45 MTBF degradation factor (decimal). A factor, expressed in decimal form, used to account for any lowering of the technical (inherent) MTBF due to operating conditions or support considerations.

30.3.46 Mean time between maintenance (measurement base). The total functional life of a population of an item divided by the total number of maintenance actions (scheduled and unscheduled) within the population during the measurement interval. The definition holds for time, rounds, miles, events, or other Measurement Base. The Measurement Base utilized with Mean Time Between Maintenance must be consistent with the Measurement Base used with the data elements titled, Annual Operating Requirements, Mean Time Between Failure, and Conversion Factor.

30.3.47 Mean time to repair (MTTR) (hours)*. The total elapsed time (clock hours) for corrective maintenance divided by the total number of corrective maintenance actions during a given period of time.

30.3.48 Measurement base*. A single position code which identifies the unit of measure for a particular operating time period or number of events. Measurement Base is associated and is assigned to the following data elements: Annual Operating Requirements, Mean Time Between Failure, Mean Time Between Maintenance, and Conversion Factor. These three data elements must utilize the same Measurement Base code.

Code A - Message Units
Code B - Catapults
Code C - Cycles
Code D - Days
Code E - Arrestments
Code F - Flight Hours
Code G - Minutes
Code H - Hours
Code K - Kilometers
Code L - Landings
Code M - Miles
Code O - Operating Hours
Code R - Rounds
Code S - Starts
Code T - Months
Code U - Underway/Steaming Hours
Code Y - Years

30.3.49 Military or civilian indicator (number). A code to indicate whether the repairman being identified is military or civilian.

Code 1 - Indicates personnel are military.
Code 2 - Indicates personnel are civilian.

30.3.50 Minimum number trained (number). The minimum number of repairmen which are trained at a maintenance location to perform maintenance on a specific failure mode of an item.

30.3.51 National stock number (NSN) needed. A code to indicate whether an NSN must be researched and assigned for a particular item.

Code 0 - Indicates an NSN already exists and is known for the item.
Code 1 - Indicates a new NSN must be assigned for the item. This means that the cost of acquiring an NSN will be incurred.

30.3.52 Number of end items supported (number). The number of end items supported at a maintenance location.

30.3.53 Number of facilities (number). The quantity of extra facilities required (the facilities needed in addition to the facilities already available) to perform maintenance functions on an item at a specified maintenance level.

30.3.54 Number of instructors (number). The estimated number of instructors required per year to teach a particular training program or portion thereof.

30.3.55 Number of locations (number). The number of similar repair activities represented by the Site Name.

30.3.56 Number of operating locations (number)*. The number of locations which will receive and operate the item under analysis.

30.3.57 Number of parts needing NSN (number). The number of new parts in an item (i.e., those not already in the supply system) that must be assigned a National Stock Number (NSN) and entered into the supply system. This number should only include the unique parts of that item which are not used elsewhere in the end item.

30.3.58 Number of parts with NSNs (number). The number of parts in an item that have a National Stock Number (NSN) assigned but will have to be added to the supply inventory at a particular maintenance level. This number should only include the unique parts of that item which are not used elsewhere in the end item.

30.3.59 Number of repairmen (number). The number of repairmen, of a particular type, required. This number is obtained by multiplying the number of maintenance locations where the particular type repairman is stationed times the number of repairmen performing a task.

30.3.60 Number of repairmen by maintenance level (number). The number of repairmen, of a particular type, required at a given maintenance level.

30.3.61 Number of repairmen performing task (number). The number of repairmen needed to complete a specific maintenance task on an item.

30.3.62 Number of shifts (number). The number of eight hour shifts per day which exist at a particular site.

30.3.63 Number of shops (number)*. The number of maintenance locations available to perform repair at each maintenance level.

30.3.64 Number of support equipment (number). The quantity of a particular support equipment required to perform maintenance on an item.

30.3.65 Number of technical manuals (number). The quantity of a particular technical manual, related to an item, required to perform a particular maintenance task.

