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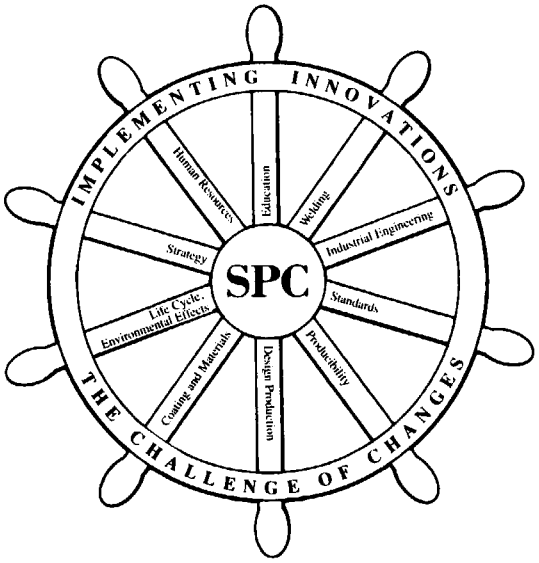

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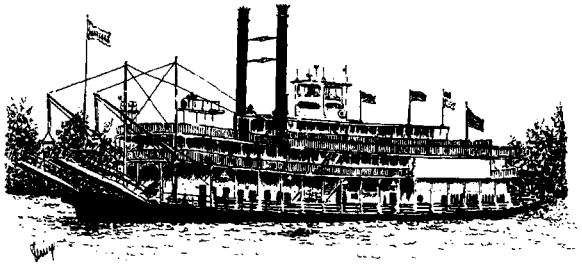

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Defining the Shipyard's Engineering Requirements

No. 4B-2

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ABSTRACT

It is customary for a shipyard to subcontract with one or more design agents for at least some portion of the detail design of a ship to be constructed by the shipyard. Past experience with this process has demonstrated that it has the potential to be the source of inefficiencies, wasted efforts and deteriorated relations between the shipyard and design agent. The Society of Naval Architects and Marine Engineers (SNAME) Ship Production Committee Panel, (SP-41, Design/Production integration, sponsored a project to improve this process. This effort developed a list of the information which should flow from a shipyard to a design agent in order for the design agent to generate the calculations, drawings and other deliverables in a timely fashion and useable format to support the construction effort. This paper describes the methodology used to develop the required information and reviews the details of the list.

BACKGROUND

The specific information about the shipyard that is needed in order for the shipyard's "in house" engineering department to provide support for the ship construction process is normally resident within the engineering department. However, because of the cyclical nature of today's shipbuilding market, not all shipyards are able to maintain a full design staff. Some of these shipyards maintain a "core" engineering group capable of managing a preliminary or detail design effort prepared by an outside design agent. In that case, designs for products which are to be built and/or assembled in the shipyard will be prepared by design agent personnel who may have little or no history and knowledge of the shipyard's design and construction capabilities and practices. Simply stated, the shipyard's problem is how to identify and communicate the vast amount of information which must flow across the interface, in both directions, to enable the outside design agent to prepare a usable design product at a cost efficient price.

The permanent shipyard engineering staff who manage the contract, have to bridge the interface between the shipyard and the "temporary" design personnel who will be doing the design work. To obtain a product from the design agent which is usable by the shipyard production departments, the permanent shipyard staff must have a thorough knowledge of the shipyard's specific requirements based upon the shipyard's capabilities, facilities and past practices, as well as a solid understanding of the "process" of how a ship is designed and built at their yard. Not only must the shipyard personnel have the information, but they have to communicate it to the design agent in a timely fashion to avoid rework and increased costs. The design agent needs to know certain information about the shipyard, the details of the current ship construction project, how the shipyard plans to build the ship, the design output required and when the deliverables are required in order to properly support the shipyard.

Although each shipyard's requirements may vary in some details, a set of generic requirements for an engineering support contract has been developed. These generic requirements are available for the shipyard to modify and use as required in developing the specific requirements for each contract. The listing of generic requirements is intended to assist both the shipyard and the design agent in assuring that the required information has been discussed and either has or will be transmitted between their organizations in a timely fashion.

