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The NATO Patrol Missile Hydrofoil (PHM)

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The United States Navy is undertaking a design and multiple production program of submerged foil hydrofoil based on over 15 years of research and development and experimental prototype hydrofoil experience. The project patrol missile hydrofoil (PHM), has also been sponsored in NATO by the U.S. and, as such, represents the first time any ship building program has been conducted as a joint NATO effort. The primary objective is to introduce the PHM into various NATO navies in an early time frame by establishing an inexpensive, standardized ship which can be jointly supported and operated. A number of difficult problems, unique to the U.S. Navy, remain to be solved, including such concepts as metric design, NATO equipment standardization and logistics sources, gold flow balance and the management of a total ship acquisition program in consort with NATO partners. Complex problems of developing and procuring various new lightweight weapons systems through established USN organizations and procedures while pursuing NATO dedicated objectives further complicate the management problem.

Introduction

IF there were ever a program conceived to guarantee the erection of every imaginable barrier in its path, it is one which calls for building a fleet of "flying ships," to design and build it in cooperation with at least two other countries, to purchase much of the major equipment from foreign countries, to develop international logistics support plus a completely new U.S. mobile logistics concept, to call for weapons systems which have not been developed or service accepted in the United States, and to initiate this from existing U.S. Navy organizations which have most of their dedicated manpower working on a multitude of other ship programs. Such is the situation of the NATO Patrol Missile Hydrofoil (NATO PHM), probably the most significant of all advance ship programs yet undertaken by the U.S. Navy.

It is the objective of this paper to provide a nontechnical situation report on the NATO PHM; its origins and recent history, the many unique features which complicate its existence and its design configuration as developed thus far. Although nontechnical in nature, it is hoped that the information provided herein will broaden the education of the technical community and increase the effectiveness of those who may someday either face the prospect of undertaking a similar program, or cross the path of PHM in some capacity.

Background History, U.S. Hydrofoils

PHM has its origins in the extensive U.S. Navy research and development program in hydrofoils which has taken place over the past 15 years at a total cost of some $85 million. This period was marked by the construction, extensive testing and service operation of four hydrofoils, HIGH POINT (PCH-1), 120 tons, delivered in 1963, FLAGSTAFF (PGH-1) and TUCUMCARI (PGH-2), 60–70 tons, in 1968, and PLAINVIEW (AGEH-1), 310 tons, in 1969. As of May 1972 these craft had accumulated over 2300 hr of foilborne operations.

In 1968, with significant progress made in dealing with HIGH POINT's early technical problems, it became apparent that the day was fast approaching when reliable hydrofoil operating capability could be presented to the naval operating community and that certain work in the area of operational mission analysis and requirements and effectiveness studies was lacking. The on-going programs of TUCUMCARI and FLAGSTAFF and their prospects for further validating the ability of the U.S. Navy to build reliable high-speed platforms having exceptional maneuverability and open ocean sea-keeping emphasized the question as to what the U.S. Navy could or would do with its revolutionary new ship system.

To help answer this question, efforts were undertaken to study the various mission roles applicable to a hydrofoil of HIGH POINT's approximate size and performance capability. Additional design studies were undertaken in 1969 to establish a feasible hydrofoil platform representing the judgement of Navy hydrofoil experts as to what could be reliably produced and delivered to the fleet. The result was a hydrofoil of 130–140 tons employing most of the scaled-up features of the highly successful TUCUMCARI; i.e., canard submerged foil configuration, flap control surfaces and a twin water jet propulsion system. Various modularized mission suits were envisaged, ranging from the Gunboat and ASW mission to Missile (Surface to Surface), Electronic Warfare and Special Warfare roles (5 missions, the initials of which spell "GAMES"). This was essentially the situation in 1969 when a growing cadre of USN flag officers, exposed to the Navy's proven hydrofoil technology, took up the concern over its exploitation and introduction into the fleet.