30.3.66 Number trained (number). The number of repairmen trained per year to perform maintenance on an item.

30.3.67 Operating and support cost (dollars/year)*. The projected annual ownership cost in dollars per end item of automatic test equipment/test measurement and diagnostic equipment, averaged over its expected useful life.

30.3.68 Operation level (days)*. The number of days worth of stock intended to sustain normal operations during the interval between receipt of replenishment shipment and submission of subsequent replenishment requisition. Does not include either safety level or order ship time quantities.

a. First subfield. Used for Operation Level of reparable items.
b. Second subfield. Used for Operation Level of discard items.

30.3.69 Operation life (years)*. The number of years the item is expected to be in service.

30.3.70 Operational availability (Ao) (decimal)*. The probability that, when used under stated conditions, a system will operate satisfactorily at any time. Ao includes standby and administrative and logistic delay time.

30.3.71 Packaging cost (units specified in Appendices D-O). The cost for packaging an item for shipment to a maintenance level (this cost includes both labor and packaging materials). The units to be used as input to the models are specified in the corresponding appendices.

30.3.72 Percentage failures repaired (decimal). The fraction of failures that are actually repaired and returned to the supply system.

30.3.73 Personnel annual salary (dollars). The basic annual salary, in whole dollars, of a repairman.

a. First subfield. The unloaded annual salary (base pay).
b. Second subfield. The loaded annual salary which includes base pay, overhead, benefits, PCS moves, hazardous duty pay, etc.

30.3.74 Procurement lead time (weeks). The average time interval in weeks between identification of a demand until the item is introduced into the supply system. This time includes administrative delay time, production time, contact delay time, and shipping time.

30.3.75 Productivity factor (decimal)*. This factor is used to account for nonproductive time and has the effect of increasing manpower requirements for performing maintenance. This factor is the fraction of time, expressed in decimal form, the repairman is available to perform maintenance actions.

30.3.76 Quantity per end item (QTY/EI) (number)*. The total number of times the line item is used in the complete system.

30.3.77 Ratio of force overseas (decimal). The fraction, in decimal form, of the total number of end items deployed to overseas locations.

30.3.78 Recurring bin cost (dollars/item/site/year)*. Recurring administrative cost of maintaining a bin for an item in the retail supply system for one year.

30.3.79 Recurring cataloging cost (dollars/year)*. Recurring administrative cost of maintaining an item in the wholesale supply system for one year.

30.3.80 Recurring contractor repair program cost (dollars/year). The annual cost for the contractor to maintain a repair program (facilities, indirect labor, etc.) on an item.

30.3.81 Repair cycle time (days)*. The elapsed time, in days, of the complete repair cycle for a reparable item, expected at each maintenance level or contractor facility. The elapsed time in days from receipt of a failed item at the maintenance level, until the item is ready for issue as a serviceable item. This time includes transportation time to the maintenance level and return to the supply point.

a. First subfield. Repair Cycle Time at Organizational/On Equipment/ Unit-Organizational level.
b. Second subfield. Repair Cycle Time at Intermediate/Direct Support/ Afloat/Third Echelon/Off Equipment/Intermediate-Forward level.
c. Third subfield. Repair Cycle Time at Intermediate/General Support/ Ashore/Fourth Echelon/Intermediate-Rear level.
d. Fourth subfield. Repair Cycle Time at Specialized Repair Activity.
e. Fifth subfield. Repair Cycle Time at Depot/Shipyard.
f. Sixth subfield. Repair Cycle Time at Contractor Facility. An expressed period of time measured in days from receipt of a failed item at the contractor's facility until the item is returned to the designated receiving point.

30.3.82 <u>Repairman available hours (hours/year)</u>. The total annual number of man-hours for which a repairman is available to perform assigned tasks. The man-hours are whose actually available to perform assigned maintenance tasks on items and does not include time spent on other duties such as physical training, guard detail, etc. and nonproductive time such as leave.

30.3.83 <u>Repairman highest maintenance level peculiar</u>. A code which indicates the highest maintenance level where the repairmen is peculiar. The following codes are utilized:

Code 0 - Repairmen is common at all levels.
Code 1 - Repairmen is peculiar at the organizational level, common at all higher levels (direct support, general support, and depot).
Code 2 - Repairmen is peculiar at organizational and direct support levels, but common at general support and depot.
Code 3 - Repairmen is peculiar at organizational, direct support, and general support, but common at depot.
Code 4 - Repairmen is peculiar at all maintenance levels.