The purpose of this paper is to report on the methodology used to develop the list of generic requirements and provide the contents of the resulting list for the use of the shipbuilding industry.

THE GOAL

The goal of this project was to identify the information which needs to be provided by the shipyard to the design agent. This information must be sufficient to ensure that the product of the design agent is directly usable by the shipyard, with negligible rework generated as a result of the shipyard's review of the design agent's products. By being able to identify the information to be transmitted, by as early as the initial stages of negotiation between the two parties, not only will adequate information flow be ensured, but more accurate cost estimates for the design agent's efforts should be possible. The timeliness of information flow will also be enhanced, since schedules can be developed and managed throughout the process.

THE APPROACH

The approach followed in performing this task was to divide the work into the four steps which are described in detail in the following sections. The assistance of a number of shipyards and design agents was enlisted to participate in the project. Some of the shipyards and design agents provided copies of contracts and other documentation used in previous projects to serve as a starting point in developing the questionnaire. All of the participants contributed valuable time and effort to the project and made significant comments and suggestions which improved the value and completeness of the final product.

First, a number of shipyards and design agents were contacted and invited to participate in the project. In depth inquiries were made with several of the shipyards and design agents to obtain and compile sufficient information to prepare the basic questionnaire which was to be sent to the larger group of participants.

Then, the questionnaire was mailed to all of the participating organizations. Follow up visits and phone calls were made as necessary to clarify the information requested and to establish a common understanding of each item.

Next, the responses received from the participants were tabulated and reviewed. Additions and deletions were made to the listing based upon the numerous comments received with the completed questionnaires. The tabulated and revised responses were then mailed to the various participants for any additional comments.

In the last step, following receipt of the final comments, a report including the final listing of engineering data which should be provided by a shipyard to a design agent providing engineering and design support services was distributed to the participants and other interested parties.

THE PARTICIPANTS

The following organizations participated in the project. Many individuals within each group made valuable contributions of both their knowledge and time.

Shipyards

Avondale Industries Inc. (ASI)
Bethlehem Steel Company (BSC)
Bath Iron Works (BIW)
lngalls Shipbuilding Division (ISD)

McDermot (McD)
National Steel and Shipbuilding Co. (NASSCO)
Peterson Builders Inc (PBI)
Textron Marine Systems (TMS)

Design Agents

CDI Marine
Gibbs and Cox (G&C)
JJH Inc.
John J. McMullin & Assoc. (JJMA)
M. Rosenblatt and Son (MRS)

THE QUESTIONNAIRE

Questionnaire Structure: Top Level

The questionnaire was prepared as a draft of a checklist for statement of requirements (SOR) for engineering support services.

The check list was structured in a work breakdown format with the top level being the five major elements of information which should be provided in a SOR. The five major elements of the listing were:

1. shipyard specific information,
2. project specific information,
3. shipyard imposed project specific requirements,
4. required deliverables, and
5. required schedule of deliverables.

Questionnaire Structure: Second Level

The five major elements of the top level were broken down into a second level as follows:

Shipyard Specific Information
1.1 Shipyard Organization,
1.2 Shipyard Facilities,
1.3 Shipyard Capabilities, and
1.4 Shipyard Standards and Practices;

Project Specific Information
2.1 Contract,
2.2 Specifications,
2.3 Contract Drawings,
2.4 Contract Guidance Drawings,
2.5 Project Peculiar Documents,
2.6 Third Tier References,
2.7 Approval Procedures,
2.8 Owner Data Requirements, and
2.9 Other Owner Requirements;

Shipyard Imposed Project Specific Requirements
3.1 Build Strategy,
3.2 Proposed Construction Plan,
3.3 Proposed Construction Schedules,
3.4 Proposed Test Program,
3.5 Drawing Format and Content,
3.6 Computer Aided Design, Engineering and Manufacturing (CAD/CAE/CAM),
3.7 Other Production Information,
3.8 Liaison Procedures,
3.9 Change Procedures,
3.10 Design Reviews,
3.11 Quality Assurance, and
3.12 Work Tracking and Status Reports;

