

INCH-POUND

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15 February 2002

SUPERSEDING

MIL-DTL-24784/17A(SH)

15 March 1999

ASSOCIATED DETAIL SPECIFICATION

HULL, MECHANICAL, AND ELECTRICAL (HM&E) SYSTEMS AND ELECTRONIC AND INTERIOR COMMUNICATION (IC) SYSTEMS MANUAL REQUIREMENTS

This specification is approved for use by the Naval Sea Systems Command, Department of the Navy, and is available for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

1.1 Scope. This specification sets forth content requirements for the preparation of technical manuals covering the installation, operation, maintenance, and parts support (without services of manufacturer's representatives) of hull, mechanical and electrical (HM&E) systems, and electronic and interior communications (IC) systems of military or commercial design (see 6.4.1).

2. APPLICABLE DOCUMENTS

2.1 General. The documents listed in this section are specified in sections 3 and 4 of this specification. This section does not include documents cited in other sections of this specification or recommended for additional information or as examples. While every effort has been made to ensure the completeness of this list, document users are cautioned that they must meet all specified requirements documents cited in sections 3 and 4 of this specification, whether or not they are listed.

2.2 Government documents.

2.2.1 Specifications, standards, and handbooks. The following specifications, standards, and handbooks form a part of this document to the extent specified herein. Unless otherwise

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Commander, Naval Sea Systems Command, ATTN SEA 05Q, 1333 Isaac Hull Ave SE Stop 5160, Washington Navy Yard DC 20376-5160 by using the Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

AMSC N/A

AREA TMSS

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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).

SPECIFICATIONS

DEPARTMENT OF DEFENSE

MIL-DTL-24784	Manuals, Technical: General Acquisition and Development Requirements.
MIL-DTL-24784/7	Technical Repair Standards (TRS) for Hull, Mechanical, and Electrical (HM&E) Equipment, Electronic Equipment, and Ordnance Equipment.

(Unless otherwise indicated, copies of the above specifications, standards, and handbooks are available from the Standardization Documents Order Desk, 700 Robbins Avenue, Building 4D, Philadelphia, PA 19111-5094.)

2.3 Order of precedence. In the event of a conflict between the text of this document and the references cited herein, (except for related associated detail specifications), 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. REQUIREMENTS

3.1 General. The requirements for acquiring the product described herein shall consist of this document and MIL-DTL-24784.

3.2 Security classifications, distribution statement and destruction notice. Security classification, distribution statement and destruction notice shall be in accordance with MIL-DTL-24784.

3.3 Deliverable products and data items. Deliverable products and data items shall be in accordance with MIL-DTL-24784 (see 6.2).

3.4 Arrangement. Unless otherwise specified in the technical manual contract requirements (TMCR) (see 6.2), the HM&E, Electronic, or IC system manual shall be arranged in a standardized format [that is, front matter, technical content, appendices, glossaries, indices and Technical manual Deficiency/Evaluation Report (TMDER)] and appropriately divided by volume, part, chapter and section in accordance with the requirements of MIL-DTL-24784 .

3.5 Format and preparation instructions. Unless otherwise specified in the TMCR (see 6.2), writing style, safety precautions, tabular material, graphics, and numbering shall be in accordance with MIL-DTL-24784.

3.6 Technical contents for systems manuals.

3.6.1 Specific requirements. The manuals shall provide system and subsystem oriented instructions for operation, maintenance, installation, and test data. Detailed equipment data should be provided by reference to the equipment manuals. However, technical data shall be developed at the equipment level and be included for all equipment system and subsystem and interface components not covered by an equipment technical manual. The contents shall be arranged in chapters according to the following:

- a. Chapter 1 - General Information.
- b. Chapter 2 - Safety precautions.
- c. Chapter 3 - Conditions of readiness.
- d. Chapter 4 - Operation.
- e. Chapter 5 - Functional description.
- f. Chapter 6 - Scheduled maintenance.
- g. Chapter 7 - Fault-isolation.
- h. Chapter 8 - Alignment procedures.
- i. Chapter 9 - Installation data.

3.6.2 Chapter 1, General Information. Chapter 1 shall describe the system in general physical and functional terms.

3.6.2.1 Introduction. The introduction shall define the system and its relationship with other systems. The mission of the system shall be stated. The text shall be supported by a diagram (see MIL-DTL-24784) showing the interrelationships of the system equipments (see figure 17-1). The major functional relationship and inputs and outputs to related systems shall be indicated.

3.6.2.2 Physical arrangement. System areas and compartments shall be described and the system equipment and units (see 6.4.4) contained in the areas shall be listed. The physical arrangement description shall be supported by the following illustrations:

- a. An inboard profile drawing of the ship or stations showing compartment locations and identifying topside equipment and equipment units comprising the system (see figure 17-2).
- b. Separate illustrations of each compartment and area, identifying the listed system equipment (see figure 17-3). Other equipment, which is installed in the subject system compartments and areas, need not be listed in the text or called out in the illustrations if they do not directly affect the operation or maintenance of the subject system.

3.6.2.3 System equipment. Each of the equipment comprising the system shall be identified and described. Descriptions of operator-attended equipment shall include general statements as to the nature and purpose of units and indicators. The text shall be supported by illustrations. All equipment shall be shown, whenever possible, in relative-scale proportion. Equipment may be separately illustrated with significant features called out, if such details are necessary for proper support of the text.

3.6.2.4 Associated system equipment.

When required, descriptions and illustrations of associated system equipment shall be limited to the major units thereof. The descriptions shall be more condensed than those of subject system equipment; otherwise, the same requirements are applicable. In the descriptions, emphasis shall be placed on those associated system equipment that constitute operational or functional interfaces with the subject system. Such units shall be included in the system illustrations.

3.6.2.5 Reference data. Reference data shall include a list of the equipment comprising the system, and its official designations. A list of common names and abbreviated or informal nomenclature, and system characteristics together with a list of referenced publications shall be included as follows:

- a. Capabilities. A summary of system capabilities shall be provided. The summary shall include data such as gallons per minute, transfers per hour, boom capacity, rated ranges, resolution, accuracy, data handling capability, number of channels, and so forth. Such data shall be presented in tabular form.
- b. Reference publications. A list of the manuals that pertain to system and system equipments, and other documents of interest, such as training manuals and manuals for associated systems equipment shall be included. The list of publications shall include the title and publication number of the referenced publications.
- c. Tools and test equipment. A list of all special tools and test equipment for system-level maintenance shall be included. Special tools are defined as those tools not listed in the Federal Supply Catalog. An illustration and description of special items required shall be provided for identification. Information shall be presented in tabular form. For each item the description or table shall include:
 1. The official name or nomenclature.
 2. Identifying number.
 3. A brief description of the use of the item with a reference to the procedures requiring its use.

3.6.3 Chapter 2, Safety precautions. Chapter 2 shall describe the hazards (see MIL-DTL-24784) associated with system operation and maintenance. To permit wide and unrestricted use on board ship, Chapter 2 shall contain only unclassified information.

3.6.3.1 Introduction. This description shall orient system supervisory personnel, and shall include the following:

- a. Purpose, scope, and organization of the system safety instructions.
- b. Basic safety concepts.
- c. Basic responsibilities for safety.

3.6.3.2 Electromagnetic radiation hazards and precautions. If applicable, describe the radiation hazards to topside personnel and the precautions to be taken. The hazards of radiation to

flammable or explosive materials also shall be described. The description shall include discussions of the following:

- a. Locations of topside and inboard radiation hazardous areas.
- b. Minimum safe distances on the axis of beam radiation.
- c. Precautions to be taken when entering areas of radiation hazard (such as the wearing of copper-screen goggles).
- d. The effect of radiation on flammable or explosive material such as induction of radio frequency currents in metals, sparking, and the consequent possibility of igniting flammables or detonating explosives. The text shall be supported by one or more illustrations identifying the areas of radiation hazards and the location of antennas, and so forth.

3.6.3.3 Hazards to divers. When applicable, the description of hazards to divers shall include but shall not necessarily be limited to the following:

- a. The nature and intensity of sound energy in water as related to divers.
- b. Precautions to be taken when working near operating equipment.
- c. Illustrations identifying the hazardous areas and locations of sonar domes.

3.6.3.4 System hazards and precautions. Descriptions of system hazards and precautions shall be included, addressed to system personnel and referenced to particular system equipments. The descriptions shall be organized to be consistent with the operation of the system. The descriptions shall supplement and extend equipment safety instructions to the system level, by warning of potential hazards that can be caused during operation or maintenance.

3.6.3.4.1 Operational safety summary. A summary shall be included which emphasizes the proper use of equipment controls, describes the hazards to operators, or as applicable, the hazards to persons in areas remote from the operation, and recommends precautions. An emergency operational routine shall be included which emphasizes the controls that permit immediate braking or de-energizing of the system.

3.6.3.4.2 Maintenance safety summary. A maintenance safety summary shall emphasize the proper use of controls, describe the hazards to maintenance personnel, potential damage to the equipment, and recommend precautions.

3.6.3.4.3 Hazardous components. Identify and briefly describe the hazardous components including radioactive devices and elements used with the system and summarize the general handling precautions for such components. The description of a hazardous component shall include brief statements as to the purpose, manner of functioning, nature of built-in safety devices, and nature of the hazardous element; it shall also indicate the relative sensitivity of the component to mechanical shock, vibration, electromagnetic and radioactive radiation, and electrostatic charges.

