

U.S. Coast Guard Research and Development Center

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Report No.

RISK-BASED DECISION MAKING GUIDELINES

**Proof-of-Principle Demonstration of a Risk Change Analysis
Tool for Marine Events**



**FINAL REPORT
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16. Abstract Many ports and waterways host a number of non-routine and special marine events that temporarily change the risk profile for the port or waterway. This report documents the evaluation of the risk Change Analysis technique from the second edition of the Risk-based Decision-making (RBDM) Guidelines for characterizing the risks associated with approving and controlling marine events. The new RBDM Guidelines are part of an ongoing research and development project to support the U.S. Coast Guard Office of Design & Engineering Standards' (G-MSE) strategy of developing a risk toolbox for marine safety activities. Change Analysis has been employed in many industries for both identifying and proactively managing risks (risk analysis), as well as for investigating contributing factors to mishaps/losses (root cause analysis). A hypothesized marine event was selected to be similar to the OPSAIL 2000 event that may occur at the Port of Baltimore during the summer of 2000. Based on the R&D proof-of-principle test, recent application to a powerboat race, and the upcoming OPSAIL 2000 marine event, Coast Guard Activities Baltimore concluded that the Change Analysis process provides an efficient and effective structure for applying risk-based decision-making to the planning and control of these marine events. The new process provides a more systematic approach that facilitates putting stakeholders into a structure, better focus on what can go wrong, i.e., looks at all of the possible mishaps that could occur in a marine event, and results in better educated marine event stakeholders and sponsors. The results of this test can serve as a model for performing other types of marine event risk Change Analysis.			
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EXECUTIVE SUMMARY

A wide variety of commercial operations and unorganized recreational activities occur regularly in ports and along waterways throughout the country. These regularly occurring activities are part of routine operations that organizations like the U.S. Coast Guard (as well as port authorities, other agencies, and industry) monitor and study to identify and manage risks effectively. However, many ports and waterways also host a number of special marine events that temporarily change the risk profile for the port or waterway. This requires a Coast Guard decision-making activity that can be classified as a non-routine, special study for approving and controlling marine events. This report documents the use of the risk Change Analysis technique from the 2nd edition of the Risk-based Decision-making (RBDM) Guidelines for characterizing the risks associated with approving and controlling marine events. The new RBDM Guidelines are part of a project to support the Office of Design & Engineering Standards' (G-MSE) strategy of developing a risk toolbox for marine safety field activities. The Change Analysis technique systematically looks for possible risk impacts and the appropriate risk management strategies for situations where change is occurring.

In this work an analysis of a hypothesized marine event was performed. The event was selected to be similar to the OPSAIL 2000 event that will occur at the Port of Baltimore during the summer of 2000. To streamline this demonstration project, the team spent little time actually collecting statistical data to support its risk characterization estimates. In a more formal analysis, the team would seek supporting information from the available data sources (e.g., numbers and types of mishaps associated with similar events in this and other ports, as well as examples of successful and unsuccessful prevention/surveillance/response activities from the past).

If this test were an analysis of the actual marine event, the risk level associated with the marine event would be considered relatively high compared to normal port operations. The analysis also produced a number of practical risk control tactics that should be considered by the captain of the port (COTP). Many of the risk control tactics focused on prevention actions that the Coast Guard may require/facilitate rather than just "policing" of the event.

Although ACTBALT staff were only initially exposed to the Change Analysis technique during the R&D proof-of-principle test, they gained additional hands-on experience with the technique in applying it to a powerboat race and to additional OPSAIL 2000 analysis.

ACTBALT staff concluded that the Change Analysis process provides an efficient and effective structure for applying risk-based decision-making to the planning and control of these types of marine events. The new process provides a more systematic approach that facilitates stakeholder involvement. It results in better-educated marine event stakeholders and sponsors. Most importantly, it provides better focus on what can go wrong, i.e., looks at all of the possible mishaps that could occur in a marine event. The risk Change Analysis is a practical tool that Coast Guard personnel with modest risk assessment expertise could implement.

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1.0 INTRODUCTION

A wide variety of commercial operations and unorganized recreational activities occur regularly in ports and along waterways throughout the country. These regularly occurring activities are part of routine operations that organizations like the U.S. Coast Guard (as well as port authorities, other agencies, and industrial organizations) monitor and study to identify and manage risks effectively. However, many ports and waterways also host a number of special marine events that temporarily change the risk profile for the port or waterway.

A marine event is an organized water event of limited duration that is conducted according to a prearranged schedule (33 CFR Part 100). The Chief Counsel of the Coast Guard has determined that this definition includes any such occurrence on, in, above, or below the water. Examples of marine events that are common include boat parades/races, air shows, swimming events, and fireworks displays. These marine events are regulated by the Coast Guard (according to the regulations set forth in 33 CFR Part 100) and potentially by a number of other agencies, depending on the nature of the event and jurisdictional authorities (local fire marshals, environmental regulators, state boating regulators, etc.).

Stakeholders, including the Coast Guard, must understand, prioritize, and manage the risks associated with these marine events. Of course, the stakeholders must consider both the risks posed by the marine events and the benefits that these events provide to the local communities. At the heart of their decision-making process is the need for a thorough understanding of the unique risks associated with individual marine events and the options available for best managing those risks.

The COTP Baltimore zone has experienced a steady rise in scheduled marine events, regattas, etc. over the years. This trend is expected to continue considering the Port of Baltimore's proximity to the nation's capitol and historic importance. ACTBALT has gone through the decision-making activity of approving and evaluating many marine events over the years using a process prescribed by regulations.

This report documents the use of one risk analysis tool for 1) characterizing the risks associated with a particular marine event and 2) suggesting both prevention and surveillance actions to most appropriately manage the risks. Specifically, representatives from the R&D Center, Coast Guard's Activities Baltimore (ACTBALT), and American Bureau of Shipping (ABS) Group Inc. Risk & Reliability Division teamed to perform an analysis of a hypothesized marine event. This hypothesized marine event was selected to be similar to the OPSAIL 2000 event that may occur at the Port of Baltimore during the summer of 2000. The team made a number of assumptions about the specifics of the marine event, which were hypothesized to demonstrate the analysis approach under a project sponsored by the U.S. Coast Guard's Research and Development Center.

2.0 OBJECTIVES

The objectives for this proof-of-principle demonstration of the Change Analysis tool were:

- To evaluate the applicability and effectiveness of the risk Change Analysis tool for a particular type of commercial marine safety and environmental protection decision-making activity (i.e., approving and controlling marine events).
- To generate results that will 1) serve as a model for subsequent analyses involving ACTBALT and 2) provide a worked-out example for inclusion in the 2nd edition of the Risk-based Decision-making Guidelines.

3.0 APPROACH

As stated previously, marine events are short-duration events that cause a temporary, but sometimes substantial, change in the risk profile for a port or waterway. Many risk analysis tools could potentially provide valuable information for managing the risks of such events, but which would be most appropriate for this type of issue?

A traditional Change Analysis methodology was chosen as a potential candidate to be employed for non-routine decision-making activities that have had little loss exposure experience. Change Analysis has been used successfully in many industries for both identifying and managing risks proactively (risk analysis), as well as for investigating contributing factors to mishaps/losses (root cause analysis). Change Analysis is built on the following four steps:

- 1.0 Define the situation of interest (i.e., the marine event for this application).
- 2.0 Define a comparable, well-understood situation (i.e., normal port operations for this application).
- 3.0 Determine all of the differences between the two situations (regardless of their presumed significance).
- 4.0 Evaluate each of the identified differences to determine their risk significance (and make recommendations for managing the associated risks).

The Change Analysis methodology was chosen as the basis for analyzing the risk of marine events because of the following.

- Change Analysis systematically explores all of the changes from normal operations that may introduce significant risks because of the marine event.
- Change Analysis is practical to implement in a reasonable amount of time, recognizing that any important issues could always be explained in more detail with other analysis tools.
- Change Analysis complements the Preliminary Risk Analysis (PrRA) performed for the port by focusing on the temporary change in the port's risk profile because of the marine event. (The PrRA is a high-level mishap-based screening tool that was used to assess risk levels across ACTBALT port activities. The PrRA risk tool underwent a proof-of-principle

demonstration in the same time frame as the Change Analysis evaluation and was reported on separately.)

- Change Analysis is a conceptually simple tool that closely models how Coast Guard personnel informally think about controlling the risks associated with marine events.

Because of the research and development nature of this project, and the fact that little was known about the specifics of the OPSAIL 2000 event in the Port of Baltimore, the team focused on testing the applicability of the risk analysis methodology, rather than crafting a highly refined analysis. The team performed only a representative portion of an overall analysis that could be performed for this type of marine event. Also, to streamline the demonstration project, the team spent little time actually collecting statistical data to support its risk characterization estimates. Of course, in a more formal analysis, the team would seek supporting information from the available data sources (e.g., numbers and types of mishaps associated with similar events in this and other ports, as well as examples of successful and unsuccessful prevention/surveillance/response activities from the past). Table 1 lists the members of the analysis team.

Table 1. Members of the Analysis Team.