Required Deliverables
4.1 Design Calculations and Studies,
4.2 System Drawings,
4.3 Composite Drawings,
4.4 Installation/Assembly Drawings,
4.5 Fabrication Drawings,
4.6 Schedules, List/Booklets,
4.7 Other Drawings,
4.8 Vendor Drawings,
4.9 Work Packages,
4.10 Test Program Documentation,
4.11 Material Procurement Documents,
4.12 Vendor Documentation,
4.13 Technical Documentation, and
4. 14 Samples Provided;

Required Schedules of Deliverables
5.1 Design Calculations and Studies,
5.2 System Drawings,
5.3 Composite Drawings,
5.4 Installation/Assembly Drawings,
5.5 Fabrication Drawings,
5.6 Schedules/Lists/Booklets,
5.7 Other Drawings,
5.8 Vendor Drawings,
5.9 Work Packages,

5.10 Test Program Documentation,
5.11 Material Procurement Documents,
5.12 Vendor Documentation, and
5.13 Technical Documentation.

Questionnaire Instructions

The following information and instructions were transmitted to the participants as guidelines for their responses:

"This document is the first draft of a listing of information that a shipyard should convey to a design agent with the Statement of Requirements (SOR) for Engineering Support Services to insure that the products received by the shipyard are of the desired quality and are directly usable. The purpose of this questionnaire is to test the checklist against existing practices and to identify those items of information which you believe should be added or deleted from the list."

"For a shipyard respondent:

Please review the following check off list and:

1. check whether your organization currently provides the information indicated with the Statement of Requirements (SOR),
2. check whether you believe that the item should be provided, and
3. add any additional items that you believe should be included with the listing."

"For a design agent respondent:

Please review the following check off list and:

1. check whether you normally receive the information with a SOR,
2. check whether you believe that the item should be provided with the SOR to facilitate your performance, and
3. add any additional items that you believe should be included with the . listing."

Questionnaire Follow-Up

Rather than passively waiting for the questionnaires to be returned for analysis, the authors visited as many of the respondents as practicable and discussed both the questionnaire and their responses. This turned out to be most valuable, since it allowed the team to resolve questions that arose in interpreting the questionnaire. It had the additional benefit of providing valuable feedback in comments that went beyond the scope of the questionnaire but were directly related to the efficiency and effectiveness with which shipyards can overcome information flow deficiencies, changes, and other obstacles to production support.

THE RESULTS

The following is a summary of the responses received from the questionnaire.

Responses

The responses to the questionnaires were very positive. None of the items listed in the draft questionnaire were rejected as unimportant, unnecessary or extraneous. The key problem that affected the shipyard's responses was the direct result in a lack of clarity in the wording of the questionnaire. When answering the question about their current practices, those shipyards which are not currently farming out a specific type of work answered "No" to that question even if they thought that the answer should be "yes" if the work were farmed out. The actual intent of the questionnaire was to find out whether they agreed that the information cited would be needed IF the shipyard were to farm out that type of work. Fortunately, the follow-up visits by team members were able to clarify this matter in many instances. Reference 1 contains a complete summary tabulation of the responses received to the original checklist items.

Additions

A number of suggested additions to the original list of information items required were received from the respondents. Some of the original items were found to require additional description. All of these additions and modification were made and included in the final listing, which is provided in the Appendix.

THE ANALYSIS

The following are some of the significant findings based upon a review of the completed questionnaires and meetings with shipyard and design agent personnel.

Data Discrepancies

Review of the summary data revealed what appeared to be considerable divergence in the responses between shipyards and design agents for the current situation. For instance, there are numerous items such as for "1.2.9 Burning Machines", where more than half of the shipyard responses indicated that the data is now being provided, but none of the design agents said that it was. Much closer agreement was obtained in responses to the questions whether the data should be provided.