3.6.4 Chapter 3, Conditions of readiness. This chapter shall be provided for guidance purposes and shall represent engineering considerations. Chapter 3 shall list conditions of readiness

requirements prior to the operation of the system. Activities or conditions within compartments or areas outside the system shall be described as necessary. When it is impractical or illogical to separate the conditions of readiness information from operational information, request shall be made with justification, to combine the requirements of Chapter 3 with the requirements of Chapter 4 (see 3.6.5).

3.6.4.1 Conditions coverage. An orientation of system personnel shall be included. The condition of readiness shall be included as follows:

- a. Watch condition.
- b. General quarters condition.
- c. Emergency condition.

Coverage shall include but not be limited to the following:

- a. A block diagram showing signal paths of the conditions of readiness (see figure 17-4).
- b. Block diagrams and descriptions of IC links between compartments and areas, including sound-powered telephone circuits, announcing systems, and closed-circuit television.
- c. Presumptions relative to system status at specified times. (For example, from watch condition to general quarters condition, or from general quarters condition to emergency condition).

3.6.4.1.1 Watch condition. The condition of all systems equipment and the personnel situation (how many of what class or type of men to be stationed where) for watch condition shall be described. The operating console and panel positions shall be illustrated.

3.6.4.1.2 General quarters condition. The condition of all systems equipment and personnel situation shall be described for general quarters condition. The operating console and panel positions shall be illustrated.

3.6.4.1.3 Emergency condition. The condition of all systems equipment and the personnel situation for emergency condition shall be described. The operating console and panel positions shall be illustrated.

3.6.5 Chapter 4, Operation. Chapter 4 shall describe system operating situations, modes, and procedures. The descriptions shall be detailed to the level required for an understanding of the operational interfaces of the system equipments and associated systems. Illustrations shall be included when necessary for clarity (see figure 17-5). The various operating modes shall first be described to acquaint the operator with all equipment combinations that can be employed to effect a given mode of operation.

3.6.5.1 Preoperational conditions and setup. Specific preoperational conditions presumed to be in effect prior to system operation shall be established. A system readiness checkoff list of significant switch positions and indicator status shall be tabulated. For indicators such as dials, where a band of readings are possible, upper and lower limits shall be delineated. The initial

conditions of associated system equipment that directly affect system operation shall be treated in a similar manner.

3.6.5.2 Operating modes. The primary operating mode shall be discussed in detail, and alternate modes shall be treated as modifications of the primary mode. Operating procedures common to all modes shall be detailed under the primary mode and referred to under the alternate modes, with such modifications of procedure as may be necessary. Each mode shall be described in the logical sequence of major phases, events, options, supervisory commands and responsive actions, and the following:

- a. Only those equipment operational controls and indicators having system significance shall be explained in the description. When controls must be actuated and indicators observed in a sequence to achieve system operation, the descriptions will cite each control and indicator with a number to indicate the position in the sequence.
- b. Emphasis shall be placed, by the use of warnings on the safe operation of controls, which, if operated improperly, could result in hazards to personnel or damage to the equipment. Each control shall be followed by a brief description of its effects (equipment actuation or display indication, or both) at the operator station and at remote stations. The primary mode description shall be supported by both general and detailed illustrations.
- c. Operational phases which involve operator judgment shall be illustrated by operational logic diagrams. The diagrams shall indicate the conditions that must be favorable prior to an operator action, or if unfavorable, indicate the alternate action. Illustrations showing dials, gauges, status lights, and so forth, which indicate the favorable or unfavorable conditions shall be included. Special procedures to be followed when an equipment failure may be bypassed (as separate from emergency procedures) shall also be described.

3.6.5.2.1 Normal operation. The duties of system operators shall be described in terms of general responsibility and specific step-by-step procedures (see MIL-DTL-24784) for operating the system in all of the primary modes. Descriptive words (such as switch, button, dial, or indicator) may be added to clarify the type of control involved, for example: "Press ACCESS button and observe channel spot." All system controls and indicators provided for the use of operators shall be covered. Controls and indicators provided only for maintenance and nonsystem application shall not be called out.

3.6.5.2.2 Emergency operation. Step-by-step procedures shall be provided for emergency operation of the system. If specially designated controls have been provided for emergencies, a short statement shall be included describing how they modify or otherwise affect normal system operation. Emergency procedures shall be supported by illustrations.

3.6.5.2.3 Special operation. Special operations such as test checkout, training, or evaluation exercises shall be described. Illustration support shall include block diagrams and pictorial diagrams.

3.6.5.3 Standard log form (model set). Standard log forms (see MIL-DTL-24784) and selected data shall be developed and prepared and included in this chapter for all ship systems requiring

monitoring of operational functions such as chemicals, data, temperatures, and so forth, required for determining safe and reliable ship's operations. Such systems shall include but not be limited to the following:

- a. Propulsion.
- b. Boiler.
- c. Electrical.
- d. Battery.
- e. Distilling.
- f. Fuel and fueling.
- g. Refrigeration.
- h. Environmental.

3.6.5.3.1 Waiver of requirement. When it is deemed necessary that the development of such a form would be of no value to the Government for the equipment being covered, a waiver (with justification and rationale) for standard log form requirements shall be requested at least 3 months prior to submittal of the review draft copy.

3.6.5.3.2 Criteria. The "model" standardized log form shall serve as an operating log that shall be a guide to all ships of all classes. It is not intended that this model will in any way inhibit an individual ship from accommodating its specific needs through the addition or deletion of readings as deemed necessary on a case basis. The basic criteria to be utilized in developing the model shall be:

- a. Analyzing the various parameters associated with monitoring the performance of the equipment to ascertain those that provide trend determinant information.
- b. Synthesizing the results of the above analysis to ensure that only "key" (that is, necessary) parameters are included; the goal being to keep to an absolute minimum the total number of log readings required in running the plant.
- c. Arranging the order of monitoring on the appropriate log forms in such a manner that the log keeper and the reviewing officer can quickly tell when problems, either short-term or long-term in nature, are beginning to develop (that is, by function as opposed to order of physical arrangement).
- d. Duplicate readings shall be eliminated where feasible (that is, where the parameter is generally associated with a single function and where duplicated readings are not normally compared with one another).

3.6.5.3.3 Training summary. A training summary for use of the form shall also be included in Chapter 4. It shall indicate how to use the chart and an explanation of the significance of the monitoring points and readings.

3.6.5.3.4 Request for number. The contractor shall advise the Government of the requirement for log forms. The Government shall arrange for a forms stock number, and printing and stocking of the log form.

3.6.6 Chapter 5, Functional description. Chapter 5 shall describe how the components or equipments comprising the system jointly perform major operations and functions, and how associated systems contribute to the performance of these major functions. Equipment or associated system interfaces shall be described only as necessary to identify the sources or destinations of system inputs and outputs (see figure 17-6). Descriptions shall not repeat the functional description provided in the equipment manuals.

3.6.6.1 Method of presentation. The presentation shall first define how the system major functions meet the purpose of the system as described in 3.6.2.1. Each major function (see 6.4.3) shall then be discussed separately at progressively increasing levels of detail. The description of the entire system shall be supported by a basic block diagram of the system (see figure 17-7). Where information can be presented better pictorially than by text, additional diagrams and other illustrations shall be used. Reference may be made to diagrams appearing in Chapter 7.

3.6.6.2 Introduction. The introduction shall describe the general approach that is used in the functional description. The introduction shall also describe briefly the interrelationship between the system and associated systems.

3.6.6.3 System function directory. A system function directory shall tabulate operation control functions and the signal data described in the detailed level of functional description (see 3.6.6.4.2). The tabulation shall include the following information, as applicable:

- a. Official name of the function, colloquial name, and symbol.
- b. Type of control or signal (alternating current frequency and voltage, direct current polarity and voltage, hydraulic pressure, mechanical motion, synchro, and so forth).
- c. The origin and termination of the control or signal.
- d. Identify equipments (relay transmitters, coordinate converters, distribution boxes, switches, and the like) between the origin and termination of the output control or signal.
- e. Figure numbers of illustrations on which the function is illustrated, including the fault-isolation diagrams in Chapter 7.

3.6.6.4 Functional description.

3.6.6.4.1 First level of functional description. The first level of the description shall be confined to data such as origin of the major functions at an equipment control or sensor; transmission of the signal via intermediate equipment such as switchboards, relay transmitters, coordinate converters, and distribution boxes; and presentation of the function at terminal equipment. Control functions essential to the development of a signal shall be introduced and briefly described in their relationship to the signal. The description shall be supported by a block diagram (see figure 17-8). The diagrams for electrical and mechanical systems may be illustrated as shown (see figure 17-9). Functions involving computations may be explained in mathematical terms, but at a level no higher than high school mathematics. The second level of analysis shall be supported by one or more diagrams.

3.6.6.4.2 Detailed (second) level of functional description. The detailed-level description shall explain the system major functions in terms directly related to the diagrams in Chapter 7. Data and control functions shall be described down to the level of an equipment or an equipment group. Functional descriptions of important parts of electrical or mechanical systems may be supported by illustrations similar to figure 17-10.