Team Member	Organization/Title
CWO Ron Houck	ACTBALT Marine Event Coordinator
Fred Burnham	Coast Guard Auxiliary ADSO-OP/NA
SCPD Danny Daniel	USCG Station Curtis Bay - Officer in Charge
Jeff Patrick	Coast Guard Auxiliary SO-OP19
LT Todd Offutt ¹	ACTBALT
Brooke Schaab ¹	RDC Research Scientist
Bert Macesker ¹	RDC COTR
David Walker ²	ABS Group Senior Engineer

¹ Part-time team member

² Team leader

The team performed this analysis using the following five steps:

Step 1 - Define the marine event of interest;

Step 2 - Establish the key differences between the marine event and normal port activities;

Step 3 - Evaluate the possible effects and recommend risk control strategies for each key difference;

Step 4 - Characterize the risk profile for the marine event;

Step 5 - Summarize and document the results.

The first three steps of this approach are consistent with the traditional use of change analysis; however, steps 4 and 5 are unique to this application and are interrelated to the port's overall risk profile. The remainder of this section of the report describes each of these steps in more detail.

Step 1 - Define the Marine Event of Interest

Before any analysis can begin, the subject of the analysis must be clearly defined. For this project, the analysis team hypothesized OPSAIL 2000 activities in the Port of Baltimore to involve a number of separate marine events that should be considered individually. Table 2 lists some of the individual marine events that are likely to be associated with OPSAIL 2000 in the Port of Baltimore.

For the purposes of this project, the analysis team selected only one of these events for analysis: *mass arrival of tall ships and their entourage*. The team further described the mass arrival of tall ships and their entourage as it considered the key differences between this marine event and normal port activities (see Step 2).

Table 2. Separate Marine Events Likely to be Associated with OPSAIL 2000 in Baltimore.

Mass arrival of tall ships and their entourage
Arrival/departure of individual ships associated with the event
Vessel parades during port stay
Shore-side festivities during stay of tall ships and their entourage (each treated as a separate marine event) • Tours of vessels • Fireworks • Races of smaller vessels • Etc.
Mass departure of tall ships and their entourage

Step 2 - Establish the Key Differences Between the Marine Event and Normal Port Activities

After defining the topic of the analysis, the team participated in a brainstorming session to identify all of the notable differences in port activities that this marine event would create. To create a more realistic analysis, the team made a number of assumptions about the OPSAIL 2000 event, and how other port activities would be affected. The team also recognized that participation in the analysis by other stakeholders (OPSAIL 2000 organizers, representatives from the Port of Baltimore, representatives from industry, and other official agencies) would improve the results of the brainstorming effort. Table 3 lists the key differences that the team identified; including some related assumptions that make the analysis more realistic.

Table 3. Key Differences Between Normal Port Activities and the Mass Arrival of Tall Ships and their Entourage.

1. Arrival of tall ships and their entourage in the port • Transit up river beginning at approximately 7:00 a.m. on a Saturday in June • Vessel parade from approximately 9:00 a.m. to approximately 6:00 p.m. through port • Moor at inner harbor, at piers along the river, and at anchorage sites along the river from approximately 6:00 p.m. to approximately 9:00 p.m.
2. Large increase in tug traffic, assisting tall ships and their entourage
3. Large increase in recreational vessel traffic (all types of vessels and crew skills expected) • On river • At inner harbor • Entering/exiting marinas and commercial establishments
4. Large increase in passenger vessel traffic • Tours • Taxis • VIP launches
5. Increase in official vessel traffic • Coast Guard vessels • Port police • Firefighting and other emergency response vessels
6. Increase in aviation activities over the river and port • Television helicopters • Security surveillance • Emergency response helicopters • Civilian aircraft
7. Masses of people along the shore • Accessible locations up river of the key bridge • Throughout the harbor
8. Traffic congestion in areas around the port (roadways entering/leaving primary event sites)
9. More fueling operations throughout the port (at marinas and through barge transfers)
10. Presence of temporary floating piers (uncharted and difficult to see at night) around the port
11. Major event with high profile visitors and international participation, publicity, and media coverage

Step 3 - Evaluate the Possible Effects and Recommend Risk Control Strategies for Each Key Difference

Each of the differences identified in Step 2 may create situations that pose substantial risks. The third step of the analysis process further investigates each of the differences in the following manner:

1.0 Describe all of the possible effects that the difference could have on any aspect of normal port operations. The team noted any discernable effects (risk factors) that the

difference could have, such as the level of vessel traffic congestion, impacts on industrial activities, communication difficulties, etc.

2.0 Recommend specific risk control strategies that may be warranted to manage the risks of potentially adverse effects that are identified. Based on the team's understanding of risk factors identified, the team discussed what types of prevention requirements and surveillance actions the Coast Guard should consider to most appropriately manage the risks. (Note that the team focused on requirements and surveillance actions that the Coast Guard could impose/implement; the recommendations would have been broader if other stakeholders had been involved.)

At the end of this step, the analysis team had completed the key elements of traditional Change Analysis applications. (A summary of the analysis team's discussions is referenced in the Results section and documented in Appendix A of this report.) With this qualitative information, effective risk management decisions could be made; however, no risk characterizations are available to prioritize the areas of risk, or to quantify the risk levels.

Step 4 - Characterize the Risk Profile for the Marine Event

The analysis team developed risk characterizations for a selected number of mishaps whose risk might be influenced significantly by the marine event. The analysis team used mishap descriptions consistent with the hierarchical structure that was defined with ACTBALT as a basis for assessing port-wide risks. This correlation integrates this analysis with the port-wide risk profile so that the risk of this marine event can be evaluated in the context of other risks in the Port of Baltimore. This correlation also promotes more consistency in discussions about risks and risk characterizations across the port. (To streamline this demonstration analysis, not all mishaps that were related to the marine event were evaluated.) For example, the increased vessel traffic during OPSAIL 2000 might significantly affect the risk of collisions/groundings involving cargo transportation vessels; thus, the risks of those types of events in the overall port risk profile would temporarily increase during the marine event. The analysis team developed each risk characterization as follows:

1. The team estimated the likelihood that the mishap would occur and result in a major impact, referred to as Severity Category 1. (See the criteria for this severity category in Table 4.)
2. The team estimated the likelihood that the mishap would occur and result in a less severe impact, referred to as Severity Category 2. (See the criteria for this severity category in Table 4.)
3. The team estimated the likelihood that the mishap would occur and result in an even less severe impact, referred to as Severity Category 3. (See the criteria for this severity category in Table 4.)
4. The team members documented their level of certainty (or confidence) in their estimates as High, Medium, or Low.

Table 4. Criteria for the Consequence Severity Categories.¹

Consequence Severity Category	Safety Impact	Environmental Impact	Economic Impact	Mission Impact
1	One or more deaths or permanent disability	Releases that result in long-term disruption of the ecosystem or long-term exposure to chronic health risks	> \$3M	> \$3M
2	Injury that requires hospitalization or lost work days	Releases that result in short-term disruption of the ecosystem	>\$10K and <\$3M	>\$10K and <\$3M
3	Injury that requires first aid	Pollution with minimal acute environmental or public health impact	> \$100 and <\$10K	> \$100 and <\$10K

¹ The consequence severity categories were developed as part of the proof-of-principle demonstration of the Preliminary Risk Analysis of operations at the Port of Baltimore.

Instead of trying to describe the likelihood of the losses described above with specific point estimates (i.e., numerical probabilities), the team selected an appropriate Frequency Category number from the scale presented in Figure 1.

Frequency Scoring Categories

Frequency Score Descriptions	Frequency Scores (with indicated frequency bounds)	Odds of the Event Occurring in Any 1 Day
Continuous	8 100/y	← 1 in 4
Very Frequent	7 10/y	← 1 in 40
Frequent	6 1/y	← 1 in 400
Occasional	5 0.1/y	← 1 in 4,000
Probable	4 $1 \times 10^{-2}/y$	← 1 in 40,000
Improbable	3 $1 \times 10^{-3}/y$	← 1 in 400,000
Rare	2 $1 \times 10^{-4}/y$	← 1 in 4,000,000
Remote	1 $1 \times 10^{-5}/y$	← 1 in 40,000,000
Incredible	0	

Figure 1. Simplified Frequency Scoring Chart.

Thus, for each mishap evaluated, the analysis team selected three frequency category numbers (i.e., one for each consequence severity category) as well as a confidence level in their estimates.

The frequency category estimates for each consequence severity category provide perspective about the level of risk that each potential mishap poses during the marine event. These estimates may be mathematically combined into one metric, called a risk index number (RIN) that describes the total risk for the mishap in one number. The derivation of RIN can be found in the Coast Guard's *Integrated Risk Assessment [IRA] User's Manual*. This RIN is calculated using the following equation:

$$RIN_{Annual} = \frac{16.5 \times 10^{\text{FrequencyScore for SeverityCategory1}} + 0.165 \times 10^{\text{FrequencyScore for SeverityCategory2}} + 0.00165 \times 10^{\text{FrequencyScore for SeverityCategory3}}}{10,000}$$

By using the midpoint values of each frequency and severity category, the RIN can be correlated to an annualized loss rate. Using this approach with the categories described in Table 4 and Figure 1, one unit of the RIN is approximately equal to \$10,000 of loss per year (i.e., a RIN of 1.6 reflects a loss potential of \$16,000 per year). Of course, the marine event does not create a loss exposure throughout the year, so the annualized loss rate must be adjusted for the duration of the loss exposure (e.g., the expected loss during a 1-day marine event would be only 1/365 of the expected annualized loss rate). The risk index number is a valuable tool for both prioritizing potential mishaps according to their loss potential and understanding the magnitude of expected loss during a marine event. The RINs (adjusted for only 1 day of loss exposure) were calculated for each of the mishaps evaluated during this step of the analysis.