As a result of the discussions that took place with some of the respondents, it was determined that some of the differences in the responses was due to the fact that some of the shipyards felt that the data was available to the design agent if it was found to be necessary to the design agent's efforts, while the design agents were indicating that they did not get the data without specifically asking for it. The significance of this is that if the data is not available at the time the design agent needs it, the design agent's work is interrupted and delayed. Both shipyards and design agents agreed that it would be much more efficient to identify data needs as early as possible and to have the data available when needed.

Required Data

The responses indicate a high degree of agreement that all of the items in the questionnaire would be necessary if the associated type of work were farmed out. In the vast majority of those cases where the shipyard answered "no"and the design agent answered "yes", it was because the shipyard was not presently farming out that type of work. When asked whether that data would be necessary if they did farm out that type of work, the shipyards answered "yes" in almost every case.

Application to Current Contracts

In most cases, the percentages of "Should Provide" answers were greater than for the "Now Provide" responses. This indicates that the shipyards and the design agents both agree that the design agents are not now receiving all of the data that they need in order to efficiently provide the shipyards with high quality products that require minimum rework. This is a significant finding that indicates that the list in the Appendix can be used immediately by all shipyards and design agents to identify data needs that have not yet been satisfied under existing contracts.

Amount of Data

There were no indications of any reluctance by the shipyards to provide information to the design agents,, as long as the information was believed to be really relevant to the management or effectiveness of the design agent's efforts. However, there is not total agreement on exactly what information is required by the design agent. There was overwhelming agreement, particularly during discussions with shipyard and design agent personnel, that a check-off list such as that provided in the Appendix would be of great assistance in achieving understanding of, and agreement on, what really is needed and that there is a need to do so. Further, there does not appear to be any significant downside risk to the shipyard in providing more data to the design agent than is absolutely necessary.

Design Agent Role

Without complete data, the design agent is limited to the traditional design role and is unable to provide products which make maximum use of the capabilities of the shipyard. The improved productivity and efficiencies which could be achieved from concurrent engineering can not be realized without the full range of data.

ADDITIONAL COMMENTS

Respondents provided additional written comments, as well as many other comments during follow up discussions, that were related to when and how to use the check-off list. They also provided many comments on the management of farm-out engineering efforts. These are summarized in the following paragraphs.

Use of Check-off List for Requests For Quotes (RF&)

The check-off list in the Appendix, should be used as a part of the initial request for quote for engineering services, by both the shipyard and the design agent. The shipyard should indicate what data will be made available. "There is an absolute need, both at the proposal stage as well as the contract stage, to have a mutual understanding of the constraints or degree of detail required by the client. For example, if the shipyard does not have pipe bending capabilities, the design agent must maximize the use of fittings. Similarly, if a shipyard has extensive in-house standards for foundations, pipe hangers, ventilation spools, etc., the design agent, if not knowledgeable of these standards, will incur unnecessary expense and provide the shipyard with an unusable product." The design agents believe such data should be made available with the RFQ so that they will know the scope of work they are bidding on more precisely. In their responses, the design agents can use the list to identify what information they need and tie their quote to the availability of the data indicated.

Use of Check-off List for Negotiationq

The check-off list can be used during negotiations prior to the award of the engineering services contract to further define information needs, as well as to establish a schedule by which the information will be provided. This schedule would be integrated with the schedule for drawing submittal.

Timeliness of Data

Design agents stressed the need for the information to be delivered in a timely manner in order to reduce time wastage and cost. One noted that even though they had indicated on the questionnaire that the information was now being provided, some of the information was only being provided after the design agent identified the need and asked for it. Several design agents indicated that although all of the necessary information normally was received by the end of the contract, it was not necessarily provided when it was needed. This is particularly true in obtaining vendor information. Late information results in wasted effort and/or incomplete drawings being provided to the shipyard.

Keeping Data Current

Information provided to the design agent must be kept current during the course of the contract. In particular, changes in the ship construction contract and specifications or shipyard construction schedule, should be conveyed to the design agent without delay.

