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SHIPBUILDING SPECIFICATIONS: BEST PRACTICE GUIDELINES

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SUMMARY

The development of Contract Specifications and Contract Plans for new ship construction is a challenge to the most seasoned professionals because those persons developing them cannot be sure how the selected shipbuilder will interpret any ambiguities in them. Based on numerous "lessons learned", which lessons have undoubtedly been learned the "hard" way, this paper presents perspectives that should be borne in mind when developing those specifications and plans. The differentiation between different forms of specifications is made, for example, to illustrate that responsibilities and risks are assigned to different parties for each different form of specification; and the developer has to decide in advance which party is to have which responsibilities. Similarly, for design development, the transfer of decision-making authority from the Purchaser's (i.e., owner's) architect-engineer to the Contractor's (i.e., shipbuilder's) engineering staff is clarified in this paper, thus giving the developers of the Contract Specifications the opportunity to alter the point in design development at which that transfer of authority takes place. Means of overcoming the often-encountered perils of owner-furnished equipment are also addressed through improved specification writing. Many other aspects of the development of Shipbuilding Contract Specifications and Contract Plans are also discussed in this paper.

1 INTRODUCTION

The purpose of Contract Specifications and Contract Plans for new ship construction is to define unique as well as some non-unique features of the technical products or deliverables which the Contractor is to provide to the Purchaser. The entirety of the Contract includes other components, the premier of which is the Agreement [1] The Agreement (or perhaps, but not preferably, the General Section of the Specifications) usually identifies the regulatory requirements and classification rules that are to be satisfied by incorporation of certain design and construction features into the vessel. Those design and construction features arising from regulatory requirements and classification rules, however, essentially are generic, not unique to the vessel being acquired under a specific contract. Many of the design and construction features identified by the Contract Specifications and Contract Plans are unique to the vessel, making it different from other vessels. These documents may also define other features that are not necessarily unique for this vessel, but are not included in the regulatory requirements and classification rules.

The contract documents, especially the Contract Specifications and Contract Plans, used in conjunction with the other components of the contract, define certain technical aspects of the ship that will be developed and delivered to the Purchaser by the Contractor. Numerous details which are not initially defined in the Contract Specifications and Contract Plans may have to be developed after the contract is executed. The contractual identification of applicable regulations, classification rules and standards will largely shape many of the developmental "micro-design" decisions that need to be made to achieve the completed ship. However, there will also be numerous developmental micro-design decisions that are not controlled by the contractually-identified regulations, classification rules and standards.

When the parties executed the shipbuilding Agreement, the authority to make those micro-design decisions was passed from the Purchaser to the Contractor, unless the contract gives the Purchaser some residual decision-making authority. This is unlikely, however, because most shipbuilding Agreements give that authority exclusively to the Contractor, modified only by the necessity of allowing the Purchaser to review detailed plans before actual ship construction. [See Ref. 1.] This matter can become a source of disputes since, during those aspects of design development under the Contractor's control, the Purchaser's designers often continue to think that their input should be used as well. However, generally there is no opportunity for additional input from the Purchaser's designers that is consistent with the Agreement. Accordingly, the Purchaser's designers must appreciate that *all* of their input to design has to be translated into the Contract Specifications and Plans before the shipbuilding contract is executed.

Thus, the Contract Specifications and the Contract Plans, as components of the contract documents, define the heart of the project and possibly make it different from other ship construction projects to the appropriate extent. This paper first addresses the intent and limitations of those documents, and then generally addresses the components within those documents as well as special concerns associated with several of those components. This paper, however, is not a substitute for a course of

[1] The term "Agreement" is used herein to identify the legal document, executed by Contractor and Purchaser, for the construction of the ship. The "Contract" is a much broader term, referring to the aggregate of the Agreement, the Contract Specifications, the Contract Plans, Guidance Plans, and all the other referenced standards, documents, regulations, etc.

study on specification preparation nor on the development of plans. (For a more complete discussion about the entirety of a shipbuilding contract, Ref. 2.)

2 NON-INCLUDED FEATURE

The Contract Specifications and Contract Plans define the unique features of the vessel and other non-unique features that are not already addressed by the appropriate regulatory requirements and classification rules. It has to be kept in mind by the developers of specifications that numerous details which are not already defined in the Contract Specifications and Contract Plans will have to be developed by the Contractor after the contract is executed. Except for unusual cases, when the parties executed the shipbuilding contract, the authority to make those additional decisions as to the form of the numerous details was passed from the Purchaser to the Contractor. The Purchaser's naval architects and marine engineers who are developing the Contract Specifications and Contract Plans must keep in mind that they will have yielded to the Contractor the right to make those decisions.

Thus, if the exact form of any lesser details are important to the Purchaser, the Contract Specifications and Contract Plans should describe them to an appropriate level of detail. If such details are not already incorporated into the Contract Specifications and Contract Plans, generally the Purchaser will have to accept the Contractor's "solution" to those details. The Purchaser's staff should bear in mind that it is most likely the Contractor will be seeking minimum-cost solutions to those technical details when working under a fixed-price contract.

The Purchaser's naval architects and marine engineers should not use the drawing review process as a mechanism to impose on the Contractor a more-expensive solution if the Contractor's solution is in all regards consistent with the contract documents. For example, if the form of mounting an item of equipment on a deck is important to the Purchaser for reduced noise transmission, that form of mounting cannot be announced after the Contractor has prepared drawings or even after the contract has been executed. Rather, because the form of mounting to minimize noise transmission likely will cost more than another form of mounting, the Contractor should have been given the opportunity to consider it before developing its bid price for the work.

3 IDENTIFYING THE REQUIRED TYPE OF SPECIFICATION

In general, there are three types of specifications:

(1) design or end product specifications;
(2) performance specifications; and
(3) procedural specifications.

Each of these three types of specifications leads to a different assignment of responsibilities between the Purchaser and the Contractor. A typical Contract Specification will include, for all the different aspects of the ship, more than one type of specification, and may even include all three types. The type of specification used for the hull form, for example, can be entirely different from the type of specification used for the ballast pumps.

A design or end product specification is a representation, by either drawings or verbal descriptions or both, of what that aspect of the ship should look like upon completion. The use of a Contract Plan for the hull lines serves to define the form of the hull from which the Contractor cannot vary [2]. Another example of a design or end-product specification may be for hull coatings. The Contract Specification may define the type, composition and colour of the coatings, as well as perhaps the manufacturer, and then go on to define the thicknesses of each of the primer, undercoat and topcoat. That is, the final configuration of the coatings, layer-by-layer, has been defined by the Contract Specifications [3]

A performance specification, on the other hand, does not in any way describe what the object will look like, but instead will describe how it is to perform. A specification for the ballast pumps on a ship, for example, could state that the two ballast pumps shall each separately be capable of pumping into and out of the ship's ballast tanks a certain number of tons of ballast water per hour. Thus, the shape, material content, and weight, among other parameters, for each of those pumps will be selected by the Contractor provided that each can pump the required number of tons of ballast water per hour. Note, too, that a loosely written specification for two ballast pumps of equal capacity may even result in two different brand names -- it is all at the discretion of the Contractor under a performance specification. (The Purchaser can write a "tighter" specification to avoid that two-brand possibility. See section 9, below, on Brand Names or Equal to supplement this discussion.)