In this proof-of-principle demonstration the analysis team members did not spend time investigating data sources that were not readily available to support their estimates. In a more formal analysis, all of the relevant data sources would be consulted. (A summary of the analysis

team's risk characterization estimates is referenced in the Results section and documented in Appendix B of this report.)

Step 5 - Summarize and Document the Results

The risk characterizations were summarized into: 1) a risk matrix providing a risk profile for the hypothesized marine event; 2) listings of the most significant risk contributors during the marine event; and 3) a summary table portraying the number of events expected in each consequence severity category during the marine event. (All of these results are based on the partial analysis performed for this demonstration project.)

4.0 RESULTS

Appendix A documents the results of the qualitative portion of the Change Analysis for the marine event. Separate columns in the table list the following:

- Differences from normal port activities
- Potential effects on port activities
- Recommended risk control strategies (both prevention requirements and surveillance actions)

The information in the table is based on the ideas generated by the team of Coast Guard personnel participating in the analysis. Consequently, the team addressed only issues related to Coast Guard jurisdictional authority and influence. If other stakeholders had been involved, the scope of the analysis would have been broader.

Appendix B documents the risk characterizations for potential mishaps whose risk could be affected by the marine event. The mishaps are described in three parts: 1) the general types of activity affected presented in bold; 2) a more specific subdivision of the general activity

presented in italics; and 3) the specific type of mishaps that may occur with this activity presented in standard font. Separate columns in the table list the following:

- Specific mishaps of interest from the port-wide risk assessment.
- Differences from normal port activities affecting the risk of the mishap.
- Frequency category estimates for the mishap during the marine event (with separate frequency category estimates listed for each severity category).
- A RIN (adjusted for 1 day of loss exposure) for each mishap *that reflects the loss exposure* during the marine event.
- The certainty that the team members had in their frequency category estimates.

The team did not query all of the data sources that would normally be incorporated in an actual analysis. Thus, some refinement of risk estimates would produce more certain results.

Figure 2 summarizes the risk characterizations for the various mishaps into a risk matrix for the marine event. The numbers in the cells indicate the number of potential mishaps having a specific combination of frequency and consequence score (e.g., the team estimated that three potential mishaps have a frequency of occurrence category of 5 resulting in a consequence severity category of 1). The cells toward the upper-left side of the matrix pose greater risks than those toward the lower-right side. The shading in the matrix distinguishes three different levels of risk: Priority 1 (no shading), Priority 2 (light shading), and Priority 3 (heavy shading). The shading does not imply acceptability of the lower priority risk, but rather focuses attention on the highest risks first. The priority thresholds for any risk matrix should be formally acknowledged or agreed upon by the unit decision-makers.

Table 5 provides a listing of the potential mishaps that the team estimated to contribute to 95% of the overall risk associated with the marine event based on the partial analysis performed

for the event. The mishaps are listed in order of decreasing RINs. For each mishap, the individual mishap's RIN and the cumulative percentage of overall risk are presented.

Frequency Categories	8			10
	7		3	3
	6	1	4	8
	5	3	12	4
	4	6	6	
	3	12	1	
	2	4		
	1			
	0			1
		1	2	3

Consequence Severity Categories

Priority 1 risks (no shading): See items 1, 2, 3, 11, and 21 in Appendix B

Priority 2 risks (light shading): See items 4, 5, 6, 7, 8, 12, 14, 26, 27, 28, 32, 35, 37, 38, 39, 40, 41, 43, and 47 in Appendix B

Figure 2. Marine Event Risk Matrix.

Table 5. Highest Risk Mishaps.

Potential Mishap	Reference Number in Appendix B	Event-related Risk Index Number	Percentage of Cumulative Risk for the Event
Recreational <i>Organized - Permitted Marine Event</i> Collision with a fixed object	3	5.02	60.7%
Recreational <i>Organized - Permitted Marine Event</i> Acute hazard exposure: passenger/crew	11	0.949	11.5%
Recreational <i>Organized - Permitted Marine Event</i> Capsizing	1	0.542	6.6%
Recreational <i>Organized - Permitted Marine Event</i> Collision with another vessel	2	0.542	6.6%
Cargo Transportation <i>All Types of Vessels</i> Loss of commerce	21	0.542	6.6%
Recreational <i>Organized - Permitted Marine Event</i> Fire/explosion	7	0.136	1.6%
Recreational <i>Organized - Permitted Marine Event</i> Collision with a floating object	4	0.095	1.1%
Recreational <i>Organized - Permitted Marine Event</i> Environmental impact	12	0.091	1.1%
Others	—	0.35	4.2%
Total	—	8.267	100%

Figure 3 prioritizes the types of port activities according to the greatest loss exposures in association with the marine event. The percentages in the graph are percentages of the cumulative RIN across all potential mishaps (based on the partial analysis performed in this proof-of-principle project).

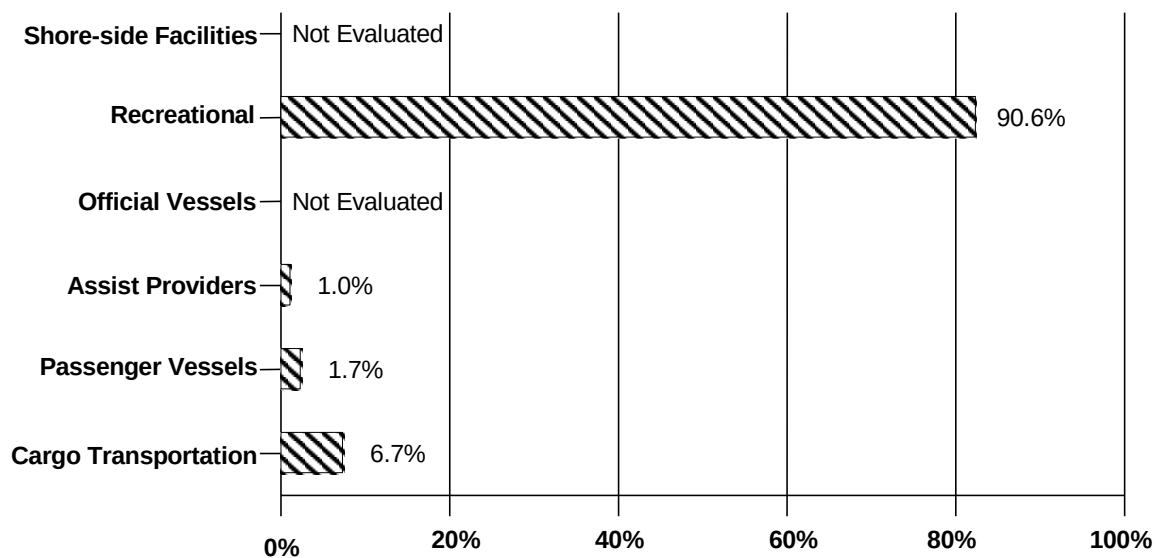


Figure 3. Risk Contributions for the Marine Event Listed by Major Port Activities.

Figure 4 prioritizes the types of mishaps according to the greatest loss exposures in association with the marine event. The percentages in the graph are percentages of the cumulative RIN across all potential mishaps (based on the partial analysis performed in this demonstration project).