On-Site Representatives

The focus of most of the discussions with the shipyards and design agents was on how to most effectively manage the engineering services contract. It was universally agreed that it is essential to have at least one representative from the shipyard on-site at the design agent's facility. Experienced personnel added the following considerations.

The shipyard representative must be very knowledgeable about at least one of the areas of work being accomplished by the design agent, so that he can provide as much direct response to questions as possible, without having to refer back to some other individual in the shipyard first. He must have commensurate decision making authority from his shipyard.

For those issues to which the on-site rep is not able to provide direct answers, it is better to have the design agent engineer/designer, rather than the on-site rep speak with a designated point of contact (POC) at the shipyard to get the answer that he needs. This requires that the designated point of contact for each discipline at the shipyard be identified in advance. The POC's should be aware of the limits of their authority. Both the POC contacted and the design agent engineer/designer should record the contact and the decisions made.

Quality Assurance Plan

The design agent's Quality Assurance plan should be compatible with that of the shipyard, so that the shipyard's system will not be examining for items that were not covered by the design agent's system.

File Translation

The shipyard and the design agent should have the same or a compatible system of computer data files to readily permit data translation and transmission.

Desian Aaent Standards

An individual from one shipyard who had been that shipyard's on-site representative at a design agent, made the highly unusual suggestion that shipyards should review the design agent's standard drawing practices and standard design details. In some cases, the design agent's standards, based on experience with many shipyards, might be superior to the those in use at the shipyard and should be adopted. In other cases, it might be less difficult and expensive for the shipyard to revise the design agent's drawings to the shipyard's standard rather than to have the design agent learn the shipyard's preferred approach.

CONCLUSIONS AND RECOMMENDATIONS

The following conclusions and recommendations are provided.

Use of Check-off List

The checkoff list contained in the Apapendix should be used in the preparation of a shipyard's engineering support contract with prospective design agents. This will ensure that all of the requisite data is identified during the design agent's proposal preparation. Further, the checkoff list can then be used to ensure that the requisite data is prepared by the shipyard and provided to the design agent when required following contract award.

Need for Direct Liaison

Use of the list provided in the Appendix will not preclude the necessity to establish good liaison, effective communication paths and manageable techniques for establishing responsibility for controlling data transmission between knowledgeable personnel in the shipyard's and design agent's organization - but it will be an invaluable first step. The need to have knowledgeable, responsive shipyard personnel available, either on-site at the design agent's facility or through an on-site shipyard representative, was stressed by every shipyard and design agent who participated in this project.

Current Contract Reviews

Shipyards should meet with their current engineering support contractors to identify all data that is considered useful for the design agent to have and to ensure that the design agent either has the data or will be given it by an agreed upon date.

Acknowledgments

The assistance of the many individuals and organizations which made this paper possible by their willing participation and assistance is gratefully acknowledged. In particular, the assistance of Jon H. Matthews and Patrick C. Hughes of JJH Inc. in developing the questionnaire was invaluable.

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References

1. "The Definition of a Shipyard's Engineering Requirements to be Met by a Design Agent", NSRP Report 0333 dated July 1991

APPENDIX

ENGINEERING SUPPORT SERVICES CHECKLIST

This Engineering Support Services Contract Checklist is intended to assist the shipyard to insure that the shipyard has provided or will provide the design agent with the requisite information in a timely fashion to enable the design agent to produce the contracted design services in a useable format, at the proper time and at the least cost.

SHIPYARD SPECIFIC INFORMATION

This section addresses information which applies uniquely to the specific shipyard and includes both physical characteristics and limitations, as well as established practices and standards.

