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ASSOCIATED DETAIL SPECIFICATION

COMBAT SYSTEM TECHNICAL OPERATIONS MANUAL (CSTOM) 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 the Naval Sea Systems Command requirements for the content, general style, and format of Combat System Technical Operations Manuals (CSTOM) (see 6.2) required for maintaining own-ship combat system (see 6.3.3) readiness. CSTOM provides operational forces and school commands with combat system level information concerning design, detailed inter-subsystem interface data, testing, maintenance, and capabilities in fleet user-oriented language and format. The CSTOM documents functional integration of all combat subsystems (see 6.3.2) in performance of the major combat system operational functions of detection and entry, tracking and identification, threat evaluation and threat-to-weapon pairing, and engagement and engagement assessment.

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.

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

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 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.

(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 specification takes precedence. Nothing in this specification, 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. The 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).

3.3.1 Microfilm compatibility. Except as specified herein, technical manuals final reproducible copy shall be in accordance with MIL-DTL-24784, and the following:

a. New foldouts shall be prepared in the following format:

1. Foldout drawings shall be divided into 17-inch image area segments, except when the balance of the image area is 8-1/2 inches or less. The remaining segment will be 8-1/2 inches.

2. There shall be no drawing data, other than horizontal lines, placed closer than 1/8-inch from the image area limit.
3. Lines shall not be vertically displaced during the transition from one image area to the next.

b. Unless otherwise specified in the in the technical manual contract requirements (TMCR) (see 6.2), halftone artwork shall not be used.
c. Minimum printed size for text shall be 8 point. Nomenclature, callouts, tabular material and symbols on illustrations shall be upper case, with 6 point minimum printed size.

3.3.2 Data research and analysis source data. When specified in the TMCR (see 6.2), a technical manual data research analysis of existing documentation shall be provided in accordance with the data ordering document.

3.4 Arrangement. Unless otherwise specified in the TMCR (see 6.2), the 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 MIL-DTL-24784 .

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

3.6 Structure of CSTOM. The manual shall comprise four volumes. The manual shall be arranged in chapters and sections and shall be in accordance with 3.5.5 of MIL-DTL-24784 and the Government accepted manual outline. Technical information shall be correct in every detail. CSTOM will not normally include operating test, or fault isolation procedural steps provided by other documentation. However, when a deficiency in the subsystem and equipment documentation exists, and bridge-the-gap data (see 6.3.1) is provided in an appendix or supplement, dangers, warnings and cautions shall be included in all operations, tests, and fault isolation procedures, prior to the step that, if incorrectly performed, might lead to injury or death of personnel or damage to equipment. The individual volumes shall be divided into individually bound parts when required. Chapter and section material content shall be in accordance with the volume arrangement provided in 3.6.3. Section and subsection content and location may vary within a particular chapter to accommodate necessary or unique data coverage as specified by the contract. For a description of the detail by each level of data coverage, see 3.6.1 and 6.3.9.

3.6.1 Data level descriptions. Descriptive portions of CSTOM will identify principal subsystem equipment with a textual synopsis for each. A reference to the subsystem documentation shall be made for detailed information. The data in CSTOM shall consist of levels of narrative and illustration coverage as follows:

LEVEL 1 DETAILED INTRODUCTION: Block or pictorial drawing with associated text, depicting system, subsystem, and equipment interfaces, and operational or testing dependencies or capabilities.

LEVEL 2 FUNCTIONAL AND OPERATIONAL DESCRIPTIONS: Block or pictorial drawings with associated text defining principal system, subsystem, or equipment functions, operations, actions, capabilities, or fault isolation methods and tools.

LEVEL 3 DETAILED DESCRIPTION: Signal-level drawings defining signal characteristics and flow or test procedures, and detailed narrative.

3.6.2 Minimum data requirements. The text, illustrations and tables prescribed in this specification reflect minimum CSTOM requirements. Where the combat system configuration provides additional weapon subsystem capabilities, operating modes or functions, other than covered herein, equal coverage of text, illustrations and tabulated data shall be provided.

3.6.3 Volume arrangement. The chapter and section arrangement for each CSTOM volume shall be as follows:

VOLUME 1 - COMBAT SYSTEM DESCRIPTION.

Chapter 1 - INTRODUCTION.
Sections - Introduction to CSTOM.
Ship and Combat System Description.
Location of Combat System Components.

Chapter 2 - COMBAT SUBSYSTEM DESCRIPTIONS.
Sections - Introduction to the Combat System.
Search Radar Subsystem.
Tactical Data Subsystem.
Electronic Warfare Subsystem.
Gun Weapon Subsystem.
Underwater Weapon Subsystem.
Missile Weapon Subsystem.
Light-Airborne Multi-Purpose System (LAMPS) Subsystem.
External Communication Subsystem.
External Navigation Subsystem.
Support Subsystem.
Bibliography.

Chapter 3 - COMBAT SYSTEM OPERATIONAL DESCRIPTION.
Sections - Introduction to Combat System Functions.
Detection and Entry.
Tracking and Identification.
Threat Evaluation and Threat-To-Weapon Pairing.
Engagement and Engagement Assessment.
Bibliography.

Chapter 14 - COMMUNICATIONS CAPABILITIES AND LIMITATIONS.
Sections - Introduction to Communications Capabilities and Limitations.
Interior Communications.
External Communications.
Bibliography.

Chapter 15 - NAVIGATION CAPABILITIES AND LIMITATIONS.
Sections - Introduction to Navigation Capabilities and Limitations.
Satellite Navigation System.
OMEGA Navigation System.
Radio Direction Finders (RDF).
Tactical Air Navigation (TACAN).
Bibliography.

Appendix A - SUPPLEMENTARY DATA.

Glossary

3.7 Volume 1 - Combat system description. Volume 1 shall provide information for combat system personnel that summarizes ship physical and functional characteristics, missions, capabilities, and the interrelationships between combat system subsystems. This volume shall provide technical personnel with a description and analysis of the principal functions of each subsystem, the interfaces between subsystems, and the dependency of the combat system mission on the subsystems. Subsystem descriptive material shall not be unnecessarily duplicated. A reference to the appropriate subsystem technical manual shall be provided for each subsystem description.

3.7.1 Chapter 1 - Introduction. This chapter shall introduce the CSTOM and provide a physical and functional description of the ship. It shall provide an overview of the ship mission and capabilities, and shall identify the subsystem equipment comprising the combat system, and the physical location of selected subsystem equipment. A general description shall be provided for each of the subsystems, together with the functional role each has in supporting the ship combat mission.

3.7.1.1 Introduction to CSTOM. This section shall briefly describe the purpose, scope, and content of CSTOM. This section shall also include submittal and routing instructions for reporting of errors and technical manual improvement in accordance with MIL-DTL-24784.

3.7.1.2 Ship and combat system description. This section shall provide a description of ship missions, capabilities, and physical characteristics; include a level 1 description of all ship combat subsystems and related armament; such as search radar subsystem, tactical data subsystem, electronic warfare subsystem, gun weapon subsystem, underwater weapon subsystem, missile weapon subsystem, LAMPS subsystem, external navigation subsystem, external communication subsystem and support subsystem. The primary ship combat missions of anti-air warfare, antisubmarine warfare, surface and shore bombardment shall be described. An introduction to

combat system operation in the manual, semiautomatic and automatic, and casualty modes shall be provided. Major combat system functions (see 6.3.5) of detection and entry, tracking and identification, threat evaluation and threat-to-weapon pairing, and engagement and engagement assessment shall be described. A level 1 block diagram, similar to figure 3-1, shall be provided. The effective engagement envelop for each weapon system shall be illustrated.

3.7.1.3 Location of combat system components. This section shall describe the ship combat system compartments and areas. A ship profile drawing, similar to figure 3-2, shall pictorially identify external subsystem components and area locations. A three-dimensional plan view, similar to figure 3-3, shall depict strategically located important combat system compartments and areas. A two-dimensional room arrangement drawing, similar to figure 3-4, shall identify and locate major subsystem equipment found in various compartments and areas. A two-dimensional room arrangement drawing, similar to figure 3-4, shall identify and locate major subsystem equipment found in various compartments and areas. Except for CSTOMs developed for a single ship configuration, these drawings shall be typical and shall represent the lead ship of a class. The developing activity shall recommend the compartments to be pictorially represented in the manual outline. Figure references shall be provided and areas shall be shaded, similar to figures 3-2 and 3-3, to identify compartments and areas for which equipment room arrangement diagrams are provided.

3.7.2 Chapter 2 - Combat subsystem descriptions. Chapter 2 shall provide an abridged description of the physical and functional characteristics and, as applicable, a brief description and flow diagrams of operational programs for each subsystem. A pictorial of the combat system, similar to figure 3-5, shall be provided. Related text shall describe subsystem and equipment functions; functions shall be described to the depth necessary to enable the reader to understand each subsystem role in the combat system. The physical and functional characteristics of the combat system subsystems shall be described to levels 1 and 2. Pictorial art, similar to figures 3-6 and 3-7, shall be used to depict the physical characteristics and define the functional interface between subsystem elements, and between equipment of the subsystem element. A separate table for each subsystem shall list major equipment. The tables shall include colloquial name or abbreviation, nomenclature, quantity, and location. A bibliography for each subsystem shall list all source documentation.

3.7.2.1 Introduction to the combat system. This section shall introduce the subsystems that comprise the combat system and will provide the user with an overview of the Chapter 2 content.

3.7.2.2 Search radar subsystem. This section shall describe and illustrate components of the sea and air search radar subsystem, including the radar recognition, and radar distribution systems; all major components shall be described.

3.7.2.3 Tactical data subsystem. This section shall describe and illustrate all components of the tactical data subsystem (see 6.3.14). Areas of interface, other than with the ship support system, shall be addressed to the extent necessary for user understanding of tactical data subsystem role in the ship combat system. Block diagrams, similar to figure 3-8, shall illustrate the tactical data subsystem and weapon subsystem computer operational module interfaces. When applicable,

tactical data subsystem equipment for monitoring subsystem performance, and for testing combat system interfaces shall be described. Identification of operating stations for each mode configuration shall be provided.

3.7.2.4 Electronic warfare subsystem. This section shall describe and illustrate all components of the electronic warfare subsystem, including electronic support measures, electronic countermeasures, and ancillary equipment.

3.7.2.5 Gun weapon subsystem. This section shall describe and illustrate all components of the gun weapon subsystem, including gun ordnance and ancillary equipment.

3.7.2.6 Underwater weapon subsystem. This section shall describe and illustrate all components of the underwater weapon subsystem, including antisubmarine ordnance and ancillary equipment.

3.7.2.7 Missile weapon subsystem. This section shall describe and illustrate all components of the missile weapon subsystem, including operational and training missile ordnance and ancillary equipment.

3.7.2.8 LAMPS subsystem. This section shall describe and illustrate all components of the LAMPS subsystem, including all airborne LAMPS equipment, ordnance, and shipboard LAMPS equipment.

3.7.2.9 External communication subsystem. This section shall describe and illustrate all external communications systems and related components. Coverage shall be provided for, but not limited to, crypto devices, secure voice and nonsecure voice links, satellite communication, teletype circuits, underwater radio (UHF and VHF), tactical data link, and ancillary equipment.

3.7.2.10 External navigation subsystem. This section shall describe and illustrate all components of the navigation subsystem. Coverage shall be provided for, but not limited to, satellite navigation, OMEGA navigation, RDF, TACAN, and ancillary equipment.

3.7.2.11 Support subsystem. This section shall describe and illustrate the support equipment associated with the combat system. Simplified block diagrams, similar to figures 3-9 and 3-10, shall depict interfaces between the ship support subsystems and the combat system. As a minimum, coverage for the following support subsystems shall be provided:

a. Air and nitrogen pressurization systems.
b. Liquid cooling and heating systems.
c. Interior-ship communications.
d. Air conditioning.
e. Bridge ship-control system.
f. Ship parameters.
g. Power distribution.
h. Test equipment repair and calibration facility, when applicable.

3.7.2.12 Bibliography. This section shall provide a list of documents used in preparing this chapter.

3.7.3 Chapter 3 - Combat system operational description. Chapter 3 shall describe major combat system functions used in all modes of combat system operations. Include combat system functions of detection and entry, tracking and identification, threat evaluation and threat-to-weapon pairing, and engagement and engagement assessment. The major functions of the combat system shall be defined and summarized, and each function shall be described in detail in subsequent sections. Level 1 combat system configurations, including normal, alternate, and backup features available through combat system switching, that relate to the major combat system functions shall be described. A level 2 function flow pictorial, similar to figure 3-11, shall be used to illustrate each combat system function or principal sub-function described in Chapter 3. The functional flow pictorial drawings in Chapter 3 shall be divided into segments that are compatible for the production of view-graphs. Each segment shall have an image area of 7-1/2-inches (vertical) by 8-inches (horizontal).

3.7.3.1 Introduction to combat system functions. This section shall introduce and define combat system functions, and subsystem functions pertinent to the modes of combat system operation, and explain data transmission between subsystems. The general description shall prepare the reader for more detailed functional descriptions in subsequent sections.

3.7.3.2 Detection and entry. This section shall describe the initial track, detection and entry functions, and functional flow between subsystems performed for all radar, sonar, visual, or remote contacts to include air, surface, or subsurface threats entered manually or automatically into the combat system.

3.7.3.3 Tracking and identification. This section shall describe tactical data subsystem tracking and identification functions and functional flow between subsystems occurring for any track entered into the combat system, either locally by own-ship sensors or remotely by any participating unit within the operational areas of the fleet.

3.7.3.4 Threat evaluation and threat-to-weapon pairing. This section shall describe threat evaluation and threat-to-weapon pairing function, including weapon assignment. Data flow between subsystems to accomplish threat evaluation and weapon pairing for tracks considered hostile to own-ship and to fleet security shall be described.

3.7.3.5 Engagement and engagement assessment. This section shall describe target engagement and engagement assessment functions for functional flow between subsystems occurring for targets assigned to the electronics warfare subsystem, gun weapon subsystem, underwater weapon subsystem, missile weapon subsystem, the interceptor aircraft, or LAMPS.

3.7.3.6 Bibliography. This section shall provide a list of documents used in preparing this chapter.

3.8 Volume 2 - Operational sequences. Volume 2 shall present the sequential functional

operations performed by combat system personnel and equipment during all major combat missions. Volume 2 shall provide coverage of total combat system operational sequences for AAW, ASW, SUW, and shore operations. Volume 2 shall assume readiness condition I manning. Information provided shall address what is done and not how it is done. The user shall be referred to subsystem technical manuals for detailed step-by-step equipment operations. The operations required of each subsystem of the combat system shall be presented in relation to their contribution to the combat system functions of detection and entry, tracking and identification, threat evaluation and threat-to-weapon pairing, and engagement and engagement assessment. An operational mode network (OMN) similar to figure 3-12, will provide the user with an overview of the combat system functional requirements. The OMN (see 6.3.10) shall reference combat system operational sequence network (OSN) (see 6.3.11), similar to figure 3-13, for explanation of the operational sequences required for each function identified on the OMN. The OMN and each combat system OSN drawings shall be supported by a textual description.

3.8.1 Chapter 4 - Operational sequences. Chapter 4 shall consist of an OMN, combat system OSN drawings, and supporting text describing the sequential functional operations of the combat system in conduct of ship combat missions.

3.8.1.1 Purpose and use of the OMN and OSN. This section shall describe the purpose and use of the drawings contained in Chapter 4 to depict combat system operational sequences. The relationship of the OMN and the combat system OSN drawings to each other and to other volumes of the CSTOM shall be explained. The OMN diagram shall define combat system operating sequences. The OMN (see figure 3-12), an overall summary and reference diagram, shall provide for entry into more detailed operational functions depicted on second-level OSN drawings, similar to figure 3-13. The OMN and OSNs shall be developed on the basis of the major combat system operational descriptions specified in 3.7.3. OMN drawings shall identify all major operational functions. Entry into the second-level OSN diagrams shall be by figure reference from the first-level OMN. Each OSN shall subsequently cover a specific operational function. Where operational functions refer to an operator action, reference shall be made to the appropriate subsystem manual or system operator manual. The OMN drawing shall be reverse-side printed with an apron to permit opening the OMN to the left while viewing individual OSN drawings to the right. Each OSN shall specify the initial setup conditions and configuration requirements upon which the OSN is predicated.

3.8.1.2 Detection and entry. This section shall describe the combat system detection and entry operational sequence for the initial response to any air, surface, or subsurface detection while operating in readiness condition I (see 6.3.7). Narrative description in this section shall be supported by the OMN, and OSNs for each combat system subsystem, as appropriate.

3.8.1.3 Tracking and identification. This section shall describe the tracking and identification operational sequence and procedures for the initial response to any normally expected threat that may occur when operating in readiness condition I. Narrative description in this section shall be supported by the OMN, and OSNs for each combat system subsystem as appropriate.

3.8.1.4 Threat evaluation and threat-to-weapon pairing. This section shall describe the threat

evaluation and threat-to-weapon pairing operational sequence for the initial response to any normally expected threat that may occur when operating in readiness condition I. Include effects of the doctrine management function as it provides for manual insertion of resource management doctrine into the combat system to adjust and select automated system reactions to threats and the tactical environments. Narrative description in this section shall be supported by the OMN, and OSNs for each combat system subsystem as appropriate.

3.8.1.5 Electronic warfare engagement and engagement assessment. This section shall describe the electronic warfare engagement operational sequence and procedures for the initial response to any normally expected threat that may occur when operating in readiness condition I. Narrative description in this section shall be supported by the OMN, and OSNs for each combat system subsystem as appropriate.

3.8.1.6 Gun engagement and engagement assessment. This section shall describe the gun engagement operational sequence and procedures for the initial response to any normally expected threat that may occur when operating in readiness condition I. Narrative description in this section shall be supported by the OMN and OSNs for each combat system subsystem as appropriate.

3.8.1.7 Underwater engagement and engagement assessment. This section shall describe the underwater engagement operational sequence and procedures for the initial response to any normally expected threat that may occur when operating in readiness condition I. Narrative description in this section shall be supported by the OMN and OSNs for each combat system subsystem as appropriate. OSNs shall be provided, as necessary, to depict torpedo countermeasure and torpedo evasion operational sequences.

3.8.1.8 Missile engagement and engagement assessment. This section shall describe the missile engagement operational sequence and procedures for the initial response to any normally expected threat that may occur when operating in readiness condition I. Narrative description in this section shall be supported by the OMN and OSNs for each combat system subsystem as appropriate.

3.8.1.9 Controlled aircraft engagement and engagement assessment. This section shall describe the controlled aircraft engagement operational sequence and procedures for the initial response to any normally expected threat that may occur when operating in readiness condition I. Narrative description in this section shall be supported by the OMN and OSNs for each combat system subsystem as appropriate.

3.8.1.10 LAMPS engagement and engagement assessment. This section shall describe the LAMPS engagement operational sequence and procedures for the initial response to any normally expected threat that may occur when operating in readiness condition I. Narrative description in this section shall be supported by an OMN and OSNs for each combat system subsystem as appropriate.

3.8.1.11 Reduced capability conditions. The last section of Chapter 4 shall provide an

explanation of the effect of reduced combat system manning, as would be experienced in readiness condition III (see 6.3.8), on combat system operational sequences. This section shall provide combat system manning requirements for various readiness conditions during combat system operational sequences for ASW, AAW, SUW, and shore missions.

3.8.1.12 Condition III considerations. The last section of Chapter 4 shall provide an explanation of the effect of reduced combat system manning, as would be experienced in readiness condition III, on combat system operational sequences. This section shall provide combat system manning requirements for various readiness conditions during combat system operational sequences for ASW, AAW, SUW, and shore missions.

3.8.1.13 Bibliography. This section shall provide a list of documents used in preparing this chapter.

3.9 Volume 3 - Combat system readiness. Volume 3 shall provide guidance to the ship electronic readiness team (SERT) (see 6.3.13) for evaluating and improving combat system material and operational readiness. Volume 3 shall primarily address organizational level maintenance within the capability of ship senior maintenance personnel.

3.9.1 Chapter 5 - Readiness assessment. Chapter 5 shall describe the principles and objectives of combat system readiness assessment (see 6.3.12) using the SERT concept, and shall define the means for determining system readiness within ship organizational constraints. Details of the PMS, with reference to the PMS record, shall be discussed.

3.9.1.1 Introduction to readiness assessment. This section shall contain an overview of the combat system readiness assessment, fault detection, fault isolation, and impact evaluation tools that shall be provided in volume 3. A drawing similar to figure 3-14 shall be used to introduce the content of Chapters 5, 6, and 7, and to explain the relationship between the chapters.

3.9.1.2 Factors contributing to readiness assessment. The section shall define the principles and objectives of readiness assessment. The description shall cover the scope and organization of readiness assessment, and identify major factors and processes contributing to combat system readiness. A drawing similar to figure 3-15, shall illustrate the dependency of readiness assessment on fault detection, fault isolation, and impact evaluation.

3.9.1.3 SERT. This section shall explain SERT organization and responsibilities. Emphasis shall be given to SERT activities such as test, training, material, and personnel management; preventive and corrective maintenance management; and status reporting. Techniques to generate optimum test schedules based on personnel and material assets and the ship's operating schedule will be presented. Recommended forms, similar to figures 3-16 and 3-17, for preparing mission summary reports and combat system daily fault reports shall be provided and described.

3.9.1.4 PMS. This section shall describe the principles and elements of integrated testing, and explain the concepts and documentation available for testing. The major objectives of fault isolation shall be defined, and the various types of fault isolation tools that personnel may select for

fault isolation shall be described. Each type of fault isolation tool, that is, directories, computer programs, fault logic diagrams, and so forth, shall be sufficiently described to facilitate its understanding and use. A figure, similar to figure 3-18, shall depict the planned maintenance system. The integration of combat system, subsystem, and equipment documentation for establishing maintenance requirements, test scheduling, fault isolation, and corrective action verification shall be depicted by a drawing similar to figure 3-19.

3.9.1.5 Training and maintenance support elements. This section shall identify and describe the training and maintenance support elements available to, or resident in, the applicable ship class, and shall evaluate their functions as tools to increase combat system personnel and equipment readiness. Tables similar to figures 3-20 and 3-21 shall be developed to:

a. Identify the subsystems of the combat system challenged by each of the exercises in fleet exercise publications, FXP2 and FXP3.
b. Identify on a system or equipment level all exercises that challenge the subsystem and identify the major subsystem functions, such as detection, entry, identification and tracking, that are challenged by each exercise.
c. Identify the training operational programs and procedures resident on the ship; determine the subsystem challenged by each one, and provide a brief description.

3.9.1.5.1 Ship test equipment repair facility (STERF). When the ship configuration includes a STERF (phase A-1, A-2, and C-1, C-2), a list shall be provided of test equipment calibration requirements that show parameters to be calibrated, calibration periodicity, and references to calibration procedures. When the ship configuration does not include a STERF, documentation shall be specified that prescribes calibration requirements and outlines procedures for obtaining off-ship calibration services.

3.9.1.6 Readiness assessment diagrams (RAD) and synoptic test descriptions. This section shall identify the top level combat system, subsystem, and equipment level tests required to determine combat system readiness for AAW, ASW, SUW, and shore missions. A table of tests, with fault isolation pictorial and fault impact evaluation references, similar to figure 3-22, and a RAD, similar to figure 3-23, shall be provided for each combat mission (AAW, ASW, SUW, and shore bombardment). The table and its associated RAD shall be provided for each major combat system function, including detection and entry, tracking and identification, threat evaluation and threat-to-weapon pairing, and engagement and engagement assessment. The RAD shall identify required functional interfaces applicable to the specific mission and major combat system function, and shall provide a reference to the table that lists the highest level test (combat system level, subsystem level, or equipment level) that verifies each function identified. The table shall immediately precede the applicable RAD, so that the table can be referred to while reviewing the RAD. Detailed, comprehensive, user instructions that explain the use of the RAD and its associated table shall be provided. A synoptic description of each combat system, subsystem, and equipment test included on all the tables shall be provided. The test descriptions shall state test objectives, restrictions and specify significant parameters that evaluate readiness.