3.6.7 Chapter 6, Scheduled maintenance. Chapter 6 shall contain all system schedule test procedures, together with necessary explanations and illustrations. It is intended that the engineering effort required to develop preventive maintenance data be expended only once and that the data, where applicable be used both in this chapter and in Logistic Support Analysis (LSA) or Maintenance Requirements Cards (MRC) where one or more of the latter three data items are required by the contract (see 6.2). The preparation of this chapter of the manual should therefore be delayed until completion of the LSA, or MRC; submissions of the manual draft copy for review should be marked "TO BE SUPPLIED UPON COMPLETION OF LSA". When the approved LSA, or MRC data is available, it shall be referenced in the manual. When included in the manual, such LSA, or MRC data shall be integrated with other technical data required by this specification to be in this chapter. These procedures shall be correlated with the installation checkout requirements of 3.6.10.6, so that any maintenance or performance test procedure also required for checkout may be properly referenced from Chapter 9, Installation data. The installation standards summary sheet (see 3.6.10.9.2) shall also include space for any maintenance or performance test result that should be recorded by the installer. The recorded information shall provide a reference to the Navy technician when troubleshooting or when needed for installation acceptance certification. Chapter 6 shall comprise the following:

- a. Introduction.
- b. Scheduled maintenance action index.
- c. Scheduled test procedures.

3.6.7.1 Introduction. The introduction shall be an explanation of the purpose, scope, and arrangement of the scheduled maintenance material. When a preventive maintenance procedure is critical to the operation of the system and the schedule for servicing is absolute (not recommended), this information shall be conspicuously written as a CAUTION. The following statement shall be included:

"The scheduled maintenance instructions in this manual are intended to duplicate those furnished in the Planned Maintenance System (PMS). In case of conflicts, the PMS documentation takes precedence. Such conflicts should be reported immediately on the user comment sheet in accordance with the maintenance procedures for this manual."

3.6.7.2 Scheduled maintenance action index. This index shall include all scheduled performance procedures. The index shall be tests and preventive maintenance tabulated as follows:

- a. Column 1, Periodicity. This column shall contain an alphanumeric list of all maintenance actions contained in the chapter. The following periodicity symbols, as appropriate, shall be used in the order of increasing periodicity as listed in Table I:

TABLE I. Periodicity symbols.

INTERVAL	SYMBOLS
Daily	D
Weekly	W
Monthly	M
Quarterly (3 months)	Q
Semiannually (6 months)	S
Annually	A
Overhaul cycle	C
As specified (explain circumstances)	R (see note 1)

1. An R periodicity shall be preceded by a recommended calendar periodicity (for example, DR, WR, MR, and so forth).

- b. Column 2, Maintenance action. This column shall list the maintenance action which corresponds to the periodicity number in column 1.
- c. Column 3, Reference. This column shall state the paragraph number that contains the procedure listed in column 2.

3.6.7.3 Scheduled test procedures. Include the detailed procedures for setting up and performing complete system tests. Each procedure shall be numbered and titled to clearly define the test action and the output to be tested.

3.6.7.3.1 Scheduled performance tests. These tests shall contain step-by-step procedures necessary to verify that the equipment is operating within standards in all modes of operation and shall contain the following:

- a. Safety precautions.
- b. A list of tools and test equipment identified by type, manufacturer, and model number.
- c. The title of the test to be performed.
- d. The minimum rating of the technician expected to perform the task.
- e. Preliminary setup data required to perform the test.
- f. Detailed procedures for accomplishing the test. Procedures requiring lengthy and identical setup data may be presented in detail in one procedure and referenced in succeeding procedures.
- g. Values or conditions, with tolerances, indicative of normal operation.
- h. References to troubleshooting or corrective actions to be used if the test values are not within tolerances.
- i. Illustrations to support the test.

3.6.8 Chapter 7, Fault-isolation. Chapter 7 shall contain fault-isolation procedures, illustrations,

and an explanation of the use of the information presented. The major objective of the system fault-isolation procedures contained in Chapter 7 shall be described. In addition, this shall contain a brief description of each type of maintenance diagram. A fault directory shall be included which relates fault symptoms found during operation to the fault-isolation procedures. Fault-isolation procedures, fault logic diagrams, control function diagrams, and data function diagrams shall be included as follows:

- a. Operation-based symptom fault directory.
- b. Fault-isolation procedures.
- c. System fault logic and troubleshooting maintenance dependency matrix diagrams.
- d. System control function diagrams.
- e. System data function diagrams.

When a separate depot-level manual is required (see 6.2), it shall include the information required by MIL-DTL-24784 and MIL-DTL-24784/7.

3.6.8.1 Operation-based symptom fault directory. The directory shall relate system faults observed during operation described in Chapter 4 to fault-isolation diagrams. The directory shall be presented in tabular form by operational modes (see figure 17-11). The tables shall include references to system fault-isolation diagrams, and where applicable, directly to equipment troubleshooting diagrams. Table content shall include, as applicable, the following information:

- a. Table headings. Table headings shall be identified by the operational mode to which the table relates.
- b. Column headings. The fault directory shall contain the following columns:
 1. Column 1, Operating procedure step. This column shall list the step of the operation procedure in Chapter 4 for which a fault symptom can be observed. (For example, if step 1 is an action step "set XYZ switch to ON" with no operational response, step 1 would not appear in the column. However, if step 1 stated "Set XYZ switch to ON and check to see that XYZ lamp lights," then step 1 would be included in the column.)
 2. Column 2, Functional description. This column shall include the reference to the paragraph number of the functional description in Chapter 5. In addition, when an operation can be identified with an output, this column shall also contain the name or symbol of the output.
 3. Column 3, Fault-isolation procedure. This column shall reference by paragraph number the fault-isolation procedure.
 4. Column 4, Alignment procedure. This column shall reference by paragraph number the alignment procedure in Chapter 8.
 5. Column 5, Fault-isolation diagram. This column shall reference the fault-isolation diagram by figure and sheet number.
 6. Column 6, Equipment document. This column shall reference the equipment technical manual when the fault can be isolated to the specific equipment causing the fault.

3.6.8.2 Fault-isolation procedures. Procedures shall be included for isolation of a trouble to a

single equipment or functional area of an equipment. The procedures shall provide for the analysis of switching combinations and observable indications (dials, gauge lamps, and meters). The use of any required test equipment shall be described. The procedures shall support the system fault-logic, control function, and data function diagrams (see MIL-DTL-24784). The supporting diagrams shall be referenced by figure number. Prerequisite control settings and conditions shall precede each procedure.

3.6.8.3 System data function diagrams. System data function diagrams shall show in detail the system information needed to isolate faults within signal or data flow paths. Data function diagrams shall include tolerance values and shall contain references to equipment publications where necessary. All inputs required to develop the output shall be shown. The data function diagrams shall be constructed in accordance with the following:

- a. Titles of diagrams shall correspond to the signal flow described.
- b. Show all test points necessary to isolate the trouble to the lowest level of hardware block (for example, subassembly). Include test parameters required to define satisfactory operation. Where signal flow diagrams depict signal flow in more than one mode of operation, that data shall be presented on the apron for all modes. Apron notes shall also include test data for test equipment setup. All inputs and outputs shall have signal description information.
- c. References shall be made to the functional description, troubleshooting procedures, corrective actions, and so forth, as appropriate by paragraph number. Normally these references shall be included with the notes.
- d. The display of more than one function or mode of operation on one diagram shall be allowed only when clarity is not sacrificed and the functions are relatively simple.
- e. Screwdriver adjustments, dial adjustments, and adjustable controls shall be shown.
- f. All built-in controls and monitoring devices shall be shown. Do not show external test equipment, unless it is a permanent part of the equipment.
- g. Hull grounds, chassis grounds, signal grounds, and power grounds shall be shown.
- h. All leads of motors, generators, synchros, and so forth, shall be identified.
- i. All relay coils that are energized by the signal shall be shown.
- j. All relay contacts and relay terminals in the flow path shall be shown and identified. All relay contacts shall be depicted in operational mode. References to control diagrams on which the relay coils appear shall be shown adjacent to the relay contacts.
- k. Signal paths shall be identified by weighted lines and arrowheads.

3.6.9 Chapter 8, Alignment procedures. Chapter 8 shall present the corrective adjustment procedures and support information necessary to restore electrical and mechanical alignment between the various system equipments. All values and tolerances shall be included. The alignment shall be cross-referenced to respective fault-isolation procedures and diagrams in Chapter 7. Alignment procedures shall include references to equipment publications where further procedures are required at the equipment level. The alignment procedures shall be presented in step-by-step form.

3.6.10 Chapter 9, Installation data. Chapter 9 shall present installation drawings and information not contained in the equipment technical manual necessary to install and checkout the system:

- a. Summary of all utilities required by the system, such as air, water, power, steam, freon, and so forth.
- b. System interconnection diagrams.
- c. Cable run diagrams (see MIL-DTL-24784).
- d. System piping diagrams (see MIL-DTL-24784).
- e. System cable interconnection check.
- f. Active system tests.
- g. System component installation procedures.

3.6.10.1 Utilities list. A utilities list shall be included that presents in tabular form all utilities required, and the quantities of each, in each system, compartment, and area.