1.1	Shipyard Organization
1.1.1	Organization plan
1 .I .2	Organizational responsibilities
1.1.3	Project organization, responsibilities
1.1.4	Telephone directory
1.2	Shipyard Facilities
1.2.1	Maximum lift capacity
1.2.2	Water depth at launch and pier side
1.2.3	Type of building ways /slab/drydock
1.2.4	Laydown area
1.2.5	Plate handling /bending/rolling limitations
1.2.6	Unit/assembly size limitations
1.2.7	Climatic conditions
1.2.8	Paint facility
1.2.9	Burning machines
1.2.10	Welding equipment
1.2.11	Machine shop equipment
1.2.12	Pipe bending machines
1.2.13	Robotic equipment
1.2.14	Temporary Services available
1.2.14.1	Staging, lighting, HVAC

1.2.15 Geographic constraints
1.2.15.1 Channel depth & width
1.2.15.2 Bridge clearances
1.2.15.3 Material transportation limitations
l-2.16 Computer programs in use
1.2.17 Material ordering limitations
1.3 Shipyard Capabilities
1.3.1 Size of workforce
1.3.2 Skill level of workforce
1.3.3 Subcontractors
1.3.3.1 Joiner
1.3.3.2 Electrical
1.3.3.3 Combat System
1.3.3.4 Insulation
1.3.3.5 Painting
1.3.3.6 Major equipment
1.3.3.7 HVAC
1.3.4 Other capabilities and limitations
1.3.4.1 Union labor constraints
1.3.4.2 Interface required with other vendors & suppliers
1.4 Shipyard standards and practices
1.4.1 Drafting practices and conventions
1.4.1 .I Dimensional control criteria
1.4.1.2 Piece marking
1.4.1.2.1 Steel, pipe, electrical, outfitting
1.4.1.3 CADICAEICAM
1.4.2 Material standards and practices
1.4.2.1 Material ordering conventions
1.4.2.1.1 Plates/shapes ordering standards
1.4 -2.1.2 Pipe ordering standards
1.4.2.1.3 Stock material
1.4.2.1.4 Catalog material
1.4 2.1.5 Special order material
1.4.2.1.6 SY fabricated standard parts
1.4.2.2 Long lead/advance material procedures
1.4.2.3 Matenal list format
1.4.2.4 Hazardous material
1.4.2.5 Make/buy criteria
1.4.2.6 Material Procurement Documents
1.4 -3.6.1 RF0
1 .4.2.6.2 Purcllase technical specification
1.4.2.6.3 Purchase order
l-4.2.6.4 Bulk material lists, steel list, valve list
1.4.3 Structural standards and practices
1.4.3.1 Metal forming and cutting
1.4.3.2 Welding procedures and details
1.4.3.3 Holes control
1.4.3.4 Bulkhead/deck sleeves
1.4.3.5 Foundations and foundation reinforcement
1.4.3.6 Pipe hanger supports
1.4.3.7 Cable way supports
1.4.3.8 Standard structural details
1.4.4 Lofting standards and practices
l-4.4.1 Conventions
1.4.4.2 Tolerances
1.4.4.3 Nesting criteria
1.4.4.4 Extra stock
1.4.5 Mechanical/Machinery standards and practices
1.4.5.1 Shaft alignment procedures
1.4.6 Electrical standards and practices
1.4.6.1 Wireways
1.4.6.2 Cable supports
l-4.6.3 Testing
1.4.7 Piping standards and practices
l-4.7.1 Fabrication practices
1.4.7.2 Bend radius
1.4.7.3 Hangers
1.4.7.4 Cleaning/flushing/testing
1.4.8 HVAC standards and practices
1.4.8.1 Manufacturing/fabrication criteria
1.4.8.2 Hangers
1.4.8.3 Testing
1.4.9 Painting/coating standards and practices
1.4.10 Jigs and Fixtures standards and practices
1.4.11 Tests and Trials standards and practices
1.4.12 Work Packages standards and practices
I .4.12.1 Work package size limitalioris
1.4.12.2 Work package format

1.4.12.3 Work package contents
1.4.12.4 Work package numbering system
1.4.13 Engineering change standards and practices
1.4.13.1 Producibility
1.4.13.2 Value engineering
l.4.13.3 Error correction
1.4.14 Fitting and accuracy standards and practices
1.4.15 Any other standards and practices

PROJECT SPECIFIC INFORMATION

This section addresses that information which applies uniquely to the specific project due to the requirements which the owner has imposed by the ship construction contract and specifications.

