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TRIDENT II (D-5) STRATEGIC WEAPON SYSTEM GUIDE FOR POTENTIAL SU--ETC(U)
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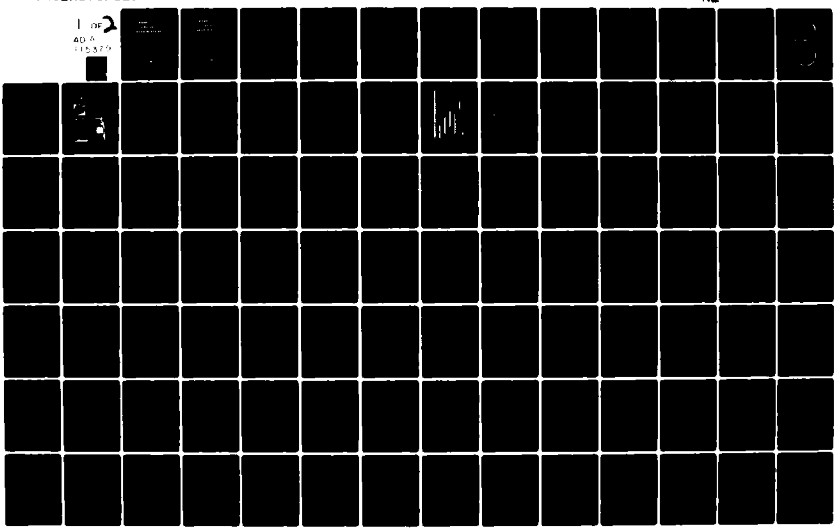

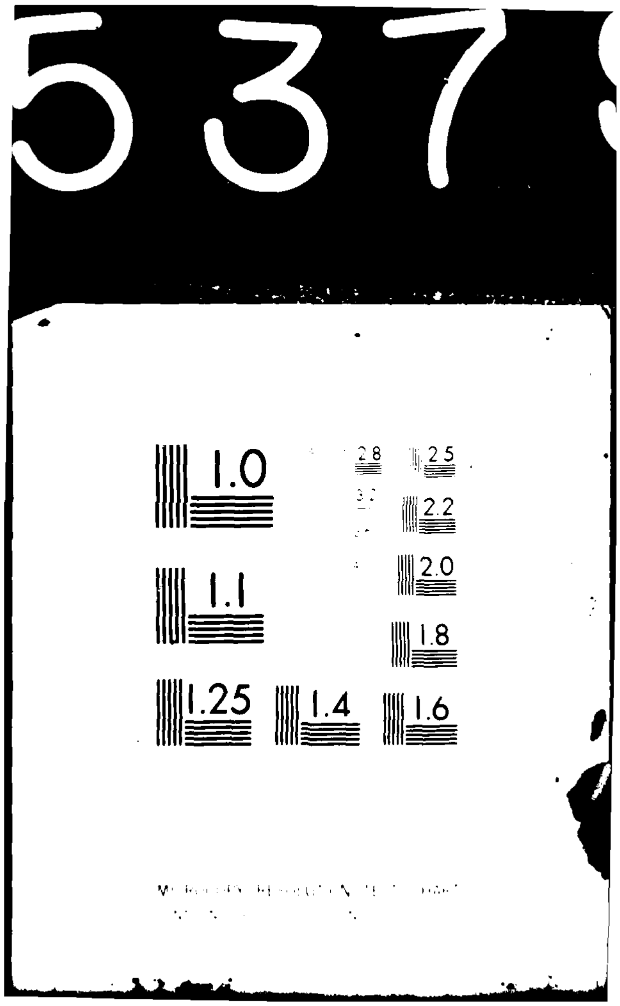
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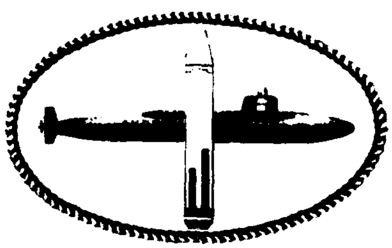
TRIDENT II (D-5) STRATEGIC WEAPON SYSTEM

GUIDE FOR POTENTIAL SUBCONTRACTORS



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TRIDENT II (D-5) STRATEGIC WEAPON SYSTEM

GUIDE FOR POTENTIAL SUBCONTRACTORS

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CHAPTER 1
INTRODUCTION

This guide will provide information to potential subcontractors (suppliers) concerning participation in the United States (U.S.) and United Kingdom (U.K.) TRIDENT II (D-5) weapon system programs. The guide will inform these subcontractors about TRIDENT II program requirements and give additional information pertinent to facilitate competitive bidding on equipment, assemblies, components, parts, and materials required for the TRIDENT II Strategic Weapon System.

PURPOSE

The purpose of this document is to provide potential U.S. and U.K. subcontractors with a brief understanding of the program and its end products; describe how the program is technically and organizationally managed (including the special technical disciplines applied to procurements relating to TRIDENT II); provide an understanding of the time frame of the program; identify the subsystem contractors that will be initiating procurements and a point of contact for each; define in broad terms the equipment to which the guide applies, and provide a description of the type of hardware or material that may be procured.

BACKGROUND

Late in the 1950's, the first POLARIS weapon system was deployed in a U.S. nuclear-powered submarine. With the development of the POLARIS A-2 and A-3 missiles in the early 1960's, the POLARIS strike capability was increased to 1500 and 2500 nautical miles, respectively.

In April 1963, the U.S. and U.K. entered into an agreement known as the POLARIS Sales Agreement. This agreement provided for the sale to the U.K. of POLARIS A-3 missiles (less warheads) and associated weapon system equipments for installation in U.K. submarines.

As a follow-on to the POLARIS weapon system, the Navy's Strategic Systems Project Office developed the POSEIDON C-3 missile. This missile was fitted into existing U.S. submarines to replace the POLARIS missile. The POSEIDON missile, which had its initial deployment in 1971, incorporated multiple warheads that could be separately targeted.

In response to Soviet submarine fleet expansion and to maintain the viability of the strategic deterrent, the TRIDENT I (C-4) weapon system was developed. An evolution of this system, the TRIDENT II (D-5) weapon system, is under development to provide for improved accuracy and performance over the TRIDENT I system.

In early 1982, an agreement between the governments of the U.S. and the U.K. provided that the TRIDENT II weapon system being developed for installation in U.S. submarines would also be purchased by the U.K. for installation in U.K. submarines. In a letter from U.S. Secretary of Defense Caspar W. Weinberger to U.K. Secretary of State for Defence John Nott relating to that agreement, Mr. Weinberger said the provisions of the agreement "permits United Kingdom (U.K.) manufacturers to compete on the same terms as United States (U.S.) firms for subcontracts for TRIDENT II (D-5) weapon system components for the program as a whole."

SCOPE

This guide applies only to U.S. and U.K. TRIDENT II Strategic Weapon System equipment, components, parts, and materials and related support equipment. It does not apply to construction of the submarine or facilities. Some areas to be addressed include services to support design, development, testing, and production of TRIDENT II weapon system components; raw materials to be used; and repair parts to support equipment and material. Depending on the type of components, there may be services required for future repair or updating.

Additionally, weapon system hardware requirements for other aspects of the program--such as equipment for training facilities, handling and transport equipment for missile assembly facilities, and special instrumentation for flight test ranges--will also be covered.

OVERVIEW

The organization of this guide stresses those elements of prime concern to potential subcontractors. Each chapter will act as one tier directed toward those aims specified in the "Purpose." An overview of the chapters will help illuminate this intent.

Chapter 2, the TRIDENT System, provides a brief description of the three basic elements of the system: the Strategic Weapon System, the submarine, and the shore facilities. The intent of this chapter is to provide a basic understanding of the many portions that constitute the TRIDENT system and explain their interrelationships.

Chapter 3, TRIDENT Program Description, provides background information regarding the evolution of the TRIDENT program, the U.K. involvement in the program, program development phases and time frames, and the program management philosophy.

Chapter 4 provides an explanation of the need for the rigid and unique technical requirements, called disciplines, that are imposed on everyone involved with the development, production, or support of the weapon system. An insight into these disciplines is provided by explaining the development philosophy that underlies the disciplines. The chapter further covers application of these requirements to subcontractors.

Chapter 5, Subsystems, consists of an overview of the changes in each subsystem required to develop TRIDENT II. Additionally, the chapter contains, for each subsystem, a description of the TRIDENT I subsystem, its components, and support equipment. The description is followed by typical components and materials that would normally be subcontracted.

Chapter 6 describes U.S. security requirements and regulations for doing subcontract work of a classified nature. Any potential subcontractor involved in procurements concerning classified information must be cognizant of the information contained in this chapter.

Chapter 7, Subcontracting, provides a brief explanation concerning how subsystem contractors generally identify and select subcontractors. The chapter also contains a list of points of contact at the subsystem contractor plants.

A Glossary of Terms and Abbreviations has been provided to facilitate understanding of terms and abbreviations used in this guide and some that may be encountered in subsequent communications concerning subcontracts.

CHAPTER 2
THE TRIDENT SYSTEM

TRIDENT is the popular name for the new sea-based missile system designed by the U.S. to provide a strategic deterrent to nuclear war. The program concept is to deploy submarines in broad ocean areas, each with the capability to launch missiles from an undetected submerged position upon receipt and authentication of command. Figure 1 portrays this concept and some of the events in missile flight. This undetectable and thus survivable launch platform, with the demonstrated capabilities of range accuracy and effectivity, makes a substantial contribution to the prevention of nuclear war.

The U.S. has initiated a program to upgrade the TRIDENT I system to incorporate improved weapon system accuracy and performance. When deployed, this upgraded system, known as TRIDENT II, will extend the strategic deterrent through the 1990's and beyond.

The TRIDENT system is composed of three major parts: the Strategic Weapon System, the submarine, and dedicated shore support facilities.

THE STRATEGIC WEAPON SYSTEM

The Strategic Weapon System is a composite of several functional subsystems working in conjunction to program and launch missiles to their targets and to record system operations during test firings. The subsystems are the fire control subsystem, the navigation subsystem, the launcher subsystem, the missile subsystem, the guidance subsystem, and the instrumentation subsystem. Figure 2 portrays the physical location of subsystems aboard the submarine. Figure 3 and the following paragraphs detail the functional relationship of each subsystem to the overall system.

Fire Control Subsystem. This subsystem coordinates the overall functions of the weapon system, controlling the missiles for sequential launch and monitoring and controlling the sequence of operation of the other subsystems during a missile launch. In addition to launch control, the fire control subsystem incorporates a large digital computer to process data such as ship's position, velocity, and attitude and determine the proper trajectory for each missile at any given moment. As the submarine moves about during patrol, much of the necessary trajectory data changes; therefore, the fire control subsystem must recompute and transfer to the missiles updated data, as required. The fire control subsystem also serves as the controlling station for system training exercises and system testing.

Navigation Subsystem. To achieve a successful missile launch trajectory, both the position of the target and the position of the launcher must be known. Because the launcher for the TRIDENT system is on a constantly moving submarine, knowing specific ship's position, velocity, and attitude at all times is of paramount importance for a successful launch. It is the navigation subsystem's job to constantly provide this information. The position velocity,

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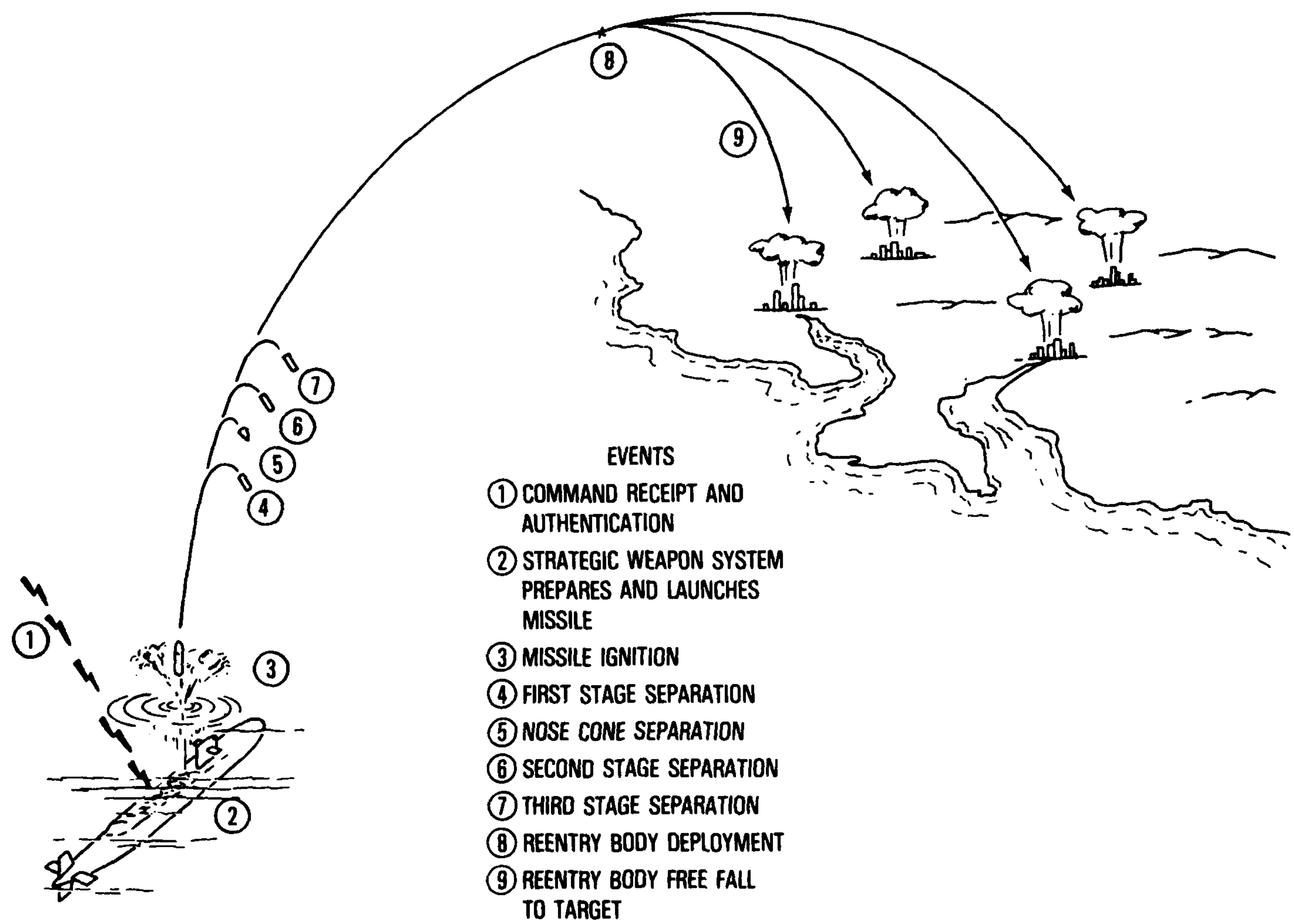

Figure 1. TRIDENT Concept.

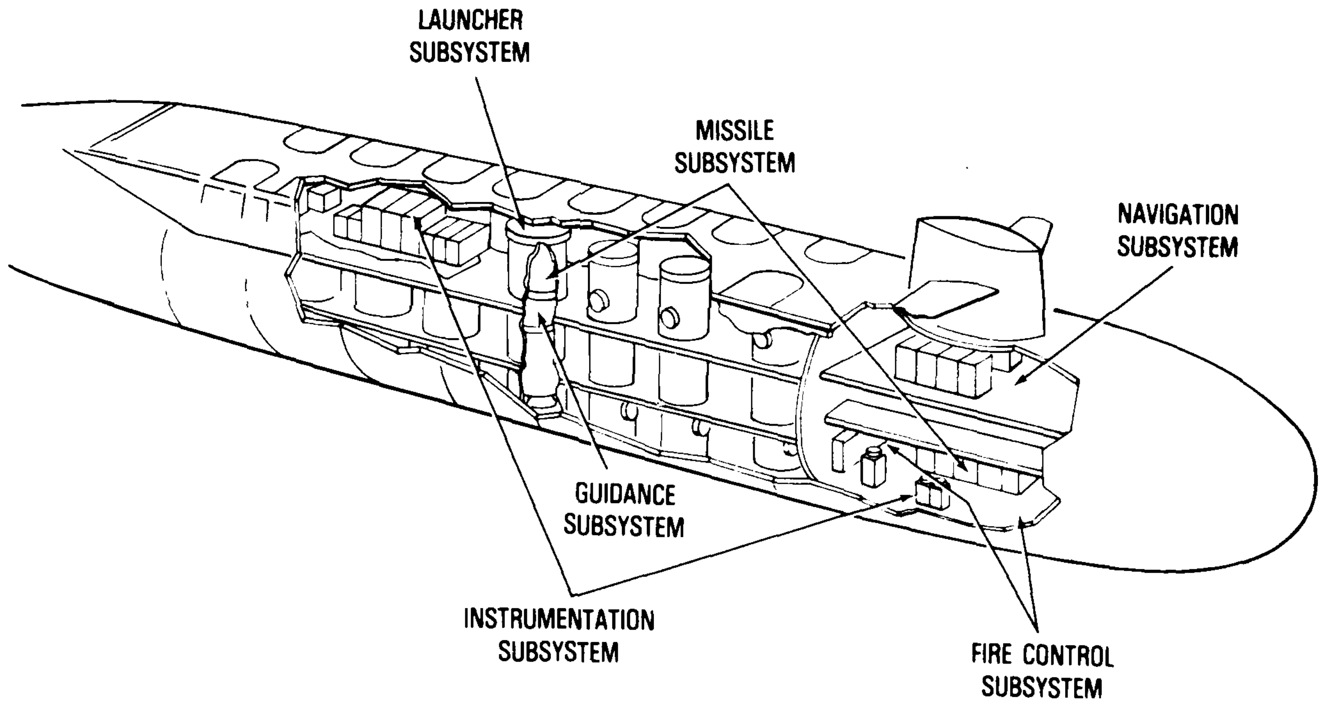

Figure 2. SWS Subsystem Physical Locations.

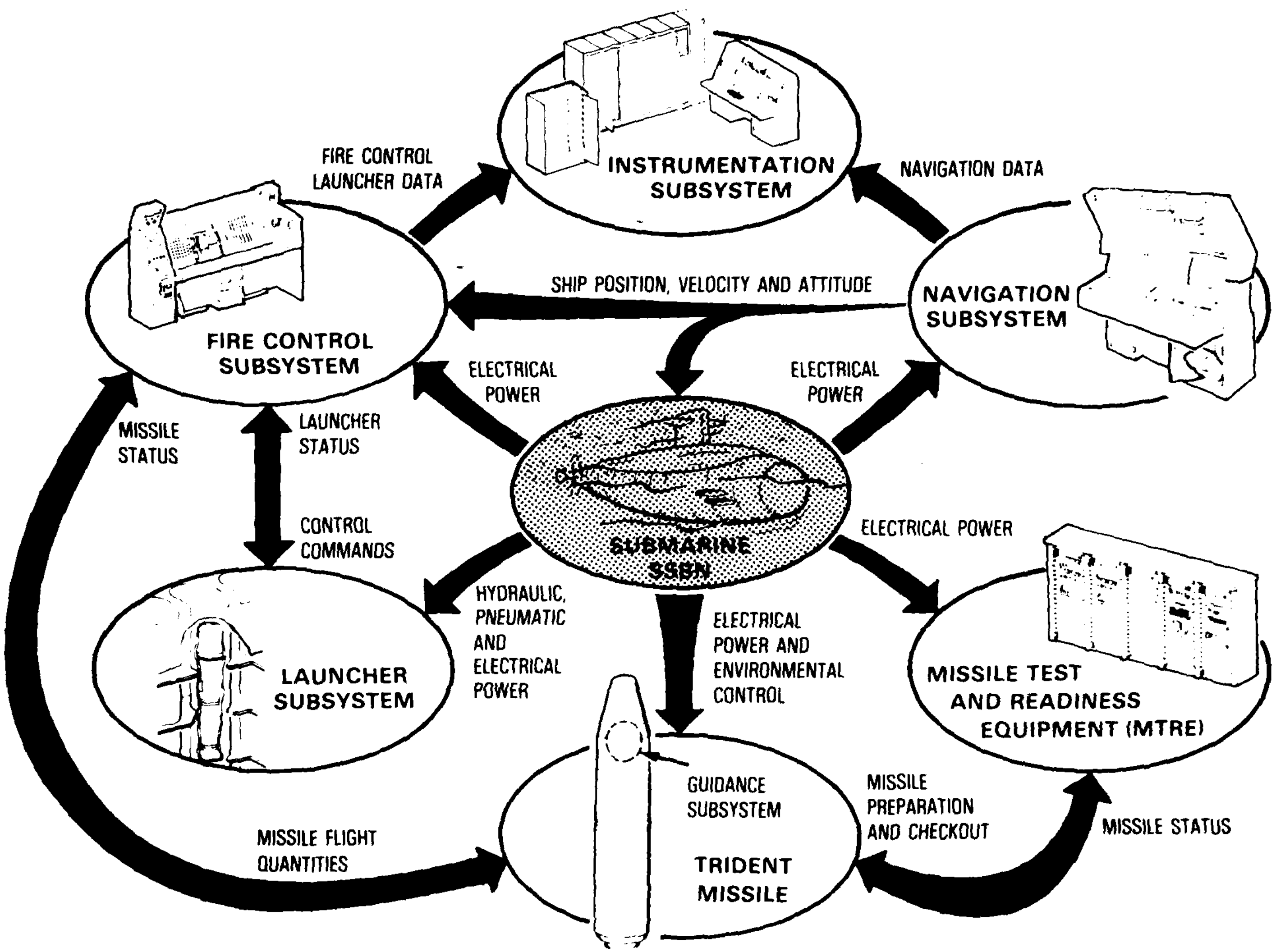

Figure 3. SWS Subsystem Functional Relationships.

and attitude data developed by the navigation subsystem, is used by the fire control subsystem in computations that relate to the missile's flight path.

Launcher Subsystem. The launcher subsystem, which includes a launch tube for each missile, provides the housing for missile storage aboard the submarine, including environmental control and shock protection. The launcher subsystem also provides the capability of ejecting the missiles from the submarine upon command to fire.

Missile Subsystem. The TRIDENT missile, a subsystem that contains solid propellant rocket motors and flight controls, is a vehicle that delivers the reentry bodies to points in space where, when released, they will free-fall to their designated targets. The missile subsystem also includes the missile test and readiness equipment installed on the submarine that provides a check on the readiness of the missile to perform its function.

Guidance Subsystem. This subsystem is a self-contained, computer operated stellar-inertial guidance device carried within each missile. It is the "memory" that is programmed by the fire control subsystem prior to launch and directs the missile flight controls to accurately position the missile to the points in space where the reentry bodies are released.

Instrumentation Subsystem. This subsystem acquires, processes, and records weapon system performance data during simulated and actual missile test launches. The data enables determination of whether the weapon system is performing according to specifications, evaluation of crew performance, and verification of the readiness of the crew and the weapon system to carry out their assigned mission.

THE SUBMARINE

The submarine is the vehicle that houses the weapon system, provides a mobile launch platform for the missiles, and provides the operating environment for the crew and equipment. The submarine also provides the required electrical, hydraulic, and pneumatic power to operate the weapon system.

The U.S. Ohio Class TRIDENT submarine is a third generation nuclear powered submarine, 560 feet long, with a submerged displacement of 18,700 tons, and equipped with 4 torpedo tubes and 24 missile tubes. It incorporates the latest advances in submarine technology to make it quieter and faster and to improve its survivability in the threat environments that may emerge over the next 30 years. The U.K. submarines to house the purchased TRIDENT II weapon system will be built by the U.K.

SHORE SUPPORT FACILITIES

Dedicated U.S. shorebases provide support for the submarines, crews, and the weapon system following each patrol. These bases include refit facilities, crew training facilities, and missile assembly and support facilities as shown in Figure 4 and detailed in the following paragraphs. Equivalent facilities are envisioned to be provided in the U.K. The U.S./U.K. POLARIS Sales

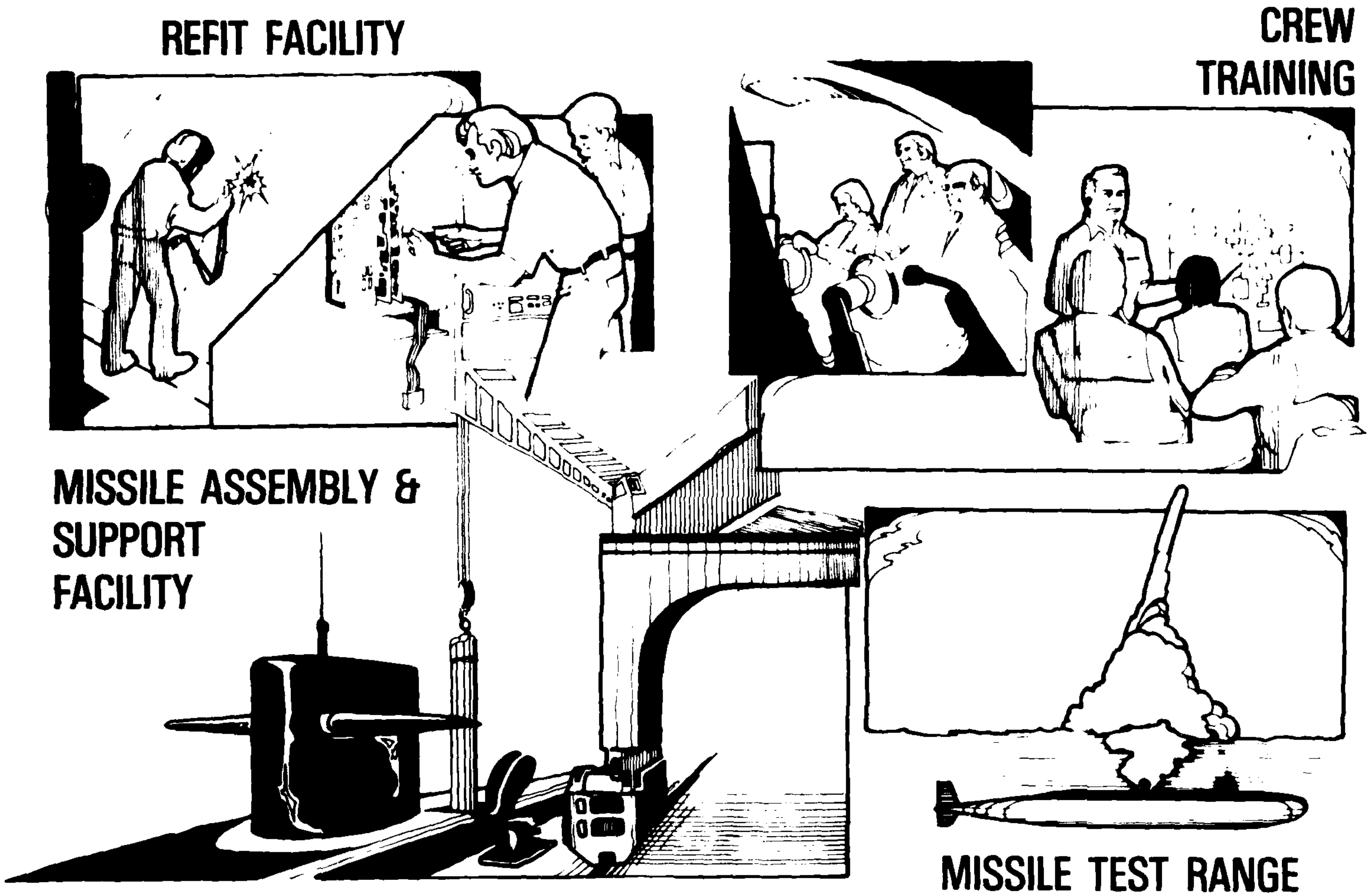

Figure 4. SWS Shore Support Facilities.