30.3.84 <u>Repairman identifier</u>. A code which uniquely identifies the repairman to accomplish the task.

30.3.85 <u>Repairman lowest maintenance level allowed</u>. A code which is assigned a to repairman to indicate the lowest maintenance level at which the repairman can be authorized for repairing or testing items.

30.3.86 <u>Repairman time used (hours)</u>. The actual amount of time, in hours, a repairman is used to repair or screen an item.

a. First subfield. The time the repairman is used to repair a particular failed item.
b. Second subfield. The time the repairman is used in screening an item to insure that it has failed and is not a false removal.

30.3.87 <u>Repairman turnover rate (decimal)</u>. The portion of personnel to be replaced by new personnel requiring training.

a. First subfield. The military turnover rate.
b. Second subfield. The civilian turnover rate.

30.3.88 Repair material cost (dollars). The total price of the material replaced in an average repair action of an item.

30.3.89 Repair material rate (decimal). A factor used to estimate the total price of material replaced in an average repair action on an item. This factor is a fraction, expressed in decimal form, of the Unit Price for the item undergoing the repair action. This rate should not include the cost of lower level reparable items that are part of the LORA model run.

30.3.90 Repair material usage rate (decimal). The fraction, expressed as a decimal, of repair actions which utilize nonstandard repair material (i.e., repair material which does not have a national stock number assigned at present).

30.3.91 Repair work space available (square feet). The total amount of floorspace, expressed in square feet, allocated for performing maintenance at a particular site. This data element includes floorspace for support equipment.

30.3.92 Repair work space cost (dollars/square foot/month)*. The cost, in dollars per square foot per month, of repair work floorspace for a maintenance facility for a specific level of maintenance.

30.3.93 Resource designation code. A code which is used to classify a resource. The designator code indicates if the resource is used by a single item (dedicated/peculiar) or used by several items (shared/common). The codes are:

Code D or P - Indicates a resource is specifically designed for use on an item and is dedicated to, or only used, for that item (i.e., the support equipment must be developed for that item).

Code C or S - Indicates a resource is unique or peculiar to the end item under analysis. However, it is used or shared with several items within the end item (i.e., the support equipment must be developed but its cost is shared among various items within the end item under analysis).

30.3.94 Resource identification code. A code which uniquely identifies support equipment, repairman, facilities, and documentation (technical manuals) so they can be tied or referenced to each other and the items in the hardware breakdown which utilize them.

30.3.95 Retail stockage criteria (number of demands/year)*. The number of demands per year required to be meet before a item is allowed to be stocked.

30.3.96 Safety level (days)*. The number of days of stock in addition to operating level to compensate for unexpected demands, pipeline, and unforeseen delays.

30.3.97 Safety stock coefficient (decimal). The fraction, expressed as a decimal, of stock required, in addition to demand stockage, which is to cover unexpected delays in shipment of spares.

30.3.98 Salvage value (dollars). The estimated salvage value, expressed in whole dollars, of an item.

30.3.99 Screened item code. A code which indicates whether an item can undergo screening prior to any repair action being attempted on the item which has failed.

30.3.100 Screening time (hours). The average time, in hours, required to screen an item to determine if it has actually failed, or if it has been falsely removed.

30.3.101 Ship time (days)*. The number of days from the time a requisition for a spare/repair part is placed with the supply system until the item is received at the maintenance shop.

30.3.102 Site code. A code which identifies the type of repair facility or operating site that supports the system under analysis. The codes are as follows:

Code 1 - Indicates the repair facility named is a carrier.
Code 2 - Indicates the repair facility named is a land-based operating site (Naval Air Station).
Code 3 - Indicates the repair facility named is a primary intermediate maintenance activity.
Code 4 - Indicates the repair facility named is a depot, either government or contractor operated.