2.1 Contract
2.1 . I CDRLS, DIDs
2.1.2 Copy of contract
2.2 Specifications
2.3 Contract Drawings
2.3.1 List of drawings by drawing number, title and revision
2.3.2 Reproducible copy of each drawing
2.3.3 CAD/CAE/CAM data files
2.4 Contract Guidance Drawings
2.4.1 List of drawings by drawing number, title and revision
2.4.2 Reproducible copy of each drawing
2.4.3 CAD/CAE/CAM data files
2.5 Project Peculiar Documents
2.6 Third Tier References
2.7 Approval Procedures
2.7.1 Shipyard approvals required
2.7.2 Owner approvals required
2.7.3 Regulatory body approvals required
2.7.4 Correspondence and distribution procedures
2.8 Owner Data Requirements
2.8.1 Integrated Logistics Support (ILS)
2.8.1.I Provisioning technical documentation
2.8.1.2 Spare parts
2.8.1.3 Selected record data & drawings
2.8.2 Commercial data information
2.8.2.1 Procurement information
2.8.2.2 Technical manuals
2.8.2.3 Booklet of General Plans
2.8.2.4 Spare parts list
2.8.3 Test and trial data
2.8.4 Training and instruction
2.8.5 COSAL
2.9 Other Owner Requirements
2.9.1 Models
2.9.2 Design briefings
2.9.3 Ceremonies
2.9.4 Certifications

SHIPYARD IMPOSED PROJECT SPECIFIC REQUIREMENTS

This section addresses the information which applies uniquely to the specific project which the shipyard has imposed.

3.1 Build Strategy
3.1.I Description of building plan
3.1.2 Establish Unit and assembly breaks - drawing
3.1.3 Product Work Breakdown Structure
3.1.4 Preoutfitting sequence
3.2 Proposed Construction Plan
3.2.1 Shipyard Master Construction Plan
3.2.2 Ship construction plan
3.2.3 Unit erection plan
3.2.4 Subcontracting plan
3.3 Proposed Construction Schedules
3.3.1 Time phased construction plan
3.3.2 Engineering and design schedule
3.3.3 Material/equipment required in yard dates
3.3.4 Vendor information required dates
3.3.5 Long lead time materials
3.4 Proposed Test Program
3.4.1 List of tests required

3.4.1.2	Required sequence of tests
3.4.2	Test procedures required
3.4.2.1	Test Procedure format and content
3.4.2.2	Test procedure numbering system
3.4.2.3	Sample test procedure provided
3.4.3	Test reports required
3.4.3.1	Test support required/ personnel/equipment
3.4.4	Trials agendas
3.4.4.1	Dock trials
3.4.4.2	Builders trial
3.4.4.3	Owner's trails
3.4.5	Trial reports required
3.5	Drawing Format and Content
3.5.1	Drawing size
3.5.2	Title Block layout and data
3.5.3	Drawing numbering system
3.5.4	Drawing layout
3.5.5	Bill of material format
3.5.6	General Notes
3.5.7	Drafting Standards
3.5.7.1	DOD-STD-1OO/DOD-Dl OOO
3.5.7.2	Commercial
3.5.7.3	Level 1,2,3
3.5.8	Sample provided
3.6	CAD/CAE/CAM
3.6.1	Required CAD/CAE/CAM application
3.6.2	Shipyard CAD/CAE/CAM system
3.6.3	Degree of compatibility required
3.6.4	Control of CAD/CAE/CAM file
3.7	Other Production Engineering Informatlon
3.7.1	NC tapes
3.7.2	Nesting sketches
3.7.3	Template information
3.7.4	Spool sketches
3.7.5	Pipe details
3.8	Liasion Procedures
3.8.1	Responsible SY personnel
3.8.2	SY approval procedures
3.8.3	SY personnel at Design Agent
3.8.3.1	Facilities required
3.8.4	Design Agent personnel at SY
3.8.5	Responsibility for meetings
3.8.6	Responsibility for reports
3.8.6.1	Frequency of reports
3.8.7	Contact with owner
3.8.8	Contact with regulatory bodies
3.8.9	Contact with vendors and subcontractors
3.9	Change Procedures
3.9.1	Change orders
3.9.1.I	Changes to basic ship construction contract
3.9.1.2	Changes to Engineering support contract
3.9.2	Engineering changes (ECNs)
3.10	Design Reviews
3.10.1	Responsibility
3.10.2	Procedures
3.10.3	Location
3.10.4	Schedule
3.11	Quality Assurance
3.1 1. I	Responsibility
3.11.2	QA plans
3.11.3	Shipyard procedures
3.11.4	Design Agent procedures
3.12	Work Tracking and Status Reports
3.12.1	Responsibility
3.12.2	Report content
3.12.2.1	Technical
3.12.2.2	Schedule
3.12.2.3	Financial
3.12.3	Reporting schedule