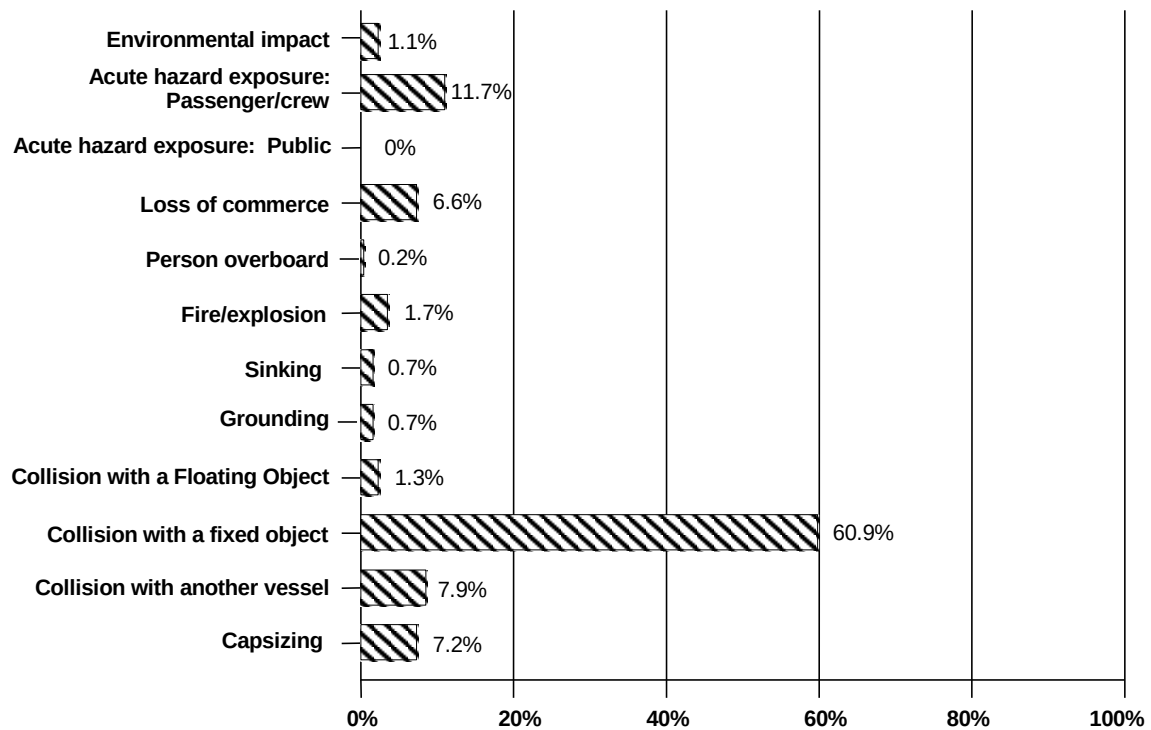


Figure 4. Risk Contributions for the Marine Event Listed by Types of Mishaps.

Table 6 provides a broader look at the risks associated with the marine event. This table presents the estimated number of mishaps associated with the value of losses that may occur during the marine event. Table 6 presents the odds of occurrence if the estimated number is less than 1. The ranges of the numbers come from considering the upper and lower bounds of the categories used to characterize risks. Although there is significant uncertainty in the estimates, Table 6 presents a reasonably clear picture of the losses expected during the marine event.

Table 6. Mishap Estimates for the Marine Event.

	Consequence Severity Category 1 Mishaps	Consequence Severity Category 2 Mishaps	Consequence Severity Category 3 Mishaps	All Mishaps
Expected Number of Mishaps¹	~ 0.4% to 4% chance of occurrence	~ 10% to 97% chance of occurrence	3 to 10	3 to 11
Expected Loss Exposure²	\$11,000 to \$113,000	\$3,000 to \$30,000	\$1,000 to \$3,000	\$15,000 to \$146,000

¹ Based on the assumption that the upper boundary for frequency category 8 would be 300 times per year.

² Based on the assumption that the average cost of losses are as follows:

Severity Category 1 — \$3,000,000;

Severity Category 2 — \$30,000;

Severity Category 3 — \$300

5.0 OBSERVATIONS ON THE PARTIAL ANALYSIS OF OPSAIL 2000

If this project were an analysis of an actual marine event, the following observations could be made:

- The risk associated with the marine event is relatively high compared to normal port operations.
- The loss exposure for the marine event includes losses related to safety/health, the environment, property damage, and interruption of commerce.
- During this hypothetical marine event it will be the recreational boaters that experience the greatest loss exposure.
- If the marine event is allowed to occur, the Captain of the Port (COTP) should expect several Category 3 mishaps and probably at least one Category 2 mishap. Furthermore, a Category 1 mishap is not out of the realm of possibility.

- A number of practical risk control tactics are available and should be considered by the COTP. Many of the risk control tactics focus on prevention actions that the Coast Guard may require/facilitate rather than just “policing” the event.
- Significant effort should be focused on recreational vessels (in particular, collision/capsizing risks and safety/health risks aboard recreational vessels) because these potential mishaps contribute most of overall risk for the marine event.
- The expected loss of commerce for cargo transportation through the port is relatively low (estimated at approximately \$5,400) because of assumptions about how the event would be conducted. If these assumptions prove true, the increase in commerce for the port activities “assist providers” and “passenger vessels” would more than offset the estimated loss for cargo transportation. (Even though loss of commerce does not appear to be a significant problem for this one marine event, if many similar events were to occur frequently, the cumulative effect may be a significant problem, or at least a headache for the industry.)
- Participation in the analysis by event organizers and other stakeholders within the port would have generated more specific recommendations for controlling the risks most effectively.
- A “What-if” analysis of some of the events considered in this Change Analysis would provide an excellent basis for developing integrated plans for coordinated prevention/response among the various jurisdictional authorities overseeing the marine event. Appendix C provides a sample page demonstrating how this type of analysis might look.

6.0 RISK-BASED DECISION-MAKING PROCESS IMPROVEMENT EVALUATION

The following evaluation of process improvement is based on an ACTBALT follow-up visit by the R&D Center several months after the proof-of-principle test and after some ACTBALT staff had an opportunity to apply this technique to real port situations.

6.1 PROCESS DESCRIPTION

A marine event is an organized water event of limited duration, which is conducted according to a prearranged schedule. The Coast Guard decision-making activity can be generally classified as a non-routine, special study for approving and controlling marine events. The decision-making process for marine events is based on requirements set forth in 33 CFR Part 100. There may be additional other agency regulation depending on the nature of the event. The Coast Guard asks sponsors of the marine event to meet these requirements, often by providing them a list of what they should do. Stakeholders meet and submit their ideas and issues. The group addresses each issue in an ad hoc structure to meet marine event goals. Issues addressed first would often depend on who was presenting them.

6.2 DECISION VALUE

Subjecting stakeholders and Coast Guard staff through the change analysis has allowed the Coast Guard to increase the risk awareness of responsible parties. In the past, the process relied on the individual experience and persuasion brought to the table for discussion. The risk change analysis has given the Coast Guard a system and structure that helps stakeholders' better focus on what can go wrong. ACTBALT staff felt that more relevant decision information is generated with the new process. They felt that there was better decision acceptance by ACTBALT management and external stakeholders because 1) a formal structured process, developed by risk professionals, was followed and 2) it included stakeholders in the process from the very beginning.

ACTBALT personnel did not feel that the marine event issue was overworked by adding the additional step of a risk change analysis. On the contrary, they felt that it made the stakeholder discussions more efficient and effective. In other words, the change analysis helped facilitate these discussions.

It was felt that the outcome of the new approach was an improvement in the decision-making process because 1) a more systematic approach was used that put stakeholders into a structure and 2) all the possible mishaps that could occur in a marine event were discussed.

6.3 IMPACT ON USE

By going through the new process, ACTBALT staff felt that there were improvements in creative thinking, which resulted in more risk control alternatives. The risk change analysis approach employed by ACTBALT staff was strictly qualitative. The tool was very simple to use from a subjective approach. No training was needed. They primarily used subject matter experts and did not attempt to quantify risk levels as in the R&D proof-of-principle test. However, if they were going to quantify risk they felt that they would have needed some training.

They found that it was not difficult to gather stakeholders for the analysis. There were often more volunteers than they needed, especially for a visible event like OPSAIL2000. Therefore, they would gather essential subject matter experts and tried to keep the analysis group to a manageable size.

ACTBALT had another opportunity to apply the Change Analysis since the R&D proof-of-principle test. ACTBALT applied this to a recent powerboat marine event in their zone. In using this technique, they felt that they had come up with a much better approach to regulating the navigation area. They had a sense that risk levels were improved but this was not quantified. They saw a big payoff in that the marine event stakeholders were better educated by going through the new process.

They believe that there would be an increase in cycle time if they tried to quantify the analysis as in the R&D proof-of principle test. However, they recognized the value in quantifying risk in future marine events. ACTBALT expects to have a steady increase in the number of marine events and knowing how the risk level of a particular marine event or type of marine event impacts port risk levels would be a further improvement in this decision-making activity.

7.0 RISK-BASED DECISION-MAKING GUIDELINES IMPLICATIONS

Risk analysis tools in the 2nd Edition of the RBDM Guidelines are generalized in three broad categories. They are hazard/risk-screening tools, broadly focused, detailed analysis tools, and narrowly focused, detailed analysis tools. The risk Change Analysis can be categorized as a “What-if” type of tool. It was applied to, at the time of this test, a hypothesized marine event in the Port of Baltimore and was used in the context of a broadly focused, detailed analysis tool. However, the Change Analysis is applicable to broad-spectrum decision-making activities and can provide the level of risk analysis resolution needed for most change issues. It is an approach that has been comparably used continuous process industries and to some degree in the Coast Guard. The Coast Guard most recently used the risk Change Analysis methodology to evaluate the risk impact on cutter crew size reductions in both the Paragon (WMEC-210) and Exemplar (WHEC-378) studies. Instruction of the risk Change Analysis technique and the Coast Guard RBDM activities that could benefit by its use is provided in the draft 2nd edition of the RBDM Guidelines.