A procedural specification usually supplements one of the two other forms of specification by defining part of the procedure that is to be followed in achieving the other part of the specification, either in the design process or the construction stage. An example of a construction procedural specification pertains to coatings: the design specification for the coatings, as described above, may be supplemented by a procedural specification that requires the Contractor to apply the coatings in accordance with the practices recommended by the coating manufacturer pertaining to surface

[2] The hull form may be subject to variance if confirming model tests are to be conducted by the Contractor.
[3] An associated procedural specification, as discussed below, establishes the criteria for appropriate surface preparation and material application.

preparation, air temperature, steel temperature, relative humidity, direct sunlight, wind speed, etc.

An example of a design procedural specification may relate to power and signal cables. The design of the cable trays may be solely at the discretion of the Contractor (other than regulatory requirements and classification rules); that is, the cable trays are defined by a performance specification. However, that performance specification may be supplemented by an applicable design procedural specification which may state that when designing the cable trays, the Contractor shall also comply with the requirements of an identified EMI (electromagnetic interference) standard to ensure that the EM emissions of power cables do not interfere with the signals within the control, alarm and monitoring cables.

The naval architects and marine engineers who develop the Contract Specifications and Contract Plans for the Purchaser can select whichever form of specification best suits the needs of the project for each item and each aspect of the ship. However, it is their responsibility to ensure that all of those specifications are compatible with one another. For example, if the EMI procedural specification requires two levels of cable tray to avoid the interference, the ship's basic design by the Purchaser's staff will have to provide ample space for those two levels; otherwise the requirements imposed on the Contractor may be impossible to achieve.

Thus, it can be appreciated that different forms of specification result in risks being assigned to different parties. When a design (end product) specification for an item is presented to the Contractor, the Purchaser will then have to accept whatever performance results from implementation of that design. If a performance specification, instead, is imposed on the Contractor, the Purchaser will have to accept the form, design and configuration, regardless of how it looks, as long as it provides the specified performance.

In the event the completed vessel does not exactly satisfy any specified performance criteria (e.g., speed, deadweight, discharge rate, etc.), the owner should not necessarily have the right to reject the vessel. Instead, in the Agreement, a range of liquidated performance damages can be established to deal with that possibility. Then, only if the performance falls far from the target figure, the owner could seek non-delivery in lieu of performance-related liquidated damages, per the Agreement.

4 STANDARD FORMS OF SPECIFICATIONS

The technical Contract Specifications can be arranged in nearly any sequence; but there are standard sequences that have been used by industry in various countries. In the United States, for example, the U.S. Maritime Commission in the 1930's and 1940's, followed by the U.S. Maritime Administration in more recent years, has developed and used a standard set and sequence of section headings, as indicated in Figure 1. Each of those section headings include multiple standard sub-headings (not shown herein due to size and number).

The value of using a standard group of headings and a standard sequence is that both owners and shipyards have become accustomed to using those headings and sequences. Of course, many of the section headings in Figure 1 may not be applicable to every project, and thus those section numbers should not be used. Other widely used standard specification headings can be used as well. A major benefit of starting with a selected form of standard headings is that it reduces the likelihood of inadvertently omitting some specification items. Additional sections for unique shipboard features are often added by selecting section numbers that are not already used.

As to the actual content of the sections, distinct from the headings, it is noted that generic, guideline, example or standard specifications also have been developed and published by many organizations world-wide. Sometimes those published specifications are quite helpful to persons developing specifications for a particular aspect of a ship for the first time. A review of such publications by specification writers will help assure that salient points will be addressed in the new specification, though not necessarily as suggested by the guidelines. When the ship type, or the system within the ship, is innovative or represents a new application of existing technology, the final specification may have only faint resemblance to the previously published specifications.

The U.S. Navy, for example, has used its "Gen Specs," being general or standard specifications, for its use in defining particular aspects of the intended product in naval construction. With rapidly developing materials technology and innovative design concepts, however, those Gen Specs do not appear to be as relevant to each new class of vessel as they once had been. Since the mid-1990s, the U.S. Navy has been relying less on those Gen Specs and more on specifications developed for the particular vessel design, materials technology and application concepts being employed in the development of its newest ships. That Gen Spec should not be confused with the section of general specifications contained within most contracts.

The U.S. Maritime Administration has published "Guideline Specifications for Merchant Ship Construction." The most recent edition (1995) is intended as a helpful generic package for ship operators and shipbuilders who will design specific commercial ships. That publication states, "These Specifications can be used as starting points for the preparation of construction specifications for any type of ship. … [They] are intended to provide guidance to the maritime industry for the preparation of specifications. They cover all aspects

of potential contract work, but may require modifications, as appropriate, to the ship design being contemplated." Recognizing that the value of such specifications has diminished due to numerous developments, the U.S. Maritime Administration no longer intends to update its published specifications.

Because published specifications, from any source, are only generic, guideline, example or standard, the contract specification has to be more supportive of the exact ship type and the newest materials technology to achieve the intended result. Also, because published specifications try to be applicable to multiple ship types and multiple situations, it is likely that the contract specifications could be briefer than the published ones. Specification writers should be cautious, however, regarding a goal of achieving brevity in their work. It sometimes appears that, due to the absence of information deleted for the sake of brevity, such shortened, and thus possibly ambiguous, specifications may lead to disputes.