3.9.1.7 Bibliography This section shall provide a list of documents used in preparing this chapter.

3.9.2 Chapter 6 - Fault detection and impact evaluation. Chapter 6 shall describe methods of detecting material and personnel faults encountered during testing and operation and shall provide guidance to the SERT in evaluating the impact of detected faults on combat system readiness. The purpose of this chapter is to support the SERT in carrying out their corrective maintenance management responsibilities of coordinating fault isolation efforts and discerning impact evaluation.

3.9.2.1 Introduction to fault detection and impact evaluation. This section shall explain the use of impact evaluation tables and operational fault directories provided in Chapter 6. The relationship of fault detection to readiness assessment shall be stressed. Primary topics shall cover the fault detection role in readiness assessment.

3.9.2.2 Operational fault directories. This section shall include operational fault directories for faults observed during combat system operation. Operational fault directories shall identify hardware and software fault isolation tools employed with each subsystem to isolate operationally related fault symptoms. Operational fault directories for each mission and major combat system functions shall be provided. Faults occurring as a result of loss or degradation of inter-subsystem functions and parameters shall be provided. A narrative shall explain the role of operational fault directories in the combat system maintenance concept (see 6.3.6). See figure 3-24 for a typical presentation format.

3.9.2.3 Impact evaluation. This section shall provide SERT with the criteria required to determine the impact of specific faults on combat system capabilities. A table, similar to figure 3-25, shall list equipment functions and the impact the loss of these functions will have on specific combat system missions. Primary topics of combat system degradation, trade-off considerations, restoration time, fault isolation constraints, and alternative combat system configurations shall be related.

3.9.2.4 Bibliography This section shall provide a list of documents used in preparing this chapter.

3.9.3 Chapter 7 - Fault isolation. Chapter 7 shall identify and describe fault isolation tools and procedures, and their effective use. Interface data for subsystem-to-subsystem functions shall be provided.

3.9.3.1 Introduction to fault isolation. This section shall introduce and describe a typical fault isolation pictorial and its associated table of interface references. The table of interface references, similar to figure 3-26, shall be described. The use of a typical fault isolation pictorial, similar to figure 3-27, for diagnosing combat system faults shall be explained in detail. When assembled in CSTOM, the table of interface references shall immediately precede its associated test and fault isolation pictorial, so that the tabulation can be referred to while viewing the test and fault isolation pictorial, which will normally be a fold-out.

3.9.3.2 Search radar subsystem fault isolation. This section shall describe search radar subsystem fault isolation tools and their effective use. Descriptions shall encompass such factors as when and under what circumstances a particular fault isolation tool should be used, and the degree of reduced capabilities incurred as a result of using a particular fault isolation tool. More detailed aspects of search radar subsystem fault isolation shall be addressed by referencing existing fault logic diagrams contained in search radar subsystem technical manuals. A synoptic description of fault isolation techniques presented in the highest level subsystem technical manual shall be provided.

3.9.3.3 Additional sections. Additional sections shall be added to describe fault isolation to the same level in accordance with 3.9.3.2 for the following subsystems, as appropriate:

a. Tactical data subsystem.
b. Electronic warfare subsystem.
c. Gun weapon subsystem.
d. Underwater weapon subsystem.
e. Missile weapon subsystem.
f. Light-airborne multi-purpose (LAMPS) subsystem.
g. External communication subsystem.
h. External navigation subsystem.

3.9.3.4 Support subsystem fault isolation. This section shall address fault isolation techniques for the various systems that comprise the support subsystem. Descriptions shall be to level 2, and involve only basic methods of fault isolation. Fault isolation material to support this section shall include system schematics similar to figures 3-28 and 3-29; a figure index, similar to figure 3-30, showing the applicability of support systems to individual subsystems of the combat system; tables of fault symptoms and probable causes, similar to figure 3-31; and a table of audiovisual alarms similar to figure 3-32. The table of audiovisual alarms, in addition to specifying alarm and alarm sensor locations, shall prescribe action to be taken when the alarms are activated. The action, in most cases, will involve preliminary checks to verify and assess the abnormal condition, and a reference to a system publication for detailed fault isolation procedures. The primary topics of this section shall support, as applicable, fault isolation of the following support subsystem elements:

a. Central dry air.
b. High pressure air.
c. High pressure nitrogen.
d. Electronic salt water liquid coolant.
e. Chilled water liquid coolant.
f. Air conditioning.
g. Steam heating.
h. Salt water firemain.
i. Anti-icing.
j. Power distribution.

k. Ship parameters.

When detailed procedures are required, reference shall be made to appropriate documentation included in the bibliography.

3.9.3.5 Test fault directories. This section shall provide test fault directories similar to figure 3-33. The test fault directories shall list each interface function by equipment and shall identify the test that verifies the function. There shall be a test fault directory for each subsystem of the combat system except the support subsystem. The purpose and content of test fault directories, and the limitations of the test fault directories caused by lack of correlation between PMS tests and referenced subsystem and equipment documentation, shall be addressed.

3.9.3.6 Inter-subsystem interface data. This list shall include all analog and digital functions that interface between the combat system subsystems. A narrative description of each function shall be provided. The description shall specify the origin of the function, its flow path, and its termination. Each digital function shall be keyed by an interface reference number, to a digital inter-subsystem interface diagram. Each analog function shall be keyed by an interface reference number, to an analog inter-subsystem interface block diagram.

a. Inter-subsystem interface function list.- This list shall include all analog and digital functions that interface between the combat system subsystems. A narrative description of each function shall be provided. The description shall specify the origin of the function, its flow path, and its termination. Each digital function shall be keyed by an interface reference number, to a digital inter-subsystem interface diagram. Each analog function shall be keyed by an interface reference number, to an analog inter-subsystem interface block diagram.
b. Digital inter-subsystem interface diagram.- One or more digital inter-subsystem interface diagrams, and associated digital interface cable lists, shall be provided. A digital interface cable list, similar to figure 3-34, shall immediately precede a digital inter-subsystem interface diagram, similar to figure 3-35. Each interface on the digital inter-subsystem interface diagram shall refer to a digital interface cable list that identifies each interface cable, its associated connectors, the equipment it interconnects and a reference for defining the digital data.
c. Analog inter-subsystem interface diagram.- One or more analog inter-subsystem interface diagrams, and associated interconnection tabulation sheets shall be provided. The interconnection tabulation sheets, similar to figure 3-36, shall immediately precede an associated analog inter-subsystem interface diagram similar to figure 3-37.

3.9.3.7 Combat system alignment. This section shall provide methods, tools, and support information necessary to determine when alignment is required. Combat system alignment structure, the dependent nature of various alignments in the structure, and alignment verification shall be defined and discussed. Information shall comprehensively reference subsystem and equipment documentation, as required to identify all relative alignment tolerances and procedures.

3.9.3.8 Bibliography. This section shall provide a list of documents used in preparing this chapter.

3.10 Volume 4 - Capabilities and limitations. Volume 4 shall provide senior ship combat system personnel with a compact presentation of technical data that effectively describes the capabilities and limitations of the combat system to counter expected threats under various environmental conditions and states of readiness. Data shall encompass only technical aspects of the combat system and shall not imply or recommend deployment or specific utilization of the combat system in tactical situations except as may be required to demonstrate system capabilities and designed-in responses to specific threats or other tactical stimuli. Level 1 and 2 descriptions shall be used in volume 4. Chapter 8, a composite description of the overall combat system capabilities and limitations against air, surface, and subsurface threats, shall be covered at level 1. Chapters 9 through 13 shall consist of detailed descriptions of combat system capabilities and limitations and shall be presented at level 2. Volume 4 shall provide combat system personnel with information useful in development of ship doctrine, with emphasis on combat system capabilities and limitations; procedural considerations to assist combat decision makers; and documentation directly usable by school commands for combat system officer training. Maximum use shall be made of illustrations, charts, graphs, and matrices to improve understanding. Volume 4 text shall include detailed explanations of all charts, graphs and matrices used to illustrate combat system capabilities and limitations. Capabilities and limitations in the manual, semiautomatic or automatic operation mode shall be described for the principle ship missions: AAW, ASW, SUW, and shore bombardment. Reduced capabilities shall be defined for degraded readiness and environment, and multi-mission activities.

3.10.1 Chapter 8 - Ship mission capabilities and limitations. Chapter 8 shall provide information to assist supervisory personnel in developing ships doctrine and to aid combat system coordinators in performing evaluations before making operational decisions. Chapter 8 shall describe the capabilities and limitations of the combat system that result from integrating the independent capabilities and limitations of the systems and associated threat processes. The capabilities and limitations for each AAW, ASW, SUW, and shore engagement mission shall be included.

3.10.1.1 Introduction to the combat system capabilities and limitations. This section shall provide an overview to Chapter 8, describing the purpose, content, and method of presentation.

3.10.1.2 Threat categories. This section shall generically categorize air, surface, and subsurface threat profiles, using available threat data. Threat categories shall be further grouped according to threat-to-mission application. Threat-mission groups shall be the basis upon which combat system capabilities and limitations shall be described throughout this volume.

3.10.1.3 Operating environments. This section shall describe the environmental conditions in which the ship may be required to operate to execute the assigned missions. The conditions shall include weather, visibility, sea state, land background, and electromagnetic emissions. The specified conditions shall be used as bases for the combat system capabilities and limitations described throughout this volume.

3.10.1.4 Combat system operational modes. This section shall describe the tactical data

subsystem manual operational mode basic to most of the material to be presented in this volume. Alternate automatic and semiautomatic operational modes, when applicable, shall also be described. Changes in capabilities and limitations associated with the alternate modes shall be described in this volume.

3.10.1.5 Ship characteristics. This section shall describe the ship characteristics during adverse sea and wind conditions. The capability to maintain speed and course under the weather and sea-state conditions specified in this chapter shall be described. Ship maneuverability shall be described for specified speeds under the same environmental conditions.

3.10.1.6 AAW mission. This section shall describe the combat system capabilities and limitations to counter, in the primary operating mode, each AAW threat group, in clear and cluttered environments, from the functional aspects of detection and entry, tracking and identification, threat evaluation and weapon pairing, engagement and engagement assessment. The AAW capabilities and limitations in the automatic and semiautomatic modes shall also be described. The capabilities and limitations of intercept aircraft, when available, in supporting the AAW mission shall be addressed.

3.10.1.7 ASW mission. This section shall provide the same information as required by 3.10.1.6, but addressing the ASW mission. The capabilities and limitations during both own-ship and LAMPS engagements shall be addressed.

3.10.1.8 SUW mission. This section shall provide the same information as required by 3.10.1.6, but addressing the SUW mission.

3.10.1.9 Shore mission. This section shall describe the combat system capabilities and limitations to engage shore targets with all applicable fire control systems and ordnance. The range limitations, accuracy, modes of firing and navigational aids and off-ship support requirements shall be addressed.

3.10.1.10 Tactical data subsystem. This section shall describe the capabilities and limitations of the tactical data subsystem, in the principal operating modes, to support own-ship combatant missions, including simultaneous multi-mission engagements, and to support or coordinate task force and aircraft operations. This section shall also describe condition I constraints caused by personnel fatigue, equipment failure due to excessive operation, and access restriction imposed by setting condition Zebra. Reduced capability conditions caused by tactical data subsystem equipment failure shall be addressed.

3.10.1.11 Reduced capability configurations. This section shall describe specific combat system configurations that will reflect the inoperability of selected systems or equipment. Reduced capabilities of the combat system shall be described for each configuration in applicable portions of this volume.

3.10.1.12 Summary of combat system capabilities and limitations. This section shall present a

summary of AAW, ASW, SUW, and shore mission capabilities and limitations. The summary shall indicate the influence of all factors considered within this volume.

3.10.1.13 Bibliography. This section shall provide a list of documents used in preparing this chapter.

3.10.2 Chapter 9 - Detection capabilities and limitations. This section shall describe the merits of various identification sources. These sources shall include IFF and selective identification feature (SIF), intelligence reports, electronic surveillance monitoring (ESM) receivers, ordered maneuver responses, and operational orders. Typical time spans required for identification and classification using each of the identifying means shall be tabulated. Primary topics shall include automatic threat identification, manual threat identification, ESM threat identification (when not a part of manual or automatic threat identification), and sonar threat identification.

3.10.2.1 Introduction to combat system detection capabilities and limitations. This section shall describe the content, purpose, and method of presentation of the material in Chapter 9.

3.10.2.2 Search radar subsystem detection. This section shall describe search radar capabilities and limitations relative to threat detection in a clear, ECM, and non-ECM degraded environments. Illustrations and tables, similar to figures 3-38, 3-39 and 3-40 shall depict the detection volume and characteristics of search radars. Description and illustrations covering search radar capabilities relative to threat detection in an ECM environment shall include passive and active jamming. Description and illustrations shall also describe search radar detection capabilities in a non-ECM environment degraded by weather, sea clutter, and land mass background.

3.10.2.2.1 IFF detection. This section shall describe own-ship IFF detection capabilities. The description shall identify range, altitude, and bearing accuracy and limitations, and available modes of operations. The maximum number of friendly tracks the system may process shall be described. Primary topics of operational modes, detection sectors, and track overloads shall be discussed.

3.10.2.3 Electronic warfare subsystem support measures detection. This section shall describe overall detection capabilities of the electronic support measures suite and the individual equipment capabilities during normal operation. Primary topics shall include electronic support measures countermeasures receiving and direction finding set capabilities and limitations.

3.10.2.4 Gun weapon subsystem radar detection. This section shall provide a description of the capabilities and limitations of the gun weapon subsystem radars in performance of initial threat detection without designated target position quantities supplied. Coverage shall include detection of air and surface targets in clear, ECM, and non-ECM degraded environments. Coverage shall be similar to that in 3.10.2.2 and 3.10.2.2.1.

3.10.2.4.1 Optical detection. This section shall describe hardware and operator capabilities and limitations of optical devices, including the target designation transmitter and television cameras. The detection ranges, field of vision, and the accuracy of the transmitted data shall be included.

Primary topics of detection ranges, clear bearing sectors, accuracy (bearing and elevation), and operator proficiency shall be discussed.

3.10.2.5 Underwater weapon subsystem sonar detection. This section shall provide a description of the capabilities and limitations of the sonar relative to threat detection in active and passive modes. Drawings similar to figure 3-41 shall be supplied to indicate expected detection ranges in a variety of water conditions resulting from optimum and degraded environments.

3.10.2.6 Missile weapon subsystem radar detection. This section shall provide a description of the capabilities and limitations of the missile weapon subsystem radars in performance of initial threat detection without designated target position quantities supplied. Coverage shall include detection of air and surface targets in clear, ECM, and non-ECM degraded environments. Coverage shall be similar to that in 3.10.2.2 and 3.10.2.2.1.

3.10.2.7 LAMPS detection. This section shall describe the capabilities and limitations of the LAMPS for detecting air, surface and subsurface targets. The detection capabilities of LAMPS devices including LAMPS search radar, ESM, sonobuoy, and magnetic anomaly detector shall be described. The constraints on normal ASW operations while employing one or more LAMPS detection devices shall be described.

3.10.2.8 Tactical data subsystem remote detection. This section shall describe remote combat system detection capabilities for link 11, link 14, and link 4A. Limitations of the data links as a function of altitude, range, weather, ECM, and sea clutter shall be described. The accuracy of received data and the data update rate shall also be addressed.

3.10.2.9 Summary of combat system detection capabilities and limitations. This section shall provide, in a figure similar to figure 3-42, a summary of detection capabilities and limitations for supporting each of the AAW, ASW, SUW and shore missions. Primary topics shall describe the impact of detection on AAW, ASW, SUW, and shore mission success.

3.10.2.10 Bibliography. This section shall provide a list of documents used in preparing this chapter.

3.10.3 Chapter 10 - Threat processing capabilities and limitations. Chapter 10 shall discuss the capabilities and limitations of the combat system with regard to target entry, tracking, identification, and classification. Limitations on position accuracy due to source and induced errors in track bearing, range, and altitude shall be described. The capabilities and limitations of the combat system to accomplish threat identification and classification in relation to specific threat categories shall also be described.

3.10.3.1 Introduction to combat system threat processing capabilities and limitations. This section shall describe the purpose, content, and method of presentation of material in Chapter 10.

3.10.3.2 Accuracy of entry data. This section shall describe the data sources identified in

Chapter 9 according to the accuracy and the conditions under which entries from one source are more accurate than those from another. The limitations imposed on the subsystems when using incomplete or unreliable data shall be discussed. Threat entries shall be described in terms of software configuration when applicable; for example, automatic mode versus manual mode. The accuracies of radar data, optical data, sonar data, ESM data, IFF data and tactical data system data links shall be provided in a table similar to figure 3-43.

3.10.3.3 Tactical data subsystem tracking and correlation. This section shall address the maximum number of tracks capable of being simultaneously processed by the tactical data system. Operator problems shall be addressed relative to radar distribution failures and console failures which require one operator to search sectors normally searched by two or more operators. The maximum and minimum processing time needed to establish a firm track under the manual and automatic modes of operation shall be described. The comparative effect of tracking accuracies on engagements by the different weapon subsystems shall be addressed. The reduced tracking and correlation capabilities resulting from tactical data subsystem equipment malfunctions and software configurations shall be described. Primary topics shall include track capacity, manual and automatic tracking and correlation rates, tracking accuracy, reduction of hardware and software capabilities caused by equipment casualties, and effect of degraded environment on tracking accuracy. A table similar to figure 3-44 shall specify tactical data subsystem track capacities.

3.10.3.4 Weapon direction system entry and tracking. This section shall describe the same basic subject matter as that specified in 3.10.3.3. Additionally, the effect of weapon direction system casualties shall be discussed. Primary topics shall include maximum number of tracks, tracking accuracy in clear environment and degraded environment, and capability reductions resulting from equipment casualties.

3.10.3.5 Identification and classification. This section shall describe the merits of various identification sources. These sources shall include IFF and SIF, intelligence reports, ESM receivers, ordered maneuver responses, and operational orders. Typical time spans required for identification and classification using each of the identifying means shall be tabulated. Primary topics shall include automatic threat identification, manual threat identification, ESM threat identification (when not a part of manual or automatic threat identification), and sonar threat identification.

3.10.3.6 Summary of combat system threat processing capabilities and limitations.
This section shall summarize the combat system threat processing capabilities and limitations for supporting AAW, ASW, SUW and shore missions. Each primary topic shall describe the impact threat processing has on mission success.

3.10.3.7 Bibliography. This section shall provide a list of documents used in preparing this chapter.

3.10.4 Chapter 11 - Threat evaluation and threat-to-weapon pairing capabilities and limitations. Chapter 11 shall describe the combat system threat evaluation and threat-to-weapon pairing capabilities and limitations during normal and reduced capability operations. All factors involved in automatic and manual threat evaluation shall be described, including threat position relative to the defended zone; threat identification; and threat course, speed, and altitude.

3.10.4.1 Introduction to combat system threat evaluation and threat-to-weapon pairing capabilities and limitations. This section shall describe the purpose, content, and method of presentation of the material in Chapter 11.

3.10.4.2 Tactical data subsystem threat evaluation. This section shall describe the capabilities and limitations of the tactical data subsystem to perform both manual and automatic threat evaluation. The capabilities and limitations inherent in the methods and algorithms used for tactical data subsystem threat evaluation shall be described. The impact of a computer failure on tactical data subsystem threat evaluations shall be described. Primary topics shall include threat value and relative threat calculations, threat evaluation displays, and reduced capabilities.

3.10.4.3 Weapon direction system threat evaluation. This section shall describe the weapon direction subsystem capabilities and limitations for threat evaluation while operating under normal and reduced capabilities including evaluation of threats detected by the target designation transmitter. The display of threat parameters relative to the accuracy achieved and the proficiency of operators in evaluating these displays shall be described. Primary topics of display, operator judgment (experience and training), and reduced capability shall be addressed.

3.10.4.4 Electronic warfare threat evaluation. This section shall describe threat evaluation capabilities and limitations of the ESM suite. Threat evaluation performed by the electronic warfare supervisor shall be addressed with regard to available display parameters under normal and reduced capabilities. Primary topics shall include types of displays, determination of display parameters, and evaluation of display parameters.

3.10.4.5 Weapon subsystem threat evaluation. This section shall describe threat evaluation capabilities and limitations of the gun weapon subsystem, underwater weapon subsystem, and missile weapon subsystem. Display capabilities relative to threat parameters, the number of threats that can be processed, and the limitations imposed by operator decisions shall be described. Primary topics of display (normal and reduced capability), operator judgment, and effects of environmental considerations shall be addressed.

3.10.4.6 Threat-to-weapon pairing. This section shall address combat system facilities for threat-to-weapon pairing, which is the process by which a threat is assigned for engagement by a particular weapon subsystem. This section shall describe the combat system manual, semiautomatic, and automatic capabilities for threat-to-weapon pairing. These capabilities shall include subsystem reaction times, engagement envelopes, non-firing and unclear zones for applicable weapons subsystems. The combat system displays and computer recommendations available to operators, and the limitations associated with these facilities shall be addressed. Primary topics of manual threat-to-weapon pairing, semiautomatic threat-to-weapon pairing,

automatic threat-to-weapon pairing, and threat-to-weapon pairing under casualty conditions shall be addressed.

3.10.4.7 Summary of combat system threat evaluation and threat-to-weapon pairing capabilities and limitations. This section shall provide a summary of threat evaluation and threat-to-weapon pairing capabilities and limitations supporting the AAW, ASW, SUW and shore mission. Included under each primary topic shall be a description of the impact threat evaluation and threat-to-weapon pairing has on mission success.

3.10.4.8 Bibliography. This section shall provide a list of documents used in preparing this chapter.

3.10.5 Chapter 12 - Engagement and engagement assessment. This section shall address combat system facilities for threat-to-weapon pairing, which is the process by which a threat is assigned for engagement by a particular weapon subsystem. This section shall describe the combat system manual, semiautomatic, and automatic capabilities for threat-to-weapon pairing. These capabilities shall include subsystem reaction times, engagement envelopes, non-firing and unclear zones for applicable weapons subsystems. The combat system displays and computer recommendations available to operators, and the limitations associated with these facilities shall be addressed. Primary topics of manual threat-to-weapon pairing, semiautomatic threat-to-weapon pairing, automatic threat-to-weapon pairing, and threat-to-weapon pairing under casualty conditions shall be addressed.

3.10.5.1 Introduction to engagement and engagement assessment. This section shall describe the purpose, content, and method of presentation of material in Chapter 12.

3.10.5.2 Electronic Warfare ECM engagement and engagement assessment. This section shall describe the capabilities and limitations of the ECM subsystem in performing active and passive engagement and engagement assessment. The combat system capabilities for an ECM engagement and engagement assessment shall first be described for a typical, non-degraded condition (AAW mission, manual mode, non-ECM, clean environment, without emission control restrictions or multi-mission conflicts). The impact of modifying considerations on ECM engagement and engagement assessment shall then be described and include the following:

a. Alternate type of mission (ASW, SUW, or shore).
b. Automatic or semiautomatic mode.
c. Combat system casualties.
d. Alternate threat categories.
e. Multi-mission activity.
f. Degraded environment (weather and ECM).
g. EMCON requirements.
h. Reduced manning level.

3.10.5.3 Additional sections. Additional sections shall be used to describe engagement and engagement assessment capabilities and limitations for other applicable weapon subsystems or

subsystem controlled functions. Where applicable, the weapon subsystem engagement capabilities shall include a description of the available subsystem firepower. The additional sections shall describe engagement and engagement assessment as in 3.10.5.2 for the following:

a. Gun weapon subsystem engagement and engagement assessment.
b. Underwater weapon subsystem engagement and engagement assessment (includes tables and illustrations similar to figures 3-45 through 3-47).
c. Missile weapon subsystem engagement and engagement assessment (includes illustration similar to figure 3-48).
d. Controlled aircraft engagement and engagement assessment.
e. LAMPS ASW and ECM engagement and engagement assessment.
f. Search radar subsystem engagement assessment.
g. Link 11, 14, and 4A engagement assessment.
h. Optical sensors engagement assessment.
i. Tactical data subsystem engagement assessment.

3.10.5.4 Summary of combat system engagement and engagement assessment capabilities and limitations. This section shall provide a summary of engagement and engagement assessment capabilities and limitations that support the AAW, ASW, SUW, and shore missions. Included under each primary topic shall be a description of the impact of engagement and engagement assessment on mission success. This section shall include discussions and illustrations of target cross-range engageability envelope versus target altitude, weapon subsystem clear firing zone limits, target engageability versus target speed, and firepower against a radial air attack.