Agreement includes the equipment necessary to accommodate TRIDENT II in the U.K. facilities.

Refit Facilities. Refit facilities provide maintenance and repair services required by the submarine between major shipyard overhauls. The refit facility, which includes drydocking capability, can handle all repairs normally performed by submarine tenders. Included in the facilities capabilities are structural, machinery, and electrical/electronic repair; equipment and material storage and handling; and related support. In addition to supporting the submarine, the refit facilities can provide weapon system support services, including all rear echelon maintenance and repair services for the shipboard weapon system equipments. A pool of replaceable equipment at the facilities allows for exchange of faulty submarine-installed equipment, thus expediting returning the submarine to service.

Crew Training Facilities. Recognizing that the man who operates and maintains the weapon system is the most important element in this complex weapon system, facilities for initial training, as well as advanced and refresher training, are provided. The training program includes engineering, operations, and Strategic Weapon System training both for individuals and teams. Training will be conducted in classrooms and laboratories as well as areas that contain both tactical and simulated tactical equipments in an environment matching that found aboard the submarine.

Missile Assembly and Support Facilities. These facilities can support the needs of the remaining parts of the weapon system--the missile, launcher, and guidance subsystems. Each facility has the capability to receive, assemble, checkout, store, handle, onload, and offload missiles. Each facility provides the capability to store, handle, and install launch-associated expendables and various missile subsystem spare parts and provide for guidance subsystem handling and testing.

Material Support Facilities. These dedicated facilities provide for weapon system material outfitting, replenishment, storage, turn-in of failed reparable items, shipment/transshipment services, and supply technical logistics services such as allowance documentation maintenance and point of entry for DOD supply system requisitions.

MISSILE TEST RANGE

In addition to the dedicated shore support facilities, another facility, the U.S. Missile Test Range, plays a major role in the TRIDENT program. During early program phases, flight tests are conducted at the test range. Additionally, the test range has the capability to support TRIDENT submarines during test Demonstration And Shakedown Operations. These operations, called DASO's, are conducted whenever a submarine comes out of the shipyard following initial construction, overhaul, or conversion. The test firing of a specially instrumented missile with inert reentry bodies provides the dual benefit of operational training for the crew and a thorough operational test of the weapon system and submarine. Thus, the readiness and reliability of the submarine, crew, and weapon system can be evaluated as an operating entity and, unless found wanting, certified ready for deployment. The test range, in addition to the instrumentation necessary to record and evaluate the DASO, has a capability to prepare missiles for test firings. The test range is capable of servicing and supporting both U.S. and U.K. submarines.

CHAPTER 3
TRIDENT PROGRAM DESCRIPTION

The TRIDENT program is not a new program concept, but one growing evolutionarily from earlier successful ballistic missile programs, the POLARIS and POSEIDON programs. These past successes were considered due to, in part, the management organization and philosophy established approximately 25 years ago and still in place today.

Involvement in the TRIDENT program requires an understanding of working relationships that are part of the program's history, as well as an understanding of program development, milestones, and management.

U.S. TRIDENT PROGRAM

In the late 1960's, the U.S. instituted studies of future ballistic missile concepts, which led to the establishment of a U.S. Navy program for development of a new long-range system. This effort, initially known as Undersea Long-Range Missile System, evolved into the TRIDENT program.

TRIDENT evolved into a two-phase program. The first phase, based on technologies of the 1970's and operational in the 1980 time frame, is TRIDENT I. The second phase, to be based on technologies of the 1980's and due to become operational approximately a decade after TRIDENT I, is TRIDENT II.

The TRIDENT I system employs the C-4 missile, which almost doubles the range of its C-3 predecessor, commonly called the POSEIDON. The elements supporting the missile, now known as the Strategic Weapon System, were markedly redesigned to accommodate the increased requirements of the new missile. Similarly, those submarine elements providing operating services and environments were designed for the increased Strategic Weapon System demands. Additionally, shore facilities were designed to provide refit and support bases for the Ohio Class submarines.

A major TRIDENT I missile design consideration was the requirement to accommodate an optional retrofit into existing POSEIDON submarines. When the missile became available well before the TRIDENT submarine, this option was exercised and a number of POSEIDON submarines were equipped with these new missiles in a program known as the C-4 Backfit.

TRIDENT II was conceived as a system that would employ the larger, longer-range D-5 missile, but more importantly, would incorporate major gains in accuracy and effectiveness through use of advanced technologies. TRIDENT II will eventually replace the existing TRIDENT I in Ohio Class submarines.

U.K. TRIDENT PROGRAM

Basically, the amended POLARIS Sales Agreement allows for the U.K. purchase of the TRIDENT II weapon system, including missiles without warheads.

The U.K. would build TRIDENT-type submarines tailored for compatibility with the purchased items. The agreement also provides for U.K. purchase of the necessary equipment to outfit U.K.-built shore facilities to accommodate the TRIDENT II weapon system. The U.S. would retain technical management of all U.S.-produced equipment, and would provide the necessary interface coordination between the U.S.-produced equipment and the U.K.-built submarines and facilities.

The U.K. TRIDENT program consists of designing and constructing TRIDENT-type submarines in a configuration compatible with U.S. equipment, installing the U.S. equipment in the submarine, and establishing total system operating capability. The program also provides for modifying existing and constructing new shore support facilities compatible with the shore support equipment purchased from the U.S.

TRIDENT PROGRAM DEVELOPMENT

The TRIDENT program, as did its predecessors, will undergo a phased development that includes a program definition phase, an advanced development phase, a full-scale engineering development phase, and a production phase.

The program definition phase was the time period used to develop concepts, study these concepts, and identify the basic objectives, technologies, requirements, and parameters of the weapon system.

In the advanced development phase, the general system concept is subjected to rigorous technical analysis. Cost and schedule factors are weighed; courses of action, such as selection of major subcontractors and components, are chosen; feasibility is or is not demonstrated; and further development is or is not recommended.

The TRIDENT II program is well along into this phase. As of May 1982, subcontractors for approximately 10 percent of the major items comprising the weapon system have been selected with selection of the remaining subcontractors occurring at a rapid rate until nearly all selections are completed by mid-1985. The sequence of selection generally follows a specific pattern. Usually high technology item subcontracts are the first selected. This is followed by critical, special long-lead time, common, and competitive item subcontracts.

In the full-scale engineering development phase, engineering solutions are arrived at, engineering prototype models constructed, development testing of equipment to be submarine installed as well as facility equipment testing accomplished, flight tests are conducted to assess missile performance, system viability is demonstrated, and system production is confirmed.

In the production phase, system elements, selected and successfully tested in previous phases, are produced on a schedule that leads to total system assembly, operational testing, and acceptance. During the production phase, the submarine is constructed and subsystems are installed. Upon installation, an extensive shipyard testing program is conducted to test subsystems independently and collectively as a weapon system. The culmination of production phase testing occurs when demonstration and shakedown operations are conducted to assess the readiness of the weapon system, crew, and submarine for deployment. These operations consist of a series of tests designed to provide performance data on the TRIDENT system in as near an operational environment as is practical.

Following the production phase, the program enters the operational support phase which provides for maintenance of the weapon system throughout its life cycle.

Program Milestones. The TRIDENT II program phases are illustrated in Figure 5 to provide a time frame orientation. The uppermost bar shows the basic program phases from program definition to production. Representative milestones for the missile subsystem within these basic phases are shown below. The bottom-most items should be of particular interest. This shows the diversity of time among other selective subsystems. Note that the navigation subsystem tests start in what appears to be the early parts of the advanced development phase. This seemingly early start is attributable to the evolutionary aspect of the program. The existing TRIDENT I navigation subsystem is the current baseline for TRIDENT II. Although some changes will be made for the new program, this subsystem's phases are not closely tied to development schedules for the rest of the weapon system. The fire control subsystem, on the other hand, has interfaces with the other subsystems and will require improvements driven by changes in those subsystems.

PROGRAM MANAGEMENT

The TRIDENT program management structure is designed to provide efficient overall system control and subordinate levels of control for each of the major system elements; i.e., the submarine, the Strategic Weapon System, and shore facilities. Within each major element, technical and financial factors are controlled by designated U.S. Navy offices. These offices in turn designate contractors responsible to them for specified system increments.

The Strategic Systems Project Office (SSPO) is responsible for technical and administrative management of development, production, and support of the Strategic Weapon System and its operational support requirements. Other naval commands are responsible for management, development, and construction of the submarine and shore facilities. Because this guide is concerned only with the weapon system and equipment at shore facilities to accommodate the weapon system, management details are limited to SSPO.

The TRIDENT Project relationships are portrayed in Figure 6. The SSPO organization is shown in Figure 7. SSPO is headed by a Director, Rear Admiral Glenwood Clark. The U.K. Project Office is represented in the U.S. by a representative of the Chief Strategic Systems Executive (CSSE). Conversely, the U.S. Project Office is represented in the U.K. by a liaison officer of SSPO. Reporting to the Director are three divisions: the Plans and Programs Division, the Technical Division, and the Administrative Division. The Technical Director is responsible to manage the integration of the total weapon system while the Plans and Programs Director performs a similar function for the Training branch. Individual subsystem management responsibilities are delegated to the Technical Division and Training branches. Each branch operates

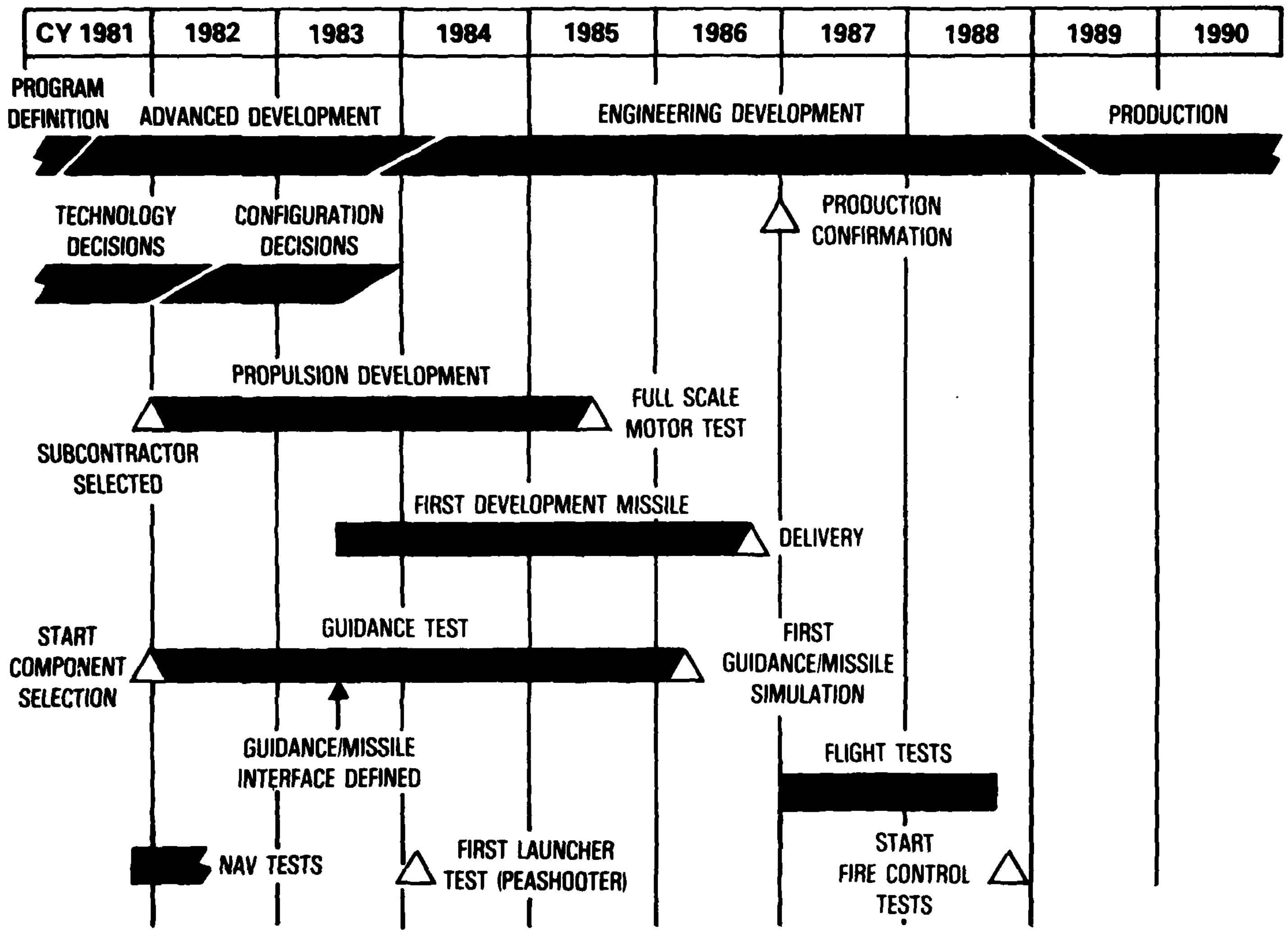

Figure 5. TRIDENT II Milestone Chart.

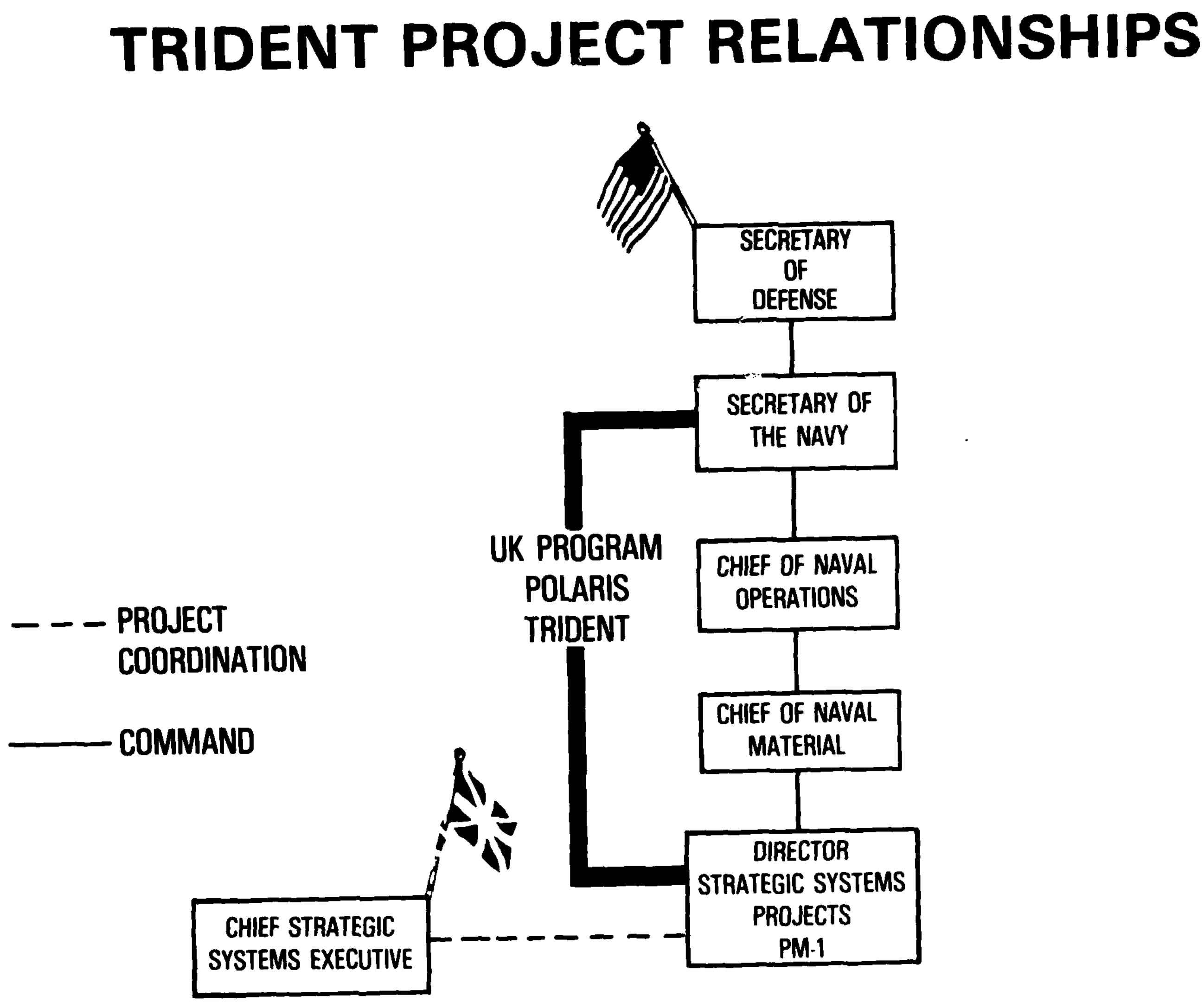

Figure 6. Project Relationships.

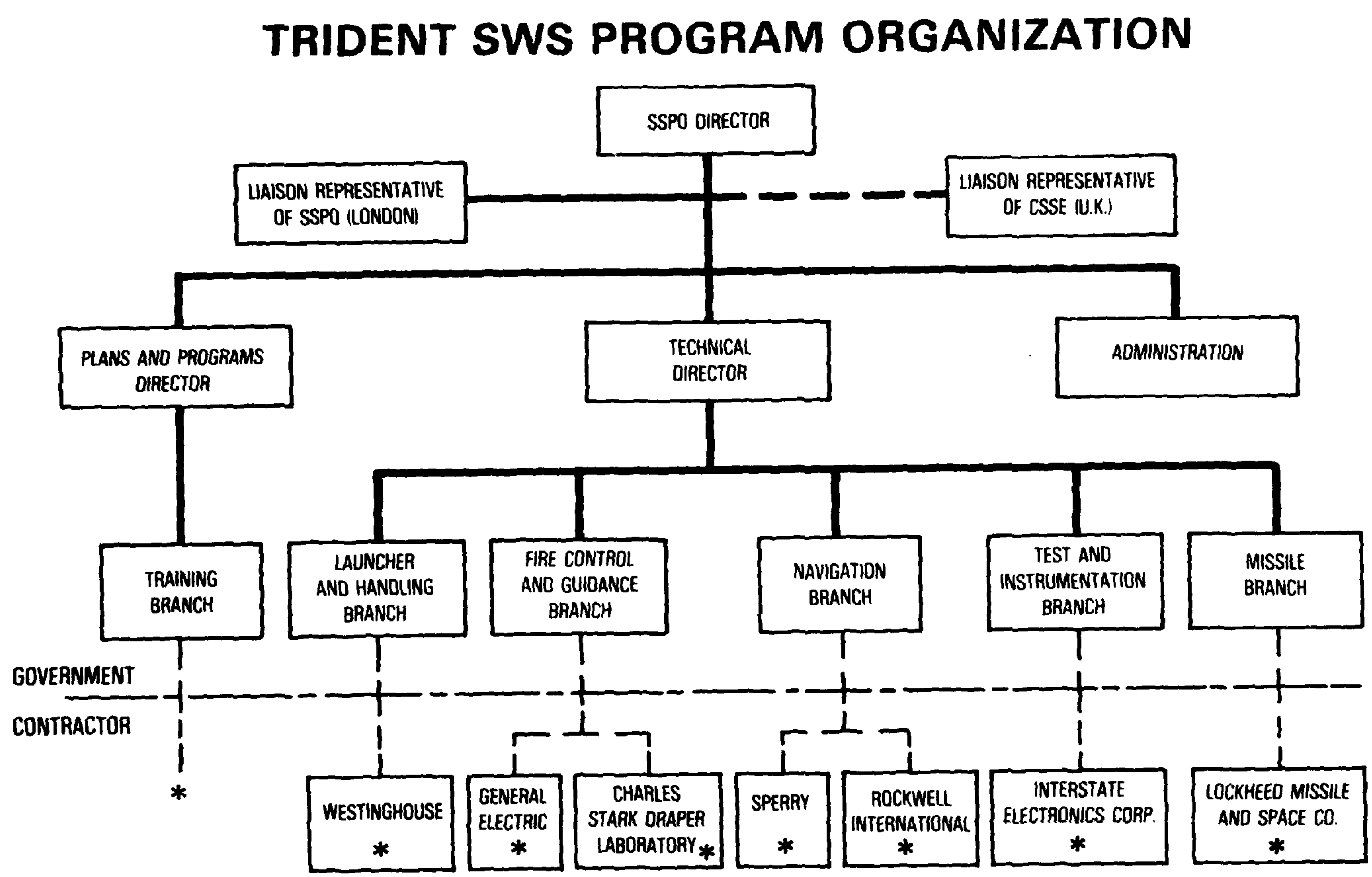

Figure 7. TRIDENT Program Organization.

within defined boundaries of authority and acts independently to provide technical direction and program guidance for subsystem design, development, production, and operational support of their respective subsystem.

This same basic organization has been employed since the early days of the POLARIS program.

Subsystem Contractor Roles. Each branch is augmented by a contractor or contractors who are responsible for development, production, and life cycle support. These contractors, who are known as "subsystem contractors," maintain close and continuous relations with the branch through the life cycle of the program.

Subsystem contractors for TRIDENT II are the same as those for the POLARIS, POSEIDON, and TRIDENT I programs. Because of their long time association with these programs these subsystem contractors have accumulated a wealth of data, knowledge, facilities, and experience in submarine-launched missile systems.

TRIDENT LIFE CYCLE

An important management philosophy of the TRIDENT program is the life cycle, or cradle-to-grave, responsibility of subsystem contractors and selected subcontractors. This total life cycle responsibility includes initial research, design, development, production, maintenance, fleet support, overhaul, and conversion. Life cycle responsibility ensures that there is no separation of responsiblity between research and development decisions and implementation of those decisions in later phases of the program. Additionally, this philosophy provides a continuation of policies, concepts, techniques, and control without loss, reduction, or new starts between program phases. Elimination of those negative factors that impact on cost and schedule has resulted in a continual improvement within the overall program.

This life cycle philosophy, coupled with the fact that the TRIDENT program is an evolutional development of the POLARIS and POSEIDON programs, points out the long and strong association between SSPO and their subsystem contractors. These associations in many cases may be carried over to the contractor/subcontractor level.

ACQUISITION PLAN

The acquisition plan for the TRIDENT II program is predicated on directions received from the Secretary of Defense at the program's outset. These directions were ". . . tailor the development and acquisition strategy to build upon and take full advantage of the existing TRIDENT program." Extrapolation of existing TRIDENT I technology permits making maximum use of the existing expertise, hardware, software, and facilities. Additionally, it permits minimizing costs and risks while reducing development time.

Based on the preceding, the decision was made to retain the existing management structure by employing the existing Navy-industrial team to design, develop, produce, test, and support the program and to obtain competition at the subcontractor level and below.

CHAPTER 4
SSPO TECHNICAL DISCIPLINES

Because the weapon system contains highly complex or critical items, SSPO has developed and invokes stringent technical program management requirements, or disciplines, to ensure that the integrity of the TRIDENT system will not be jeopardized in areas of safety, reliability, or performance. These disciplines provide the program with a definitive approach to maintaining high standards of reliability and readiness for weapon system operation and performance throughout the program's life cycle.

These disciplines were developed at the start of the POLARIS program and have been fully applied through successive generations of weapon systems. The success achieved throughout each generation has proven the value of the disciplines.

Although subcontractors may not be involved in all aspects of these disciplines, some will apply. Therefore, it is important to understand the philosophy behind these unique disciplines to recognize why they are being imposed and the degree to which they are imposed.

DEVELOPMENT PHILOSOPHY

The various items that constitute the weapon system have many subtle interactions, and experience has shown that seemingly trivial changes in a proven design, or the manner in which it is produced, can cause unpredictable, and sometimes serious, consequences. Therefore, once a design and method of production has been evaluated and proven through testing (and in the case of the missile, extensive flight testing), strict disciplines must be applied to ensure the reproducibility of the approved item.

These disciplines start in the early stages of an item's development. A thorough design evaluation is undertaken, with the major emphasis on proving the design by extensive in-plant and, if applicable, missile flight testing. These items are considered prototypes of the production item and, as such, must be built the same way as production items. This means that the production process, controls, and techniques are also developed and evaluated during the early development effort.

When the item has been successfully demonstrated by testing to be acceptable, the design, as well as the manufacturing process and procedures, are fully documented and frozen. A strict change control system is enforced thereafter.

Production items are then manufactured using the same design and manufacturing processes and procedures with the assurance that, if nothing changes, then the production units will be as acceptable as the development unit that was proven successful through testing.

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APPLICATION

SSPO implements its philosophy by contractually invoking the necessary disciplines upon each of its subsystem contractors. Individual subsystem contractors are, in turn, responsible for establishing and maintaining assurance to SSPO that products and services purchased from subcontractors comply with SSPO requirements. They fulfill this responsibility by imposing requirements and acceptance criteria upon subcontractors and establishing provisions for subcontractor surveillance to assure satisfactory performance.

A requirement imposed upon subsystem contractors is that they establish and document a system to control procurement and specify to subcontractors which applicable procurement control requirements and responsibilities will be imposed. Applicability is based on product complexity and its critical or noncritical application within the subsystem as well as the impact of defective products on the program. Among other things, this required system of controls forms the basis for determining approved sources, audit procedures, change control procedures, and control of purchased items via surveillance and inspection.

Approved Sources. Once a procurement source is selected, the subcontractor is objectively evaluated on a continuing basis using data from subsystem contractor source inspection, receiving inspection, fabrication, assembly, acceptance test and inspection, onsite surveys, audits, and field use feedback. This information is used in subsequent procurements.

In the case of major subcontracted or critical items, once approved sources are selected, they are generally retained for the life of the program.

Subcontractor Audits. The subsystem contractor establishes and maintains a system to schedule and conduct onsite audits to assure compliance with procurement document requirements. The frequency, scope, and method for auditing is based upon the criticality or complexity of the items being procured, known problems or difficulties, and quality history. The planned coverage of each audit is documented and includes examination of product assurance program elements, operations, articles, materials, and documentation to determine compliance with the established requirements. Audits are performed by an independent audit group or by personnel not having assigned responsibilities at the subcontractor facility. Results of the audits, with recommendations for corrective action if needed, are documented. Follow-up is required to verify that effective corrective action has been taken.

SSPO also reserves the right to review both subsystem contractor and subcontractor operations to determine compliance with contractual requirements. In the case of major subcontracts and those subcontracts for critical and complex items, SSPO or a U.S. Navy activity representing SSPO may conduct onsite audits at subcontractor's plants to ensure that applicable disciplines are being invoked.

Change Control. It is the subsystem contractor's responsibility to provide for the control and approval of changes to drawings, test procedures, specifications, and other procurement documents, and for the incorporation of approved changes. Design modifications must be approved in accordance with established procedures prior to incorporation of changes in procurement documents. For items procured to contractor design, the control shall include assurance of notification of change to the subcontractor, verification of the incorporation, and appropriate identification of those items on which the change is incorporated. When subcontractor design, fabrication methods, or processes have been approved or qualified by the subsystem contractor, controls are established to monitor and approve subcontractor notices of proposed changes.