3.6.10.2 System interconnection diagrams. System interconnection block diagrams shall be prepared and presented with each equipment or component shown as a block (see figure 17-7). All cables running between equipments shall be identified by cable number. The number of active and spare leads in each cable shall be included. The illustrations shall also indicate all junction boxes, switchboards, and so forth, into which interconnection cables enter or leave.

3.6.10.3 System cable interconnection check. Cold-wire check procedures shall be provided to verify the proper installation of all system cables. These checks shall be prepared to be conducted with all power off and all equipment completely shut down.

3.6.10.4 Active system tests. All active system test procedures required to verify the proper installation and operation of the system shall be included. Reference may be made to applicable tests and procedures in Chapter 6. Procedures for complete setup, testing, shut down, and data analysis shall also be provided.

3.6.10.5 System component installation procedures. Complete step-by-step instructions shall be provided for installation of system components not covered in any of the equipment manuals for the equipment comprising the system. The following types of supplemental information not provided in the equipment technical manual shall be included:

- a. Instructions required to assemble components.
- b. Instructions required to mount components. Include boring and bracing diagrams and data on shock mounts.
- c. Instructions for making electrical, waveguide, plumbing, and all other interface connections between equipments, components, and other systems.
- d. Servicing procedures, such as initial lubrication and adjustments.
- e. Instructions for bonding and grounding.

3.6.10.5.1 Installation drawings. The following drawings shall be included:

- a. Pictorial diagrams.
- b. Outline and mounting dimension data.

- c. Interconnecting wiring and cabling diagrams.
- d. Primary power distribution.
- e. Piping diagrams.

3.6.10.6 Installation checkout. Step-by-step procedures shall be provided to demonstrate that the system operates correctly and within tolerances. These procedures shall provide for system checkout in three test phases as follows:

- a. Phase 1 - Installation inspection and pre-energizing procedures.
- b. Phase 2 - Turn-on and preliminary tests.
- c. Phase 3 - Installation verification test.

3.6.10.7 Phase 1 - Installation inspection and pre-energizing procedures. Inspection procedures shall be provided in the form of check lists to verify the following:

- a. That the system and required auxiliary equipments have been installed and that their location and orientation is proper; that all cables, antennas, waveguides, transmission lines, dehydrators, coolant lines, piping, and so forth, have been installed in accordance with plans and specifications; that continuity exists in all interconnections.
- b. That special system test equipment listed in Chapter 1 is on board, operating satisfactorily, and has been calibrated.
- c. That all field changes, mandatory retrofits, or ship alterations have been accomplished.
- d. That all rotating devices are free from obstruction.
- e. That there is access to the system components for maintenance.
- f. That all pre-energizing servicing procedures, including lubrication, have been accomplished.
- g. That it is safe to operate the system.

3.6.10.8 Phase 2 - Initial turn-on and preliminary test. Procedures shall be included for energizing the system for the first time. This may be accomplished by reference to the applicable portions of Chapter 4. Step-by-step procedures shall be included for testing electrical, steam, and fluid supply circuits, distribution panels, breakers, and interlocks. Procedures shall be included for testing piping, cables, transmission lines, and waveguides for proper installation, including checks for hanger spacing, torquing of connectors, pressure testing, voltage standing wave ratio, and attenuation checks.

3.6.10.9 Phase 3 - Installation verification test. Complete instructions shall be included for testing the system in all modes of operation. Where applicable, refer to the scheduled performance tests in Chapter 6. Procedures shall cover checking gauges, meters, alarms, and other sensing devices for proper operation and calibration. Tests shall verify that all inputs are in tolerance. Where applicable, include voltage standing wave ratio and insertion loss tests to verify the proper installation of antenna-to-equipment waveguides runs; transducer impedance and source level checks to verify proper installation of transducers, domes, and cables; dynamic and static load tests for hoists, winches, and so forth. Preliminary setup data shall be included in each procedure. When it is required that an alignment be accomplished prior to performing a test, the alignment shall be included or referenced in the procedure.

3.6.10.9.1 Test procedures. Testing procedures shall be presented in a logical order as follows:

- a. Energize the system.
- b. When test results are within the required tolerance, include a reference to the next logical test.
- c. When test results are out of tolerance, include a reference to the corrective maintenance or troubleshooting data. Reference shall be made to troubleshooting diagrams except where probable causes of failure can be predicted, in which case reference may be made directly to an alignment or repair procedure.

3.6.10.9.2 Installation standards summary sheets. The installation standards summary sheet shall provide spaces for recording the results of all installation verification and maintenance standard tests (see figure 17-12). Spaces shall also be provided for recording the results of all maintenance or performance standards tests included in Chapter 6, scheduled maintenance, that are required for reference by the Navy technician when troubleshooting or for Government acceptance certification. Each space shall be identified by the step or paragraph number which provides the instructions for accomplishment. Each space shall contain the respective unit of measurement (for example, vdc or Hz.). When applicable, waveforms shall be included to show the points on the pattern where the measurement is to be taken. In addition, critical installation data shall be included, such as length of transmission line.

4. VERIFICATION

4.1 Quality assurance requirements. The quality assurance requirements for delivery of book plans, review draft copies, preliminary technical manuals, final reproducible copy, technical manuals, replenishment materials, changes and revisions shall be in accordance with MIL-DTL-24784.

5. PACKAGING

5.1 Packaging. For acquisition purposes, the packaging requirements shall be as specified in the contract or order (see 6.2). When actual packaging of materiel is to be performed by DoD personnel, these personnel need to contact the responsible packaging activity to ascertain requisite packaging requirements. Packaging requirements are maintained by the Inventory Control Point's packaging activity within the Military Department or Defense Agency, or within the Military Department's System Command. Packaging data retrieval is available from the managing Military Department's or Defense Agency's automated packaging files, CD-ROM products, or by contacting the responsible packaging activity.

6. NOTES

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

6.1 Intended use. The technical manuals prepared to this specification are intended to be used for installation, operation, maintenance, repair, and parts support of HM&E, electronic and IC systems. The technical manual will be used as a training document in the classroom and as a source for on-the-job training.

6.2 Acquisition requirements. Acquisition documents must specify the following:

- a. Title, number, and date of the specification (or any TMCR referencing this specification).
- b. Issue of DoDISS to be cited in the solicitation, and if required, the specific issue of individual documents referenced (see 2.2.1).
- c. Type and quantity of deliverable products (see 3.3).
- d. Arrangement if other than standardized format (see 3.4).
- e. Format and preparation instructions if other than as specified in MIL-DTL-24784 (see 3.5).
- f. Waiver of log form requirement (see 3.6.5.3.1).
- g. When LSA or MRC data is required (see 3.6.7).
- h. When a separate depot-level manual is required (see 3.6.8).
- i. Packaging requirements (see 5.1).

6.3 Technical manual acquisition. This specification (or a TMCR based on this specification) must be listed on the Contract Data Requirements List (DD Form 1423) in order to acquire the technical manuals described by this specification. An alternate acquisition strategy should be devised by contracting officers for those solicitations or contracts which are exempted from using the Uniform Contract Line Item Numbering System (UCLINS).

6.4 Definitions. The words or phrases used throughout this specification must be as defined in MIL-DTL-24784 and the following.

6.4.1 Commercial design. Equipment engineered and manufactured primarily for commercial purposes. For military applications, the acceptability of commercial off-the-shelf manuals supporting the equipment or system can be established in accordance with MIL-DTL-24784/4 or this specification as directed by the Government.

6.4.2 Interim change. The Naval Space and Warfare Command method of promulgating rapid changes to a technical manual. The information required to amend, correct or modify a manual when emergency or urgent changes are necessary and there is insufficient time available to publish a permanent change. Interim changes are subject to replacement by a permanent change. (Interim changes are often referred to as temporary changes.)

6.4.3 Major function. An essential functional operation which is fundamental to operation (as

opposed to a circuit) of the equipment (for example, transmit, receive, display, hoist, and so forth).

6.4.4 Unit. A major building block for a set or system, consisting of a collection of basic parts, subassemblies, and assemblies packaged together as a physically independent entity. Refer to IEEE 200 for a detailed description.