3.10.5.5 Bibliography. This section shall provide a list of documents used in preparing this chapter.

3.10.6 Chapter 13 - Emission control. Chapter 13 shall describe available ship features that minimize electronic detection by hostile forces, the relative effectiveness of these techniques, and methods for monitoring own-ship emissions. The EMCON plans on combat system readiness shall be described with regard to reduced capabilities for detection and engagement during an EMCON condition.

3.10.6.1 Introduction to EMCON. This section shall introduce the topic EMCON and shall describe the purpose, content, and method of presentation of material in Chapter 13.

3.10.6.2 Cover and deception. This section shall describe technical capabilities of ship systems and equipment to provide cover and deception. Topics shall include the means available for active and passive cover and deception.

3.10.6.3 EMCON plans. This section shall discuss the existing ship EMCON plans relative to the reduced combat system capabilities that are imposed. The primary topic shall be effects of EMCON plans on combat system readiness. This section shall include tabular presentation of radiating equipment and effects on combat system readiness.

3.10.6.4 Radiation characteristics. This section shall define radiation characteristics of own-ship equipment, such as frequency and power directly related to the risk of having emissions intercepted by the enemy. Emission characteristics of all significant electromagnetic sources as defined by the contracting activity, shall be included in a matrix similar to figure 3-49, listing the emission characteristics, radiation power levels, transmission frequency, beam pattern, and silence features.

3.10.6.5 EMCON monitoring. This section shall detail ship capabilities for monitoring emitter status (on, off, dummy load). The relative effectiveness of internal and external emission monitoring features as they affect detection avoidance shall be discussed.

3.10.6.6 Summary of combat system EMCON capabilities and limitations. This section shall provide a summary of EMCON capabilities and limitations that support AAW, ASW, SUW and shore missions. Included under each primary topic shall be a description of the impact of EMCON on mission effectiveness.

3.10.6.7 Bibliography. This section shall provide a list of documents used in preparing this chapter.

3.10.7 Chapter 14 - Communications capabilities and limitations. Chapter 14 shall describe capabilities and limitations of ship internal and external communication systems. Primary and alternate communication systems integral to conduct of ship combat missions shall be addressed.

3.10.7.1 Introduction to communications capabilities and limitations. This section shall introduce the topic of communications and shall describe the purpose, content, and method of presentation of material in Chapter 14.

3.10.7.2 Interior communications. This section shall describe the capabilities and limitations of all ship interior communication systems and related components. Coverage shall include tactical data subsystem intercommunications, sound powered telephone, announcing circuits, and dial telephone circuit.

3.10.7.3 External communications. This section shall describe the capabilities and limitations of all ship external communication systems and related components. Coverage shall include satellite communication, crypto devices, secure voice and non-secure voice link, teletype circuits, underwater radio (UHF and VHF), and tactical data subsystem links 11, 14, and 4A.

3.10.7.4 Bibliography. This section shall provide a list of documents used in preparing this chapter.

3.10.8 Chapter 15 - Navigation capabilities and limitations. Chapter 15 shall describe all ship navigation subsystem capabilities and limitations with respect to conduct of ship combat missions. Coverage shall include satellite navigation, OMEGA, direction finder sets, and TACAN.

3.10.8.1 Introduction to navigation capabilities and limitations. This section shall introduce the

topic of navigation and shall describe the purpose, content and method of presentation of material in Chapter 15.

3.10.8.2 Satellite navigation system. This section shall describe the capabilities and limitations of the satellite navigation system. Accuracy and reliability of the satellite navigation system in clear and degraded weather, and effects of temperature variations and sunspot activity shall be addressed. Reduced capabilities resulting from equipment casualties shall also be described.

3.10.8.3 OMEGA navigation system. This section shall describe the capabilities and limitations of the OMEGA navigation system. Accuracy and reliability of the OMEGA navigation system in clear and degraded weather, and effects of daily and seasonal ionospheric variations shall be addressed. Reduced capabilities resulting from equipment casualties shall also be described.

3.10.8.4 Radio direction finders (RDFs). This section shall describe the capabilities and limitations of shipboard RDFs. Accuracy and reliability of RDF readings in clear and degraded weather, and effects of daily and seasonal ionospheric variations and sunspot activity shall be addressed.

3.10.8.5 TACAN. This section shall describe the capabilities and limitations of the shipboard TACAN navigation system. Reduced capabilities for airborne navigation resulting from equipment casualties shall be addressed.

3.10.8.6 Bibliography. This section shall provide a list of documents used in preparing this chapter.

3.11 Appendix A - Supplementary data. An appendix shall provide test procedures, fault isolation tools, or other maintenance data either unavailable or inadequately covered in subsystem or equipment documentation. An engineering analysis of subsystem documentation shall determine the need for the appendix. The appendix shall be sectionalized by subsystem. Text shall be developed to the same style and format as that provided by the respective subsystem technical manual. Diagrams, schematics, tables and line art developed as part of the appendix shall be prepared to the same format, density and depth as equivalent material contained in the respective subsystem technical manual. The method of promulgating the appendix, whether as an addendum to volume 3 or a separately bound document, shall be specified by the Government.

4. VERIFICATION

4.1 Quality assurance provisions. 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. Technical manuals developed in accordance with this specification are intended for use by the Navy in operation and maintenance of ship combat system at organizational and management levels. The manuals are also intended for use in personnel 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. Type and quantity of the manual required (see 1.1).
c. Issue of DoDISS to be cited in the solicitation, and if required, the specific issue of individual documents referenced (see 2.2.1).
d. Type and quantity of deliverable end products (see 3.3).
e. Halftone artwork (see 3.3.1b) must be specified when it is suitable for illustration and economical.
f. Data research and analysis source data (see 3.3.2).
g. Arrangement other than as specified in MIL-DTL-24784 (see 3.4).
h. Indicate format and development instructions if other than specified (see 3.5).
i. Packaging requirements (see 5.1).

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

6.3.1 Bridge-the-gap data. Data that is identified by engineering analysis as being required to complete subsystem documentation. Bridge-the-gap data will be initially included in a CSTOM appendix until such time as the subsystem documentation is updated to eliminate the deficiency.

6.3.2 Combat subsystem. A combat subsystem is a grouping of equipment that comprises a selected portion of the combat system; it is a physically limited quantity of associated equipment whose combined functions result in achieving a predetermined objective. Combat subsystems may be functional, organizational, or mission-oriented and are identified as unique systems when not considered as part of a combat system. For example, a missile weapon subsystem may be comprised of a weapons direction system, a guided missile fire control system, and a guided

missile launching system. Each of these systems may be independently identified as systems when being discussed as functional or architectural entities.

6.3.3 Combat system. The composite of those elements of a platform whose functions include surveillance, detection, processing, and actively or passively engaging enemy forces. The functions performed by the combat system are accomplished by an integrated assemblage of systems, methods, trained personnel, and documentation having regular interaction and interdependence.

6.3.4 Combat system baseline. The level at which subsystems are interfaced to form the foundation of the combat system. It represents documentation necessary for integrated testing and fault isolation of combat subsystems.

6.3.5 Combat system functions. The combat system functions referred to herein are those major operational functions that include detection and entry, tracking and identification, threat evaluation and threat-to-weapon pairing, engagement and engagement assessment.

6.3.6 Combat system maintenance. Combat system maintenance, as provided in CSTOM, does not entail any peculiar scheduled or unscheduled maintenance procedures. However, combat system maintenance does identify PMS subsystem and equipment tests that verify combat system functions (detection and entry, tracking and identification, threat evaluation and threat-to-weapon pairing, and engagement assessment) associated with each of the combat system missions (AAW, ASW, SUW, and shore). The results of these tests are used to assess degraded readiness for specific combat system missions, and to aid in combat system intersubsystem fault isolation.

6.3.7 Watch condition I. Defines ship wartime cruising during periods when active combat is imminent, and the complete battle complement at stations is required.

6.3.8 Watch condition III. Defines ship normal wartime cruising during periods when active combat is not imminent, and about one-third of the battle complement at stations is required. This provides optimum balance between combat readiness and personnel efficiency for extended cruising periods.

6.3.9 Level of data coverage. A unit of data description that represents depth of content beginning with an overview and progressing to more detailed coverage. Levels of data description 1 through 3 are applicable to CSTOM as defined in 3.6.1.

6.3.10 OMN. A drawing that specifically defines combat system operating sequences and provides the link between subsystem functional descriptions and OSN drawings.

6.3.11 OSN. Narrative and graphic representations which specifically identify operations that are sequentially performed when operating the combat system in a tactical environment.

6.3.12 Readiness assessment. A method to assess a level of confidence in the combat system to

meet an assigned mission, and to evaluate the level of degradation of combat system effectiveness when a fault occurs.

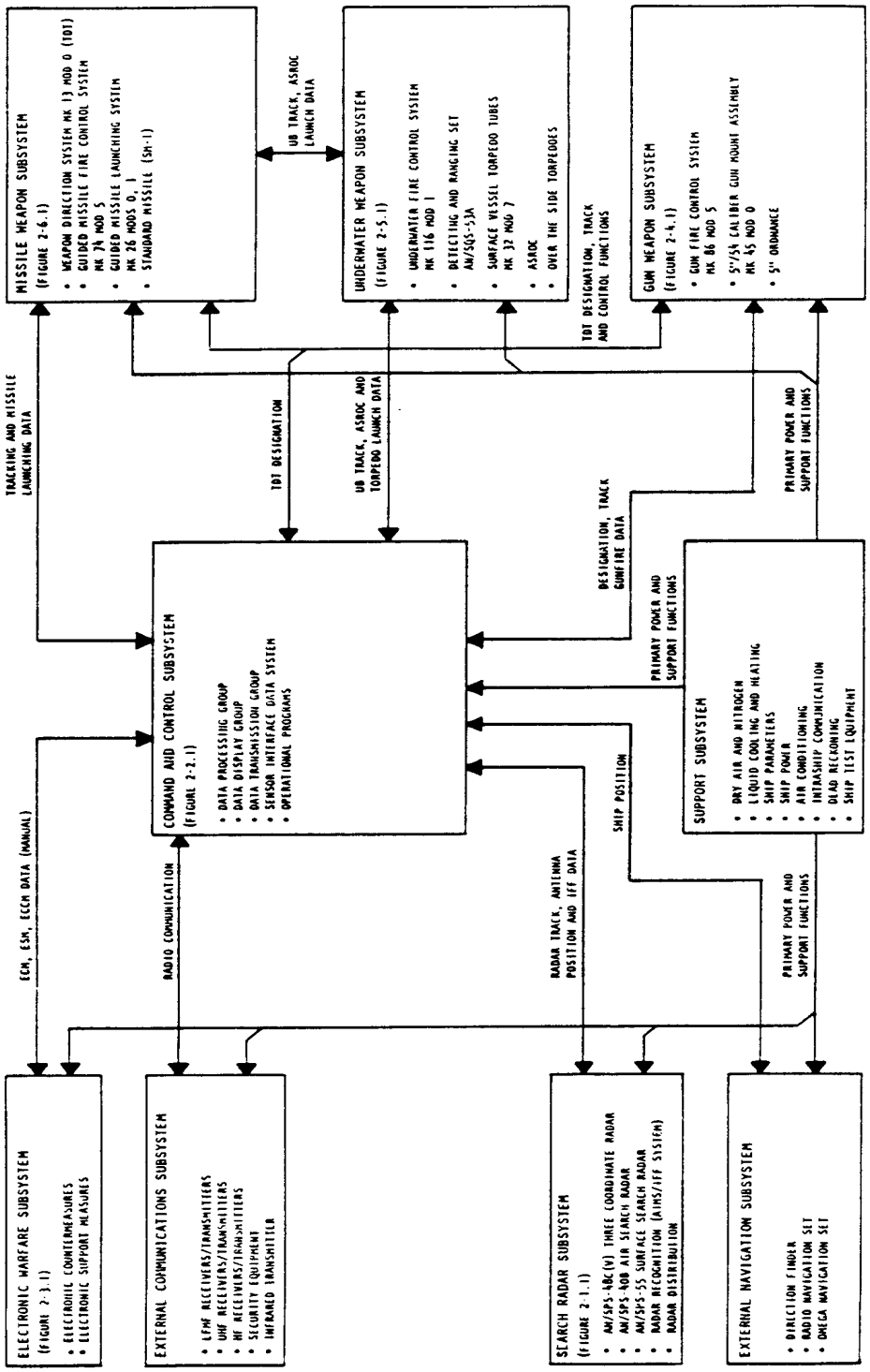
6.3.13 SERT. Senior maintenance personnel assigned within ship organization whose responsibilities encompass maintenance personnel training, combat system testing, and fault isolation. This includes systematic conduct of testing to reveal combat system degradation and fault isolation with the goal of maintaining maximum operational readiness.

6.3.14 Tactical data subsystem. As used in this specification, the tactical data subsystem refers to any or all elements of the most basic to the most sophisticated tactical data collecting, correlation, processing, and distribution systems installed in a modern Navy ship. As a part of the combat system, the tactical data subsystem may include the naval tactical data system, command and control system, sensor interface data system, command and decision system, remote data links, or any other similar system installed on particular ships.

6.4 Subject term (key word) listing.

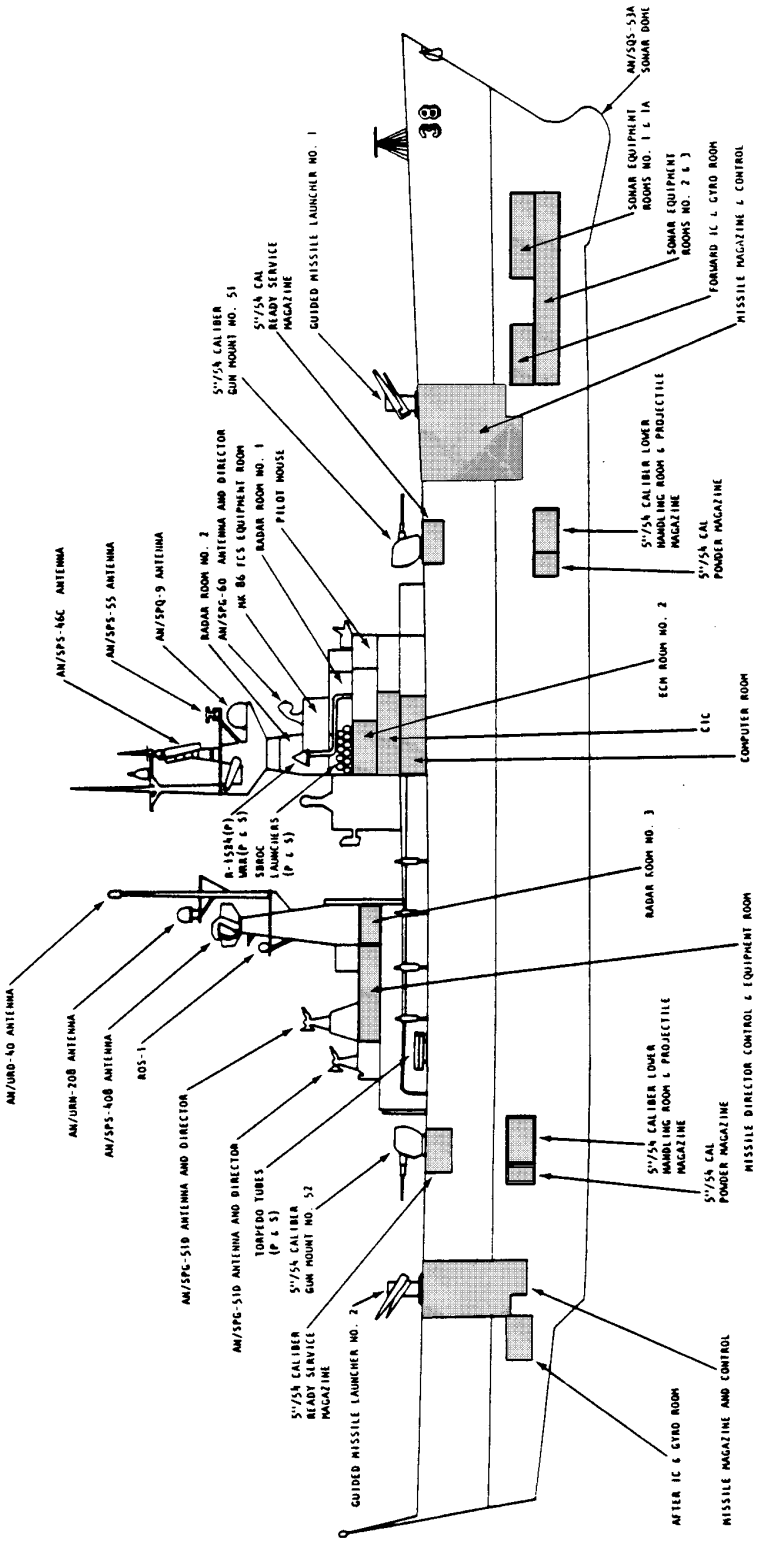
Design
Interface data
Maintenance
Threat evaluation
Tracking

6.5 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.



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

FIGURE 3-1. Combat system level 1 block diagram. (Sample)



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

FIGURE 3-2. Ship profile and external components pictorial. (Sample)

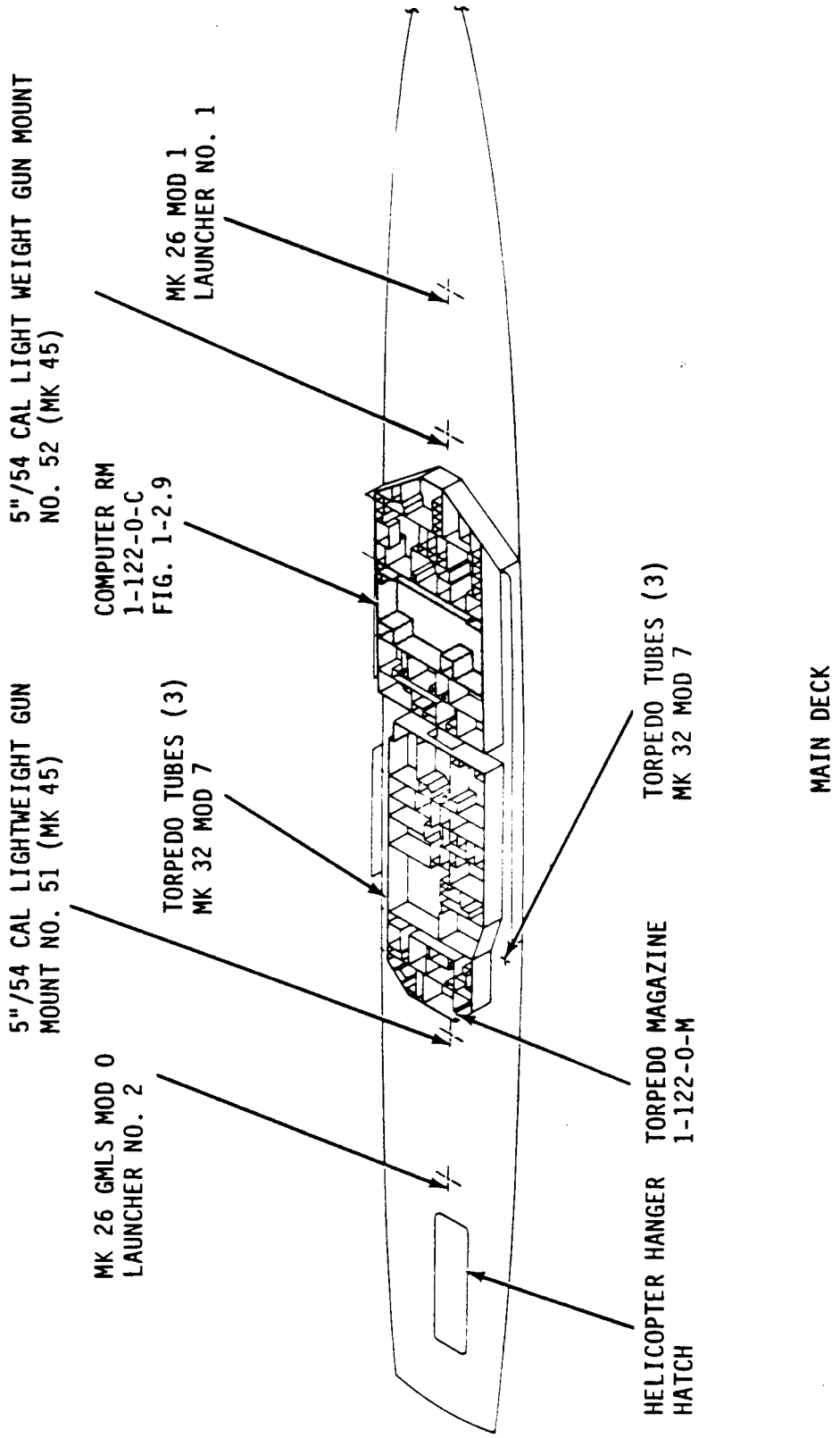


FIGURE 3-3. Three dimensional deck and compartments arrangement pictorial. (Sample)