Control of Purchased Items. The subsystem contractor is required to verify the quality of purchased items, materials, and services by performing appropriate inspections and tests either upon receipt at his facility or at the subcontractor facility. The production test and inspection plan for this control, although not formally submitted in all cases, must reflect a coordinated program of controls at the source and at the subsystem contractor facility. The following are specific requirements, cited as examples of the extent of these controls that are imposed upon the subsystem contractors.

- Criteria for Subsystem Contractor Source Inspection. The subsystem contractor shall perform appropriate actions, including source inspection at the subcontractor facilities, when any of the following conditions apply:

  a. Items are being procured at a level of assembly that prevents verification of the quality at the subsystem contractor facilities.

  b. Manufacturing processes have an effect on the item such that quality cannot be determined solely by examination or test of the completed item at the subsystem contractor facilities.

  c. Destructive tests are necessary at the subcontractor facilities.

  d. Special test and inspection equipment and environments required cannot feasibly and economically be reproduced or made available at the subsystem contractor facilities.

  e. Shipments of completed items are made to destinations other than the subsystem contractor facility.

- Subsystem Contractor Source Inspection and Surveillance Procedures. The subsystem contractor shall establish and maintain procedures to be followed by the subsystem contractor source inspector. These procedures and instructions shall include the following:

  a. Requirements for performing, witnessing, sampling, or verifying tests and inspections.

  b. Methods for monitoring subcontractor processes, fabrication, and assembly operations.

c. Requirements for documenting, collecting, and submitting source inspection and surveillance data.

- <u>Subsystem Contractor Source Inspection and Surveillance Records</u>. The subsystem contractor shall maintain the following:

  a. Records of inspections and tests performed by the source inspector.

  b. Records of inspections and tests witnessed by the source inspector, including quantities witnessed and nonconformance data, disposition made of nonconforming items, and corrective actions required of subcontractors.

  c. Periodic reports from the source inspector to the subsystem contractor on subcontractor operations monitored, including problems found and corrective actions taken.

- <u>Receiving Test and Inspection</u>. The subsystem contractor shall establish and maintain a receiving test and inspection system that includes the following:

  a. Test and inspection of purchased items to verify compliance with specification and drawing requirements either at the source or at the subsystem contractor facilities.

  b. Assurance that purchased items have been qualified when required.

  c. Evidence that required test and inspection by the subcontractor have been performed and that required data have been provided.

  d. Evidence that required subsystem contractor source inspection has been performed, and required data submitted.

  e. Verification of the acceptability of required subcontractor test and inspection data.

  f. Assurance that purchased items determined to be subject to age or environmental deterioration include proper control markings.

  g. Earliest practicable inspection of government-furnished material.

  h. Clear identification of items procured for use in Navy Strategic Weapon Systems.

  i. Segregation of items awaiting test or inspection. Segregation of acceptable items and nonconforming items.

  j. Identification of purchased items released from receiving inspection to clearly indicate acceptance or nonconforming status.

k. Sampling test and inspection. (Sampling tests used by subcontractors may be subject to review and approval by the subsystem contractor.)

<u>Government Inspection, Monitoring, and Acceptance</u>. Although the subsystem contractor usually performs in-process testing and inspection during fabrication and assembly, SSPO or a U.S. Navy activity representing SSPO also reserves the right to inspect at the source any items procured by subcontract. Normally such inspection is limited to highly complex or critical items. In addition, final government acceptance may be performed onsite at the subcontractor's facilities.

CHAPTER 5
SUBSYSTEMS

The TRIDENT II subsystems will be based on the experience and technology gained from the TRIDENT I program. The missile itself will be increased in length and diameter. The range of the missile will be enhanced, and it will carry an increased payload. Energy management in the missile will be improved as well. An all new guidance subsystem with redesigned steering and navigation equations, software and hardware will provide improved accuracy. Missile test and readiness equipment will also be new.

The fire control subsystem will require major redesign, modification, and upgrading. The fire control computer will be upgraded and its memory capacity expanded to accommodate the new guidance subsystem. Power source and power distribution will require modification. A new interface with the new missile test and readiness equipment and a new interface with the navigation subsystem will be required.

Although the control functions of the launcher subsystem are adaptable for TRIDENT II, the launch tube and its associated groups will be resized to accommodate the larger missile. The missile support group and the launch tube closure will be redesigned. In addition, the ejector group will include a new variable energy ejection system.

The navigation subsystem will be upgraded to include new interfaces and sensors. The signal interfaces to the submarine and the fire control subsystem will be converted to digital for TRIDENT II. To support the TRIDENT II accuracy requirements, additional sensors will be employed in the gravity sensor area. A velocity measuring sonar and global positioning satellite will also be added.

The instrumentation subsystem will have an enhanced data collection and processing capability, an increased telemetry capability and new interfaces with other subsystems. New sensors will be developed to support the TRIDENT II accuracy requirement.

The TRIDENT II system is still in the advanced development stage, therefore a detailed physical and functional description is not provided. However, since TRIDENT II is evolutionary, TRIDENT I is described in the following paragraphs to facilitate understanding of the subsystems and subsequently the components and parts that may be subcontracted. Subcontracts may range from off-the-shelf, or stock, items to items requiring special design, development, and documentation.

Many of the subsystem contractors have already selected major subcontractors by virtue of their participation in the POSEIDON or TRIDENT I programs. Although these major subcontractors are not necessarily identified herein, it is expected that they will initiate procurements that will be of interest to potential suppliers. To this end, inquiries from potential suppliers received by subsystem contractors will also be referred to the major subcontractors in order that the inquiries may also obtain consideration by these firms.

MISSILE SUBSYSTEM

Subsystem Description. The TRIDENT I (C-4) missile is an inertially guided, three-stage, solid-propellant missile with a maneuverable post boost vehicle which is separated to independently deploy reentry bodies. The missile, as shown in Figure 8, consists of first-stage, interstage, second-stage, adapter, third stage, equipment, reentry, and nose fairing sections.

The first-stage section provides thrust for missile acceleration and thrust vector control during first-stage flight. The first-stage section is a structural member of the missile body and is made up of a motor chamber, igniter, propellant, thrust vector control components, and nozzle. The interstage connects the first-and second-stage sections, and has doors to provide access to the first-stage and second-stages, as well as air bleed holes to permit pressure equalization. The second-stage section provides thrust for missile acceleration and thrust vector control during second-stage flight. It is similar to the first-stage section except that it is smaller.

The equipment section provides the mounting platform for the major missile electronic packages, the guidance subsystem (described separately), and the third stage motor, and is the launch platform for the reentry bodies. The flight control electronics package is a rectangular package containing the flight control computer and interface circuits. The package provides event commands and issues missile steering commands during missile flight. The flight control rate gyro package detects missile response to attitude changes. The post boost control gas generators and integrated thrusters provide thrust to maneuver the equipment section during the deployment phase of flight. The command sequencer is a data processing unit that accepts, decodes and transmits digitial data from the fire control subsystem to individual reentry bodies during the prelaunch phase. The missile interlocks control ignition and separation events throughout missile flight with accelerometers, an initiation data decoder, control logic circuits, and switching circuits. The missile inverter consists of an 8-kHz oscillator and an ac power amplifier, which converts power from the primary electronics battery.

The nose fairing section is an aerodynamic-shaped structure that protects the forward end of the missile during launch and early boost flight. The nose cap portion contains a telescoping aerospike to reduce atmospheric drag on the missile during the initial part of flight. The aerospike is extended by an inertial deployment system after launch.

The submarine-installed missile test and readiness equipment, shown in Figure 9, performs preparation and checkout functions to determine the operational readiness of each missile prior to launch. This equipment is rack-mounted, interconnected electrical and electronic components such as actuator-indicators, computer circuits, measurement circuits, display devices, timers, meters, and tape reader-printers, among others.

The missile subsystem is also comprised of support equipment, both electrical and mechanical. Electrical support equipment, some of which are shown in Figure 10, comprises those items of equipment required to test and process missiles, subassemblies, packages, and components at the source of supply, the processing facility, and aboard the submarine. Electrical support equipment construction will range from small simulators, suitcase units, and single bay consoles to multi (over 30) bay systems. The following are categories of electrical support equipment used for the TRIDENT program:

Package and Component Test Consoles
Factory and Facility System Test Consoles
Shipboard Test Consoles
Ancillary Test Equipment (portable)

Mechanical support equipment, a sample of which is shown in Figure 11, comprises those pieces of equipment required to transport, protect, assemble, store, checkout, and load TRIDENT missiles. The following are categories that are used for the TRIDENT program:

Lifting Equipment, Slings, Strongbacks, etc.
Up-Ending Equipment
Environmental Control Equipment
Mechanical Test/Checkout Equipment
Rolling Stock, Trailers, Dollies, etc.
Containers
Hand Tools
Ladders, Stands, and Handling Fixtures
Static Grounding Equipment
Enclosures, Service Unit, Transfer Unit, etc.
Restraints and Tiedown Equipment for Transportation

Subsystem Contractor. Lockheed Missile and Space Company (LMSC) is the missile subsystem contractor. LMSC provides the missiles, without propulsion motors, using components procured from subcontractors. The propulsion motors are fabricated by a joint venture of Hercules Inc. and Thiokol Corp. who ships them directly to the missile assembly and support facilities for assembly into the missile. Much of the support equipment procured is constructed by subcontractors. Technologies required are too numerous to list herein. Based on TRIDENT I experience, the following are examples of components that LMSC may procure from subcontractors:

RAW MATERIALS

Aluminum Sheets	Ablative Materials
Rod, Bar, and Tube Stock	Conductive Rubber and Plastics
Composite Parts	Substrates

CONFIGURED RAW MATERIALS

Heat Shields	Extrusions
Insulators	Plastic Shapes

<u>CONFIGURED RAW MATERIALS</u> (Cont'd)

Hoses
Seals
Rubber Shapes
Silicone Shapes
Wire and Cable
- -

<u>CASTING AND FORGINGS</u>

Titanium Castings
Aluminum Castings
Steel Castings
Titanium Forgings
Aluminum Forgings
Steel Forgings

<u>MECHANICAL PARTS AND COMPONENTS</u>

Manifolds
Machine Parts

<u>ELECTRICAL PARTS AND COMPONENTS</u>

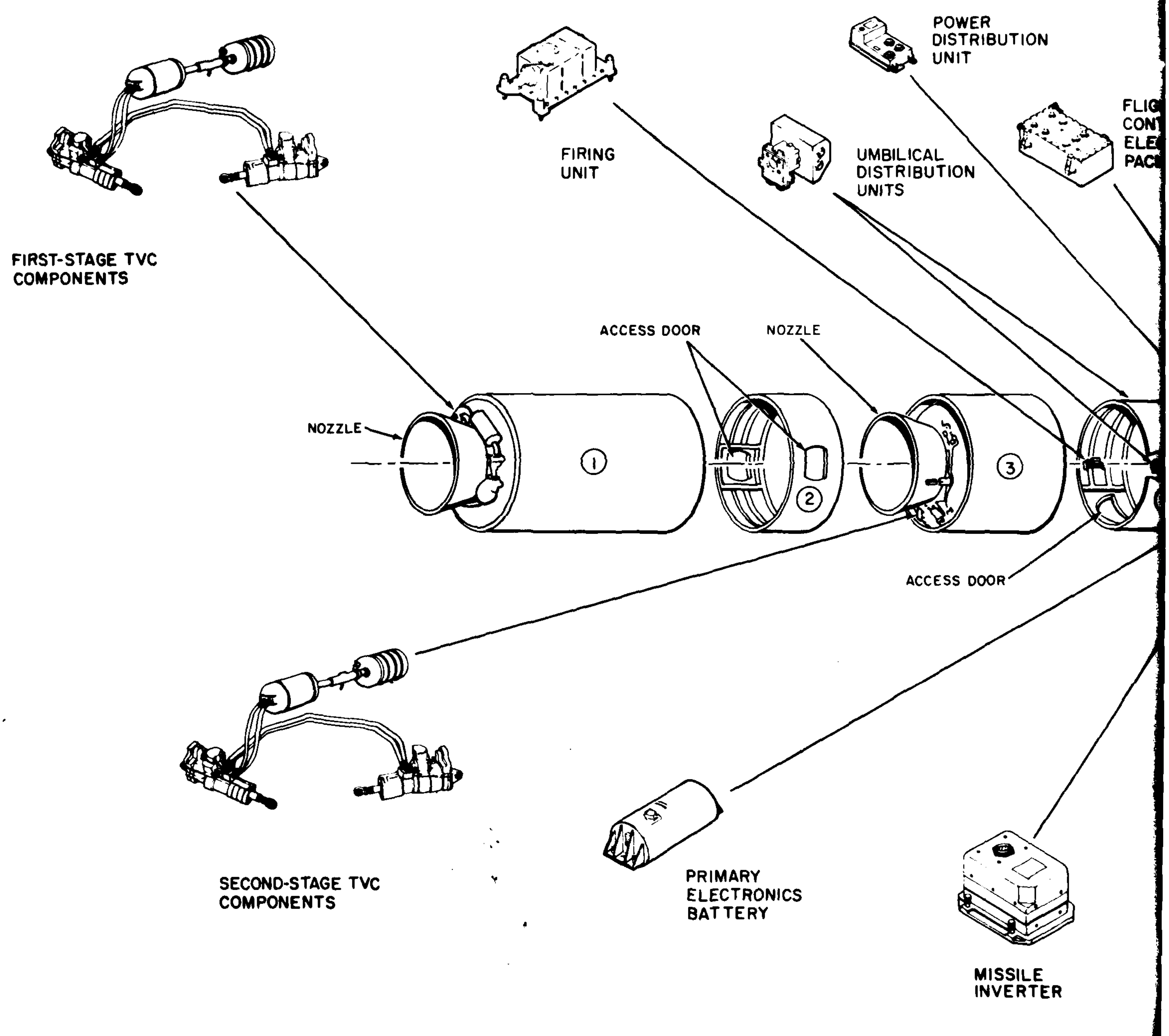
Special Connectors
RF Transmission Lines
Antennas
Umbilical Cables
Power Suppliers
Fans
Switches
DC to DC Converters
Relays
Transformers
Servoactuators
Electromechanical Power System

<u>ELECTRONIC PARTS AND COMPONENTS</u>

Circuit Boards
Transducers
Amplifiers
Multiplexers
Frequency Translator
Transmitters
Transponder
Rate Gyro
Accelerometers
- -

<u>ORDNANCE</u>

Initiators
Separation Nuts/Bolts
Thruster Assemblies
Gas Generators
Small Rocket Motors
Detonators
Cartridges
Shaped Charge, Flex Linear
Detonation Cord
- -



POWER DISTRIBUTION UNIT
FIRING UNIT
UMBILICAL DISTRIBUTION UNITS
FIRST-STAGE TVC COMPONENTS
ACCESS DOOR
NOZZLE
NOZZLE
1
2
3
ACCESS DOOR
SECOND-STAGE TVC COMPONENTS
PRIMARY ELECTRONICS BATTERY
MISSILE INVERTER

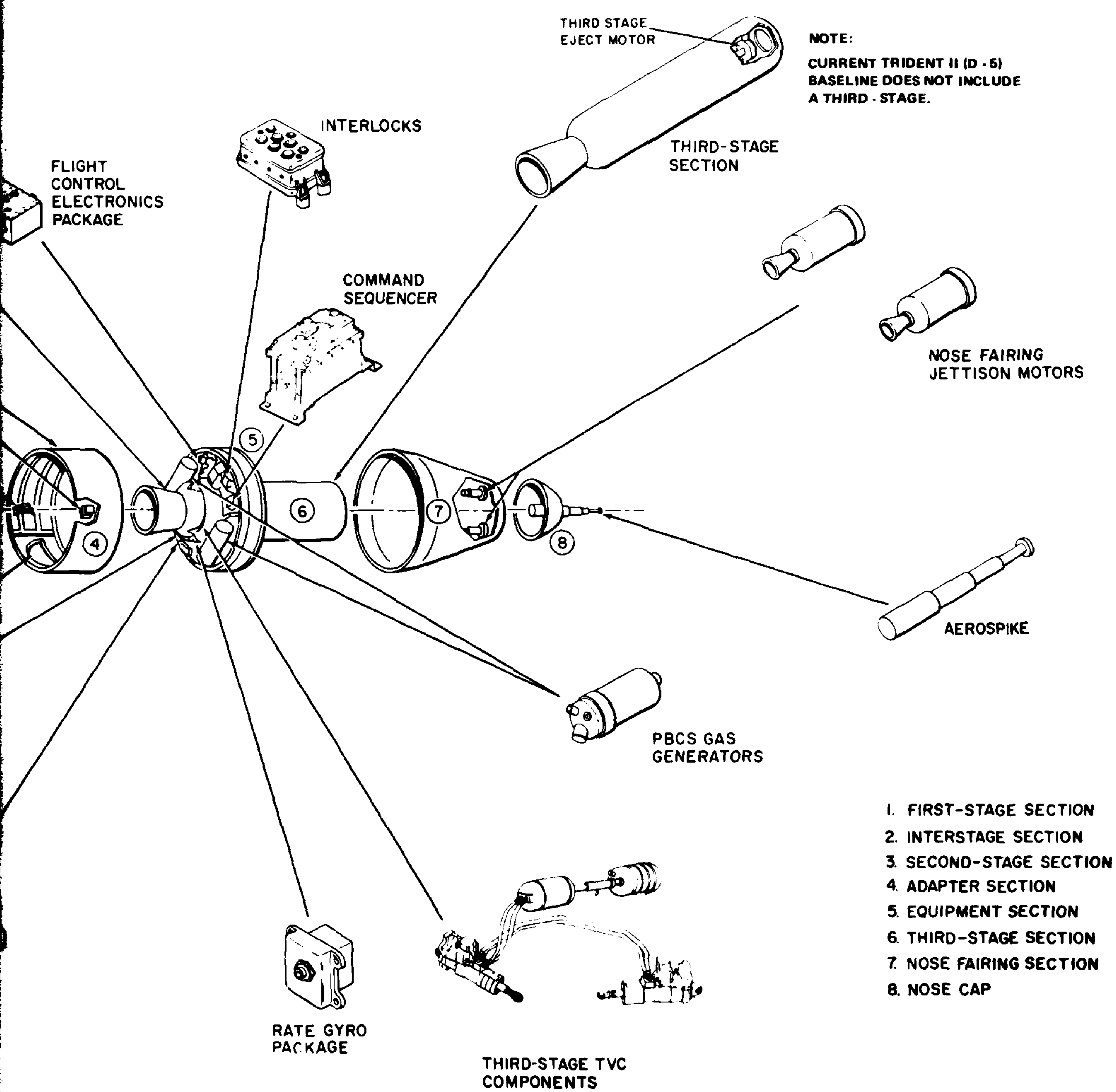


Figure 8. TRIDENT I (C-4) Missile Subsystem - Missile.

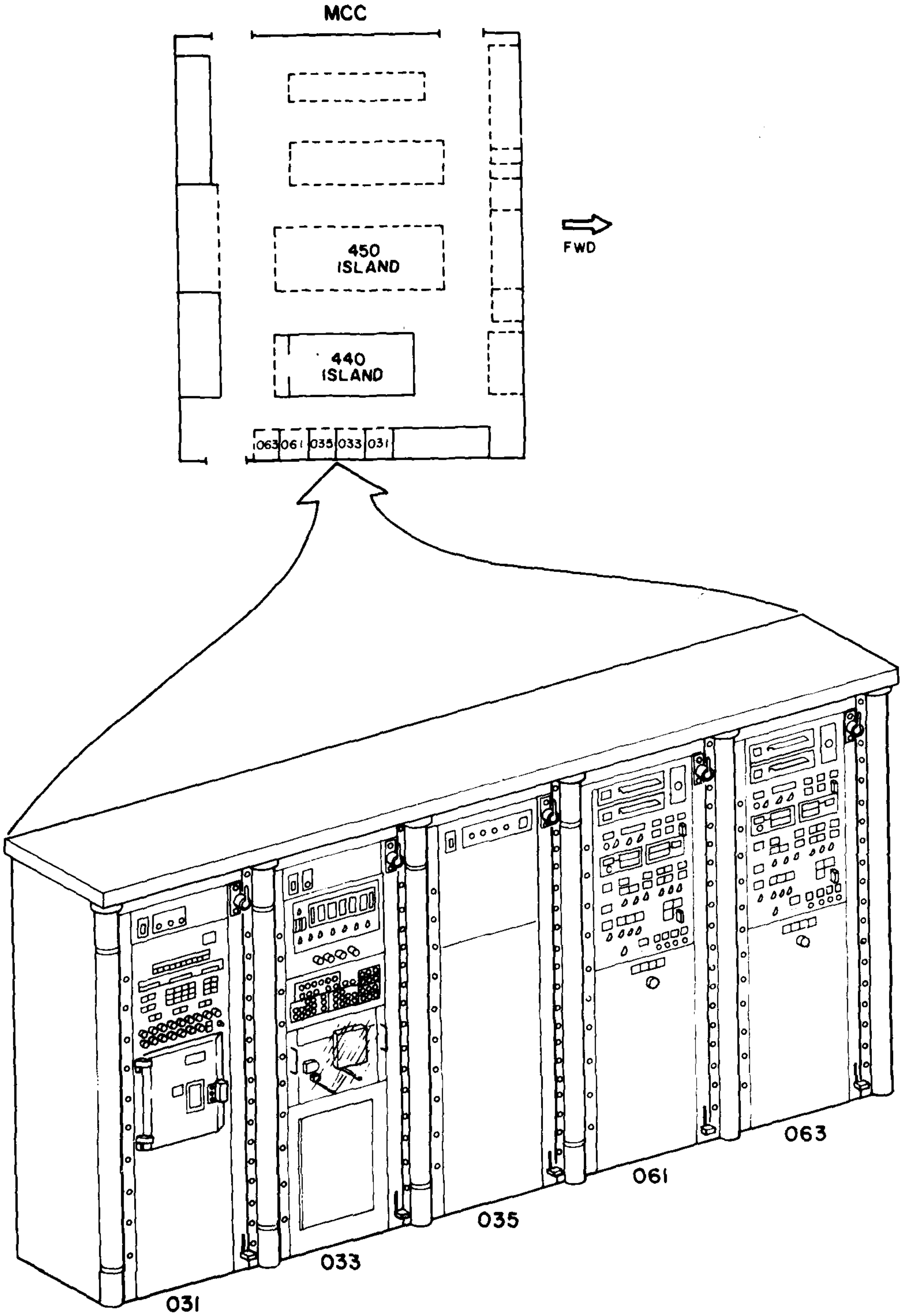


Figure 9. TRIDENT I (C-4) Missile Subsystem - Missile Test and Readiness Equipment.

INSTRUMENTATION

Gages
Calorimeters
Magnetometers
Oscilloscopes
Frequency Generators
Digital Multimeters

CRT's
LED's
Multiplexers
Decommutators
Test Systems
RF Test Equipment

OPTICS

Optical Windows

Fiber Optics

HANDLING EQUIPMENT

Dollies
Slings
Trailers
Winches
Turntables
Upenders
Straddle Carriers
Reusable Containers
Jacks

Pallets
Pneumatic Devices
Special Purpose Tools
Stands
Clearbores
Guide Rails
Installation Mechanisms
Air Conditioning Systems
- -

COMPUTER AND PERIPHERALS

Memories
Micro Processors
Mini Computers

Memory Systems
Disk Drives
- -

HARDWARE/SUPPLIES

Sealers
Sleeving
Toolings
Compounds
Paints

Adhesives
Chemicals
Cabinets
Titanium Fasteners
Aluminum Fasteners

HYDRAULIC

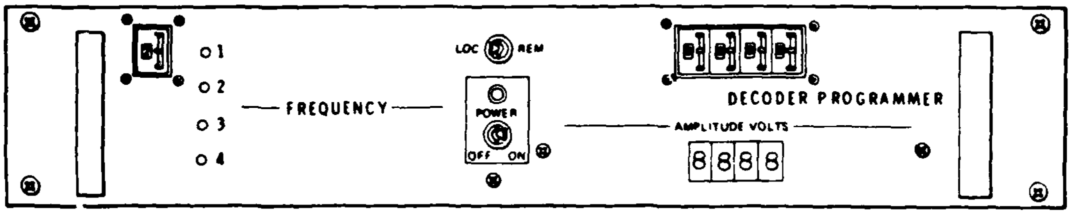
Hydraulic Valves

Hydraulic Pumps

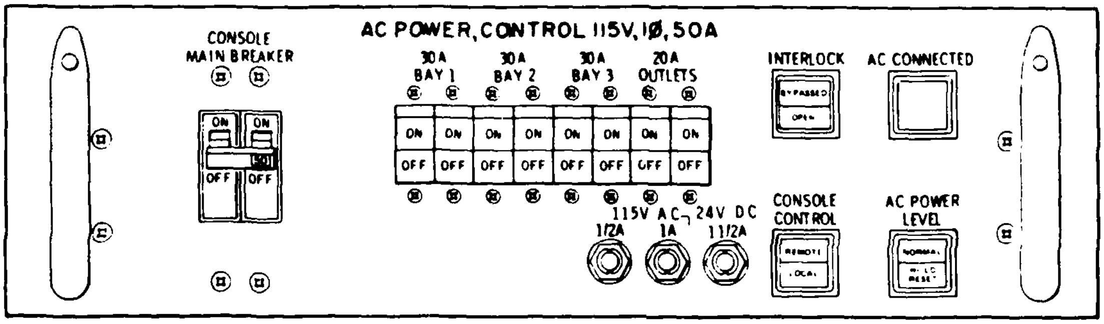
SPECIALTY ITEMS

Hi-Rel Piece Parts

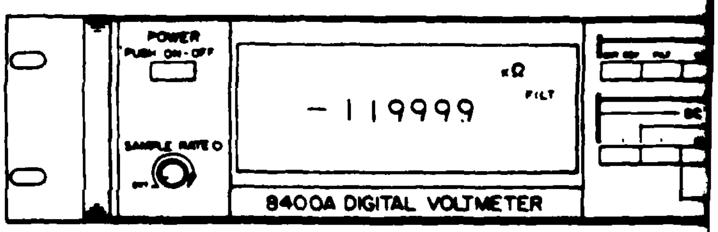
Electronic Black Boxes



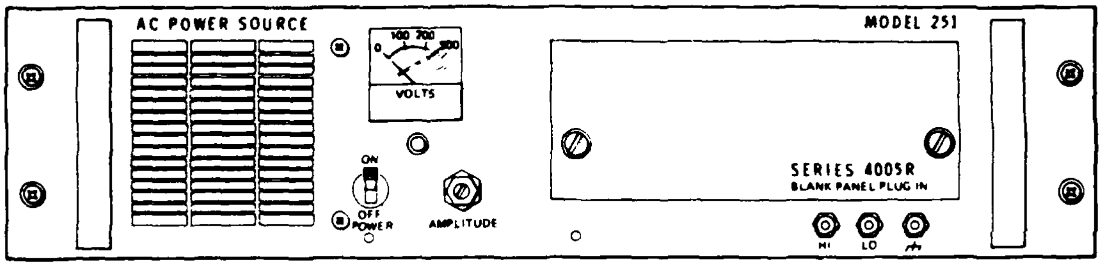
DPTC - Decoder Programer, Controls and Indicators



