REPORT OF THE

AWO/USCG QUALITY ACTION TEAM

ON

Tank Barge Transfer Spills

Managing Toward Zero Spills

Presented to

The AWO/Coast Guard National Quality Steering Committee

October 1997

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AWO/USCG QAT on Tank Barge Transfer Spills
Executive Summary

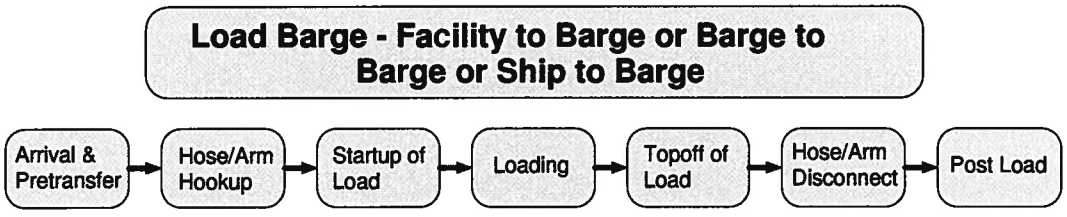
The American Waterways Operators (AWO) and the United States Coast Guard (USCG) Quality Action Team (QAT) on Tank Barge Transfer Spills was formed under a charter issued by the AWO/USCG National Quality Steering Committee (NQSC) in August 1996. The purpose of the QAT was to:

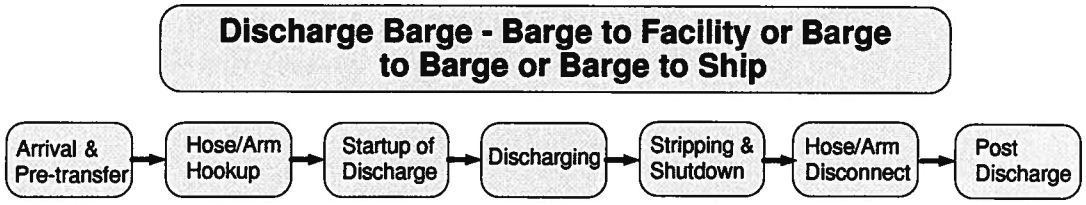
> *"Investigate the circumstances and causes of tank barge transfer spills, including spills which result from vessel-to-vessel transfers, as well as vessel-to-shore transfers, and develop a list of proposed recommendations to reduce the incidence of such spills for consideration by the NQSC".*

The 14 person team consisted of 6 representatives from coastal and inland liquid marine operators, 3 representatives from waterfront facilities and service companies and 5 representatives from the USCG. In addition to the AWO, three other industry associations were represented on the team: the Chemical Manufactures Association (CMA), the American Petroleum Institute (API) and the Independent Liquid Terminals Association (ILTA). The QAT presented its report to the NQSC in April, 1997.

Approach: The QAT used the Focus, Analyze, Develop and Execute (FADE) problem solving process to analyze spills occurring during tank barge transfer operations. The team developed a mission statement, outlined both the loading and discharge processes, analyzed all available data, summarized data findings into a problem statement and then developed root cause diagrams. Five root causes were identified as critical and solutions were identified to address each cause. Finally, action plans were developed for each of the 25 solutions. In addition to an extensive data analysis, the QAT relied on its members' expertise in marine transfer operations, responses to a survey of AWO's inland liquid members and numerous reports related to tank barge transfer spills. Because information on "deck spills" was not readily available, the QAT decided to focus its inquiry on "reportable spills" as defined by regulations.

The process flow diagrams developed for both the loading and discharging processes consisted of seven major steps (shown below) with detailed steps under each major step (see Appendix D).





Data Analysis: The QAT conducted an extensive analysis of the data available on tank barge transfer spills. Available industry, government and private studies were also reviewed. The QAT's data summaries are included as Appendices E & L and represents the most comprehensive data analysis on tank barge transfer spills available to date.

Available data on the root causes of spills is very poor because data is handled inconsistently by both the Coast Guard and the industry. In the Coast Guard database, the root causes were recorded as "unspecified" for two thirds of the oil transfer spills reported during 1991 through June 1996. The remainder of the causes were stated in terms of equipment failures with no mention of human failures. In the case of industry data, the most commonly cited root causes are "personnel" and "equipment.". The QAT concluded that some of the spills attributed to "equipment" were more properly attributed to "personnel."

In a survey of AWO's inland and coastal liquid members by the QAT, the five most frequently cited causes of transfer spills were: people not following procedures (27%), equipment not functioning (16%), workplace hurry up (13%), misuse/not using equipment (10%), and people not knowledgeable (8%).

After examining the data on root causes, the QAT concluded that industry is responsible for implementing adequate spill prevention measures. Furthermore, company management has the greatest impact in improving all areas of spill prevention through personnel support and quality initiatives. Thus, problems in "equipment" and "personnel" areas should not be viewed as the sole responsibility of maintenance and vessel crews.

Key Findings:

- Spills occurring during tank barge transfer operations are the most frequent type of spill from barges, yet these spills account for a small portion of the total volume spilled each year.

- Over half of tank barge transfer spills involve volumes of less than eleven gallons.

- Barge transfer spills occur at a rate of approximately 1.4 reportable spills per 1,000 transfers.

- The loading process is associated with more spills than the discharge process.

- Spills that occur during the loading process are more frequent at the steps of "loading" and "topoff". The "discharging" step is associated with the highest number of spills during offloading operations.

- Spills occur more frequently during daylight hours, possibly because transfer personnel are attempting to do more tasks at one time during the day time.

Proposed Solutions and Action Plans: The QAT developed 25 solutions and action plans for each of the 5 most critical identified root causes of transfer spills as follows:

1. ***PEOPLE NOT FOLLOWING PROCEDURES:***

- Verify Person in Charge (PIC) knowledge of process - see action plan # 16
- Provide performance incentives - see action plan # 17
- Provide training and use job safety analysis tool with cargo transfers - see action plan # 18
- Empower employees to change procedures - see action plan # 19
- Ensure adequate manpower at critical times - see action plan # 20
- Eliminate conflicting duties for PIC - see action plan # 21
- Improve communication between PIC's - see action plan # 22

2. ***EQUIPMENT NOT FUNCTIONING/EQUIPMENT NOT MAINTAINED PROPERLY:***

- Improve preventative maintenance - see action plan # 3
- Conduct pre-transfer test of equipment - see action plan # 4
- Improve equipment defect correction - see action plan # 5
- Improve equipment design and selection - see action plan # 6
- Establish a database regarding defects - see action plan # 7
- Enhance inspection programs - see action plan # 8
- Provide better tools and equipment - see action plan # 6

3. ***PERSONS NOT KNOWLEDGEABLE AND/OR SKILLED:***

- Improve training of new and existing employees - see action plan # 12
- Verify reading skills - see action plan # 13
- Ensure PIC capability with adequate relief, water, etc. - see action plan # 14
- Improve communication between PIC's - see action plan # 15

4. *INADEQUATE PROCEDURES:*

- Use process safety review to improve procedures - see action plan # 1
- Establish minimum transfer procedures - see action plans # 1, 9
- Ensure communication during all phases of transfer - see action plan # 10
- Use quality assurance system approach to planning and controlling procedures and auditing for compliance with procedures - see action plan # 9
- Share best practices across the industry - see action plan # 2
- Develop load plan for barges - see action plan # 23
- Improve schematics of piping, stripping, vapor systems - see action plan # 24
- Provide procedures specific to the type of operation and the barge - see action plan # 24
- Improve consistency of USCG monitoring - see action plan # 25
- Use document control system to ensure most current procedures on board - see action plan # 24
- Obtain certification under an accepted quality standard such as ISO 9002, ISM, CMA, AWO's Responsible Carrier program - see action plan # 11

5. *MISUSE OF EQUIPMENT/NOT USING EQUIPMENT:*

- Ensure design is user friendly - see action plan # 6
- Improve training on equipment - see action plan # 18

Recommendations to Key Parties: In addition to action plan solutions for individual companies/operators, broader based recommendations are made to the industry, AWO, and the Coast Guard in Section 3.0 of this report.

Recommendations for Measurements: Quantitative measures are needed to monitor progress toward improved performance. Thus, the QAT is proposing a data collection program to supplement AWO's existing annual survey. The QAT recommends AWO members complete a simple "Transfer Spill Report" form (see Appendix I) whenever a "reportable spill" occurs. The results would be published quarterly by the AWO. With better information, more effective solutions can be developed and implemented.

Communication Plan for Report: The team recommends that this report be distributed to all AWO members (liquid transportation), and all USCG Captains of the Port. Presentations will be made to industry groups and at USCG Industry Days to explain the QAT's findings and to enlist support for the QAT's recommendations.

Conclusion: Tank barge transfer spills are the most frequent type of barge spill but usually involve small quantities of cargo and do not have the environmental impact associated with larger spills from collisions, allisions and groundings. Although tank barge transfer spills tend to be small, they still represent a threat to industry personnel, the environment and the public. Furthermore, both customers and the public have zero tolerance for spills no matter how small. Therefore, it is incumbent upon the inland marine industry to make significant progress toward eliminating all spills including tank barge transfer spills.

This report contains action plans and best practices which can help both small and large companies develop a quality program (or improve existing quality programs) such as the Responsible Carrier Program.

The QAT believes that most tank barge transfer spills are preventable and that a quality approach supported by management can significantly improve spill prevention procedures. The solutions presented by the QAT recognize barge transfer operations occur in complex systems and require a multi-pronged approach to achieve improvement. Finally, it is imperative that the effectiveness of spill prevention solutions be monitored using quantitative measures and that spill statistics be kept highly visible within the industry and with its regulators. In this way, we will be *managing toward zero spills.*

REPORT OF THE AWO/USCG QUALITY ACTION TEAM ON TANK BARGE TRANSFER SPILLS

1.0 Introduction: Partnerships and Quality Action Teams

The AWO/USCG Safety Partnership was established in September 1995 to strengthen the working relationship between the Coast Guard and the barge and towing industry and to provide a mechanism for cooperative AWO/USCG action to advance the two organizations' mutual goals of marine safety and environmental protection. A memorandum of understanding was signed September 19, 1995, by Rear Admiral J.C. Card, Assistant Commandant for Marine Safety and Environmental Protection, and AWO President Thomas Allegretti providing the framework for the partnership, which centers around the AWO/USCG National Quality Steering Committee (NQSC). The NQSC is a small group of senior Coast Guard and AWO leaders, a principal function of which is to identify safety or environmental protection issues of national scope as candidates for cooperative agency-industry attention. The NQSC then oversees the establishment of subject-specific AWO/USCG Quality Actions Teams (QATs) comprised of Coast Guard and industry experts to analyze selected issues and develop recommended process improvements based on total quality management principals.

1.1 Background

In March, 1996, the NQSC approved the establishment of a AWO/USCG Quality Action Team to examine the causes of tank barge transfer spills, including vessel-to-vessel and vessel-to-shore transfers, and to develop recommendations aimed at preventing such spills from occurring. The NQSC's decision to select tank barge transfer spills as the second major issue to be addressed through the AWO/USCG Safety Partnership was based on its view that preventing oil and hazardous substance spills is central to the partnership's fundamental objective of enhancing marine environmental protection. Indeed, while spills resulting from incidents underway account for the majority of tank barge-generated oil pollution by volume, the small operational spills which occur during transfer operations comprise the overwhelming majority of tank barge industry spills by frequency. The NQSC posited that the relative frequency of transfer spills might suggest the existence of common "process problems" which could be identified through quality-based analysis and alleviated by cooperatively developed recommendations for process improvement.

The NQSC's decision to proceed with a QAT on Tank Barge Transfer Spills was also based on the recommendations of the AWO Inland Liquid and Coastal Sector Committees, the two AWO standing committees whose members include inland and coastal tank barge operators, and consistent with the objectives of the Coast Guard's Marine Safety and Environmental Protection Business Plan. A charter formally establishing the AWO/USCG Quality Action Team on Tank Barge Transfer Spills was

signed by National QSC CO-chairs RADM Card and AWO President Allegretti in August 1996. The charter is included in Appendix A.

The charter from the National Quality Steering Committee directed the QAT to review the following areas:

- Operating environment and the role of the human element;
- Personnel training and experience;
- Communications procedures/barriers;
- Industry-implemented management practices or operational procedures;
- Coast Guard transfer regulations;
- Equipment standards/conditions;
- Impacts and cost of the recommended actions; and,
- Other areas important in achieving the goal of reducing the incidence of tank barge transfer spills.

Many different parties play a role the prevention of tank barge transfer spills. The QAT charter called for representation not only from the Coast Guard and the tank barge industry, but from oil and hazardous material transfer facility interests and tankering services. QAT members included: Coast Guard Headquarters and field personnel; tank barge operating company representatives serving the inland and coastal trades; a representative of the largest independent tankerman service in the United States; and facility operators representing the American Petroleum Institute, the Chemical Manufacturers Association, and the Independent Liquid Terminals Association. The QSC believed that this broad representation would ensure not only the range of expertise necessary to address the issue of tank barge transfer spills in a comprehensive way, but the range of interests and stakeholders necessary to ensure broad-based acceptance of the QAT's findings and recommendations. A list of QAT members is provided as Appendix B.

1.2 Mission Statement

Transfer spills account for the largest share of tank barge industry pollution incidents. While there are certain inherent risks in oil and hazardous material transfer operations, these spills are widely viewed as preventable and, in large part, personnel derived. The tank barge industry is in a period of transition, with new pollution prevention regulations and practices being phased in by both barge and facility operators. Nonetheless, spills continue to occur, and the publics "zero tolerance" attitude toward pollution incidents,

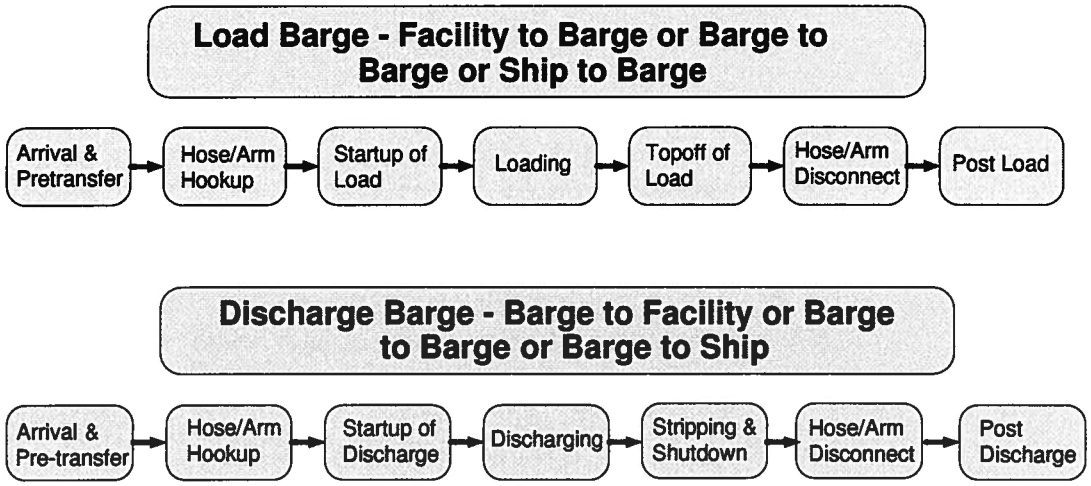
the high financial and opportunity costs of the operational delays and cleanup operations necessitated by spills, and the need to protect industry personnel as well as the environment from the impacts of oil and hazardous material spills dictate that industry take the lead in implementing measures to eliminate transfer spills, with the goal of zero spills the ultimate objective. Achieving these goals will result not only in a cleaner environment, but in improved public perception of industry operations, greater efficiency and profitability for both tank barge and facility operators, a higher degree of customer confidence, and a reduced need for governmental regulation. Achieving these goals through the cooperative mechanism of a Coast Guard-industry quality action team will also serve to highlight the value of cooperative government-industry action to address marine safety and environmental protection problems.

1.3 Approach

The QAT used the Focus, Analyze, Develop and Execute (FADE) problem solving process to analyze spills occurring during tank barge transfer operations (Appendix C). The team developed a problem statement, outlined both the loading and discharge processes, and developed root cause diagrams. Five root causes were identified as critical and solutions were identified to address each cause. Each of the solutions was supported by an action plan. A complete description of the Teams approach and steps taken is included as Appendix D.

The QAT relied on its members' expertise regarding marine transfer operations, responses to a survey conducted of AWO's inland liquid members, the USCG's marine casualty database and numerous reports related to tank barge transfer spills. Because information on deck spills was not readily available, the QAT decided to focus its inquiry on "reportable spills" as defined by regulations.

The process flow diagrams developed for both the loading and discharging processes consisted of seven major steps (shown below) with detailed steps under each major step.



Primary causes of transfer spills were identified by the QAT and grouped into the following five major categories:

- 1 - People not following procedures;
- 2 - Equipment not functioning/equipment not maintained properly;
- 3 - Persons not knowledgeable and/or skilled;
- 4 - Inadequate procedures; and
- 5 - Misuse of equipment/not using equipment

1.4 Proposed Solutions and Action Plans

The QAT developed a set of proposed solutions that specifically addressed the primary causes of transfer spills. These solutions are presented in section 3.1 of this report. Each proposed solution was supported by action plan(s), each of which were rated for their potential effectiveness at reducing the incidence of transfer spills, and for the anticipated cost of implementation to companies in the tank barge industry.

Appendix M contains a complete set of the action plans developed by the QAT.

QAT members also identified a list of 66 best practices currently employed by companies in the tank barge industry which are contained in Appendix H.

2.0 FINDINGS

2.1 Data Sources and References

The QAT extensively searched for studies and data concerning tank barge transfer spills; particularly for root cause analysis studies. The Coast Guard's Prevention Through People (PTP) Quality Action Team Report of July 15, 1995 included an excellent list of references which were reviewed. A listing of the most applicable references reviewed pertaining to tank barge and transfer spills are included in Appendix J.

Many of the references and reports reviewed by the QAT were based on data from the Coast Guard's Marine Safety Information System (MSIS). While MSIS is the most comprehensive of any publicly available data base, it lists only general causes for spills in a broad range of categories. Summary data for 925 transfer spills from 1991 through June, 1996 was analyzed to support this project.

Rather than relying solely on the MSIS database summaries, the QAT conducted its own in depth analysis on 284 transfer spill cases from 1994 and 1995. The QAT also surveyed the AWO membership, and reviewed proprietary data made available by the QAT members companies to validate our findings. See Appendices E & L for data summaries.

2.2 Key Findings: Problem of Tank Barge Transfer Spills

2.2.1 Tank Barge Transfer Spills

Spills that occur during tank barge transfer operations are the most common type of barge spill. At the same time, they tend to be small volume spills.

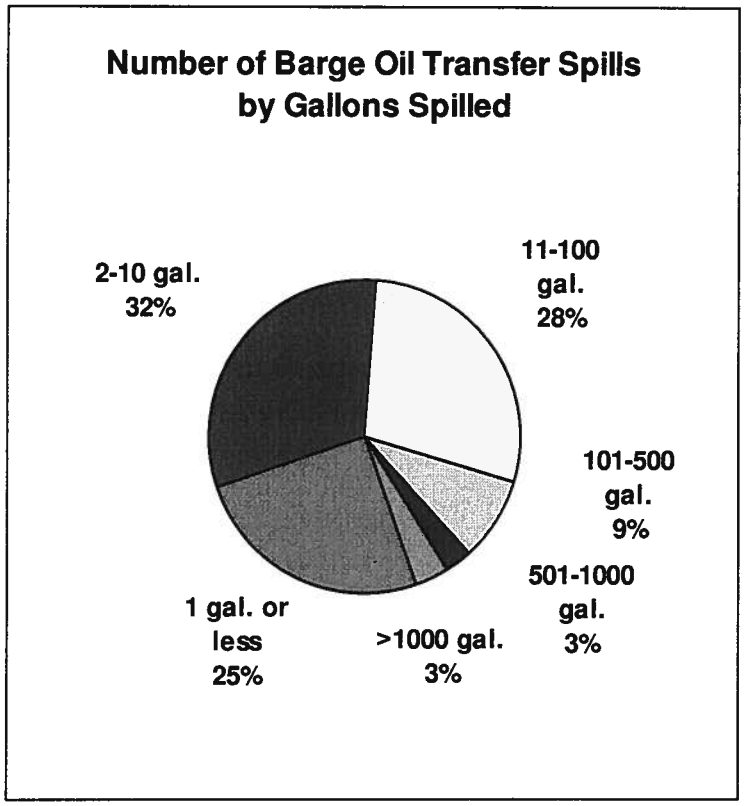
- Spills from transfer operations accounted for 65% of the spills between 1991 and June, 1996.