Figure 1 -- Possible Specifications Section Headings

1 General
2 Structural Hull
3 Houses And Interior Bulkheads
4 Sideports, Doors, Hatches, Manholes
5 Hull Fittings
6 Deck Coverings
7 Insulation, Linings And Battens
8 Kingposts, Booms, Masts, Davits
9 Rigging and Lines
10 Ground Tackle
11 Piping--Hull Systems
12 Air Conditioning, Heating and Ventilation
13 Fire Detection And Extinguishing
14 Painting and Cementing
15 Navigating Equipment
16 Life Saving Equipment
17 Commissary Spaces
18 Utility Spaces and Workshops
19 Furniture and Furnishings
20 Plumbing Fixtures and Accessories
21 Hardware
22 Stowage & Protective Covers
23 Miscellaneous Equipment and Stowage
24 Name Plates, Notices and Markings
25 Joiner Work and Interior Decoration
26 Stabilization Systems
27 Container Stowage and Handling
50 Main And Auxiliary Machinery
51 Main Diesel Engines
52 Reduction Gears and Clutches -- Main Propulsion
53 Main Shafting, Bearings and Propeller
55 Distilling Plant
56 Fuel Oil System
57 Lubricating Oil System
58 Sea Water Systems
59 Fresh Water System
60 Feed and Condensate Systems
61 Steam Generating Plant
62 Air Intake, Exhaust and Forced Draft Systems
60 Feed and Condensate Systems
61 Steam Generating Plant
62 Air Intake, Exhaust and Forced Draft Systems
63 Steam and Exhaust Systems
64 Machinery Space Ventilation
65 Air Conditioning & Refrigeration Equipment
66 Ship's Service Refrigeration
67 Cargo Refrigeration -- Direct Expansion System
68 Liquid Cargo System
69 Cargo Hold Dehumidification System
70 Pollution Abatement Systems and Equipment
71 Tank Level Indicators
72 Compressed Air Systems
73 Pumps
74 General Requirements For Machinery Pressure Piping Systems
75 Insulation -- Lagging For Piping and Machinery
76 Diesel Engines Driving Generators
78 Tanks--Miscellaneous
79 Ladders, Gratings, Floor Plates, Platforms & Walkways in Mach'y Spaces
80 Engineer's and Electrician's Workshops, Stores And Repair Equip.
81 Hull Machinery
85 Instruments and Miscellaneous Gage Boards -- Mechanical
86 Spares -- Engineering (Crating and Storage)
87 Electrical Systems, General
88 Generators
89 Switchboards
90 Electrical Distribution
91 Auxiliary Motors and Controls
92 Lighting
93 Radio Equipment
94 Navigation Equipment
95 Interior Communications
96 Storage, Batteries
98 Test Equipment, Electrical
99 Centralized Engine Room and Bridge Control
100 Planning And Scheduling, Plans, Instruction Books, Etc.
101 Tests And Trials
102 Deck, Engine and Stewards Equipment and Tools, Portable
103 Requirements For Structure-borne Noise Control
App A Owner Furnished Equipment List

5 CONTRACT DELIVERABLES

At the beginning of this paper it was stated that the purpose of the Contract Specifications and Contract Plans is to define the technical products or deliverables which the Contractor is to provide to the Purchaser. Note the use of the plural of "technical products or deliverables." The Purchaser is paying the Contractor not only for the ship itself, but also for numerous other deliverables. Without many of those other deliverables, the ship by itself is not completely usable or maintainable by the owner. Some of those deliverables are defined by the applicable regulatory requirements and classification rules. The rest have to be defined by the Agreement (primarily the financial deliverables) or the Contract Specifications (primarily the technical deliverables).

The contract deliverables, other than the hardware of the ship and spare parts, will take many forms. Some of the deliverables will be engineering calculations (trim, weight and stability calculations, finite element analyses, fatigue strength calculations, electrical load and fault-current analyses, heat-load and heat-balance calculations, among others); some will be drawings (detail plans for review, classification-approved plans, as-built/as-fitted drawings, and others); some deliverables will be copies of shipyard correspondence with classification and regulatory bodies; some will be certificates from classification and regulatory bodies, and possibly from others); some deliverables will be test and trial agendas and subsequent reports; some will be warranty forms from vendors and others; and some deliverables may be shipyard scheduling information, hazardous waste disposal records, insurance information, among many other possibilities. This list is by no means complete.

The completion and delivery of each of those deliverables from Contractor to Purchaser represents a source of costs to the Contractor. If each of them is to be accomplished, the Contractor must know about them prior to bidding or pricing the work in order to have the budget available for each of them. Accordingly, the persons developing the Contract Specifications for the Purchaser must ensure that each such deliverable (hardware, drawings, calculations, correspondence, computerized files, etc.) is identified as a required deliverable in the documents made available to bidding shipyards from the outset. All of the deliverables, besides the ship itself, have to be defined by the contract documents or they are beyond the workscope requirements of the Contractor.

6 DEFINING THE COMPLETE SCOPE OF WORK

In addition to the ship, the spares and all the other contract deliverables, the entire scope of work which the Contractor will have to undertake needs to be defined to the extent that there is sufficient information in the bid package or at the time of contract negotiations such that the Contractor can identify and estimate all sources of costs. In other words, if an owner's requirement for any information, materials or special tests will cause the Contractor to incur costs, such items must be separately identified in the contract documents as a Contractor responsibility.

Some examples of such items are: (a) the payment of fees for classification and regulatory approvals, if needed; (b) confirming model tests if they are to be accomplished after contract signing; (c) maintenance of a detailed weights-and-centers spreadsheet for every item of equipment if appropriate; (d) rental of testing equipment if it will be needed (test weights, electrical load banks, etc.), and (e) any special testing requirements on owner-furnished equipment that the Contractor has to perform.

There are some aspects of technical specifications that cannot be glossed over without increasing the likelihood of some consequential disputes. A negative example -- one to be avoided -- is illustrated by the following wording taken from a recent specification. *"All work necessary to perform the specified work shall be deemed to be part of the specified work whether specified or not."* This was an attempt by the specification writers to convey to the Contractor the responsibility to make everything complete and functional at no extra cost to the Purchaser. However, such wording is too broad to be usable for estimating and pricing, and thus likely could not be enforced in court.

The intent may have been to include, for example, the unspecified supply and installation of remote motor controllers for some of those electrical motors defined by the specifications. But inasmuch as the specification writer had information particular to the specified motor, that writer was in a better position to know if a remote motor controller would be needed. When estimating the workscope, the Contractor would not automatically know that a remote motor controller would be required, and thus the cost of it would not be included in the fixed contract price.

A Purchaser should not rely on requirements such as "first class marine practice" or "best marine practice" or other ill-defined phrases in order to ensure quality of material selection or quality of workmanship. Highly subjective requirements, phrased as those, are not conducive to quantitative estimating, and thus cannot be included in the price of the shipbuilding contract.

It should be remembered that, in soliciting bids or requesting pricing from a potential Contractor, the Purchaser is seeking quantities -- quantities of production hours, material costs, subcontractor costs, facility and equipment costs, and schedule days. Accordingly, all aspects of the Contract Specifications and Contract Plans must be suitable for "translation" into such quantities. Broad concepts, such as the negative example given above, are not directly translatable into quantification

prior to accomplishment of most of the remaining design development, and thus do not constitute well-defined specifications.

It is recognized that a ship is large, complicated, and takes considerable time to construct after contract execution. This may make it almost impossible for the owner's staff to have fully specified in advance every aspect of the vessel for which the owner wishes to control the design development. Accordingly, it is likely that formal changes will be needed. To avoid disputes and unexpected delays arising from those issues, the changes will have to be developed and approved on a timely basis. Since the contents of those changes are not known at the outset of the contract, the procedure for incorporating a change has to be carefully spelled out in the Agreement, and full compliance with that procedure must be achieved during contract performance.

7 SHIPYARD SCHEDULE AND UPDATES

Many requests for proposals or similar solicitations by owners from bidding shipyards require that a preliminary schedule be supplied with the bid to ensure that the bidder has an understanding of the workscope comparable to that of the Purchaser's staff. It is common, but not necessary, for the contract documents to require that the Contractor provide the Purchaser with a detailed schedule within a stipulated period of time after contract execution. Regardless of the reasons why the Purchaser's staff wishes to see the detailed schedule, it is essential that the Specifications address that issue so that the shipyard cannot allege at a later time that requests for the detailed schedule are improper.