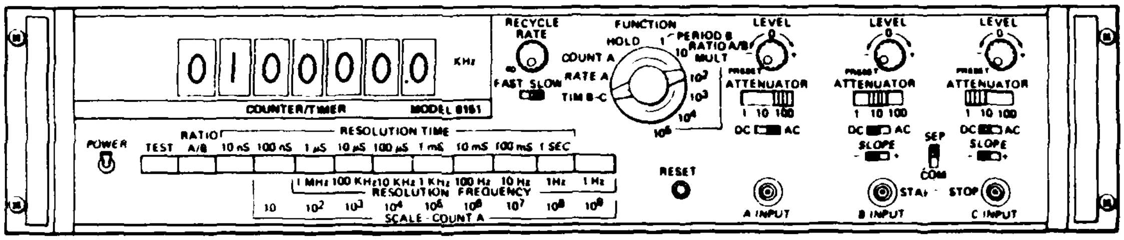
DPTC - AC Power Control Panel, Controls and Indicators



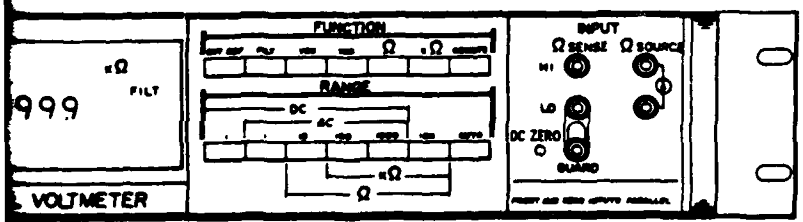
DMU Digital Voltmeter, Controls, Indic



DPTC - 2-kHz Power Supply, Controls and Indicators

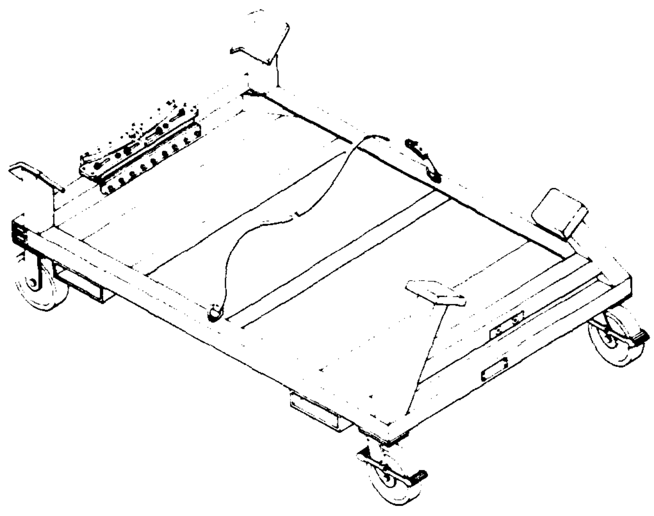


DPTC - Counter-Timer, Controls, Indicators, and Connectors

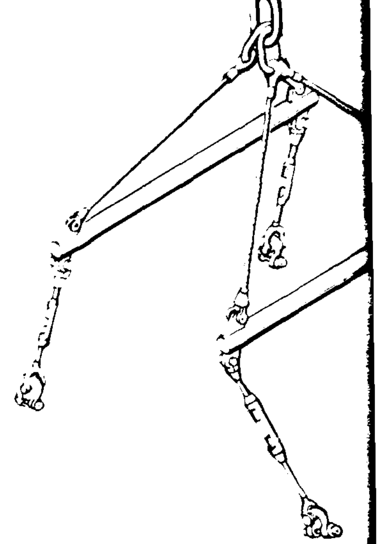


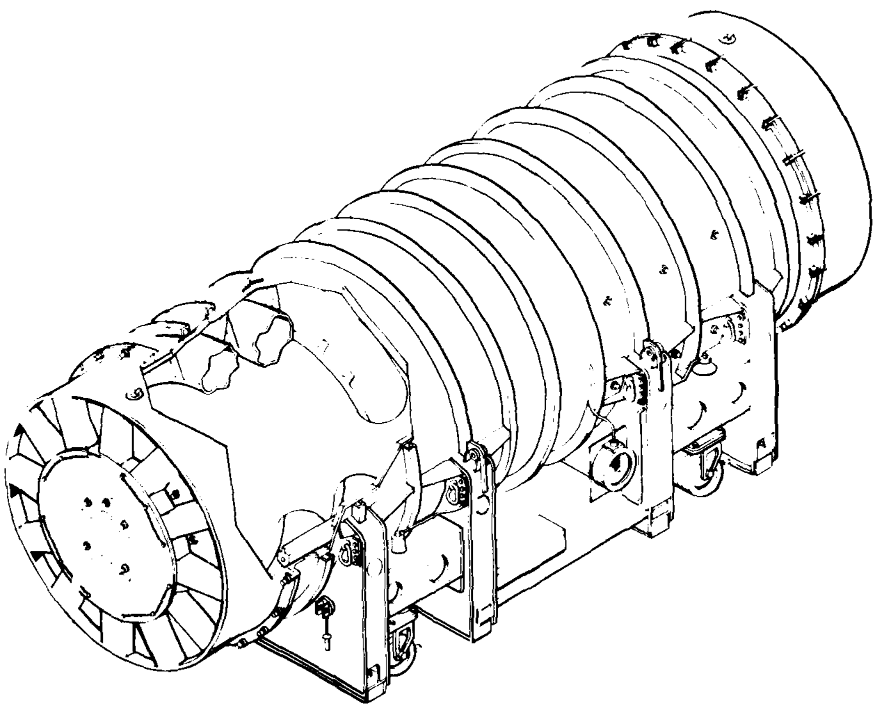
oltmeter, Controls, Indicators, and Connectors

Figure 10. TRIDENT I (C-4) Missile Subsystem - Electrical Support Equipment.

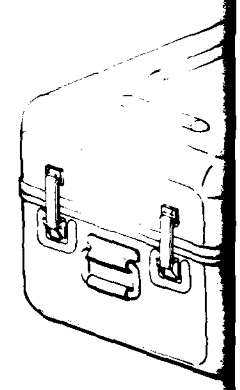


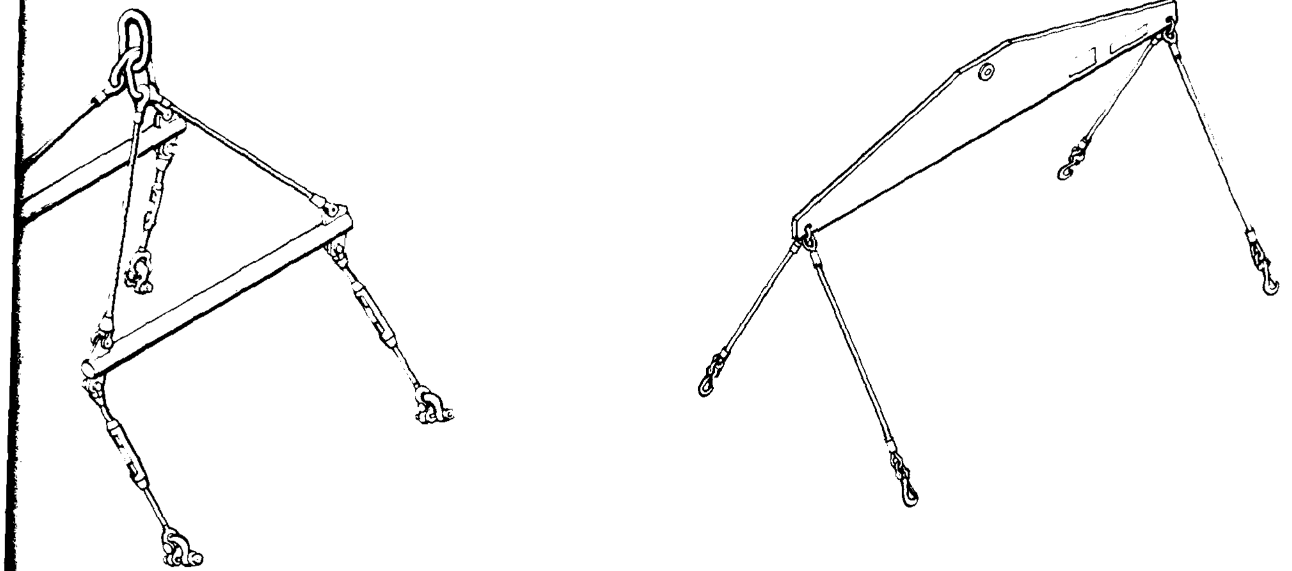
DOLLY



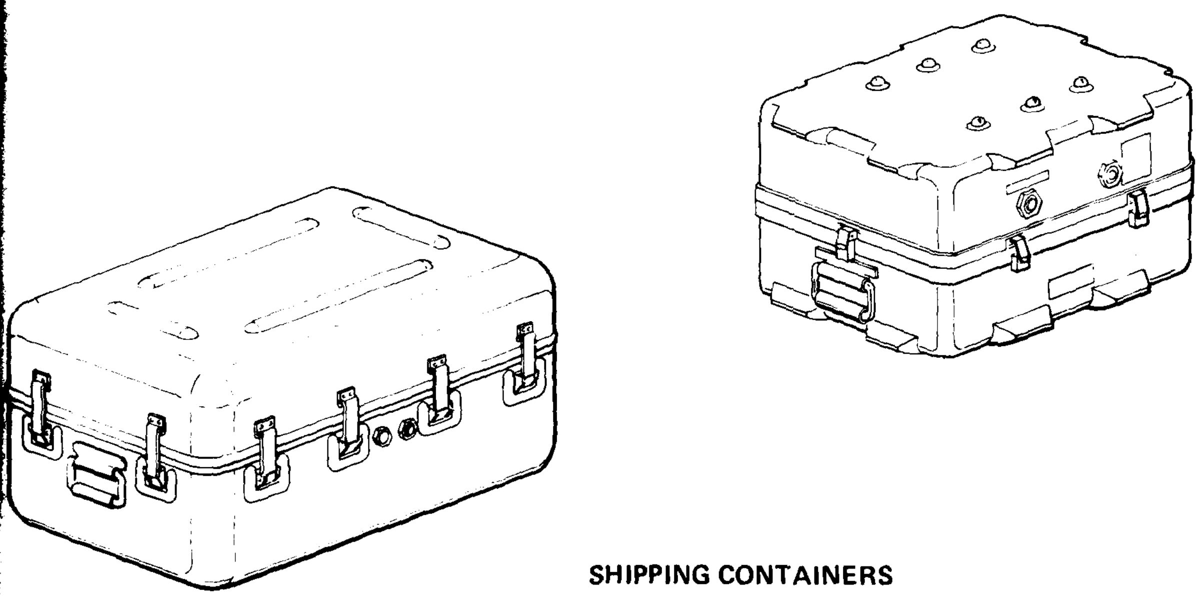


TRANSPORT EQUIPMENT

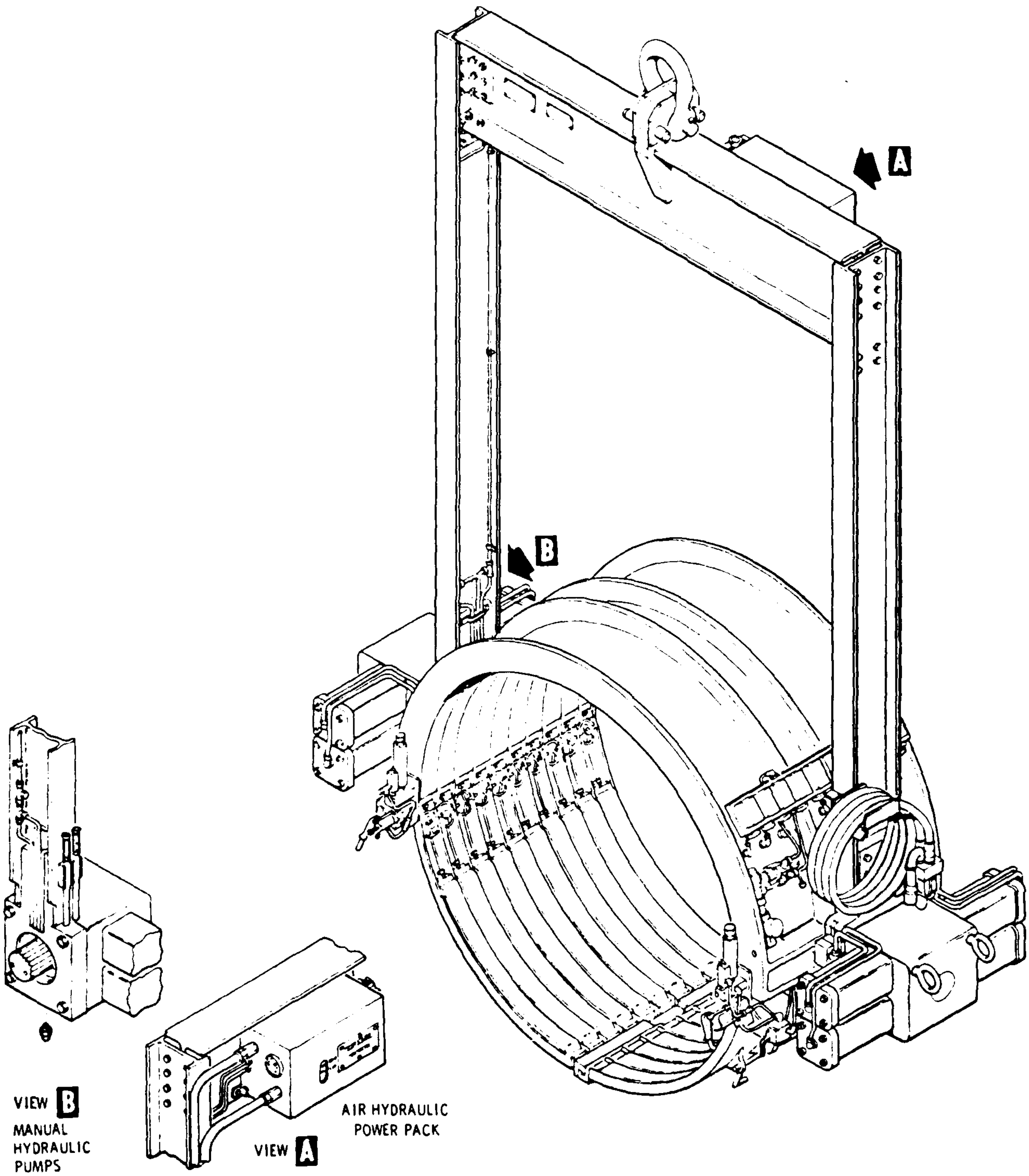




SLINGS AND STRONGBACKS



SHIPPING CONTAINERS



FACILITY HANDLING EQUIPMENT

Figure 11. TRIDENT I (C-4) Missile Subsystem - Mechanical Support Equipment.

GUIDANCE SUBSYSTEM

Subsystem Description. The guidance subystem employs a stellar-inertial guidance concept allowing the missile to accurately reach a point and velocity on the trajectory where reentry bodies are released and will free-fall to their targets. This accuracy is provided by an inertially referenced guidance system coupled with the capability of in-flight course corrections. The guidance subsystem, shown in Figure 12, is made up of the inertial measurement unit and the electronics assembly. Flight information, provided by fire control data transmissions prior to launch, enable missile self-guidance after launch.

The inertial measurement unit contains inertial components that provide the missile with a reference orientation relative to inertial space and a measurement of missile velocity. The inertial measurement unit is a sealed, spherical case. Inside the case are four gimbals and associated components; two miniature two-axis gyroscopes mounted on the innermost gimbal maintain a stable orientation relative to inertial space throughout missile flight. Three accelerometers, mounted on the same gimbal, measure changes in missile velocity. The inertial measurement unit also contains equipment to conduct a stellar sighting to provide in-flight trajectory correction data. Resolvers on the gimbals provide missile attitude data. Water connectors service a heat exchanger coil and maintain inertial measurement unit temperature within specifications. Electrical connectors transfer data between the inertial measurement unit and the electronics assembly.

The electronics assembly provides gimbal and gyro torque current to position inertial measurement unit gimbals. Information from the inertial measurement unit is processed in the guidance computer contained in the electronics assembly. The computer makes the necessary guidance computations and provides steering and force vectors, mode status, and event initiation for the missile flight control electronics package. The electronics assembly is a rectangular package which is water cooled; quick disconnect water and electrical connectors are also connected to the package.

Subsystem Contractor. The subsystem contractor for the guidance subsystem is Charles Stark Draper Laboratory, Incorporated (CSDL). CSDL designs the guidance subsystem. General Electric Ordnance Systems and Singer-Kearfott Division manufacture the inertial measurement unit; the Raytheon Company and Hughes Aircraft Company produce the electronics assemblies. All four are under subcontract to CSDL. Many of the parts and materials used in the guidance subsystem are procured directly by the four subcontractors. The more critical parts and materials are procured by one of the subcontractors in a program management role. This subcontractor then distributes the needed quantities to the other subcontractors.

The types of components and materials used in the guidance subsystem range from normal aircraft quality to those needing ultra-controlled processes utilizing very recent technology. Examples may include the following:

RAW MATERIALS

Rubber
Desiccants
Steel Bars
Aluminum Alloys
High Density Metals
Nickel-Iron Alloy
Polyurethane Foam
Wire
Plastic Sheet

CONFIGURED RAW MATERIALS

Copper Clad Epoxy Board
Beryllium and Beryllium Shapes
Aluminum Spinnings
Aluminum Hydroforms
Sheet Metal Covers
Machined Covers
Machined Aluminum Frames
Nickel Plated Frames

CASTING AND FORGINGS

Precision Castings
Aluminum Castings, Weldments
Nickel Aluminium Stampings, Vacuum or Dip Brazed

MECHANICAL PARTS AND COMPONENTS

Pressure Switches

ELECTRICAL PARTS AND COMPONENTS

Heat Sinks
Wiring Plates
Slip Ring Assembly Brush Contacts
Motors
Miniature Electrical Connectors
Switches
Torque Motors

ELECTRONIC PARTS AND COMPONENTS

Resistors
Capacitors
Integrated Circuits
Multispeed Resolvers
Printed Wiring Boards
Accelerometers
Terminal Boards

INSTRUMENTATION

Humidity Indicators
Slip Ring Test Station
Resolver Test Station
Torque Motor Test Station
Digital Module Test Station
Analog Electronics Test Station
Tape Recorders
Oscilloscopes
Digital Multimeters
Wave Analyzers
Commercial Test Equipment

OPTICS

Optical Glass (including coatings, windows, and porro mirrors)

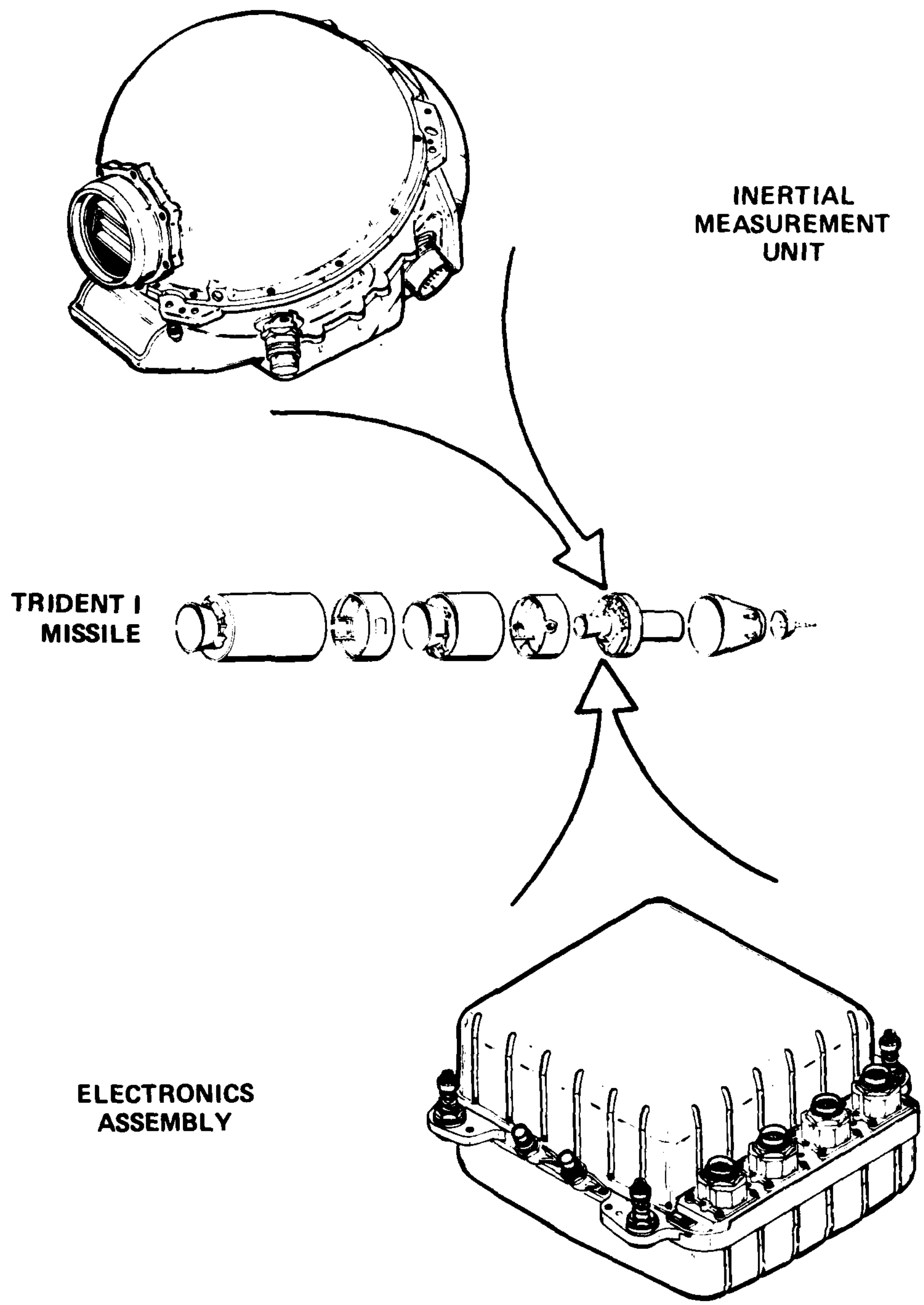


Figure 12. TRIDENT I (C-4) Guidance Subsystem.

HANDLING EQUIPMENT

Handling Fixtures

IMU and EA Shipping and Transfer Containers

HARDWARE/SUPPLIES

Precision Bearings
O-Rings
Valves
Cable Clamps
Module Housings
Mylar Tape
Electrical Tape
Lacing Tape
Adhesives
Dyes
Varnish
Paint
Thinner
Ink
Potting Compound
Polyurethane Resin

Sealant
Dielectric Coating
Flux
Lubricants
Screws
Nuts
Bolts
Washers
Rivets
Studs
Helical Inserts
Spring Pins
Hinges
Heater and Sensor (flex tape and wirewound fabrication)

SPECIALTY ITEM

Heat Exchangers
Beryllium Parts (precision machining-size tolerance as small as .000050 in.)
Element Set (cassegrainian telescope of polished beryllium mirrors)
Vidicon Focusing Coils

Miniature Vidicons
Elastomeric Shock/Vibration Isolators
Precision Resolvers
Temperature Sensors
Resolvers
Encoders

FIRE CONTROL SUBSYSTEM

Subsystem Description. The fire control subsystem coordinates the operations of the weapon system during a launch sequence. Most of the fire control equipment is located in the submarine Missile Control Center (MCC) on post-mounted doors which provide mounting for modular components, as shown in Figure 13. Additional fire control equipment is located in the Missile Compartment (MC). This equipment consists of power supplies and their controls, as well as the precision optical alignment system.

The electrical components that make up a large part of the subsystem are small plug-in type modules called Type 3 modules. Several of these Type 3 modules fit into connector panels called Type 2 modules that in turn are mounted on door assemblies called Type 1 modules. The Type 1 modules are fastened by hinges to structures known as door-post assemblies. Door-post assemblies may support one or two doors. The outer door consists of an A face and a B face. The inner door consists of a C face and a D face. The A face usually contains panels, and the B, C, and D faces contain the electronic components (Type 2 and Type 3 modules) that control the system. Each door has an upper and lower latch for securing the doors.

The majority of the Type 3 modules are comprised of Standard Electronic Modules (SEM's) derived from a standardization program to develop reliable electronic modules at a reduced cost and to facilitate the design, production, and logistic support of military electronic systems. The SEM program, conducted under the auspices of the U.S. Department of Defense, encompasses a specialized examination and testing process whereby U.S. firms are qualified to supply SEM modules. Qualification of U.K. firms to supply SEM modules is contained in existing NATO standards. Those firms who are interested in supplying SEM modules in support of the TRIDENT II (D-5) program must have been previously qualified in accordance with established Department of Defense or NATO procedures. Additional information concerning the SEM program may be obtained from the subsystem contractor's point of contact.

MCC equipment, shown in Figure 14, includes power distribution and conversion equipment, which select, monitor, convert, and distribute electrical power by means of power distribution panels and power conversion equipment. Components include display modules, meters, power select switches, circuit breakers, fuses, and power converters. A control console also located in the MCC provides operational control of the weapon system, utilizing an integrated test operating panel, operator control panel, time-of-day control and display panel, and a system printer. A wing assembly attached to the console houses the missile firing trigger assembly which initiates the signal to fire missiles.

In the MCC, equipment provides additional storage and printout information, interface, timing, and synchronization signals for digital circuits and switching circuitry. Equipment consists of a computer printer, magnetic tape file, and logic assemblies. Equipment located in the nearby computer island performs digital computations and provides storage and operator interface for data entry into the digital control computer. This is accomplished by means of a computer operator panel and logic assemblies, a keyboard, and a display panel. The computer island also includes a computer maintenance panel and the magnetic disk files.

Fire control equipment in the Missile Compartment (MC) includes the fire control switchboard, the MC power distribution panels, spare guidance monitor and testers, a stowage container/test-in-place for spare guidance subsystems, temperature monitor power supplies, and an optical alignment group.

The fire control switchboard has posts containing display panels and switching assemblies which provide the interface to other subsystems. The temperature monitor power supplies provide the external power to the missiles to enable guidance spinup until they are switched to internal missile power during the launch sequence. The temperature monitor power supplies also monitor the temperature of the guidance system inertial components. Each unit services one missile and is contained in a cabinet assembly.

The optical alignment group is comprised of station assemblies and light tube assemblies which direct a light beam during missile misalignment measurement, and provide a stable environment through open-ended, hollow tubes for transmission of the light beam. The light beam source is a bedplate optics assembly located in the Navigation Center (NAV CTR), which contains two azimuth transfer autocollimators, an optical reference assembly and a bedplate optics subassembly.

Subsystem Contractor. General Electric, Ordnance Systems (GEOS) is the subsystem contractor for the fire control subsystem. Wire-wrap, cable fabrication, electrical assembly, structure fabrication and assembly, and system test are done at GEOS. Most electronic and electrical components and general hardware are procured on a subcontract basis. This includes most of the plug-in modules, called Type 3 modules, which are the lowest replaceable electrical units in the fire control subsystem, and most of the Type 2 modules, the next higher assemblies on which the Type 3 modules are mounted. Certain major subsystem components such as the basic processor and the system printers are also procured on a subcontract basis, but source selection has already been made on the basis of previous programs. Components and material that are generally procured are listed below. Of these, the Type 3 module is, by far, the most numerous.