- The majority of tank barge transfer spills involved small volumes. For the period of 1991 through June 1996, 57% of the spills from tank barge transfer operations were 11 gallons or less. Median volume was 10 gallons per spill.

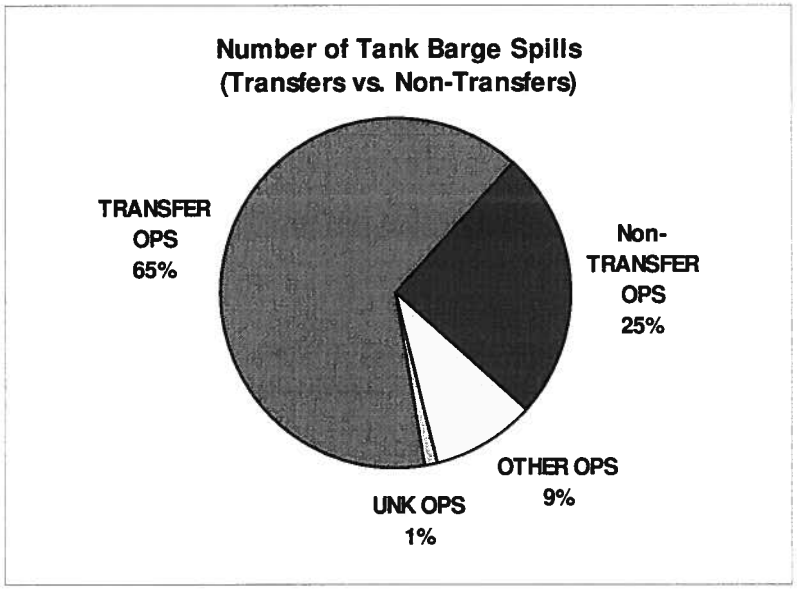
- Spills from transfer operations occur at a rate of approximately 1.4 spills per 1,000 transfers (0.01 spills per 100,000 barrels transferred).

- The majority of tank barge transfer spills (both number and volume) occur during the loading process.

The majority of transfer spills are small. Between 1991 and June, 1996 the median volume was 10 gallons per spill.



Transfer operations resulted in 65% of the spills between 1991 and June, 1996 (925 of 1,429 oil spills).



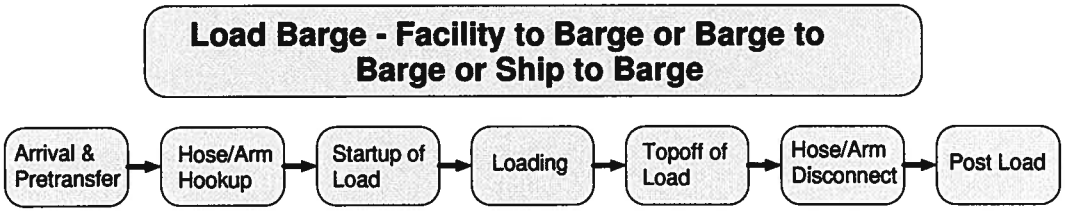
Spills that occur during tank barge transfer operations are more frequent during the loading process than during the discharge process.

- Analysis of USCG MSIS data for transfer spills during 1994 and 1995 shows that spills during the loading process occurred at a rate 20+% over the discharge process (55% for loading vs. 42% for discharging).

- For 1995, AWO members reported 2 spills during the loading process for every 1 spill during the discharging process, i.e., 77 vs. 35.

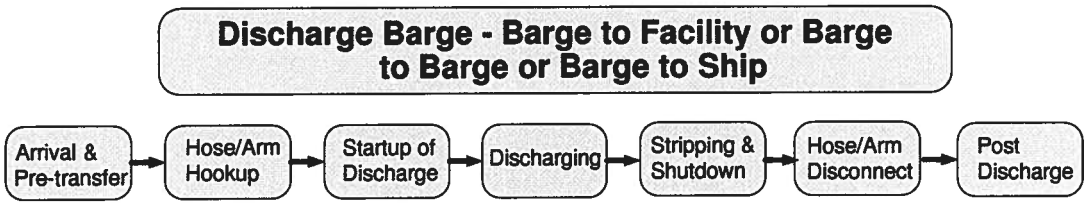
- AWO members also reported that during the loading process the steps of "loading" and "topoff" were associated with the highest number of spills followed by the step of "discharge" during the discharge process.

NUMBER & % SPILLS AT EACH STEP - LOADING



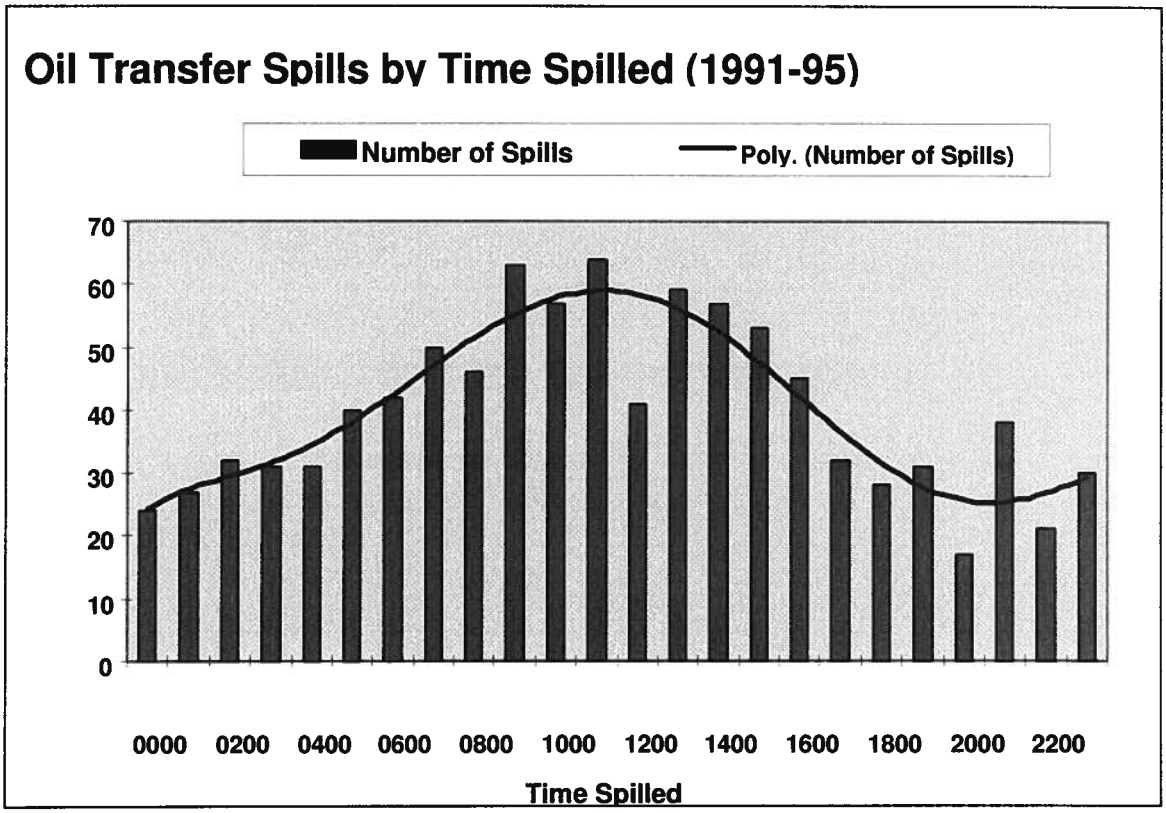
0	3	3	28	27	4	12
(0 %)	(4 %)	(4 %)	(36 %)	(35 %)	(5 %)	(16 %)

NUMBER & % SPILLS AT EACH STEP - DISCHARGING



1	3	5	19	4	3	0
(3 %)	(9 %)	(14 %)	(54 %)	(11 %)	(9 %)	(0 %)

Spills that occur during tank barge transfer operations rise sharply during daylight hours, possibly because transfer personnel are attempting to perform more tasks at once during the daytime.



- Nationally, the largest number of spills occurs at 1100 and the smallest number occurs at 2000. The number of spills at 1100 is 260% higher than the number at 2000.

Spills associated with tank barge transfer operations occur at an even rate throughout the seasons in the country overall. However, regions of the country showed more variability by season.

2.2.2 Tank Barge Spills Overall

Reported spills from all vessel and barges in US waters have been rising in recent years. At the same time, the total volume of spills and the number of large spills has dropped dramatically. Both trends are attributable to stricter definitions and regulations regarding spills and the heightened awareness of customers, and vessel and facility operators.

- Number of reported spills from all vessels, including barges, was 3,018 in 1986 versus 5,546 in 1995.

- Average annual spill volume dropped 70% for barges and 85% for all vessels in the early 1990's compared with the late 1980's.

Average Annual Volume Spilled

	1986 to 1990	1991 to 1995
Barges	1.6 million gallons	0.5 million gallons
All vessels	6.3 million gallons	0.9 million gallons

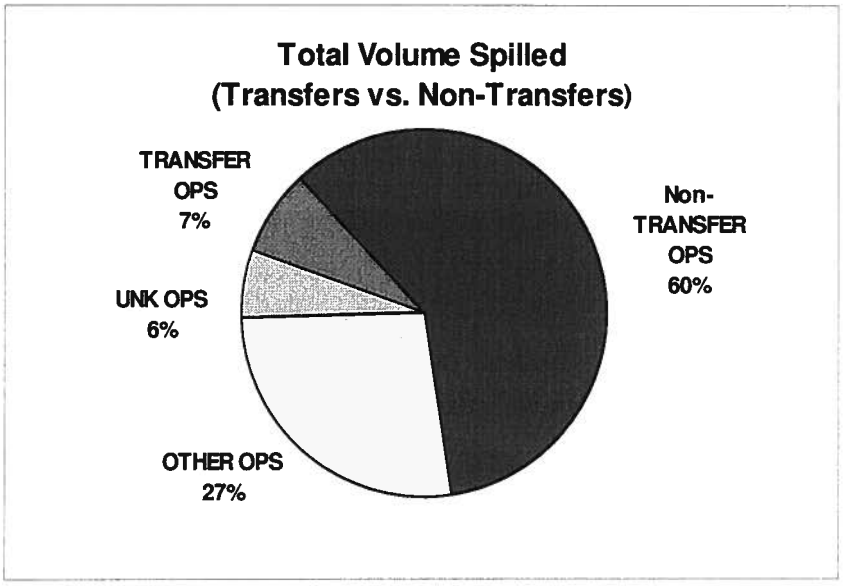
- Dropping spill volume overall is closely tied to the drop in large spills for all vessels. In 1986 through 1990, large spills occurred at an average rate of almost 10 per year. In 1991 through 1995, the average number per year had dropped over 50% to less than 4 large spills per year.

Tank Barges accounted for the highest number and volume of medium and major oil spills from maritime sources for the period of 1992 to 1996.

Source Type	Number	%	Volume	%
Waterfront Facilities	19	27 %	851,882	14 %
Barges	24	34 %	4,038,791	67 %
Tankship	8	11 %	485,481	8 %
Freight Ship	8	11 %	365,727	6 %
Other Vessel	12	17 %	296,916	5 %

Spills that occur during tank barge transfer operations account for a small portion of the total volume spilled from barges.

- Non-transfer operations produced 60% of the volume of spills between 1991 and June, 1996.



2.3 Key Findings: Root Causes of Barge Transfer Spills

The quality of root cause data is very poor. Therefore, conclusions based on currently available root cause information should be regarded as qualitative rather than quantitative.

- Current data is incomplete. Two thirds of the causes associated with tank barge spills were listed as "unspecified" in the USCG's database although the narrative report often contained information on causes. When a specific cause was listed, it was almost always a type of equipment failure.

- Current data is unreliable. No standardized system for either investigating incidents or documenting their causes has resulted in data which is handled consistently across industry and within the Coast Guard.

Equipment and personnel are the two most frequently cited causes for tank barge transfer spills.

- The QAT suspects that many of the incidents currently attributed to "equipment causes" should in fact be attributed to "human factors" or "management practice/policy".

- While "personnel" and "equipment" are commonly used cause categories within the industry, the use of "management practice/policy" is seldom used because of legal liability issues. In reality, management bears a major responsibility for either the success or failure of spill prevention efforts because management is responsible for instilling a strong safety culture and committing necessary resources.

- The top five causes of spills most frequently cited by AWO members were:

People - Not following procedures	27 %
Equipment - Not functioning	16 %
Environment - Work place hurry up	13 %
People - Misuse/not using equipment	10 %
People - Not knowledgeable	8 %

The pattern of higher spills during daylight hours may be a result of "work place hurry up" as tankerman attempt to perform more than one job during daylight hours. The same issue may be the underlying cause of "not following procedures" in some cases. Further analysis is needed.

- A detailed review for the QAT of tank barge transfer spills in 1994 and 1995 showed that personnel and equipment failures as the primary cause:

Personnel error	46 %
Equipment failure or malfunction	31 %
Hull Failure or leakage	23 %

- The loading process produces more spills than the discharge process, primarily because of the topoff step which typically involves loading a tank barge very close to its full capacity.

More information in the following areas would enhance spill prevention efforts:

- Despite the fact that PIC's are regularly cited as the cause of spills in company data, the QAT did not discover data describing PIC's involved with spills, ex., age, experience, tenure, training, number of days on vessel, number of hours worked in 24 hours prior to spill, etc. Undoubtedly, some companies have collected this information for internal purposes but no industry wide data is available. Also, further investigation is needed to determine how PIC's involved with spills differ from those with spill free records.

- The strength of the safety culture versus spill performance has not been systematically tested. In particular, what are those aspects of the culture which are the most powerful in preventing spills?

- Detailed information on the equipment involved with spills including manufacturer, age, condition, maintenance history, etc.

3.0 RECOMMENDATIONS

3.1 Proposed Solutions

The QAT's 25 proposed solutions are presented below under the root cause they were designed to address. Each of these solutions is supported by action plans which appear in Appendix M.

People Not Following Procedures:

- VERIFY PIC KNOWLEDGE: Use periodic oversight and audits to verify PIC (facility & vessel) are knowledgeable of procedures. Use both formal & informal approaches and conduct on both an announced & unannounced basis. Share results with fleet. *See Action Plan #16*

- PERFORMANCE INCENTIVES: Use incentives to reward positive performance and punitive/corrective action in response to deviations. Stress personal accountability. Consider incentive based compensation. *See Action Plan #17.*

- TRAINING/JSA: Provide initial and refresher training and hold frequent safety meetings. Develop Job Safety Analysis (JSA) for transfers. Distribute JSA for transfers to industry. Use simulation of loading and discharge process in training. Train both office and vessel personnel including new hires. Use mentoring program. *See Action Plan #18.*

- EMPLOYEE EMPOWERMENT: Empower employees to develop and change procedures. *See Action Plan 19#.*

- ADDITIONAL MANPOWER AT CRITICAL TIMES: Use additional manpower where process requires. ex., extra tankerman for split loads, dangerous cargoes. Vessel management on barge during critical times. *See Action Plan #20.*

- PERFORM ONE JOB AT A TIME: Eliminate conflicting duties for both vessel and facility PIC during transfer operations. PIC's should be expected to concentrate on "one job at a time" during topoff and other critical times. *See Action Plan #21.*

- COMMUNICATION: Make Declaration of Inspection (DOI)/pre-transfer conference more effective. Improve communications between PIC's on shore and vessel (or between vessels.). *See Action Plan #22.*

Equipment not functioning/Equipment not maintained properly:

- PREVENTATIVE MAINTENANCE: Implement routine preventative maintenance program, improve existing maintenance programs and provide adequate p/m budget. Management commits time and money. *See Action Plan #3.*

- PRE-TRANSFER TEST: Conduct pre-transfer test of equipment, ex., valve integrity, radios, vital systems survey. *See Action Plan #4.*

- DEFECT CORRECTION: Improve reporting of equipment defects and follow-up on defects. *See Action Plan #4.*

- SELECTION/DESIGN: Improve equipment selection and design. *See Action Plan #5.*

- DATABASE: Use a database to record rate and cause of equipment failures. *See Action Plan #6.*

- ENHANCE INSPECTION: Enhance inspection programs. *See Action Plan #7.*

- BETTER TOOLS: Provide proper and better tools and equipment, Ex., radios, isolating deepwells, better valve maintenance, improve design of valves to make easier to use. *See Action Plan #6.*

Persons not knowledgeable and/or skilled:

- TRAINING: New employees receive orientation and training on procedures. Existing employees receive training on new procedures and refresher training. Improve training by adding hazard assessment, lessons learned, best practices and practical skills assessment. Management commits time and money. *See Action Plan #12.*

- VERIFY READING SKILL: Verify that all PIC's have minimum reading and comprehension skills needed to perform job tasks. *See Action Plan # 13.*

- ENSURE PIC CAPABILITY: Prevent diminished capability of PIC by providing adequate relief, water, shelter, etc.. *See Action Plan #14.*

- IMPROVED COMMUNICATION: Improve sharing of information between shore and vessel PIC's and crews (or between vessels). Improve distribution of information from facility. *See Action Plan #15.*

Inadequate Procedures:

- PROCESS SAFETY REVIEW: Use process safety review to identify and improve procedures. Periodically review procedures and training plans and involve employees in the review. *See Action Plan #1.*

- MINIMUM PROCEDURES: Develop minimum list of procedures, ex., maintenance, drip pans empty. Include hazard assessment in procedures. *See Action Plans #1 & #9.*

- COMMUNICATION: Ensure communication between PIC's and transfer personnel during all phases of transfer. *See Action Plan #10.*

- QUALITY ASSURANCE SYSTEM APPROACH: Ensure that procedures include elements required by ISM, CMA, and AWO's Responsible Carrier Program. *See Action Plan #9.*

- SHARE BEST PRACTICES: Industry should share procedures and best practices. *See Action Plan #2.*

- LOAD PLANS: Develop load plan for barges. *See Action Plan # 23.*

- SCHEMATICS: Improve schematics of piping, stripping, vapor systems. *See Action Plan # 24.*

- PROCEDURES: Provide procedures specific to the type of operation and the barge. *See Action Plan # 24.*

- CONSISTENCY: Improve consistency of USCG monitoring. *See Action Plan # 25.*

- DOCUMENT CONTROL SYSTEM: Use a document control system to ensure most current procedures on board. *See Action Plan # 24.*

- CERTIFICATION: Obtain certification under an accepted quality standard such as ISO 9002, ISM, CMA, AWO's Responsible Carrier program. *See Action Plan # 11.*

Misuse of equipment/not using equipment:

- USER FRIENDLY DESIGN: Redesign/modify equipment to make it more user friendly, ex., winch wheels, hose booms, color codes. *See Action Plan #6.*

- TRAINING: Ensure PIC's and transfer personnel receive training on use of equipment. *See Action Plan #18.*

3.2 Recommendations to Key Parties

A. Executive Management of marine companies should establish a clear, attainable, and defined goal of "No spills during transfer operations" and:

1. Develop a strategic plan and supporting corporate policies that address management, equipment, and human factors issues;

2. Communicate management expectations throughout the company; share ideas and best practices throughout the industry;

3. Commit the personnel and financial resources required to implement an effective spill prevention program. Hire, train, and retain a high quality workforce. Promote and employ new technology to improve safety;

4. Implement the vision: Empower employees - support their decisions to do the right things right. Go beyond what is required by law or regulation - strive for excellence, and;

5. Improve the vision: Utilize third parties to perform audits and oversights at all levels of the company. Learn from accidents - yours and others. Integrate quality into company operations; utilize quality principles as a means of continuous improvement - become a model company.