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PHM Origins and Recent History

The NATO Patrol Missile Hydrofoil (NATO PHM) had its beginning in mid-1969 when CINCSOUTH presented to NATO a mission requirement for countering the OSA/KOMAR threat in the Mediterranean Sea. Discussions held later that year by an 11-nation NATO Information Exchange Group resulted in a threat definition that included major Soviet combatants, as well, over the whole European Allied Command area. In early 1970 NATO Exploratory Group Two was formed to deliberate the concept of a NATO Common Fast Patrol Craft (Guided Missile) to counter this threat and in September 1970 the group concluded that the submerged-hydrofoil craft, basically of the 140-ton size proposed by the United States Navy, was the craft most suitable for meeting the NATO mission requirement. Acting upon these recommendations, the NATO Naval Armaments Group established NATO Project Group Six to conduct the planning stages of the program and the initial determination of PHM characteristics which would satisfy the specific mission requirements of nations having serious intentions of joining the PHM program.

Under U.S. sponsorship and chairmanship, Project Group Six held its first meeting in November 1970 and established general agreement of the management approach to be pursued. Through June 1971 a series of four "open" meetings were held with participation by all interested nations (10 in all) and during this period the United States presented a draft outline of a Memorandum of Understanding (MOU) and further hydrofoil baseline design and cost estimates. In addition, as program sponsor, the United States committed to the building of two PHM lead ships, with or without successful negotiation and formulation of a cost sharing program. To accomplish this, the United States placed funding for a two ship program in the fiscal year 1973 budget and reprogramed a limited amount of early design and long lead procurement funding for fiscal year 1972.

The June 1971 meeting concluded with mutual agreement that future meetings would be limited to nations willing to formally declare their intent to proceed with the cooperative project and, subject to conclusion of an agreed MOU, to formally enter the program as an "engaged" nation and commit resources thereto. Letters of Intent were signed by Italy, Germany, Great Britain, and Canada. In October 1971, the United States announced its intentions of awarding the lead ship design and construction contract to The Boeing Co., builder of HIGH POINT and TUCUMCARI, and that the initial effort under the contract would be additional feasibility design studies. The objective of these studies was to obtain clear agreement on a specific common ship design which would satisfy requirements of all engaged nations. Further, due to the advance in program schedule without having yet obtained a satisfactory MOU, the United States indicated it would proceed at its own expense with the NATO design, share the results of these studies with all engaged nations (with costs to be reimbursed only by those engaged nations which later signed the MOU), and to conduct all aspects of the design development, contract definitization and management in cooperation with the engaged nations.

Thus, in November 1971, a letter contract for Phase I of a three phase design and construction program for the PHM was awarded to The Boeing Co. The total program is planned as follows:

Phase I: Design work leading to completion of contract design of the NATO Standard PHM and completion of contract design of the United States' national variant thereto. Target completion December 1, 1972.

Phase II: Detail design and construction of two U.S. variant PHM lead ships, each to be built over 24 months, 3 months apart. Possible construction of other national lead ships if so determined by other participating governments and authorized according to the terms of the MOU. Delivery of a complete production data package suitable for competitive procurement of ships by any of the participating nations. Target start date was set for December 1, 1972; completion by March 1975 (delivery of 2nd lead ship).

Phase III: Production Phase. In the United States, follow-on production shall be by competitive procurement, using the production data package delivered under Phase II, and with The Boeing Co. providing lead yard services; target start date late 1974. NATO production to be in accordance with the MOU as modified by a future production supplement.

Throughout early 1972 efforts have been devoted to completion of the Feasibility Design (completed in March 1972 and depicted in the information of this paper) and completion of a draft PHM Memorandum of Understanding which is suitable for ratification. It became clear early in the year that signing of the MOU and commitment of funds would not occur until some appreciable time after draft MOU completion; hence additional letters of intent, fully acknowledging the specific design and cost schedule obligations being entered into were requested by the United States and provided by Italy and Germany in April and May 1972, respectively. All other nations have either dropped from the program or reverted to observer status. Observers presently include Great Britain, Canada, Denmark and The Netherlands.

General Operating, Logistics and Design Concepts

As indicated by its name and the preceeding discussion, PHM is intended as a surface combatant against either high speed patrol craft or major combatants. Its primary weapons system is a surface missile battery (presently varying from nation to nation, but potentially being made a common system) and its secondary battery is the Italian 76mm Otto-Melara rapid fire cannon (common for all ships). The ship will have a top speed in excess of 40 knots, be capable of sustained at sea operations with refueling, and have open ocean foilborne performance and transit capabilities improved over that of its hydrofoil predecessors.