CONFIGURED RAW MATERIALS

Aluminum Extrusions	Seals
Gaskets	- -

CASTING AND FORGINGS

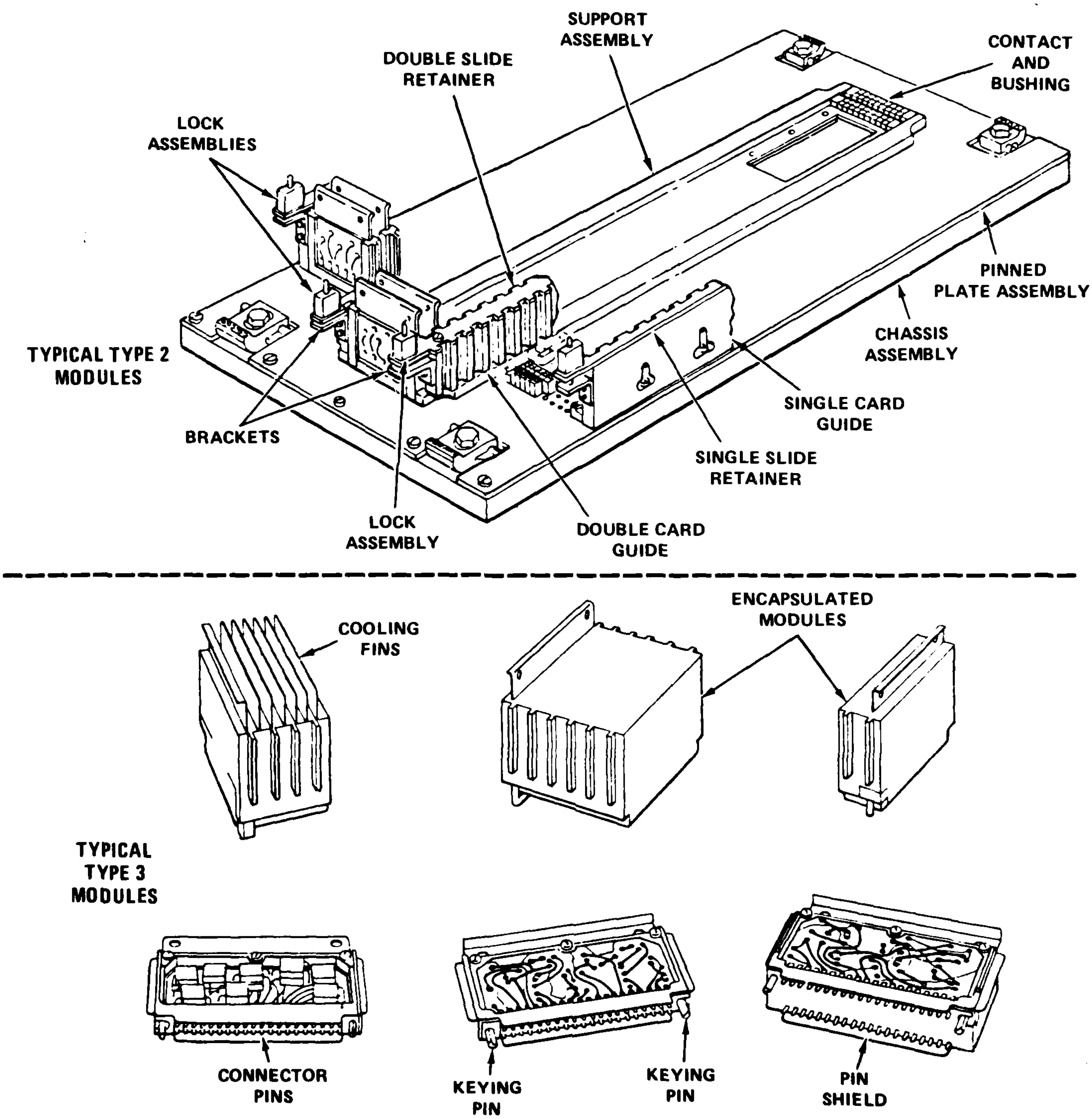
Aluminum Castings	Other Castings

MECHANICAL PARTS AND COMPONENTS

Bearings	Alignment Pins
Latch Blocks	Gears

ELECTRICAL PARTS AND COMPONENTS

Circuit Breakers	Delay lines
Inductors	Plasma Panels
Fans	Power Converters
Semi-Conductors	Connectors
Fuses	Pin Plate Assemblies
Motors	Backplanes
Transformers	Wire and Cable
Switches	Bus Bars


SUPPORT ASSEMBLY
DOUBLE SLIDE RETAINER
CONTACT AND BUSHING
LOCK ASSEMBLIES
PINNED PLATE ASSEMBLY
CHASSIS ASSEMBLY
TYPICAL TYPE 2 MODULES
SINGLE CARD GUIDE
BRACKETS
SINGLE SLIDE RETAINER
LOCK ASSEMBLY
DOUBLE CARD GUIDE
COOLING FINS
ENCAPSULATED MODULES
TYPICAL TYPE 3 MODULES
CONNECTOR PINS
KEYING PIN
KEYING PIN
PIN SHIELD

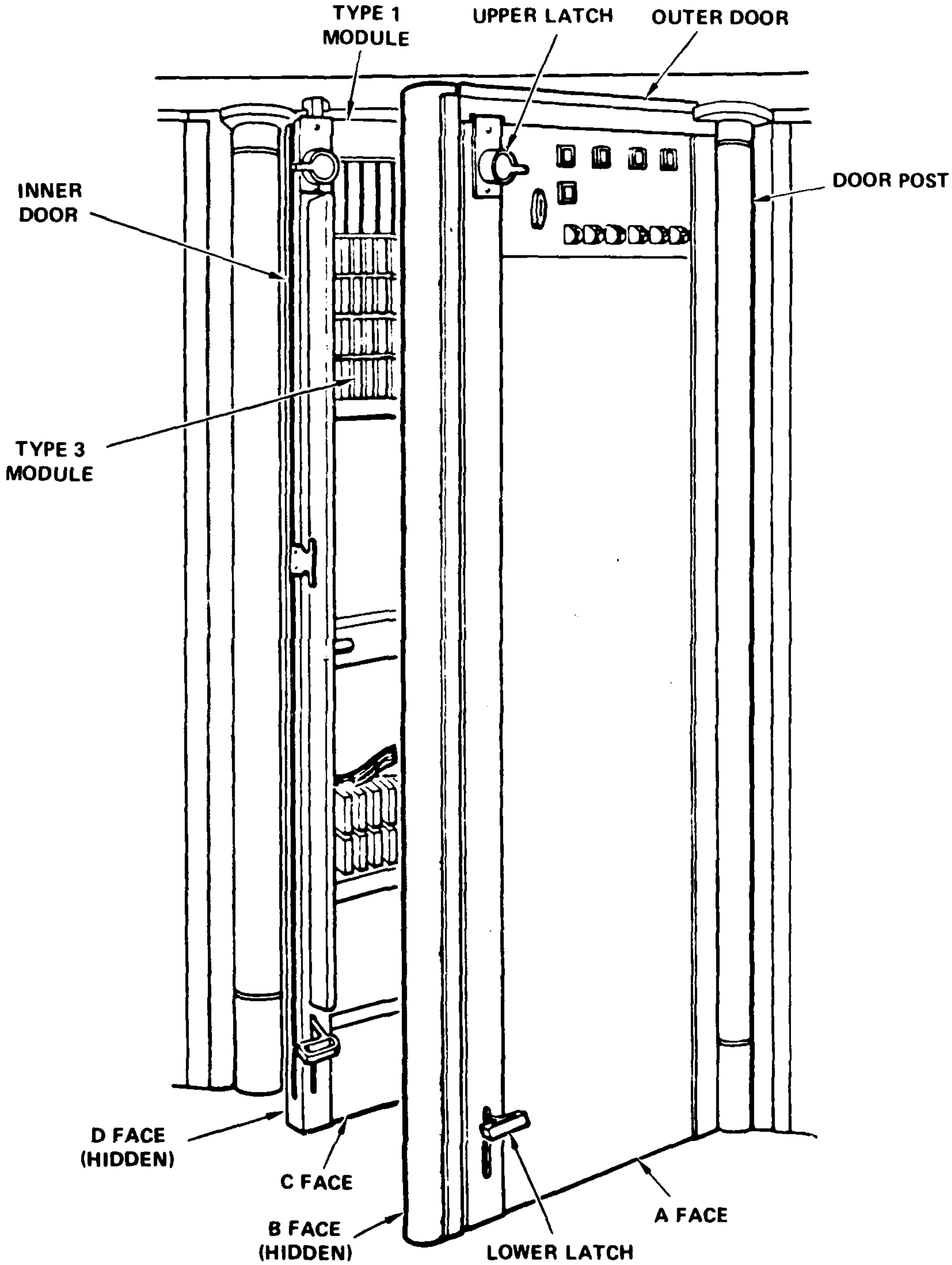
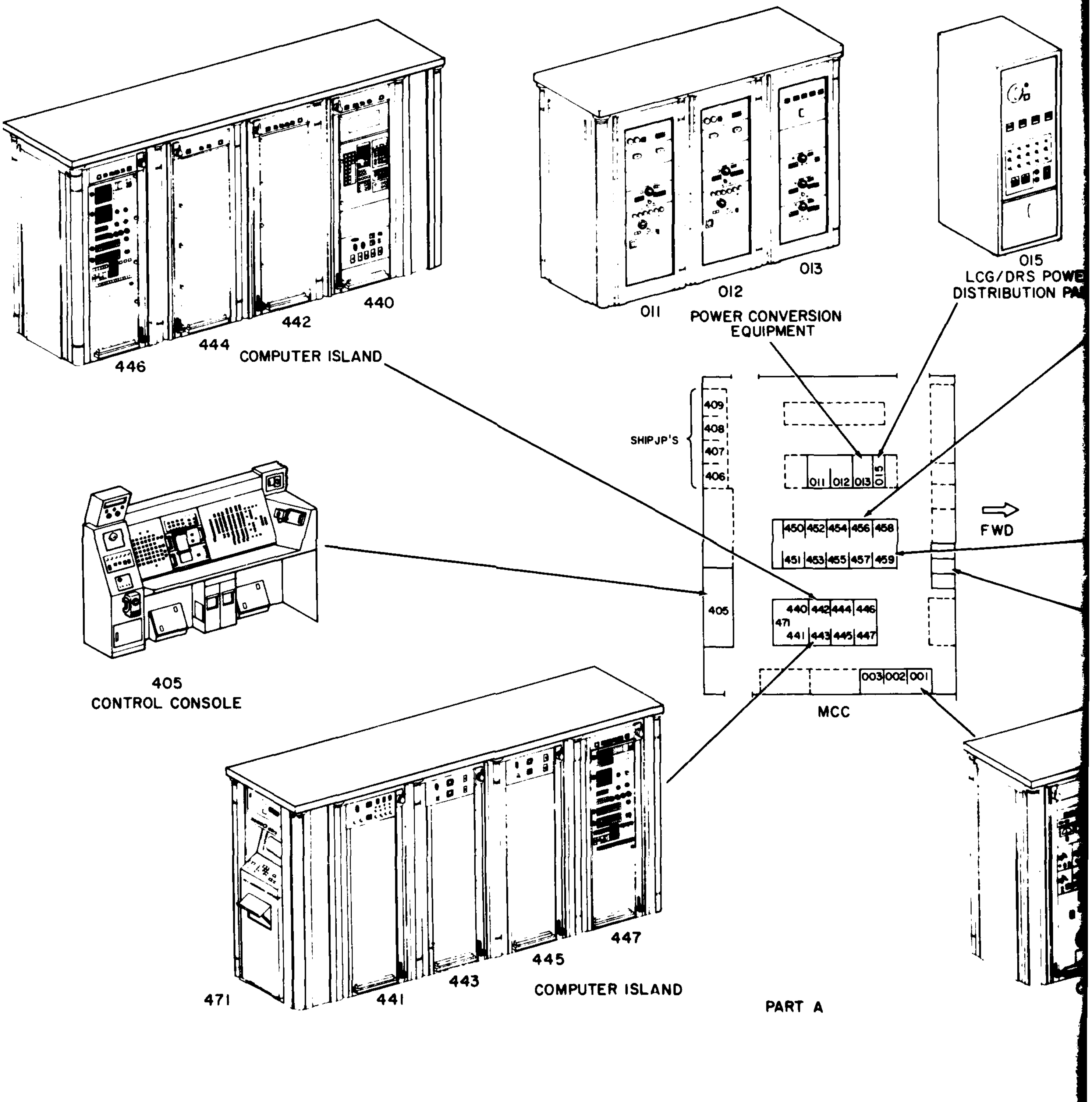


Figure 13. Fire Control Subsystem - Typical Door Assembly.



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POWER CONVERSION
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CONTROL CONSOLE
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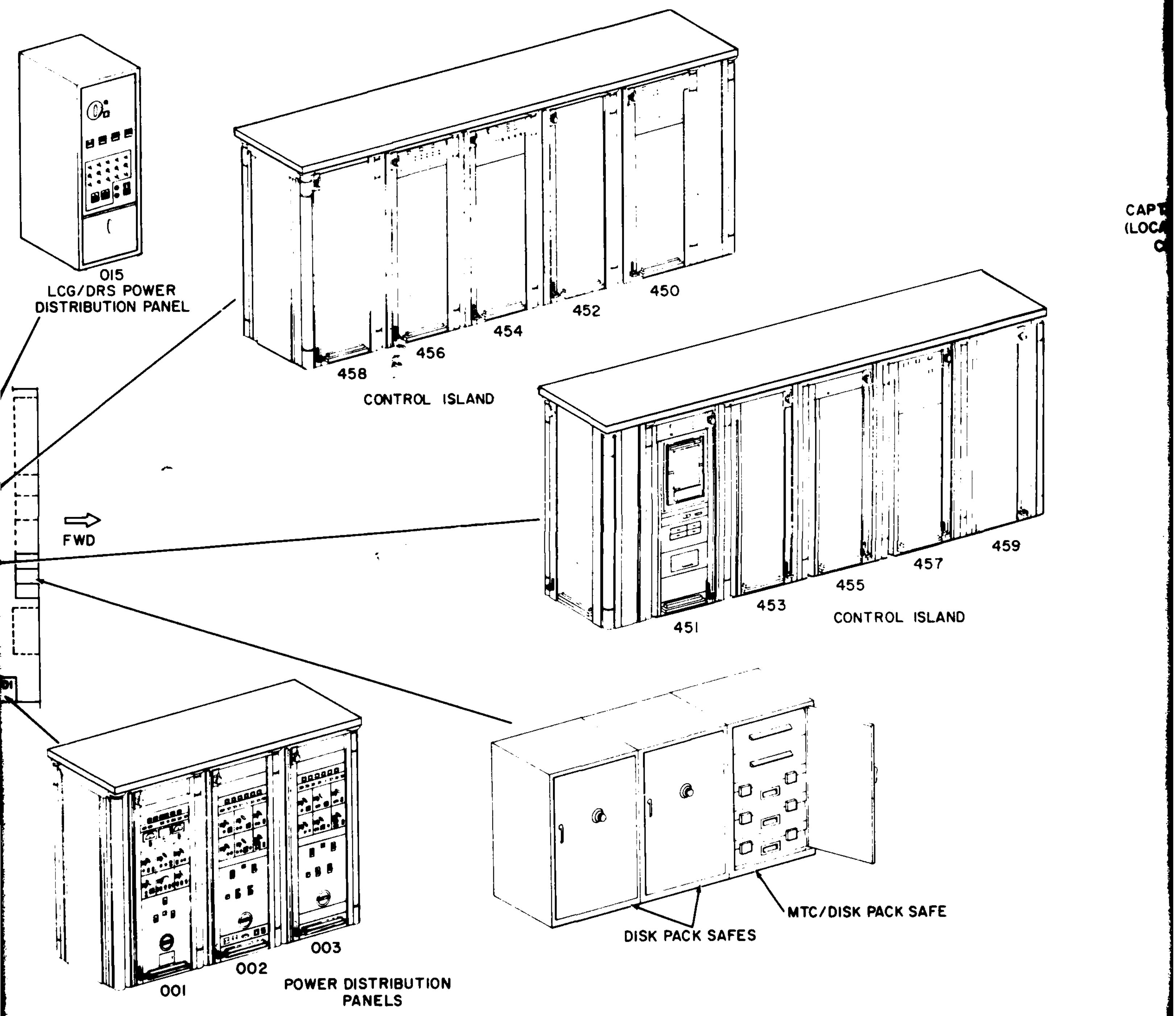
COMPUTER ISLAND

PART A


015
LCG/DRS POWER
DISTRIBUTION PANEL
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POWER DISTRIBUTION
PANELS
DISK PACK SAFES
MTC/DISK PACK SAFE

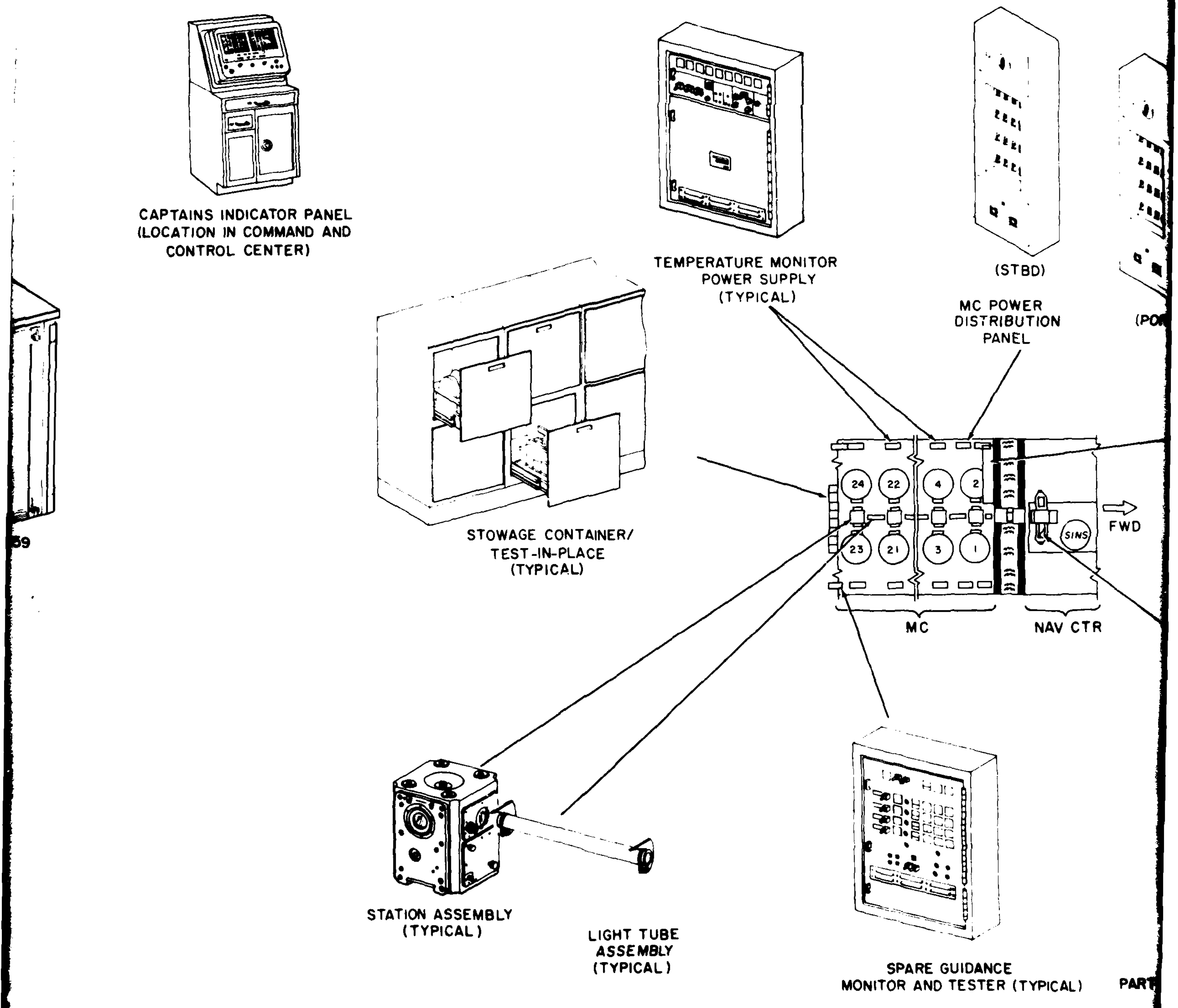


Figure 14. TRID

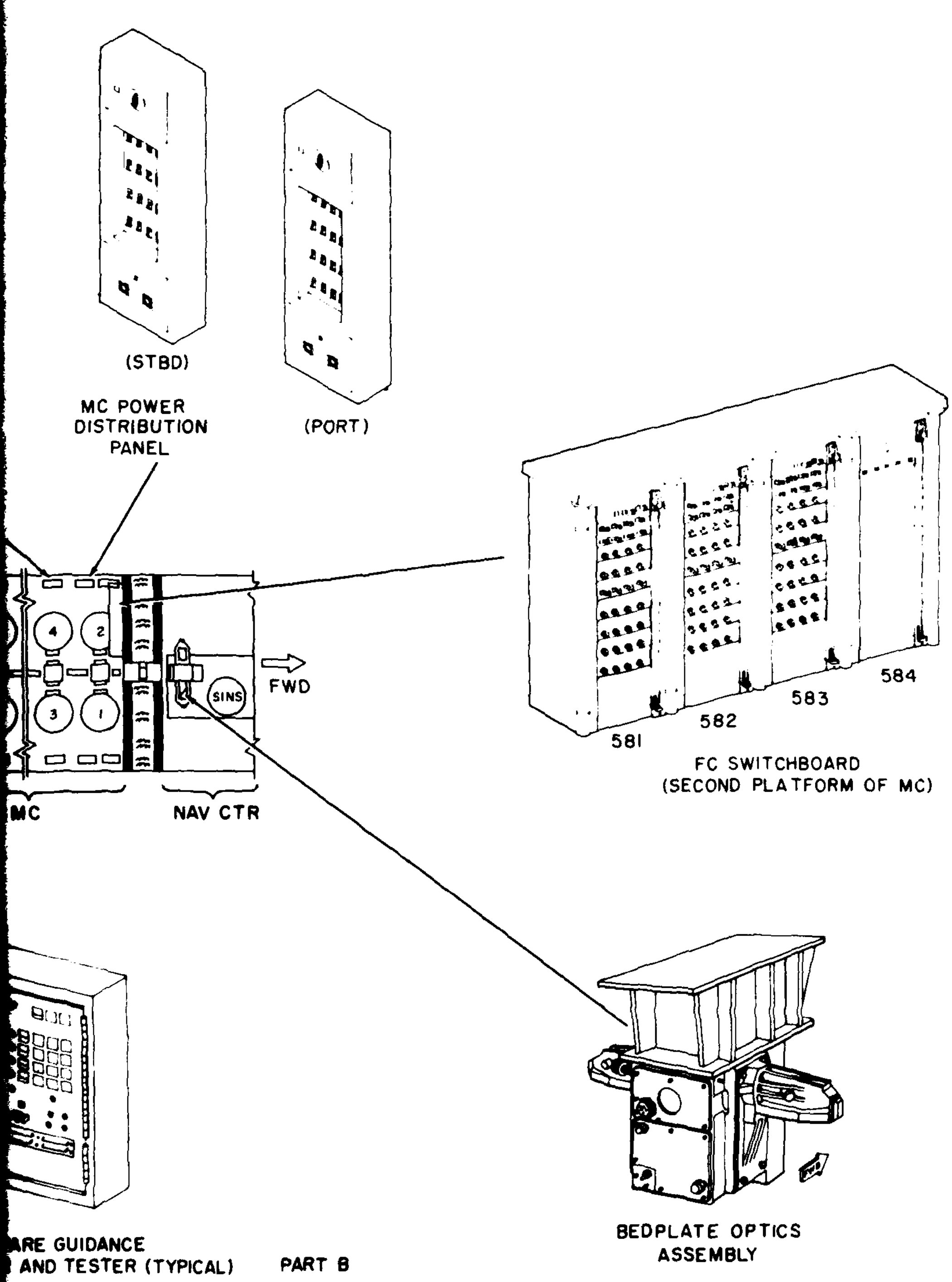


Figure 14. TRIDENT I (C-4) Fire Control Subsystem - Equipments.

ELECTRONIC PARTS AND COMPONENTS

Electronic Components	Standard Electronic Modules (type 3)
Printed Circuit Boards	- -
Non-Standard Electronic Modules (type 3)	

INSTRUMENTATION

Test Equipments	Check Out Lamps
Test Fixtures	- -

OPTICS

Optics	- -

HANDLING EQUIPMENT

Handling Fixtures	- -

COMPUTER AND PERIPHERALS

Magnetic Tape Drives	Computer Peripherals
Commercial Computers	Mass Memories

HARDWARE/SUPPLIES

Cabinets (sheet metal)	Latches
Screws	Handles
Nuts	Water Connectors

SPECIALTY ITEMS

Magnets	Magnetic Shields

LAUNCHER SUBSYSTEM

Subsystem Description. The launcher subsystem houses and protects the missiles, prepares the launch tubes for launch, controls and monitors launch tube functions, and ejects the missile on command. The launcher subsystem, shown in Figure 15, consists of three groups: the launch tube group, the missile ejector group, and the launcher control group.

The launch tube group is comprised of a launch tube subassembly, penetration seals, an eject chamber and extension, a support ring assembly, liquid spring and leveling cylinder assemblies, centering cylinders, a launch tube closure, and missile umbilical retractors. The open ended launch tube assembly is lined with teflon-faced liner pads to provide lateral support and trajectory guidance, thermal panels to maintain missile temperature within limits, and launch seals to maintain uniform pressure buildup. Penetrations in the launch tube provide optical windows, umbilical connections, piping and electrical connections, and personnel access to the missile. Umbilical retractors in the tube remove the missile umbilical connector(s) at launch. The eject chamber and eject chamber extension form the bottom closure to the tube; the launch tube closure seals the top from the sea when the muzzle hatch is open. A support ring assembly in the tube provides a seat for the missile. The support ring is stabilized and protected from shock by liquid spring and leveling cylinder assemblies and centering cylinders.

The missile ejector group provides the pressurized mixture of gas, steam, and water to eject the missile from the tube during launch. Major components of the group are a temperature controlled gas generator, a standpipe assembly to the eject chamber, and a water-filled cooling chamber.

The launcher control group controls, monitors, and displays the status of the launcher subsystem, as well as operations and tests associated with other subsystems, during missile loading, cruising, launching, and jettisoning. The group consists of one firing unit and detonator relay box per tube, a launcher console, a launch safing assembly, and an eight cabinet enclosure containing the following assemblies: missile tube logic and control, subsystem logic control and alarm, missile tube alarm, detonator power, and built-in test equipment. The launcher console has switch and display panels to control launcher operations and to display subsystem and individual tube status. The launch safing assembly generates the firing pulse to the gas generator firing unit, and has switches to select launcher configuration and test modes. Electrical relays in the missile tube logic control, system logic control and alarm, and missile tube alarm assemblies provide the logic to enable the sequence of events in tube pressurization, muzzle hatch operation, and missile ejection, and also to monitor tube and system conditions during all states of readiness.