6.5 Subject term (key word) listing.

- Installation
- Maintenance
- Operation
- Parts support

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

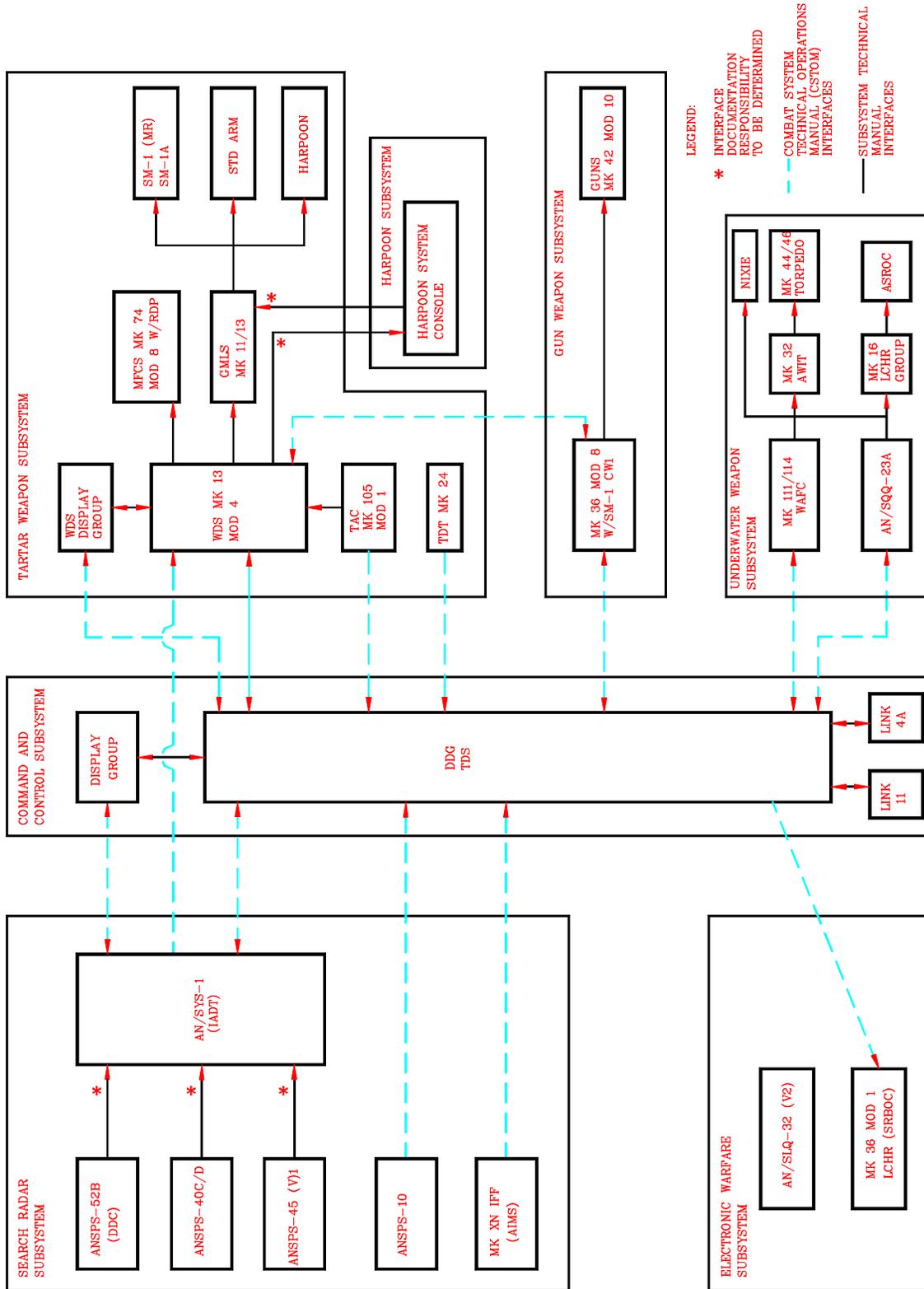
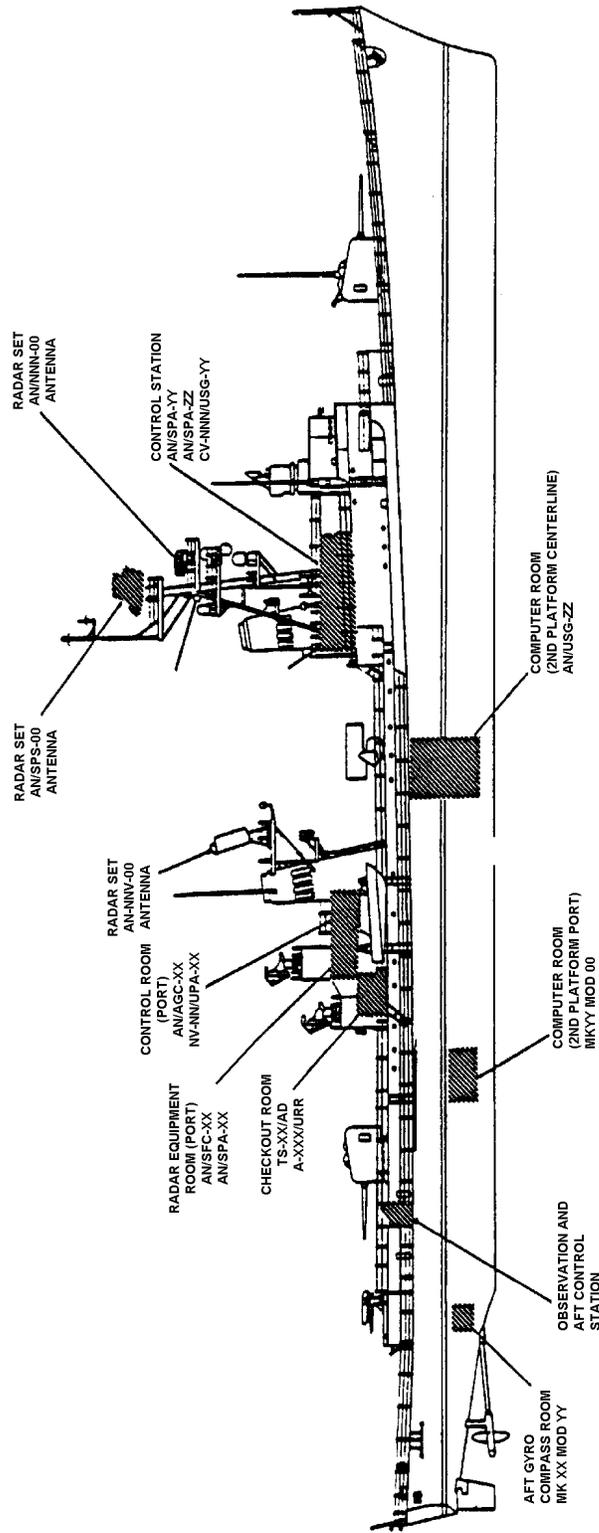


FIGURE 17-1. System block diagram interface documentation.



Sample arrangement only. Type size does not conform to minimum specification requirements.

FIGURE 17-2. System compartments.

