

# RESEARCH RECOMMENDATIONS FOR FISCAL YEAR 2008



## Ship Structure Committee

American Bureau of Shipping  
Defence Research Establishment Atlantic  
Maritime Administration  
Military Sealift Command  
Naval Sea Systems Command  
Society of Naval Architects and Marine Engineers  
Transport Canada  
United States Coast Guard

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<b>16. Abstract</b> This annual report updates the multiyear research program of the Ship Structure Committee (SSC). The SSC is a body through which the U.S. Coast Guard, Naval Sea Systems Command, Maritime Administration, Military Sealift Command, American Bureau of Shipping, Transport Canada, Defence Research Development Canada – Atlantic, and the Society of Naval Architect and Marine Engineers (SNAME) coordinate their research on structural performance of marine structures. The SSC's research program is intended to accommodate advanced concepts and long-range planning. It supports research in the focus areas of structural design, life cycle risk management of ship structures and production technologies.  The updated research program covers the fiscal years (FY) 1997-2007. The report includes (1) detailed project descriptions for the 20 projects proposed for FY 2008; (2) brief summaries of active projects; and (3) a listing of recently completed projects. Two appendices provide the Strategic Plan of the Ship Structure Committee and the process for project selection by the Committee		<b>13. Type of Report and Period Covered</b> Final Report		
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## **ABSTRACT**

This annual report of the Ship Structure Committee (SSC) proposes research projects for consideration of funding during Fiscal Year 2008. The SSC is a body through which the American Bureau of Shipping, Defence Research and Development Canada - Atlantic, Maritime Administration, Military Sealift Command, Naval Sea Systems Command, Society of Naval Architects and Marine Engineers, Transport Canada, and the U.S. Coast Guard, coordinates their ship structure research. The SSC's research program is intended to support research in the focus areas of structural design, life cycle risk management of ship structures, and production technologies.

The report includes: (1) detailed project descriptions for the new projects proposed for FY 2008; (2) a comprehensive review of the entire research program, including work performed in FY 2007 and 2006, and (3) a brief summary of recently completed projects and all active projects in the program. The appendices provide detailed descriptions of the Committee's Strategic Plan, and the organization of the SSC.

## **FOREWORD**

The Mission of the Ship Structure Committee is to enhance the safety of life at sea, promote technology and education advancements in marine transportation, and to protect the marine environment. This will be done through advocating, participating in, and supporting cooperative research and development in Structural Design, Life Cycle Risk Management of Ship Structures, and Production Technologies.

On January 21, 1999, the SSC unanimously endorsed the SSC Strategic Plan, and Organizational Manual addressing strategic goals and SSC processes to support the attainment of these goals. The plan provided the focus for the research projects and programs addressed herein.

Each of the recommended projects supports at least one of the SSC's focus areas, and work towards improving the structural performance, the inspectability and maintenance of aging ships, and the safety of ships while at sea.

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**1****INTRODUCTION**

This annual report outlines a coordinated research plan for the interagency Ship Structure Committee (SSC). Technical input to the SSC is provided by the Ship Structure Subcommittee (SSSC), industry liaison members, academic institutions, and professional societies.

The SSC research program is intended to accommodate advanced concepts and long-range planning in support of goals set forth in its Strategic Plan. The SSC's Strategic Plan was reproduced in its entirety in Appendix B. Periodic review and revision by the SSC will keep the plan current with the changing needs of the maritime industry.

**REPORT ORGANIZATION**

This report encompasses a research-planning program to develop recommendations for specific SSC research projects for Fiscal Year 2008. Research activities from FY 2007 and earlier years are also reviewed. The report contains four sections comprising the following:

1. Introduction
2. Focus Areas
3. FY 2008 Project Recommendations
4. Active and Pending Projects
5. Recently Completed Projects

In the following chapters, projects designated with an "SSC" prefix are published SSC reports; those designated with an "SR" prefix are currently being funded or are recently completed but not yet published; and those with a "08" prefix are recommended for initiation in FY 2008.

## **PROGRAM AND PROJECT DEVELOPMENT**

The SSC recognizes that this research is being sponsored by agencies with varying levels of overall objectives compared with those of the SSC. Therefore, the challenge becomes one of developing research agendas and recommending meaningful and timely research programs that are complementary to each sponsoring agency efforts.

Industries, agencies, and research committees should contact the Executive Director of the SSC if they are interested in completing any of the projects listed in this report or in related initiatives.

The SSC develops its research agendas and recommendations for programs and projects by drawing on a wide range of expertise from within each agency and industry. The SSC Partners and Liaison Members include representatives from all relevant technical disciplines, academia, the research community, and the marine industry. These groups use their own knowledge, experience, and contacts to prepare project outlines, which are submitted to the SSC for consideration and further development.

## **RECOMMENDATIONS FOR IMPLEMENTING THE STRATEGIC PLAN**

In June 1998, the SSC held a meeting of the SSC Principal Members. In this and other 1998 meetings, the Principals discussed the Committee research and development program; the focus areas of interest that should be addressed by SSC research recommendations; and the availability of financial and other resources. The SSC strategic goals are listed below:

- Goal 1** To identify gaps in structural knowledge, and to develop a research and development plan to bridge the gaps.
- Goal 2** To address today's ship structural performance and safety assessment issues.
- Goal 3** To be recognized as a credible resource for ship safety experts.
- Goal 4** To advocate and search out cost share opportunities and partnerships, where possible and practicable, to complete the projects recommended by the Committee.