B. National Quality Steering Committee

1. Make Coast Guard and industry resources available to pursue the solutions recommended by this QAT.

2. Continue support of future national level USCG and Industry QAT's.

C. American Waterways Operators

1. Market or list member companies which comply with all elements of the Responsible Carrier Program in newsletters, brochures, etc.,

2. Highlight the success of the Responsible Carrier Program as a quality program.

3. Recognize/share best practices or company audit programs of member companies enrolled in the Responsible Carrier Program to improve compliance with program requirements.

4. Establish an interactive Internet Bulletin Board site where AWO member companies can exchange information by uploading and downloading company policies, procedures, best practices, etc.

5. In conjunction with the USCG, co-sponsor and co-organize an annual single or multiple day tank barge industry conference. The conference could be conducted in a manner similar to the annual Society of Naval Architects and Marine Engineers (SNAME) conference or the biennial oil spill conference.

6. Serve as the clearinghouse for AWO member companies in the tank barge industry completing the "Transfer Spill Report". Develop a national database to archive and sort the information submitted on the survey forms. Publish spill statistics quarterly. Use the information to improve the Responsible Carrier Program.

7. Ensure the elements comprising the Responsible Carrier Program are reviewed either annually or biennially. Make revisions to the elements comprising the program based on the annual or biennial reviews.

D. United States Coast Guard

1. In conjunction with AWO, co-sponsor and co-organize an annual single or multiple day tank barge industry conference. See #5 in AWO section above.

2. Recognize companies which successfully implement/utilize quality programs such as AWO's RCP, ISM Code, etc. and base boarding procedures, identification of nonconformity's and other examinations on improving quality.

3. Develop and implement policy/guidance for field personnel regarding cargo transfer monitors, vessel examinations and spill investigations. For example, boarding team members should be trained to not distract or interrupt PICs during critical phases of cargo transfer operations.

4. Change the focus of pollution investigator and Investigating Officer (IO) training courses to make field investigators more aware of the role of human factors in pollution incidents and vessel casualties. Integrate root cause failure analysis training into these training courses.

5. Develop a centralized system similar to the port state control matrix to target Coast Guard field resources towards less responsible tank barge operators. Work with AWO and the tank barge industry to develop guidelines for system development and implementation.

E. Tank Barge Companies

1. Incorporate the QAT's specific recommendations contained in Section 3.1 as part of the company's standard operating procedures.

2. Implement quality initiatives such as AWO's RCP or ISM Code procedures.

3. Report water spills to AWO using the new "Transfer Spill Report" form.

4. Implement root cause failure analysis in the investigation of actual and potential spills and actual and near-miss vessel casualties.

F. Independent Liquid Terminal Owners Association

1. ILTA should consider sponsoring a similar joint QAT between it's member companies representing the bulk liquid terminal industry and the Coast Guard to review bulk liquid facility spills during cargo transfer operations with marine vessels (ships and barges).

2. Implement the Responsible Carrier Program or a similar quality approach among its member companies.

3.3 Recommended Measurement and Data Collection Improvements

Quantitative measures are needed to monitor progress toward improved performance. To that end, the QAT supports the continuation of AWO's annual safety statistics survey report which includes data on cargo transfer spills. However, the QAT proposes an additional data collection program to supplement AWO's existing annual survey. The QAT is recommending that AWO members be requested to complete a "Transfer Spill Report" form (see Appendix I) whenever a water spill occurs. Although some of the data on the form is also requested on AWO's annual survey, some of the data

would be new such as: step in either the loading or discharge process at which the spill occurred, type of cargo spilled, time of day and month of spill, and cause of spill using 14 possible causes rather than the 5 used in AWO's current survey. The form is designed to be sent to AWO within 10 days after the spill. Company name is not included on the form and data would be treated confidentially. The QAT proposes that summary data would be reported on a quarterly basis in an AWO publication.

The value of this new data collection program is that spill data would be available on a more timely basis and would help heighten industry awareness on the issue. Furthermore, the data collected would offer new insights into the nature and causes of spills occurring during tank barge transfer operations. With better information, more effective solutions can be developed and implemented.

3.4 Recommended Areas For Further Investigation and Action

A. Utilize the data analysis in this report, the identified 5 most prevalent root causes and action plans to conduct a comprehensive review of existing federal regulations contained in Titles 33 and 46 of the Code of Federal Regulations (CFR) applicable to spill prevention and transfer operations for vessels and facilities to determine which regulations should be revised or eliminated.

B. Develop a standardized root cause failure analyses and spill incident investigation methodology throughout the tank barge industry. Publish as an industry best practice.

C. Develop specific recommendations to improve the Coast Guard's ability to capture and analyze data related to actual/potential pollution incidents and actual/near miss vessel casualties on it's MSIS computer network or other data base.

D. Initiate partnerships with the marine insurance industry to jointly develop standards for quality organizations.

E. Review/investigate the effect of the new tankerman regulations on the prevention of spills.

APPENDIX B

AWO/USCG QUALITY ACTION TEAM ON TANK BARGE TRANSFER SPILLS MEMBERS AND THEIR YEARS OF MARINE EXPERIENCE

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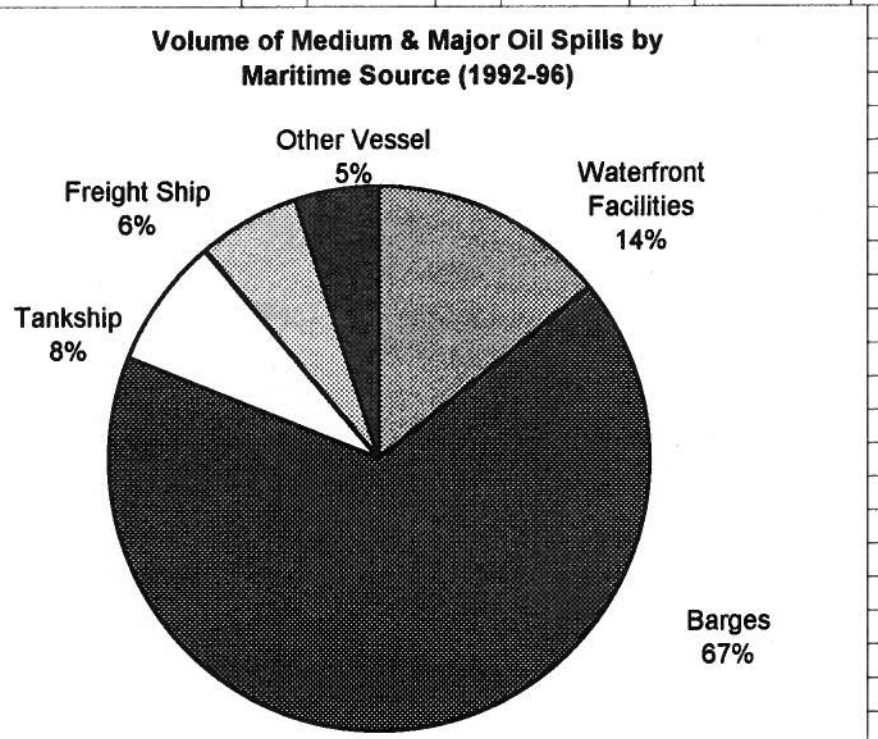
APPENDIX C. Quality Approach - Description of FADE

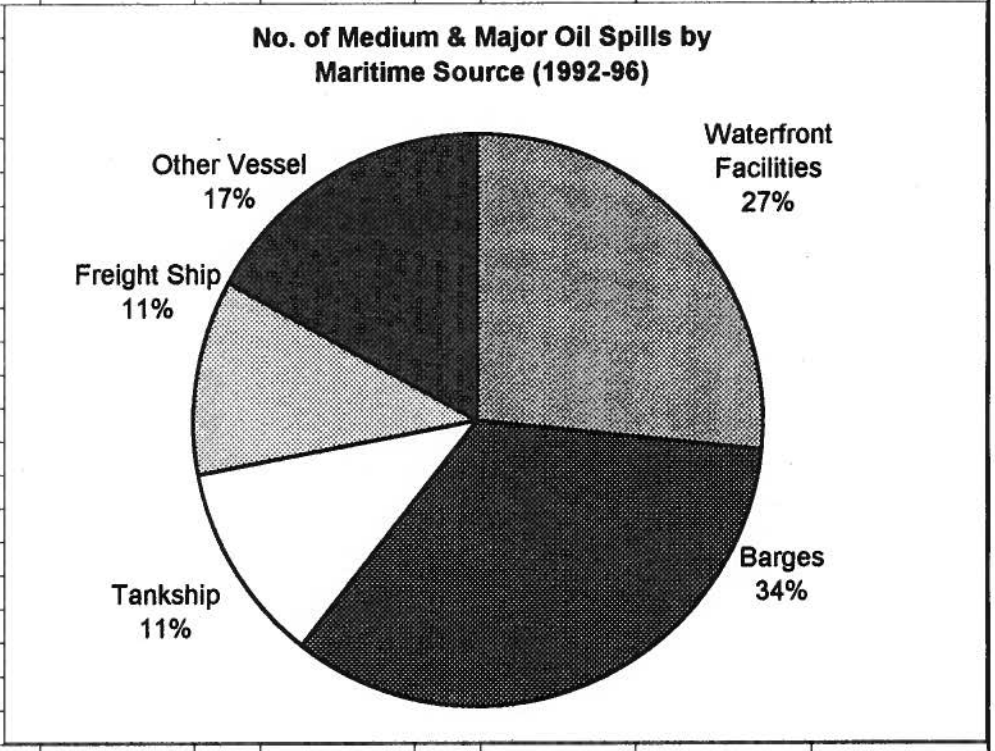
FADE is a problem solving process used in the U.S. Coast Guard that requires participants to complete the outputs in each step before moving on to the next step. Failure to do so can doom the attempt to solve a problem or minimize the quality of recommended solutions.

REQUIRED OUTPUTS for F.A.D.E. PROCESS

FOCUS - A written problem statement detailing: • ***The current state of your process (What is happening now)*** • ***The negative impacts of that state (Why change is needed)*** • ***The desired state (What you want to happen)*** • ***The impacts of achieving the desired state (Benefits)***
ANALYZE - Verified problem statement/list of "root" causes • ***A flowchart of the current work process*** • ***A list of "root" causes for problems/gaps identified***
DEVELOP - List of proposed solutions/Action Plans • ***List of recommended solutions*** • ***Action Plan(s) to implement the solutions*** • ***Who, What, When, Where, Why and How of the plan*** • ***Appropriate documentation to explain/justify recommendations***
EXECUTE - Process and Results Measures • ***Measures of process efficiency/effectiveness*** • ***Data collection/monitoring plan***

Number and Volume of Medium and Major Oil Spills from Maritime Source 1992-96



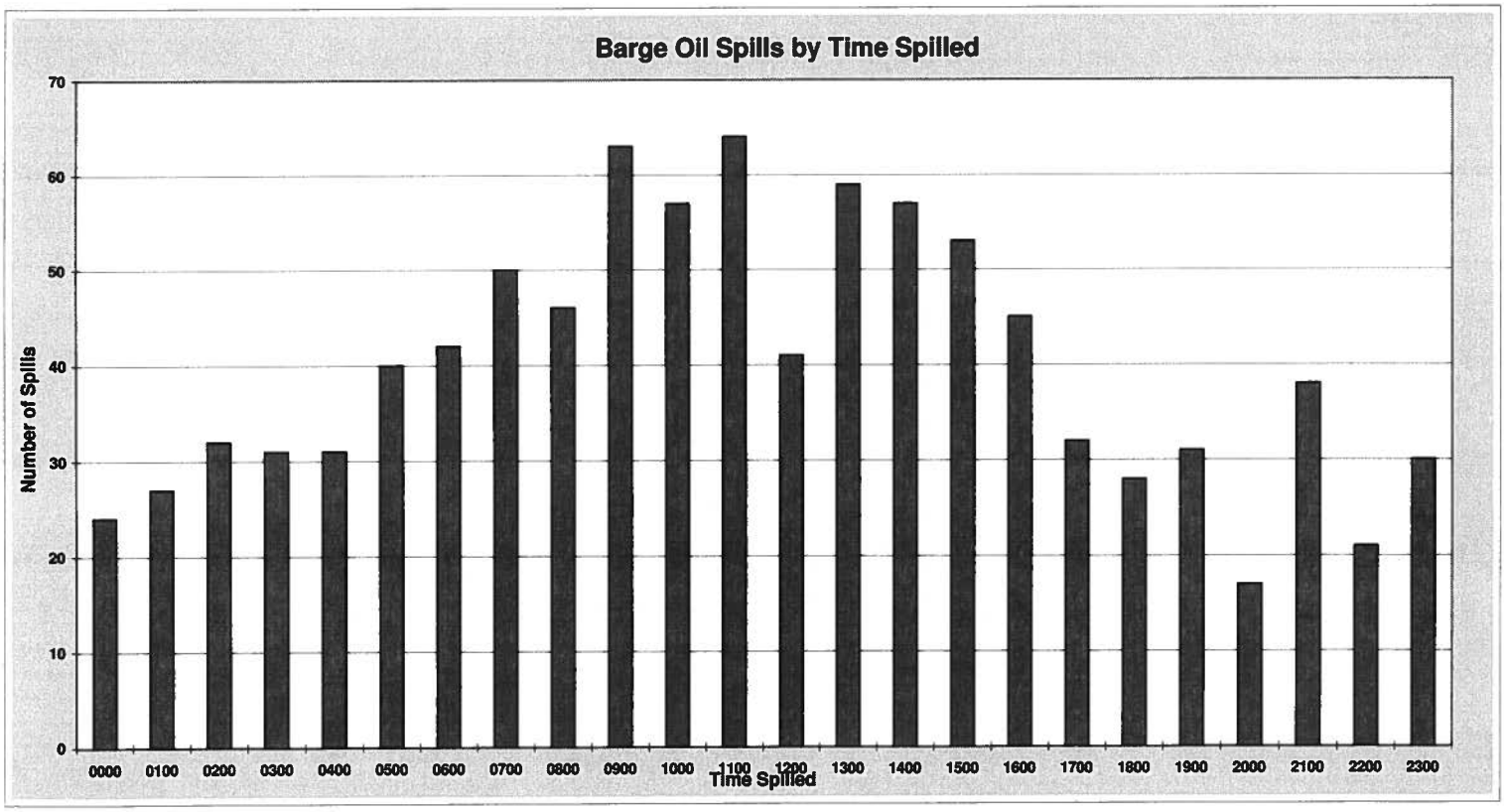


Source Type	1992		1993		1994		1995		1996		1992-96		1992-96	1992-96
	No.	Volume	No.	Volume	No.	Volume	No.	Volume	No.	Volume	No.	Volume	% Vol	% No
Waterfront Facilities	10	362,340	5	169,000	3	290,342	1	30,200	0	0	19	851,882	14%	27%
Barges	4	158,000	4	631,875	5	849,262	6	1,082,162	5	1,317,492	24	4,038,791	67%	34%
Tankship	1	98,725	1	33,558	1	35,700	3	83,834	2	233,664	8	485,481	8%	11%
Freight Ship	1	144,600	2	38,761	2	23,816	2	120,550	1	38,000	8	365,727	6%	11%
Other Vessel	2	28,392	3	123,000	2	31,000	4	72,524	1	42,000	12	296,916	5%	17%
Total	18	792,057	15	996,194	13	1,230,120	16	1,389,270	9	1,389,270	71	6,038,797	100%	100%

3PROD TYPE	(All)
PORT	(All)
OPERATION	(All)
PROD TYPE	Oil & Petroleum
SERVICE	TANK BARGE
YEAR	(All)
SPILL IN WTR	(All)
SPILL TIME	(All)
CAUSE	(All)
IDENTIFIED CAUSES	(All)

Data

TIME SPILLED, HOURLY INCREMENTS	Number of Spills	Volume Spilled	Avg Gal/Spill	% Total Volume
0000	24	3,672	153	2.11%
0100	27	2,818	104	1.62%
0200	32	7,433	232	4.28%
0300	31	7,077	228	4.07%
0400	31	17,879	577	10.29%
0500	40	7,663	192	4.41%
0600	42	14,963	356	8.61%
0700	50	4,981	100	2.87%
0800	46	19,512	424	11.23%
0900	63	4,701	75	2.71%
1000	57	2,233	39	1.29%
1100	64	4,574	71	2.63%
1200	41	8,633	211	4.97%
1300	59	10,711	182	6.17%
1400	57	11,942	210	6.87%
1500	53	2,537	48	1.46%
1600	45	2,458	55	1.41%
1700	32	2,196	69	1.26%
1800	28	1,023	37	0.59%
1900	31	1,825	59	1.05%
2000	17	10,740	632	6.18%
2100	38	6,172	162	3.55%
2200	21	4,557	217	2.62%
2300	30	13,360	445	7.69%
(blank)	3	52	17	0.03%
Grand Total	962	173,712	181	100.00%

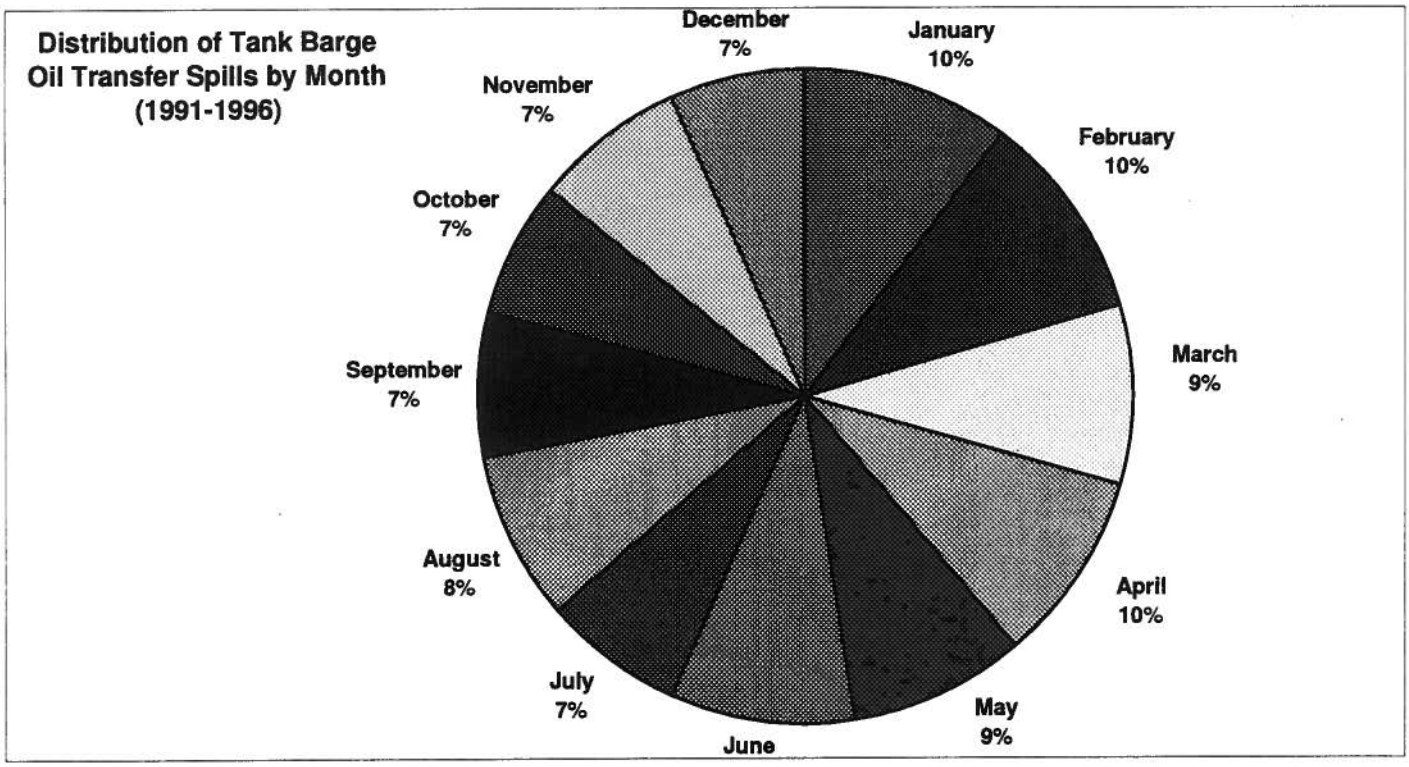


There are generally more spills during daylight hours.