The Contract Specifications may present more detailed requirements for the project scheduling to supplement the general requirements of the Agreement. The more detailed requirements may address, for example, the use of separate activities for each of engineering, procurement, fabrication, installation and testing for each item of equipment. The necessity of providing the Purchaser with updates may be supplemented by stating that such updates shall be made periodically (the period depends on the particular project) or more frequently if major changes have been agreed upon.

If both the Agreement and the Contract Specifications address the Contractor's responsibilities regarding project schedule, it is essential to ensure that they complement one another and do not conflict.

8 ENGINEERING, DESIGN RESPONSIBILITIES

Between the time of development of the Contract Specifications and Contract Plans, on one hand, and the shipyard's development of the detailed plans or working drawings, on the other, numerous developmental design decisions likely will have to be made. Some of them will be guided or controlled by the regulatory requirements, classification rules or identified standards (such as industry standards or Mil Specs), but many others are not so guided or controlled. In almost all shipbuilding contracts, when the parties executed the shipbuilding contract, the authority to make those decisions was passed from the Purchaser to the Contractor. The only residual decision-making authority that the Purchaser retains is indirect confirmation through review of the detail plans or working drawings.

From the shipyard's perspective, however, that decision-making authority is a mixed blessing. It is appreciated by shipyards because it gives shipyards the authority to seek least-cost solutions to ship production. In contrast, however, it puts them at a disadvantage when bidding the work because each shipyard does not know with certainty how much economy, compared to the Contractor's competitors, it will be able to build into the vessel though the use of such opportunities.

A shipyard is put at a further disadvantage when it has responsibility for significant design development because it must use or hire naval architecture and marine engineering design staff or subcontractors to accomplish that design development. This creates risks for the shipyard because the naval architects may be more likely to perfect the vessel's performance attributes or operational efficiency instead of making the ship more economically producible.

The Purchaser's staff, when developing the Contract Specifications and Contract Plans, should bear in mind the shipyard's general wariness at having to incur such risks arising from undertaking significant design development. This does not mean that a Purchaser must allow the Contractor to avoid that responsibility, but it does mean that the Purchaser, through the Contract Specifications and Contract Plans, must ensure that it is perfectly clear that the Contractor will, in fact, have those responsibilities as appropriate to the project.

Accordingly, the Contract Specifications or the Agreement must clearly define the Contractor's responsibilities to perform all the engineering and design development tasks necessary to translate the requirements of the contract documents into material procurement, equipment procurement, detail plans, working drawings, and production plans, all of which are then used for ship production. If the Purchaser is not going to be providing any additional engineering or design support for the project, it might be best to clearly state, rather than merely imply, that no additional design information is being provided by the Purchaser.

When the Purchaser is assigning to the Contractor such responsibilities, the Purchaser's technical staff should be mindful of the fact that they will no longer have control over those decisions. If the Purchaser's technical staff is

concerned that the Contractor may find means of making the ship construction too economical to suit the Purchaser, then "tighter" or more-detailed specifications should be developed for those particular aspects of the ship that are of greatest concern to the Purchaser[4].

9 BRAND NAMES OR EQUAL

One mechanism that is often used in Contract Specifications developed by the Purchaser is to identify a particular brand name and model number of an item of equipment, and then state that the Contractor must provide and install that particular item "or equal." The intent, by the Purchaser, is to ensure that a certain quality is achieved. While this may be a worthwhile effort, it may not lead to the Purchaser's expected results for any of several reasons.

When an "or equal" mechanism is utilized in the specifications, the specifications usually reserve to the Purchaser the right to accept or reject the substitution proposed by the Contractor. The Purchaser can minimize the likelihood of a misunderstanding of what will or will not be acceptable by giving greater definition. In particular, the Contract Specifications could define what parameters are going to be considered when determining if a shipyard-offered substitution is truly "equal." For example, the parameters that could be important for a motor/pump combination on a high-speed passenger ferry likely would be different than those being considered for a large tanker. Figure 2 presents a partial list of parameters that might be considered in such situations; other parameters would be appropriate for other forms of equipment.

Another mechanism used in shipbuilding contracts to limit the choices for equipment that will be made by the Contractor is to negotiate or include a "maker's list" for various items. The maker's list identifies the brand name and model of equipment that is included in the base-line design. Some maker's lists will include more than one possible brand name and model for several particular items of equipment. Whether or not the Contractor has the right to seek an "equivalent" to the items on the maker's list must be defined in the contract documents; without such clarification, the Contractor may interpret that it does have such rights and the Purchaser may interpret that it doesn't.

[4] A Purchaser's technical staff should be cautious when responding to a Contractor's request for additional design information by means of "clarifications." This may be symptomatic of the Contractor's reluctance to undertake the design effort that it is contractually obligated to accept. Further, it may lead to allegations by the Contractor that the design information, if provided by the Purchaser, implies a greater workscope than otherwise required, thus necessitating a Change Order.

Figure 2
Selected Parameters for Determining
Equivalency of Combined Pump/Motor
(Add or Delete as Appropriate)

- Maximum Continuous Rate of Output
- Maximum Peak Rate of Output
- Pressure at Various Rates of Output
- Materials of Construction
- Weight
- Audible Noise
- Vibration Transmission
- Mean Time Between Failures
- Metric or Non-Metric Fittings
- Electrical Feedback Characteristics
- Controllability of Rate of Output
- Power Requirements and Efficiency
- Availability of Spare Parts
- Availability of Tech Rep's
- Proven Marine Experience
- Manuals in the Selected Language
- Ease of Maintenance
- Commonality with Purchaser's Fleet

10 REVIEW OF THE CONTRACTOR'S EQUIPMENT SELECTIONS

Some Purchasers may seek to review the Contractor's selection of major items of equipment that are not already identified by brand name and model number, or are not covered by an "or equal" clause, or are not included in a maker's list. The purpose of the Purchaser's pre-purchasing review of the Contractor's purchase technical specifications that will accompany a purchase order is to ensure that the Contractor's interpretation of the Contract Specification's requirements pertaining to that item of equipment is compatible with the Purchaser's interpretation. If the Purchaser seeks to have this right of an advance review of the purchase technical specifications for selected items of equipment, the contract documents should create that right, remind the Contractor to provide the purchase technical specifications on a timely basis so as to not delay the schedule, and indicate the period of time that the Purchaser has to conduct such review.

As with the review of the Contractor's detail plans and/or working drawings, some Purchasers may try to use this review process to "persuade" the Contractor to adopt the Purchaser's interpretation when, in fact, alternate interpretations may also be valid. When the contract was executed, the Purchaser not only gave the Contractor the responsibility to select that item of equipment, but also gave the Contractor the right to select it to maximize the benefit to the Contractor. The burden of demonstrating that the Contractor-selected item is not compatible with the contract documents lies with the Purchaser. If the Purchaser can show that the Contractor-selected brand name and model does not satisfy the contractual

requirements, the Contractor must revise its purchase order to achieve such compliance.