30.3.103 Site deployment factor (decimal). Average fraction, in decimal form, of the year that a site supports the end item.

30.3.104 Site name. An identifying name for a repair facility or operating site that supports the system under analysis. Note that a repair facility can be an operating site where the system under analysis is not only supported but operated in its intended environment (i.e., an aircraft carrier supports an item and serves as its operating site also).

30.3.105 Site use (hours/year). The amount of time, expressed in hours per year, a particular site performs maintenance on the end item or items within the end item under analysis.

30.3.106 Stockage confidence level (decimal). The probability, expressed in decimal form, of having sufficient stockage available when required.

30.3.107 Support alternative number. A title which uniquely identifies the support alternative under consideration. Various support alternatives may be identified so tradeoffs can be accomplished between different sets of support equipment and repairman, which could be used to accomplish the same maintenance action.

30.3.108 Support alternative number. A number which uniquely identifies the support alternative under consideration. Various support alternatives may be identified so tradeoffs can be accomplished between different sets of support equipment and repairman, which could be used to accomplish the same maintenance action.

30.3.109 Support equipment available hours (hours/year). The annual number of hours a particular support equipment is available to perform maintenance functions on the end item undergoing LORA evaluation.

30.3.110 Support equipment development price (dollars). One time estimated cost in dollars to develop a particular support equipment (e.g., hardware, entire test program set, test program set software, interface connecting device, and associated resources for the support equipment). It should be noted an entire test program set includes: software; interface connecting device; and, associated instructions.

30.3.111 Support equipment full item name*. The name of the support equipment.

30.3.112 Support equipment highest maintenance level peculiar. A code which indicates the highest maintenance level where a particular support equipment is peculiar. This code indicates the support equipment does not exist at a particular maintenance level and all levels below the particular maintenance level and must be procured and placed at those levels.

Code 0 - Support Equipment is common at all levels.
Code 1 - Support Equipment is peculiar at the organizational level, common at all higher levels (direct support, general support, and depot).
Code 2 - Support Equipment is peculiar at organizational and direct support levels, but common at general support and depot.
Code 3 - Support Equipment is peculiar at organizational, direct support, and general support, but common at depot.
Code 4 - Support Equipment is peculiar at all maintenance levels.

30.3.113 Support equipment installation cost (dollars). A one time cost, in dollars per support equipment, associated with setup or installation of a piece of support equipment at a particular maintenance level.

30.3.114 Support equipment installation cost factor (decimal). A factor which is used to account for the one time cost associated with setup or installation of a piece of support equipment at a particular maintenance level.

30.3.115 Support equipment lowest maintenance level allowed. A code assigned to each different piece of support equipment to indicate the lowest maintenance level at which the support equipment can be authorized for use. In other words, a piece of support equipment may not currently be available at a maintenance level; however, it is authorized for use at that level and can be used if it were procured and placed at that level.

30.3.116 Support equipment time used (hours). The actual amount of time a particular support equipment is used to repair or screen an item.

a. First subfield. The time the support equipment is used to repair a particular failed item. This time also includes any time the support equipment is used to recalibrate an item after it is repaired.
b. Second subfield. The time the support equipment is used in screening an item to insure that it has failed and is not a false removal.

30.3.117 Support equipment use rate (decimal). A factor used to identify the portion or fraction rate, expressed in decimal form, of a particular support equipment which is used solely to support a specified item.

30.3.118 Support of support equipment cost factor (decimal)*. A decimal value which expresses the cost factor for supporting support equipment. This factor is derived from the ratio of the yearly support equipment costs to the support equipment unit costs. There are two subfields defined as follows:

a. First subfield. This value includes the installation cost and the first year's maintenance cost
b. Second subfield. The yearly maintenance cost factor.

30.3.119 Support of support facility cost factor (decimal). A decimal value which expresses the cost factor for supporting support facility.

30.2.120 Technical documentation cost (dollars/page). The average cost to develop one page of technical documentation.

30.3.121 Technical documentation pages (number). The number of pages of technical documentation that must be developed to fully describe/illustrate the procedures to accomplish repair of an item.