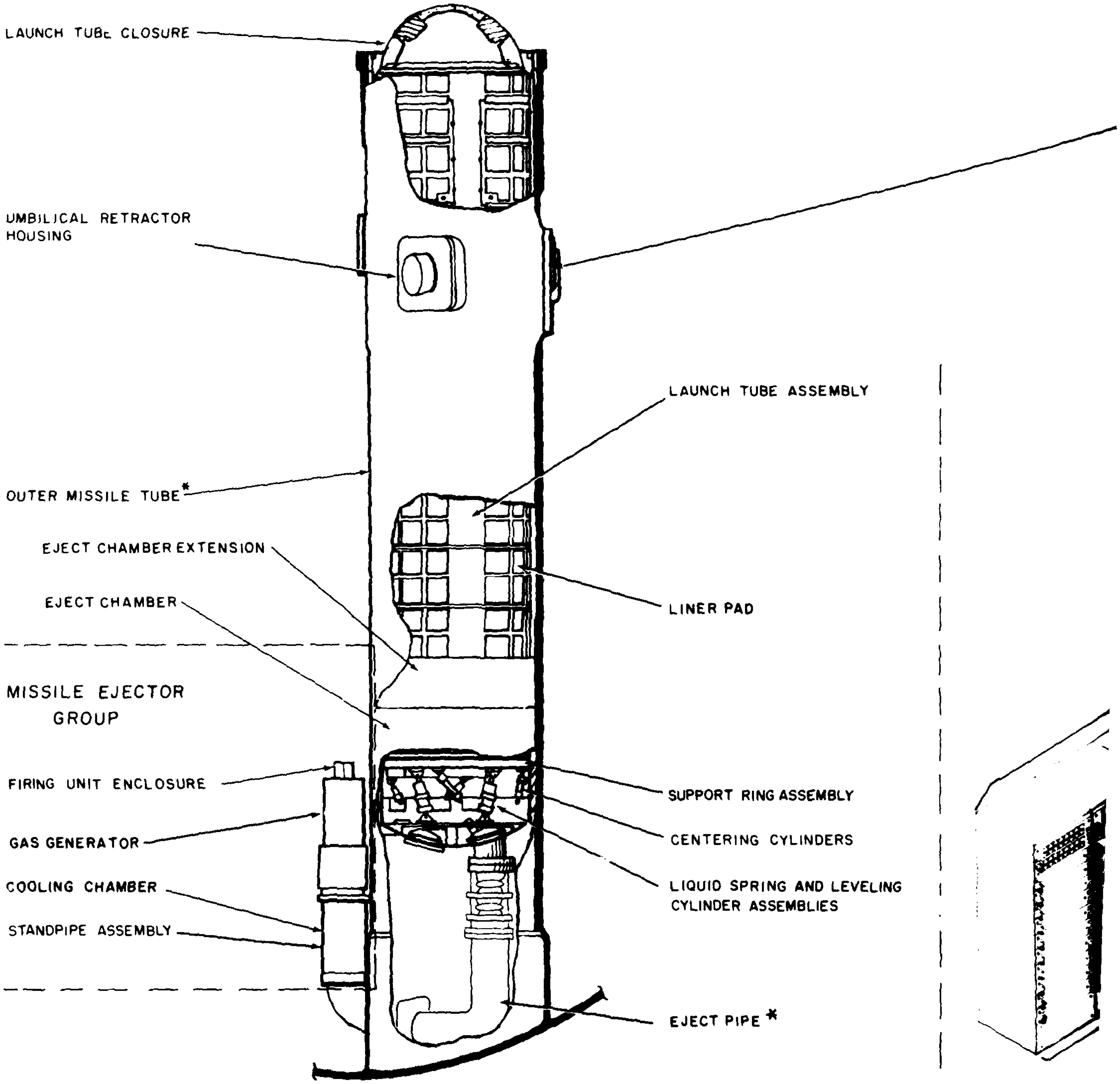
Subsystem Contractor. The contractor for the launcher subsystem is Westinghouse Electric Corporation (WEC). WEC procures the majority of items that form the complete launcher subsystem. This procurement includes some assembled components such as consoles and items like the liquid springs in the vertical support group. WEC does some fabrication, machining, and component assembly and performs all the final assembly and test of the units that constitute the launcher subsystem. Examples of generally procured items by WEC for the launcher subsystem are tabulated.

RAW MATERIALS

Lead Weights	Flexible Foams (open cell polyurethane)
Rolled Plate (copper, nickel, steel - 1/4 to 4 inch thick)	- -

CONFIGURED RAW MATERIALS

Structured Shapes	O-Rings
Tubing and Fittings (bronze, copper, nickel, stainless steel, and steel 1/8 to 4 inch diameter)	Polyurethane Liner Pads (special techiques required)



LAUNCH TUBE GROUP

*PART OF SHIP

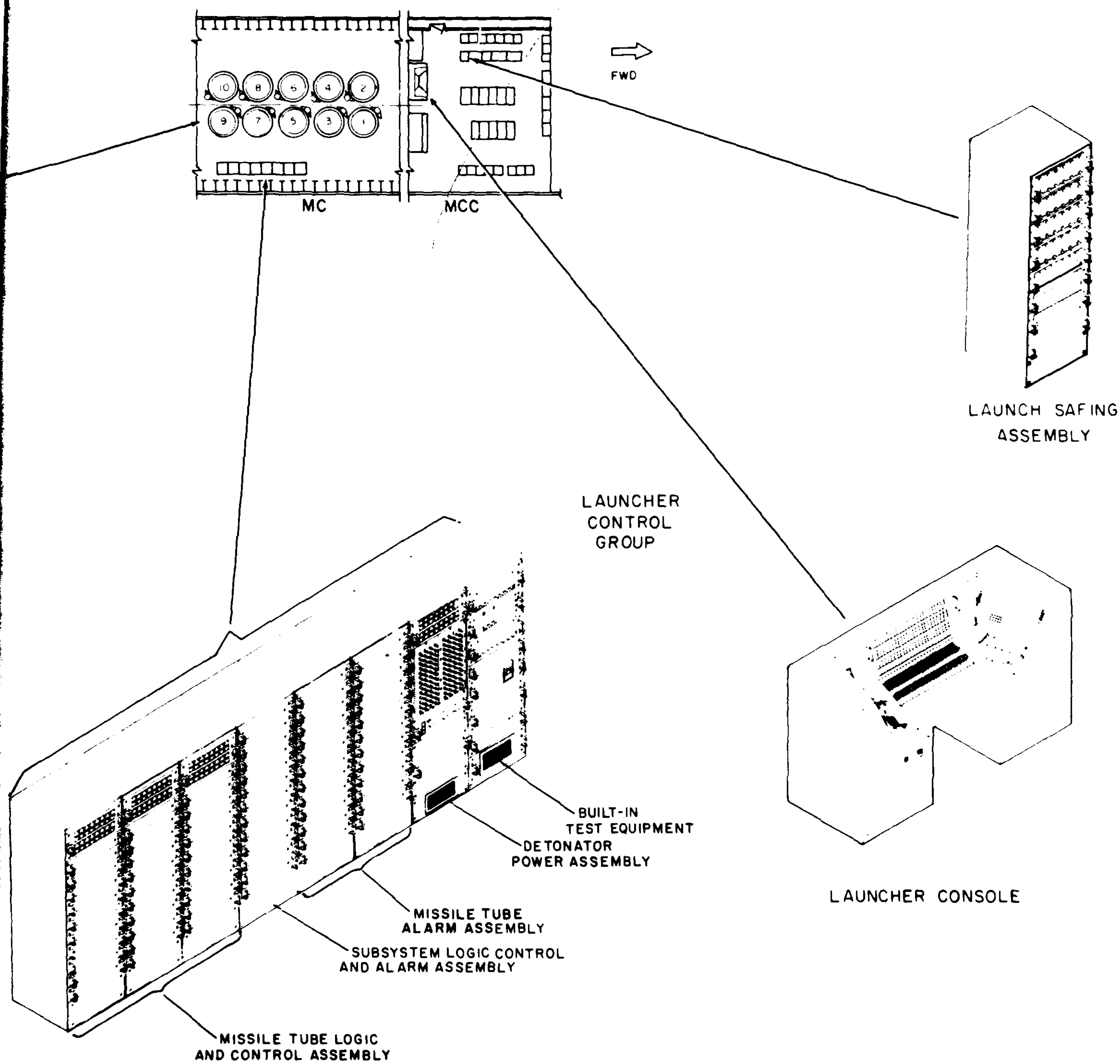


Figure 15. TRIDENT I (C-4) Launcher Subsystem - Equipment.

CONFIGURED RAW MATERIALS (Cont'd)

Flanged Head Steel Disks	Prepregnated Fiberite/ Metal Shells (special technique and qualifications required)
Inconel Housings	
Dished Heads	
Ceramic Insulators	
Natural Rubber Mounts	- -
Polyurethane and Neoprene Seals (special techniques	- -

CASTING AND FORGINGS

Aluminum	Centrifugal
Bronze	Investment (steel, CRES 17-4ph)
Nickel	
Steel	- -

MECHANICAL PARTS AND COMPONENTS

Accumulators-Pneumatic Receivers (750 psi, 30-50 cu. inch)	Gearing
	Retract Mechanisms
Valves - Pneumatic and Hydraulic (ball type needle and check, pressure reducer, relief)	Pneumatic Power Units (750 psi, 30-40 SCFM)
	- -
Cyclinders-Weight Positioning	- -

ELECTRICAL PARTS AND COMPONENTS

Cable Assemblies	Electrical Solenoids
Power Supplies	Electrical Limit Switches
Electrical Junction Boxes	Electrical Pressure Transducers
Electrical Connectors	
Electrical Power Supplies	Wire Wrap Plates

ORDNANCE

Detonating Cord	Neoprene Explosive Products
Linear Shaped Charges	

INSTRUMENTATION

Pressure Gaugings (hydraulic and pneumatic)	Mobile Unit Test Bed Indicators

HANDLING EQUIPMENT

Carriage (steel construction)	Hoist Inspection Platform
Hoist Block Extension	Hoist Block Extension

HANDLING EQUIPMENT (Cont'd)

Ladders (aluminum, steel)
Special Handlng Slings
Steel Shipping Containers
Test Cover Stowage Platform
Mobile Test Bed
Weight Positioning Cylinder
Weight Frame and Lead Weights
- -

HARDWARE/SUPPLIES

Welding Studs and Rods
Fasteners
Roller Fixtures
Turning Fixtures
Clean and Paint Fixtures
Metal Cabinets and Consoles
Nuts
Bolts
- -

HYDRAULICS

Accumulators-Hydraulic Receivers (3000 psi, 2000-2500 cu. inch)
Cylinders-Hydraulic Drive (3000 psi, 2-8 inch diameter)
Hydraulic Power Units (3000 psi, 15-20 GPM)
Shock Absorbers with Compressible Fluid (liquid springs)

SPECIALTY ITEMS

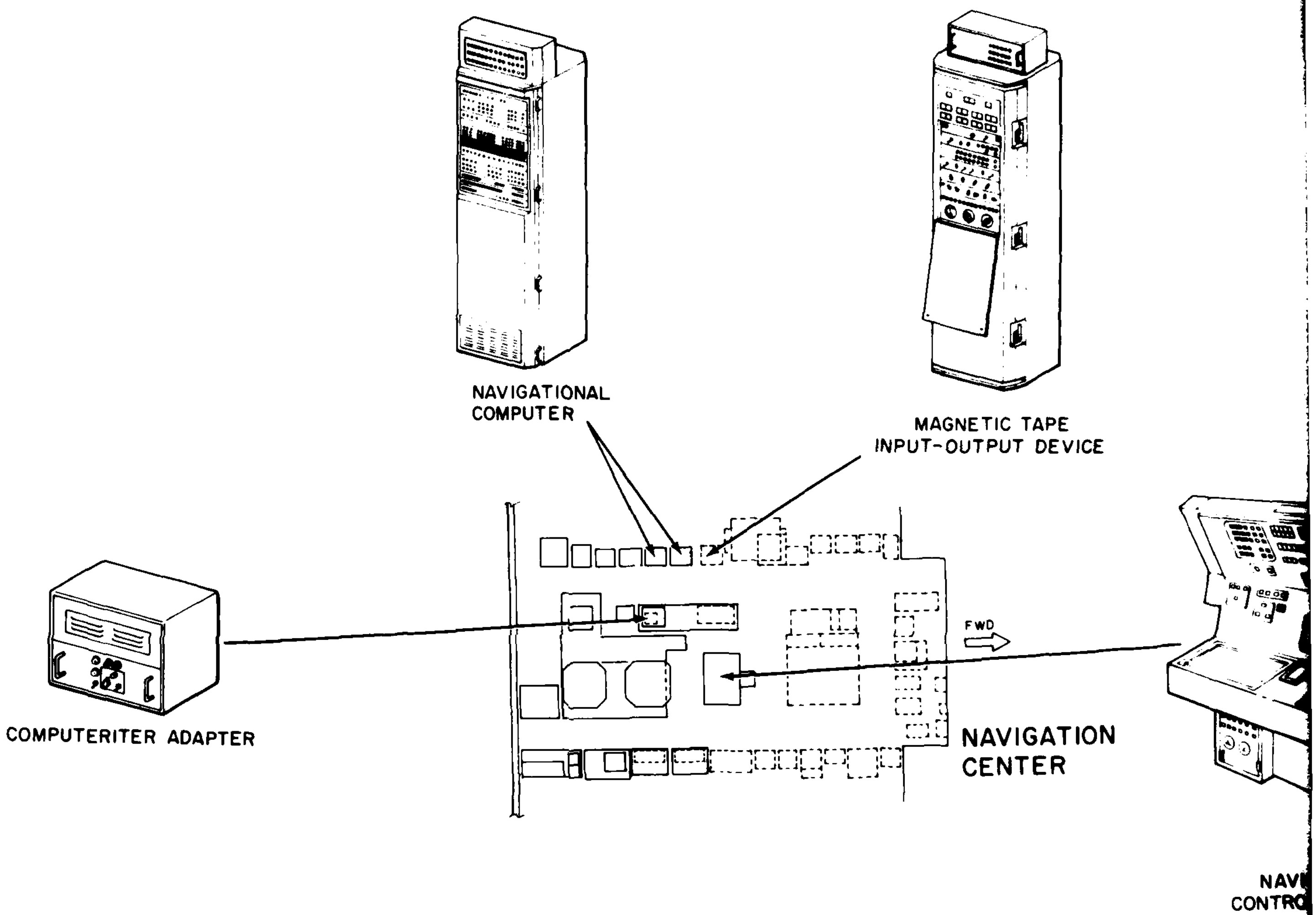
Load Cells
Grout Bags
Four Tube Cluster Trainer
- -

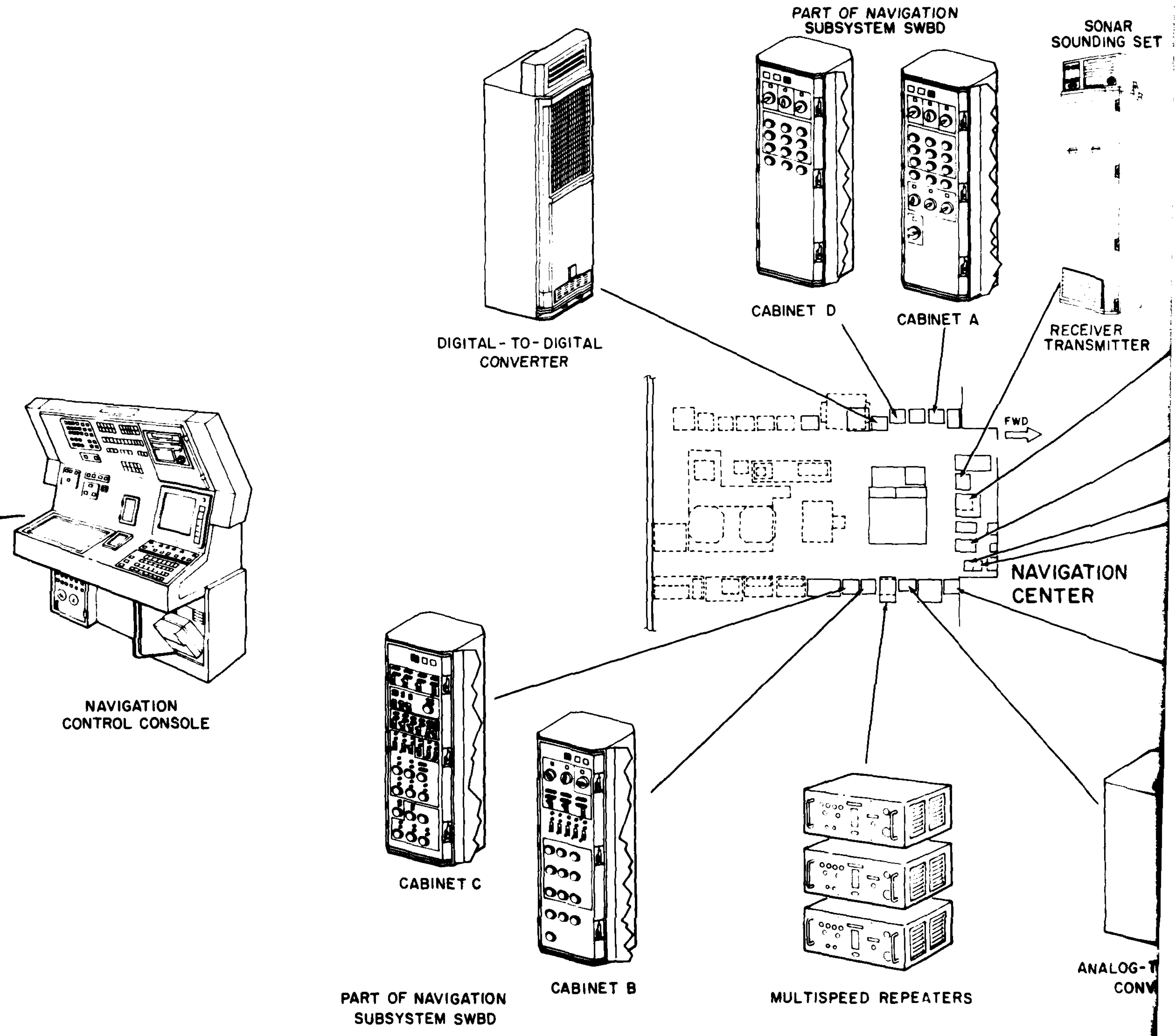
NAVIGATION SUBSYSTEM

The navigation subsystem provides navigational data from various sources for use in conjunction with the inertial navigation sources. These data are used by the submarine to navigate and by the fire control subsystem to prepare missiles for launch. Although the navigation subsystem is normally considered as one subsystem, for purposes of this guide because there are two subsystem contractors, subsystem description and subsystem contractor discussion will be separated into two parts--navigation subsystem (less inertial navigation) and inertial navigation.

Navigation Subsystem (Less Inertial Navigation) Description. Navigation subsystem equipment, shown in Figure 16, is located in the navigation center, and includes the navigation control console, a central navigation computer, digital-to-digital and analog-to-digital converters, a magnetic tape input/output device, a computeriter adapter, navigation subsystem switchboards, a radio navigation set, a LORAN receiving set, and a frequency standard.

The navigation control console controls and monitors navigation equipment, and is divided into six segments. The central navigation computer is a general purpose, stored program digital computer that functions as the central computer in the subsystem. The digital-to-digital and analog-to-digital converters


NAVIGATIONAL COMPUTER
MAGNETIC TAPE INPUT-OUTPUT DEVICE
COMPUTERITER ADAPTER
FWD
NAVIGATION CENTER



Figure
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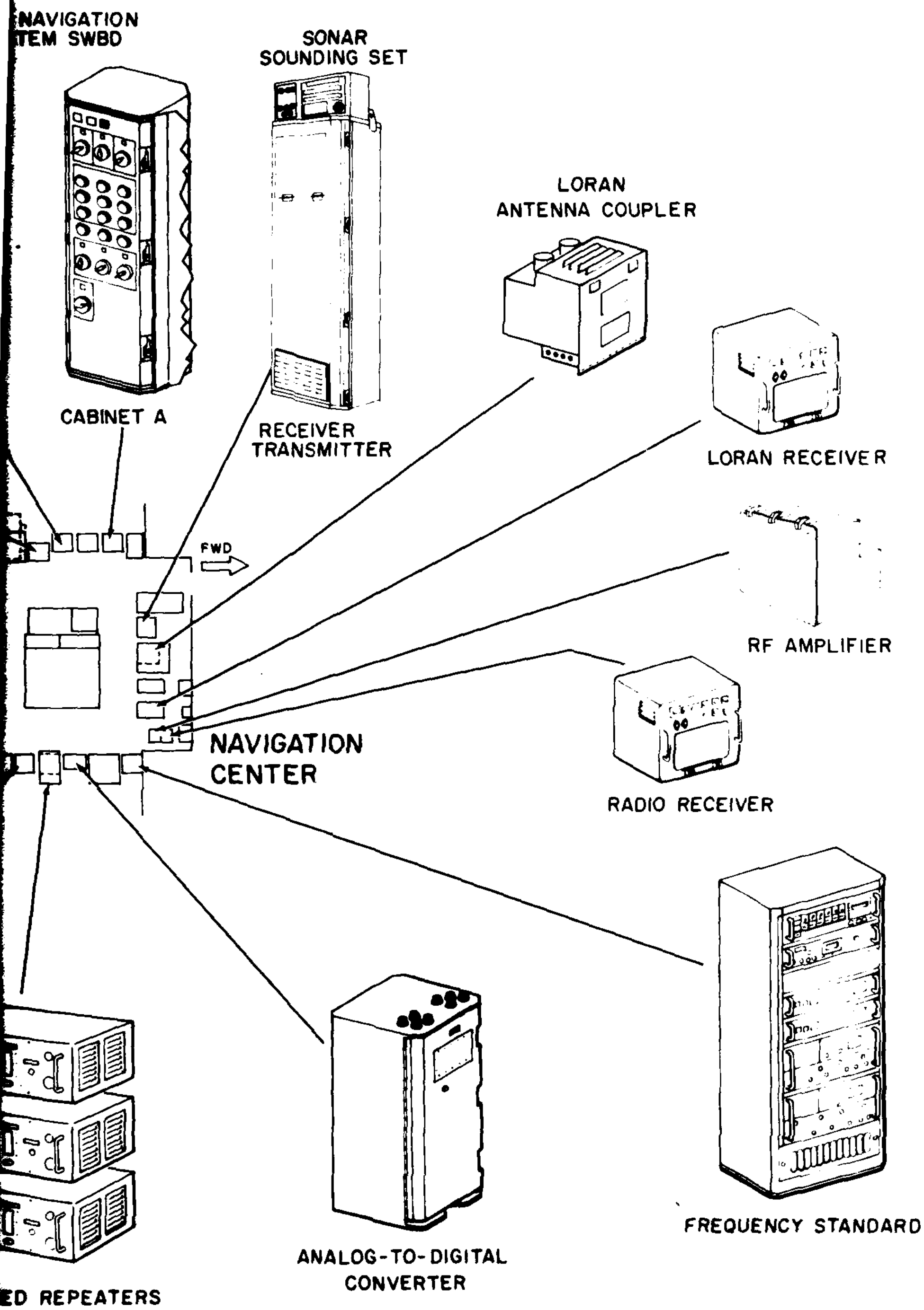


Figure 16. Navigation Subsystem (Less Inertial Navigation) - Equipments As Installed on C-4 Configured Submarines.

convert data flowing between external equipment and the central navigation computer.

The computeriter adapter is a buffer converter that provides interface coupling between the spare typewriter and the central navigation computer. The navigation subsystem switchboard controls, selects, and monitors the flow of data within the subsystem, and is housed in four rectangular cabinets. The radio navigation set is an all-weather radio navigation aid that converts satellite orbital data into ship position data for the central navigation computer using a radio receiver, an antenna, and an rf amplifier. The LORAN receiving set consists of antennas, an antenna coupler, and a receiver which receives navigation fix data from land-based transmitters. The frequency standard provides real time references and contains two cesium-beam frequency standards, a phase comparator, power supplies and operator controls.

Subsystem Contractor. Sperry Systems Management (SM) is the subsystem contractor for the navigation subsystem. SM is responsible for total tactical navigation specification, and for design engineering and contracting for procurement of all non-inertial subsystem equipments. SM does not manufacture any subsystem equipments. SM first-tier subcontractors provide complete equipments to specifications and schedules established by SM. Because of the complexity of the navigation subsystem, Rockwell International was established as the subsystem contractor for the inertial navigation equipments.

The following complete units of equipment are candidates for subcontract by SM:

Printer/Plotter
Digital Magnetic Tape Cartridge Unit
Reel to Reel Tape Unit
Auxiliary Printer Terminal
Keyboard

Special technologies required for the Printer/Plotter, Auxiliary Printer Terminal, and Keyboard are mechanical print head technology and microprocessor-based electronic architecture; and for the digital magnetic tape elements use of medium scale integration circuitry and microprocessed technology.

SM is also responsible for designing, procuring, assembling, and delivering a navigational trainer, as shown in Figure 17. The trainer includes non-tactical equipment that will be procured by SM from subcontractors, including the instructor's console and associated cabinetry, dummy loads, and simulators of tactical equipment.

RAW MATERIALS

Sheet Metal

Shim Stock

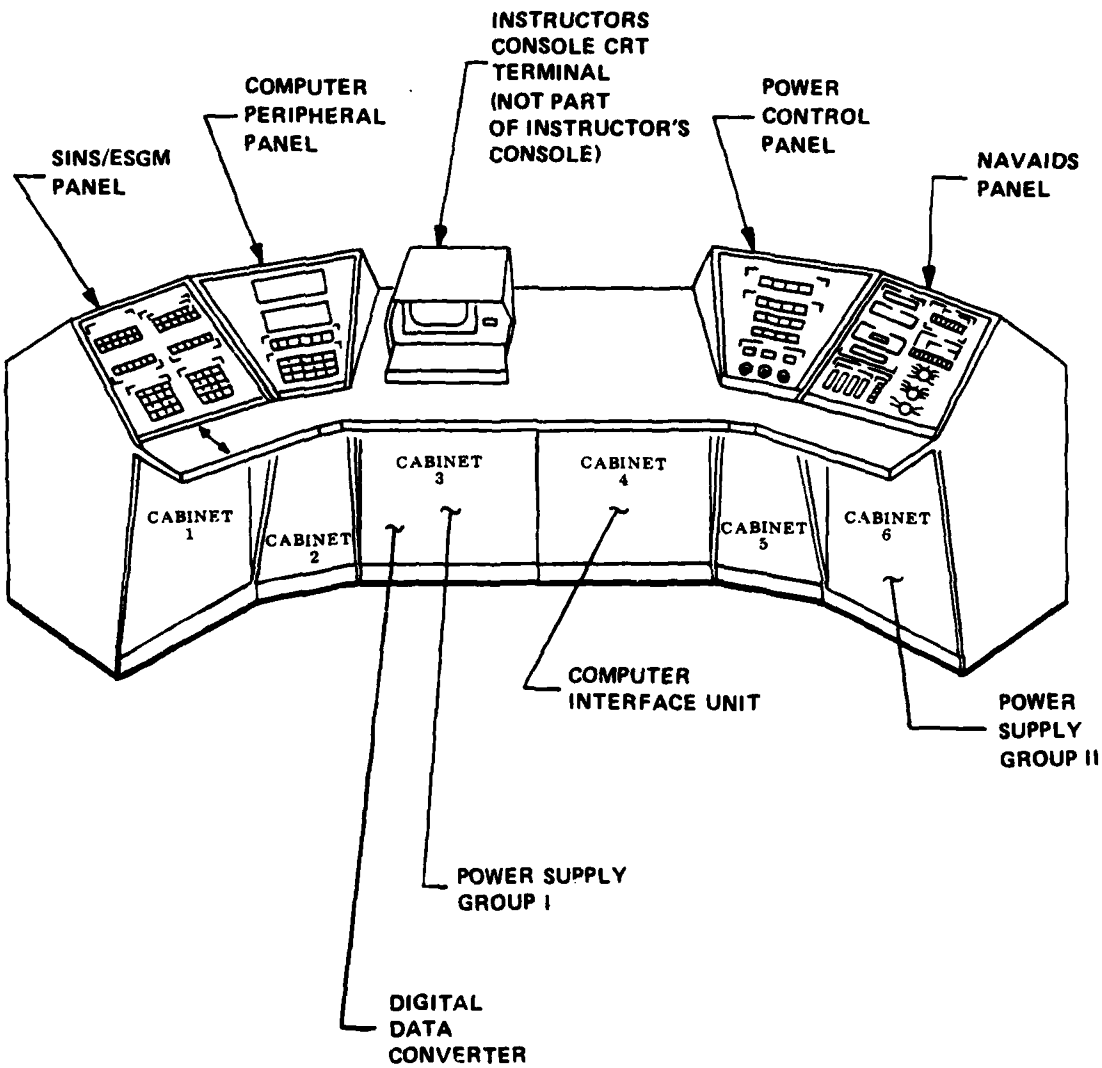


Figure 17. Navigation Trainer - Instructors Console.