Two other risk tools were tested at the same time as the risk Change Analysis and are reported separately. A preliminary risk analysis to establish a port-wide risk profile and a detailed analysis of lifeboat inspection and drills on deep draft foreign vessels. ACTBALT is planning on employing a port-wide risk analysis in the spring of 2000. Appendix D provides a hypothetical discussion on how the different risk tools analyzed as part of the ACTBALT proof-of-principle tests can be tied together to form a risk management strategy for a port. In the short term, ACTBALT staff does not feel they have much use for detailed risk assessments before performing a much-needed broad-brush look at port risks, activity costs, and areas where the COTP has influence.

8.0 CONCLUSIONS/OBSERVATIONS

Overall, the risk Change Analysis process employed for this application appears to be a valuable tool for addressing the risk impact marine events can have on a port. The process provides an efficient and effective structure for applying risk-based decision-making to the planning and control of these marine events. Of course, this level of analysis is most appropriate for non-routine marine events that are not well understood. For simpler types of events that occur frequently (annual fireworks displays, swimming event, etc.), this type of process could be performed once to serve as a model and then applied to the various events as they occur. Also, simpler events may not require as much (or any) risk characterization to support decision making. In those cases, applying only the qualitative aspects of Change Analysis may be warranted. The following are some general conclusions and observations from the evaluation of the risk Change Analysis for the activity of approving and controlling marine events.

- The risk Change Analysis improves the Coast Guard marine event decision-making process by providing a thorough understanding of the unique risks associated with individual marine events and the risk control options available for best managing those risks.
- The new process provides 1) a more systematic approach that facilitates structuring of stakeholder input, 2) better focus on what can go wrong, i.e., looks at all of the possible mishaps that could occur in a marine event, and 3) better educated marine event stakeholders and sponsors.
- The new process provides more creative risk control strategies, both in prevention and surveillance.
- ACTBALT staff were comfortable in applying qualitative aspects of the risk Change Analysis without any external training. Although, they see the RBDM value of quantifying risk in future marine events, e.g., knowing how the risk level of a particular marine event or type of marine event impacts port risk levels, they felt they might need some additional training to effectively employ this.

Based on the potential value-added observed with the application of the risk Change Analysis tool, a worked-out example was included in the draft 2nd edition of the Risk-based Decision-making guidelines.

Based on this proof-of-principle test and the other tests at ACTBALT, some general observations can be made:

- Activity-based cost models must correlate with risk models to demonstrate value added by Coast Guard prevention and response activities.
- Detailed risk analysis must be prudently selected to avoid overly complex analysis that provides marginal additional value to decision-makers.
- ACTBALT staff interviewed felt comfortable with the qualitative implementation of these techniques and their added value to existing decision-making processes.

Appendix A

Summary of the Change Analysis for the Hypothesized Marine Event

Change Analysis of Mass Arrival of Tall Ships and Their Entourage			
Differences from Normal Port Activities	Potential Effects on Port Activities	Recommended Risk Control Strategies	
		Prevention Requirements	Surveillance Actions
1. Arrival of tall ships and their entourage in the port	Commercial traffic flow affected Sufficient number of local pilots may not be available Potential for insufficient anchorage space Some impacts on commercial fishing downstream of the Key Bridge More congestion in waterway among event vessels Potential for insufficient amount of adequate pier space Potential for insufficient or incompatible shore facility support for event vessels Increased traffic on the radios	Work closely with the media to publicize event schedule (particular times/areas where waterway traffic may be impacted) Establish a liaison officer with commercial industry to plan schedules for minimizing commercial impact Establish specific radio frequencies to be used by different groups (a communications operations plan) Establish fixed zone along parade route (navigation channel and entire inner harbor area), possibly wider than channel (e.g., 200 ft), along channel Broadcast notice to mariners Require sponsor to place special markers along route (working with Coast Guard liaison to event)	Provide temporary vessel traffic management to coordinate commercial and event traffic (probably with zone beginning at the Key Bridge with check-in at the mouth of Patapsco and possibly other check-in points along the way) Establish command post(s) with event sponsor to coordinate surveillance activities with event activities Provide for additional Coast Guard support of auxiliary vessels More small spill prevention patrols

Change Analysis of Mass Arrival of Tall Ships and Their Entourage			
Differences from Normal Port Activities	Potential Effects on Port Activities	Recommended Risk Control Strategies	
		Prevention Requirements	Surveillance Actions
1. Arrival of tall ships and their entourage in the port (continued)		Designate emergency anchorage locations (possibly restricting some use of some existing anchorage space) Require a designated emergency tug in the inner harbor and one in the river (probably near the harbor) Include pilots association in planning meetings Consider designating anchorage spaces for event vessels for better control and support Have designated spectator anchorage spaces and mark them well Include event information in publications likely to reach fisherman	
2. Large increase in tug traffic, assisting tall ships and their entourage	Sufficient number of tugs may not be available for event and commercial vessels Increasing traffic density Increased radio traffic on Channel 13 (ship to ship) Potential increase in occupational injuries on tugs due to number of operations	Involve tug operators in the planning meetings Designate specific radio frequency for event boat mooring Require event sponsor to notify tug operators about unique vessels with tall ships	Make tugs participants in temporary vessel traffic system

Change Analysis of Mass Arrival of Tall Ships and Their Entourage			
Differences from Normal Port Activities	Potential Effects on Port Activities	Recommended Risk Control Strategies	
		Prevention Requirements	Surveillance Actions
3. Large increase in recreational vessel traffic	Increasing traffic density in conjunction with reduced transiting areas Increase in law enforcement actions Increase in SAR case load Increase in disabled vessels, tow boat activity, and salvage Increase in environmental issues (trash, sewage, spills, etc.) Increase in radio traffic on Channels 12, 16, and 22a Increase in ramp usage	Work closely with media to make public aware of (1) regulated areas and space availability and (2) Coast Guard safety points (DWI, communications, planning, etc.) Plan staging points for arrest transfers, vessel confiscation, and medical emergencies	Increase patrols along regulated areas (roving and stationary presence) Implement Incident Command System
4. Large increase in passenger vessel traffic	Increasing traffic density in conjunction with reduced transiting areas Fatigue issues may reduce performance (especially for smaller operators) Potential for overcrowding on vessels Increase in congestion in tour boat piers	Involve passenger vessel operators in planning meetings Focus on this event during upcoming annual inspections	Make the passenger vessels part of the temporary vessel traffic systems

Change Analysis of Mass Arrival of Tall Ships and Their Entourage			
Differences from Normal Port Activities	Potential Effects on Port Activities	Recommended Risk Control Strategies	
		Prevention Requirements	Surveillance Actions
5. Increase in official vessel traffic	Increasing traffic density in conjunction with reduced transiting areas Miscommunication among authorities Fatigue issues may reduce performance (especially for smaller operators) Insufficient support facilities Potential VIP security threats Reduction in event surveillance resources dedicated to VIP security details	Mark vessels as official vessels (sponsors, etc.) Plan for a floating support platform with shuttle service Include State Department and Secret Service in planning meeting, including definition of security zones Provide separate communications channel	Allocate resources for security details
6. Increase in aviation activities over the river and port	Potential for an air incident	Involve the Federal Aviation Administration in event planning	

Change Analysis of Mass Arrival of Tall Ships and Their Entourage			
Differences from Normal Port Activities	Potential Effects on Port Activities	Recommended Risk Control Strategies	
		Prevention Requirements	Surveillance Actions
7. Masses of people along the shore	Access to water-front facilities congested, possibly impeding commercial facilities and emergency response activities Potential for people to fall into the harbor or river Increase in routine slip, trip, and fall injuries Potential damage to shore facilities (including historic sites) from the masses of people Increased trash in river (and increase in trash boat traffic) Increased crime threats	Work closely with media to make the public aware of (1) regulated areas and space availability and (2) Coast Guard safety points (DWI, communications, planning, etc.) Plan staging points for arrest transfers, vessel confiscation, and medical emergencies	Normal police patrols
8. Traffic congestion in areas around the port	Access to water-front facilities congested, possibly impeding commercial facilities and emergency response activities Increased traffic incident threats	Work closely with media to make the public aware of (1) regulated areas and space availability and (2) Coast Guard safety points (DWI, communications, planning, etc.) Establish a liaison officer with commercial industry to plan schedules for minimizing commercial impact	

Change Analysis of Mass Arrival of Tall Ships and Their Entourage			
Differences from Normal Port Activities	Potential Effects on Port Activities	Recommended Risk Control Strategies	
		Prevention Requirements	Surveillance Actions
9. More marine fueling operations	Potential for fires and oil spills Potential for insufficient/delayed response resources	Pre-stage oil clean-up equipment at various areas throughout the port Use dedicated auxiliary boat for transport of response personnel Outreach to fueling stations about oil spill prevention during fueling	Increase patrols along regulated areas (roving and stationary presence)
10. Presence of temporary floating piers	Reduces navigable areas (not on charts/maps and not very visible)	Require lighting/markings for floating piers that extend near navigable areas	Have patrols watch for new floating piers (perhaps a designated tour a couple of days before the event)
11. Large multi-national event	Increased terrorist threat Potential for political or activist protests	Seek updated intelligence on expected threats/protests Involve FBI in planning meetings Review any situations that occurred at previous event sites (especially US sites)	Coordinate patrols with government anti-terrorism groups