REQUIRED DELIVERABLES

This section addresses the information which the design agent is required to deliver to the shipyard under the terms of the engineering support contract between the shipyard and the design agent. This section addresses whether the shipyard and the design agent have clearly identified all of the deliverables required by the shipyard from the design agent.

4.1	Design Calculations and Studies Identified
4.1.1	Weight Estimate
4.1.2	Inclining Experiment Report
4.2	System & Arrangement Drawings
4.2.1	Structural Scantling

	drawings
4.2.2	General Arrangement Drawings
4.2.3	Machinery Arrangement Drawings
4.2.4	Control Space Arrangement Drawings
4.2.5	Diagrams
4.2.6	Diagrammatic Arrangements
4.2.7	Advanced material list
4.2.8	Material List
4.2.9	Compartment and Access Drawings
4.3	Composite Drawings
4.3.1	Composites/multisystem drawings
4.4	Installation/assembly Drawings
4.4.1	Unit drawings
4.4.1.1	Outfitting Lists
4.4.2	Machinery packages
4.5	Fabrication drawings
4.5.1	Pipe details/spool pieces
4.5.2	Piping hanger support details
4.5.3	Ventilation details
4.5.4	Foundation list
4.5.5	Foundation drawings
4,5.6	Hole list
4.5.7	Key List
4.6	Schedules/lists/Booklets
4.6.1	Paint schedule
4.7	Vendor Drawings
4.7.1	Vendor Geometry Drawings
4.7.2	Vendor Compliance Drawings
4.7.3	Vendor MilSpec Drawings
4.8	Other Drawings
4.8.1	Closure Lists
4.8.2	Label Plates
4.8.3	Cableways
4.8.4	Lighting
4.8.5	Shafting
4.8.6	Joiner
4.8.7	Insulation
4.8.8	Deck Covering
4.9	Work Packages
4.9.1	Work package master list
4.10	Test Program Documentation
4.10.1	Test procedure master list
4.10.2	Test reports master list
4.10.3	Testing support required
4.10.4	Trial support required
4.11	Material Procurement Documents
4.11.1	Material ordering master list
4.11.2	Spare parts list
4.12	Vendor Documentation
4.12.l	Master list of vendor documentation required
4.12.2	Number of copies required
4.13	Technical Documentation
4.13.1	Master list
4.13.2	Training
4.13.3	Safety
4.14	Have samples of above items been provided?

REQUIRED SCHEDULE OF DELIVERABLES

This section addresses the schedule on which the design agent is required to provide the deliverables to the shipyard under the terms of the engineering support contract between the shipyard and the design agent. The items in this section address whether the shipyard and the design agent have established the required dates for the deliverables to the shipyard in order to perform to the contract and specifications.

	Required Dates for:
5.1	Design Calculations and Studies
5.2	System and Arrangement Drawings
5.3	Installation/Assembly Drawings
5.4	Fabrication Drawings
5.5	Schedules/Lists/Booklets
5.6	Other Drawings
5.7	Vendor Drawings
5.8	Work Packages
5.9	Test Program Documentation
5.10	Material Procurement Documents
5.11	Vendor Documentation
5.12	Technical Documentation