CONFIGURED RAW MATERIALS

Gaskets
Grommets
Rubber
Foam
EMI
Wire
Vibration Mounts
Shock Absorbers
Lacing Tape
Springs
Extrusions
- -

CASTING AND FORGINGS

Castings
Forgings

MECHANICAL PARTS AND COMPONENTS

Bearings
Bushings
Machined Parts
Chains
Bushings
Brakes
Clamps
- -

ELECTRICAL PARTS AND COMPONENTS

EMI Filters
Connectors
Cables
Harnesses
Tape Cables
Contracts
Test Points
Wire Wrap Backplanes
Twist Capsules
Slip Rings
Resolvers Torquers
Motors
Relays
Solenoids
Transformers
Pot Cores
Resistors
Potentiometers
Capacitors
Inductors
Semiconductors
Diodes
Transistors
Switches (togle, push, lighted, switchboard multipole, multithrow, thermostatic, pressure, coaxial)
Coaxial Cable
Shielding Finger Stock
Sockets (relay, transistor, crystal)
Terminal Lugs
Solder
Flux Preforms
Fuseholders
Lampholders
Lamps
Display Panels
Keyboards
Decals
Batteries
Blowers
Heaters
Air Filters
Power Dividers
Elapsed Time Meters
Panel Meters
Snap Slide Switches
Power Suppliers
Wire Wrap Trays
Printed Circuit Boards
Connectors
Resistors
Relays
Semiconductors (integrated circuits, LSI)
Standard Electronic Modules (SEM)

ELECTRICAL PARTS AND COMPONENTS (Cont'd)

LC and Crystal Filters
RF Crystals
RF Mixers

Printed Circuit Boards and Material
- -

INSTRUMENTATION

Test Equipment
Scope Meters

Signal Generators
- -

HARDWARE/SUPPLIES

Nuts and Bolts
Screws
Eyelets
Rivets
Washers
Hinges
Knobs
Handles
Paints
Adhesives

Potting
Grease
Identification Plates
Scaling and Insulating Chemicals
Tools (general purpose)
Cabinets
Slides
Drawers
Panels
- -

Inertial Navigation Description. The inertial navigation equipment, see Figure 18, provides continuous and accurate navigational data in the form of ship's velocity, attitude, and position. To accomplish this, inertial instruments and electronic devices measure the forces of gravity and the motions of the submarine.

The inertial navigation equipment consists of two stable platform units which provide an inertially stabilized reference. The two units are each combined with a navigation console and a transmission set to form two ship inertial navigation systems which share a gyro monitor console and a maintenance test set. The stable platform units each consist of a gimbal assembly and stable platform, on which inertial instruments and electronic devices are mounted. A binnacle encloses and protects the unit. The gyro monitor control console controls and monitors the monitor gyro on both stable platforms and contains the platform electronics drawer and gyro monitor drawers. The maintenance test set contains test units for operational checks on a specialized computer.

The electrostatically supported gyro monitor provides ship position data for use by the ship inertial navigation system to reduce the need for external fixes during patrol periods. The electrostatically supported gyro monitor is comprised of a binnacle, an electronic equipment console, and a digital computer. The binnacle provides an environmentally controlled protective enclosure for the platform structure, which contains a five axis gimbal system, two electrostatically supported gyros, and three accelerometers. The electronic equipment

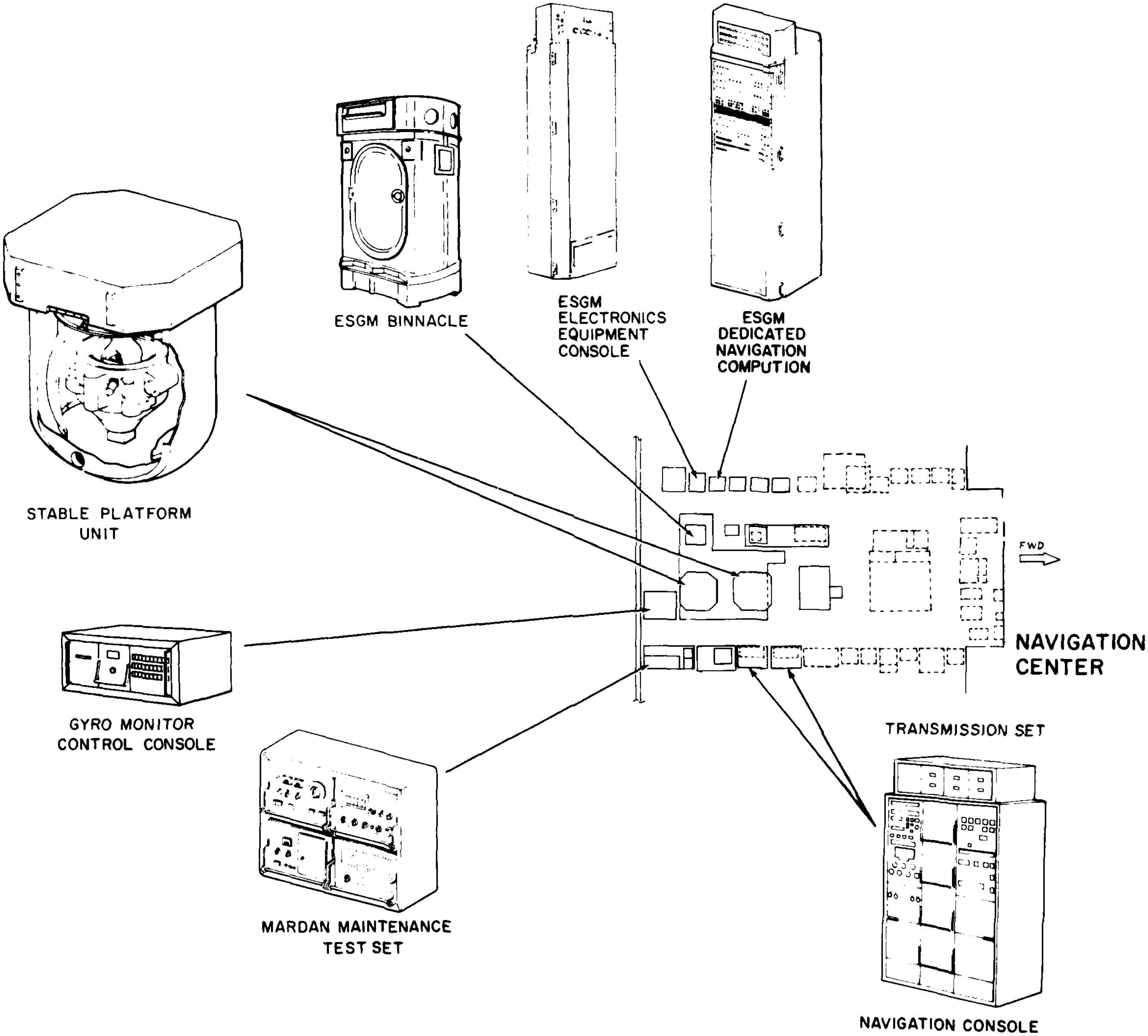


Figure 18. Inertial Navigation Equipment As Installed on C-4 Configured Submarines.

console contains platform electronics, power supplies, a duplex platform interface buffer, control and display panels and a battery support unit. The computer is a general purpose, stored program digital computer which receives inputs from the electrostatically supported gyro monitor and processes them for the central navigation computer.

Subsystem Contractor (Inertial Navigation). Rockwell International (RI) is the subsystem contractor responsible for design, development, and production of tactical inertial navigation equipments. RI produces this equipment under direct contract to SSPO. RI produces the equipments from inertial components fabricated in-house, and from electronic/electromechanical subassemblies and parts procured from subcontractors.

The following are examples of components RI may procure from subcontractors:

CONFIGURED RAW MATERIALS

Seals	Shock Mounts (rubber-metal)
Gaskets	Housings
Panels	Ducting
Shrouds	Wire
Sleeving	Bellows

CASTING AND FORGINGS

Casting	- -

MECHANICAL PARTS AND COMPONENTS

Gears	Shafts
Bearings	Machined Parts (end caps, etc.)
Mounting Brackets	- -

ELECTRICAL PARTS AND COMPONENTS

DC Torque Motors	Cable Ties
Motors	Capacitors
Resistors	Fans
Heaters	Transformers
Crystals	Terminals
Cables	Coils
Tape Cables	Filters
Bus Bars	Synchros
Lamp Holders	Generators
Switches	Fan Assemblies
Fuse Holders	Time Meters
Fuses	Terminal Boards
Lamps	Keyboards
Connectors	Display Panels
Relays and Relay Sockets	- -

HARDWARE/SUPPLIES

Nuts
Bolts
Valves
Washers
Hoses
Screws
Bushings
Fittings
Brackets

Nameplates
Cabinets (metal)
Covers
Sheetmetal Structures (ducting, chassises, shrouds, enclosures)
Clamps
Nut plates
Slides
- -

SPECIALTY ITEMS

Heat Dissipators
Temperature Sensors

Resolvers
Encoders

INSTRUMENTATION SUBSYSTEM

Subsystem Description. Shipboard weapon system instrumentation, shown in Figure 19, acquires, processes, and records weapon system performance data during patrols to determine overall weapon system performance and reliability. Functions and events in fire control, navigation, launcher, and ship are monitored and recorded on digital magnetic tape, which is then returned to a shore-based facility for evaluation and analysis. Instrumentation includes six equipment racks and a console in the Missile Control Center (MCC), two equipment racks in the Missile Compartment (MC), and a three-axis accelerometer assembly mounted on the ship's centerline.

The equipment racks in the MCC contain most of the data processing components, switching, controllers, recording/reproducing equipment, and control/display panels associated with data collection. Multiplexer/analog-to-digital converters convert resolver or dc analog signals into serial digital form for further processing. A multiplexer/control and calibration unit provides control and calibration functions for analog signal processing components. Digital data and serial events processors provide an interface between instrumentation and monitored weapon system subsystems. An audio recorder/reproducer records up to three separate sound-powered conversations. A central processing unit provides programmed control of maintenance functions and data display. A dual-cartridge recorder/reproducer allows program loading into the central processing unit and recording of performance data.

The console in the MCC consists of status and alarm, system control and maintenance, and communications panels; a display control and keyboard; a console data processor; a printer; a power sequencer; and a weapon system events processor.

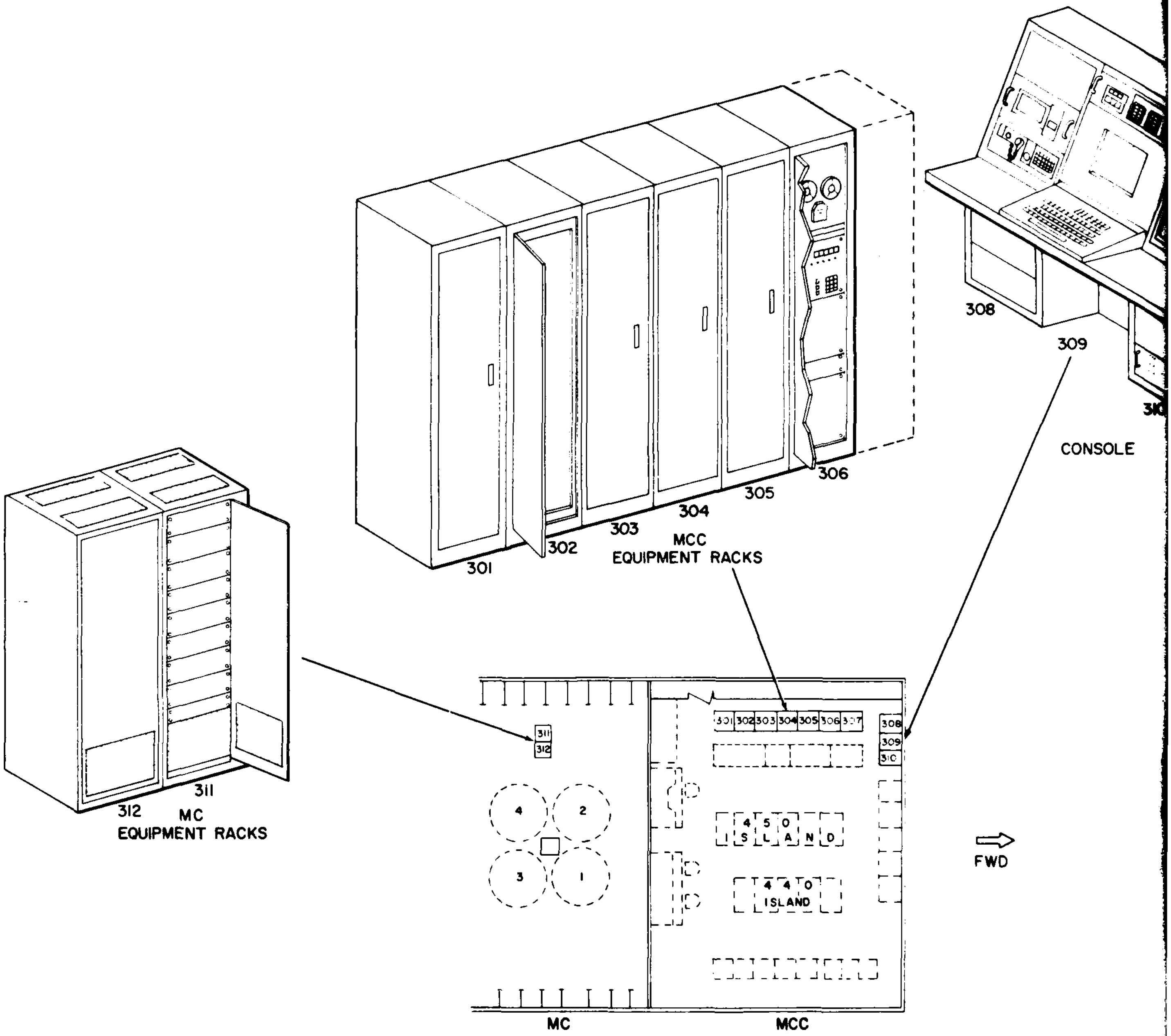
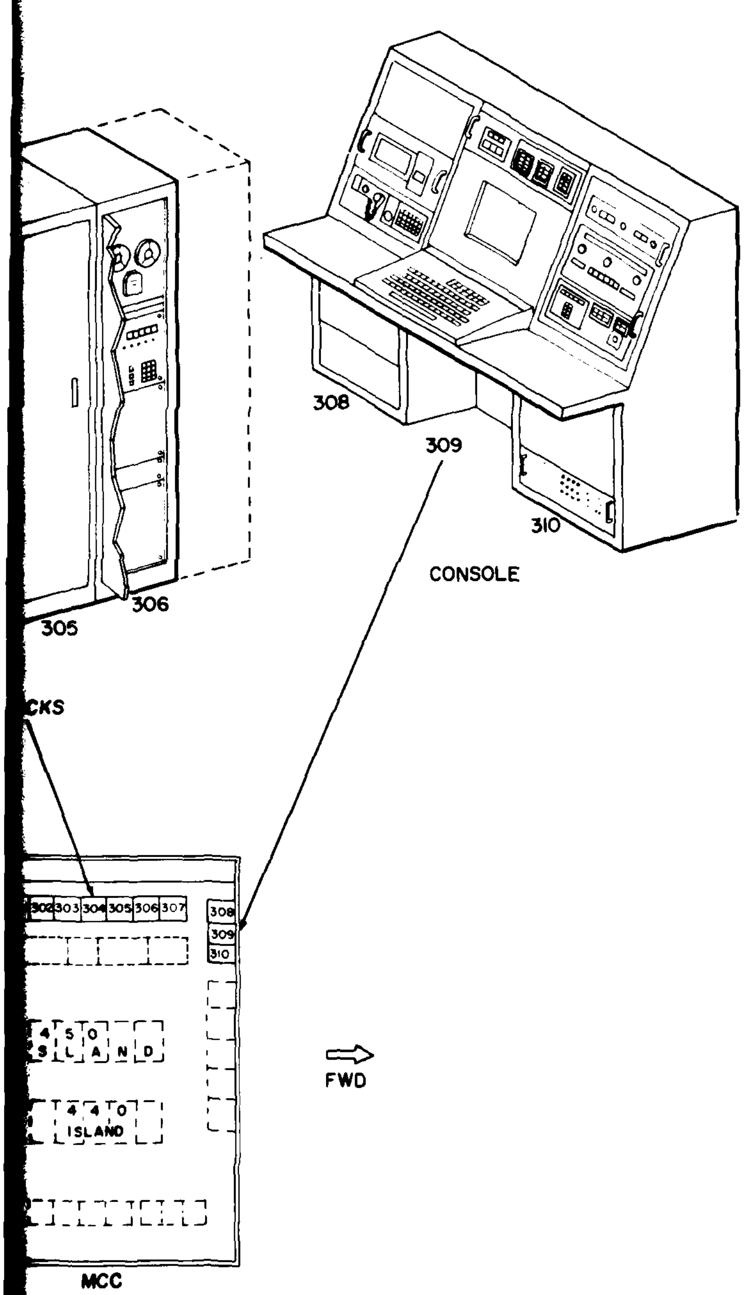


Figure 19. TRIDENT I (C-4) Instrumentation Subsystem



T I (C-4) Instrumentation Subsystem - Equipment.

MC equipment racks contain data processing, and control and maintenance equipment associated with the collection of performance data from equipment located in the MC. Equipment on racks includes ship and MC events processors, a bus control unit, a multiplexer/control and calibration unit, a maintenance panel, and an analog processor.

The three-axis accelerometer assembly provides ship heave, surge, and sway measurements to instrumentation.

Several different types of these subsystems are provided by Interstate Electronics Company (IEC) for use on the TRIDENT program: one type will be used aboard SSBN's as part of the TRIDENT II Strategic Weapon System; other types are used aboard missile range ships and at the missile test range facility that supports missile flight test operations.

Subsystem Contractor. IEC is the test instrumentation subsystem contractor. IEC is responsible for the design, development, and production of the test instrumentation subsystems.

In general, IEC procures components that are available on an off-the-shelf basis, and they build the components in those instances when off-the-shelf units are not available. Examples of components built by IEC are control panels, display units, and status and alarm panels. IEC also builds processor components, such as I/O bus converters, data controllers, and data buffers. IEC assembles the complete subsystem. The following are examples of components generally procured by IEC:

CONFIGURED RAW MATERIAL

Sheet Metal	- -

MECHANICAL PARTS AND COMPONENTS

Handles	Base Plates
Latches	Connectors
Bus Bars	Antennas

ELECTRICAL PARTS AND COMPONENTS

Low Voltage DC Power Supplies	Power Supplies
Antennas (large variety)	Relays
Circuit Boards	Integrated Circuits
Potentiometers	Diodes
Resistors	Transistors
Capacitors	Amplifiers
Coils	Multiplexers
Filters	Attentuators
Circuit Boards	Meters
Transformer	- -

INSTRUMENTATION

Voltmeters	RF Power Meters
Oscilloscopes	Strip Chart Recorders
Frequency Counters	- -

COMPUTER AND PERIPHERALS

Printers	Tape Recorders
Plotters	Displays
Computers	Terminals
Disk Drives	- -

HARDWARE/SUPPLIES

Screws	Nuts and Bolts

SPECIALTY ITEMS

RF Equipment	Communications Equipment

TRAINING INSTALLATIONS AND EQUIPMENT

Description. The training installations generally consist of tactical weapons subsystems or portions thereof, supplemented by computer controlled nontactial hardware to stimulate/simulate tactical elements. Installation of tactical and nontactical equipment; cabling, and provision of supporting hardware and services in the training facility are generally subcontracted on a competitive basis.

Shorebased training systems, in addition to tactical components and assemblies, often employ large function modules in nontactical hardware assemblies which are housed in free standing cabinets that do not have to withstand the rigorous tactical shock requirements.

Full-scale, operating, missile launcher training equipment has been designed for the TRIDENT Fleet Ballistic Missile Program.

The TRIDENT Training Launcher (TTL) is used for training personnel in the operation and maintenance of the missile launching and related support equipment.

The TTL simulates the missile and launch tube installation for a TRIDENT Class submarine, and also includes selected launching equipment and submarine components required for training purposes.

The Four-Tube Cluster Trainer is also used in training personnel in the operation of the launching subsystem and related support areas.

Subsystem Contractor. Training installation equipment that is nontactical and developed specifically for training purpose is also in the purview of the subsystem contractors for the tactical equipments. Requirements for commodities and equipments used in training are included in the lists for LMSC, GEOS, WEC, SM, and IEC.

COMMODITY SUMMARY

Table 1 provides a summation relating the major categories of procurements with the subsystem contractors seeking to make procurements in those categories.

Table 1. Major Procurement Category Matrix. (Continued)

	Instrumentation	Optics	Handling Equipment	Computer & Peripherals	Hardware & Supplies	Hydraulics	Specialty Items
LAUNCHING & HANDLING (Westinghouse)	X		X		X	X	X
FIRE CONTROL (General Electric)	X	X	X	X	X		X
GUIDANCE (Chas. Stark Draper Lab)	X		X		X		X
NAVIGATION (Sperry & Rockwell Int.)	X			X	X		X
TEST INSTRUMENTATION (IEC)	X			X	X		X
MISSILE & MISSILE CHECKOUT (Lockheed)	X	X	X	X	X	X	X

Note: Firms with related specialties or interest in developing high technology items should also provide their capabilities to the points of contact.

Table 1. Major Procurement Category Matrix.

	RAW Material	Configured RAW Material	Castings & Forgings	Mechanical Parts & Components	Electrical Parts & Components	Electronic Parts & Component	Ordnance
LAUNCHING & HANDLING (Westinghouse)	X	X	X	X	X		X
FIRE CONTROL (General Electric)		X	X	X	X	X	
GUIDANCE (Chas. Stark Draper Lab)	X	X	X	X	X	X	
NAVIGATION (Sperry & Rockwell Int.)	X	X	X	X	X	X	
TEST INSTRUMENTATION (IEC)		X		X	X		
MISSILE & MISSILE CHECKOUT (Lockheed)	X	X	X	X	X	X	X

CHAPTER 6
SECURITY REQUIREMENTS

GENERAL REQUIREMENTS

Most of the commodities and associated engineering support required by subsystem contractors will not be classified and will be procured or manufactured using unclassified subcontracts. However, to the extent that such subcontracting might involve classified (CONFIDENTIAL or SECRET) defense information, adequate security safeguards will be required to satisfy the U.S. National Disclosure Policy and existing U.S./U.K. General Security and Industrial Security Agreements.

Classified aspects of procurements (or planned procurements) by subsystem contractors (or their major subcontractors) from U.S. firms are subject to the requirements of the Department of Defense Industrial Security Regulations, and specific procedures to be followed by government and industry for handling and safeguarding classified information are in existence. U.S. firms not familiar with these security regulations may obtain additional information from the Defense Investigative Service cognizant security office for their region.

The remainder of this chapter will address security requirements for U.S. subsystem contractors (or their major U.S. subcontractors) and U.K. firms who may be involved in the process related to procurement of items in support of the TRIDENT II (D-5) Strategic Weapon System.

U.S./U.K. security requirements are governed by the terms of the POLARIS Sales Agreement (as amended for TRIDENT) which is quoted, in part, herein. Additionally, the two countries have entered into a Bilateral Reciprocal Industrial Security Agreement that obligates each country to follow the security procedures of the originating country for handling classified information.

> "The Government of the United Kingdom shall not, without the prior express consent of the Government of the United States, transfer, or permit access to, or use of, the missiles, equipment, services, or documents or information relating thereto which are provided by the Government of the United States under this Agreement, except to a United Kingdom officer, employee, national or firm engaged in the implementation of this Agreement.
>
> The Government of the United Kingdom shall undertake such security measures as are necessary to afford classified articles, services, documents or information substantially the same degree of protection afforded by the Government of the United States in order to prevent unauthorized disclosure or compromise."

In accordance with the foregoing, it is necessary that access to classified information be regulated by the respective U.S. and U.K. governments.

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Accordingly, the following procedures apply for TRIDENT II (D-5) Strategic Weapon System procurements described in Chapter 1 of this guide. Questions concerning security requirements, including the implementation of these procedures, should be directed to the Ministry of Defence (MOD) point of contact (in the case of U.K. firms) or SSPO (in the case of U.S. subsystem contractors).

PROCEDURES

The following U.S./U.K. security procedures apply for subcontracting associated with the TRIDENT II (D-5) Strategic Weapon System. Because information pertinent to the security of the U.S. may be jeopardized, two sets of procedures are provided; those related to classified information and material as well as those related to unclassified information and material.

- Procedures Relative to Classified Information and Material.

    1. MOD will provide assurance, via the SSPO Liaison Representative in London (SPUK), that the U.K. firms bidding on contracts or who are soliciting business from the U.S. are under U.K. ownership, control, or influence.

    2. Prior to disclosure of classified information (oral, visual, or documentary) from U.S. firms to U.K. firms, MOD will have arranged for appropriate facility and personnel clearance of the U.K. firms.

    3. Visits of U.S. personnel to U.K. firms pertaining to classified matters will be coordinated with SPUK who, in turn, will coordinate with MOD.

    4. Visits of U.K. personnel to U.S. subsystem contractors or major subcontractors pertaining to classified matters will be conducted in accordance with the following U.S./U.K. visit procedures.

        a. MOD will provide visit requests to SPUK of authorized representatives of U.K. firms.

        b. SPUK will coordinate visits of the U.K. personnel with the U.S. firms. A normal four (4) week leadtime subsequent to receipt of U.K. visit requests is required before the visit is to take place. Shorter leadtimes will be processed on a case-by-case basis.

    5. The transmission of classified information will be government-to-government. SPUK and MOD will be the U.S./U.K. interface for the transfer of all classified documentation.

    6. Classified hardware will be transferred in accordance with the U.S./U.K. Transportation Plan which contains specific marking and shipping instructions.

7. In instances wherein performance under a contract may require access by U.K. representatives to U.S. shipyards or to U.S. Navy operational commands (e.g., submarines, tenders, etc.), U.S. firms must obtain the advance approval of SSPO prior to awarding the contract to a U.K. firm, and each visit will be coordinated as cited previously.