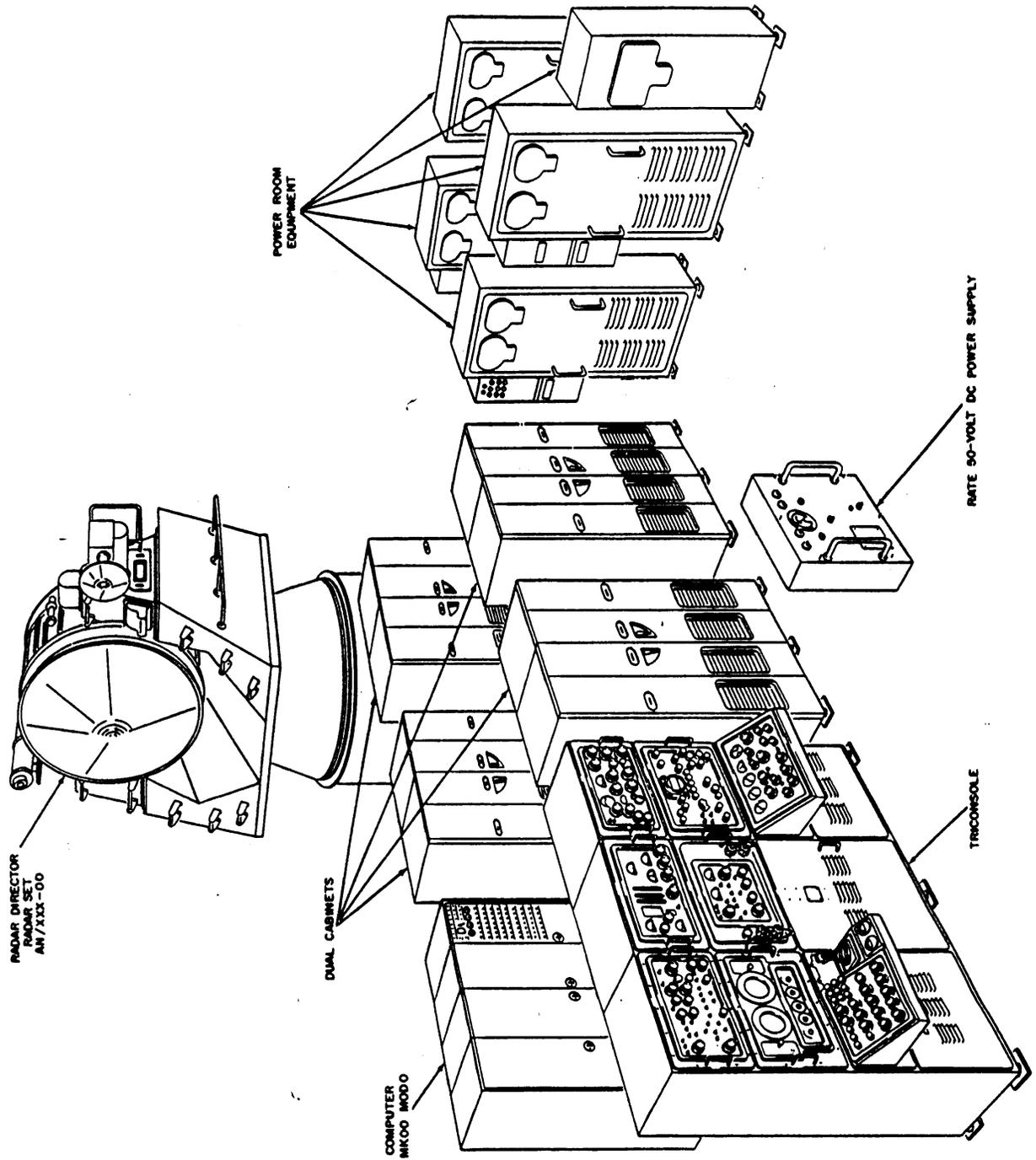
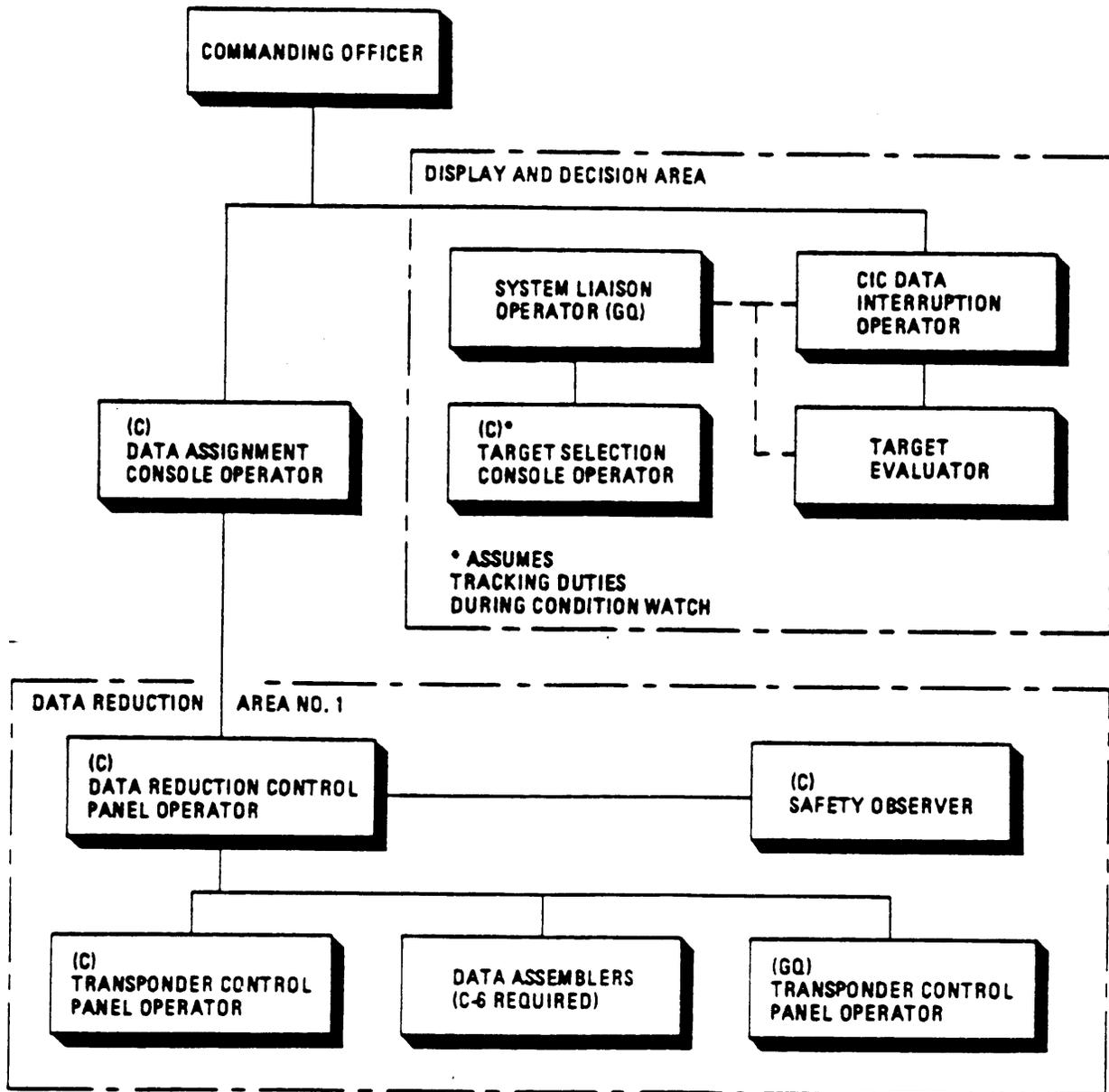


FIGURE 17-3. Compartment areas.

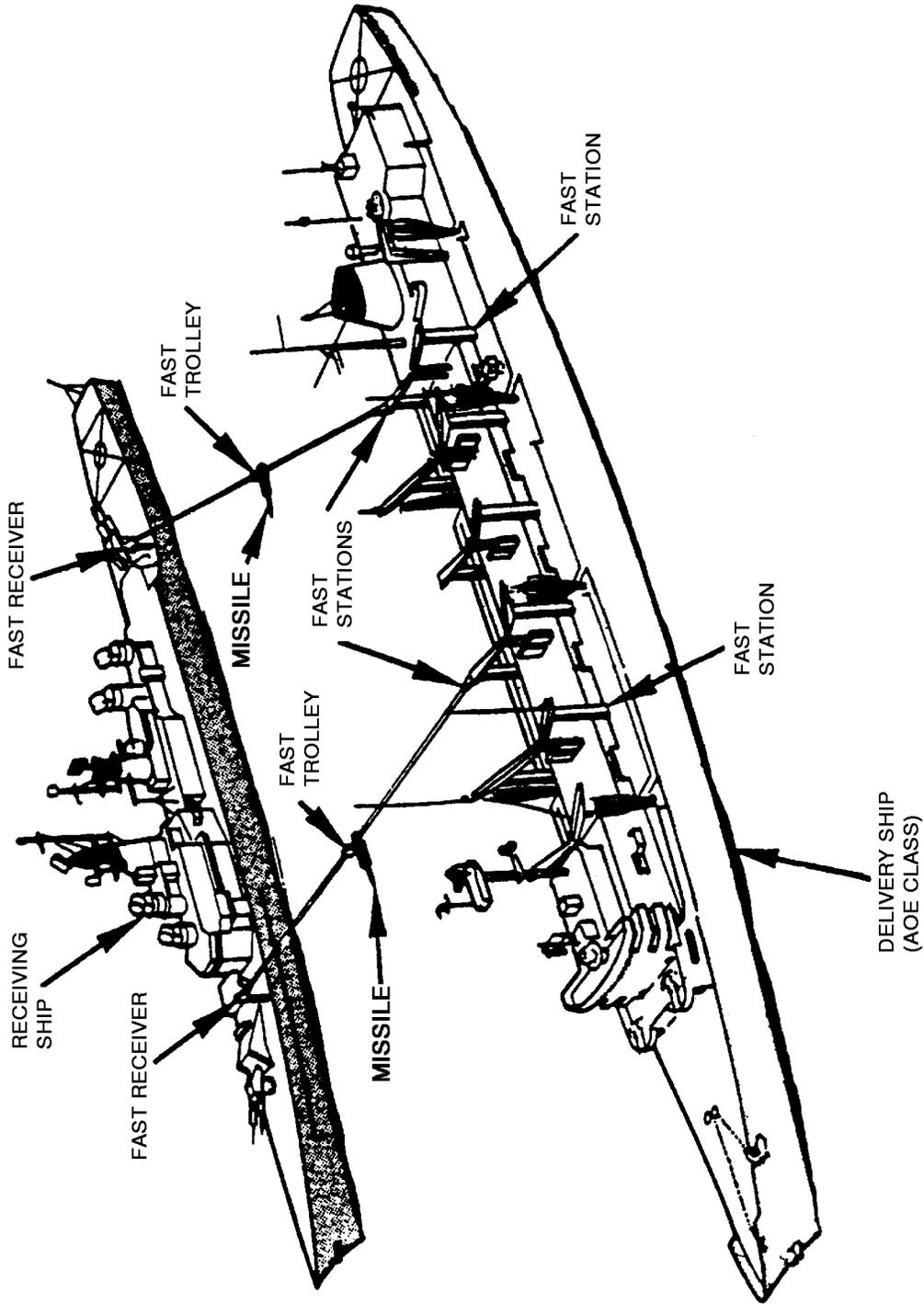


Sample arrangement only. Type size does not conform to minimum specification requirements.

FIGURE 17-4. Conditions of readiness, general quarters conditions.