The design is to be based upon existing technology, with heavy dependence upon "off the shelf" components and materials and heavy emphasis upon reliability and proof of performance prior to delivery. Phase II performance trials will cap a comprehensive test and evaluation program, commencing with hull and strut/foil model tests near the start of design and extending through tests of individual custom build componentry which is considered vital to design validation. The Phase II performance trials will be required not only to validate contract performance requirements, but also to support the decision for Phase III and follow-on PHM production.

PHM, like the four previous U.S. Navy hydrofoils, is to be manned by a small, highly trained crew and will be strongly dependent upon outside support for maintenance, administrative and logistics support. For the U.S. PHM, a key element to the operational concept is the establishment of a Naval Auxiliary as Tender/Mother Ship for each PHM squadron. The Tender will deploy with the PHM squadron as its Mobile Logistics Support Force and have the capacity to provide most, if not all, intermediate logistics support functions. (Docking is the most doubtful question mark.) The crew of 4 officers and 17 men will be extensively crosstrained in watchstanding, preventative maintenance and emergency corrective maintenance underway, and in port, will supplement tender personnel for upkeep and preventative/corrective maintenance. Planning for personnel billets and training requirements is still

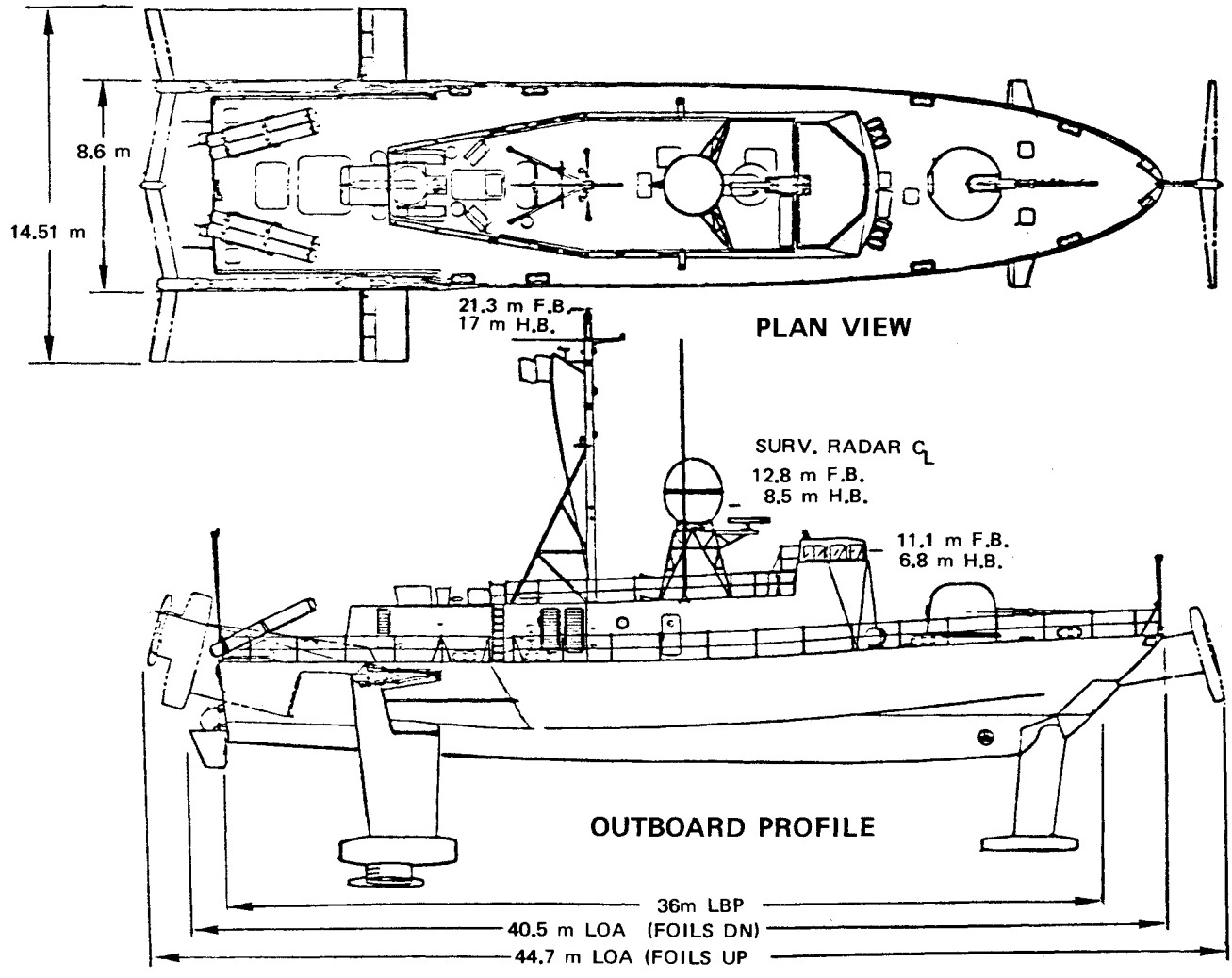


Fig. 1 General arrangements; plan view and outboard profile.

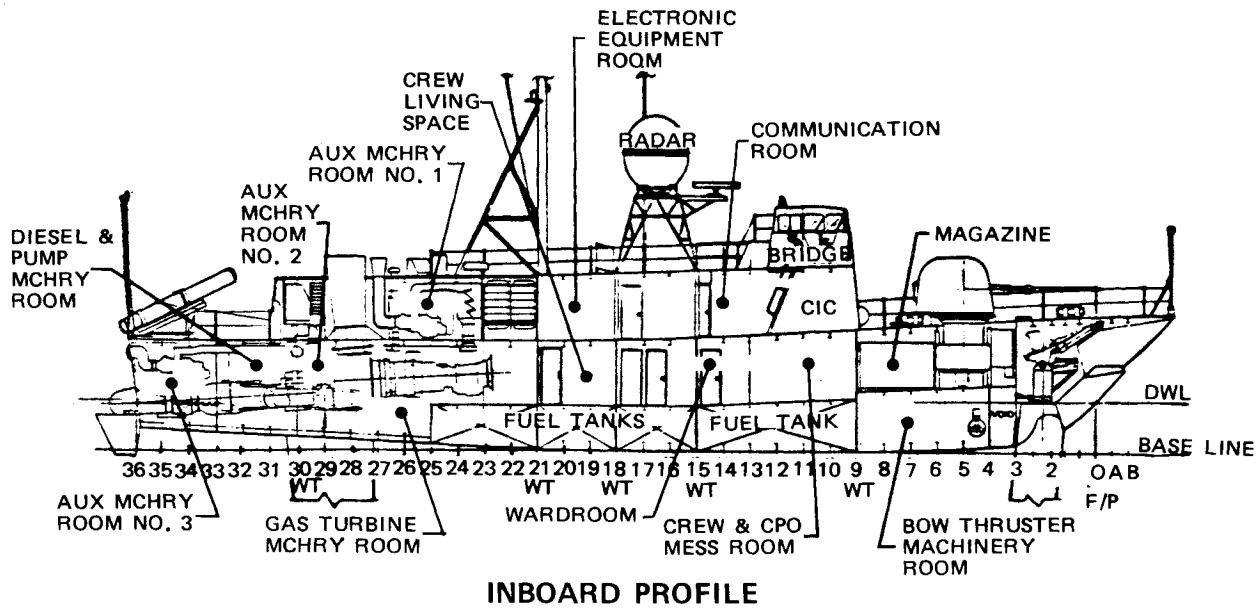
at an early stage and at present it is still not established what type of naval auxiliary will be used as a mothership. Planning requires this decision to be made within the next year to be incorporated into the FY 74 or 75 budget for activation and conversions. The introduction of a basically aviation oriented operational maintenance concept into a major ship program is expected to involve great difficulties and a good deal of trial and error.

Design Status

When the NATO program was initiated, there was great divergence of opinion as to what size craft would suitably meet a common NATO surface warfare mission. Being limited to fundamentally nondevelopmental extrapolation of existing U.S. military hydrofoils, it had clearly to be of relatively modest size. However, opinions ranged from a simply extrapolated "two-times' TUCUMCARI" of about 120 long tons full load displacement (originally postulated by Great Britain, the United States, and others) to one of 240 tons proposed by Germany. The German study was based upon an extensive study conducted within their government and with The Boeing Co. to develop an improved supplement to their Fast Patrol Boat (KKB 143) and was the most comprehensive study of an individual national requirement which existed at that time.