In some cases, the process of such review may lead the Purchaser to appreciate that, although the Contractor's selection is consistent with the contract documents, the Purchaser now sees that such a valid, alternate interpretation of the contract documents leads to a less-than-satisfactory equipment selection. The Purchaser may then seek to use this review process as a basis for requesting a Change Order to achieve a more-satisfactory equipment selection. However, this action by a Purchaser may result in higher costs, delays, impacts on drawings and engineering, and secondary impacts on other contract deliverables.

11 RESOLUTION OF INTERFERENCES

Composite drawings present isometric views of spaces or compartments within the ship, including scaled representations of all structure, equipment items and distributive systems. If prepared in advance of physical construction, composite drawings can identify physical interferences that would result from the use of unmodified Contract Specifications and Contract Plans. It is not a common practice for the owner's naval architects and design engineers to prepare composite drawings of the structures, items of equipment and distributive systems shown in and/or described by the Contract Specifications, Contract Plans or other contractually-defined standards. Thus it is possible, if not likely, that interferences between elements of the contract design will result from a strict interpretation of the contract documents.

In the event that the resolution of such interferences has an impact on the productivity of the shipyard's crafts, the Contractor may look to the Purchaser for compensation for that rework or temporarily-reduced productivity. To avoid that situation, either the Agreement or the Contract Specifications could advise the Contractor of the possibility of such interferences, require the Contractor to not undertake physical construction until the possibility has been examined and addressed, and further require that the resolution of such interferences are to be achieved by Contractor at no additional cost to Purchaser.[5]

12 INSPECTION OF CONTRACTOR'S WORKMANSHIP

The Agreement usually includes a clause which establishes the right of the Purchaser's representatives to have access to the vessel and shops, including subcontractor sites, and to inspect work in progress. Inspection deficiency reports, expressing the Purchaser's dissatisfaction with already accomplished or allegedly incomplete work, should only be issued if the Purchaser's representative can point to a part of the Contract Specifications, Contract Drawings or referenced standards with which compliance has not been achieved.

Many Contract Specifications state that the Contractor's workmanship shall be adjudged by the Purchaser's representative, and only that individual shall have the authority to make a determination of satisfactory workmanship. However, if there is no other identified standard against which the workmanship will be measured, the Contractor is effectively being asked to work to the unwritten standards in the mind of that Purchaser's representative. This is often an unsatisfactory mechanism, since the Contractor cannot know in advance what standard will thus be applied.

Accordingly, the Contract Specifications should include sufficient information to provide a non-ambiguous basis for determining if the Contractor's workmanship is adequate. Certainly the workmanship must satisfy the applicable regulatory requirements and classification rules. The workmanship must also satisfy any applicable standards that are identified in the contract documents (usually in the Contract Specifications or in the Agreement). These referenced standards may be marine industry standards, professional society standards (such as SNAME standards), well-distributed government standards (such as US Navy Mil Specs), or even standards that are applicable but not necessarily unique to the marine industry.[6]

The lack of an identified standard against which workmanship can be judged creates risks for both parties, which risks may result in disputes, an unsatisfactory product, rework and/or delay. Thus, the developers of the Contract Specifications should take the time and effort to include therein the standards against which the on-site Purchaser's inspectors will determine the acceptability of workmanship that is not already covered by applicable regulatory requirements and classification rules.

13 IDENTIFICATION OF ITEM'S ENTIRE WORKSCOPE

This is the heart of technical specification writing. It is a fairly complex matter, and not to be undertaken lightly or by unpracticed personnel. The history of risks and consequences that are associated with incomplete or misleading specifications is a sufficient basis for many books. As a foundation for discussing this subject, four points that have been already discussed are brought to the forefront.

[5] In ship conversion or repair, the Contractor could be given access to the vessel for a pre-bid ship check to identify potential interferences if the Contractor is responsible for the correction of them at no additional cost.

[6] The Agreement or the General Section of the Specifications typically contains express language requiring the Contractor to correct, at no additional cost to the Purchaser, any workmanship or materials which fail to meet the standards.

First, at the beginning of this paper, the three basic forms of specifications were discussed: (a) design (or end product); (b) performance; and (c) procedural.

Second, the desirability of avoiding too-broad specification language was also discussed (the negative example was given, *all work necessary to accomplish the specified work ....*).

Third, the fact that the Contractor is given rights, not just responsibilities, to make decisions about details and materials after the contract is executed has been discussed above.

Fourth, the shipyard's decision-making authority gives it the right to implement least-cost solutions in design development and materials selection as long as it remains consistent with the Contract Specifications, Contract Plans, the defined regulation, the selected classification rules and the identified standards.

The identification of the entire workscope for each item requires that those four points be kept in mind when each element of the technical specifications is developed. For each element of the technical specifications, the specification writer must be able to express in words and in supporting sketches or drawings what is important (and therefore stated unambiguously) and what is also to be included but is not as important (allowing the Contractor to make detail decisions).

Each technical specification must reveal whether the performance is important to the owner, or if the form/design/configuration is more important. (If the specification is a design or end product, generally the Purchaser is responsible for performance[7]) If certain procedures and/or standards are to be used or achieved in the development of details or the execution of the work, those procedures and standards must be clearly identified. The writer of technical specifications must also understand what decisions the Contractor may be able to make with respect to each technical aspect while still being consistent with the contract documents, and determine whether a possible "least-cost" solution will be acceptable; if not, a more-tightly-defined solution is to be specified.

All of the elements of the workmanship and materials must be adequately defined to enable a shipyard to translate the technical specification into quantities (labor hours, material costs, and subcontractor costs), or the performance capabilities of the technical item must be translatable into such quantification after the Contractor's suitable pre-bid design effort.

[7] A contract which includes a "design certification process" by the Contractor may serve to alter the assignment of certain risks. Precisely which risks and responsibilities are different from the usual form of contract will depend on the specific wording of the section of the Agreement which describes the design certification process.

There is no single style or form of technical specifications that is superior to other possible styles or form. Each organization developing Contract Specifications and Contract Plans should use the style and form with which it is most comfortable, provided that such style and form has not resulted in prior contractual disasters or near-disasters. Individual styles or forms should give way to corporate styles and forms, so that a Contractor is not confronted with different styles or forms in the same Contract Specification.

A specification-related risk that is too-often encountered is that of "pride of authorship." Even if a contractual disaster or near-disaster has previously resulted from the use of a particular wording of a specification, the writers of it may continue to believe that the troubles were not due to the specification, but rather due to an alleged intransigent attitude by the shipbuilder. This pride of authorship has no place in a professional engineering environment; if the wording of a specification has proven unsatisfactory in the past, instead of pointing the finger of responsibility at some other party, the wording should be changed, based on a "lesson-learned" analysis of the disaster or near-disaster.

14 TECHNICAL DOCUMENTATION REQUIREMENTS

In addition to the hardware of the ship itself and spare parts, Purchasers usually require substantial, supporting documentation. This documentation is additional to the certificates from regulatory agencies and classification.