30.3.122 Technical documentation update factor (decimal). The fraction, expressed in decimal form, of pages in a document that are updated or changed each year. This factor is used to account for the annual cost of updating documentation.

30.3.123 Technical manual development cost (dollars). The cost, in dollars and cents, of developing a particular technical manual. This cost includes costs associated with reproducing required quantities of the particular technical manual developed.

30.3.124 Technical manual name. The identifying name of a technical manual used to distinguish it from other documents.

30.3.125 Test program sets (TPS) problem decay factor (decimal). A factor which is used to account for the annual decline of problems in the TPS software. The factor is the annual fractional decline, expressed as a decimal, of the TPS Problem Factor.

30.3.126 TPS problem factor (decimal). A factor which is used to account for the cost of correcting any unforeseen initial problems in the TPS software for an item. The factor is a fraction, expressed as a decimal, of the Support Equipment Development Price for the TPS software.

30.3.127 Time between inspection (hours). The elapsed time, in hours, the item operates between organizational level inspections.

30.3.128 Time between rework (hours). The time, in whole hours, the item operates before rework is performed.

a. First subfield. The hours the item operates before mandatory rework is performed due to failure of the item.
b. Second subfield. The hours the item operates before a scheduled removal and rework of the item is performed to preclude its failure.

30.3.129 Total number of parts (number). The total number of different parts contained in an item. This number should only include the unique parts of that item which are not used elsewhere in the end item.

30.3.130 Total systems supported (number)*. The total number of systems intended for operational use.

30.3.131 Training activation cost (dollars). The estimated one-time cost for activating training sites to teach a particular training program (or portion of a program). This cost does not include costs associated with training aids or equipment.

30.3.132 Training aids cost (dollars). The cost, in whole dollars, of procuring training aids, for all training sites, required to teach maintenance actions on an item.

30.3.133 Training cost (dollars/repairmen)*. The cost, in whole dollars, of training a single repairman.

30.3.134 Training cost by item (dollars/hour). The cost, expressed in whole dollars per hour, of training a single repairman to perform maintenance on a particular item which has failed.

30.3.135 Training indicator code. A code utilized to indicate whether a particular repairman identified requires training before that repairman can perform maintenance actions on a particular item.

Code Y - Indicates training is required for the repairman.
Code N - Indicates the repairman already has the necessary skills to perform maintenance on the item and training is not required.

30.3.136 Training package development cost (dollars). The estimated one-time cost, in whole dollars, for developing a particular training program (or portion of a program) for maintenance of an item.

30.3.137 Training time (hours). The training time, in hours, required to teach the additional skills/procedures necessary for a repairman to be able to complete maintenance actions on a particular item.

30.3.138 Training use rate (decimal). A factor used to identify the portion or fraction, expressed in decimal form, of a particular training program or package which is dedicated to maintenance procedures of a specified item.

30.3.139 Transportation cost (dollars/pound). The average cost, expressed in dollars and cents per pound, for transportation of a packed item.

30.3.140 Transportation rate (dollars/pound-mile). The shipping rate, expressed in dollars and cents per pound mile, for transportation of material.

30.3.141 Type of supply system code*. A letter code indicating the type of supply system to be employed. *

Code N - Indicates a non-vertical supply system. A non-vertical supply system exists when the general support maintenance level performs a maintenance function and stocks only those items removed and replaced at the general support maintenance level in quantities necessary to provide shop stock. If an item is repaired by the general support maintenance level it is assumed the item is repaired and returned to stock.

Code V - Indicates a vertical supply system. A vertical supply systems exists when the general support maintenance level performs a normal supply mission.

Code X - Indicates a direct exchange supply system. A direct exchange supply system exists when the general support maintenance level is permitted to stock those items which are repaired at the general support maintenance level (if the item meet the retail stockage criteria) in addition to the necessary shop stock.

30.3.142 Unit packed volume (cubic feet). The volume, based on outside dimensions, of the unit container expressed in feet.

30.3.143 Unit pack weight (pounds)*. The gross weight of the unit pack expressed in pounds. This data element specifies the packed weight of an item. This weight includes the weight of the container, if any, in which the item is shipped.