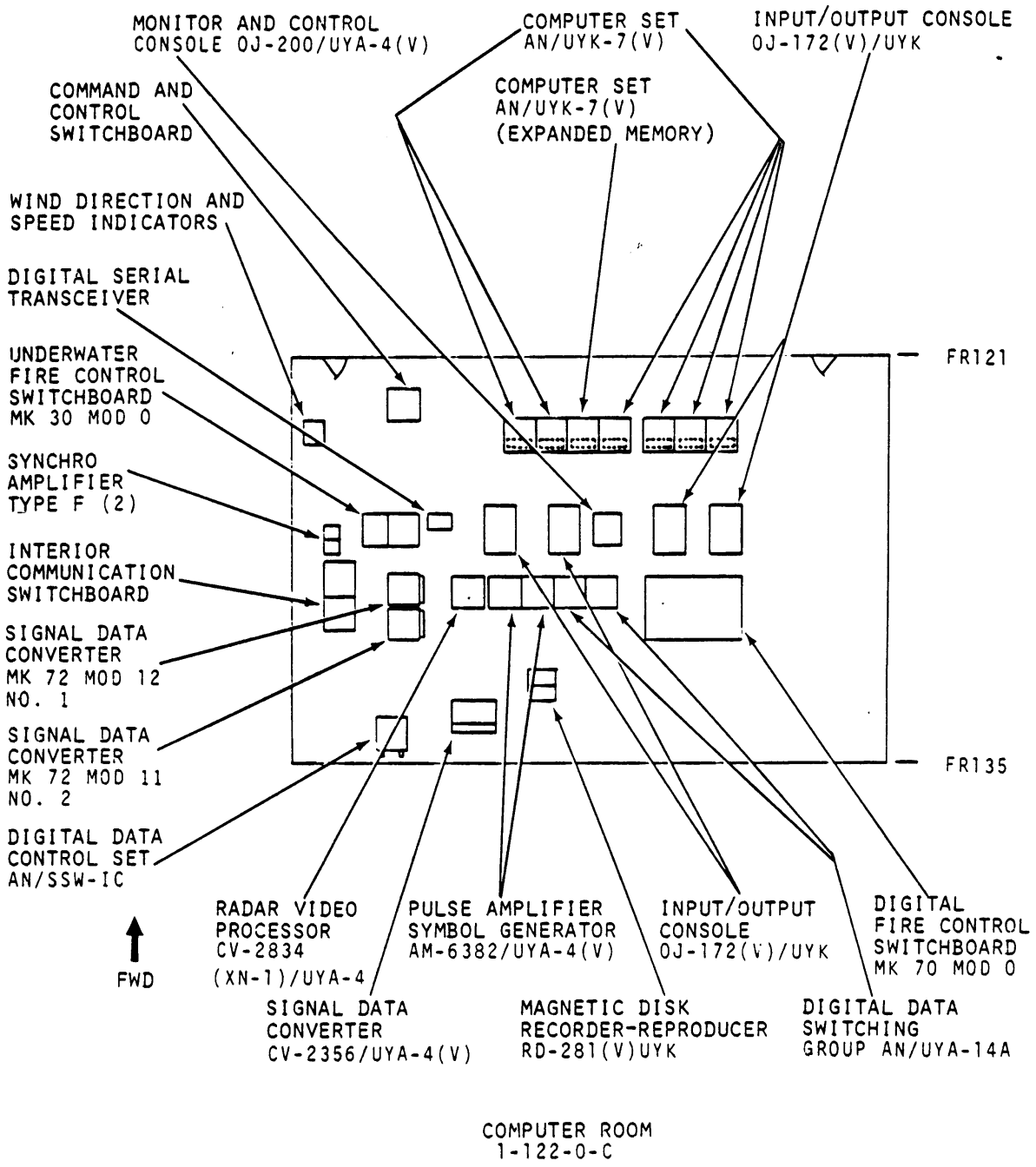
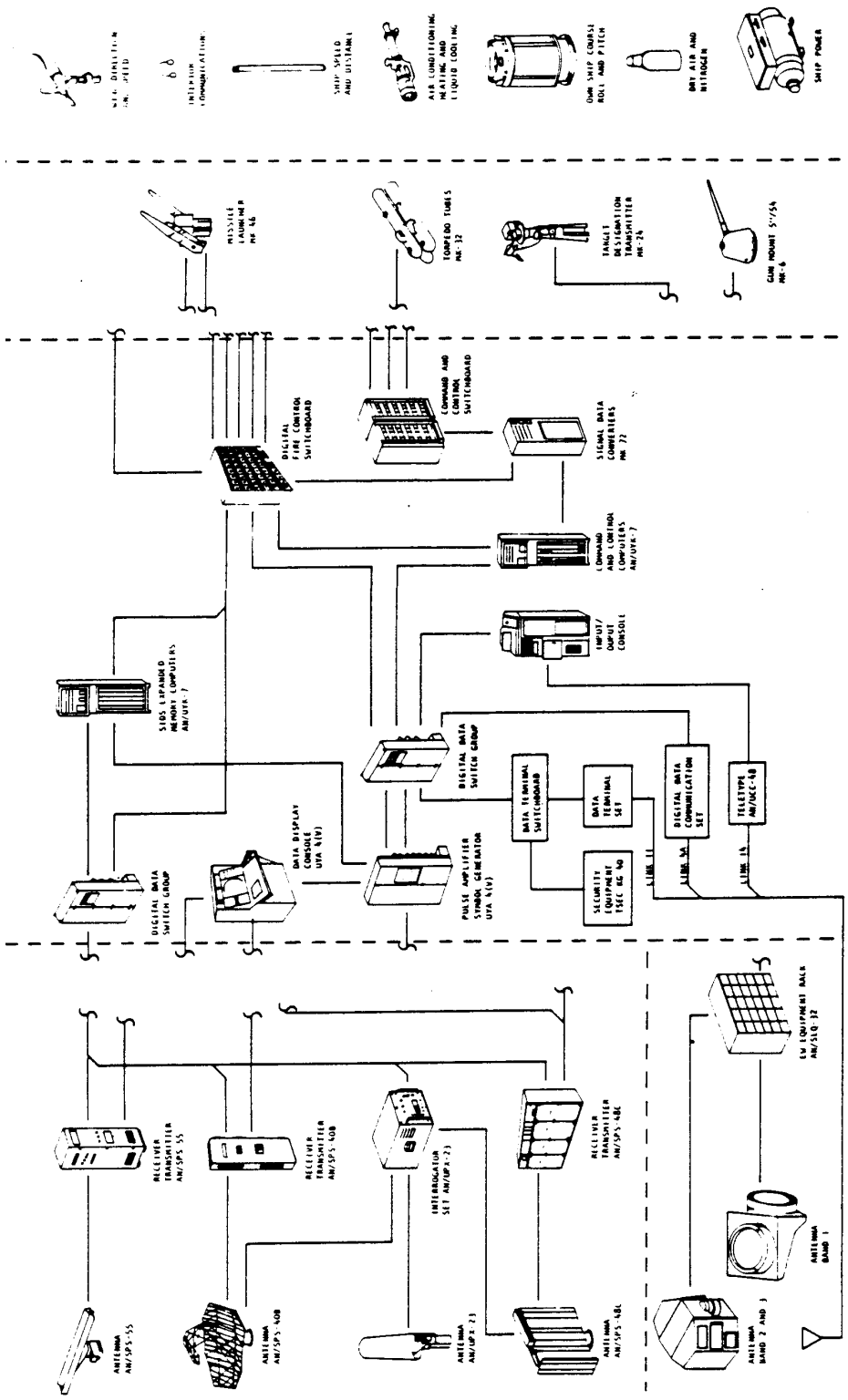
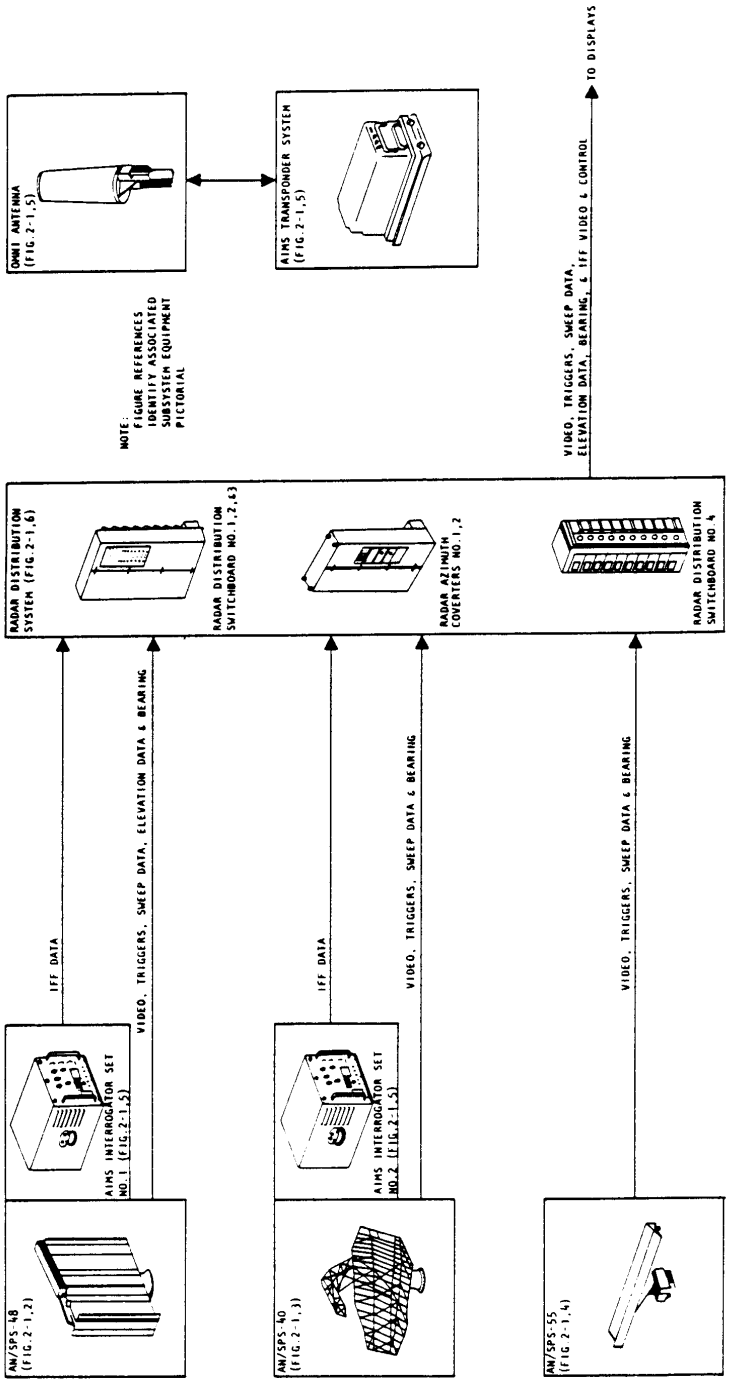


FIGURE 3-4. Room arrangement diagram. (Sample)



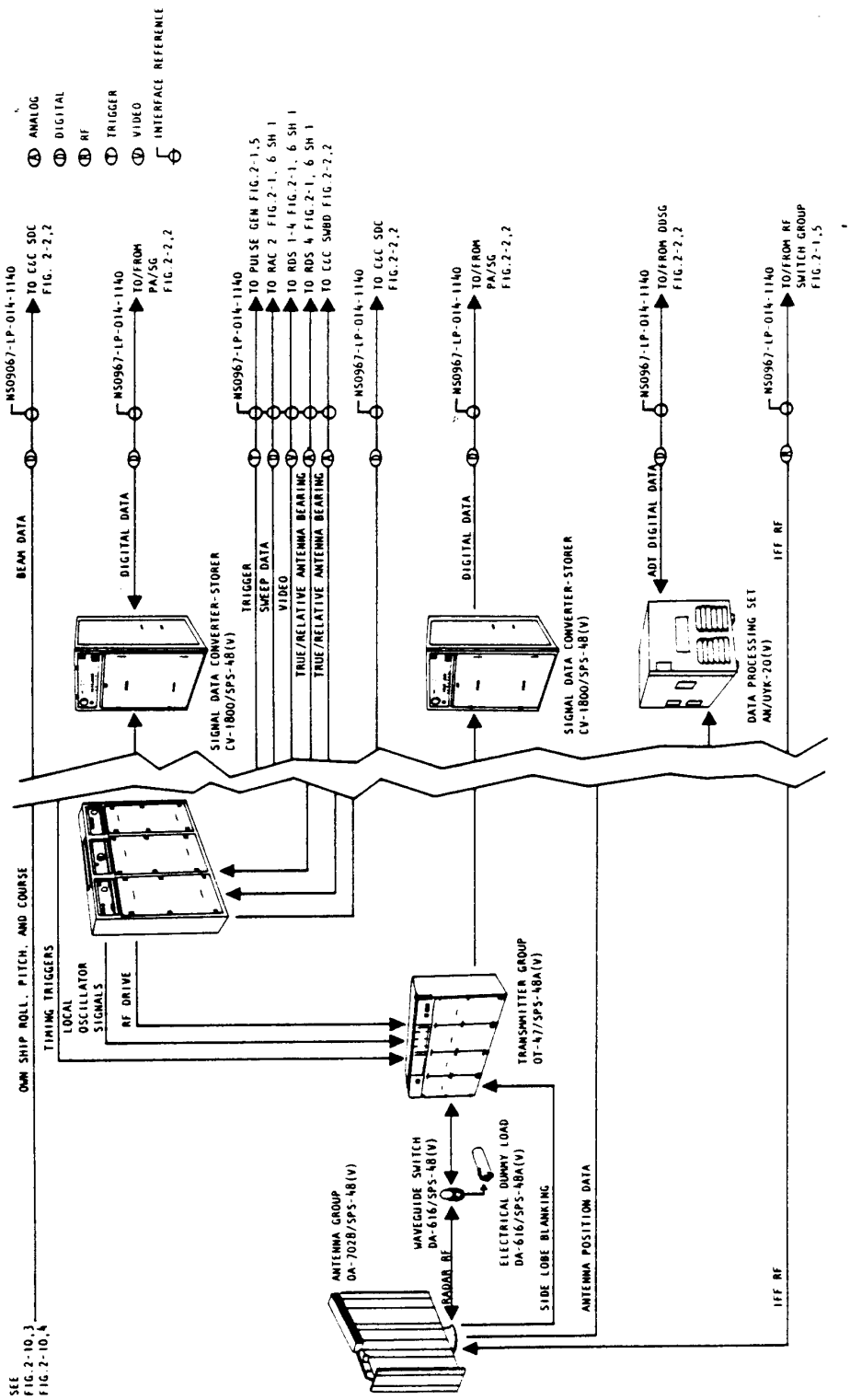
Note: Sample arrangement only. Size and legibility requirements do not necessarily conform to minimum specification requirements.

FIGURE 3-5. Combat system level 1 pictorial. (Sample)



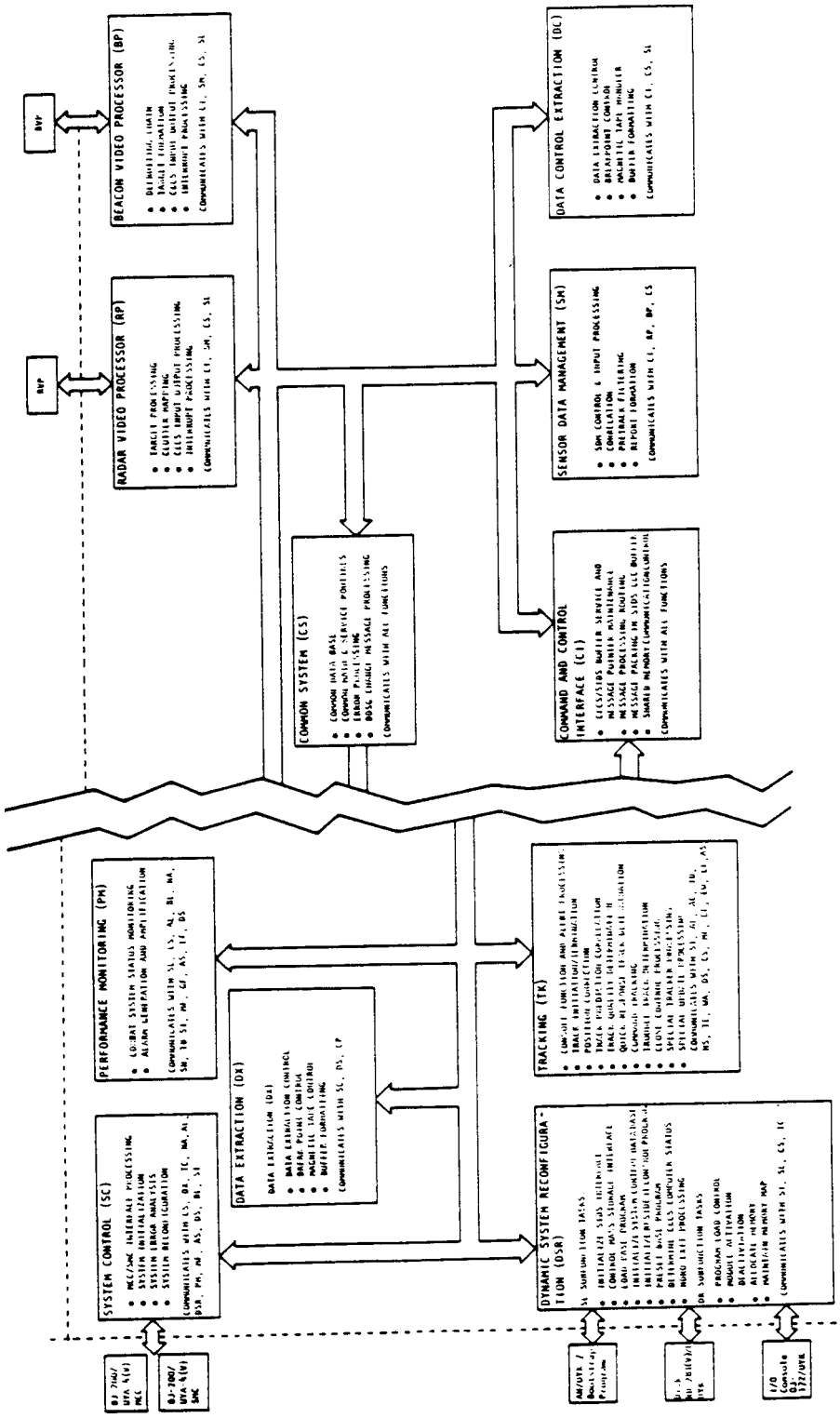
Note: Sample arrangement only. Size and legibility requirements do not necessarily conform to minimum specification requirements.

FIGURE 3-6. Subsystem level 2 pictorial. (Sample)



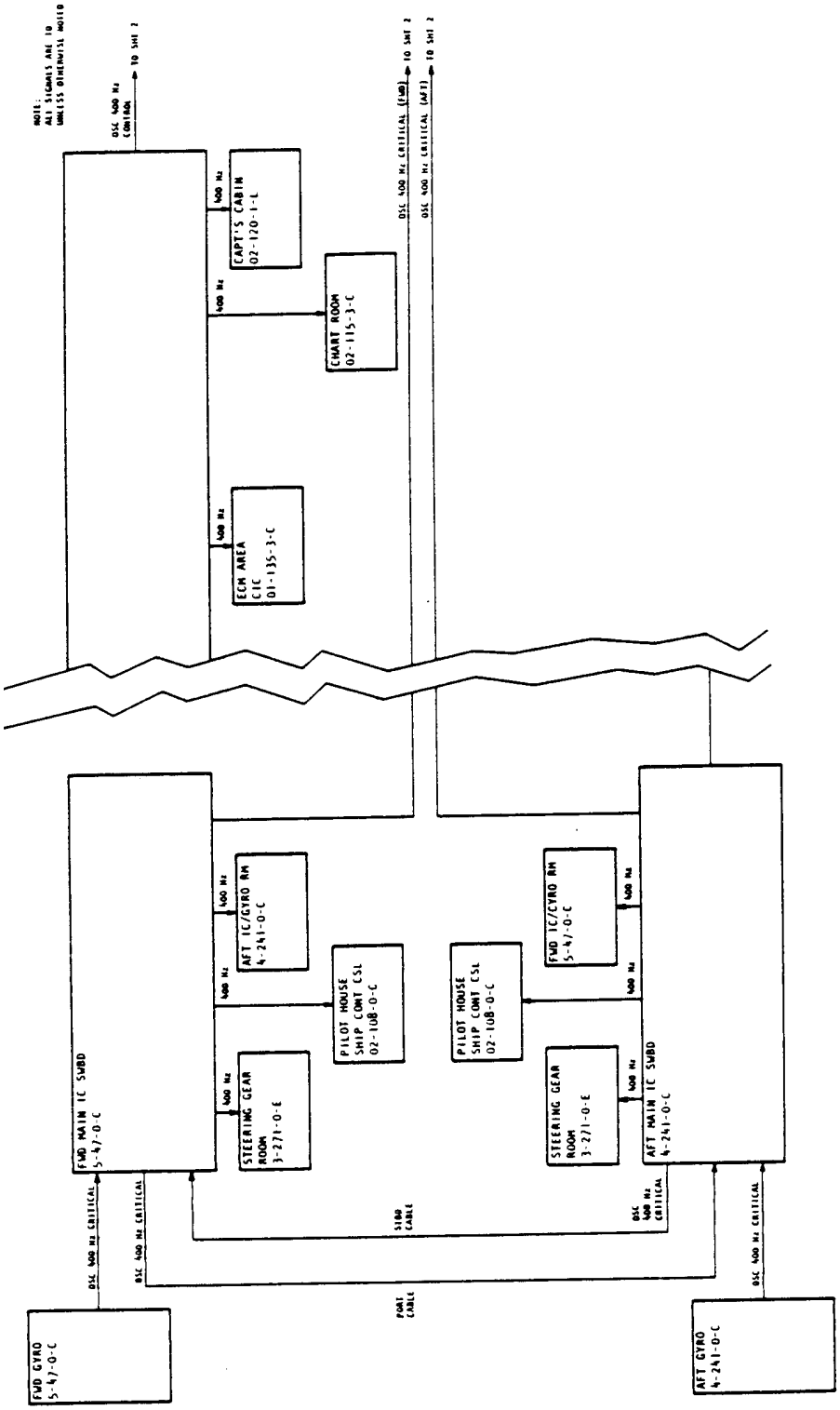
Note: Sample arrangement only. Size and legibility requirements do not necessarily conform to minimum specification requirements.

FIGURE 3-7. Equipment level 2 pictorial. (Sample)



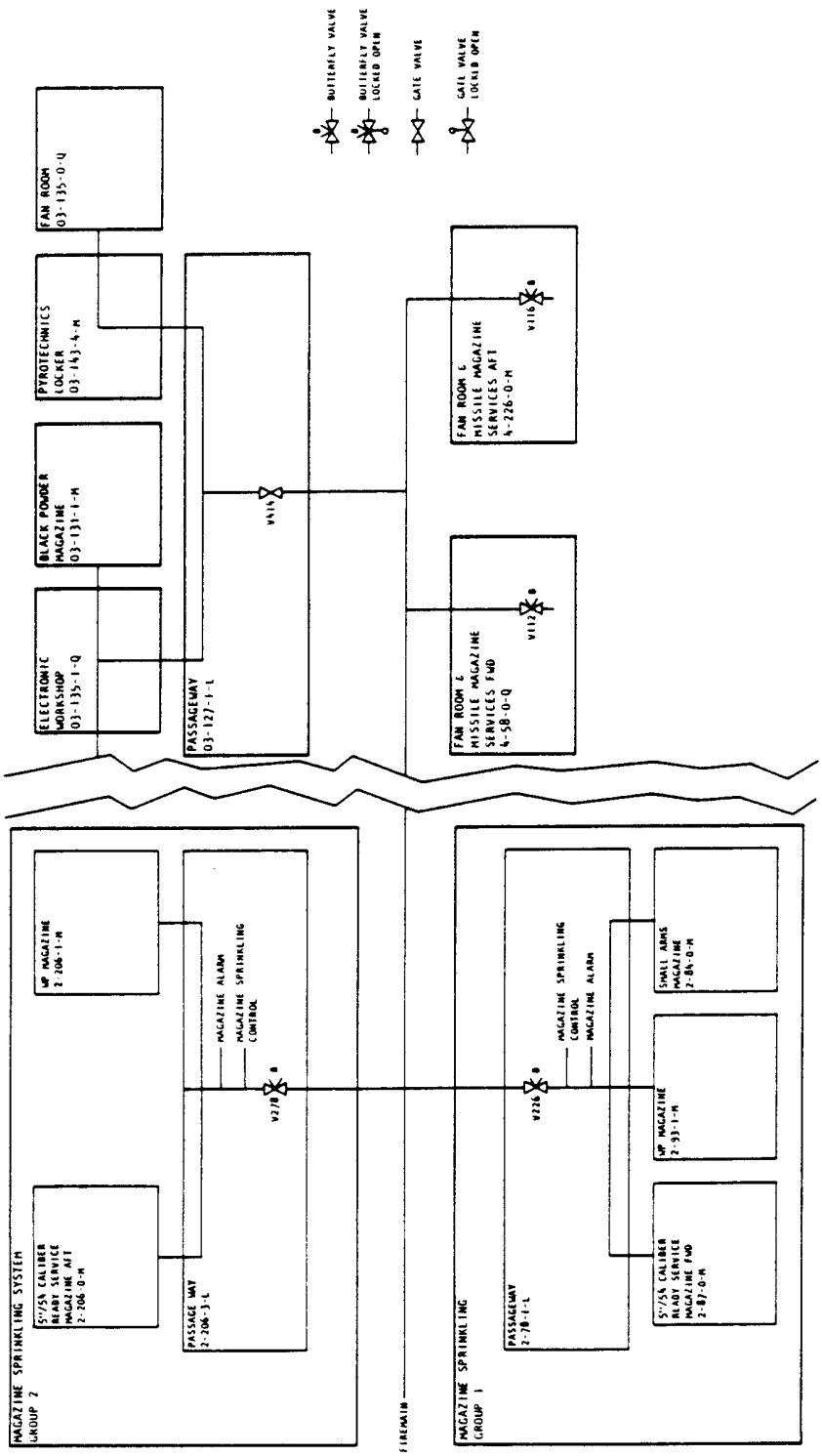
Note: Sample arrangement only. Size and legibility requirements do not necessarily conform to minimum specification requirements.