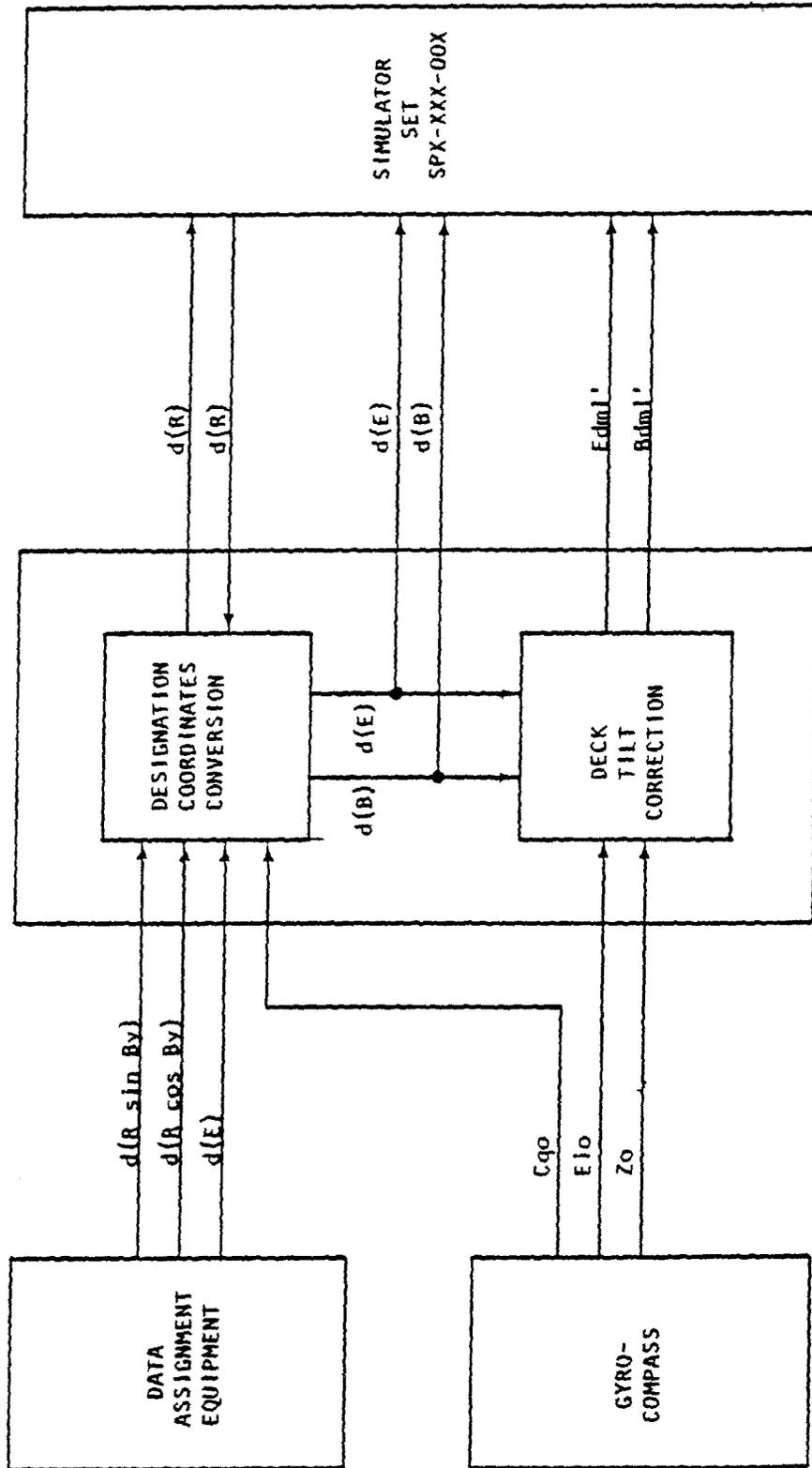
STEP	OBSERVE	REFERENCE								
<p>1. Preliminary Procedure.</p> <p>a. Position the following switches on rear deck assembly 1A210A1 as indicated.</p> <table border="0"> <tr> <td><u>Switch</u></td> <td><u>POSITION</u></td> </tr> <tr> <td>POWER</td> <td>OFF</td> </tr> <tr> <td>BATTLE SHORT</td> <td>OFF</td> </tr> <tr> <td>STOW</td> <td>BRAKES APPLY</td> </tr> </table> <p>b. Position POWER switch on console 1A220A20 (see figure 5-2) to OFF.</p> <p>c. Check to ensure that all chassis or subassemblies in the four compartments of electronic rack assembly, 1A70 are in the retracted position and all covers are secured.</p> <p>d. Remove all obstructions from the rotational paths of the director main antenna assembly.</p> <p>2. Power off</p> <p>a. At power control panel perform the following.</p> <p>(1) Check convenience lamp indicators.</p>	<u>Switch</u>	<u>POSITION</u>	POWER	OFF	BATTLE SHORT	OFF	STOW	BRAKES APPLY	<p>Covers Secured</p> <p>Director Clear</p> <p>Lighted</p>	<p>Schematic, figure 5-233</p>
<u>Switch</u>	<u>POSITION</u>									
POWER	OFF									
BATTLE SHORT	OFF									
STOW	BRAKES APPLY									
<p>e. At track meter panel, 1A340-02. check COOLANT FAILURES lamp.</p>	<p>Extinguished (Depress RESET button if lamp is lighted)</p>	<p>Relay diagram, figure 5-77, SH #(4B)</p>								

FIGURE 17-5. Operational procedure.



NOTE: Sample arrangement only. Size and legibility do not necessarily conform to minimum specification requirements.

FIGURE 17-6. System illustration showing interface.



NOTE: Sample arrangement only. Size and legibility do not necessarily conform to minimum specification requirements.

FIGURE 17-7. Functional block diagram, system.

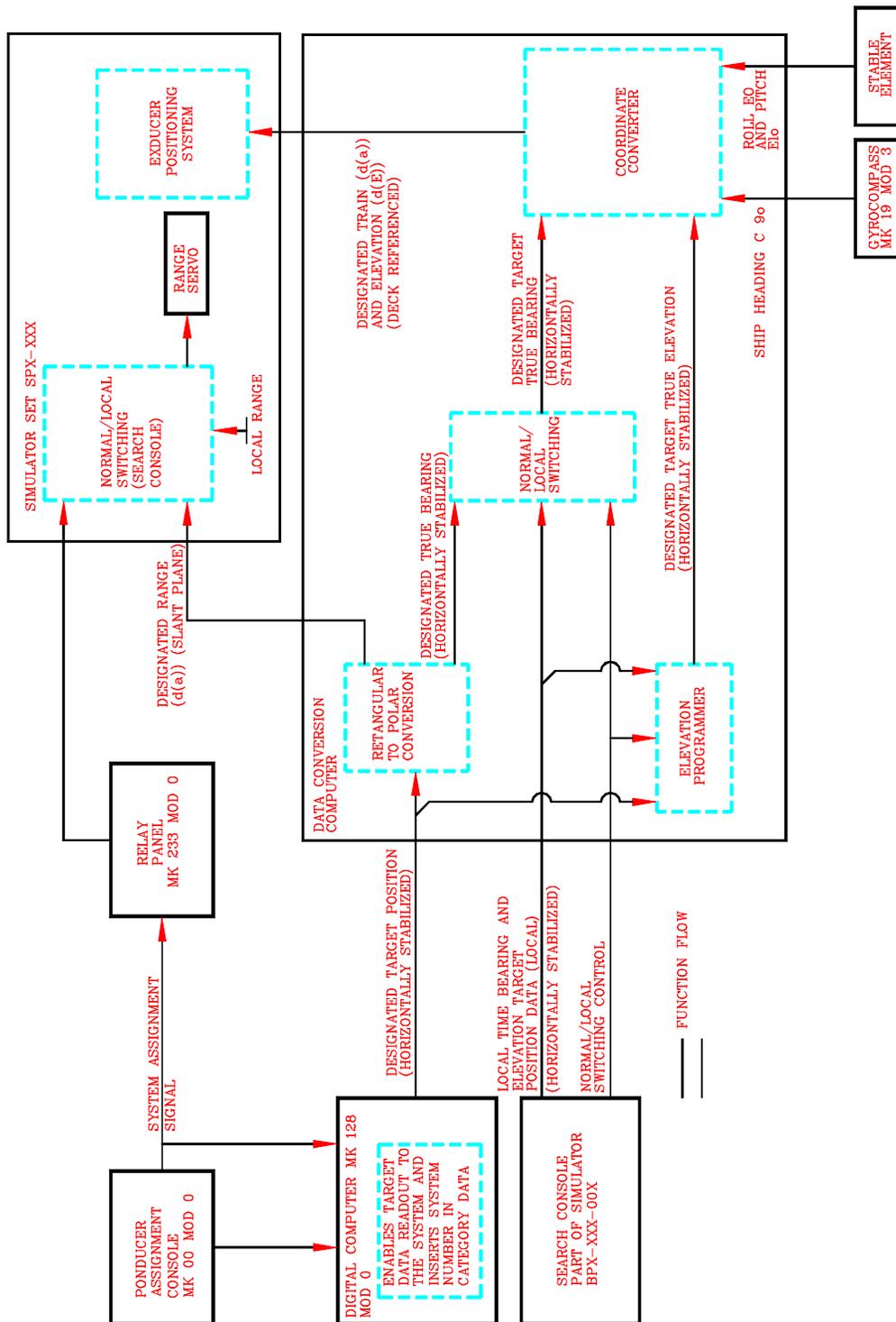


FIGURE 17-8. Functional description electronic system, first level.