Some of the required documentation is short-lived, such as megger readings after installing (pulling) electrical cable or steel and air temperature readings when applying coatings. Once ship construction and testing is satisfactorily completed, no one will be interested in that documentation unless it becomes a warranty problem. Other components of the documentation are long-lived, such as the sea trial results for all the machinery, forming a life-time engineering database for those items. Examples of the types of documentation which may be required are listed in Figure 3.

The development of each of those items of documentation represents additional cost to the Contractor. Some of those documentation items may be generated by the Contractor or its naval architects and design engineers in the course of obtaining regulatory and/or classification approvals. For those documentation requirements which are not needed for such purposes, the Contractor cannot be expected to prepare them unless the need for them is clearly stated in the Contract Specifications (or in the Agreement) so that they can be included in the Contractor's budget. Even for those documentation items generated in the course of obtaining regulatory and/or classification approvals, the Contractor may not be obligated to go the extra step of providing them to the Purchaser unless they, too, are identified in

the contract documents as being “deliverable” to the Purchaser. If any of those documentation deliverables are to be provided to the Purchaser in computerized form, the Contract Specifications should clearly state that requirement in order to avoid disputes over interpretation of what constitutes usual practice.

Figure 3
Examples of Documentation Required by Owner for New Ship Construction
(Add or Delete as Appropriate)

hull model test results
propeller model test results
propeller-induced vibration studies
---
preliminary weights and centers reports
preliminary trim, weight & stability
final weights and centers reports
final trim and stability reports
damage stability analyses
tank tables
---
correspondence with classification organization
correspondence with regulatory agencies
---
detailed initial schedule (eng'g, procurement, production, testing)
updated schedules as appropriate and per contractual requirements
---
working plans
detail drawings
production sketches
drawings submitted to classification
drawings submitted to regulatory bodies
P.O. technical specifications
responses to comments on drawings
---
finite element analyses
fatigue analyses (structural)
heat load calculations
electrical load calculations
fault current analyses
---
inspection deficiency reports
responses to inspection reports
temperature/humidity during coatings
megger readings (electrical cable)
---
noise-level readings
test results (numerous types)
vibration readings
crane and trolley test results
dock-trial test results (numerous items)
sea-trial test results (numerous items)
---
operational placards on the bridge
safety placards throughout the ship
progress photographs
component manuals
system manuals
final photographs
as-built (as-fitted) drawings

15 COMMON PROBLEMS WITH SPECIFICATION LANGUAGE

The workscope of shipbuilding contracts is sometimes beset by problems with grammar and word usage. The idea of using a common language between the Contractor and Purchaser is to ensure complete understanding. Contract documents between, say, a European shipowning organization and an Asian shipbuilder may be in English because both parties are reasonably fluent in English as well as their own language, but not fluent in the other party’s language. Once a common language is selected, it is important that both parties use it in the same, correct manner.

Significant problems have arisen over colloquial word usage when involving two parties that both use English. For example, when a project involves a British naval architect and an American shipyard; both parties speak English as their native tongue, but in fact the colloquialisms that each use sometimes have significantly different meanings. (Example: Americans “pull” cable when installing it, whereas the British “pull” cable when removing it.) The point made here is to avoid colloquialisms for which others may not have the same working definition.

For the reasons discussed above in §6, words and phrases like "workmanlike", "first-class marine practice" and "good shipbuilding practice" cannot be relied upon and should generally be avoided.

The words "any" and "all" are not equivalent. "Any" is an indeterminate number or amount, which may mean one, some or all. It is usually better to use "all" or "any and all" to preclude the shipyard from misconstruing the workscope.[8]

16 OWNER-FURNISHED EQUIPMENT

The decision by the Purchaser to supply owner-furnished equipment (OFE) to the Contractor for installation aboard the newbuilding ship may be based on any of several possibilities: (i) long lead time procurement requirements; (ii) already-stocked by the owner’s organization; (iii) absolute control over equipment selection; (iv) potential savings; (v) easier procurement than by shipyard; among other possible reasons. Regardless of the motivation and/or reasoning by the Purchaser which results in the use of OFE, none of them can guarantee a risk-free relationship between the Purchaser and the Contractor.

[8] In ship repair, phrases such as "as necessary", "as required", "to suit" and "as directed" must be used with extreme care in order to avoid ambiguities. Those phrases do not lend themselves to development of estimates of quantities, which is basis of a bid and contract. In cases where the extent of repairs cannot be known beforehand, the specification should be carefully drawn and a procedure should be implemented to handle open-and-inspect items and other conditional work.

The incidence of disputes and/or misunderstandings associated with OFE is far too common to dismiss as an aberration. Rather, analysis of past OFE-related disputes indicates that there are six aspects of OFE that often are not adequately addressed in the specifications, thereby causing disputes and/or misunderstandings:

(i) content,
(ii) form,
(iii) place of delivery,
(iv) schedule of delivery,
(v) vertical integration, and
(vi) horizontal integration.

Each of these elements of OFE are discussed herein to promote an understanding of the potential problems that must be circumvented by appropriate specification language.

The *content* of the OFE needs to be defined with sufficient precision so that the Contractor knows what is and what is not being provided. The Contractor will be responsible for supplying all of the necessary fixtures, fittings and connections that are necessary to incorporate the OFE into the ship; but the Contractor must base its bid price on an understanding of what hardware it has to provide. Consideration of the interface hardware provides examples: foundations; conversion fittings (metric to imperial units); connector cables and hoses; and resilient mountings; among others. Some Purchaser's have supplied the entire propulsion system as OFE, in which instances questions arose over which shaft bearings and which foundations were also to be OFE. One owner thought the rudder and its control mechanism were part of the propulsion system that was being purchased separately from a vendor. Other owners have mistakenly thought that the governor is always part of the owner-supplied diesel engine; this is not necessarily correct. These examples are mentioned to illustrate that what is going to be supplied as part of the OFE may be "obvious" to one party may be far from obvious to another.

The *form* in which OFE will arrive at the shipyard should be communicated to the Contractor by the specifications to ensure that all costs and schedule impacts arising from the OFE can be included in the bid price. The extent of assembly work that will be required if the OFE arrives in pieces is important to the Contractor. The need to provide temporary protective covering or other maintenance services prior to shipboard installation may also be a cost basis to the Contractor. Any other aspects of the form of OFE that may require labor or materials to prepare the OFE for shipboard installation should also be addressed in the specifications.

The *place of delivery* of OFE is usually addressed in the Agreement, such as the Contractor's warehouse at a specific street. However, if it is not addressed in the Agreement, the point of delivery should be included in the specifications. If some of the OFE is being delivered at a near-by seaport or airport, and other OFE is being delivered to the shipyard, that differentiation should be made. If the Contractor has to provide transportation of the OFE from a remote (non-shipyard) location, the Contractor may wish to include those costs in its bid price (drivers, insurance, truck rental, etc.).

The Contractor is usually required, per the Specifications, to provide to the Purchaser a report on the condition of the OFE upon its delivery to the shipyard, identifying any damages or unexpected conditions. The Purchaser is usually responsible for correction of those damages or conditions, and the Contractor becomes responsible for any subsequently-noted damages.