FIGURE 3-8. Subsystem operational program block diagram. (Sample)



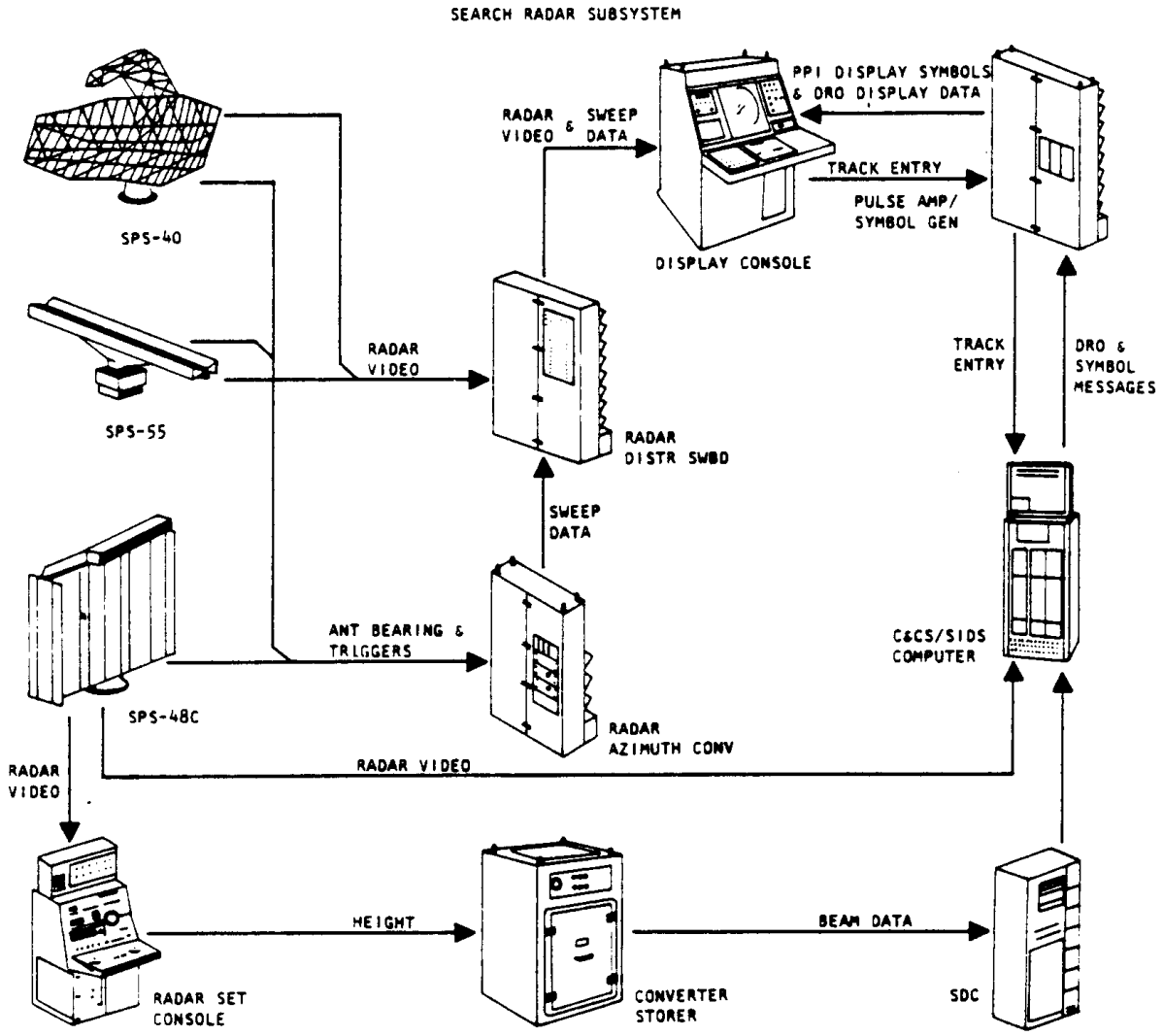
Note: Sample arrangement only. Size and legibility requirements do not necessarily conform to minimum specification requirements.

FIGURE 3-9. Support subsystem (own ship heading distribution) block diagram. (Sample)



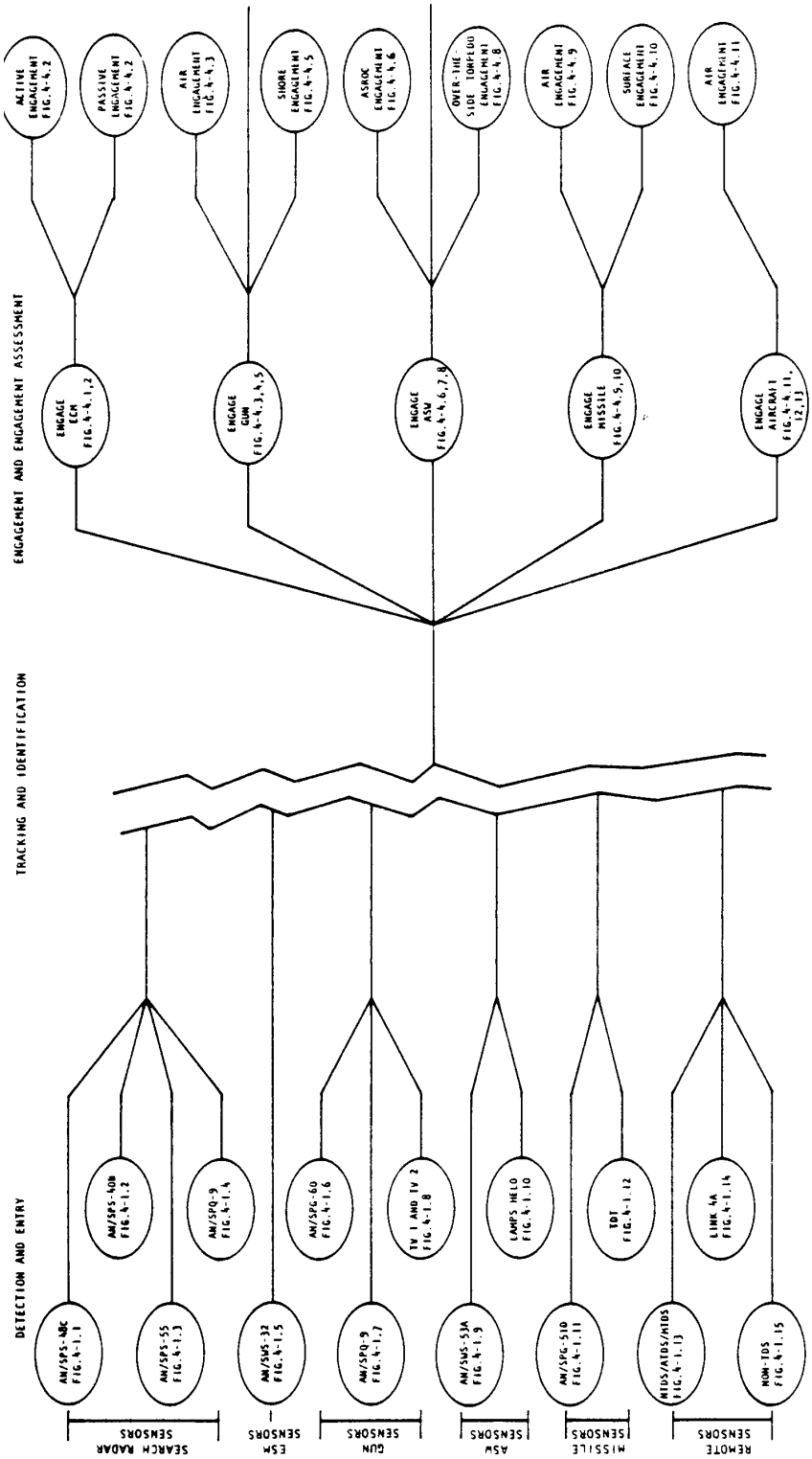
Note: Sample arrangement only. Size and legibility requirements do not necessarily conform to minimum specification requirements.

FIGURE 3-10. Support subsystem (coolant, steam and fire main) block diagram. (Sample)



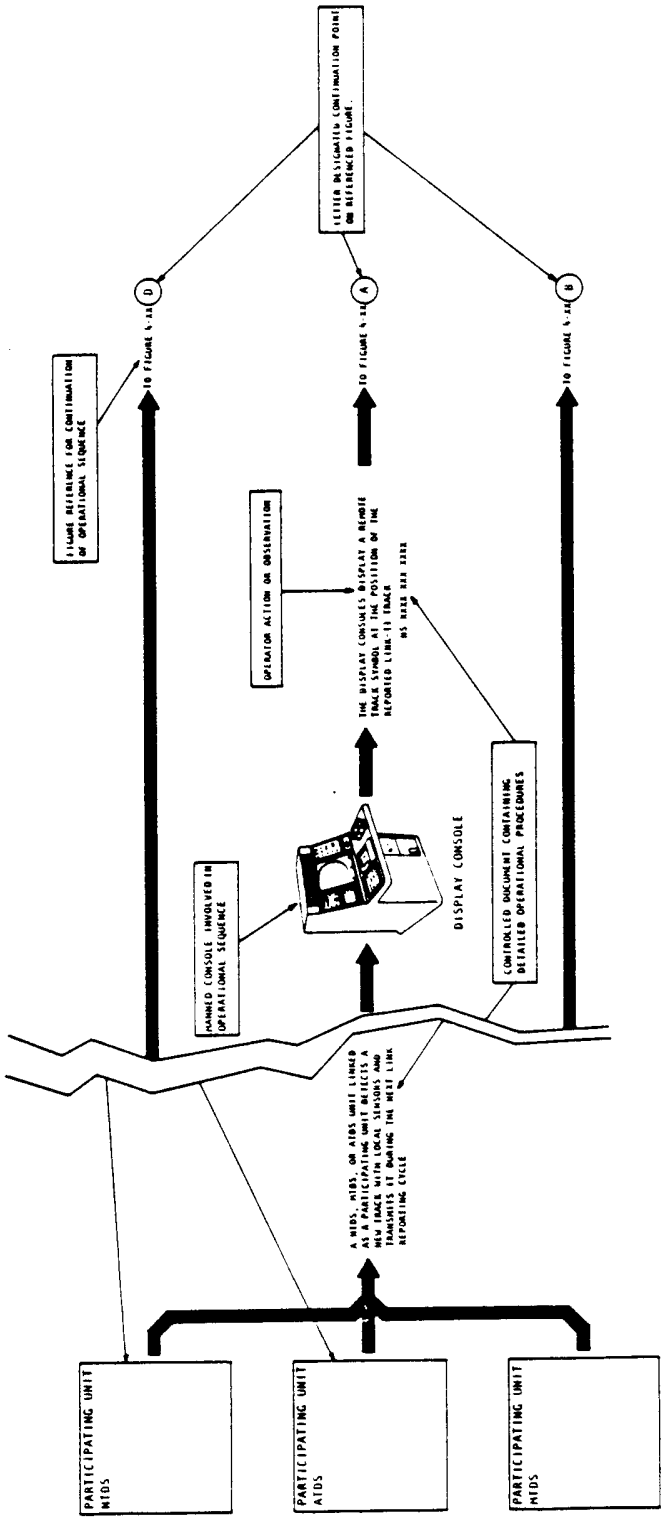
Note: Sample arrangement only. Size and legibility requirements do not necessarily conform to minimum specification requirements.

FIGURE 3-11. Functional flow pictorial, level 2. (Sample)



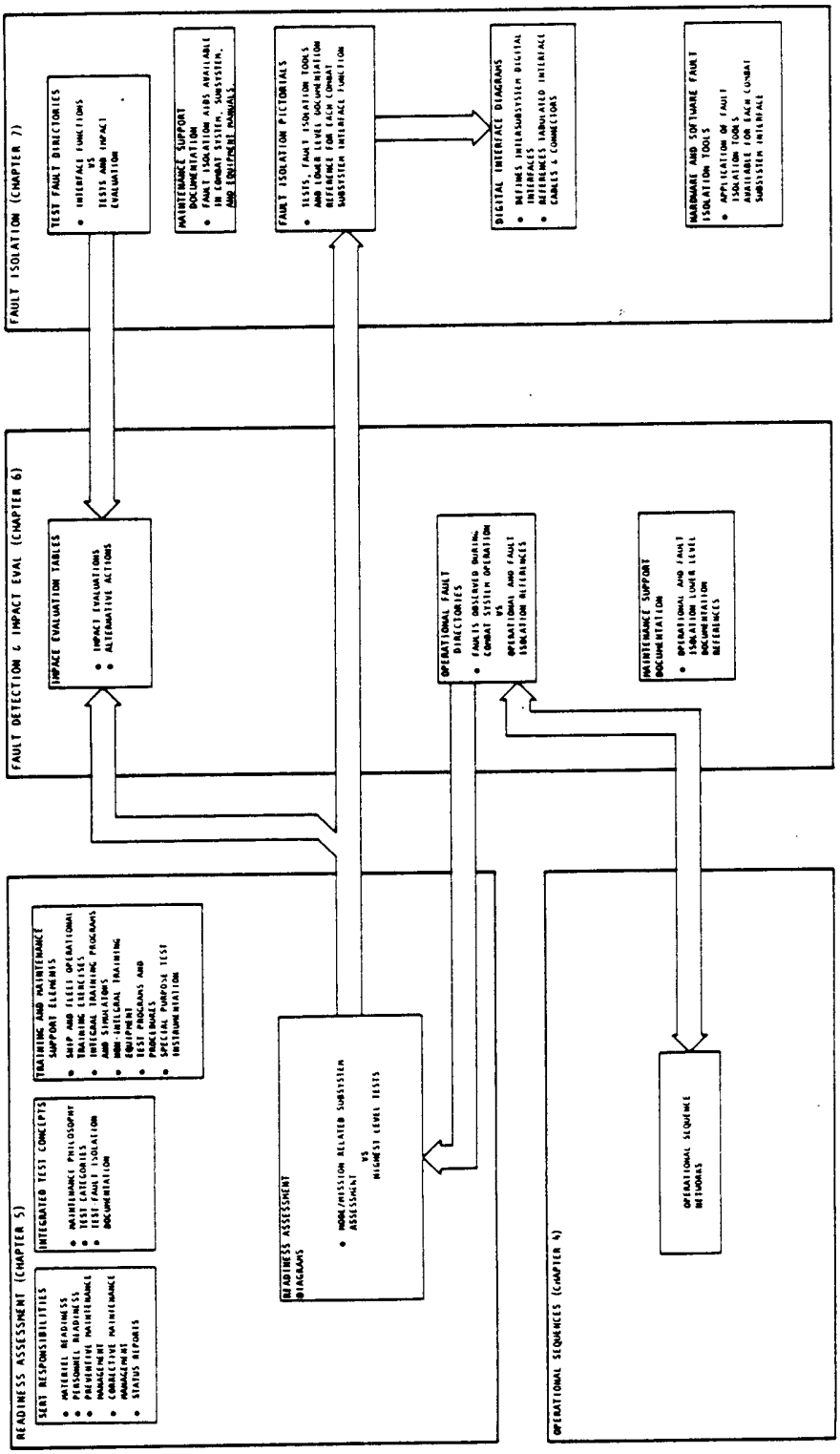
Note: Sample arrangement only. Size and legibility requirements do not necessarily conform to minimum specification requirements.

FIGURE 3-12. Operational mode network (OMN). (Sample)



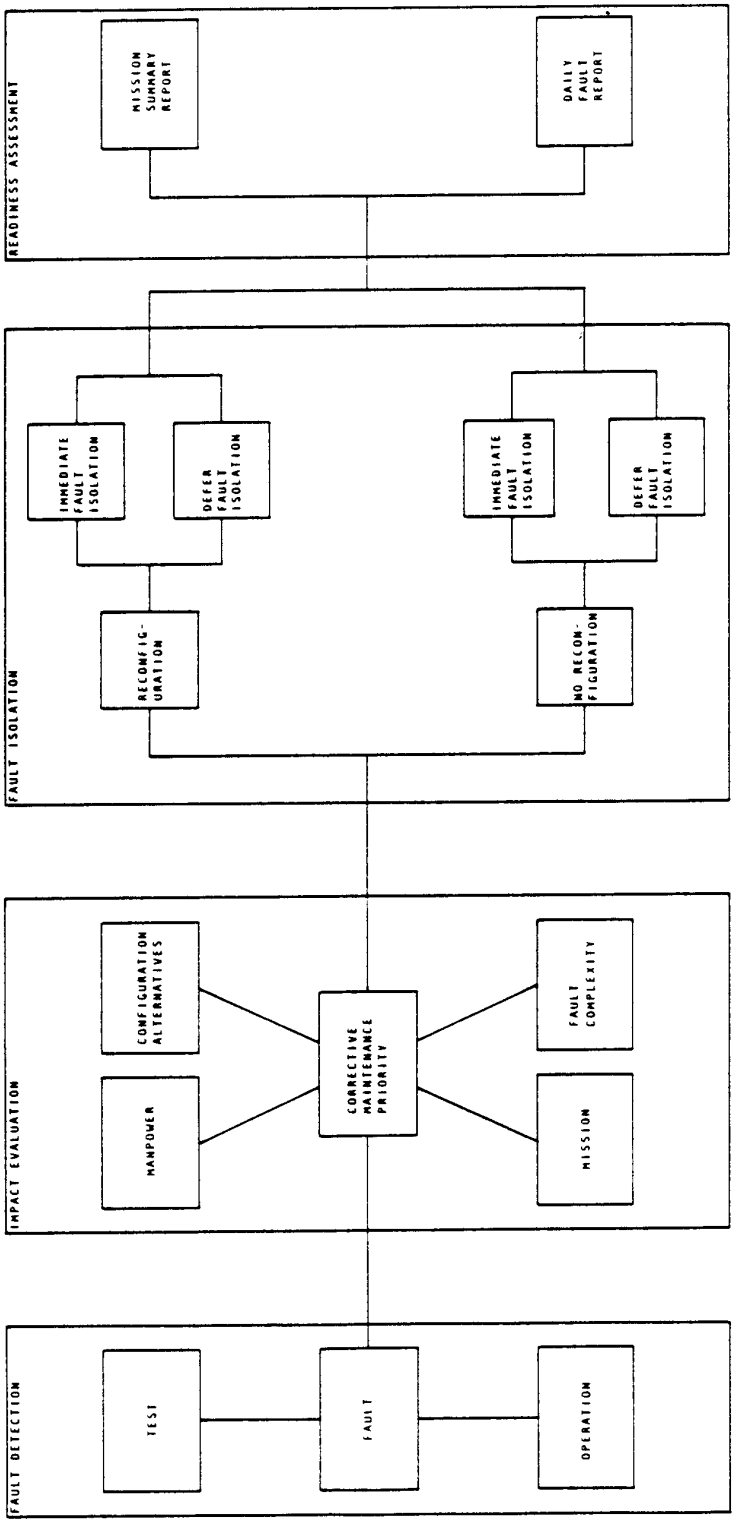
Note: Sample arrangement only. Size and legibility requirements do not necessarily conform to minimum specification requirements.

FIGURE 3-13. Operational sequence network (OSN). (Sample)



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

FIGURE 3-14. Readiness assessment and fault isolation tools overview. (Sample)



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

FIGURE 3-15. Readiness assessment process diagram. (Sample)

FUNCTION	DETECTION	PROCESSING EVALUATION	COMMAND DECISION	WEAPONS ASSIGNMENT	FIRE ENGAGEMENT	MISSILE ENGAGEMENT	GUN ENGAGEMENT	UNDER ROAD ENGAGEMENT
STATUS	SCR	CR	CR	MCR	CR	MCR	MCR	NA
REMARKS	REDUCED DETECTION RANGE			MARGINAL DESIGNATION TO GFCS		SPG-49 NO. 2 TRANSMITTER DOWN	MARGINAL DESIGNATION ACCURACY	

SAMPLE

LEGEND: SCR SUBSTANTIALLY COMBAT READY
CR COMBAT READY
MCR MARGINALLY COMBAT READY
NCR NOT COMBAT READY

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

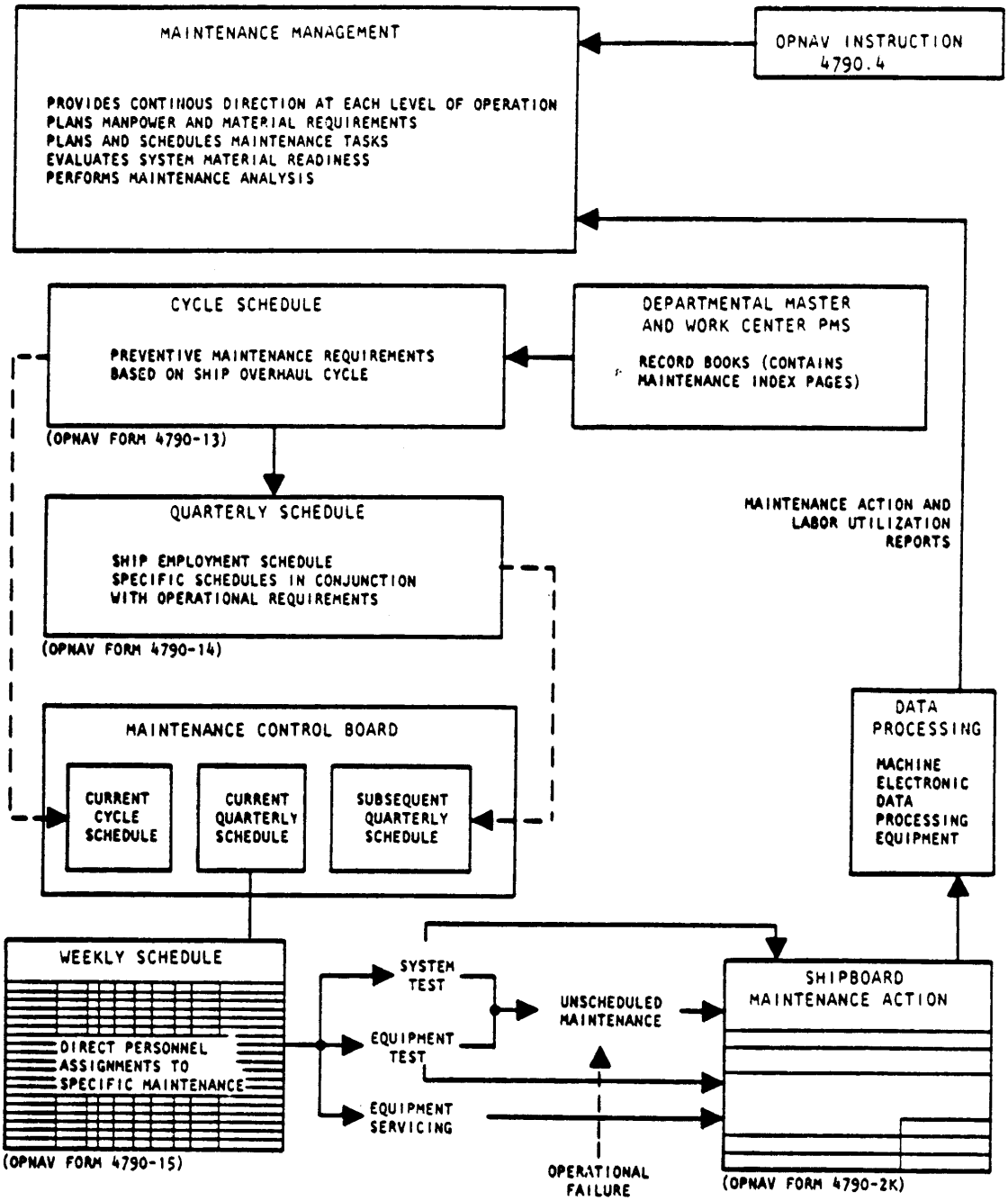
FIGURE 3-16. Mission summary report. (Sample)

MAINTENANCE STATUS	FAULT	IMPACT					ALTERNATIVE	CIR	NOTE
		AAW	ASW	SURFACE	SUBSURF				
D	SPS-48 Low Power Output	Reduced range	NA	NA	NA		3D SPS-30 2D SPS-43	16.00	-
D	Marginal designation to GFCS	Increased acquisition time	ASROC Tracking questionable	Increased acquisition time	NA		IBN or SPA-4	Sunday	Alignment
M	SPS-49 No. 2 pulse transformer	Reduced forward fire power	NA	NA	NA		None		No part CASREPT

LEGEND: D - DEFERRED
M - MANDATORY

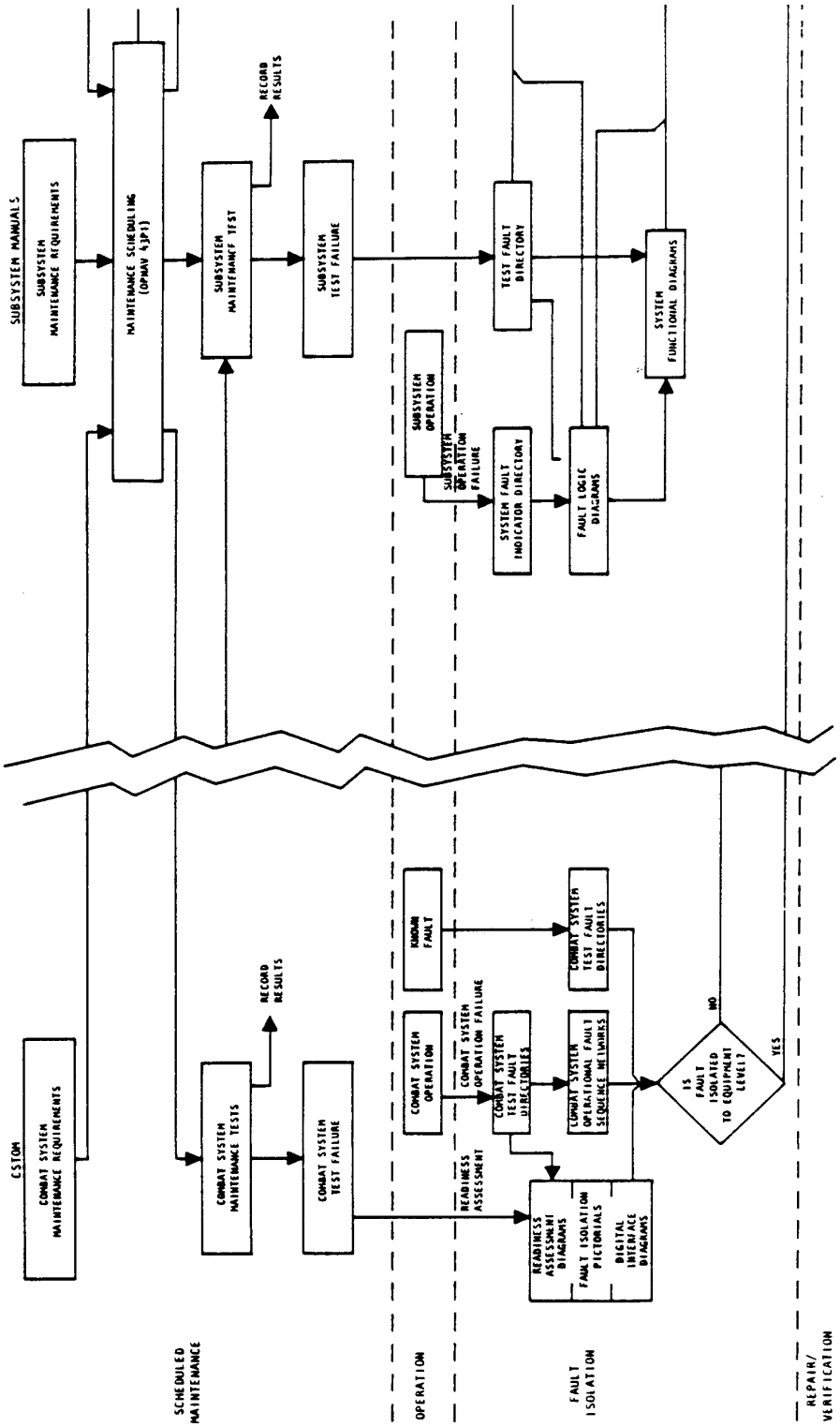
Note: Sample arrangement only. Size and legibility requirements do not necessarily conform to minimum specification requirements.