3PROD TYPE	(All)
PORT	(All)
PROD TYPE	**Oil & Petroleum**
OPERATION	(All)
SERVICE	**TANK BARGE**
YEAR	(All)
SPILL IN WTR	(All)
CAUSE	(All)
SPILL DT	(All)
IDENTIFIED CAUSES	(All)
SPILL SEASON	(All)

Data

SPILL MONTH	Total Number of Spills	Total Gal Spilled	Average Gal/Spill
January	100	6,325	63
February	98	23,114	236
March	84	34,431	410
April	92	11,178	122
May	84	13,181	157
June	86	22,159	258
July	68	8,242	121
August	79	11,998	152
September	70	6,687	96
October	65	16,884	260
November	71	3,109	44
December	65	16,404	252
Grand Total	962	173,712	181



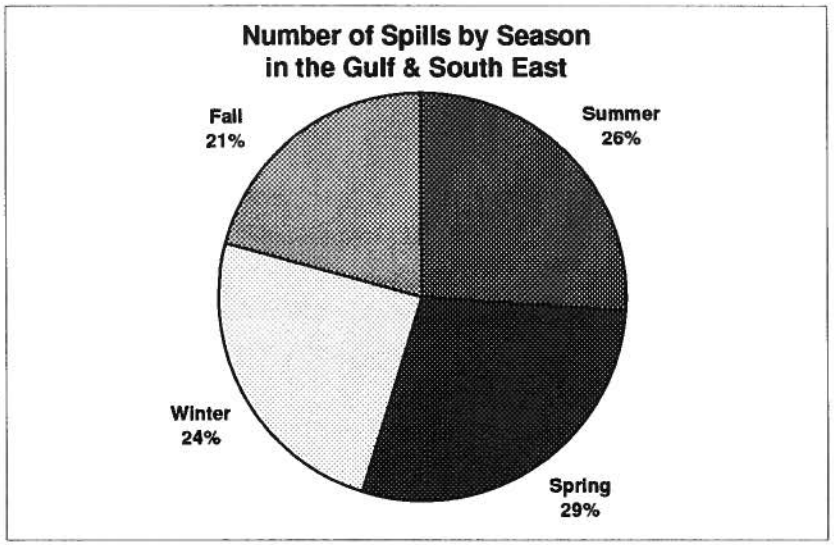
On a national level, there appears to be no pattern of spills by season.

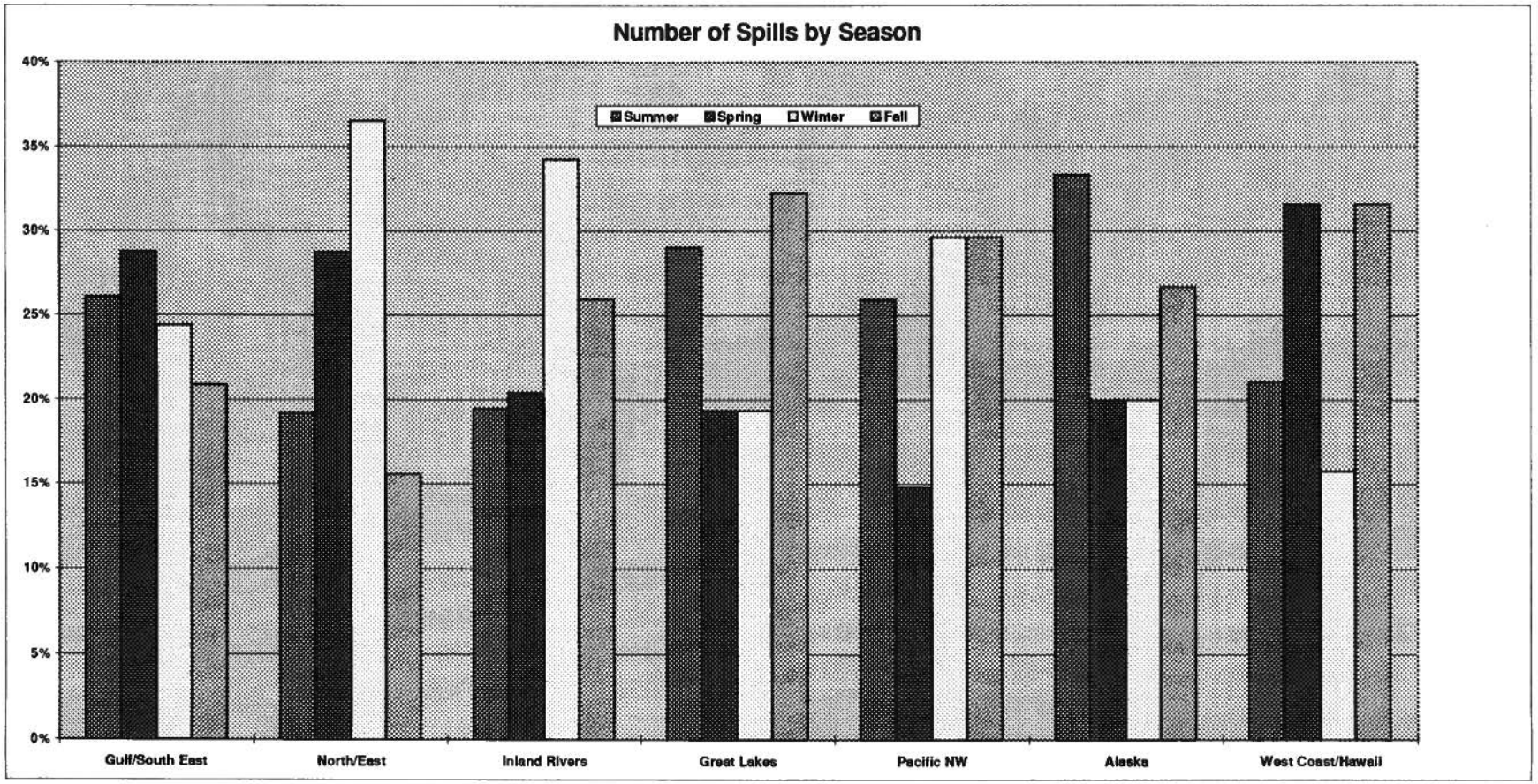
3PROD TYPE	(All)
OPERATION	(All)
YEAR	(All)
CAUSE	(All)
SPILL IN WTR	(All)
SPILL DT	(All)
IDENTIFIED CAUSES	(All)
SPILL MONTH	(All)
PORT	(All)
SERVICE	**TANK BARGE**
DIST	(All)
PROD TYPE	**Oil & Petroleum**

Total Number of Spills SEASON

Region	Summer	Spring	Winter	Fall
Gulf/South East	26%	29%	24%	21%
North/East	19%	29%	37%	16%
Inland Rivers	19%	20%	34%	26%
Great Lakes	29%	19%	19%	32%
Pacific NW	26%	15%	30%	30%
Alaska	33%	20%	20%	27%
West Coast/Hawaii	21%	32%	16%	32%

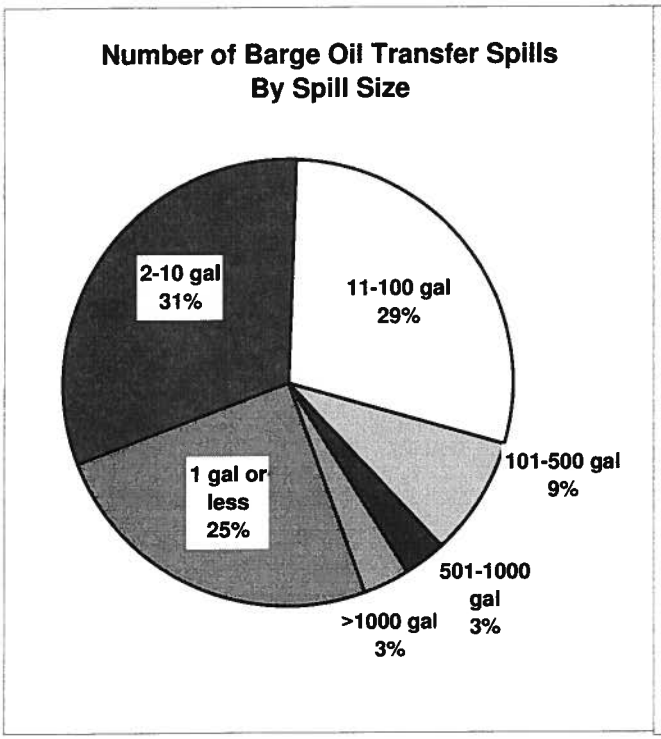
Spills occur with generally steady frequency throughout the year.

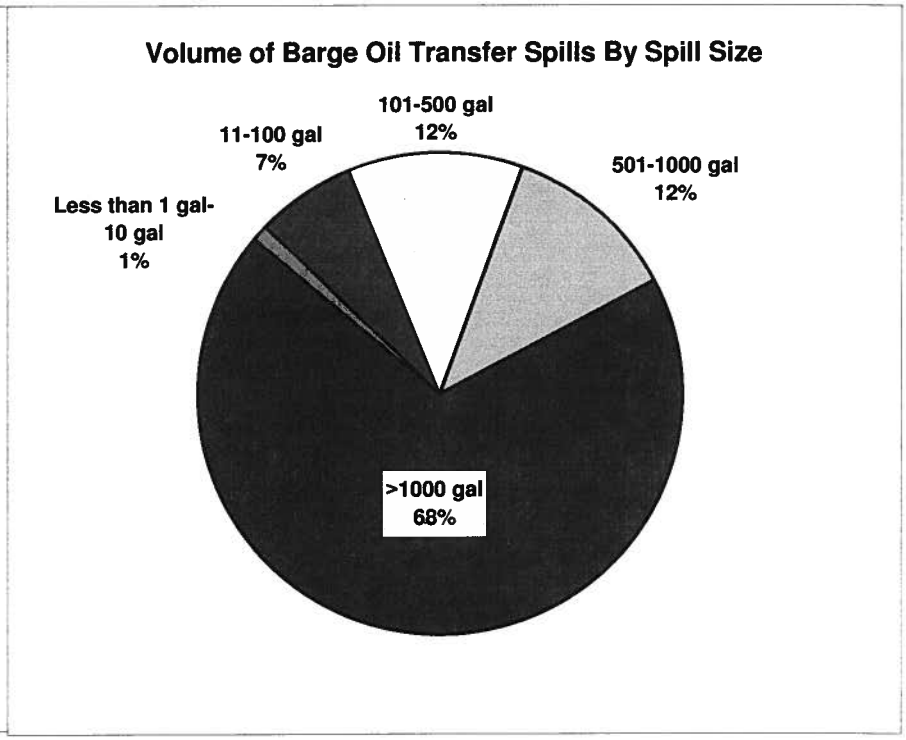




3PROD TYPE	(All)
PORT	(All)
OPERATION	(All)
PROD TYPE	**Oil & Petroleum**
SERVICE	**TANK BARGE**
YEAR	(All)
CAUSE	(All)

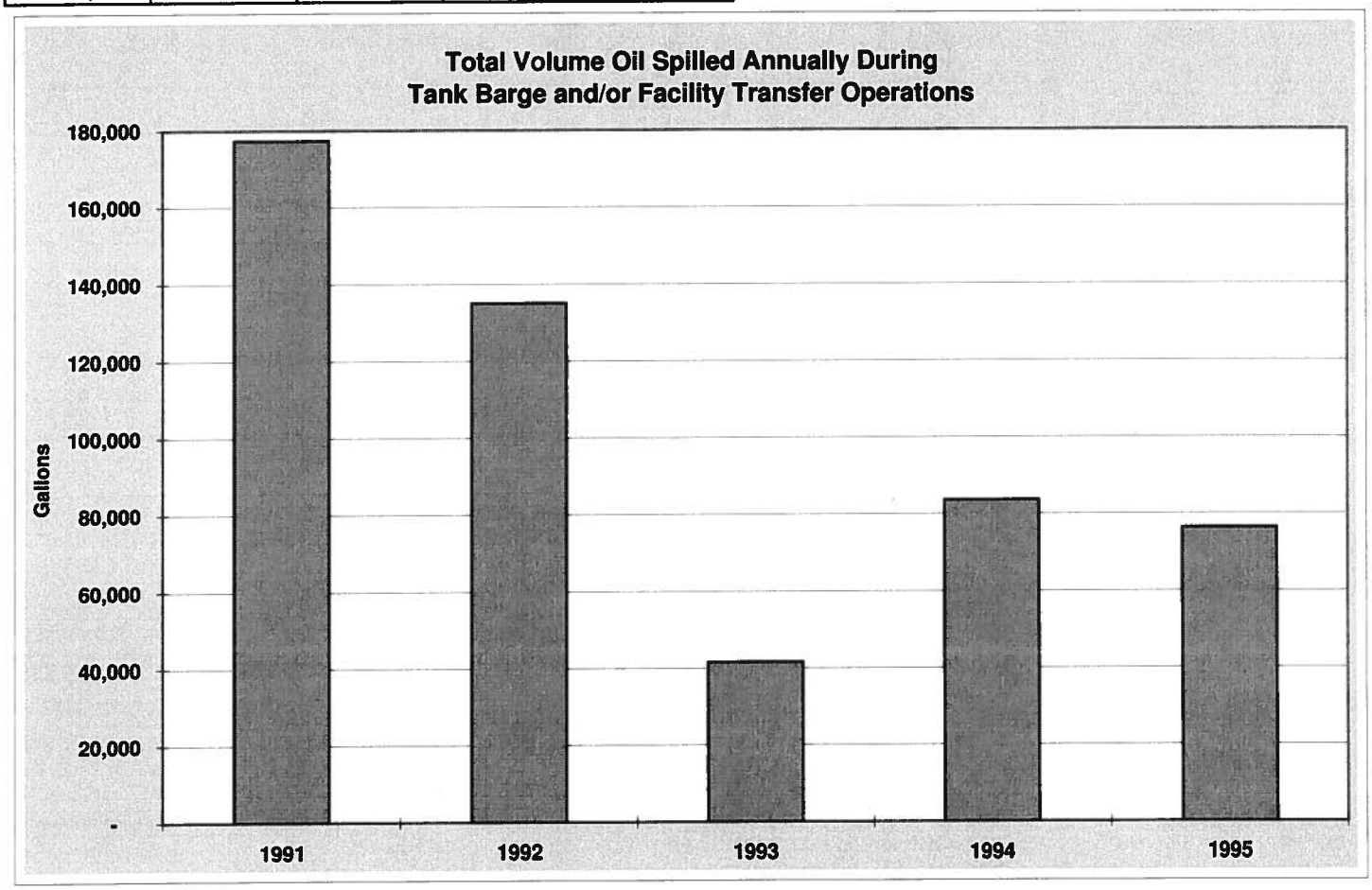
Gallons Spilled	Number of Spills	Percent Spills	Percent of Total Volume Spilled
1 gal or less	237	24.6%	0.1%
2-10 gal	303	31.5%	0.9%
11-100 gal	279	29.0%	6.7%
101-500 gal	82	8.5%	11.7%
501-1000 gal	28	2.9%	11.8%
>1000 gal	33	3.4%	68.8%
Grand Total	962	100.0%	100.0%





Tot Vol Spilled

1991	1992	1993	1994	1995
137,205	69,060	37,870	66,957	68,823
34,220	23,925	3,259	16,081	4,872
4,332	16,120	10	55	20
200	15,633	-	-	-
464	7,248	49	154	841
334	2,761	57	2	620
564	65	309	272	1,101
11	180	-	-	-
177,330	134,992	41,554	83,521	76,277



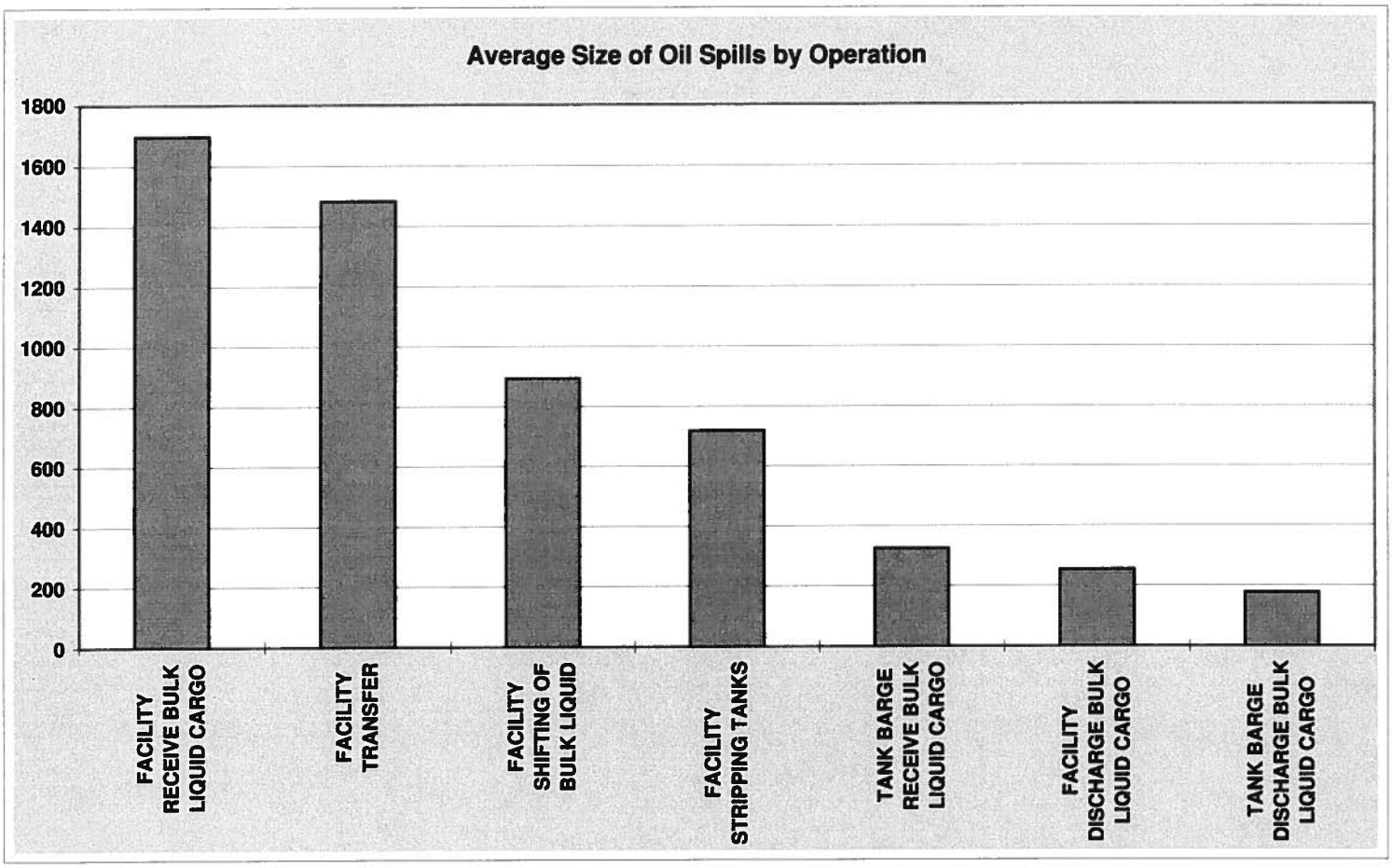
Barge &Waterfront Facility Transfer Spills

(Includes Discharge or Receive Bulk Liquid Cargo, Lightering, Offloading, Shifting Bulk Liquid, and Stripping Tanks.)