## 2

**FOCUS AREAS**

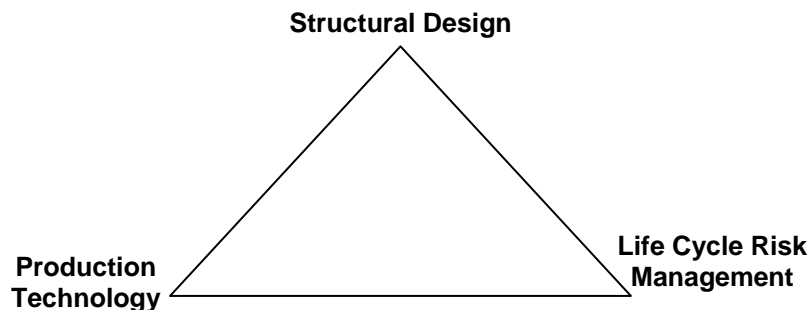
The SSC serves as a coordinating body for cooperative research and development between its member agencies, its partners and the industry. This leadership includes sponsorship, management, and coordination of research as well as information collection and dissemination. In recognition of global-scale pressures in the maritime industry, the implementation of the SSC Strategic Plan emphasizes design tools and information systems development that encompass a broad customer base, including designers, owner/operators, educators, manufacturers, regulators, and insurers. Consequently, planned activities span the entire life cycle of ships—from identification of initial requirements for design, and construction, to recommend practices for operation, maintenance, inspection, and safety assessment, to recommendations for refitting or scrapping of the structure.

This report of *Ship Structure Committee Research Recommendations* grouped the proposed research projects into three focus areas:

- Structural Design
- Life Cycle Risk Management of Ship Structures
- Production Technologies

Each of the recommended research projects contributes to the advancement of at least one of the focus areas. Advances in each of these areas are considered to be important in achieving the strategic goals of the SSC.

The three focus areas are strongly inter-linked as shown in Figure 2-1. There is, of course, not always a clear distinction as to the proper category to which a particular project should be assigned. Where appropriate, commonality and important linkages with other projects are also described. The following sections briefly describe each of the focus areas.



**FIGURE 2-1**  
**Relationships among the three focus areas**

## **STRUCTURAL DESIGN**

Like the other focus areas, design methods face a rapidly changing environment. Current trends in design require concurrent engineering methods and the need to consider manufacturing and cost constraints in the early stages of design. Acquisition reform and, specifically, changes in the way ships are being procured, coupled with the technological advances in computational capabilities are significantly impacting the nature of ship structural design. This is creating new challenges and demands on the nature of the R&D work which is required to support these designs. With the current industry-wide trend of pursuing risk-based structural design, R&D will increasingly be relied on to assist in developing a complete understanding of failure mechanisms, modes as well as initiation. Applied R&D can fill a tremendous void here, as past design practices that are based on rules of thumb or successful in-service experience are replaced with reliability methods that provide explicit & direct calculations as well as detailed and accurate computational assessments. Structures R&D will continue to be required as there will be a greater need to statistically characterize: material properties (existing & emerging), fatigue and strength properties and the environmental loads imposed globally & locally on the ship's hull. Advances in computational capabilities have made complex structural modeling and analyses a more routine part of the ship structural design process. Alternative arrangements, concepts and materials can be rapidly assessed in the design spiral. In addition, advances in the areas of fatigue and fracture mechanics combined with the analytical power of the finite element method have made detailed & rigorous stress, fatigue and fracture assessment not only accurate & quicker, but also an expectation of the design process.

## **LIFE CYCLE RISK MANAGEMENT OF SHIP STRUCTURES**

Degradation of ship structures will progress at varying rates depending on numerous design, construction, and operational factors. Corrosion of marine structures incurs considerable costs for preventive measures as well as for repair. Time-variable stresses from winds, waves, and service loading lead to damage accumulation and fatigue crack growth. Over the past several years, the SSC has completed several research projects supporting inspection and repair of vessels.

There are always economic considerations encouraging the extension of the service life of vessels. There are also now demands for increased safety of life at sea and reduced environmental risk. These demands call for a proper service life program for maintaining the structural integrity of ships.

New methods of collecting inspection data are needed, and new ideas for integrating these data concurrently in the engineering environment should be explored. With new maintenance systems being developed, more uniform methodologies for damage assessment and repair documentation are needed both for ship structural components and for coatings.

The operational performance of marine structures manifests the integration of materials, loading and response, design methods, and production of marine structures. The linkage of these focus areas will be incomplete if attention is not directed to the ability of the operational system to

perform their tasks. Superior design, construction, inspection, maintenance, and repair methodology are essential for safe operation.

### **PRODUCTION TECHNOLOGY**

Productivity improvement and quality work have long been recognized as some of the key factors in reducing costs and meeting market needs. Advances in computer-integrated manufacturing allow for developing build strategies in parallel with early design activities. Designs can now be assessed for suitability and better tailored to production facilities. These strategies will result in the reduction of re-works and hence, the initial acquisition cost. Furthermore, a well produced ship with good fit-ups and production details will minimize the potential of premature failures, such as cracking, buckling and so on. These will in turn result in the savings of operating and maintenance costs. Coupling together the reduction in the initial cost and the life-time savings in the operating and maintenance costs will afford the U.S. shipyards to be worldwide competitive once again.