FIGURE 3-17. Combat system daily faults report. (Sample)



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

FIGURE 3-18. Planned maintenance system block diagram. (Sample)



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

FIGURE 3-19. Integrated maintenance concept block diagram. (Sample)

FXP Series Exercise	Title	Subsystem					Operational Phase			
		Search Radar	C&CS	Missile Weapon	Gun Weapon	EW	Detection, Evaluation, FCS Assign, and Track	Engageability Evaluation	Launcher Assign and Missile Firing	Engagement Assessment
Z-1-GM	Single Target Processing	X	X	X			X	X	X	
Z-2-GM	Multiple Target Processing	X	X	X			X			
Z-3-GM	Multiple Target Processing	X	X	X			X	X		
Z-4-GM	ECCM - Mechanical Jamming	X	X	X			X			
Z-5-GM	ECCM - Cap Coordination Mechanical Jamming	X	X	X			X	X	X	
Z-6-GM	ECCM - Electromagnetic Jamming	X	X	X			X			
Z-7-GM	ECCM - Mechanical and Electro-magnetic Jamming	X	X	X			X			
Z-10-GM	Tactical AAW	X	X	X			X	X	X	
Z-11-GM	Tactical AAW - Simulated Countermeasures	X	X	X			X	X	X	
Z-12-GM	Tactical AAW - Live Countermeasures	X	X	X		X	X	X	X	
Z-13-GM	Tactical AAW - CAP and Missile Coordination	X	X	X			X	X	X	
Z-14-GM	Tactical AAW - CAP and Missile Coordination with Simulated Countermeasures	X	X	X			X	X	X	
Z-15-GM	Comprehensive Non-Firing SAM in AAW	X	X	X	X	X	X	X	X	
Z-20-GM	Coordinated Missile Employment in Fleet AAW	X	X	X			X	X	X	
Z-21-GM	Coordinated Missile Employment in Fleet AAW - Countermeasures Envir.	X	X	X			X	X	X	

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

FIGURE 3-20. Table of fleet training exercises subsystem applicability. (Sample)

Test	Subsystem							Purpose and description	Reference document	Time reqd	Period-icity	Scheduling responsibility
	Search radar	TDS	Missile weapon	Gun weapon	EW	Underwater weapon						
ASW CSOT (Live)	X	X		X		X		Verifies combat system ASW operability between surface-search radar, C&CS, UFCS and SONAR, and GFCS.	OD 44859 CSOT	1 hr	M	CGN-38
ASW CSOT (Simulated)		X		X		X		Verifies combat system ASW operability between C&CS, UFCS and SONAR, and GFCS. This test is similar to the live ASW CSOT, except a simulated target is entered by C&CS and sonar target acquisition is simulated	OD 44859 CSOT	1 hr	M	CGN-38

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

FIGURE 3-21. Table of operational test program. (Sample)

Ref	Test	Test brief	Fault isolation pictorial*	Impact evaluation reference **
1		CSAT	Fig. 7-X.X	Table 6-X.X
2	R-81/R-2D	AN/SPS-48 Radar		
3	R-81/R-3D	AN/SPS-48 Radar		
4	R-81/R-6D	AN/SPS-48 Radar		
5		OCSOT		
6	TD-68/Q-1	AN/UYA-4 Data Display Group		
7	TD-141/R-1Q	Display Pofa		
8	R-13/R-2D	AN/SPS-40 Radar		
9		OCSOT		

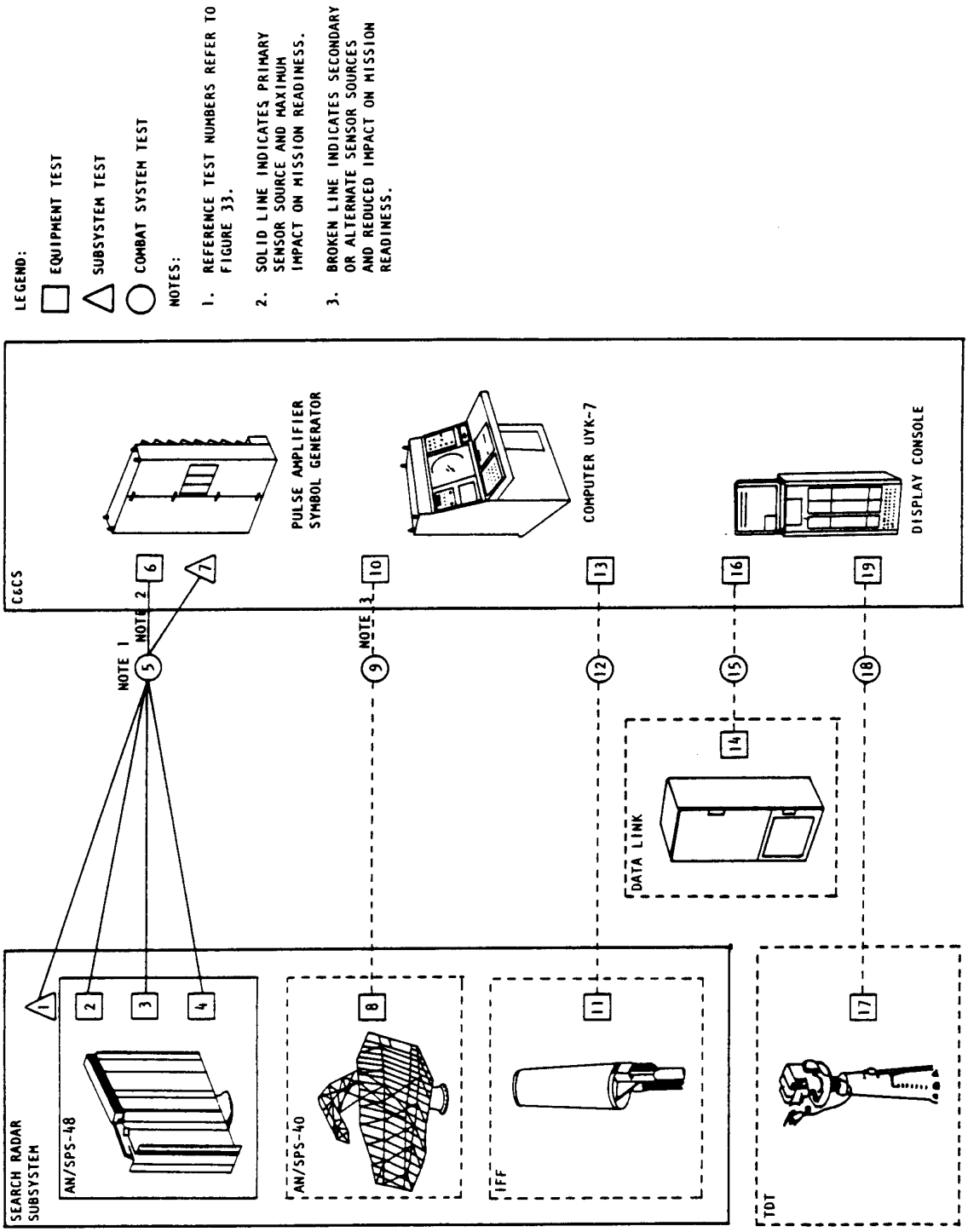
Note: This table and the associated diagram comprise the Readiness Assessment Diagram (RAD). Each RAD shall identify the highest level test or combination of tests that will verify readiness of the combat system to perform in a particular phase of a given mission. Specific tests are tabulated and reference given to a pertinent fault isolation pictorial as well as an impact evaluation reference.

* Refers to fault isolation pictorial in chapter 7 and interface data tabulation reference on that figure.

** Refers to impact evaluation table in chapter 6.

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

FIGURE 3-22. Table of test and fault impact evaluation references. (Sample)



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

FIGURE 3-23. Readiness assessment diagram. (Sample)

Fault Symptom	Operational reference									Fault isolation reference	
Note:* F = Figure	*	OSN Vol 2. F4-1.1	OSN Vol 3. F4-1.2	NS0967-LP-014-1160	RAD. F5-5.8	NS0967-441-9010	NS0967-238-7010				
SPS-48C: DETECTOR TRACKER											
No radar video displayed in RADAR 5 positions.	X		X		X		X				
SPS-48-C: DETECTOR TRACKER											
No symbology displayed when new track is entered.	X		X		X		X				
SPS-40B: DETECTOR TRACKER											
No radar video displeyed in RADAR 4 positions.		X	X		X	X	X				
SPS-40B: DETECTOR TRACKER											
No symbology displayed when new track is entered.		X	X		X	X					
TRACK SUPERVISOR											
No radar video displayed in RADAR 5 positions.	X		X		X	X					
TRACK SUPERVISOR											
No symbology displayed when new track is entered.	X	X	X		X						
SPS-48C: RADAR SET CONSOLE											
Track not on SPS-48C RSC sequence list.	X				X						
TRACK SUPERVISOR											
No late detect alert on a late detect target.	X	X	X		X	X					

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

FIGURE 3-24. Operational fault directory (Sample)

EQUIPMENT/FUNCTION	AAW	ASW	SUW	SHORE	IMPACT	ALTERNATE
AN/SPS-48C RADAR						
1. Ro	X	X	X		1. Reduced designation capability due to loss of sweep on display consoles in radar select position 5.	Use alternate radar select position for designation inputs.
2. Rmax	X	X	X		2. Reduced designation capability due to inaccurate range data.	Same as above.
3. v_0, v_1, v_2, v_3	X	X	X		3. Reduced designation due to no video presented on display consoles in radar select position 5.	Same as above.
AN/SPS-55						
1. To	X				1. Reduced surface designation capability due to loss of sweep on display consoles in radar select position 2.	Use alternate radar select position for designation inputs.

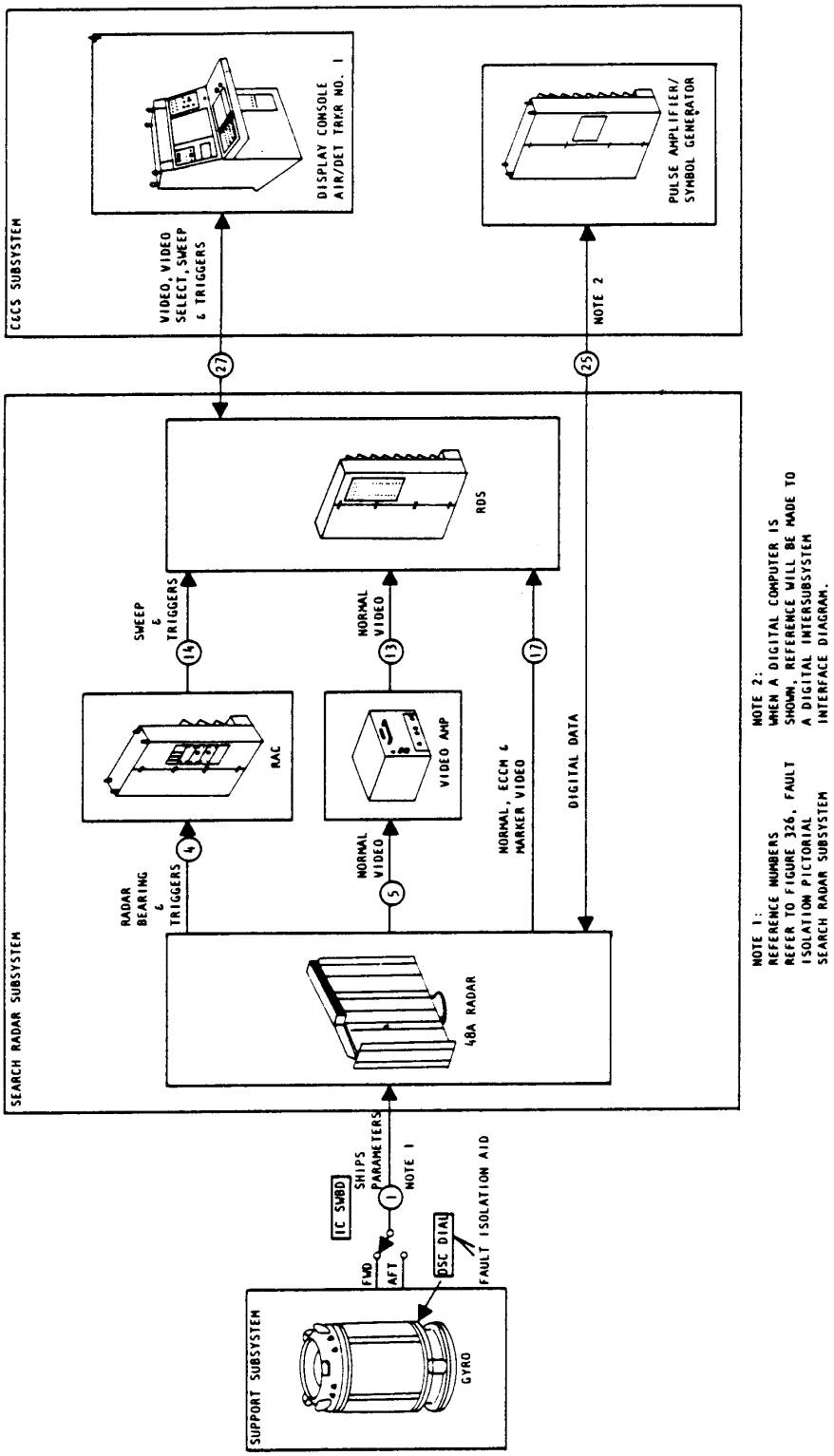
Note: Sample arrangement only. Size and legibility requirements do not necessarily conform to minimum specification requirements.

FIGURE 3-25. Subsystem impact evaluation table. (Sample)

Test no.	Function name	Drive		To		Interface reference
		Equipment	Test	Equipment	Test	
4	Ro	SPS-48A	RBI/B-3	RAC	ID141/R-14	NS 0967-1P-014-1140 Vol 3/Pt 2
	Rmax	SPS-48A	RBI/B-3	RAC	ID141/R-14	NS 0967-1P-014-1140 Vol 3/Pt 2
	Rss	SPS-48A	RBI/B-3	RAC	ID141/R-14	NS 0967-1P-014-1140 Vol 3/Pt 2
	Sin By 5	SPS-48A	RBI/N-7	RAC	ID141/R-14	NS 0967-1P-014-1140 Vol 3/Pt 2
	Cos By 5	SPS-48A	RBI/N-7	RAC	ID141/R-14	NS 0967-1P-014-1140 Vol 3/Pt 2
5	Vo	SPS-48A	SPS-48 Self Test	Video Amp No. 1	R25/Q-2	NS 0967-1P-014-1140 Vol 3/Pt 2
13	Vo	Video Amp No. 1	R25/Q-2	RDS	ID141/R-14	NS 0967-1P-014-1140 Vol 3/Pt 2
14	ΔX, ΔY	RAC	ID141/R-14	RDS	ID141/R-14	NS 0967-1P-014-1140 Vol 3/Pt 2
	Sign ΔX, ΔY	RAC	ID141/R-14	RDS	ID141/R-14	NS 0967-1P-014-1140 Vol 3/Pt 2
	ωb	RAC	ID141/R-14	RDS	ID141/R-14	NS 0967-1P-014-1140 Vol 3/Pt 2
	End Sweep	RAC	ID141/R-14	RDS	ID141/R-14	NS 0967-1P-014-1140 Vol 3/Pt 2

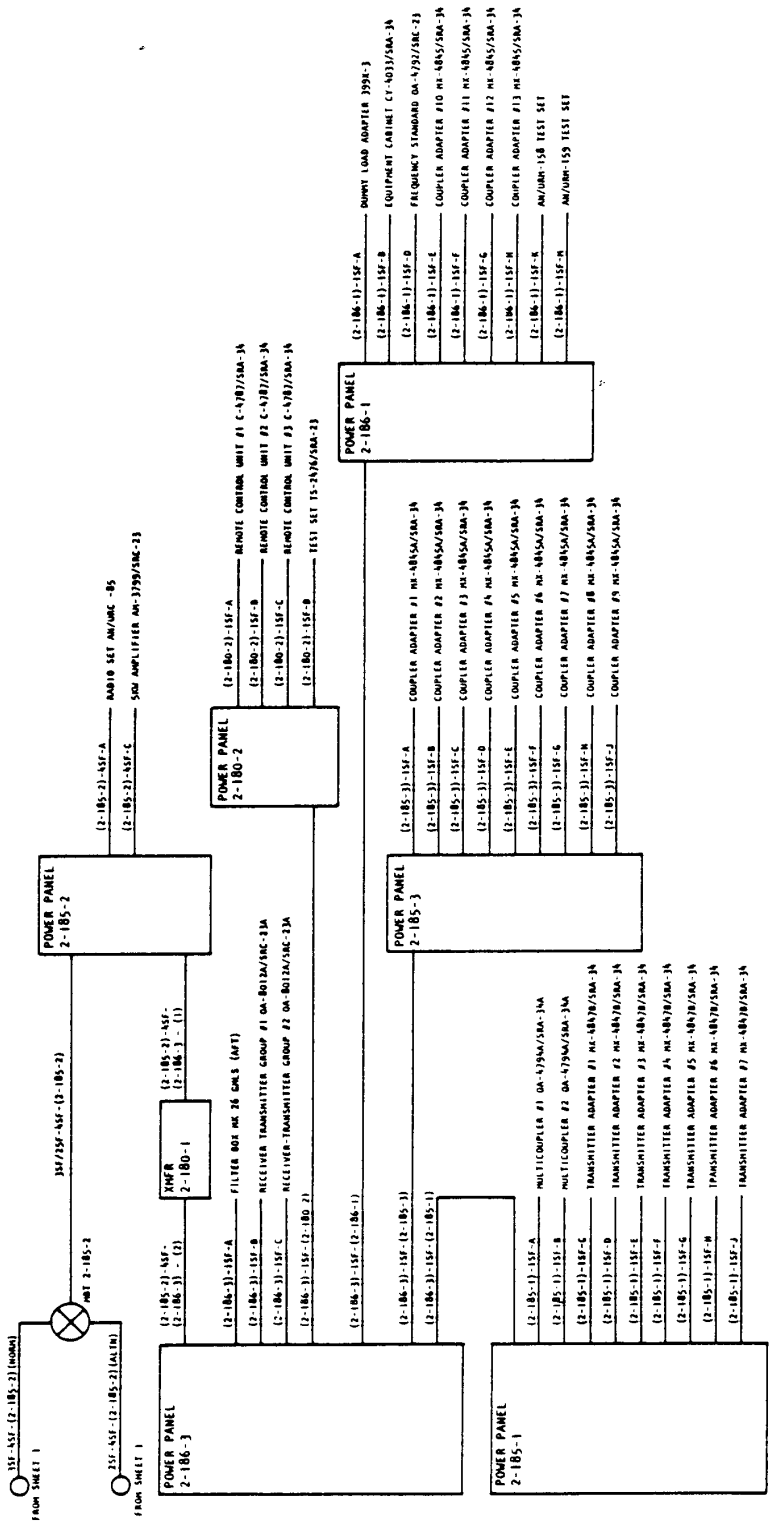
Note: Sample arrangement only. Size and legibility requirements do not necessarily conform to minimum specification requirements.

FIGURE 3-26. Table of interface reference for fault isolation pictorial. (Sample)



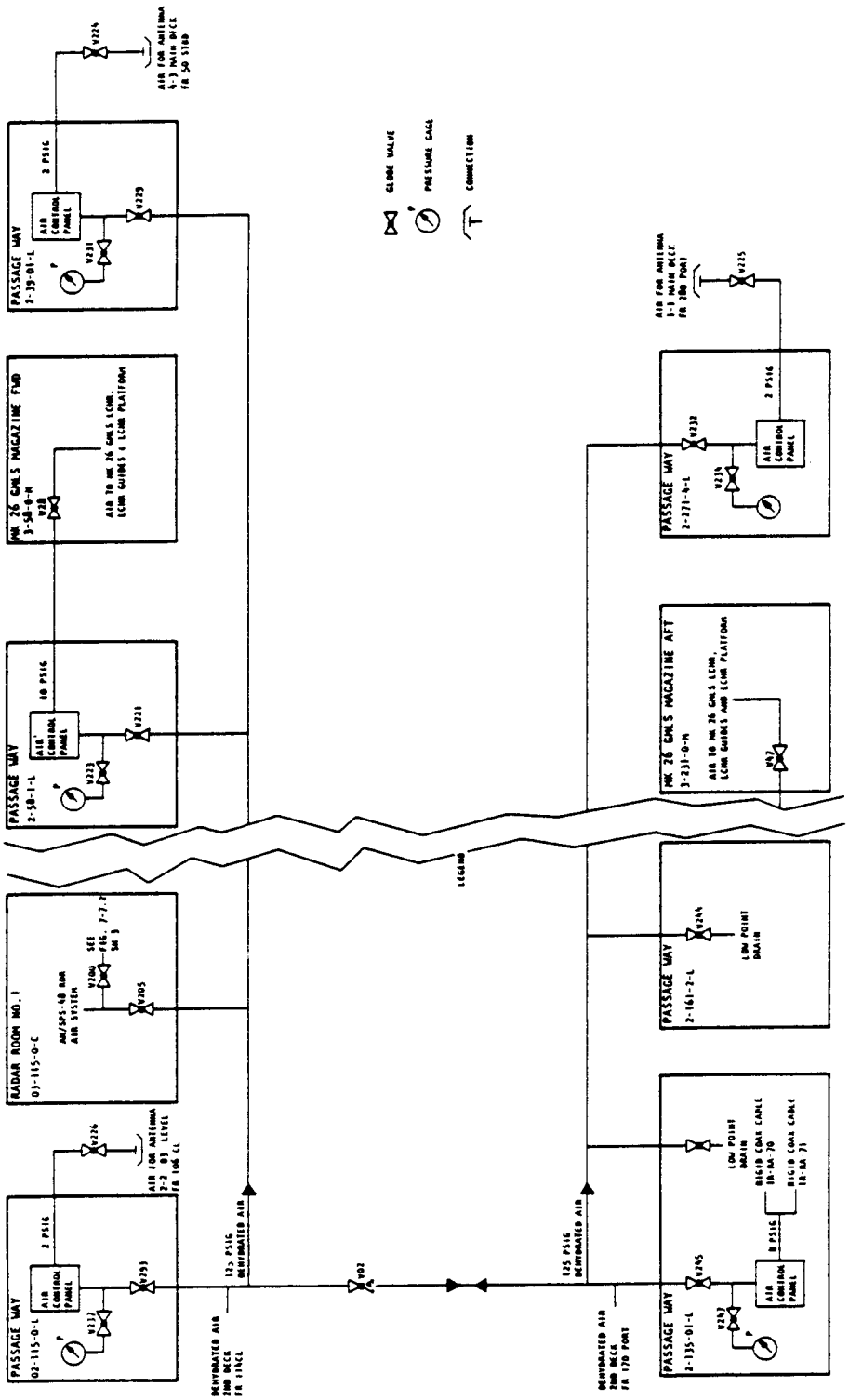
Note: Sample arrangement only. Size and legibility requirements do not necessarily conform to minimum specification requirements.