30.3.144 Unit price (dollars). The cost, in whole dollars, to purchase one unit of an item, support equipment, facility, software (i.e., TPS software, automated manuals, built-in-test, etc.), repair part, or technical manual. The unit price is for off-the-shelf and production items. Production items may be corrected by learning curves.

30.3.145 Unit weight (pounds)*. The unpacked weight of the item expressed in pounds.

30.3.146 User specified report header. A alpha-numeric character string that describes the analysis.

30.3.147 Unserviceable return rate (decimal). The fraction, expressed as a decimal, of failed items that are actually returned for maintenance. This is used to account for the fact that not all reparable items are returned for repair; some failed, but reparable, items are lost or misplaced when they are sent for repair.

30.3.148 Washout rate (decimal). The fraction, expressed as a decimal, of failures on a reparable item that are not repaired due to physical damage or loss of the failed item.

NONECONOMIC ANALYSIS

10. SCOPE

10.1 Purpose. This appendix provides guidance on how to perform a LORA noneconomic evaluation (Task 301.2.2). This appendix is not a mandatory part of this standard. The method described in section 40, provides a means of examining the factors which affect the maintenance level(s) at which items are repaired or discarded.

10.2 General. A noneconomic LORA addresses preempting factors which override cost considerations or existing LORA decisions on similar systems to determine the maintenance level(s) where repair or discard can be performed. This evaluation is performed without consideration of costs; however, any recommendations or conclusions based upon this evaluation should also include an economic analysis which will assign economic value to the noneconomic decisions. Preempting factors are normally a restraint, stipulation, or special requirement which forces the repair or discard decision to a specific maintenance level or limits the support alternatives available. The preempting factors used in this method are identified in table Q-I and defined in appendix B.

20. APPLICABLE DOCUMENTS.

This section is not applicable to this appendix.

30. LORA NONECONOMIC ANALYSIS.

The noneconomic LORA is a logical sequence of questions concerning factors that affects the level at which repair or discard can be performed. The questions in table Q-I should be asked of each item on the LORA candidate list. The response should be: yes or no; the maintenance level where repair or discard decisions are restricted; and, reason for the restriction. After all questions have been answered, the analyst groups the yes responses and reasons together. Then the analyst determines a preliminary maintenance concept based on the yes responses. All questions may not pertain to all systems under analysis and should be tailored to meet the needs of the system being analyzed. It should be noted that repair or discard decisions should not be based solely on a noneconomic evaluation.

TABLE Q-I. Noneconomic analysis.

Noneconomic Factor	Yes	No	Maintenance Level Affected or Restricted	Reason for Restriction
Safety: Do hazardous conditions exist which preclude the item from being repaired at any specified maintenance level? Conditions to be considered include, but are not limited to: High Voltage Radiation Temperature Extremes Chemicals or Toxic gases Excessive noise Explosives Excessive weight Other: 1. 2.				
Security: Do security conditions exist which preclude the item from being repaired at a specific maintenance level?				
Policy/existing maintenance concepts: Are there specifications, standards, or regulations pertaining to the level of maintenance at which a particular item can or cannot be repaired? This includes existing maintenance concepts or policies on similar systems to be used as a baseline for comparison				

TABLE Q-I. Noneconomic analysis - Continued.

Noneconomic Factors (continued)	Yes	No	Maintenance Level Affected or Restricted	Reason for Restriction
Warranties: (1) Are there warranties on any items in the LORA candidate list which restrict the maintenance level for repair or discard? (2) Does the warranty eliminate organic support of an item?				
Readiness/Mission Success: Will mission readiness be compromised if any item is repaired or discarded at a specified maintenance level?				
Transportation/Transportability Are there any transportation factors which might preclude the transfer of systems from the user to the maintenance activity for repair. The factors include: weight size volume special handling requirements susceptibility to damage Other:				
Support Equipment & Test Measurement & Diagnostic Equipment (TMDE) a. Are special tools/TE required which would force repair to be performed at a specific level of maintenance (e.g., ATE and TPS)				

TABLE Q-I. Noneconomic analysis - Continued.