A more recent and applicable United States study, in the meantime, predicted that nominal U.S. requirements could be accommodated in a 170 ton ship. The resulting diversity of opinion, therefore, on what was necessary versus what could be achieved (with low technical risk and still capable of containing required mission equipment) led to establishment of an agreed set of NATO PHM requirements characteristics plus individual national requirements and the above mentioned first effort under the lead ship design program to determine what size ship and features would be necessary to accommodate all the characteristics requirements. Following 6 months of extensive design effort, technical negotiation, and cost information exchange, the NATO Standard PHM design has presently been established at 214.7 long tons (including design and building margin plus a 2% reserve for contract characteristics changes). General Arrangements are illustrated in Figs. 1 and 2. Individual national variants weigh either more or less depending upon their national weapons payload and fuel necessary to attain required national range.

As of June 1, 1972, the PHM design had progressed to the point where essential dimensions, weights and arrangements had been determined, the main propulsion engine selected and Long Lead Procurement of the engine authorized. Most major system preliminary design definitions are scheduled for August 1972 and the bulk of long lead procurement will take place between August and December 1972. Design characteristics and general arrangements are illustrated in Table 1 and Figs. 1 and 2, respectively. The design technical approach and general management features are described in the following section.



INBOARD PROFILE

Fig. 2 General arrangements; inboard profile.

Special Program Features

As indicated at the outset of this paper, there are numerous special features of this program that are related to its multination NATO status and which serve to complicate an already difficult enough process involved in the acquisition of new ships.

Balance of Payments

One very special feature of the program which is not akin to any previous United States or other normal national shipbuilding program, is the requirement for balance of payments equalization between all participants. Each nation is thus assured that within reasonable limits, the value of components, materials and services it purchases from other participating nations will be offset by the combined purchases made by the other nations from itself. Thus, if one country were to subscribe to 40% of the total value of the PHM production program, then it could be expected that approximately 40% of the value of each PHM would be labor or material procured in that country. This requirement places very large demands for looking ahead at the outset of the program and attempting to predict the likely necessary offset distribution formula necessary for the follow-on production program, so that it can be used in the lead ship program and facilitate negotiating the most favorable long range terms and conditions with the original vendors. It also requires much stricter demands upon contracting provisions for rights and data and/or licensing agreements from vendors, in order to allow some flexibility in redistribution of equipment sources when other nations join the program and, in any event, to enhance reprocurement capability from more than one source. It has developed thus far that many U.S. domestic manufacturers have or will readily provide licenses to one or more European organizations to meet this requirement, whereas reprocurement data packages for some of the equipments to be used in PHM will probably not be so readily obtainable.

Table 1 PHM characteristics

Displacement (metric tons)	
full load, design	227.6
full load, at delivery	218.6
light ship	169.5
minimum operating	201.8
Dynamic lift at takeoff (metric tons)	221.5 (design)
Length (meters)	
over-all, foils up	44
over-all, foils down	39.5
between perpendiculars	36
Beam (meters)	
main deck maximum	8.4
design waterline	7.5
over-all foil span	14.3
Draft (meters)	
hullborne, foils down (keel to design waterline)	1.9
hullborne, foils down (lowest point on foil system)	7.2
hullborne, foils up (lowest point on rudder)	2.6
foilborne (nominal, to lowest point on foil)	2.8
Height (meters)	
masthead light, hullborne	12.5
masthead light, foilborne	16.9
bridge, hullborne	6.6
bridge, foilborne	11.0
Fuel load (metric tons)	
design	33
maximum tankage	48.5
Normal complement	
4 officers, 17 men	

The above fundamental presumption that the program must call for procurement of portions of the ship from foreign sources over the life of the production program triggers strong negative reaction from some quarters which must be overcome at all costs. National philosophies must be agreed upon early and decisions made at the outset as to how costs and procurement will be shared; (subsequent unilateral decisions to shift procurement from foreign to domestic sources amounts to a violation of agreement with the partners who are purchasing their share from you).

Examples of some of the expensive subsystems and assemblies which must be candidates for the balance of payments offset arrangement are as follows: Gear Boxes, Water Jet Pumps, Automatic Control System, Strut and Foil Assemblies, Gun and Missile Systems, Electronics Equipment, and the Hull construction and ship assembly itself. It is understandable that concepts involving having any one of these groups of systems procured from other than domestic sources conceivable for the life of a ship-

building program should trigger reaction in even the most objective American reader, not to mention the nonobjective reactions of long established, experienced and qualified personnel in establishments responsible for training, maintenance, overhaul planning, spare parts support or reprocurement of similar equipment for other U.S. Navy ship types. But it is emphasized again that distribution of procurement is the most basic working precept of a multination production program and is essential if the program is even to exist.