FIGURE 3-27. Fault isolation pictorial. (Sample)



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

FIGURE 3-28. Support subsystem electrical power distribution diagram. (Sample)



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

FIGURE 3-29. Support subsystem dry air system distribution diagram. (Sample)

SHIPS SERVICES → / SUB SYSTEMS ↓	450V 60 HZ	120V 60 HZ	450V 400 HZ	120V 400 HZ	120V DC	50V DC	SHIP SPEED (Lmho)	OWN SHIP HEADING (Cgo)	ROLL & PITCH (Zdo & Eio)	WIND SPEED & DIR. (Wdo & Bwdo)	CENTRAL DRY AIR	H.P. AIR	H.P. NITROGEN	S/W SUPPLY	C/W SUPPLY	STEAM SUPPLY	EMERGENCY S/W SUPPLY
TACTICAL DATA SYSTEM																	
DATA PROCESSING GROUP		1-7.X	1-7.X	1-7.X		1-7.X				1-7.X				1-7.X			1-7.X
DATA DISPLAY GROUP		1-7.X		1-7.X		1-7.X											
DATA TRANSMITTING GROUP		1-7.X		1-7.X		1-7.X	1-7.X	1-7.X	1-7.X								
ASW																	
SONAR	1-7.X	1-7.X		1-7.X										1-7.X			1-7.X
ASROC	1-7.X	1-7.X	1-7.X	1-7.X	1-7.X		1-7.X	1-7.X	1-7.X	1-7.X	1-7.X	1-7.X	1-7.X	1-7.X		1-7.X	1-7.X
TORPEDO TUBES		1-7.X									1-7.X						
COMMUNICATION																	
AN/GRC-27A (UHF)																	
AN/GLR-31			1-7.X														
MISSILE WEAPON																	
WDS		1-7.X	1-7.X	1-7.X		1-7.X		1-7.X									
TARTAR FCS	1-7.X	1-7.X	1-7.X	1-7.X		1-7.X		1-7.X	1-7.X					1-7.X		1-7.X	
AN/SPG-51C		1-7.X	1-7.X					1-7.X									
TARTAR ECMG. SYS.	1-7.X	1-7.X				1-7.X						1-7.X			1-7.X		
TAOS FCS	1-7.X	1-7.X	1-7.X	1-7.X	1-7.X	1-7.X	1-7.X	1-7.X		1-7.X		1-7.X					
AN/SPW-2			1-7.X	1-7.X	1-7.X	1-7.X					1-7.X						
AN/SPG-49			1-7.X	1-7.X	1-7.X	1-7.X		1-7.X						1-7.X		1-7.X	
TAOS ECMG. SYS.	1-7.X	1-7.X	1-7.X	1-7.X	1-7.X	1-7.X						1-7.X					
NAVIGATION																	
AN/SAN-6	1-7.X								1-7.X		1-7.X						
AN/UND-4		1-7.X															
UHF SYSTEM (ASMS)																	
AN/WPA		1-7.X															
AN/WPX		1-7.X															
TELEMETRY																	
AN/SKQ-2			1-7.X			1-7.X											

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

FIGURE 3-30. Figure index of support diagram applicable to subsystem equipment. (Sample)

Fault symptom / Fault cause	Pressure relief valve opens	High inlet pressure	Low inlet pressure	High outlet pressure	Low outlet pressure	Dew point alarm ON	High flow rate	Low flow rate	Pressure alarm ON
Panel outlet pressure too high	X								
Relief valve maladjustments	X								
Defective relief valve	X								
Excessive air main pressure		X							
Failure priority valves			X						X
Air leaks			X		X	X	X		X
Unauthorized uses on line			X			X			X
essure drop in dehydrator			X						X
Line valve partially closed			X						X
Bypass valve not closed				X					
Internal RS maladjustment				X	X				X
RS component failure				X	X				X
Excessive Moisture						X			
Improper sensor setting						X			X
Defective sensor						X			X
Line blockage							X		X

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

FIGURE 3-31. Support subsystem symptom/cause fault directory. (Sample)

System Parameter	Type alarm	Alarm location	Sensor location	Normal parameter range/set point	Action required
SMS-53A Distilled Water Low Flow	Audio & Visual	Electronic Cooling Equipment Room No. 1 (5-39-1-C) and Sonar Control Room (01-135-4-C)	Sonar Equipment Room No. 2 (6-23-0-C)	2.2 GPM	Check for proper setup. Refer to NAVSEA 0905-LP-507-2030.
SMS-53A Distilled Water High Temp.			Sonar Equipment Room No. 3 (6-39-0-C)	17.8 GPM	
				2.2 GPM	
				1.5 GPM	
				3.3 GPM	
				1.1 GPM	
				1.9 GPM	
				2.2 GPM	
				3.0 GPM	
			Sonar Equipment Room No. 1A (5-35-0-C)	2.2 GPM	
Communications Distilled Water Low Flow		Electronic Cooling Equipment Room No. 3 (02-161-1-Q) and Communications Center (2-166-0-C)	Electronic Cooling Equipment Room No. 1 (5-39-1-C)	56.0 GPM	Check for proper circulating pump operation. Refer to NAVSEA 0905-LP-507-2030.
				950 F	Check for proper setup. Refer to NAVSEA 0905-LP-507-2030.
			Radio Transmitter Room (2-182-0-C)	11.1 GPM	
				11.9 GPM	
AN/SPS 40B Distilled Water Low Flow			Radar Room No. 3 (02-161-0-C)	5.2 GPM	
				7.4 GPM	
				6.2 GPM	
AN/SPS-40B/Communication Distilled Water Low Flow			Electronic Cooling Room No. 3 (02-161-2-Q)	42.0 GPM	Check for proper circulating pump operation. Refer to NAVSEA 0905-LP-507-2030.

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

FIGURE 3-32. Table of audio-visual alarms. (Sample)

Equipment/function	Test																Fault impact
	R-81/R-250	R-176/R-1W	CSO-1	CSO-2	CSO-6,	OCSOT Phase III	5W BL000/M-1	5W BL000/R-2	5W BL000/R-3	5W BL000/R-4	R-607/R-2W	R-81/R-20	R-81/M-25	R-81/S-6	Table 6-2.1		
Radar Set AN/SPS-48C:																	NS 0967-LP-014-1140 V3 P2
Os		X	X	X	X	X	X	X	X	X				X			NS 0967-LP-014-1140 V3 P2
Lb		X															NS 0967-LP-014-1140 V3 P2
End of Sweep											X	X					NS 0967-LP-014-1140 V3 P2
SIF Trigger											X	X					NS 0967-LP-014-1140 V3 P2
Height		X	X	X	X	X	X	X	X	X							NS 0967-LP-014-1140 V3 P2
Track Number		X	X	X	X	X	X	X	X	X							NS 0967-LP-014-1140 V3 P2
Cqo	X																NS 0967-LP-014-1140 V3 P2
Eio	X																NS 0967-LP-014-1140 V3 P2
Zdo	X																NS 0967-LP-014-1140 V3 P2
Nb																	NS 0967-LP-014-1140 V3 P2
Nb Enable																	NS 0967-LP-014-1140 V3 P2
Sin By 5													X				NS 0967-LP-014-1140 V3 P2
Cos By 5													X				NS 0967-LP-014-1140 V3 P2
Ro												X					NS 0967-LP-014-1140 V3 P2
Rmax												X					NS 0967-LP-014-1140 V3 P2
Rss		X										X					NS 0967-LP-014-1140 V3 P2
Vo		X	X	X	X	X	X	X	X	X	X	X					NS 0967-LP-014-1140 V3 P2
V_1												X					NS 0967-LP-014-1140 V3 P2

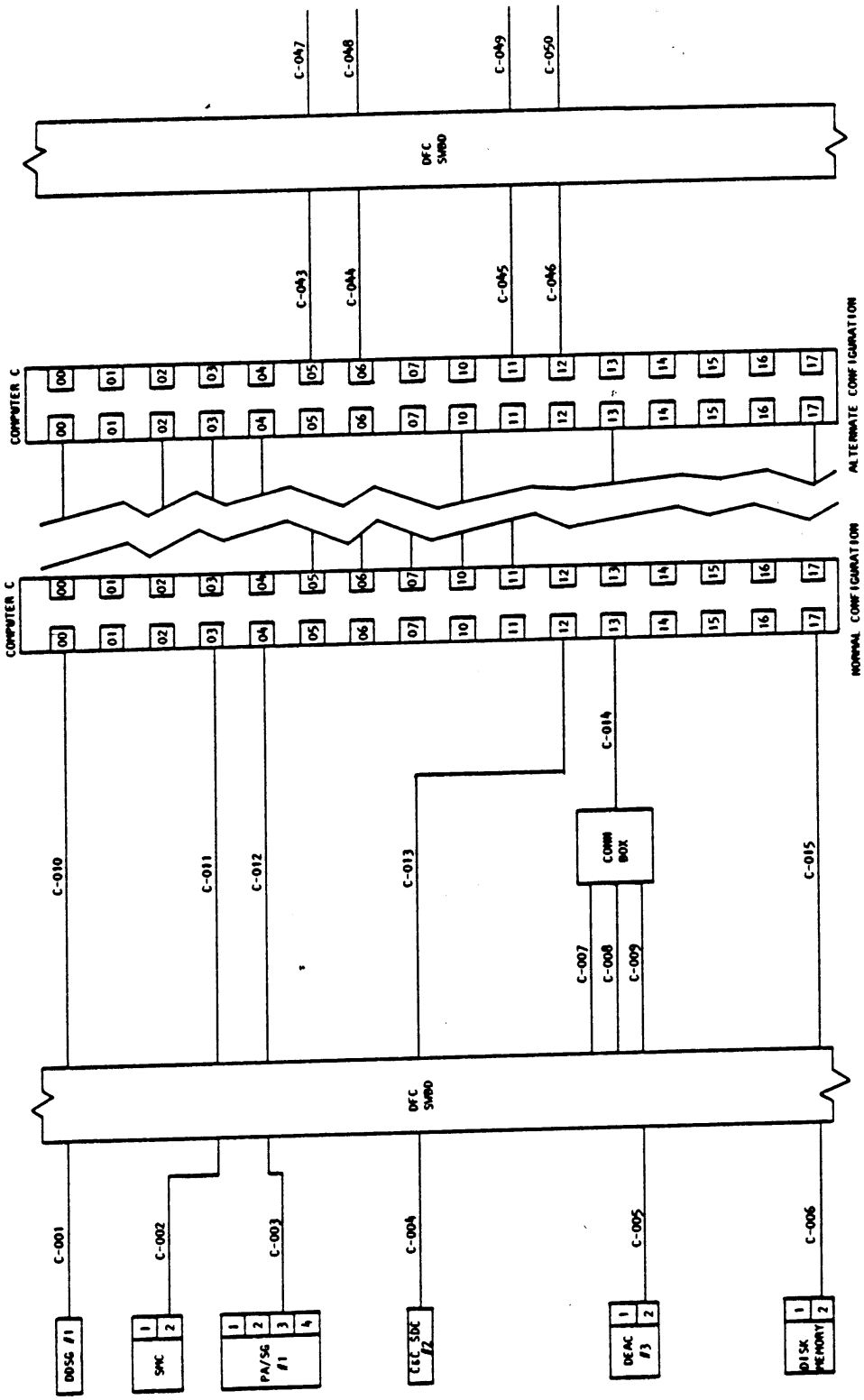
Note: Sample arrangement only. Size and legibility requirements do not necessarily conform to minimum specification requirements.

FIGURE 3-33. Test fault directory. (Sample)

Interface		Unit A		Unit B		Reference Document
No.	Cable	Conn	Equip	Conn	Equip	
C-030	G-GLC4	J6	LSMC No. 2	5J3	DFC Switch-board	OP 4165 V3 P9
	G-GLC3	5J1	DFC Switch-board	J8	LSMC No. 2	
C-031	IR-D0219	J2	DEAC No. 4 (chan 2)	47J3	DFC Switch board	OP 4165 V3-P9
	IR-D0220	47J1	DFC Switch-board	J1	DEAC No. 4 (chan 2)	
C-032	IR-DD222	J4	Disk Memory (chan 2)	39J1	DFC Switch-board	OP 4165-V3 P9
	IR-DD223	39J3	DFC Switch-board	J3	Disk Memory (chan 2)	
C-033	IR-DD189	34J7	DFC Switch-board	TB1-4.9	UFCC Computer conn box	OP 4165 V3 P9
	IR-DD190	TB5-9	UFCC Com-puter conn box	34J5	DFC Switch-board	
C-034	IR-DD191	35J4	DFC Switch-board	TB1-4.9	UFCC Com-puter conn box	OP 4165 V3 P9
	IR-DD192	TB5-9	UFCC Com-puter conn box	35J2	DFC Switch-board	
C-035	IR-DD193	47J8	DFC Switch-board	TB1-4.9	UFCC Com-puter conn box	OP 4165-V3-P9
	IR-DD194	TB5-9	UFCC Com-puter conn box	47J6	DFC Switch-board	
C-036	IR-DD57	7J3	DFC Switch-board	J41	UFCC (chan 0)	OP 4165 V3 P9
	IR-DD58	J42	UFCC (chan 0)	7J1	DFC Switch-board	
C-037	IR-DD59	14J7	DFC Switch-board	J57	UFCC (chan 2)	OP 4165 V3 P9
	IR-DD60	J58	UFCC (chan 2)	14J5	DFC Switch-board	
C-038	IR-DD61	46J8	DFC Switch-board	J57	UFCC (chan 3)	OP 4165 V3 P9
	IR-DD62	J58	UFCC (chan 3)	46J6	DFC Switch-board	

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

FIGURE 3-34. Digital inter-subsystem interface cable list. (Sample)



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

FIGURE 3-35. Digital inter-subsystem interface diagram. (Sample)

INTERSUBSYSTEM INTERCONNECTION TABULATION (ANALOG)			
REFERENCE NO. AND FUNCTION	UNIT A AND TERM NO.	CABLE AND WIRE NUMBERS	UNIT B AND TERM NO.
1	VP MK 2		TRIG AMP 2
RANGE ZERO TRIG SPQ-9	J6 - C	2GSB15A111	J25 - BC
SHIELD	- M	111R	- BL
2	VP MK 2		VIDEO AMP 2
VIDEO, SPQ-9	J9 - K	4GSA15D110	5J42 - A
BEACON/RAW SHIELD	- T	110R	- u
3	VP MK 2		VIDEO AMP 3
VIDEO, SPQ-9 CLEAR PLOT	J9 - S	13GSA55A111	5J42 - L
SHIELD	- V	111R	- o
4	GFC SWBD MK 16		RDS - 4
ANT BRG REL/TRUE S1	JC2AE - L	4GSA83A111	20J5 - A
SPQ-9 1X S2	- M	112	- B
S3	- N	113	- E
115V 60 Hz ØA R1	- K	110	- C
ØB R2	- B	110R	- U
5	GFC SWBD MK 16		TDS SWBD
ANT BRG REL S1	JC2AA - m	4GSA95E111	JB2 - 3
SPQ-9 1X S2	- n	112	- 4
S3	- w	113	- 5
	- x	111S	- 1
SHIELD	- AH	4GSA95E110	- 7
115V 60 Hz R1	- AT	110R	- 8
SYNCHRO REF R2	- AU	110T	- 9
STUB	- BC	110S	- 2
SHIELD			

FIGURE 3-36. Analog interface interconnection tabulation. (Sample)

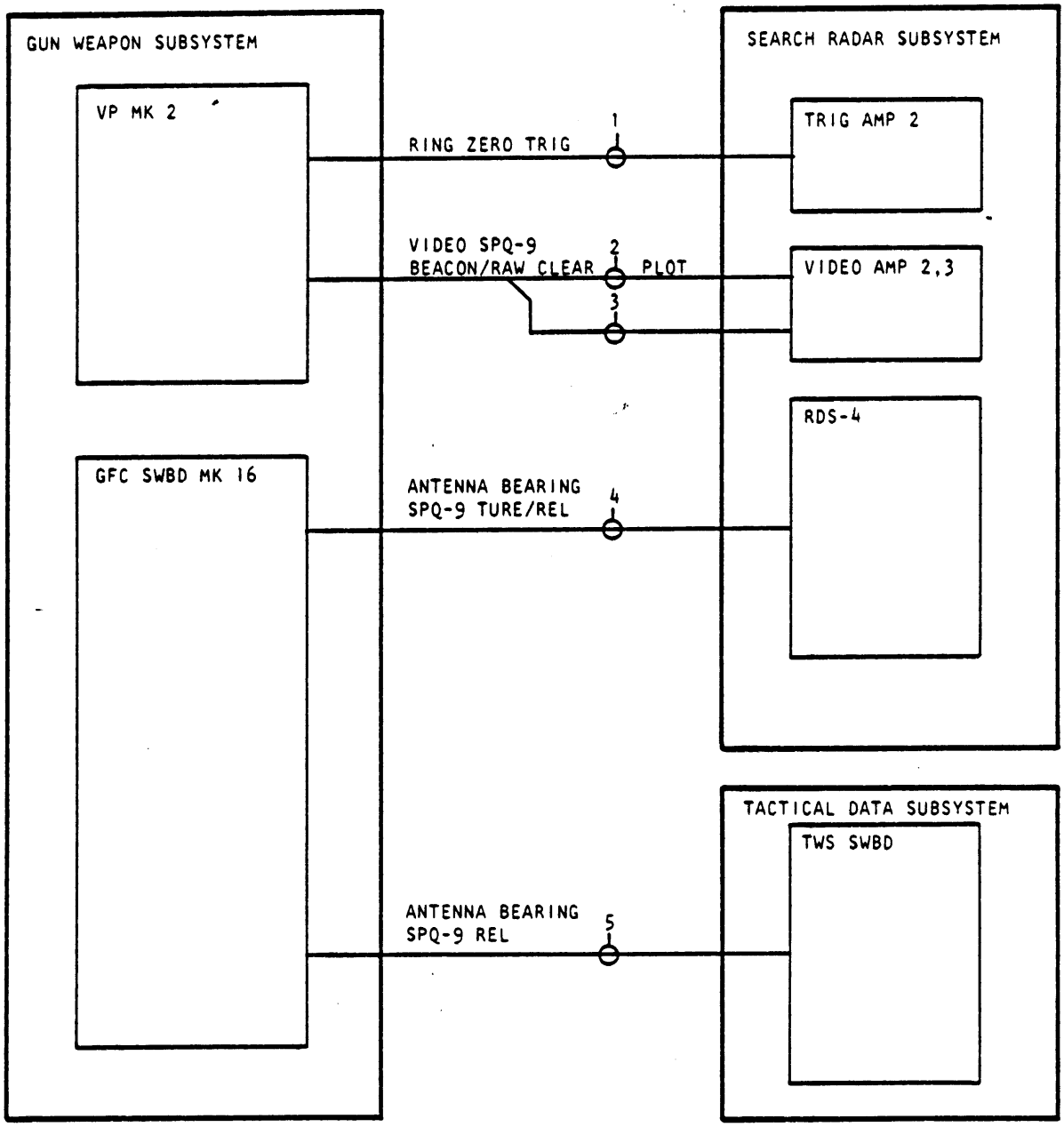
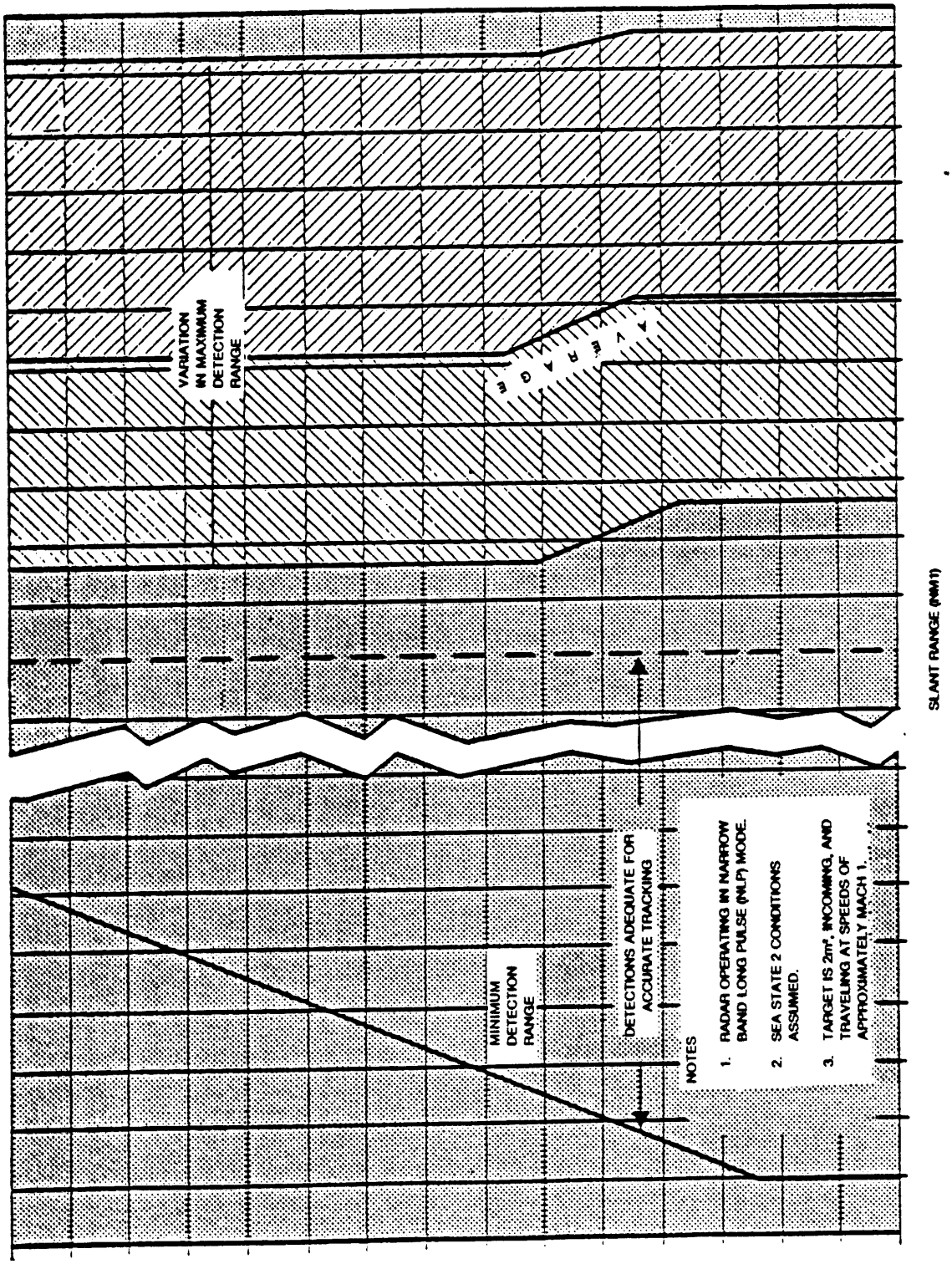