Appendix B

Summary of Risk Characterizations for Potential Mishaps Affected by the Hypothesized Marine Event

Item	Related Mishaps from the Port-wide Risk Analysis	Differences from Normal Port Activities	Event-related Risk Estimates				
			Event-related Frequency Scores			Risk Index Number for Event	Score Certainty
			Severity Category 1	Severity Category 2	Severity Category 3		
1	Recreational <i>Organized - Permitted Marine Event</i> Capsizing	1. Arrival of tall ships and their entourage in the port 3. Large increase in recreational vessel traffic	5	6	8	0.542	M
2	Recreational <i>Organized - Permitted Marine Event</i> Collision with another vessel	1. Arrival of tall ships and their entourage in the port 2. Large increase in tug traffic, assisting tall ships and their entourage 3. Large increase in recreational vessel traffic 4. Large increase in passenger vessel traffic 5. Increase in official vessel traffic	5	6	8	0.542	H
3	Recreational <i>Organized - Permitted Marine Event</i> Collision with a fixed object	1. Arrival of tall ships and their entourage in the port 3. Large increase in recreational vessel traffic	6	7	8	5.02	H
4	Recreational <i>Organized - Permitted Marine Event</i> Collision with a floating object	1. Arrival of tall ships and their entourage in the port 3. Large increase in recreational vessel traffic 10. Presence of temporary floating piers	4	5	8	0.095	M

Item	Related Mishaps from the Port-wide Risk Analysis	Differences from Normal Port Activities	Event-related Risk Estimates				
			Event-related Frequency Scores			Risk Index Number for Event	Score Certainty
			Severity Category 1	Severity Category 2	Severity Category 3		
5	Recreational <i>Organized - Permitted Marine Event</i> Grounding	1. Arrival of tall ships and their entourage in the port 3. Large increase in recreational vessel traffic	3	5	8	0.054	H
6	Recreational <i>Organized - Permitted Marine Event</i> Sinking	1. Arrival of tall ships and their entourage in the port 3. Large increase in recreational vessel traffic	3	5	8	0.054	M
7	Recreational <i>Organized - Permitted Marine Event</i> Fire/explosion	1. Arrival of tall ships and their entourage in the port 3. Large increase in recreational vessel traffic 11. Large multinational event	4	6	8	0.136	M
8	Recreational <i>Organized - Permitted Marine Event</i> Person overboard	1. Arrival of tall ships and their entourage in the port 3. Large increase in recreational vessel traffic	3	5	7	0.014	M
9	Recreational <i>Organized - Permitted Marine Event</i> Loss of commerce		Not assessed because of minimal risk impact				
10	Recreational <i>Organized - Permitted Marine Event</i> Acute hazard exposure: public	1. Arrival of tall ships and their entourage in the port 3. Large increase in recreational vessel traffic	Not assessed because of minimal risk impact				
11	Recreational <i>Organized - Permitted Marine Event</i> Acute hazard exposure: passenger/crew	1. Arrival of tall ships and their entourage in the port 3. Large increase in recreational vessel traffic 11. Large multinational event	5	7	8	0.949	M

Item	Related Mishaps from the Port-wide Risk Analysis	Differences from Normal Port Activities	Event-related Risk Estimates				
			Event-related Frequency Scores			Risk Index Number for Event	Score Certainty
			Severity Category 1	Severity Category 2	Severity Category 3		
12	Recreational <i>Organized - Permitted Marine Event</i> Environmental impact	1. Arrival of tall ships and their entourage in the port 3. Large increase in recreational vessel traffic 9. More marine fueling operations	2	6	8	0.091	M
13	Cargo transportation <i>All types of vessels</i> Capsizing		Not assessed because of minimal risk impact				
14	Cargo transportation <i>All types of vessels</i> Collision with another vessel	1. Arrival of tall ships and their entourage in the port 2. Large increase in tug traffic, assisting tall ships and their entourage 3. Large increase in recreational vessel traffic 4. Large increase in passenger vessel traffic 5. Increase in official vessel traffic	3	5	5	0.009	M
15	Cargo transportation <i>All types of vessels</i> Collision with a fixed object		Not assessed because of minimal risk impact				
16	Cargo transportation <i>All types of vessels</i> Collision with a floating object	10. Presence of temporary floating piers	Not assessed because of minimal risk impact				
17	Cargo transportation <i>All types of vessels</i> Grounding		Not assessed because of minimal risk impact				
18	Cargo transportation <i>All types of vessels</i> Sinking		Not assessed because of minimal risk impact				
19	Cargo transportation <i>All types of vessels</i> Fire/explosion		Not assessed because of minimal risk impact				

Item	Related Mishaps from the Port-wide Risk Analysis	Differences from Normal Port Activities	Event-related Risk Estimates				
			Event-related Frequency Scores			Risk Index Number for Event	Score Certainty
			Severity Category 1	Severity Category 2	Severity Category 3		
20	Cargo transportation <i>All types of vessels</i> Person overboard		Not assessed because of minimal risk impact				
21	Cargo transportation <i>All types of vessels</i> Loss of commerce	1. Arrival of tall ships and their entourage in the port 2. Large increase in tug traffic, assisting tall ships and their entourage 3. Large increase in recreational vessel traffic 4. Large increase in passenger vessel traffic 5. Increase in official vessel traffic	4	7	8	0.542	M
22	Cargo transportation <i>All types of vessels</i> Acute hazard exposure: public		Not assessed because of minimal risk impact				
23	Cargo transportation <i>All types of vessels</i> Acute hazard exposure: passenger/crew		Not assessed because of minimal risk impact				
24	Cargo transportation <i>All types of vessels</i> Environmental impact		Not assessed because of minimal risk impact				
25	Assist providers <i>Tug/tow</i> Capsizing	2. Large increase in tug traffic, assisting tall ships and their entourage	Not assessed because of minimal risk impact				
26	Assist providers <i>Tug/tow</i> Collision with another vessel	1. Arrival of tall ships and their entourage in the port 2. Large increase in tug traffic, assisting tall ships and their entourage 3. Large increase in recreational vessel traffic 4. Large increase in passenger vessel traffic 5. Increase in official vessel traffic	4	5	6	0.050	M

Item	Related Mishaps from the Port-wide Risk Analysis	Differences from Normal Port Activities	Event-related Risk Estimates				
			Event-related Frequency Scores			Risk Index Number for Event	Score Certainty
			Severity Category 1	Severity Category 2	Severity Category 3		
27	Assist providers <i>Tug/tow</i> Collision with a fixed object	2. Large increase in tug traffic, assisting tall ships and their entourage	3	5	6	0.009	M
28	Assist providers <i>Tug/tow</i> Collision with a floating object	2. Large increase in tug traffic, assisting tall ships and their entourage 10. Presence of temporary floating piers	2	4	6	0.001	M
29	Assist providers <i>Tug/tow</i> Grounding	2. Large increase in tug traffic, assisting tall ships and their entourage	2	4	5	0.001	M
30	Assist providers <i>Tug/tow</i> Sinking	2. Large increase in tug traffic, assisting tall ships and their entourage	Not assessed because of minimal risk impact				
31	Assist providers <i>Tug/tow</i> Fire/explosion	2. Large increase in tug traffic, assisting tall ships and their entourage 11. Large multinational event	Not assessed because of minimal risk impact				
32	Assist providers <i>Tug/tow</i> Person overboard	2. Large increase in tug traffic, assisting tall ships and their entourage	3	4	6	0.005	M
33	Assist providers <i>Tug/tow</i> Loss of commerce	2. Large increase in tug traffic, assisting tall ships and their entourage	Not assessed because of minimal risk impact				
34	Assist providers <i>Tug/tow</i> Acute hazard exposure: public	2. Large increase in tug traffic, assisting tall ships and their entourage	Not assessed because of minimal risk impact				
35	Assist providers <i>Tug/tow</i> Acute hazard exposure: passengers/crew	2. Large increase in tug traffic, assisting tall ships and their entourage 11. Large multinational event	3	5	7	0.014	M

Item	Related Mishaps from the Port-wide Risk Analysis	Differences from Normal Port Activities	Event-related Risk Estimates				
			Event-related Frequency Scores			Risk Index Number for Event	Score Certainty
			Severity Category 1	Severity Category 2	Severity Category 3		
36	Assist providers <i>Tug/tow</i> Environmental impact	2. Large increase in tug traffic, assisting tall ships and their entourage 9. More marine fueling operations	Not assessed because of minimal risk impact				
37	Passenger vessels <i>All types of vessels</i> Capsizing	4. Large increase in passenger vessel traffic	4	5	0	0.050	M
38	Passenger vessels <i>All types of vessels</i> Collision with another vessel	1. Arrival of tall ships and their entourage in the port 2. Large increase in tug traffic, assisting tall ships and their entourage 3. Large increase in recreational vessel traffic 4. Large increase in passenger vessel traffic 5. Increase in official vessel traffic	4	5	6	0.050	M
39	Passenger vessels <i>All types of vessels</i> Collision with a fixed object	4. Large increase in passenger vessel traffic	3	5	6	0.009	M
40	Passenger vessels <i>All types of vessels</i> Collision with a floating object	4. Large increase in passenger vessel traffic 10. Presence of temporary floating piers	3	5	7	0.014	M
41	Passenger vessels <i>All types of vessels</i> Grounding	4. Large increase in passenger vessel traffic	3	4	6	0.005	M
42	Passenger vessels <i>All types of vessels</i> Sinking	4. Large increase in passenger vessel traffic	Not assessed because of minimal risk impact				
43	Passenger vessels <i>All types of vessels</i> Fire/explosion	4. Large increase in passenger vessel traffic 11. Large multinational event	3	4	5	0.005	M

