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15. Supplementary Notes

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16. Abstract (MAXIMUM 200 WORDS)

The Crew Size Evaluation Method (CSEM) is a task-based approach to determining crew size on commercial ships. CSEM was used to examine the effects of three factors on crew needs: port call frequency, shoreside maintenance support, and three different sets of work/rest standards (U.S. Oil Pollution Act of 1990 (OPA '90); Seafarers' Training, Certification, and Watchkeeping Code (STCW); and International Labor Organization Convention 180 (ILO 180)). The analyses identified how these changes resulted in differing needs for particular crew types and shipboard tasks. This demonstrates CSEM's ability to clarify how different operational scenarios impact crew needs and to aid in determining how to redistribute tasks to other crew members or add additional crew in order to avoid overloading particular crew members.

This is one of two reports on the use of CSEM to evaluate crew needs under different operational scenarios. This report contains a detailed description of how CSEM is used to analyze scenarios and discusses several criteria, which can be applied in the evaluation of sufficient crew. A related paper, "Simplified Crew Size Evaluation Method," CG-D-13-00, explains how the full-scale analyses from CSEM can be packaged into simple lookup tables, yielding a quick and practical tool for crew size evaluation.

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Executive Summary

The Crew Size Evaluation Method (CSEM) is a task-based approach to determining crew size on commercial ships. CSEM simulates a voyage by scheduling the shipboard tasks which must be performed during each phase of the voyage (open waters, restricted waters, and in port), and assigns appropriate crew members to each task. CSEM records the number of hours worked by each crew member over each day of the voyage and tracks tasks that were delayed due to crew unavailability. This gives CSEM the capability to compare the effects of different operational factors on the number of crew needed to perform all tasks without exceeding work-hour limits (such as those mandated by OPA ’90). This report examines the effects of three factors: port call frequency, shoreside maintenance support, and three different sets of work/rest standards (OPA ’90, STCW, and ILO 180).

The effect of port call frequency was studied. Three different voyage scenarios used by United States (US) tankers with different port call frequencies were compared: one port call in 14 days, 3 in 14, and 7 in 14. As the number of port calls increases, there are increasing numbers of hours required for restricted waters transit, line handling, and cargo transfer operations. The CSEM analyses indicated a direct relationship between increased port call frequency and increased crew tasking. This would indicate a need for crew workload relief or adding crew members to accommodate the higher tasking levels.

The use of shore-based maintenance support has received interest as a possible means of reducing the amount of maintenance required by the ship’s crew, thereby reducing the size of the crew. Three shipping companies were interviewed as to the types of shoreside maintenance support they currently receive, and what types of support they might contemplate in the future. Four levels of maintenance support were considered; under the lowest level, almost no shoreside assistance is received, while under the highest level, almost all the maintenance and repair tasks were assumed to be performed by shore-based personnel. It was found that for a vessel with a fully-attended engine room, watchkeeping operations far outweigh maintenance tasks as the driver of crew size.

CSEM indicated that the highest level of shoreside maintenance and repair did not reduce engine room crew complements.

In the final analysis, three work/rest standards were compared: OPA ’90, STCW, and ILO 180. When the work-hour limits of OPA ’90 are combined with either or both of the other two standards, it resulted in an increase in the number of times crew members exceeded the work-hour limits. However, combining the standards was not seen to reduce the work hours for the crew. This reflects the relatively large number of high priority tasks which cannot be delayed, and suggests that these tasks will be performed even when it results in crew members exceeding the work/rest standards.

It is important to note that CSEM and the analyses reported here make several assumptions about shipboard organization and procedures which may not match actual operations on every ship. The analyses reported here were based on operational and task data collected on three tankships. From these data we abstracted “typical” rules which the CSEM model uses to prioritize shipboard tasks, to assign crew to those tasks, and to manage crew work hours so as to avoid exceeding work-hour limits. To the extent that a given ship operates differently from these assumptions, the specific crew size that a vessel may need may differ from those shown in our analyses. However, the *trends* shown in the analyses (i.e., increasing or decreasing work hours as a function of a given operational factor) will be valid for all ships.

These analyses demonstrate the ability of CSEM to analyze the effects of different maritime operational factors and regulations on crew size and crew work hours. CSEM is a flexible and powerful tool which can be used to understand what crew types and what shipboard tasks are most affected by changes in operations. Thus, it can be used to educate the industry on the crew size implications of certain operations, and it can help to anticipate the effects of potential regulatory changes.

A related paper, “Simplified Crew Size Evaluation Method,” CG-D-13-00, explains how the full-scale analyses from CSEM can be packaged into simple lookup tables, yielding a quick and practical tool for crew size evaluation.