Metric Design

The U.S. Navy's initial approach to the question of metrication was with a great deal of caution and uncertainty. It was originally presumed that, of course, the U.S. design would have to be in customary English units because the difficulty of building and (more important) maintaining a craft design in metric units would be too severe. There was furthermore, some concern over the calibre of opposition such a decision would arouse. Consequently, the early clauses in the draft MOU called for two designs, one in metric units and the other in English (U.S.) units (Paradoxically, the English are now shifting to metric!). However, as the ramifications of this question were looked at in more depth, particularly with regard to the construction and maintenance of new equipment for PHM, the new logistics support concepts mentioned earlier and the status of United States pending and current moves toward metrication—opinion firmed that NATO PHM should be of one design only–metric.† Furthermore, at the point in MOU negotiations where this issue and its cost impact had to be resolved, high level U.S. Navy endorsement was provided and the decision for metric design was made. The only exception to this policy will be in the selection of existing "off-the-shelf" components which are available only in English units.

Project Management

The development of special NATO management of PHM has been slow in evolving to date, due to the fact that the International Memorandum of Understanding has not yet been signed and only recently were the final letters of intent signed by Italy and Germany. Thus, it has been a U.S. Navy managed program so far, with all the contracting and project management resources being provided by the Naval Ship Systems Command (PMS 391).

To date, over-all guidance responsibility has resided in Project Group Six. However, upon signing of the MOU, a Steering Committee is to be formed which exercises total executive control over the project office. With the signing of the most recent letters of intent by Italy and Germany, a Provisional Steering Committee has been formed which will act in lieu of Project Group Six. The U.S. Navy Project Office is now implementing changes to bring the above Italian and German project personnel aboard on an official basis, much as took place with NATO SEASPARROW.

Most other NATO programs, such as SEASPARROW, have undergone an evolutionary change in their organization and management. Originally operating as a Naval Material Command project office, it took SEASPARROW approximately 2 years to complete the transition to separate location, administrative support and dedicated civil service staffing, although the incorporation of key foreign personnel into the project management was accomplished soon after SEASPARROW was established as a NATO Project.

This preceded by many months for the formal signing of the SEASPARROW MOU by participating nations. Whether the NATO PHM program will follow a similar path has yet to be determined. However, since January 1972, additional office spaces have been provided for various national technical representatives that have been participating in the design and program staff work for their respective countries. As time progresses, more of the project management functions such as Logistics, Data and Configuration Management, Training, etc. for the total program will be assigned to the Deputy Project Managers (i.e., senior project representatives) from the other participating nations.

By the time this paper is published, it is expected that full time project representatives will have been assigned from Italy and Germany and the question will be fully upon us, "How much longer can we continue to function as part of a United States Navy organization, rather than a NATO organization?" The answer will be resolved at the higher levels of the Navy and in the NATO Steering Committee and will no doubt be guided by circumstances and the precedents of other NATO projects.

The extent to which formal PHM project office segregation or relocation may occur prior to the signing of the MOU, however, is not yet determined as of this writing.

Design Management

The manner of government technical administration of PHM contract design effort has taken on somewhat unique features for a shipbuilding program. The program is characterized by a) the first design of an advanced ship type (hydrofoil) scheduled for multiple production, and b) special requirements for design visibility and management control to facilitate protection of NATO and individual nations' interests in PHM. The program is also nonuniquely characterized by its somewhat ambitious schedule, which, nevertheless, we consider attainable from a technical standpoint.