Item	Related Mishaps from the Port-wide Risk Analysis	Differences from Normal Port Activities	Event-related Risk Estimates				
			Event-related Frequency Scores			Risk Index Number for Event	Score Certainty
			Severity Category 1	Severity Category 2	Severity Category 3		
44	Passenger vessels <i>All types of vessels</i> Person overboard	4. Large increase in passenger vessel traffic	2	3	5	0.001	M
45	Passenger vessels <i>All types of vessels</i> Loss of commerce	4. Large increase in passenger vessel traffic	Not assessed because of minimal risk impact				
46	Passenger vessels <i>All types of vessels</i> Acute hazard exposure: public	4. Large increase in passenger vessel traffic	Not assessed because of minimal risk impact				
47	Passenger vessels <i>All types of vessels</i> Acute hazard exposure: passenger/crew	4. Large increase in passenger vessel traffic 11. Large multinational event	3	4	6	0.005	M
48	Passenger vessels <i>All types of vessels</i> Environmental impact	4. Large increase in passenger vessel traffic 9. More marine fueling operations	Not assessed because of minimal risk impact				
49	Official vessels <i>All types of vessels</i> Capsizing	5. Increase in official vessel traffic	Not evaluated because of time/scope limitations				
50	Official vessels <i>All types of vessels</i> Collision with another vessel	1. Arrival of tall ships and their entourage in the port 2. Large increase in tug traffic, assisting tall ships and their entourage 3. Large increase in recreational vessel traffic 5. Increase in official vessel traffic	Not evaluated because of time/scope limitations				
51	Official vessels <i>All types of vessels</i> Collision with a fixed object	5. Increase in official vessel traffic	Not evaluated because of time/scope limitations				

Item	Related Mishaps from the Port-wide Risk Analysis	Differences from Normal Port Activities	Event-related Risk Estimates				
			Event-related Frequency Scores			Risk Index Number for Event	Score Certainty
			Severity Category 1	Severity Category 2	Severity Category 3		
52	Official vessels <i>All types of vessels</i> Collision with a floating object	5. Increase in official vessel traffic 10. Presence of temporary floating piers	Not evaluated because of time/scope limitations				
53	Official vessels <i>All types of vessels</i> Grounding	5. Increase in official vessel traffic	Not evaluated because of time/scope limitations				
54	Official vessels <i>All types of vessels</i> Sinking	5. Increase in official vessel traffic	Not evaluated because of time/scope limitations				
55	Official vessels <i>All types of vessels</i> Fire/explosion	5. Increase in official vessel traffic 11. Large multinational event	Not evaluated because of time/scope limitations				
56	Official vessels <i>All types of vessels</i> Person overboard	5. Increase in official vessel traffic	Not evaluated because of time/scope limitations				
57	Official vessels <i>All types of vessels</i> Loss of commerce	5. Increase in official vessel traffic	Not evaluated because of time/scope limitations				
58	Official vessels <i>All types of vessels</i> Acute hazard exposure; public	5. Increase in official vessel traffic	Not evaluated because of time/scope limitations				
59	Official vessels <i>All types of vessels</i> Acute hazard exposure: passenger/crew	5. Increase in official vessel traffic 11. Large multinational event	Not evaluated because of time/scope limitations				
60	Official vessels <i>All types of vessels</i> Environmental impact	5. Increase in official vessel traffic 9. More marine fueling operations	Not evaluated because of time/scope limitations				

Item	Related Mishaps from the Port-wide Risk Analysis	Differences from Normal Port Activities	Event-related Risk Estimates				
			Event-related Frequency Scores			Risk Index Number for Event	Score Certainty
			Severity Category 1	Severity Category 2	Severity Category 3		
61	Shore-side facilities All types Fire/explosion	3. Large increase in recreational vessel traffic 11. Large multinational event	Not evaluated because of time/scope limitations				
62	Shore-side facilities All types Person overboard	3. Large increase in recreational vessel traffic 7. Masses of people along the shore	Not evaluated because of time/scope limitations				
63	Shore-side facilities All types Loss of commerce	3. Large increase in recreational vessel traffic 7. Masses of people along the shore 8. Traffic congestion in areas around the port	Not evaluated because of time/scope limitations				
64	Shore-side facilities All types Acute hazard exposure: public	3. Large increase in recreational vessel traffic 7. Masses of people along the shore 8. Traffic congestion in areas around the port 11. Large multinational event	Not evaluated because of time/scope limitations				
65	Shore-side facilities All types Acute hazard exposure: workers	3. Large increase in recreational vessel traffic 5. Increase in official vessel traffic 8. Traffic congestion in areas around the port 11. Large multinational event	Not evaluated because of time/scope limitations				
66	Shore-side facilities All types Environmental impact	3. Large increase in recreational vessel traffic 7. Masses of people along the shore 8. Traffic congestion in areas around the port	Not evaluated because of time/scope limitations				

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Appendix C
Example Page of What-if Analysis That Could be Performed
to Address High Risk Issues in More Detail

1.1 What-if...	Response to Question	Prevention Requirements		Surveillance/Response Actions	
		Requirement	Responsible Organization	Action	Responsible Organization
1. A recreational boater collides with a temporary floating pier in the harbor at night	Potential for injury/fatality, property damage, and possibly an environmental impact. This situation would most likely result from a new floating pier not being appropriately marked/lit or from a tired/distracted/ impaired recreational boater. A night time event would complicate recognition of the event as well as search and rescue	Require lighting (when possible) or at least clear reflective markings on floating piers installed for the event • • •	Facility owners • • •	Have harbor patrols watch for new floating piers and inspect for the suggested prevention requirement Verify that designated transfer locations to shore-side emergency vehicles are well lit and accessible at night • •	Coast Guard and Port Authority Local ambulance service and Coast Guard • • •
2. Two recreational boaters collide in the harbor during the tall ship arrival parade	• • •	• • •	• •	• •	• •
• • •	• • •	• • •	• • •	• • •	• • •
7. A recreational boat moored in the harbor caught on fire	• • •	• • •	• • •	• • •	• •

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Appendix D

Tying the Tools Together

Coast Guard field unit managers can enhance their decision-making by performing risk assessments to better understand the general nature of risks in their area of responsibility. These risk assessments are often viewed as nonroutine activities to address some immediate decision-making activity. However, an enterprise-wide risk management strategy with ties to field unit business plans could be developed using a combination of risk tools. Although, the risk tool tests at ACTBALT were evaluated as separate partial applications and considered proof-of-principle, there is a common thread that can tie them together into a simple continuous improvement strategy. The three risk applications, documented in separate R&D Center reports, were a Preliminary Risk Analysis (PrRA) of the Port of Baltimore, a risk Change Analysis of a hypothesized marine event, and detailed hazard analysis of lifeboat inspection/drill activities on foreign-flagged deep draft vessels.

Pockets in the Coast Guard may have difficulty obtaining and defending resources for controlling risks because relative priorities of risks across the organization are not available to managers making these resource allocation decisions. A high-level technique like the PrRA can be used to provide some risk management standardization across field units and still be flexible enough to reflect a meaningful risk structure to the individual unit activity. The PrRA is a high-level, systematic, mishap-based, “What-if” type of technique that can generate a risk profile for selected and/or all activities in a port. It is a common approach used by other agencies and industry to characterize a wide range of diverse risks such as safety/health, environmental, property loss, and business interruption or mission loss.

The PrRA activity hierarchy was defined to be consistent with the ACTBALT activity cost hierarchy structure, as it was at the time of this study. By constructing a risk activity model in this way, direct links can be made to activity costs so that unit activities can be driven by well-defined risk priorities. Risk levels can be accounted for as well as the costs of the activities to manage these risks. A PrRA type of approach could support a strategy to provide both routine and strategic risk management information to a port. However, the port is indeed a dynamic

enterprise that will see changes and sometimes issues that require a more narrowly focused risk understanding.