In order to plan the work appropriately, the *schedule of delivery* of OFE must be communicated to the Contractor if it is not already stated in the Agreement. If the schedule of delivery is not identified by the contract documents, it may be established by the Contractor and communicated to the Purchaser through development and transmittal of the detailed project schedule. If this occurs, the Purchaser may face OFE delivery commitments that cannot be achieved, in which case the Purchaser must advise the Contractor of more-appropriate OFE delivery schedules before the project is substantially underway.

Vertical integration of OFE refers to the process of integrating each item of OFE with all those parts of the ship which the Contractor has responsibility to supply. This integration may include consideration of piping and electrical connections, air and exhaust connections, fuel and lube oil supply, water and steam connections, the structural foundation, as well as the control, alarm and monitoring systems. Before the physical integration takes place, the design integration requirements have to be addressed by having the Purchaser supply to the Contractor all relevant connectivity and interface information. The vertical integration also addresses the need for component, system and ship testing as appropriate. The Contractor will need to know, for scheduling purposes, if the vendor's technical representative will have to conduct independent tests to ensure proper installation as a basis for issuing the vendor's warranty.

Horizontal integration of OFE refers to the process of integrating each item of OFE with other items of OFE, as appropriate. When the Purchaser is supplying multiple components of a system as OFE, responsibility for the compatibility and connectivity of all those components with one another usually rests with the Purchaser, not the Contractor. For example, if the OFE includes a diesel engine as well as a torsional coupling, the compatibility of the physical mating of the torsional coupling to the engine's flywheel may have to be assured by the Purchaser, not by the Contractor. If hydraulic cylinders as well as a hydraulic power pack are being supplied as OFE, the hydraulic, electrical, control and alarm

connections between them need to be addressed, since the Contractor may otherwise believe that the Purchaser is supplying and arranging for all those connections to be completed by the vendor of the equipment.

Accordingly, specification writers must thoroughly investigate, understand and communicate in the written Contract Specifications all aspects of OFE that may cause the Contractor to incur costs and/or schedule impacts. If any assumptions have to be made by the Contractor to price the OFE-related work, the specification writer should realize that the assumptions will be "least-cost" ones, placing a greater burden on the Purchaser and the vendors of the OFE (at the expense of the Purchaser) unless clearly stated otherwise in the Contract Specifications.

17 IDENTIFYING NECESSARY TESTS AND TRIALS

The process of conducting any test or trial represents a cost to the Contractor. In order to prepare a complete bid, the Contractor has to know in advance the nature and extent of all tests and trials that need to be conducted. Thus the Contractor must be able to ascertain from the contract documents, primarily the Contract Specifications, both the nature and the extent of the required tests and trials. The necessity for tests may originate with regulatory agencies, classification organizations, the Purchaser's additional requirements, or the OFE vendor's requirements.

Many of the tests and trials will have to be conducted to satisfy the regulatory requirements and the classification rules. If, as is customary, the Contractor is solely responsible for obtaining all regulatory and classification approvals, the Purchaser need not spell out each and every such test that is within that part of the workscope. However, if the Agreement doesn't already state it, the specifications should clearly state that the Contractor must perform all inspections and tests necessary to obtain all the approvals and certificates from the various regulatory agencies and the classification organization that are listed elsewhere in the contract documents, all at no additional cost to the Purchaser.

The more challenging aspect of this section of the specifications is to address the Purchaser's additional test requirements and the OFE vendor's test requirements that are supplementary to the other, already-addressed tests and trials. There is no nearly-universal set of tests that fall within this category. Every ship type has differing requirements, and within each ship type, every Purchaser will have differing requirements. The Purchaser's and OFE vendor's test and trial requirements are shaped, in part, by their perception of what is needed above and beyond the regulatory and classification tests and trials. It should be noted that the duration or extent of tests and trials is also an important cost factor to the Contractor. If, for example, there is special equipment aboard the ship due to its particular owner and mission, some Purchasers may require a full 24-hour heat run, and others may be content with a 4-6 hour test; the Contractor must know the extent of those tests and trials in advance of bidding, perhaps by references to appropriate SNAME, ASTM, or other standards and procedures.

18 WORK PERFORMED BY OFE VENDORS

When the vendor of OFE sends a technical representative ("tech rep") to the shipyard to direct or oversee the installation or start-up of OFE, the Contractor may have to provide support services to that tech rep. These services may be limited to the provision of temporary lighting and ventilation or scaffolding and ladders. Sometimes the OFE vendor's tech rep may require the assistance of several of the shipyard's mechanics or other craftsmen for a period of time.

For each instance where the OFE vendor's tech rep will require shipyard support services, the rendering of those services will be a cost to the Contractor. Accordingly, the Contract Specifications could advise the Contractor of the need to provide such support services and indicate the nature and duration of the manpower and equipment needed for such support services. If this matter is not adequately covered by the Contract Specifications, the Purchaser may be asked later for a Change Order to cover those costs.

19 DEVELOPMENT OF CONTRACT PLANS

Throughout this paper, the emphasis has been on the wording of the Contract Specifications, and only occasionally have the Contract Plans been mentioned. This is not to lessen the importance of the Contract Plans, but rather recognizes that the Contract Plans are usually considered to be part of the Contract Specifications, or at least to be below the Contract Specifications in the hierarchy of the contract documents.

The purpose of Contract Plans is to convey to the Contractor the spatial relationships, the configurations, the arrangements and the appearances of the various parts of the vessel that are not capable of being conveyed solely by written words. By identifying them as Contract Plans, the intent is that they are non-alterable except by a formal Change Order.

The contract-level design expressed in part by the Contract Plans can vary considerably; some contract-level designs will include only a few drawings and be sparse with details; others will include a large number of drawings, each of which contains considerable details.

From the outset of the project, the Purchaser and its naval architects and design engineers have to decide what design configurations pertaining to the ship must be controlled entirely by the Purchaser (these become the Contract Plans), what design configurations can be deter-

mined from regulatory and classification requirements, and what design configurations can be determined by the Contractor so long as they satisfy all other contractual requirements. The phrase "design configurations" is used here because that is the type of information that is best contained in plans rather than specifications. In other words, development of the list of drawings that will be Contract Plans is the output of a risk-decision analysis. If the configuration of a certain aspect of the ship is not included in a Contract Plan, the final configuration will be determined by the Contractor in its search for a least-cost solution.

If the presence of inclined ladders in a particular area of the ship is important to the Purchaser, for example, when regulations would otherwise permit vertical ladders, that requirement may be best communicated to the Contractor in a Contract Plan. The shape of the hull is usually considered too important to be left to the discretion of the Contractor; but if the vessel is a low-speed barge, only general guidance as to the bow and stern configuration may be necessary, thereby allowing the Contractor to design it as a least-cost solution.