The original Phase I letter was awarded to The Boeing Co. in November 1971 with a government Request for Proposal that had been many months under preparation. (It was noteworthy that this RFP was later unofficially complimented by the contractor as "the most complete and comprehensive government RFP ever seen by that group of personnel, which included selected top managers from Boeing's Apollo programs). The proposal requirements heavily accentuated government participation in the design effort and much formal study and documentation of the various design alternatives and tradeoffs to support design decisions. It also provided for a three-month gap in effort between the Phase I and Phase II contract schedules. It proved impracticable, however, to accomplish the Phase I design phase of the program in this manner within the cost and schedule objectives. Following receipt and evaluation of the contractor's original responding proposal, it was decided to adopt a revised technical approach with considerably reduced formal documentation and increased heavy dependence upon "real time" government technical and managerial visibility on the design effort. A good deal of the original formal documentation has now been deleted or deferred until the postdesign decision period (whereas in the original technical approach, formal documentation was required to precede most design decisions). Dependence upon internal contractor design information and informal documentation of design studies, tradeoffs etc., has been greatly increased together with the full-time engagement of Navy engineering systems personnel who maintain frequent face-to-face and telephone contact with their contractor counterparts. Office space has been made available for longer term visiting government personnel.

Design is tied to meeting stipulated performance requirements, which retain precedence over the developing

†Report to Congress, "Metrication; An Idea whose Time has Come," U.S. Department of Commerce, 1971.

design description throughout design and lead ship construction. In cases where the government negates a contractor recommended design decision and imposes an alternative, then the alternative design solution becomes the new applicable system "requirement" in lieu of the original performance requirements. Thus, responsibility for the respective portions of the design which the government and contractor determine is to be carefully maintained.

Program reviews are carried out on a monthly to 6-week basis, with the immediately preceding day being devoted to engagement of contractor and government technical personnel in the scheduled agenda presentation information. At the Review, technical status and opinion is critiqued by Navy technical personnel, thus providing Navy and Contractor management with the most accurate assessment available of design and program progress, difficulties and alternatives for actions required.

In addition to the above progress reviews, approximately a dozen specific major system design areas have been designated for "Preliminary Design Review" (PDR), a semi-formal presentation of required design study results, tradeoff analysis, drawings, etc., which illustrate and substantiate the design effort to that point as a basis for proceeding to detailed design and/or procurement specifications. Each PDR is formally documented and the sum of all the PDR's constitutes the major portion of the design configuration to be established under Phase I of the PHM program.

Several key design decisions remain formally submitted to the project office for decision. Such cases as the strut/foil material selection, main propulsion plant configuration and electrical system decisions require submission of all supporting tradeoff studies and arguments in writing together with the contractor's recommended solution prior to a formal government decision.

Participation of the engaged NATO countries is provided for in design decisions to the same extent that formal project office participation or control is provided for in the contract. Design Decision Papers are resolved by the Project Manager in consultation and review with the designated NATO representatives, and other program functions such as PDR's and Progress Reviews are conducted with their participation as well. In the event a conflict arises which the Project Manager is unable to resolve, provisions have been made (but not yet exercised) for the disagreeing participating nation to appeal to the NATO Steering Committee. As a general rule, the cost-shared design will be that which has the largest number of nations supporting, with any other nation free to develop its own preference as a variant design, at extra (nonshared) cost.

PHM technical support is provided by the Naval Ship Engineering Center, which has assigned a full time cadre of approximately eight personnel to act as the PHM Project Office's Design Agent. This group, working under formal arrangement with the project office, is in turn supported by the functional technical specialties of NAVSEC according to the PHM design program requirements and schedule. It is hoped that this extensive technical support will be effective, also, in providing much of the technical staffing which foreign project office personnel may require in order to perform their roles in the project, although this is presently still unclear. The final arrangements may involve some supplementary staffing of the NAVSEC group by foreign personnel plus some continued dependence upon technical resources and advice from the individual countries, particularly for work related to national variant designs.