8. Award of a subcontract of a classified nature to a U.K. firm requires prior authorization of SSPO, who will coordinate with MOD.

9. Each classified contract awarded to a U.K. firm will include:

   a. A security requirements clause which will limit the U.K. subcontractor in awarding classified subcontracts.

   b. Security classification guidance describing those aspects of the contract that are classified.

- <u>Procedures Relative to Unclassified Information and Material</u>.

1. Visits of U.K. personnel to U.S. subsystem contractors or their major subcontractors will be conducted in accordance with the following U.S./U.K. visit procedures:

   a. MOD will provide visit requests to SPUK of authorized representatives of U.K. firms.

   b. SPUK will coordinate visits of the U.K. personnel with the U.S. firms.

   c. A normal two (2) week leadtime subsequent to receipt of U.K. visit requests is required before the visit is to take place.

2. The subsystem contractors or their major subcontractors will ensure that U.K. nationals are effectively denied access to classified information.

3. The subsystem contractors or their major subcontractors may communicate (oral, visual, or documentary) directly with U.K. firms on an unclassified basis provided that the unclassified information pertains to the TRIDENT II (D-5) Strategic Weapon System.

4. In instances wherein performance under a contract may require access by U.K. representatives to U.S. shipyards or to U.S. Navy operational commands (e.g., submarines, tenders, etc.), subsystem contractors must obtain the advance approval of SSPO prior to awarding the contract to a U.K. firm, and each visit must be coordinated as cited previously.

CHAPTER 7
SUBCONTRACTING

For all TRIDENT II subsystem procurements to be arrived at competitively, both U.S. and U.K. firms will be treated equally; there are no offset arrangements, and no "set-asides" for U.K. firms. Conversely, there are no "exclusions" or procurements which would not be open to both U.S. and U.K. firms (except for any sources already selected). To facilitate equal competition, the requirements of the Buy American Act and International Traffic in Arms Regulations (in addition to other U.S. procurement regulations) will be accommodated to the extent necessary to conduct business in respect to the TRIDENT II program.

The respective governments will not be involved in the contracting process. They will not participate in solicitations, source selections, awards, or negotiations. All subcontract activity in this regard will be conducted exclusively between the TRIDENT II subsystem contractor and their subcontractors. The guide functions to facilitate initial communications between subsystem contractors and potential subcontractors. These communications will not involve government agencies, except as required by Chapter 6.

Of particular importance, with regard to the subcontracting procedures, is the element of time. Most subcontractors are selected during the early phases of the program. The program is currently in the advanced development stage, so it is necessary that prospective subcontractors express their interest and capabilities to the subsystem contractors immediately, even though it may be some time before the contracts are actually awarded. Early contact with subsystem contractors does not necessarily enhance the subcontractor's probability of selection; however, those applying late may stand less chance of being considered.

SUBCONTRACTING OPPORTUNITIES

Most areas of opportunity are for the specific commodities listed in Chapter 5. However, with these areas many variables exist. For example, some critical and complex items are often obtained from dual sources for logistic, economic, and technical reasons. Consequently, in these situations, opportunities exist for two subcontractors to be selected as suppliers.

Specific commodities are sometimes subcontracted on a life cycle basis and sometimes on an annual, price-only competitive bid. Usually, sources selected as part of a design and development effort are those retained for the life cycle. Annual, price-only competitive opportunities exist in many areas and requires that the subsystem contractor be aware of a firm's capability and has included that firm on their bidders list.

Major subcontractors to the subsystem contractor may also have needs for materials and components beyond those listed in the subsystem contractor's listing in Chapter 5. Questions regarding this possibility should be directed to, and the appropriate points of contact obtained from, the subsystem contractor.

Needs also exist for specialty and high technology firms. Firms with capabilities in those areas are urged to make contact with the subsystem contractors to make them aware of existing capabilities.

Potential suppliers should be aware that the program is dependent on funding cycles. Long delays may exist between the time initial contact is made and source selection determined. Additionally, funding cycles affect awarded quantities. In some cases, awards may be made for only a portion of the required quantity.

SUBCONTRACTING PROCEDURE

Each subsystem contractor has established its own procedures and requirements to fulfill subcontracting needs. Because of the evolutionary nature of this program, subsystem contractors have already developed a listing of approved, or qualified, suppliers. Inclusion in this listing is essentially based on experience that has been proven through a satisfactory record in areas of technical accomplishments, reliable products, cost control, project management, and schedule performance. In the case of new suppliers without previously proven quality, reliability, and cost efficiency records, the general method of selection is described in subsequent paragraphs and illustrated in Figure 20.

In order to be considered for subcontracting, all interested firms should determine which subsystem contractors have needs for material and components capable of being supplied. (A review of the information in Chapter 5 will provide an indication of needs.) The firm should then contact the appropriate subsystem contractor(s) point of contact, provided in Table 2, to express their interest in supplying a specific type of material or component required by the contractor or their subcontractors. To facilitate matters it is advisable to take the initiative of providing capability, product line, and qualification data when initial contact is made with the subsystem contractors. Table 3 provides a tabulation of the type of information that is helpful to subsystem contractors in evaluating the capability of potential suppliers.

Once contacted by a prospective subcontractor, the subsystem contractor may request the subcontractor to provide additional information about the firm's business operations and products. The type of information requested by each subsystem contractor varies and depends largely on the type of material or component involved. In more critical or complex items, information requested by the subsystem contractor may be even more specific and detailed.

The subcontractor should supply all information requested and return the information to the subsystem contractor in a timely manner. It is especially important to note that the subsystem contractor uses whatever information is provided as a basis for evaluating which subcontractors may be qualified suppliers. A request to conduct an onsite survey to aid in the evaluation process is also possible. The data so provided is analyzed by engineering,

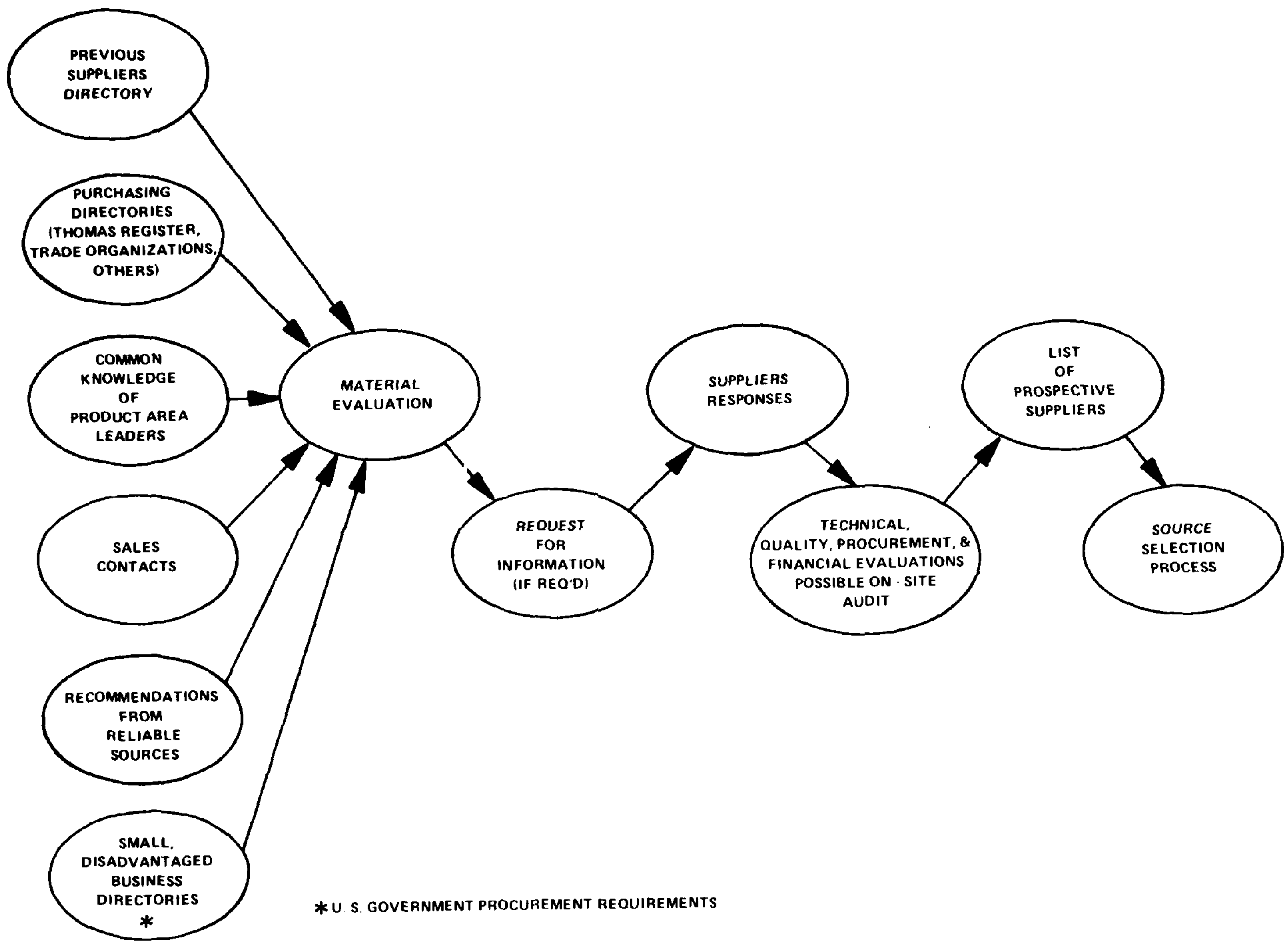

Figure 20. General Prospective Supplier Identification Sequence.

Table 2. Points of Contact.

SUBSYSTEM CONTRACTORS			
[illegible]CHER -	A. E. PATTERSON (408) 735-2577 WESTINGHOUSE ELECTRIC CORPORATION MARINE DIV, BLDG 21-4 HENDY AVENUE SUNNYVALE, CA 94088	INERTIAL NAVIGATION -	J. C. CLIFFORD (714) 632-4851 ROCKWELL INTERNATIONAL P.O. BOX 3105 ANAHEIM, CA 92803 MAIL CODE GG49
GUIDANCE -	M. J. FIOCCOPRILE (617) 258-3230 CHARLES STARK DRAPER LABORATORY, INC. 555 TECHNOLOGY SQUARE CAMBRIDGE, MA 02139	INSTRUMENTATION -	E. A. MELANDER (714) 772-2811 INTERSTATE ELECTRONICS CORPORATION POST OFFICE BOX 3117 ANAHEIM, CA 92803
FIRE CONTROL -	I. T. RENAK (413) 494-2061 GENERAL ELECTRIC ORDNANCE SYSTEMS 100 PLASTICS AVENUE PITTSFIELD, MA 01201	MISSILE -	F. F. ROBBINS (408) 742-9791 ALTERNATE - C. E. FITZSIMMONS (408) 742-0777 LOCKHEED MISSILE AND SPACE COMPANY, INC. POST OFFICE BOX 504 SUNNYVALE, CA 94086
NAVIGATION -	A. ROMMEL (516) 574-2954 SPERRY SYSTEMS MANAGEMENT GREAT NECK, NY 11020		
INFORMATION GUIDANCE AND ASSISTANCE			
	MR. R. HEISER (01) 218-2491 CHIEF STRATEGIC SYSTEMS EXECUTIVE MINISTRY OF DEFENCE, MAIN BUILDING WHITEHALL, LONDON SWIA 2HB	CDR R. G. LACHER, USN (01) 218-2319 STRATEGIC SYSTEMS PROJECTS LIAISON OFFICER MINISTRY OF DEFENCE, MAIN BUILDING WHITEHALL, LONDON SWIA 2HB	

Table 3. Helpful Source Selection Information.

I. General Information
   1. Name of Company
   2. Address
   3. Name of Point of Contact
   4. Company familiarity with U.S. Military contract requirements
   5. Availability of U.S. Government Inspection
   6. Number of years company has been in business
   7. Unionization in company facilities
   8. A work breakdown by:
      a) Percert of work for commercial concerns
      b) Percent of work as a Government Prime Contractor
      c) Percent of work as a Government subcontractor
   9. Facility Security Clearances, if any

II. Production Information
   1. List of principal products
   2. List of customers for principal products
   3. List of products you wish to provide under subcontract
   4. Demonstration or certification of product reliability and by whom

III. Production Facilities
   1. Description of your physical plant
   2. Description of any special processes you use
   3. Description of the condition of your production facilities
   4. Description of your production capabilities

IV. Financial Information
   1. Your Annual Report and Balance Sheet
   2. Your total volume of sales for the last completed year

V. Procurement Information
   1. Description of your purchasing system
   2. Approval of your purchasing system by the U.S. Government or U.K. Government, if any
   3. Procedures for recording cost data for analysis and audit

VI. Personnel Information
   1. Total employment figures
   2. Employment breakdown by job type and level
   3. Employment breakdown by hourly and non-hourly pay

VII. Quality Assurance
   1. Description of your Quality Assurance Program
   2. Description of your Quality Assurance Organization
   3. Extent of compliance with Quality Assurance Specifications and Standards
      a) MIL-I-45208
      b) MIL-Q-9858

Table 3. Helpful Source Selection Information. (Continued)

	c) OD 21549A
	d) Others (list)
4.	Description of your Training and Certification Program and its application to specific positions or areas
5.	Description of Change Control or Configuration Management Systems used
6.	Description of your Test and Measurement Equipment Calibration program and source of calibration standards
7.	Description of Quality Control requirements placed upon your lower tier suppliers by contact

quality, manufacturing, procurement, and financial specialists in the subsystem contractor's organization. Qualified suppliers are placed on the subsystem contractor's list of approved or qualified prospective suppliers and will be considered to receive a Request for Quotation (RFQ) or Request for Proposal (RFP), as applicable, when the subsystem contractor releases the contracts for bid. Generally speaking, only those subcontractors who are included on the list of approved or qualified suppliers will be requested to participate in subsequent bidding for specific materials or components. In some cases new sources may be required to submit preproduction samples for qualification testing before any shipments may be made to the subsystem contractor. In such cases the new source is qualified only after his product has successfully passed qualification testing.

When a procurement requirement emerges, the subsystem contractor issues an RFP or RFQ, as applicable to all applicable suppliers on the approved list. An RFP may contain statements of work, delivery schedules, quality requirements, subcontract terms and conditions, type of contract anticipated, requirements for cost and pricing data, program reporting requirements, and a variety of technical and administrative requirements tailored to the significance (size, dollar value, risk involved) of the contemplated subcontract. The RFP usually will require a response (proposal) from interested parties in a relatively short (30 to 90 days) time period. The proposal must address each of the requirements provided in the RFP, or it may be declared nonresponsive.

If formal source selection is required, the subsystem contractor will determine selection criteria prior to receipt of proposals. There will usually be an evaluation of technical merit, quality/management aspects, and proposed costs.

Bidding data may reference a number of documents that provide criteria for manufacture and procurement of weapon system components. For those U.S. and U.K. firms that are unfamiliar with the governing documents, Table 4 has been provided, which lists the document's abbreviation or acronym, full title, and an address where the documents can be procured.

Table 4. Governing Documents.

ABBREVIATION OR ACRONYMN	FULL TITLE	SOURCE OF SUPPLY
Mil-Std	Military Standard	Naval Publications and Forms Center 5801 Tabor Avenue Philadelphia, Pennsylvania 19120
Mil-Spec	Military Specification	
Fed Spec	Federal Specification	
Fed Std	Federal Standard	
Mil Hndbk	Military Handbook	
OP	Ordnance Pamphlet	
OD	Ordnance Data	Commanding Officer Central Technical Documents Office Naval Ordnance Station Louisville, Kentucky 40214
WS	Weapons Specification	
OS	Ordnance Specification	
NAVORD DWGs	Naval Ordnance Drawings	
ANSI	American National Standards Institute	American National Standards Institute 1430 Broadway New York, N.Y. 10018
ASA		
ASI		
USASI		

Table 4. Governing Documents. (Continued)

ABBREVIATION OR ACRONYMN	FULL TITLE	SOURCE OF SUPPLY
ASTM	American Society of Testing Materials	American Society of Testing Materials 1916 Race St. Philadelphia, Pennsylvania 19103
-	Anti-friction Bearing Manufacturers Association	Anti-friction Bearing Manufacturers Association Century Building, Suite 15 2341 Jefferson Davis Highway Arlington, Virginia 22202
SAE AMS	Society of Automobile Enginers	Society of Automobile Engineers 400 Commonwealth Drive Warrendale, Pennsylvania 15096
IEEE	Institute of Electrical and Electronics Engineers	Institute of Electric and Electronics Enginers Service Center 445 Hoes Lane Piscataway, New Jersey 08854
Other	Source control drawings and other subsystem contractor documents.	Point-of-contact listed in Chapter 7.

Note: Some of these documents are available in the U.S. through various information handling services and in the U.K. through the respective trade associations.

The Strategic Systems Projects Liaison Officer in concert with the Chief Strategic Systems Executive Office/U.K. Industrial Participation (TRIDENT) officer, both located in the U.K. at the Minstry of Defence, is available to provide guidance and assistance in obtaining information. However, their function is not to act as an intermediary for U.K. firms in subcontracting matters.

Any questions arising about technologies, quantities, specifications, etc., regarding listed items in this guide should be directed to the applicable subsystem contractor.

SUBCONTRACTING SUMMARY

To provide a convenient checklist of significant and salient subcontracting considerations, a subcontracting summary is provided. In considering doing business with subsystem contractors or their major subcontractors, potential subcontractors should be mindful of the information which is contained elsewhere within this guide but is summarized for ease of reference.

- All contracts will be in U.S. dollars ($).
- The inch-pound will be the basic system of measurement.
- Doing business with SSPO subsystem contractors is not the same as doing business with other Department of Defense areas. Technical disciplines are stringently applied.
- Technical disciplines will be selectively applied to subcontracted items down to a level deemed necessary to maintain weapon system integrity.
- Subcontractors for critical or complex components should expect audits by either or both SSPO and the subsystem contractor throughout the development and manufacturing process to ensure procedures and controls are established and maintained to carry out the technical disciplines and requirements imposed by contract.
- For many items, once a subcontractor has been selected it is expected that the same firm will provide all future requirements for that item as well as program support throughout its life cycle including repair services, modification, sustaining engineering, etc.
- Because of the life cycle support concept espoused above, most subcontractors are selected early in the development phase of the program. For this reason, it behooves potential suppliers to express interest as early as possible - delay until product commences will be too late to participate in the procurement of many items.

- The listings of items that may be procured competitively are only typical and therefore represent no offer to procure, nor do they limit items that will be procured. In recognition of this fact, all firms interested in being a supplier are encouraged to make their product lines and capabilities known to the subsystem contractors.

- Subsystem descriptions and illustrations are of TRIDENT I (C-4) as opposed to TRIDENT II (D-5).

- Suppliers are urged to contact as many subsystem contractors as they wish.

- The subsystem contractors are actively seeking assistance with the development of complex and high technology items to be used in Strategic Weapon System equipments. Because of space limitations, special nature, and/or difficulties encountered in attempting to explain these requirements it is not possible to completely describe such items in this guide. However, firms who are interested in the development and production of complex and high technology parts or components are encouraged to contact the subsystem contractors for further information.

- Major subcontractors to the subsystem contractors may also have needs for materials and components beyond those listed in Chapter 5. Questions regarding this possibility should be directed to, and the appropriate points of contact obtained from, the subsystem contractor.

- Due to the evolutionary nature of the program, sources for many major items have been selected by virtue of previous programs; however, many opportunities still exist.

- Dual source selection is a common practice in some critical and complex items. This is done for logistic, economic, and technical reasons.

- Subsystem contractors continually search for better, more reliable, or more economic sources of supply. It behooves interested firms to make their capabilities known.

- Potential suppliers should be aware that the program is dependent on funding cycles. These cycles will impact on both time for source selection and awarded quantities.

- Early submittal of product lines and capabilities does not ensure an award; however, late submittals ensures that consideration will most likely not be given. Submit your data as early as possible for consideration of future RFQ's or RFP's.

ADDITIONAL GUIDE COPIES

For additional copies of this guide, U.K. subcontractors should contact the U.K. Ministry of Defence, Mr. R. Heiser (telephone number (01) 218-2491). U.S. subcontractors may obtain additional copies by either contacting the subsystem contractor point of contact or contacting the Strategic Systems Projects Office, Attention SP 2015, Navy Department, Washington, D.C. 20376 (telephone number 202-695-2814).

GLOSSARY OF TERMS AND ABBREVIATIONS

Glossary

Acceptance Criteria	Acceptance Criteria may consist of technical specifications that must be met, performance objectives that must be met, or other criteria that is provided and which the item must meet before it will be accepted as fulfiling contractual requirements for the specified phase of development or production.
Backfit	The process of converting the POSEIDON Class submarines to carry the TRIDENT I C-4 Missile. A backfit will also be made of the TRIDENT Class submarines to carry the D-5 missile.
Change Control System	A Change Control System is an administrative system whereby changes to items of hardware, software, or documentation are reviewed for their effects on cost, schedule, performance, etc., and are either formally approved and implemented or are disapproved.
Configuration Control	Configuration control is another term for change control. It may also be called Configuration Management or CM.
Demonstration and Shakedown Operations (DASO)	Demonstration and Shakedown Operations are exercises which serve to evaluate the readiness of the complete weapon system and crew for operational deployment.
Deploy	To place into active service use. The system is deployed when it is capable of performing its designated function in an operational environment and is placed into that environment in order to perform its function when called upon.
Disciplines	Technical program requirements, processes, and procedures that are applied throughout the life cycle of a program

to ensure reliability of the weapons system.

Field Activity — SSPO Field Activities perform as the onsite technical representatives of the Director, Strategic Systems Project. They assist in the administration of contracts at the contractor facilities and provide engineering and technical direction, coordination, liaison, monitoring, and review for SSPO.

Facility Clearance — A Facility Clearance is granted when a firm (office, plant, etc.) has been inspected and found to be compliant with all requirements concerning the handling of classified information. A facility that has clearance is approved for the storage and handling of classified material. A Facility Clearance does not affect the requirements for individual personnel clearances which authorize specific individuals to access classified information.

Field Office — See "Field Activity."

Firmware — Firmware consists of instructions to a piece of hardware that are permanently encoded in the electronic logic of the hardware equipment. Once programmed, firmware instructions can not be readily changed.

Hardware — Hardware consists of physical equipment that operates mechanically, electrically, or electronically and performs a function.

HI-REL — High Reliability. This te[illegible] is used in relation to certain piece parts, components, or equipments which because of their importance to proper functioning of the system must be of extraordinarily high reliability. The failure of a Hi-Rel item would jeopardize mission success.

Inertial Guidance — Guidance by self-contained automatically controlling devices that respond to inertial forces.

Life Cycle

A term used when describing the weapon system from its initial conception until its retirement from active use or its replacement by a more advanced system or concept.

Maintenance Levels

Four maintenance levels are used in the Strategic Weapon System. Maintenance to be accomplished at each level is based on the complexity of facilities, tools, equipment, procedures, manpower, skills, documentation, capability, and time required to perform the maintenance and will be specifically authorized by SSPO.

a. First level maintenance is the maintenance specifically authorized by SSPO to be performed on Strategic Weapon System (SWS) equipments by the submarine crews on board the submarine, utilizing only those skills, personnel, spare/repair parts, tools, equipment, and documentation available aboard the submarine. All first level maintenance tasks must be capable of being performed while the submarine is submerged and underway.

b. Second level maintenance is that maintenance specifically authorized by SSPO to be performed on SWS equipments on board the tender or in second level maintenance shops at the Refit Complex, utilizing those skills, personnel, tools, equipment, repair parts, and documentation available which are additional to, but not available on the submarine during patrol, or cannot be performed while the submarine is underway and submerged.

c. Third level maintenance is depot maintenance specifically authorized by SSPO to be performed on SWS equipments at POMFLANT/SWFPAC or at other government facilities specified by SSPO, utilizing those skills, personnel, tools, repair parts, test equipment, repair capacity, and documentation available at those facilities which provide capability additional to that at the first and second maintenance levels.

d. Fourth level maintenance is depot maintenance which is authorized by SSPO to be performed at specific contractor facilities utilizing the full range of capabilities, skills, documentation, special facilities, and test equipments which are available only at contractor's plants.

Major Subcontractor — Because of the complexity of the SWS and the evolutionary nature of the system, certain subcontractors have established a relationship as major subcontractors who provide certain major components of the subsystems. Their contractual obligation is to the subsystem contractor, to produce a major and important component of the subsystem and have been preselected as the subcontractor for that component. An example of a major subcontractor would be Joint Venture who is contracted by Lockheed Missile and Space Corp to manufacture the solid propellant rocket motors.

Milestones — Milestones are designated important events or the completion of specified phases in the weapon system development, production, and deployment. Milestones are established for the purpose of program reviews and to evaluate progress.

Missile Range Ships — Missile Range Ships are used to monitor progress and telemetry during test launches of the missile. These ships are specially instrumented to collect data for later analysis concerning test launches.

Naval Plant Representative Office (NAVPRO) — The NAVPRO representative acts as the technical representative and contracting officer in all matters relating to the administration of contracts with the government at the contractors facility. He is responsible for insuring that all engineering requirements of assigned contracts are performed in accordance with requirements of the contracts and associated specifications. The NAVPRO representative performs quality assurance functions necessary to assure that material and services being acquired by the government conform to contractual requirements prior to their acceptance. In this role, the representative may inspect material arriving directly from subcontractors that will be used without modificaiton or that requires quality inspection prior to incorporation into the end item.

Nontactical Equipment — Nontactical equipment consists of all equipment related to the Strategic Weapon System that is not used to directly support the missile or other SWS component needed for the maintenance, handling, preparation, or launch of the missile.

Ohio Class Submarine — The Ohio Class submarine is the 726 class also known as the TRIDENT submarine. This class vessel was designed from the keel up to carry the Strategic Weapon System and is configured to allow backfit of the TRIDENT II D-5 missile when it is available.

Patrol — A patrol is a period of time during which a submarine is actively pursuing its mission by operating in a designated geographical area in such a manner that it remains undetected and ready to launch its missiles when and as directed.

Plug-In Modules — Plug-in modules are electronic packages that are designed to be easily replaceable as a result of the use of plug type connectors of standardized dimensions and arrangement.

POLARIS	POLARIS was the name given to the first generation of submarine launched ballistic missiles developed by the U.S. There were three modifications of the missile that were deployed: A-1, A-2, and A-3.
POSEIDON	POSEIDON was the name given to the second generation of submarine launched ballistic missiles. The POSEIDON missile was an evolutionary improvement over the POLARIS. The missile was designated the C-3 missile.
Post Boost Vehicle	The Post Boost Vehicle is that portion of the missile which contains the reentry bodies and various control equipments used to manuever the platform for deployment of the reentry bodies.
Prime Contractor	See "Subsystem Contractor."
Prototype	An item which is designed and built according to the specifications of the proposed production item. A prototype is used in testing and proofing prior to entering full scale production. A prototype is not generally constructed until the design process has reached a point where it is possible to predict with reasonable accuracy the final production design specification.
Purchase Order	The term purchase order is frequently used interchangeably with "subcontract", especally when dealing with "firm fixed price" contracts.
Refit Facility	A facility where intermediate (second) level maintenance is performed between patrols. See "Maintenance levels."
Request for Information (RFI)	A request for information may be made to a prospective subcontractor in order to determine whether that prospective subcontractor has the capabilities required to perform the desired work.