Noneconomic Factor	Yes	No	Maintenance Level Affected or Restricted	Reason for Restriction
b. Does the item require calibration which mandates performance of maintenance at a certain level(s) due to system sensitivity or lack of calibration equipment at a level?				
c. Does availability, mobility, size, or weight of SE and TMDE restrict the maintenance levels?				
Packaging, Handling, and Storage:				
a. Does the item's size, weight, or volume, impose restrictions on storage? This may restrict the level where items/parts can be stocked. This would include storage of SE and TMDE.				
b. Are there are special PH&S requirements (i.e. packaging of computer hardware/software, hazardous materials, fragile material, climate control, and packaging of materials susceptible to damage during transportation).				
Manpower and Personnel:				
a. Is there an adequate number of skilled personnel available to perform repair at a specified maintenance level?				

TABLE Q-I. Noneconomic analysis - Continued.

Noneconomic Factor	Yes	No	Maintenance Level Affected or Restricted	Reason for Restriction
b. Would repair or discard at a level create a problem on the existing workload?				
Facilities:				
a. Special/unique facility requirements: clean rooms size of test equipment climate control corrosion control forging/casting/stamping sophisticated calibration equipment nuclear hardness requirements				
b. Special Procedures for Repair hermetically sealed units excessive repair times magnetic particle inspection X-ray inspection Testing procedures: Vibration/shock analysis Wind tunnel testing Alignment procedures				
Others Factors (if applicable):				

CONCLUDING MATERIAL

Custodians:
Army - TM
Navy - AS
Air Force - 95
Federal Aviation Administration - ACO

Review activities:
Army - AR, AT, AV, CR, MI, TM
Navy - AS, EC, MC, OS, SH, YD
Air Force - 11, 13, 15, 16, 17, 95
OSAD - CL, IR, WS
Miscellaneous DOD/NASA - DC, DH, DS, NA, NS
Civil Agencies and Coordinating Activities - ACO, FAA, APM

Preparing activity:
Navy - AS

Agent:
Army - TM

(Project ILSS-0040)

STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

INSTRUCTIONS

1. The preparing activity must complete blocks 1, 2, 3, and 8. In block 1, both the document number and revision letter should be given.
2. The submitter of this form must complete blocks 4, 5, 6, and 7.
3. The preparing activity must provide a reply within 30 days from receipt of the form.

NOTE: This form may not be used to request copies of documents, nor to request waivers, or clarification of requirements on current contracts. Comments submitted on this form do not constitute or imply authorization to waive any portion of the referenced document(s) or to amend contractual requirements.

I RECOMMEND A CHANGE:	1. DOCUMENT NUMBER MIL-STD-1390D	2. DOCUMENT DATE (YYMMDD) 930119

3. DOCUMENT TITLE
LEVEL OF REPAIR ANALYSIS (LORA)

4. NATURE OF CHANGE *(Identify paragraph number and include proposed rewrite, if possible. Attach extra sheets as needed.)*

5. REASON FOR RECOMMENDATION

6. SUBMITTER

a. NAME *(Last, First, Middle Initial)*	b. ORGANIZATION	
c. ADDRESS *(Include Zip Code)*	d. TELEPHONE *(Include Area Code)* (1) Commercial (2) AUTOVON *(If applicable)*	7. DATE SUBMITTED *(YYMMDD)*

8. PREPARING ACTIVITY

a. NAME COMMANDING OFFICER, NAVAL AIR WARFARE CENTER AIRCRAFT DIVISION LAKEHURST SYSTEMS REQUIREMENTS DEPARTMENT	b. TELEPHONE *(Include Area Code)* (1) Commercial (908) 323-7488	(2) AUTOVON 624-7488
c. ADDRESS *(Include Zip Code)* CODE SR3 LAKEHURST, NJ 08733-5100	IF YOU DO NOT RECEIVE A REPLY WITHIN 45 DAYS, CONTACT: Defense Quality and Standardization Office 5203 Leesburg Pike, Suite 1403, Falls Church, VA 22041-3466 Telephone (703) 756-2340 AUTOVON 289-2340	