Cost Sharing and Commonality

While there is no doubt that the technology which the United States is offering to NATO countries for mutual defense purposes is attractive in its own right, an essential consideration which makes the program practical and desirable to a potentially large number of countries is that of economics. It is a characteristic of all NATO programs that, by sharing the nonrecurring design and production costs and establishing maximum commonality so that the largest possible portion of nonrecurring costs is shared rather than borne alone, each nation can thereby attain a new modern weapons system for little more than the unit recurring costs. Consequently, there is great impetus in the PHM program to establish a mutually agreed upon "common" design that includes as much of the expensive ship and mission equipment as possible. A ship is a particularly difficult total system for which to accomplish this because, as opposed to most other systems which have become NATO projects, it consists of so many separately, already developed and supported major subsystems to which each government is particularly committed. At one time the divergence in opinion as to what size ship would be required raised serious doubts as to the level of commonality which could be attained in the hull, primary machinery and auxiliary systems, although it now appears that most of these problems have been resolved. We feel that the project can be successful in building a common ship with a good chance to remain standard in all its basic ship equipments throughout the various national shipbuilding programs. No doubt the pressures driving other nations away from commonality will be as great as in the United States. We will have to strive for design and logistic support solutions which make remaining with NATO standard design features financially attractive. At present, however, the prospects for success in this area have been elevated to the point where the program is now seriously investigating commonality in mission equipment—which comprises nearly half the total ship system costs. Most of the electronics and weapons, as might be expected, are quite similar in functional requirements and are therefore subject to the possibility of establishing standard equipments, within the limits of national political and economic feasibility.

The major system candidate is the fire control system, supporting computer and programing. It is hoped that by July 1972, in time to incorporate into the NATO Standard Design, at least two of the three nations involved will have succeeded in establishing an agreed upon common fire control system. Once this is established, the prospects for cost savings and the resulting forces for commonality in many of the remaining electronics systems will become even greater.

Under the provisions of the MOU, nonrecurring design costs are to be equally shared between all participants throughout Phase I, except those costs associated with a particular national variant design. Nonrecurring costs associated with lead ship production in Phase II are to be pro-rata shared according to estimated lead ship production, assuming two for the United States and one each for other nations. All NATO Standards PHM nonrecurring costs in Phase II have arbitrarily been defined to be 25% associated with design (equally shared) and 75% associated with production (pro-rata shared). Nations which join the program will pay according to the same sharing formulas, resulting in rebates for the original nations.

General Observations and Conclusion

In addition to the development of the various concepts and subjects discussed here, the PHM program has been involved in a multitude of other activities, which follow various levels of routine for shipbuilding programs. There is the perpetual cycle of cost estimating and budget defense plus the continuous maintenance of management relationships and work under Ship Project Directives

(SPD's) with supporting Systems Commands and other Naval Activities.‡ A major effort has been involved in design contract definitization. As soon as this is completed, the administrative development Phase II contract must be commenced. At every hour of the day there are sources seeking information and a host of active, constantly fluid problems and situations which demand immediate attention. Most of the PHM critics are friendly, but not all, and one of the major continuing problems can be characterized by the socalled "ever-widening circle" routine in which it seems that the energy necessary to educate and overcome each obstacle remains always undiminished, no matter how far removed is the obstacle from the source, and likewise, the number of such obstacles seems never to diminish. The PHM sphere of influence is small and, like any set of new ideas, exists in a somewhat hostile world. There is no shortage of people available to inform PHM that it will be unable to accomplish any of the unusual features of its program. Usual supporting arguments include vague reference to the Buy America Act or some other existing high level regulation. Investigation by legal counsel has indicated that the NATO PHM program, as described above, can be implemented within existing statutory constraints. We do recognize, however, the special attention that will be necessary with higher level DOD/congressional concerns. Usually, of course, it is the fact that existing policy and the customary way of doing things is being challenged that creates resistance. And there is always ample logic to defend against new concepts and practices in other impacted spheres of influence. This is only to be expected; indeed, the real surprise would be if this were not the case. So far, extensive dialogue and the slow process of education have achieved good results, though in a few critical situations, timely help from high levels has paved the way—a sure sign of the priority which we feel has been accorded this program.

Throughout the whole period of concept, management and design development, there have been countless unpredicted and traumatic events which have given great pause and concern to the individuals and organizations involved. Mere examples include the occasion where one nation announced in effect that all her PHM program funding had been cancelled for at least a year; in another case cost repercussions in the United States placed the whole program in jeopardy after the most recent letters of intent had been provided by Germany and Italy. Though such happenings are certainly not unique to this program, it is unfortunate that this paper does not allow the relating of any of these enlightening and sometimes humorous experiences, which, as a result, will probably remain undocumented except for a few dusty handwritten notes and as thoughts in the minds of those fortunate enough to have participated. What has happened already seems to be very immense and significant and accomplished only as the result of great effort. But we have not yet welded a seam or produced an ounce of hardware; we have only really commenced!

‡The basic agreement between Naval activities which establishes services and costs to be rendered by one Naval Activity for another.