Gallons of Oil & Petroleum (1991 to 1st Qtr of 1996)

Sorted by Avg Spill Size

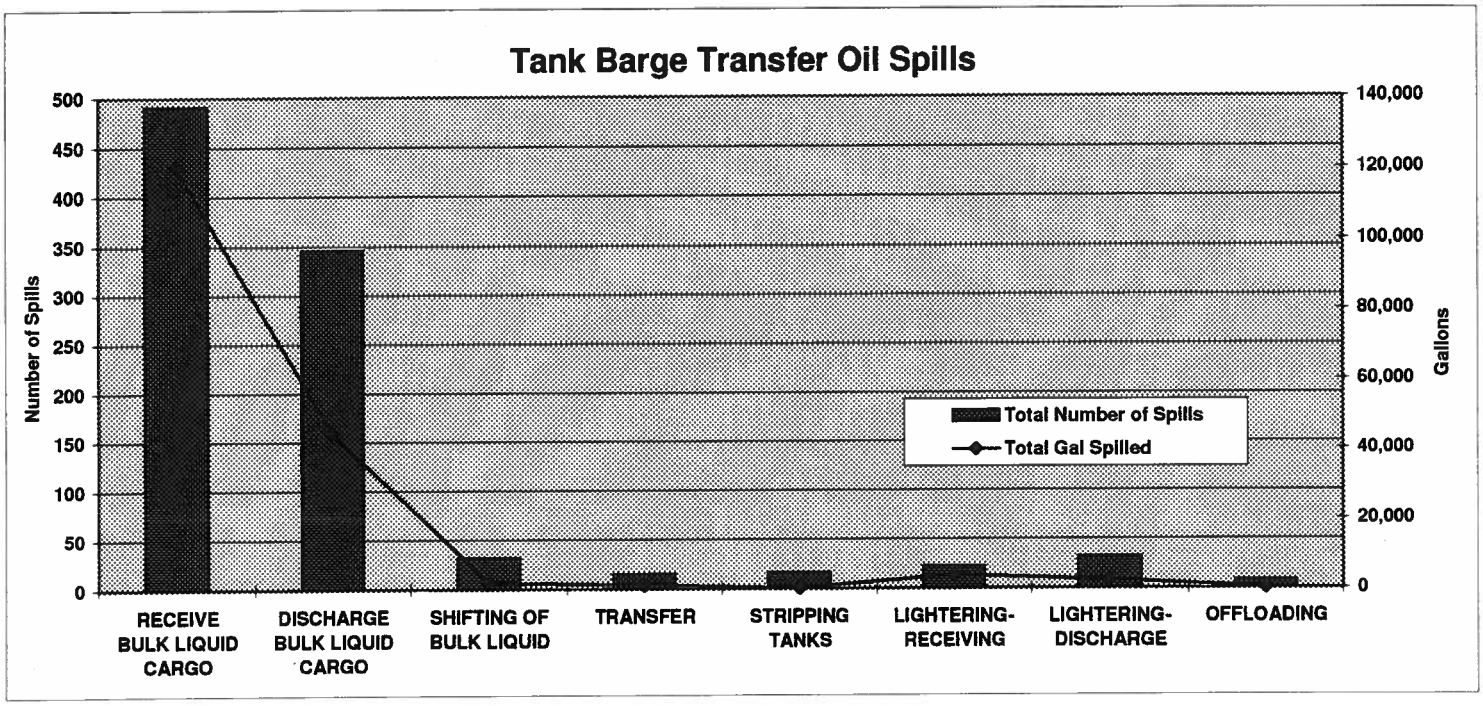
OPERATION	SERVICE	Number of Spills	Avg Spill Size	Total Vol Spilled
RECEIVE BULK LIQUID CARGO	FACILITY	133	1,696	225,583
TRANSFER	FACILITY	10	1,482	14,822
SHIFTING OF BULK LIQUID	FACILITY	21	893	18,751
STRIPPING TANKS	FACILITY	12	718	8,615
RECEIVE BULK LIQUID CARGO	TANK BARGE	492	324	159,407
DISCHARGE BULK LIQUID CARGO	FACILITY	162	253	40,906
DISCHARGE BULK LIQUID CARGO	TANK BARGE	348	176	61,287
LIGHTERING-RECEIVING	TANK BARGE	22	172	3,774
LIGHTERING-DISCHARGE	TANK BARGE	32	72	2,311
TRANSFER	TANK BARGE	15	67	1,011
SHIFTING OF BULK LIQUID	TANK BARGE	32	56	1,786
OFFLOADING	TANK BARGE	8	24	191
STRIPPING TANKS	TANK BARGE	16	9	141
Grand Total		1,303	413	538,585



3PROD TYPE	(All)
PORT	(All)
PROD TYPE	**Oil & Petroleum**
SERVICE	**TANK BARGE**
YEAR	(All)
SPILL IN WTR	(All)
CAUSE	(All)
IDENTIFIED CAUSES	(All)

Data

OPERATION	Total Number of Spills	Percent of Total Number of Spills	Total Gal Spilled	Average Gal/Spill	% Total Volume
RECEIVE BULK LIQUID CARGO	491	51%	120,161	245	69%
DISCHARGE BULK LIQUID CARGO	346	36%	44,337	128	26%
SHIFTING OF BULK LIQUID	32	3%	1,786	56	1%
TRANSFER	15	2%	1,011	67	1%
STRIPPING TANKS	16	2%	141	9	0%
LIGHTERING-RECEIVING	22	2%	3,774	172	2%
LIGHTERING-DISCHARGE	32	3%	2,311	72	1%
OFFLOADING	8	1%	191	24	0%
Grand Total	962	100%	173,712	181	100%



Well over twice the volume of oil spilled during transfer operations was lost when the barge was receiving cargo (69% of all barge oil transfer spill volume)
as opposed to discharging cargo (26% of all barge oil transfer spill volume).

Over half of all barge oil transfer spills occurred when the barge is receiving cargo;
36% of all barge oil transfer spills occurred when the barge is discharging cargo.

Barge &Waterfront Facility Transfer Spills
Pounds of Chemicals & Unlisted Substances (1991 to 1st Qtr of 1996)

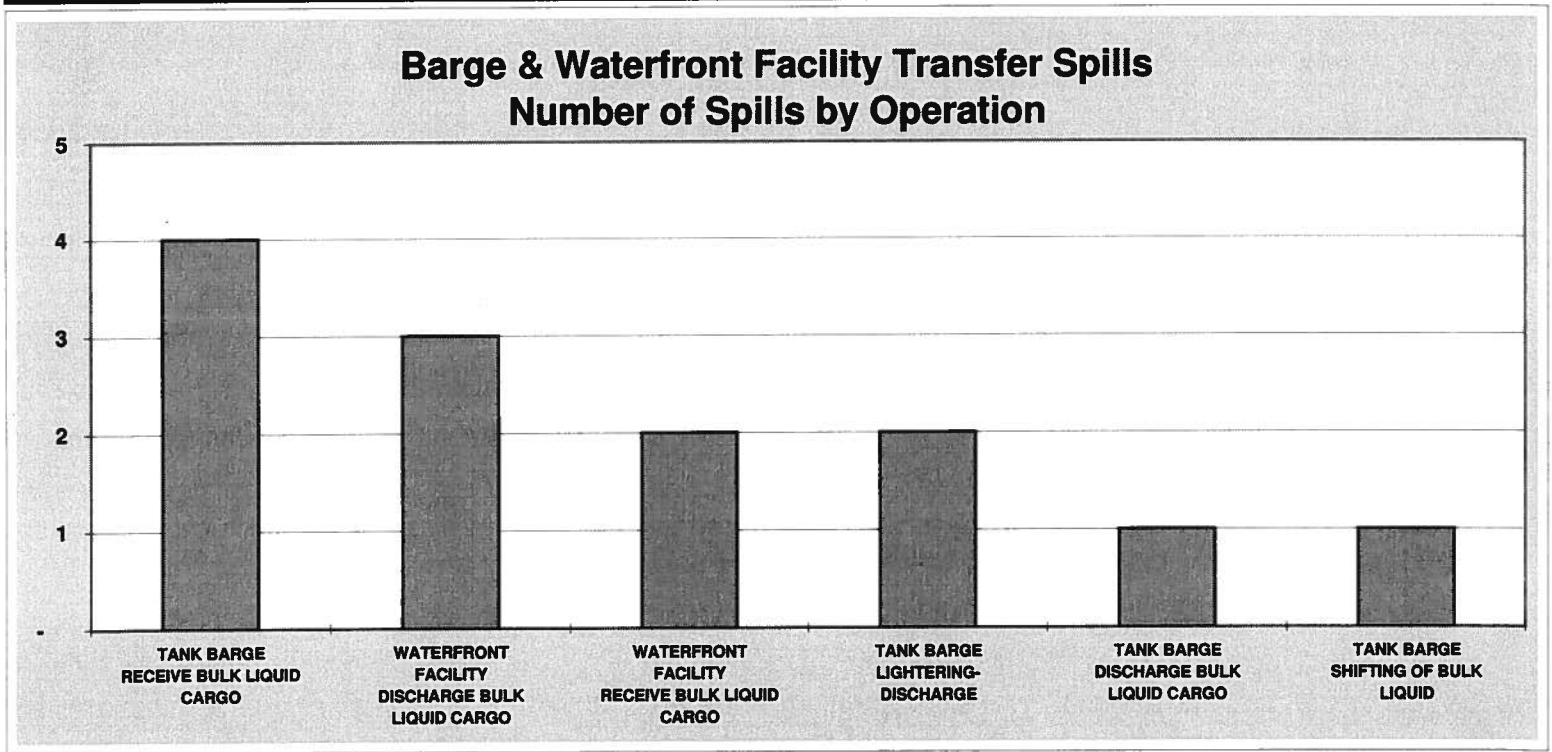
(Includes Discharge or Receive Bulk Liquid Cargo, Lightering, Offloading, Shifting Bulk Liquid, and Stripping Tanks.)

Sorted by Number of Spills:

OPERATION	SERVICE	# of Spills	Avg Spill Size	Tot Lbs Spilled
RECEIVE BULK LIQUID CARGO	TANK BARGE	4	1,148	4,592
DISCHARGE BULK LIQUID CARGO	WATERFRONT FACILITY	3	834	2,501
RECEIVE BULK LIQUID CARGO	WATERFRONT FACILITY	2	897,304	1,794,608
LIGHTERING-DISCHARGE	TANK BARGE	2	222	444
DISCHARGE BULK LIQUID CARGO	TANK BARGE	1	100	100
SHIFTING OF BULK LIQUID	TANK BARGE	1	4,260	4,260
SHIFTING OF BULK LIQUID	WATERFRONT FACILITY	-	-	-
TRANSFER	TANK BARGE	-	-	-
LIGHTERING-RECEIVING	TANK BARGE	-	-	-
OFFLOADING	TANK BARGE	-	-	-
Grand Total		13	138,962	1,806,505

Sorted by Total Lbs Spilled:

OPERATION	SERVICE	# of Spills	Avg Spill Size	Tot Lbs Spilled
RECEIVE BULK LIQUID CARGO	WATERFRONT FACILITY	2	897,304	1,794,608
RECEIVE BULK LIQUID CARGO	TANK BARGE	4	1,148	4,592
SHIFTING OF BULK LIQUID	TANK BARGE	1	4,260	4,260
DISCHARGE BULK LIQUID CARGO	WATERFRONT FACILITY	3	834	2,501
LIGHTERING-DISCHARGE	TANK BARGE	2	222	444
DISCHARGE BULK LIQUID CARGO	TANK BARGE	1	100	100
SHIFTING OF BULK LIQUID	WATERFRONT FACILITY	-	-	-
TRANSFER	TANK BARGE	-	-	-
LIGHTERING-RECEIVING	TANK BARGE	-	-	-
OFFLOADING	TANK BARGE	-	-	-
Grand Total		13	138,962	1,806,505



Chemical spills reported in pounds generally followed the pattern of oil spills. Due to the small number of chemical transfer spills and the similarity between chemical & oil transfer processes, the QAT analysis focused on oil spill statistics.

APPENDIX F. Summary of Reports

Analysis & Research of Prior Studies and Literature Review

General

In an effort to benefit from existing work, the QAT conducted a literature search to identify, gather and review existing papers, reports, or statistical studies that might provide the Team data or procedures to be evaluated. Searches were conducted drawing on the industry knowledge and broad scope of professional affiliations represented by the Team's diverse membership. Several papers were identified with ownership/authorship based in either government, industry, the public sector or trade associations. Searches were also conducted on the Internet.

In addition to the extensive listing of references is contained in the Coast Guard's Prevention Through People QAT Report, numerous other credible and pertinent references were identified as follows:

Review of Significant / Pertinent Studies

1. **Human Factors - Control and Enforcement**, Robert I. Price, VADM, USCG (Ret) INTASAFCON 4, Brighton, England, November 1979.

a. Summary: This report was presented at a safety seminar in England in 1979. The paper does not address the concept of oil spills or oil transfer procedures directly. However, it is worth mentioning that major focus was placed on human factors. VADM Price discussed such matters as personal involved in a transfer must not only be well trained, but they should also be motivated to follow the training principles they have learned. The need for equipment to be in proper working order is also stressed.

b. Relevance to QAT: Highlights the role of the human element and human factors in any process and the need for their consideration and control.

2. **Inland Towing Vessel Guide to Federal Oil Transfer Procedures**; Industry - Coast Guard Quality Action Team Report for the Mid-Continent Regional Quality Steering Committee; July 1996.

a. Summary: This document was compiled by a joint Industry - Coast Guard Quality Action Team to assist the commercial towing industry develop transfer procedures for various oil products. It provides an excellent outline of sample transfer procedures for three typical transfers: fueling a vessel; taking on lube oil in bulk; and, discharging waste oil or slop oil. The procedures outline in detail the proper steps to be followed. While the procedures are generic, they are very concise, readable and easy to understand. If the procedures are followed by the personnel involved in a transfer, and assuming there are no mechanical failures, the possibility of a water or deck spill is remote.

b. Relevance to QAT: This document does not contain any statistical data on spills. It is designed to be a practical users guide for companies to develop procedures and practices to comply with the federal pollution prevention regulations. The generic transfer procedures are a starting point for a company to develop procedures that can be tailored to specific vessels. The report's emphasis on having well documented written procedures is consistent with this QAT's conclusion that a primary cause for transfer spills is Inadequate Procedures.

3. **Petroleum Industry Environmental Performance**, Fourth Annual Report; American Petroleum Institute; May 1996.

a. Summary: The report provides a statistical basis for claiming that significant achievements have been made in reducing the number and severity of oil spills. The report documents spill data broken down by numerous parameters, such as by size of vessel; volume of oil spilled from vessels by source; and number of spills by facilities by size of spill. The statistics were current through 1994 and, where possible, five to ten years of historical information is provided as a basis for comparison in some categories. Points made by the report: the majority of oil spills are less than 10 gallons; the number of large spills (10,000 gals or more) are occurring less; large spills account for most of the total volume of oil spilled; and, of the oil spilled in 1994, approximately 20% was from tank barges. Note: statistics to be included in the Fifth Annual Report, to be published in May 1997, were available. In 1995, the amount of oil spilled decreased significantly from 1994 (down 71%). A key reason was the decline in large spills from 8 in 1994 to 2 in 1995. Of most interest to our QAT, the percentage of oil spilled from barges was 36% of the annual total of 1,180,710 gallons.

b. Relevance to QAT: While all of the spill data was of general interest, the figures which received the focus of attention of this QAT were those related to spills from tank barges. In many portions of the report, the discussion makes reference to U. S. Coast Guard spill data. In our own comparison of the data presented in the API report to the Coast Guard data reviewed by the QAT, the data from this API report was consistent.

4. **Washington State Procedures for Safe Bunkering**; Washington State Administrative Code 317-40; Joint Industry, Labor, State of Washington, U. S. Coast Guard Task Force; 1994.

a. Summary: A joint industry, labor, State and U.S. Coast Guard task force was brought together to develop measures to reduce the number and severity of oil spills resulting from bunkering operations. The group was called the Bunkering Technical Advisory Committee. They developed procedures and practices to meet the stated goal. The Washington State Office of Marine Safety was the lead agency and developed a state regulation as a result of the committee's study.

The regulations limit work hours and require English language proficiency. The regulations specifically requires the receiving vessel to have an accommodation ladder rigged for access between the vessel and the facility. If the vessel Master determines that the ladder is inaccessible from the delivering vessel or facility, another means of access

must be provided that meets Safety of Life at Sea (SOLAS) requirements. The purpose of this requirement is to ensure safe access so a face to face conference may be conducted.

Additional provisions require a "deck watch rover" on the receiving vessel who has the specific job of monitoring the area on and around the vessel for oil spills. Work hours are limited to no more than 15 hours in a 24 hour period or no more than 36 hours in any 72 hour period, except in emergency spill response operations. Training must be conducted on the receiving vessel 48 hours prior to the scheduled bunkering. Those persons involved in the bunkering operation must have no other tasks and remain at their stations during the topping off stage of the transfer operation.

b. Relevance to QAT: The regulation emphasizes the importance of proper procedures, communications, and monitoring before, during, and after a bunkering operation. It requires the receiving vessel to develop a pre-load plan, conduct a training session, perform face to face pre-transfer conferences, and locate trained personnel at critical areas when topping off. The reasoning for the development of these state regulations is totally consistent with conclusions of this QAT report that topping off is a critical step and that Inadequate Procedures is a primary cause of transfer spills.

5. **Marine Transport and Transfer of Oil in New York Harbor: Oil Spill Prevention by the Barge and Towboat Industry;** A.T. Kearney; 1993.

a. Summary: The study contains the results of reviews conducted at nine major barge companies which operate in New York Harbor. The focus of the survey was on oil handling practices. These nine companies operate a total of 90 tugs and 118 oil barges in New York Harbor. The companies included four affiliates of integrated oil companies and five independent barge companies. The study conducted independent reviews of the product handling practices and corporate policies in place at the companies participating. The authors conducted site visits, conducted industry self-assessments, and held interviews with management. The report identified six major areas for evaluation of company operations: management, personnel, operational, location, equipment, and maintenance. The report further identified "Exemplary Practices" in each of these areas being implemented by the companies. These "Exemplary Practices" were outlined in detail and recommended for adoption. The report also addresses the topic of risk; and contains a discussion on "major" and "potential" risk factors.

b. Relevance to QAT: The report determined that spills at oil facilities in New York Harbor account for approximately one out of every five spills; and account for four of every ten gallons spilled. On a frequency basis, approximately two-thirds of the spills at oil facilities occur during transfer operations with a vessel. Statistically the report claimed: 37% of spills are related to procedural errors; 22% of spills are due to structural failures of barges, tanks or pipelines; 29% of spills are due to equipment failures; and 12% are due solely to activities on the facility/terminal side of the operation. The statistical information supports this QAT's conclusion that Inadequate Procedures and Equipment Not Functioning are primary causes for transfer spills.