A high-level risk profiling technique, combined with a risk Change Analysis of actual and proposed changes from routine port operations, present a powerful continuous risk capability for a port. The Change Analysis process was tested on a hypothesized marine event, OPSAIL 2000, to examine the potential loss exposure that might be introduced to the port. To illustrate this concept, a COTP might want to know how one significant marine event might affect the overall loss exposure to the port. Figure B.1 provides a side-by-side overview of some of the results from the partial PrRA and risk Change Analysis of a marine event performed at ACTBALT. Using the partial analysis information from the ACTBALT studies, the total risk to the port including the risk associated with the one-day marine event can be derived by,

$$\text{Risk}_{\text{total}} = \text{Risk}_{\text{port}} (364/365) + \text{Risk}_{\text{marine event}}$$

$$\text{Risk}_{\text{total}} = 2265 \text{ RIN } (364/365) + 8.3 \text{ RIN}$$

$$\text{Risk}_{\text{total}} = 2267 \text{ RIN } (\$22,670,000.00)$$

In this example, the ports loss exposure would only increase by about 0.1% with the approval of this one marine event. However, ten similar marine events in the same year would increase loss exposure by more than 3%, which might not be as tolerable to port stakeholders if it were presented to them in this way. On a different scale, the COTP might be concerned with mishaps associated with the presence of temporary floating piers in a marine event. Using the partial analysis information from the ACTBALT studies, the change in mishap risk can be derived by,

$$(\text{Mishap}_{\text{marine event RIN}} - \text{Mishap}_{\text{PrRA RIN}} (1/365)) / \text{Mishap}_{\text{PrRA RIN}}$$

In this example, there would be more than a 50% increase in loss exposure associated with a collision with a floating object compared to normal port risks with this mishap type. The COTP could make a risk informed choice about approving the use of temporary floating piers knowing how the relative risk levels have changed and having at his or her disposal a set of risk

control strategies generated from the Change Analysis, i.e., both prevention and surveillance options. In the spirit of continuous improvement, the PrRA could be updated with the risk levels determined in the Change Analysis if the activity is permitted.

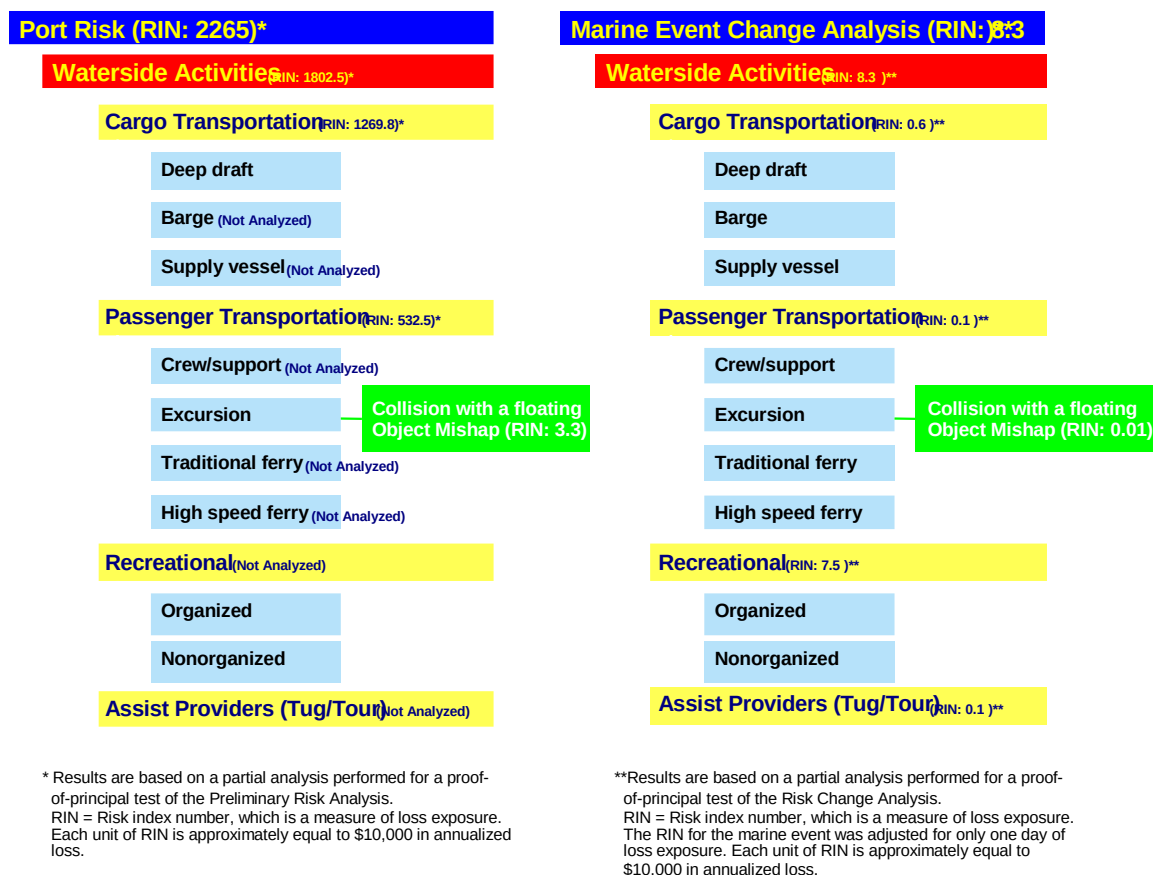


Figure B.1 Connection between Preliminary Risk Assessment and Change Analysis

Certainly, the Preliminary Risk Assessment represents a good first pass at assessing risk levels of port activities and will be sufficient for most port risk-based decision-making. However, there may be instances where more resolution is needed on an issue or particular activity, e.g., confidence in the mishap analyzed during the PrRA was low, a risk reduction recommendation could not be generated at the PrRA resolution level, or the mishap itself could not be well defined. In these instances, a narrowly focused detailed analysis may be needed to develop a better risk model/ improve the detail of information. The proof-of-principle detailed

hazard analysis of lifeboat inspection/drill activities on foreign-flagged deep draft vessels at ACTBALT could have been an instance where there was low certainty in evaluating the *Acute hazard exposure: workers* mishap associated with the **Waterside/Cargo Transportation/Deep Draft/ All Package Forms/All Contents** activity analyzed in the PrRA. The low certainty could have been due to a question about the specific kinds of hazards and risks associated with lifeboat inspection and drill activities. The two methods used in the ACTBALT detailed risk study were the:

- Worker and Instruction Safety Evaluation (WISE) review
- Human error (error-likely situation) review

These tools facilitated a more structured look at risks to ship personnel in performing these activities. The results provided a better understanding of these hazards and risks that could have been used to refine their frequency and severity estimates in the PrRA model. It also generated risk reduction recommendations that probably would not have been identified without the detailed analysis. Figure B.2 illustrates this connection.

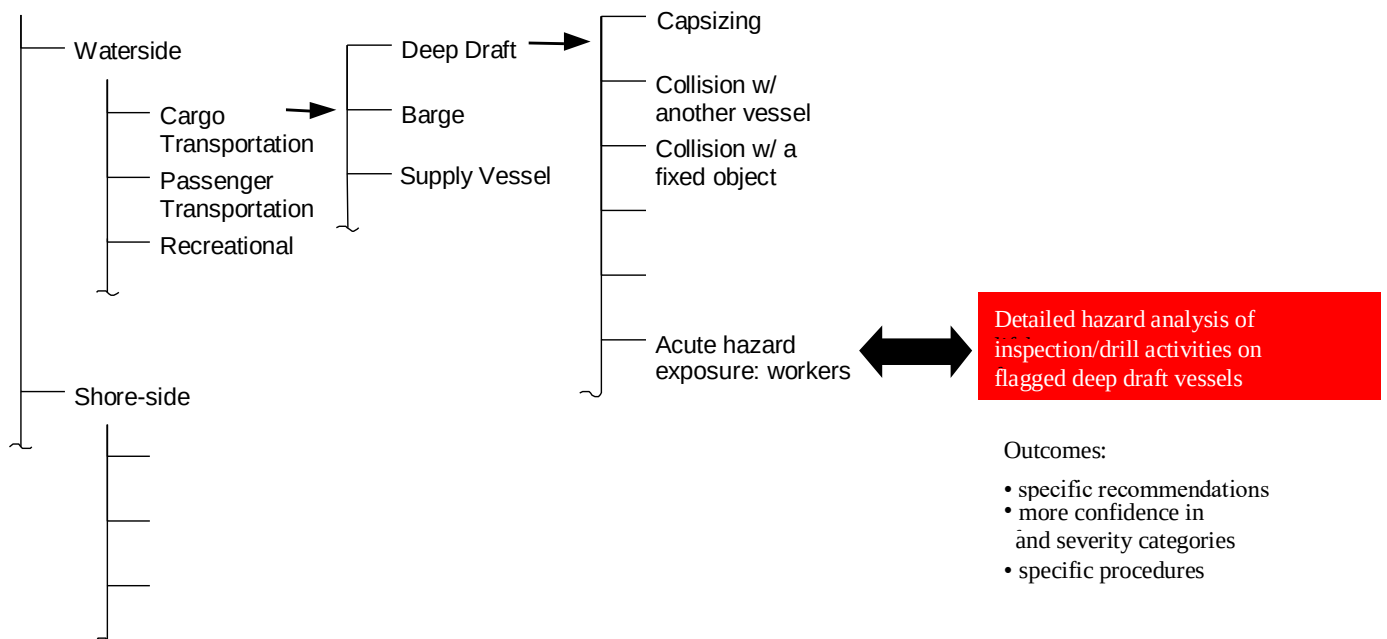


Figure B.2 Connection between Narrowly Focused Detailed Analysis and Preliminary Risk Assessment.