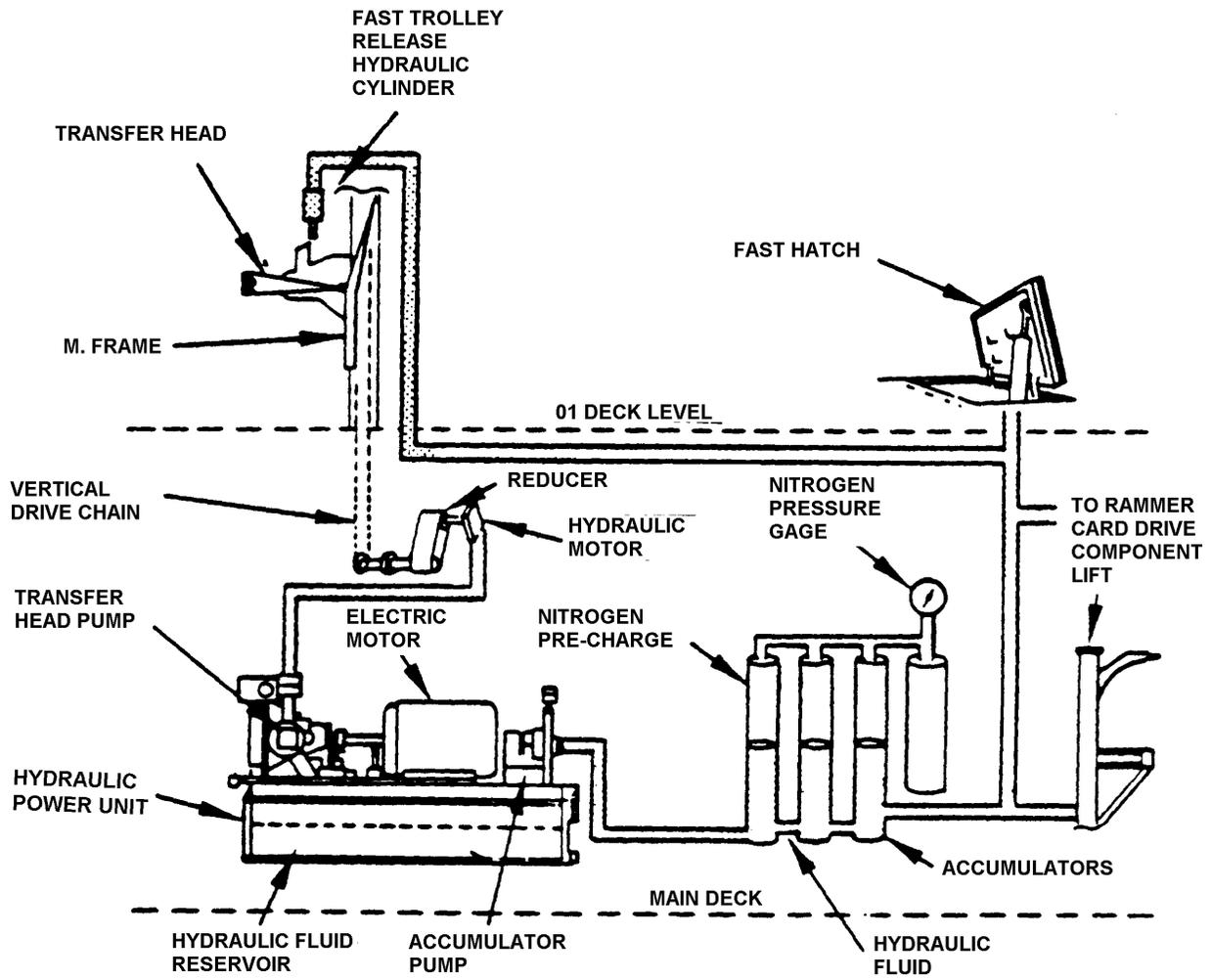


FIGURE 17-9. Functional description diagram for electrical/mechanical system, first level.

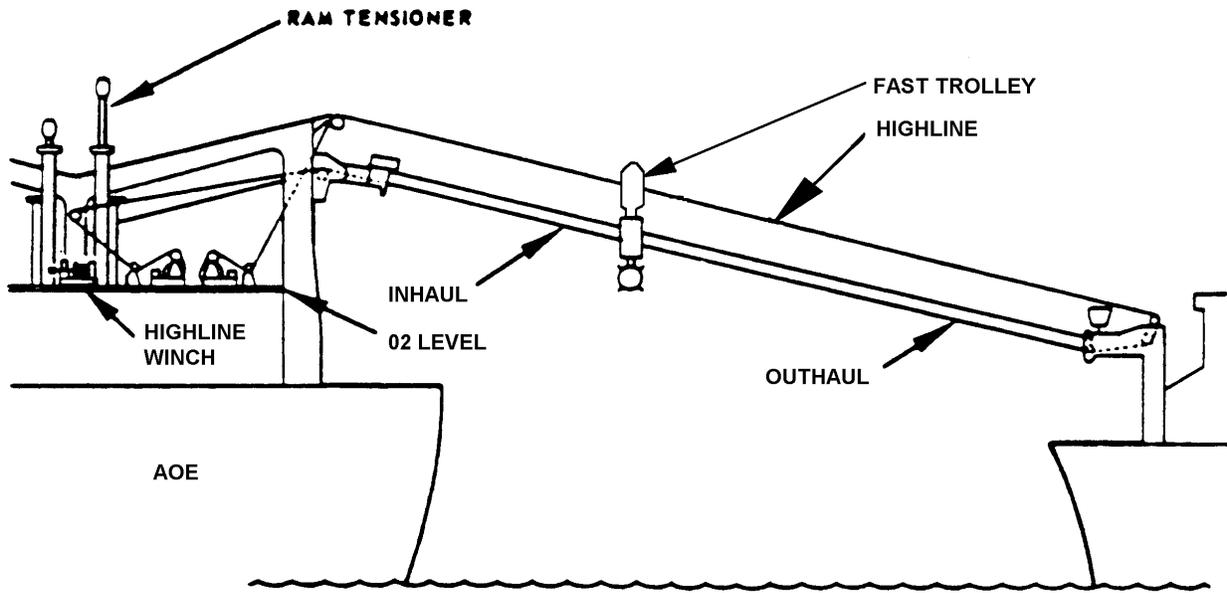


FIGURE 17-10. Functional description diagram for electrical/mechanical system, second level.

TABLE ZZ. Operation-based symptom fault directory.

Operating Procedure Step	Functional Description	Fault Isolation procedure	Alignment Procedure	Fault-Isolation Diagrams	Equipment Document
Normal Operating Mode - Paragraph 4-5					
List the step numbers associated with the fault indications. (Example) 4-3. R dial	Noun or Symbolic name of function being monitored. dCR	Fault-isolation procedure contained in Chapter 7. Figure 7-1 Para 7-68	Applicable alignment procedure and paragraph number required to restore normal operation. Para - 8-4	List associated fault-isolation diagram. Figure 7-38 Sheet 2	Reference to applicable equipment technical manual number and other TM reference if available. NAVSEA 0000 Chapter 4
Next Operating Mode - Paragraph 4-6					
(CONTINUE INFORMATION AS ABOVE)					

FIGURE 17-11. Operation - based symptom fault directory.

RADIO RECEIVER R-XXX/URR
NAVSEA
 INSTALLATION STANDARDS SUMMARY

Input Voltage _____ Vac Input Frequency _____ Hz (When reference standard tests are made)	Date _____ Serial Number _____ of Model _____ Installed in (ship or station) _____ Length of transmission line _____
--	--

Record on this summary sheet the test indications which have been obtained during the installation verification test.

Paragraph No.	Ref. Std.	Paragraph No.	Ref. Std.
8-10	a. _____ Check	8-46	a. _____ μ V
8-21	a. _____ Vdc		b. _____ μ V
	b. _____ Vdc		c. _____ Check
	c. _____ Vdc		d. _____ μ V
	d. _____ Vdc		e. _____ μ V
8-33	a. _____ Vdc	8-51	f. _____ μ V
	b. _____ Vdc		a. _____ Sec
	c. _____ Vdc		b. _____ Check
	d. _____ Vdc		c. _____ Check
			d. _____ Hz
			e. _____ Hz
			f. _____ Check
			g. _____ Check

NOTE: This sheet may be reproduced locally to size of manual page.

FIGURE 17-12. Installation standards summary sheet.

Custodian:
Navy - SH

Review Activity:
Navy - EC

Preparing activity:
Navy - SH
(Project TMSS-N323)

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 and send to preparing activity.
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-DTL-24784/17B (SH)

2. DOCUMENT DATE (YYYYMMDD)

15 February 2002

3. DOCUMENT TITLE HULL, MECHANICAL AND ELECTRICAL (HM&E) SYSTEMS AND ELECTRONIC AND INTERIOR COMMUNICATION (IC) SYSTEMS MANUAL REQUIREMENTS

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) DSN

(if applicable)

7. DATE SUBMITTED

(YYYYMMDD)

8. PREPARING ACTIVITY

a. NAME

SEA 05Q

b. TELEPHONE *(Include Area Code)*

(1) Commercial

(202) 781-3726

(2) DSN

c. ADDRESS *(Include Zip Code)*

Commander, Naval Sea Systems Command
ATTN: SEA 05Q, 1333 Isaac Hull Ave SE Stop 5160,
Washington Navy Yard DC 20376-5160

IF YOU DO NOT RECEIVE A REPLY WITHIN 45 DAYS, CONTACT:

Defense Standardization Program Office (DLSC-LM)
8725 John J. Kingman Road, Suite 2533,
Fort Belvoir, VA 22060-6221
Telephone (703) 767-6888 DSN 427-6888