6. **Tank Barge / Tow Vessel Workshop**; sponsored by the U.S. Coast Guard, the American Waterways Operators, and the Northeast States at the Massachusetts Marine Academy, Bourne, MA; June 5-6, 1996.

a. Summary: The two-day workshop brought together representatives from the States, industry, environmental groups, and the U. S. Coast Guard to discuss pertinent, regional operational and safety issues related to the transportation of oil products on waters in the Northeast United States. Numerous issues were discussed; such as manning of barges, licensing of mariners, inspection of tow vessels, and installation of barge anchoring equipment. The seminar concluded with the formation of a Regional Risk Assessment Team chartered to review operating procedures for companies transporting petroleum. The Team was comprised of volunteers from all stakeholders; the States, industry, environmental groups, and the U. S. Coast Guard. A four person Steering Committee was formed with a representative from each of these groups.

b. Relevance to QAT: Data contained in the workshop minutes only included U. S. Coast Guard figures for spills in the First Coast Guard District from 1992-1995. Also included were detailed case notes for tug/barge marine casualties in the New York area from October 1994 through March 1996. Data supports the premise that tank barge spills comprise a significant portion of the oil spilled in the specified years.

7. **Technical Report - Study: Written Analysis**; prepared by the KEVRIC Company for the U. S. Coast Guard as part of rulemaking for Tank Vessel Response Plans and Facility Response Plans; May 1996.

a. Summary: The study is actually a series of reports performed by the KEVRIC Company under contract to the U. S. Coast Guard. The study provided the U. S. Coast Guard with information for regulatory project on vessel response plans, and facility response plans, for hazardous chemicals. The recommendations focus on the concepts of risk and risk reduction as related to planning for emergency response. The reports evaluate factors to be considered in the safe transport and transfer of hazardous chemicals by vessel and transfers at facilities

b. Relevance to QAT: Various techniques were used to analyze and treat spill data. Intuitive methods based on the collective professional expertise of members of the study team were also used in order to rank order hazards involved in product transfer and transportation operations.

8. **AWO Responsible Carrier Program**; approved by the Board of Directors of the American Waterways Operators; December 1994.

a. Summary: The AWO Responsible Carrier Program (RCP) is a three-pronged effort which establishes industry standards and a code of practice for company management and administration, vessel equipment and inspection, and human factors, such as crew qualifications, training and operator proficiency. The provisions of this program provide a standard which exceeds the requirements of federal law and Coast Guard regulation. This program is designed to be applicable to all segments of the barge and towing industry; coastal, inland and harbor operations; dry and liquid cargo carriers;

and small and large companies alike. All members of AWO have committed to achieving compliance with the program by 1 January 1998 and AWO has implemented a comprehensive implementation assistance program to ensure that members have the requisite tools to achieve this goal. Further, in October 1996, the AWO Board of Directors approved a Responsible Carrier Program third party audit program to verify and document compliance with the parameters of this initiative.

b. Relevance to QAT: The Responsible Carrier Program is viewed by this QAT as a primary means for implementing many of the recommendations contained in the Tank Barge Transfer Spills QAT report. The recommendations of this QAT report would enhance and expand some of the areas of management, equipment inspection and human factors currently contained in the Responsible Carrier Program.

9. **1996 AWO Safety Statistics Survey Report**, Calendar Year 1995. American Waterways Operators; September 1996.

a. Summary: This report is the third edition of the American Waterways Operators annual Safety Statistics Survey. The survey collects and tabulates demographic company information, cargo spill data, groundings/collisions/allisions data and personnel injury statistics. The data is collected in a manner that allows the calculation of frequency data. This facilitates trend analysis, over time as historical survey data is created. The survey is conducted under the direction of the AWO Common Issues Council to help promise environmental safety, to provide a statistical base, and to enhance the industry's image as a safe transporter of bulk commodities. This year's survey questionnaire was completed by a total of 76 companies.

b. Relevance to QAT: The data in this report overlaps considerably with other work of the QAT and validates the results of the QAT's efforts. Data on spills is reported under two categories; "tank barge cargo spills" and "towing vessel fuel and other." This report was one of the few reviewed by the QAT that provided a frequency of cargo transfer spills per 1,000 transfers. This report also provided cause analysis data for tank barge transfer spills and validated the preliminary finding that the two most common causes of transfer spills were personnel error and equipment problems.

10. **Oil Spills in US Waters,** 1997 Edition (Draft); American Petroleum Institute (publication planned for May 1997).

a. Summary: Data for the period of 1986 through 1995 is based on U. S. Coast Guard records of oil spills that occur in, or reach, the navigable waters under U. S. jurisdiction. Non-petroleum spills are not included. Spill data is analyzed by the amount spilled by year, sources of spills (vessels and facilities); number of spills per year, amount spilled by vessel per year and amount spilled by facilities per year.

b. Relevance to QAT: The data in this report only covers the amount and source of oil spills. No information is presented as to the operation that was in progress at the time of the spill, the frequency of spills per 1,000 transfers nor the volume of spills as a percentage of cargo volume. The report notes that over the past ten years while the number of spills has increased, the number of large spills has continued to trend

downward. The report also supports the QATs findings that the majority of oil spills, regardless of source, are small (in 1995 about 74 percent of all spills were under 10 gallons). The report also notes that the 1.2 million gallons spilled in 1995 were about two-tenths of one percent of the oil consumed by Americans in one day, and less than one percent of the oil improperly disposed of by do-it-yourself oil changers each year.

11. **Results of Pollution Prevention Regulations Study**; Quality Action Team on Pollution Prevention Regulations, November 1995.

a. Summary: The Quality Action Team on Pollution Prevention Regulations was formed in St. Louis, MO to review all applications of the pollution prevention regulations in Title 33 CFR Parts 154, 155 and 156. The overriding conclusion of the committee was that all parties working in the marine transportation industry must accept responsibility for the protection of the environment. While the industry must comply with specific pollution prevention requirements, the Coast Guard must ensure that regulatory interpretation is standardized and sensible. To that end, that QAT developed a matrix of regulations to be used as a tool for clarifying regulatory cite priorities and responsibilities.

b. Relevance to QAT: There are no spill statistics or data contained in this study. The purpose of this study was to ensure all parties understood who was responsible for requirements contained in the regulations and that each party involved agreed on a standard and sensible interpretation of the regulatory requirements.

12. **Human Factor Analysis of Human Reliability in Marine Systems**; University of Miami (Report to be published/released in Summer 1997).

a. Summary: The objective of this study is to predict the likelihood of the occurrence of human error at specific stages of the marine transportation system in order to develop corrective actions so the likelihood will be reduced. The stages of the project consists of: a) identifying the triggering events using the National Marine Oil Transportation System Model (NMOTSM) and the performance influencing factors and the human error tendencies, b) predict potential errors by creating a deeper contextual basis for understanding human tasks, and developing a framework that can be used to both identify potential for human errors and understand their causes, and c) identifying appropriate design interventions and countermeasures.

b. Relevance to QAT: There are no spill statistics or data contained in this study. However, in support of the study, the U. S. Coast Guard provided the authors with a list of the USCG Marine Safety Information System (MSIS) marine casualty cases for calendar years 1994 and 1995 where the operation involved the movement of bulk liquid cargo or fuel. The QAT reviewed each of the MSIS case files individually to determine if root cause analysis could be conducted. The information in the case files was not detailed enough to support a standard root cause analysis methodology. The information obtained from the case review did support the general findings of the QAT; i.e., the majority of tank barge transfer spills are small, the two primary causes of transfer spills are personnel error and equipment failure, and the majority of transfer spills occur during the loading process. One finding not documented elsewhere was that approximately 23 percent of the spills recorded were from holes or leaks in the tank barge hull.

13. **AWO Survey on Tank Barge Transfer Spills**, American Waterways Operators, December 1996.

a. Summary: In support of this QAT's effort, AWO surveyed its member companies to gather data on tank barge transfer spills not contained in the other materials reviewed. Twenty four member companies responded with information for calendar year 1995. Information was requested on how many reportable spills occurred per 1,000 transfers, when in the transfer process did the spills most frequently occur, and what were the primary root causes of the spills.

b. Relevance to QAT: The data obtained by this survey overlaps considerably with other work of the QAT. One unusual result not documented elsewhere was that "workplace hurry-up" was reported to be the third most common root cause of spills by the member companies responding. The results were otherwise consistent with previous findings. The average was approximately 1.4 spills per 1,000 transfers; Loading, Top-off and Discharge were the steps in the transfer process where the majority of the spills occurred; and People Not Following Procedures and Equipment Not Functioning were the two primary root causes. Results of the survey are in Appendix G.

14. **Prevention Trough People; Quality Action Team Report**; Office of Marine Safety, Security, and Environmental Protection; Office of Navigation, Safety and Waterways Services; July 15, 1995.

a. Summary: The Prevention Through People (PTP) Report examines the extent of human error for causing casualties in the maritime environment. The focus on the human element as a means of achieving safety performance is a relatively new perspective for the U. S. Coast Guard which has traditionally used engineering and technological standards to promote safety. Human error is presented as the major cause of more than 80% of marine casualties. Human error causes can be classified as related to either management, operator status, working environment, knowledge, or decision-making. A four point strategy for achieving human error prevention is presented along with a detailed implementation plan directed to the USCG and the marine industry. The overall objective is to change the culture and practices employed in the industry so that human errors are prevented. The strategy included four key elements: collaboration by all stakeholders organizations to address human error from an overall systems approach; use of risk management; employment of human error detection, assessment, and prevention techniques; and improvement of investigative methods.

b. Relevance to QAT: The report includes USCG data on casualties and spills. The towing vessel - tank barge industry is identified in the report as a high-risk industry in part because it accounted for 23% of oil spills and tank barges produced 20% of the spilled oil volume. This AWO/CG QAT is a direct outcome of the recommendations of the PTP Report. Consistent with this conclusion, the PTP Report identified the process of topping off tanks as a high risk step in the oil transportation process.

APPENDIX G

Results of AWO Survey on Tank Barge Transfer Spills
December 10, 1996

Results From 24 Surveys

How many spills that reached the water per thousand barge transfers did your company have during 1995? (Formula--Number of Spills X 1000 divided by number of transfers)

Spills in water per 1,000 transfers

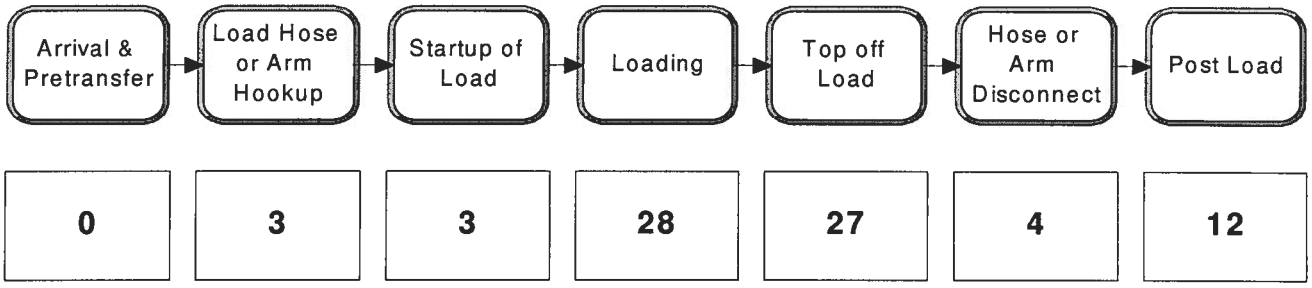
1.41

How many spills that are contained on deck per thousand Barge Transfers did your company have during 1995? (Formula--Number of Spills X 1000 divided by number of transfers)

Spills on deck per 1,000 transfers

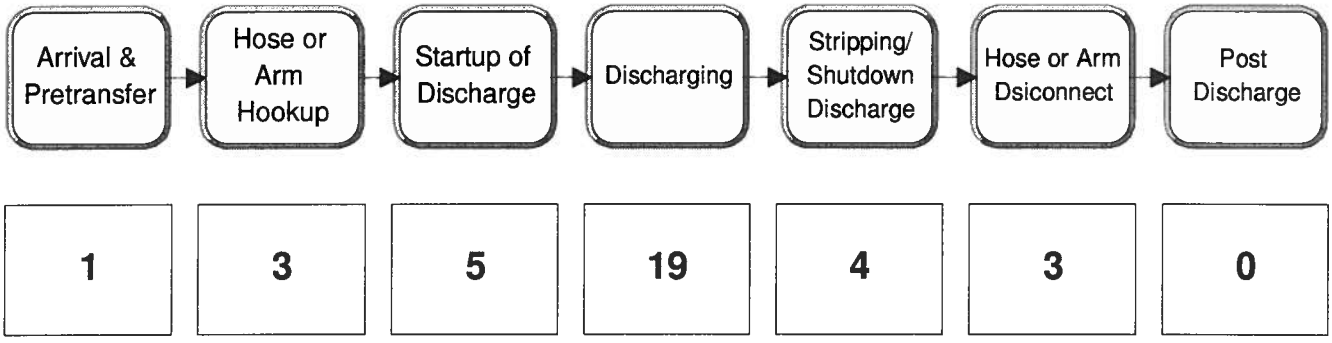
0.66

LOAD BARGE PROCESS (Facility to Barge or Barge to Barge or Ship to Barge)



How many spills in the water occurred at each of the steps above in 1995?

DISCHARGE BARGE(Barge to Facility or Barge to Barge or Barge to Ship)



How many spills in the water occurred at each of the steps above in 1995?

APPENDIX G

AWO Survey on Tank Barge Spills
Page 2 of 2

Results From 26 Surveys

- Column B shows 14 types of causes for tank barge spills during transfers.
- Columns C, D, E, and F show the steps in the loading and discharging processes which the QAT estimates are the steps usually associated with spills.
- Please identify the top three causes of spills for your company in each of the columns C, D, E, and F. Therefore, each column will have three causes marked.
- Your comments are invited.

A- Major Category	B- Sub-category	C- Loading Startup	D- Loading Top Off/ Shutdown	E- Discharge Startup	F- Discharge Shutdown/ Stripping	G- Total
People	1. Not following procedures	14	15	14	11	54
	2. Misuse/ not using equipment	5	5	5	4	19
	3. Not knowledgeable/ skilled	3	6	4	3	16
Equipment	4. Missing equipment	2	1	1	0	4
	5. Equipment not functioning	9	9	7	6	31
	6. Equipment not maintained	3	2	3	2	10
	7. Poor equipment design	1	2	1	0	4
Procedures	8. No written procedures	1	1	1	0	3
	9. Inadequate procedures	3	2	2	1	8
	10. Missing procedures	1	1	1	0	3
	11. Unusual operations	3	3	2	1	9
Environment	12. Natural conditions	2	2	2	1	7
	13. Waterway	1	1	1	1	4
	14. Workplace- hurry up	5	8	7	6	26
TOTAL		53	58	51	36	198

APPENDIX H Best Practices		**Name of Company**
Management	Hire, retain, and recognize quality people	Crowley; Cenac Towing; Maritrans; Kirby
Equipment	Preventative maintenance program in place which ensures equipment is well maintained.	Crowley; Cenac Towing; Coastal Towing; ; Kirby
Training	Regular Safety meetings (including lessons-learned).	Crowley; Cenac Towing; Maritrans; Coastal Towing; JIT Terminal; Kirby
Communications	Investigate incidents and share findings (causal factors, root cause) with entire fleet.	Petroleum Service Corporation; Crowley; Cenac Towing; Coastal Towing; Kirby
People not following procedures	Use of Hi-level indicators during topoff; audible/visible alarm.	Cenac Towing; Maritrans; Coastal Towing; Kirby
Inadequate Procedures	Investigate incidents, conduct root cause analysis, involve employees in process improvements, share lessons learned.	Petroleum Service Corporation; Crowley; Cenac Towing; Maritrans; Coastal Towing; Kirby
Procedure	Reduce top-off load rates.	Petroleum Service Corporation; Crowley; Cenac Towing; Kirby
Procedure	Watch change policy: no watch/shift changes during "critical" points.	Crowley; Cenac Towing; Coastal Towing; Kirby
Equipment	Upgrading barges (replace single skin barge with double hull/vapor recovery/overfill-protected barges.	Cenac Towing; Maritrans; Kirby
People not following procedures	No crew change during critical phases; e.g. topoff, etc.	Crowley; Cenac Towing; Maritrans; Coastal Towing; Kirby
People not following procedures	Internal audit of procedures; third party (experienced/knowledgeable) or self	Maritrans; Kirby
Management	Management involved; frequent visits to get to know people & support	Crowley; Cenac Towing; Coastal Towing; JIT Terminal; Kirby;
Procedure	Employee involvement in procedure and process improvements	Petroleum Service Corporation; Maritrans; JIT Terminal; Kirby
Procedure	Clear and precise "oil transfer procedures" for all classes of barges.	Maritrans; Kirby
Communications	Encourage reporting of unsafe conditions.	Petroleum Service Corporation; Cenac Towing; Maritrans; Coastal Towing; JIT Terminal; Kirby
Equipment	Use of all available technology such as remote gauge indicators/alarms.	Crowley; Cenac Towing; Kirby
Equipment not functioning or not maintained properly	Preventive maintenance sytem developed and implemented.	Cenac Towing; Coastal Towing; Kirby
Management	Keeping the same people working together; consistent crews	Cenac Towing; Maritrans
Communications	More formal incident investigation.	Petroleum Service Corporation; Cenac Towing; Kirby
People not knowledgeable or skilled	Development and implementation of formal training plan.	Crowley; Cenac Towing; Maritrans; Coastal Towing; ; Kirby
People not knowledgeable or skilled	Familiarization with vessel & equipment.	Cenac Towing; Maritrans; Kirby
Management	Spill/injury incentive bonus (quarterly)	Petroleum Service Corporation; Maritrans; Coastal Towing; Kirby
Management	Wheelhouse personnel be tankerman licensed	Cenac Towing; Kirby
Management	Career ladder opportunities available	Maritrans; Coastal Towing; Kirby

Best Practices (3)

Management	Employee suggested improvement system	Maritrans; Coastal Towing; JIT Terminal; Kirby
Procedure	Stop loads at 95%.	Crowley; Maritrans (98%); Coastal Towing
Training	USCG approved tankerman liquids school.	Petroleum Service Corporation; Cenac Towing; Maritrans; Coastal Towing; JIT Terminal; Kirby
Communications	QA audits and on-scene spot checks.	Petroleum Service Corporation; Cenac Towing; Maritrans; Coastal Towing; Kirby
Procedure	Pre-readiness barge check in a documented form.	Crowley; Cenac Towing; Maritrans; Coastal Towing; Kirby
Procedure	Documented pre-transfer conference, dockman included; both PIC's, Vessel Captain.	Crowley; Coastal Towing
Procedure	Start-up, top-off, connect & disconnect policies/practices: wheelman on barge during these phases as "extra" set of eyes.	Crowley; Cenac Towing; Coastal Towing; Kirby
Training	SIP (Streamlined Inspection Process) trained crews. They are better educated because they take ownership.	Cenac Towing; Kirby
Training	Mentoring (apprenticeship) program.	Petroleum Service Corporation; Coastal Towing; JIT Terminal; Kirby
Training	Shoreside Tankerman "best of best" observe trainees.	Coastal Towing
Communications	Review near misses (deck spills) for what went right!	Crowley
Communications	Partnering relationships with customers.	Petroleum Service Corporation; Cenac Towing; Maritrans; Coastal Towing; JIT Terminal; Kirby; AWO/USCG
Communications	Informing employees on spill trend analysis.	Petroleum Service Corporation; Cenac Towing; Maritrans; Coastal Towing; Kirby
People not following procedures	Continual training.	Cenac Towing; Coastal Towing; JIT Terminal; Kirby
Equipment not functioning or not maintained properly	Select appropriate equipment for intended service/use.	Cenac Towing; Maritrans
Equipment not functioning or not maintained properly	Pre-transfer equipment checks (similar to "vital system survey" on vsls > 5,000 GT)	Crowley; Maritrans
People not knowledgeable or skilled	Indoctrination procedure with basic knowledge.	Petroleum Service Corporation; Crowley; Cenac Towing; Maritrans; Kirby
People not knowledgeable or skilled	Periodic refresher training	Petroleum Service Corporation; Cenac Towing; Maritrans; Kirby
Management	Support employees family etc. while working away from home.	Cenac Towing; Coastal Towing; Kirby
Procedure	Establishing reasonable maximum workday policy	Petroleum Service Corporation; Crowley; Coastal Towing; Kirby
People not following procedures	USCG don't interrupt PIC during critical operations.	
People not following procedures	Ensure all employees have access to procedures.	Cenac Towing; Maritrans; Coastal Towing; JIT Terminal; Kirby

Best Practices (3)

Equipment not functioning or not maintained properly	Failure analysis review.	
Equipment not functioning or not maintained properly	PIC's exchange information on observed problems.	
Management	Tugs/barges are one unit. Do not switch barges between boats. Result: crew familiarization w barge & subsystems is consistent.	Cenac Towing; Maritrans (most of the time)
Procedure	Tracking rest period between jobs.	Petroleum Service Corporation
Training	Training employees on towing customer expectations/requirements.	Petroleum Service Corporation; Cenac Towing; Maritrans
Training	Redundant crews/training available to reduce stress, illness, family concerns.	Cenac Towing
Training	Different phases of training throughout "learning process" & follow-up; i.e. continuous learning/training	Cenac Towing; JIT Terminal; Kirby
Communications	Record/measure transfer data.	Petroleum Service Corporation; Cenac Towing
Communications	Tankerman/Tug operator allowed input on sales transaction.	
Equipment	Provide tools/comfort for barge people.	Cenac Towing; Maritrans
People not following procedures	Background checks for new hires.	Cenac Towing; Maritrans; Coastal Towing; JIT Terminal; Kirby
Equipment not functioning or not maintained properly	Enhanced survey of structure and equipment for barges < 5,000 GT.	Maritrans
Communications	Surveying customers on expectations.	Petroleum Service Corporation; Cenac Towing; Maritrans
Communications	Developing qualification certifications for specific jobs.	Petroleum Service Corporation; Maritrans
Communications	Quality Reporting System (tracking).	Petroleum Service Corporation; Kirby
Communications	Quality Report System (sharing lessons learned).	Petroleum Service Corporation; Cenac Towing; Kirby
Equipment	In-house staff of mechanics that maintain barges. Result: better quality control.	Cenac Towing; Maritrans; Coastal Towing
Equipment not functioning or not maintained properly	Equipment failure rate database; eg. CMMS.	
People not knowledgeable or skilled	Use of "What if" scenarios in training.	Petroleum Service Corporation
Training	Trainers compensated	Petroleum Service Corporation
Communications	Use data for reasonable delivery promises.	
People not knowledgeable or skilled	New tankerman regulations are improving quality of people.	Petroleum Service Corporation; Cenac Towing

Transfer Spill Report

To be completed when there is a spill that reaches the water during barge cargo transfer operation.