Once a decision is made as to what information will be conveyed to the Contractor by the Contract Plans, the Purchaser's naval architects and design engineers must ensure that the Contract Plans are not misleading. For bidding purposes, the Contractor is allowed to rely on information contained within the Contract Plans as being consistent with the nominated regulations and classification rules. If, for example, the Contract Plans include a schematic ventilation plan showing 14 fire dampers, the Contractor is allowed to rely on the fact that only 14 fire dampers will satisfy regulatory requirements. If a lesser number is required, the Contractor is still obligated to install the indicated 14 fire dampers; but if a greater number is required, the excess above 14 may become the basis of an essential Change Order.

Tolerances that are to be achieved are often implied by reference to a standard, in which case the standard should be reviewed for applicability before citing it. However, if tolerances for certain elements of the ship are of special concern to the Purchaser, they should be expressly stated in the relevant Contract Plans or Contract Specifications. For example, the tolerances within cell guides for container ships may be different from normal shipbuilding standard tolerances.

20 INTERPRETATION OF CONTRACT PLANS

In order to avoid misunderstandings that arise later, it may be advisable for the Purchaser's naval architects and design engineers to seek regulatory and/or classification approvals of the anticipated Contract Plans before the contract is executed. Problems have arisen in the past due to the fact that the Purchaser's naval architects did not interpret the classification requirements in the same manner as the classification organization itself. Pre-contract approval of the Contract Plans, however, does not eliminate the need for further approvals of the more-detailed plans that are to be developed by the Contractor after contract execution.

The Purchaser's naval architects and design engineers should appreciate that many objects shown on Contract Plans are representations only, and do not indicate with precision the dimensional proximity of structures or other items of equipment. This means that the Contractor will have a "window" of placement of that item of equipment. If clearances around that item of equipment are important, it would be best if the drawing noted that requirement, possibly with reference to an appropriate Contract Specification item.

Both parties have to recognize that the notes contained within a drawing are as much a part of that drawing as are the graphical representations. If the note states that the dimensions and linear weight of a stiffener is "typ." or typical for a group of stiffeners, the Contractor cannot pretend that the information was lacking. On the other hand, the Purchaser's naval architects need to appreciate that shipyard personnel cannot read the minds of the persons preparing the drawings. Thus, the working rule should be that if there is any doubt as to how someone other than the author of a plan will interpret part of it, then more information is better than less and more notations are better than fewer, even at the risk of making the drawing look too "busy." If it is necessary to refer to a second Contract Plan to fully understand the first, it is best to not assume the Contractor will examine both plans concurrently. Rather, the first plan could reference the second one, and vice-versa, to ensure clarity, without which risks are being created.

A previous section of this paper addressed the subjects of composite drawing and the resolution of interferences. Naval architects and design engineers who have not prepared composite drawings prior to the execution of the contract should anticipate that likely there will be interferences arising from a strict interpretation of the contract documents. Accordingly, those persons should be prepared to accept variations from the Contract Specifications and Contract Plans that need to be achieved to eliminate such interferences. Again, it can be expected that the Contractor will seek to eliminate those interferences in a least-cost manner.

If the Purchaser's naval architects and design engineers are not going to be receptive to Contractor-determined resolution of interferences which arise from the contract documents, perhaps they may wish to undertake the development of composite drawings prior to contract execution. However, this would be meaningful only for those situations in which the Purchaser wishes to control nearly all of the spatial relationships, configurations, arrangements and appearances through the use of a large number of Contract Plans, which is fairly common for naval combatant vessels and passenger ships.

Contract Plans generally should not include quantities of materials, though they could indicate types of materials in a Bill of Materials at the top of the drawing if the types are not already identified in the Contract Specifications. The presence of exact quantities on Contract Plans may lead to allegations of "extras" by the Contractor, resulting in an otherwise unnecessary Change Order.

If the Contract Specifications and Contract Plans are available in computerized format, the Purchaser can provide them to bidders as long as a contractually-binding hard (paper) copy, produced by the original developer of them and not by another party, becomes the official contract document.

21 USE OF GUIDANCE PLANS

Some naval architects who develop and/or assemble the technical documents for a shipbuilding contract incorporate into the contract package several Guidance Plans in addition to Contract Plans. One possible reason for the differentiation between Guidance Plans and Contract Plans may be that the naval architect has in mind a different degree of required compliance by the Contractor.

Another possible reason for the inclusion of Guidance Plans is to give the Contractor a "starting point" for its own design development responsibilities. A third possible reason for incorporating two different types of plans in the contract package is to encourage the Contractor to seek alternative, lower-cost means which will lead to savings for both Purchaser and Contractor. There are several other possible reasons for including Guidance Plans in a contract package.

The realization that there may be any of several reasons for using Guidance Plans in addition to Contract Plans points out a potential cause of contractual difficulties. Namely, the Contractor may attach a different significance to the Guidance Plans than intended by the Purchaser. The means of avoiding such difficulties or disputes is to either avoid using Guidance Plans, or to define the use of the word "guidance." For example, the phrase Guidance Plans can be defined in the Agreement to mean plans from which the Contractor may vary, at no additional cost to the Purchaser, only if approved in advance by the Purchaser.

Another possible definition of Guidance Plans could be, for example, plans which must be adhered to in all respects except that the exact dimensions shown or implied therein may result in physical interferences with other components of the ship, which interferences are to be resolved by the Contractor at no additional expense to the Purchaser. There are, of course, many other possible definitions of Guidance Plans; but failure to define the term, when Guidance Plans are included in the contract package, may lead to confusion at best, or serious disputes at worst.

22 OTHER SPECIFICATION REQUIREMENTS

The vessel owner's on-site representatives may find that during vessel construction they wish to have some control over other tangible aspects of the process that do not directly affect the design and construction of the vessel. Nevertheless, because of their various concerns, it may be useful to add to the specifications sections which address the mechanics and responsibilities for each of the following, among other possibilities.

- Use of subcontractor or vendor representatives (such as for hull coatings) to ensure availability of warranty from the vendor.
- Compartment close-out inspections to ensure the shipyard has cleaned-up and withdrawn from each compartment before vessel turnover.
- Disposal of hazardous and toxic wastes generated during construction.
- Facilities to be provided for owner's representatives.

23 NEWBUILDING VERSUS REPAIR AND CONVERSION

Although this paper is intended to apply to new ship construction, certain aspects of it also apply to ship conversion and repair. It should be appreciated, however, that this paper on the development of Shipbuilding Specifications is least applicable to ship repair, and a slightly greater portion of it may apply to ship conversion. For ship repair, the specifications address each repair item individually, although the general section of the Contract Specifications may be somewhat applicable to repair as well as newbuilding. Ship conversion which involves a significant amount of new steel and/or new arrangements may appear to be more related to newbuilding than to ship repair. However, ship conversion specifications are even more difficult to write than newbuilding specifications. The reason for that greater difficulty is that in ship construction, the specifications and plans must only define the final product, but in ship conversion, the specifications and plans must define both the starting point (the ship before conversion) as well as the end point.

These points about ship repair and ship conversion specifications are included only to caution the reader that those types of projects are quite different from new ship construction. Accordingly, the development of Contract Specifications and Plans for ship repair and the development of Contract Specifications and Plans for ship conversion both will be a measurably different process than discussed above.

24 REFERENCE

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