FIGURE 3-37. Analog inter-subsystem interface diagram. (Sample)



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

FIGURE 3-38. Air target detection capabilities. (Sample)

Environment (sea state 2)	Operating mode	Positive detection and tracking range (NMI)	Maximum expected range (NMI)
Clear weather	Narrow-bank, long pulse (NLP)		
Fog - medium	Narrow-bank, long pulse (NLP)		
- heavy	Narrow-bank, long pulse (NLP)		
Rain	Wide-band, short pulse (WSP)		
Land	Wide-band, short pulse (WSP)		

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

FIGURE 3-39. Radar detection capabilities, summary. (Sample)

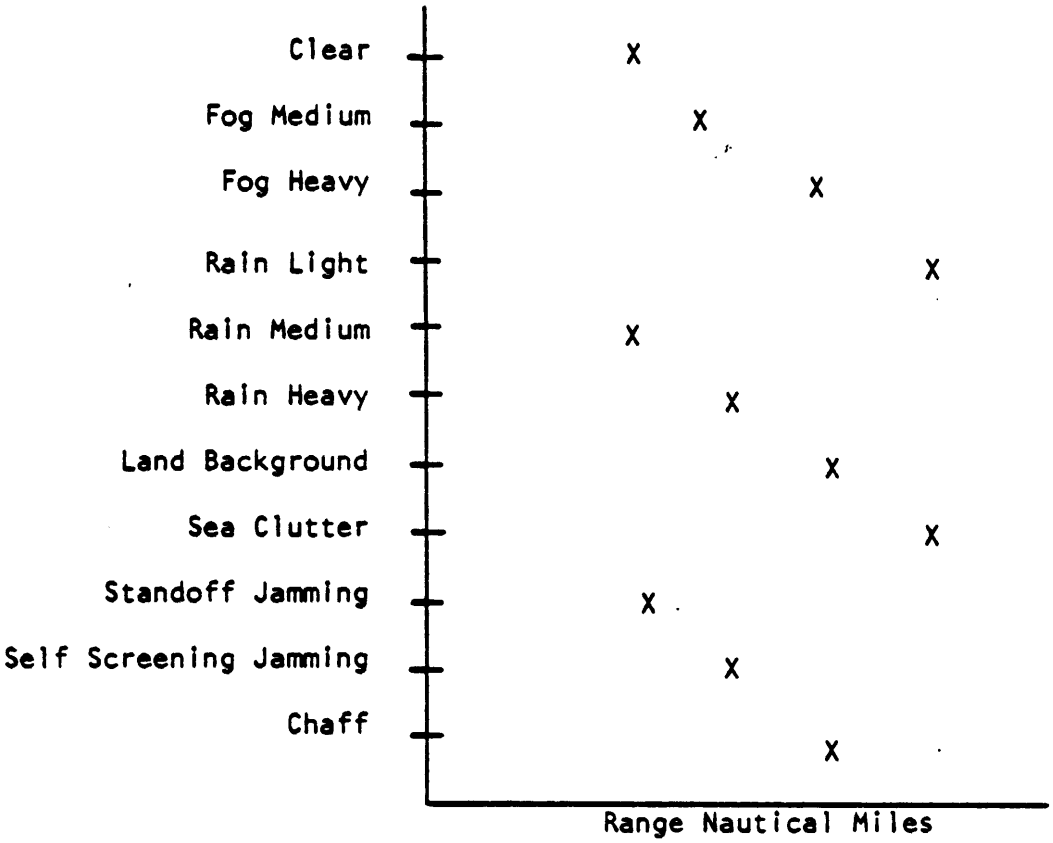
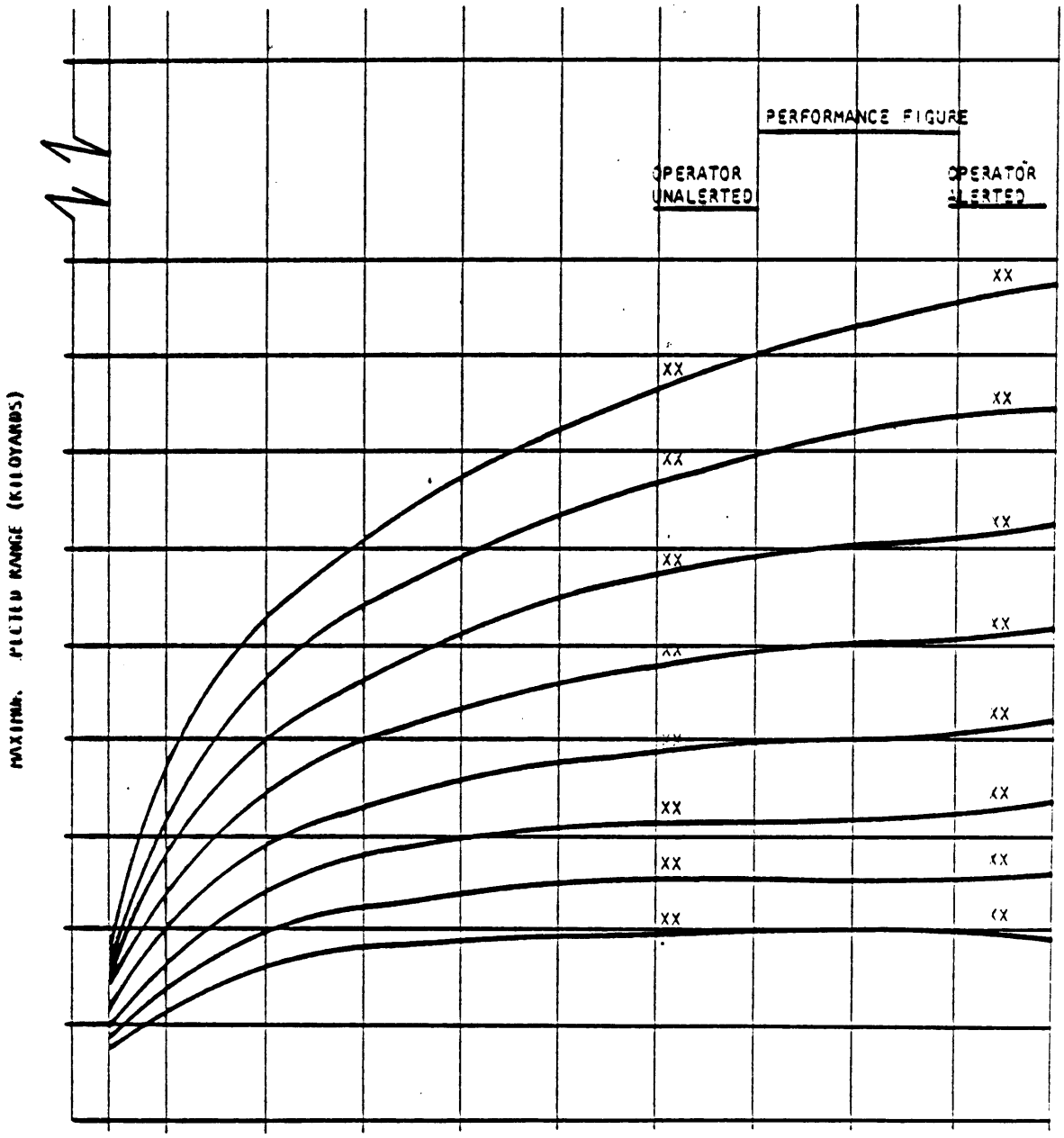
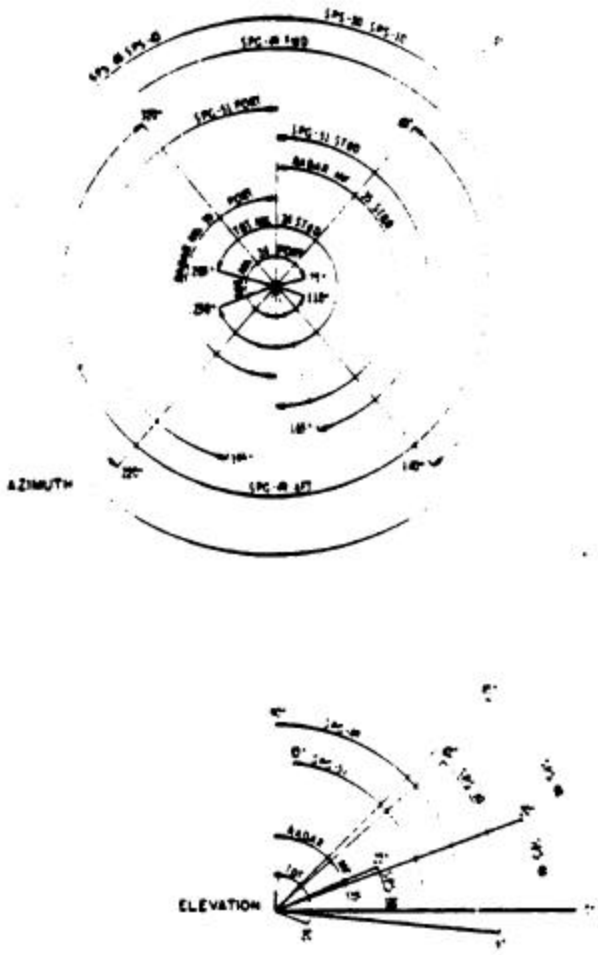


FIGURE 3-40. Missile detection capabilities. (Sample)



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

FIGURE 3-41. Graph of detection ranges versus layer depth. (Sample)



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

FIGURE 3-42. Air target detection zones for various sensors. (Sample)

Sensor	Bearing (o)	Range (yd)	Elevation (o)	Remarks
Primary air Search radar	± x.xx	± xxx	± x.x	Bearing and elevation resolution + 1/2 beamwidth.
Primary surface search radar	± x.x	± xxxx	NA	Bearing resolution ± 1/2 beamwidth; Range error increases as track range increases.
Secondary air-surface search radar	± x.x	± xx	± x.x	Bearing and elevation resolution ± 1/2 beamwidth.
Target designation xmitter	± x.x (sea state 2)	NA	± x.x (sea state 2)	Bearing and elevation accuracy will degrade as sea state increases. Range data is estimated and is not used in TDS. Range estimates are used as input data for GFCS Mk 68 and GMFCS Mk 76 designation.
IFF	± x.x	± xxx	(± xxx ft altitude)	Altitude data not presently implemented.
ESM receiver	± x.x	NA	NA	Bearing accuracy exclusive of antenna system. Antenna error is inversly proportional to frequency and varies from x.x° at high frequencies to xx° at low frequencies.
ESM direction finder	± x.x	NA	NA	ESM bearing input to TDS via ECM universal keyset accuracy ± x.x°

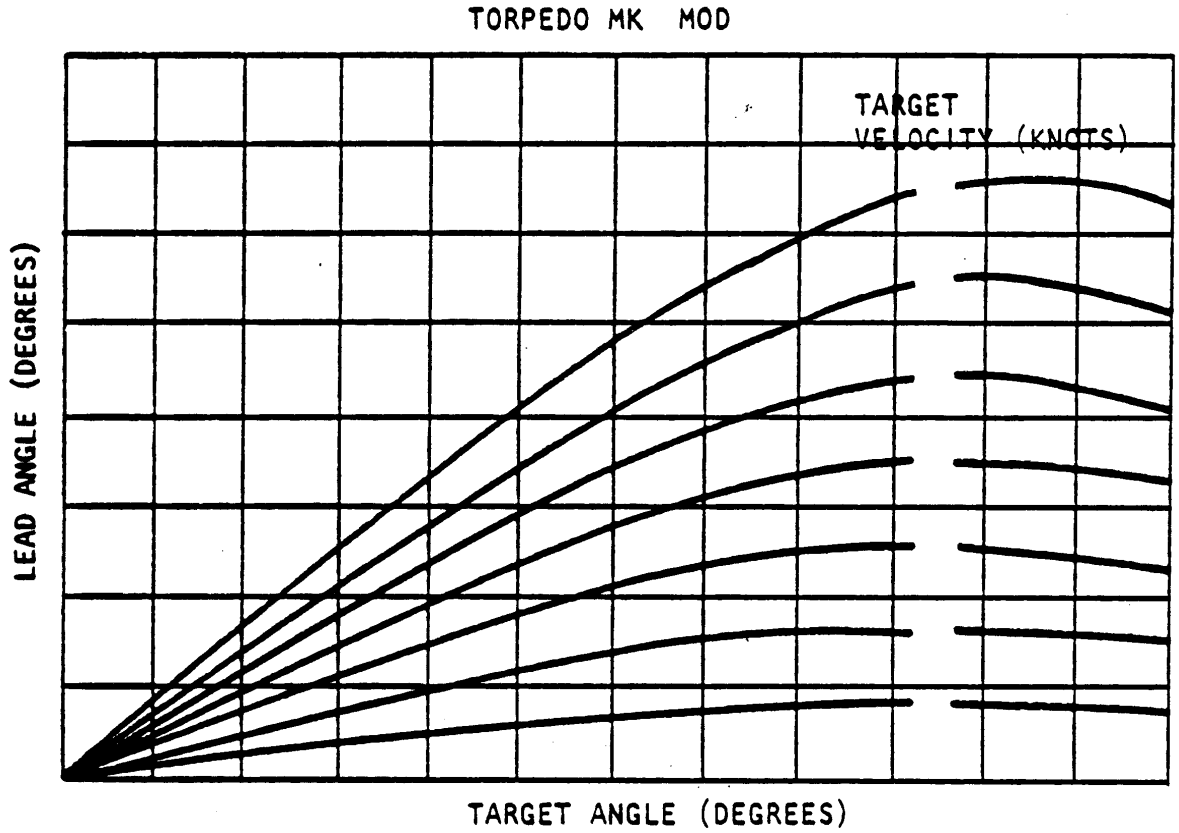
Note: Sample arrangement only. Size and legibility requirements do not necessarily conform to minimum specification requirements.

FIGURE 3-43. Table of sensor position accuracy and resolution. (Sample)

Track data Category	Capabilities (Number)
Aircraft, command tracked	
Strike aircraft	
OR tracks	
Bearing lines, local ESM	
Bearing lines	
Bearing lines, total ESM	
Electronic warfare threats	
ESM fixes	
Link-11 Pus	
Local interceptors	
Local strikes	
Simulated target reports	
Special points	
Special tracks	
Tracks, remote TDS	
Tracks, local TDS	
Tracks, system	

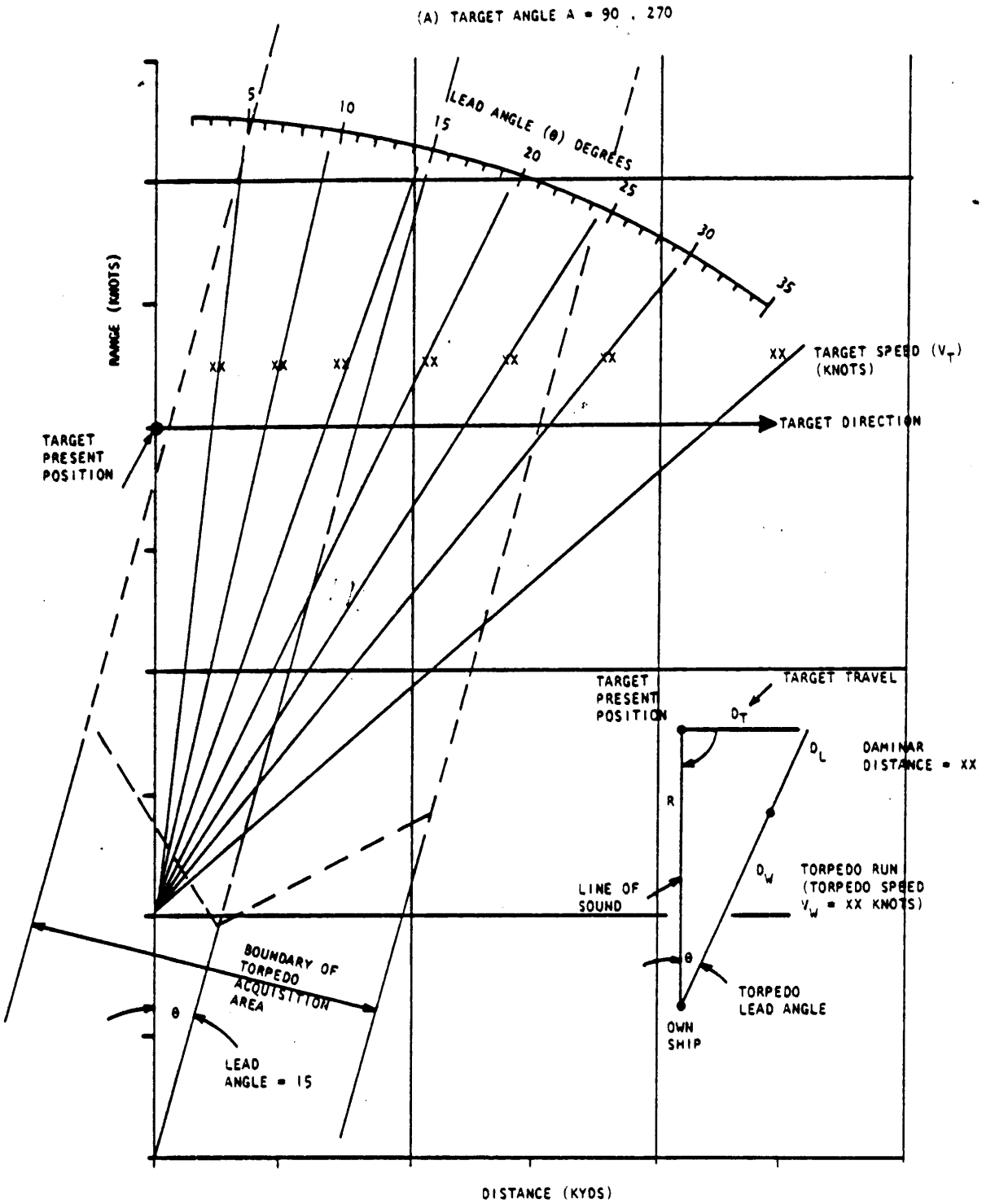
Note: Sample arrangement only. Size and legibility requirements do not necessarily conform to minimum specification requirements.

FIGURE 3-44. Table of tracking program capabilities. (Sample)



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

FIGURE 3-45. Graph of torpedo lead angle dependency on target angle/target velocity. (Sample)



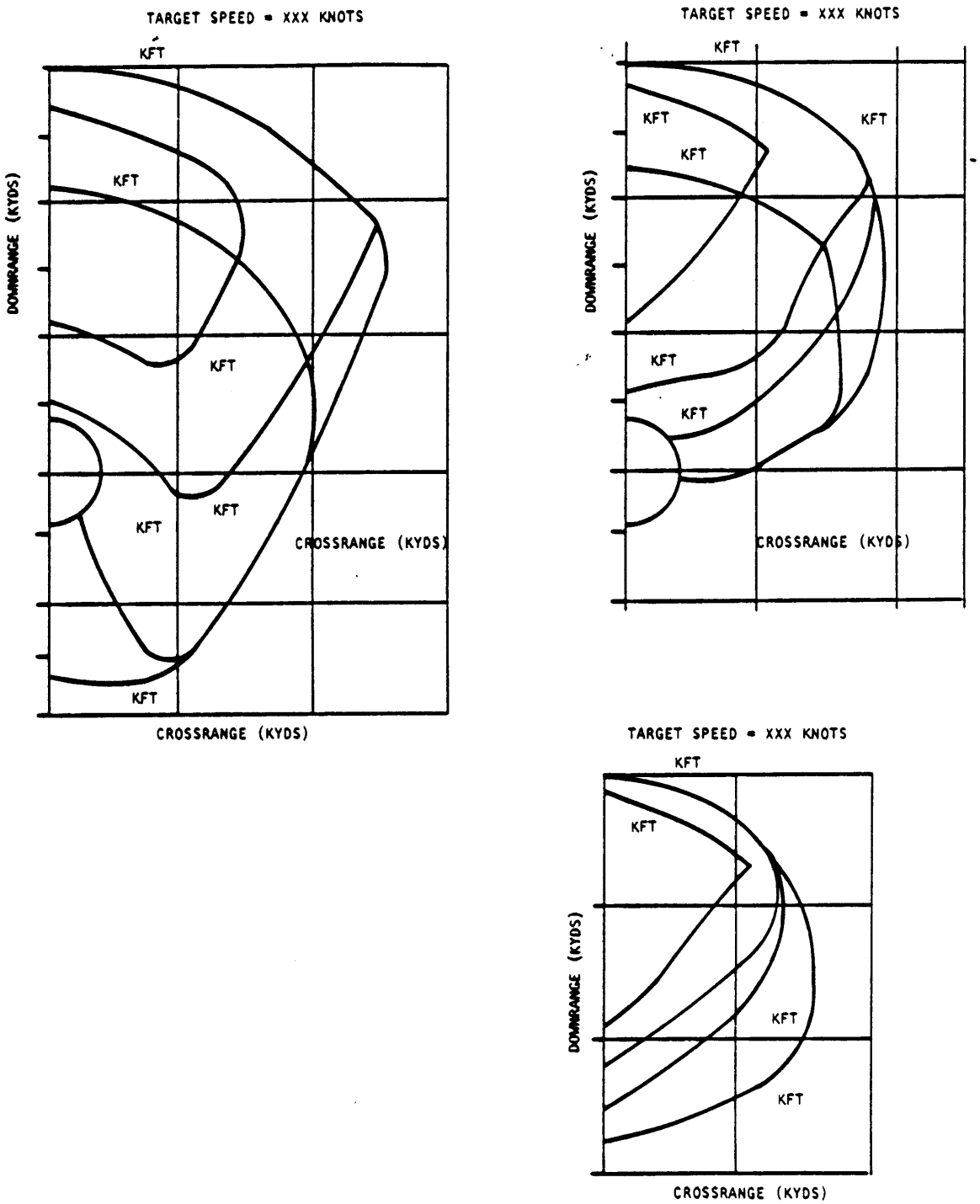
Note: Sample arrangement only. Size and legibility requirements do not necessarily conform to minimum specification requirements.

FIGURE 3-46. Torpedo attack geometry. (Sample)

OTS Torpedo attack capability	Target angle (degrees)		
	30/330	60/300	90/270
Selected deflection lead angle			
OTS Torpedo Mk xx Mod x:			
Target present range			
Intercept range coverage			
Target speed coverage			

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

FIGURE 3-47. Torpedo attack capability for selected deflection lead angles, summary. (Sample)



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

FIGURE 3-48. Target cross-range engageability envelope variation with target altitude. (Sample)

Type	Equipment	Frequency	Power (peak)	Status	Control station	EMCON Responsi-bility	Index
Communi-cations	WRT-1A WRC-1B SRC-23A URC-32/32B WRT-2 SRC-20-20A SRC-21 SRC-31A URC-9 URC-80 SAT-2			Off rad Off rad Off rad Off dummy rad Off dummy rad Off rad Off rad Off rad Off rad Off rad Off rad			
Search	SPS-48C SPS-40B SPS-55 Seafarer (LN 66)			Off stby dummy rad Off stby dummy rad Off stby dummy rad Off on/rad			
FC/GM/GL	SPG-51D Track CWI SPG-60 Track SPQ-9A			 Off dummy rad Off dummy rad Off dummy rad Off stby rad			
NAV/ID	UPX-23 APX-72 SRN-9			Off rad Off rad Off rad			
DECM							
Acous-tics	SQS-53A UNQ-1D WQC-2 SLQ-25 (nixie)			Off stby rad Off stby rad Off rad Off rad			

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

FIGURE 3-49. Table of radiating equipment. (Sample)

Custodian:
Navy - SH

Review Activity:
Navy - EC

Preparing activity:
Navy - SH
(Project TMSS-N315)

STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

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3. DOCUMENT TITLE
COMBAT SYSTEM TECHNICAL OPERATIONS MANUAL (CSTOM) REQUIREMENTS

4. NATURE OF CHANGE *(Identify paragraph number and include proposed rewrite, if possible. Attach extra sheets as needed)*

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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	