Step in the transfer process where the water spill occurred

(check only one)

A) LOADING BARGE (see definitions on back):

1 Arrival & Pre-transfer	→	2 Hose/Arm Hookup	→	3 Startup	→	4 Loading	→	5 Top-off Load	→	6 Hose/Arm Disconnect	→	7 Post-Transfer
○		○		○		○		○		○		○

B) DISCHARGING BARGE (see definitions on back):

1 Arrival & Pre-transfer	→	2 Hose/Arm Hookup	→	3 Startup	→	4 Discharging	→	5 Shutdown/ stripping	→	6 Hose/Arm Disconnect	→	7 Post-Transfer
○		○		○		○		○		○		○

Approximate number of gallons spilled *(check only one)*

- ○ < 1 gallon
- ○ 1-9 gallons
- ○ 10-24 gallons
- ○ 25-49 gallons
- ○ 50-74 gallons
- ○ 75-99 gallons
- ○ 100-999 gallons
- ○ 1000 or more gallons

Transfer Involved *(Check only one)*

- ○ Barge - Barge
- ○ Barge - Ship
- ○ Barge - Facility

The type of product spilled *(check only one)*

- ○ Oil
- ○ Chemical

Month/Year of Spill

Month _____ Year _____

Time of Day *(use 24 hour clock)* _____

The cause or causes of spill *(check up to 3)*

PEOPLE	○ **1** Not following procedures	○ **3** Lack of knowledge or skill
	○ **2** Misuse or non-use of equipment	
EQUIPMENT	○ **4** Missing Equipment	○ **6** Equipment not maintained
	○ **5** Equipment not functioning	○ **7** Poor equipment design
PROCEDURES	○ **8** No written procedures	○ **10** Missing procedures
	○ **9** Inadequate procedures	○ **11** Unusual Operations
ENVIRONMENT	○ **12** Natural conditions	○ **14** Workplace-hurry up
	○ **13** Waterway	

Mail or fax within 10 working days of spill to:

AWO
1600 Wilson Blvd., Suite 1000
Arlington VA 22209

(703) 841-9300
fax: (703) 841-0389

Definitions and Processes

SPILL DEFINITIONS

SPILL

Any cargo or operating fluid that escapes the designed containment system

WATER SPILL

Any spill that reaches the water

LOADING PROCESS STEPS

STEP 1 - ARRIVAL AND PRE-TRANSFER

Secured at dock prior to hose connection

STEP 2 - HOSE/ARM CONNECTION

Preparation to receive dock hose/arm up to point at which the hose is secured to the manifold

FOLD

STEP 3 - STARTUP

From agreement between barge and shore PIC to begin transfer up to reaching agreed upon maximum (flow/discharge) rate

STEP 4 - LOADING

From reaching maximum flow rate up to reaching top-off* on first compartment.

STEP 5 - TOP-OFF*

From top-Off* of first compartment up to top-off* of last compartment being loaded

STEP 6 - DISCONNECT

Completion of load up to removal, securing, and bleeding hose/arm and manifold.

SET 7 - POST-TRANSFER

Completion of disconnect up to release from dock

*TOP-OFF LEVEL

Equals a level established by company (e.g. 95% tank capacity; or 15 min prior to reaching level; etc.)

FOLD

DISCHARGE PROCESS STEPS

STEP 1 - ARRIVAL AND PRE-TRANSFER

Secured at dock prior to hose connection

STEP 2 - HOSE/ARM CONNECTION

Preparation to receive dock hose/arm up to point at which the hose is secured to the manifold

STEP 3 - STARTUP

From agreement between barge and shore PIC to begin transfer up to reaching agreed upon maximum (flow/discharge) rate

STEP 4 - DISCHARGING

From reaching maximum flow rate until flow rate is reduced to begin stripping process.

STEP 5 - STRIPPING/SHUTDOWN

From reduction of rate until completion of transfer when discharge pump is disengaged and valves are closed on vessel and dock.

STEP 6 - DISCONNECT

Completion of discharge up though removal, securing, and bleeding of hose/arm and manifold.

SET 7 - POST-TRANSFER

From completion of disconnect up to release from dock

Place Stamp Here

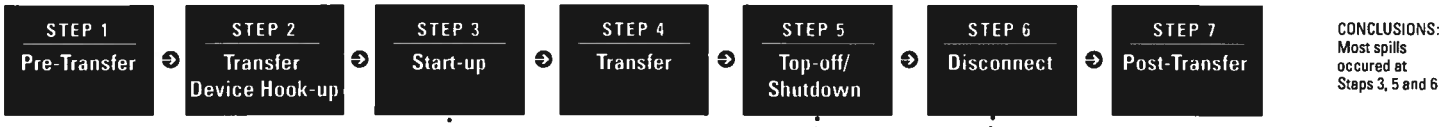
AWO
1600 Wilson Boulevard, Suite 1000
Arlington VA 22209

Appendix D

Quality Approach - Specific Results

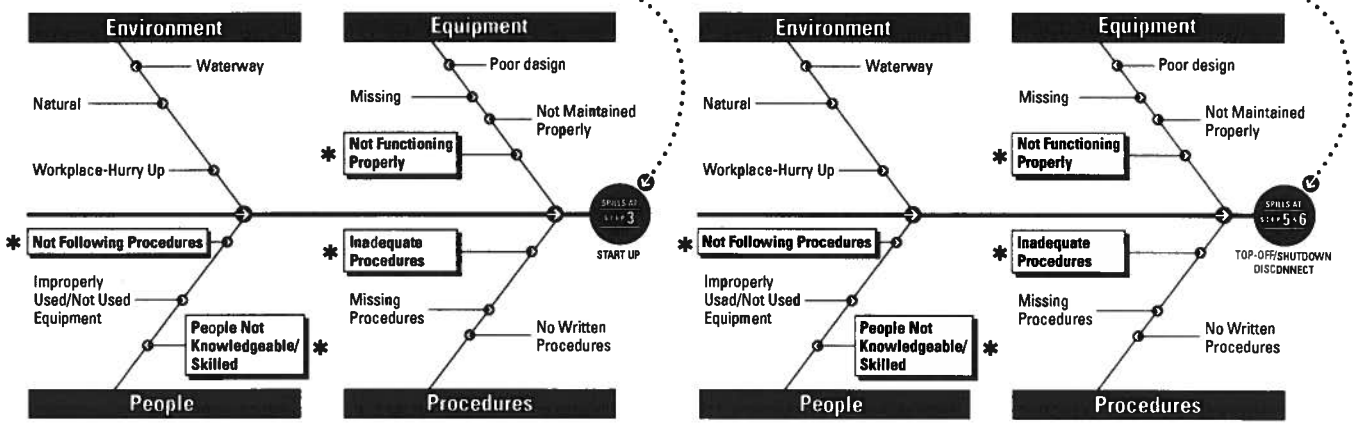
Loading Barge

PROCESS*



CONCLUSIONS: Most spills occured at Steps 3, 5 and 6

ROOT CAUSE DIAGRAM**



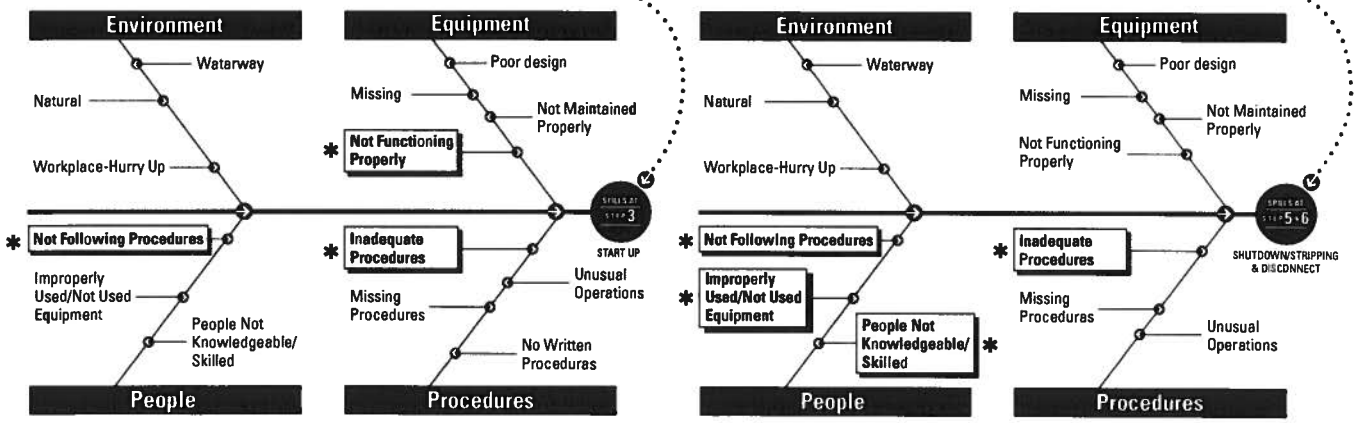
CONCLUSIONS: Highest impact causes are starred ✱

Discharging Barge

PROCESS*

CONCLUSIONS: Most spills occurad at Steps 3, 5 and 6

ROOT CAUSE DIAGRAM**

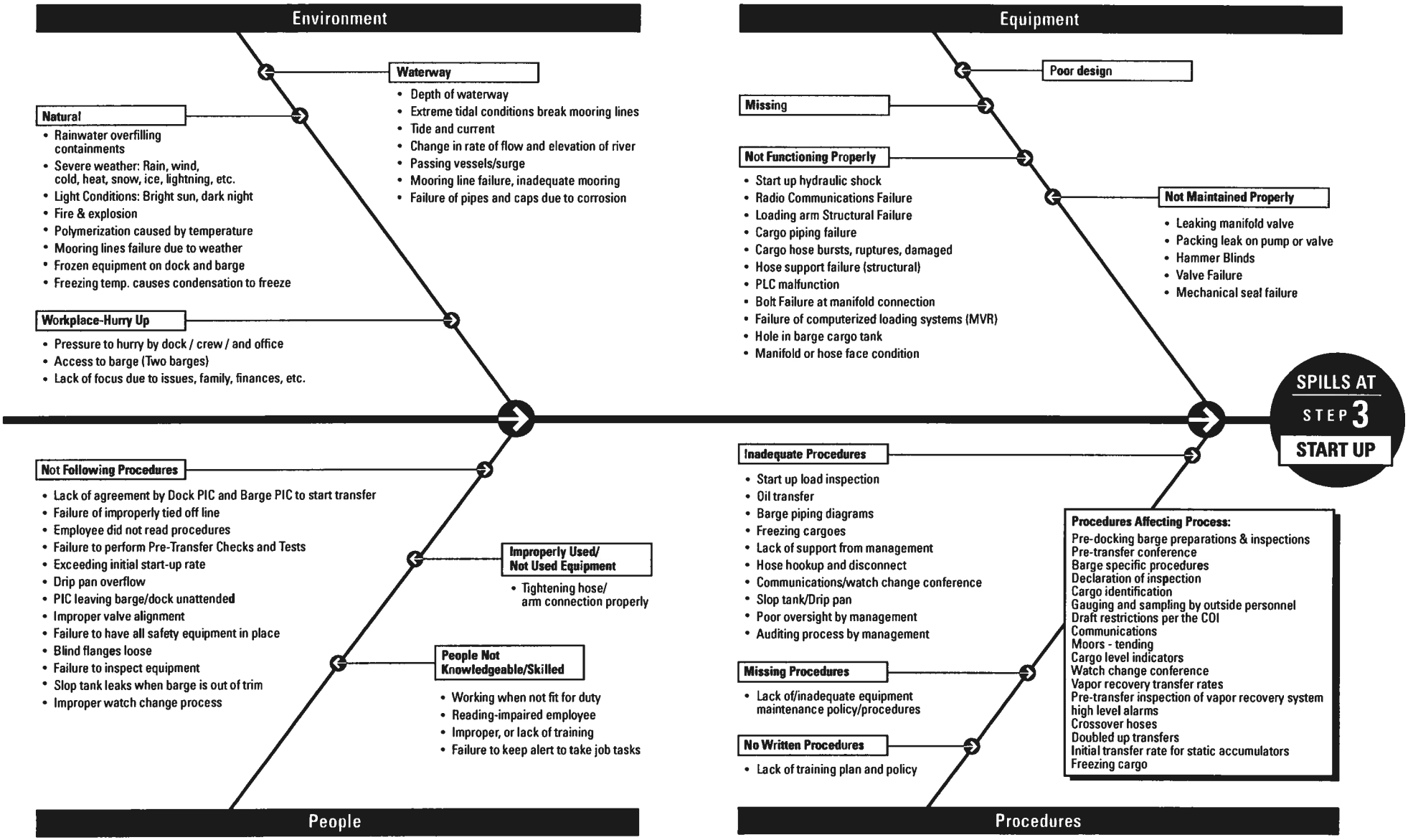


CONCLUSIONS: Highast impact causes are starred ✱

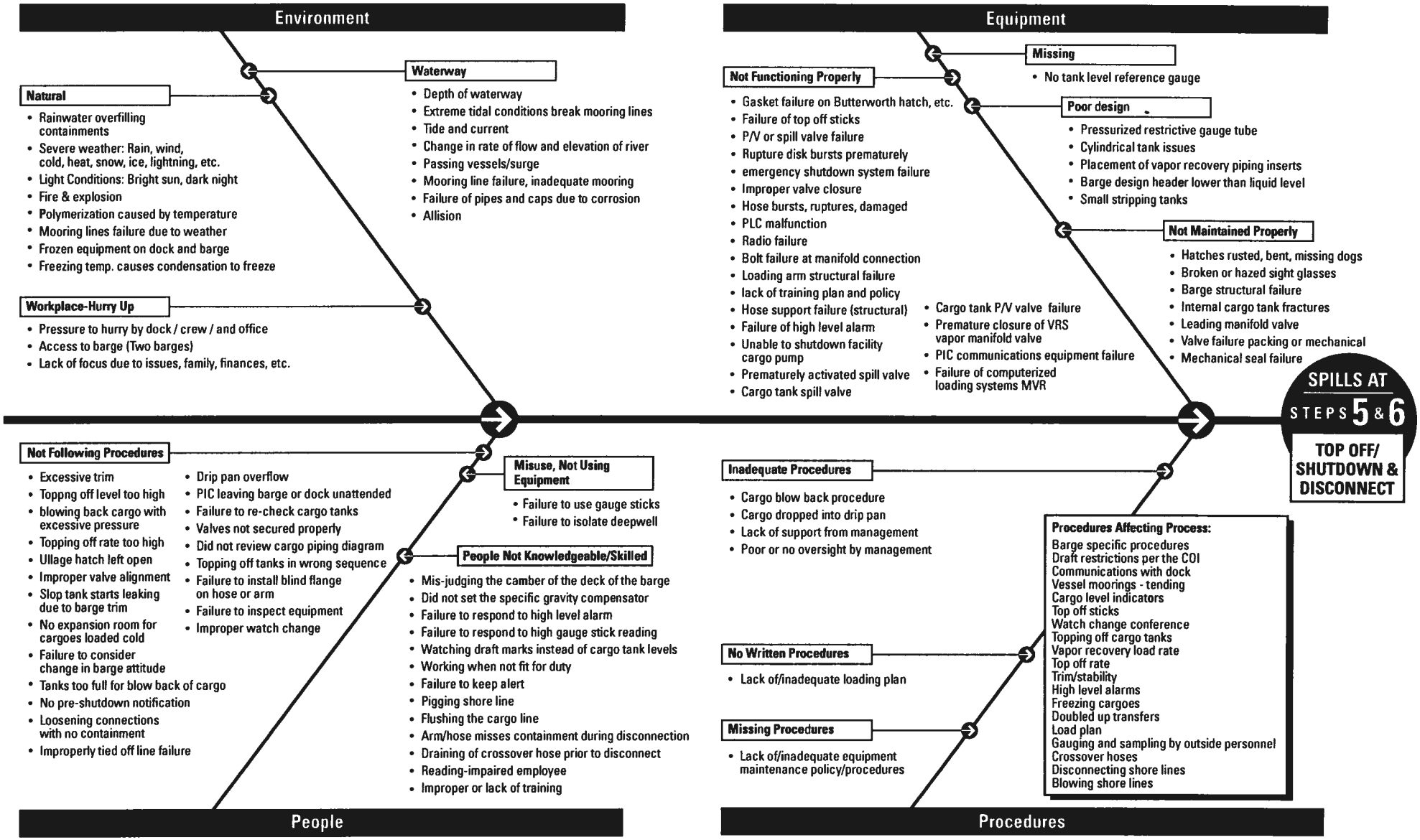
*PROCESSES - Detailed in Appendix D-7

**ROOT CAUSE DIAGRAMS - Detailed in Appendices D-2 through D-5

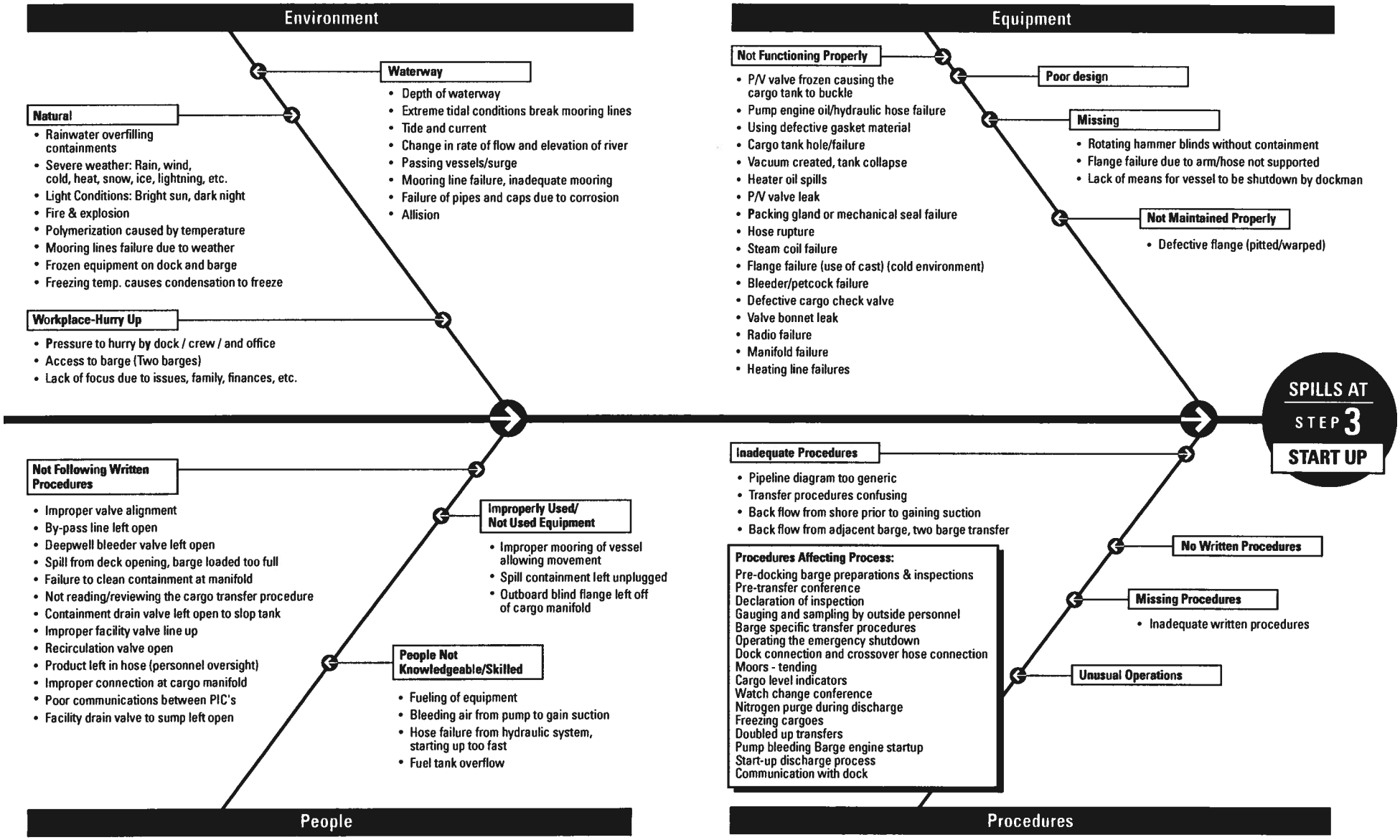
Loading


Environment
Waterway
• Depth of waterway
• Extreme tidal conditions break mooring lines
• Tide and current
• Change in rate of flow and elevation of river
• Passing vessels/surge
• Mooring line failure, inadequate mooring
• Failure of pipes and caps due to corrosion
Natural
• Rainwater overfilling containments
• Severe weather: Rain, wind, cold, heat, snow, ice, lightning, etc.
• Light Conditions: Bright sun, dark night
• Fire & explosion
• Polymerization caused by temperature
• Mooring lines failure due to weather
• Frozen equipment on dock and barge
• Freezing temp. causes condensation to freeze
Workplace-Hurry Up
• Pressure to hurry by dock / crew / and office
• Access to barge (Two barges)
• Lack of focus due to issues, family, finances, etc.
Equipment
Poor design
Missing
Not Functioning Properly
• Start up hydraulic shock
• Radio Communications Failure
• Loading arm Structural Failure
• Cargo piping failure
• Cargo hose bursts, ruptures, damaged
• Hose support failure (structural)
• PLC malfunction
• Bolt Failure at manifold connection
• Failure of computerized loading systems (MVR)
• Hole in barge cargo tank
• Manifold or hose face condition
Not Maintained Properly
• Leaking manifold valve
• Packing leak on pump or valve
• Hammer Blinds
• Valve Failure
• Mechanical seal failure
SPILLS AT STEP 3 START UP
Not Following Procedures
• Lack of agreement by Dock PIC and Barge PIC to start transfer
• Failure of improperly tied off line
• Employee did not read procedures
• Failure to perform Pre-Transfer Checks and Tests
• Exceeding initial start-up rate
• Drip pan overflow
• PIC leaving barge/dock unattended
• Improper valve alignment
• Failure to have all safety equipment in place
• Blind flanges loose
• Failure to inspect equipment
• Slop tank leaks when barge is out of trim
• Improper watch change process
Improperly Used/ Not Used Equipment
• Tightening hose/ arm connection properly
People Not Knowledgeable/Skilled
• Working when not fit for duty
• Reading-impaired employee
• Improper, or lack of training
• Failure to keep alert to take job tasks
Inadequate Procedures
• Start up load inspection
• Oil transfer
• Barge piping diagrams
• Freezing cargoes
• Lack of support from management
• Hose hookup and disconnect
• Communications/watch change conference
• Slop tank/Drip pan
• Poor oversight by management
• Auditing process by management
Missing Procedures
• Lack of/inadequate equipment maintenance policy/procedures
No Written Procedures
• Lack of training plan and policy
Procedures Affecting Process:
Pre-docking barge preparations & inspections
Pre-transfer conference
Barge specific procedures
Declaration of inspection
Cargo identification
Gauging and sampling by outside personnel
Draft restrictions per the COI
Communications
Moors - tending
Cargo level indicators
Watch change conference
Vapor recovery transfer rates
Pre-transfer inspection of vapor recovery system high level alarms
Crossover hoses
Doubled up transfers
Initial transfer rate for static accumulators
Freezing cargo
People
Procedures

Loading


Environment
Natural
• Rainwater overfilling containments
• Severe weather: Rain, wind, cold, heat, snow, ice, lightning, etc.
• Light Conditions: Bright sun, dark night
• Fire & explosion
• Polymerization caused by temperature
• Mooring lines failure due to weather
• Frozen equipment on dock and barge
• Freezing temp. causes condensation to freeze
Waterway
• Depth of waterway
• Extreme tidal conditions break mooring lines
• Tide and current
• Change in rate of flow and elevation of river
• Passing vessels/surge
• Mooring line failure, inadequate mooring
• Failure of pipes and caps due to corrosion
• Allision
Workplace-Hurry Up
• Pressure to hurry by dock / crew / and office
• Access to barge (Two barges)
• Lack of focus due to issues, family, finances, etc.
Equipment
Not Functioning Properly
• Gasket failure on Butterworth hatch, etc.
• Failure of top off sticks
• P/V or spill valve failure
• Rupture disk bursts prematurely
• emergency shutdown system failure
• Improper valve closure
• Hose bursts, ruptures, damaged
• PLC malfunction
• Radio failure
• Bolt failure at manifold connection
• Loading arm structural failure
• lack of training plan and policy
• Hose support failure (structural)
• Failure of high level alarm
• Unable to shutdown facility cargo pump
• Prematurely activated spill valve
• Cargo tank spill valve
• Cargo tank P/V valve failure
• Premature closure of VRS vapor manifold valve
• PIC communications equipment failure
• Failure of computerized loading systems MVR
Missing
• No tank level reference gauge
Poor design
• Pressurized restrictive gauge tube
• Cylindrical tank issues
• Placement of vapor recovery piping inserts
• Barge design header lower than liquid level
• Small stripping tanks
Not Maintained Properly
• Hatches rusted, bent, missing dogs
• Broken or hazed sight glasses
• Barge structural failure
• Internal cargo tank fractures
• Leading manifold valve
• Valve failure packing or mechanical
• Mechanical seal failure
SPILLS AT STEPS 5 & 6
TOP OFF/ SHUTDOWN & DISCONNECT
Not Following Procedures
• Excessive trim
• Toppng off level too high
• blowing back cargo with excessive pressure
• Topping off rate too high
• Ullage hatch left open
• Improper valve alignment
• Slop tank starts leaking due to barge trim
• No expansion room for cargoes loaded cold
• Failure to consider change in barge attitude
• Tanks too full for blow back of cargo
• No pre-shutdown notification
• Loosening connections with no containment
• Improperly tied off line failure
• Drip pan overflow
• PIC leaving barge or dock unattended
• Failure to re-check cargo tanks
• Valves not secured properly
• Did not review cargo piping diagram
• Topping off tanks in wrong sequence
• Failure to install blind flange on hose or arm
• Failure to inspect equipment
• Improper watch change
Misuse, Not Using Equipment
• Failure to use gauge sticks
• Failure to isolate deepwell
People Not Knowledgeable/Skilled
• Mis-judging the camber of the deck of the barge
• Did not set the specific gravity compensator
• Failure to respond to high level alarm
• Failure to respond to high gauge stick reading
• Watching draft marks instead of cargo tank levels
• Working when not fit for duty
• Failure to keep alert
• Pigging shore line
• Flushing the cargo line
• Arm/hose misses containment during disconnection
• Draining of crossover hose prior to disconnect
• Reading-impaired employee
• Improper or lack of training
Inadequate Procedures
• Cargo blow back procedure
• Cargo dropped into drip pan
• Lack of support from management
• Poor or no oversight by management
No Written Procedures
• Lack of/inadequate loading plan
Missing Procedures
• Lack of/inadequate equipment maintenance policy/procedures
Procedures Affecting Process:
Barge specific procedures
Draft restrictions per the COI
Communications with dock
Vessel moorings - tending
Cargo level indicators
Top off sticks
Watch change conference
Topping off cargo tanks
Vapor recovery load rate
Top off rate
Trim/stability
High level alarms
Freezing cargoes
Doubled up transfers
Load plan
Gauging and sampling by outside personnel
Crossover hoses
Disconnecting shore lines
Blowing shore lines
People
Procedures

Discharge


Environment
Waterway
• Depth of waterway
• Extreme tidal conditions break mooring lines
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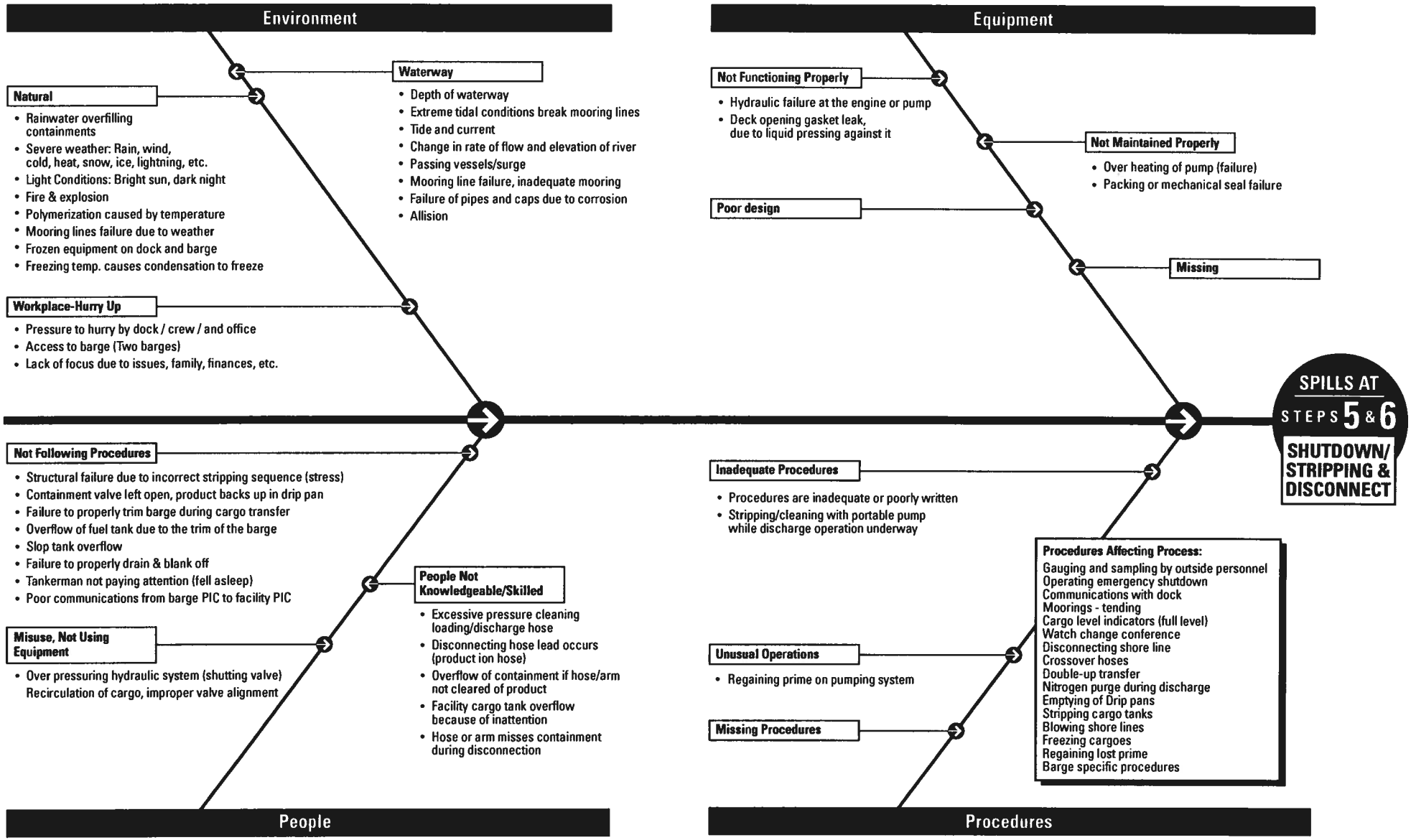
• Passing vessels/surge
• Mooring line failure, inadequate mooring
• Failure of pipes and caps due to corrosion
• Allision
Natural
• Rainwater overfilling containments
• Severe weather: Rain, wind, cold, heat, snow, ice, lightning, etc.
• Light Conditions: Bright sun, dark night
• Fire & explosion
• Polymerization caused by temperature
• Mooring lines failure due to weather
• Frozen equipment on dock and barge
• Freezing temp. causes condensation to freeze
Workplace-Hurry Up
• Pressure to hurry by dock / crew / and office
• Access to barge (Two barges)
• Lack of focus due to issues, family, finances, etc.
Equipment
Not Functioning Properly
• P/V valve frozen causing the cargo tank to buckle
• Pump engine oil/hydraulic hose failure
• Using defective gasket material
• Cargo tank hole/failure
• Vacuum created, tank collapse
• Heater oil spills
• P/V valve leak
• Packing gland or mechanical seal failure
• Hose rupture
• Steam coil failure
• Flange failure (use of cast) (cold environment)
• Bleeder/petcock failure
• Defective cargo check valve
• Valve bonnet leak
• Radio failure
• Manifold failure
• Heating line failures
Poor design
Missing
• Rotating hammer blinds without containment
• Flange failure due to arm/hose not supported
• Lack of means for vessel to be shutdown by dockman
Not Maintained Properly
• Defective flange (pitted/warped)
SPILLS AT STEP 3 START UP
Not Following Written Procedures
• Improper valve alignment
• By-pass line left open
• Deepwell bleeder valve left open
• Spill from deck opening, barge loaded too full
• Failure to clean containment at manifold
• Not reading/reviewing the cargo transfer procedure
• Containment drain valve left open to slop tank
• Improper facility valve line up
• Recirculation valve open
• Product left in hose (personnel oversight)
• Improper connection at cargo manifold
• Poor communications between PIC's
• Facility drain valve to sump left open
Improperly Used/ Not Used Equipment
• Improper mooring of vessel allowing movement
• Spill containment left unplugged
• Outboard blind flange left off of cargo manifold
People Not Knowledgeable/Skilled
• Fueling of equipment
• Bleeding air from pump to gain suction
• Hose failure from hydraulic system, starting up too fast
• Fuel tank overflow
People
Inadequate Procedures
• Pipeline diagram too generic
• Transfer procedures confusing
• Back flow from shore prior to gaining suction
• Back flow from adjacent barge, two barge transfer
Procedures Affecting Process:
Pre-docking barge preparations & inspections
Pre-transfer conference
Declaration of inspection
Gauging and sampling by outside personnel
Barge specific transfer procedures
Operating the emergency shutdown
Dock connection and crossover hose connection
Moors - tending
Cargo level indicators
Watch change conference
Nitrogen purge during discharge
Freezing cargoes
Doubled up transfers
Pump bleeding Barge engine startup
Start-up discharge process
Communication with dock
No Written Procedures
Missing Procedures
• Inadequate written procedures
Unusual Operations
Procedures

Discharge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• Tide and current
• Change in rate of flow and elevation of river
• Passing vessels/surge
• Mooring line failure, inadequate mooring
• Failure of pipes and caps due to corrosion
• Allision
Workplace-Hurry Up
• Pressure to hurry by dock / crew / and office
• Access to barge (Two barges)
• Lack of focus due to issues, family, finances, etc.
Equipment
Not Functioning Properly
• Hydraulic failure at the engine or pump
• Deck opening gasket leak, due to liquid pressing against it
Not Maintained Properly
• Over heating of pump (failure)
• Packing or mechanical seal failure
Poor design
Missing
SPILLS AT STEPS 5 & 6
SHUTDOWN/ STRIPPING & DISCONNECT
Not Following Procedures
• Structural failure due to incorrect stripping sequence (stress)
• Containment valve left open, product backs up in drip pan
• Failure to properly trim barge during cargo transfer
• Overflow of fuel tank due to the trim of the barge
• Slop tank overflow
• Failure to properly drain & blank off
• Tankerman not paying attention (fell asleep)
• Poor communications from barge PIC to facility PIC
People Not Knowledgeable/Skilled
• Excessive pressure cleaning loading/discharge hose
• Disconnecting hose lead occurs (product ion hose)
• Overflow of containment if hose/arm not cleared of product
• Facility cargo tank overflow because of inattention
• Hose or arm misses containment during disconnection
Misuse, Not Using Equipment
• Over pressuring hydraulic system (shutting valve) Recirculation of cargo, improper valve alignment
Inadequate Procedures
• Procedures are inadequate or poorly written
• Stripping/cleaning with portable pump while discharge operation underway
Procedures Affecting Process:
Gauging and sampling by outside personnel
Operating emergency shutdown
Communications with dock
Moorings - tending
Cargo level indicators (full level)
Watch change conference
Disconnecting shore line
Crossover hoses
Double-up transfer
Nitrogen purge during discharge
Emptying of Drip pans
Stripping cargo tanks
Blowing shore lines
Freezing cargoes
Regaining lost prime
Barge specific procedures
Unusual Operations
• Regaining prime on pumping system
Missing Procedures
People
Procedures

Quality Approach - Specific Results

High Impact Root Causes	**Solutions*** (Output of brainstorming)	**Solutions High Impact** (Output of voting)
PEOPLE Not Following Procedures	23	7
PEOPLE Misuse/ Not Using Equipment	5	2
PEOPLE Not Knowledgeable/ Skilled	14	4
EQUIPMENT Not Functioning	18	7
PROCEDURES Inadequate	10	5
5	70	25

Solutions → **Action Plans**

- List Actions and who responsible and when
- Communication plan for solutions
- Costs/Benefits
- QAT ratings on effectiveness and cost of each activity

*SOLUTIONS (70) - See Appendices D-8 through D-10

Transfer Process

Loading Barge

1.1 Pre-arrival inspection/notify
1.2 ID cargo with MSDS, CIC card
1.3 Identify PPE required for cargo
1.4 Vapor recovery inspections
1.5 Inspect moorings
1.6 Take facility line samples
1.7 Gauging service clearance
1.8 Execute DOI
1.9 Conduct pre-transfer conference
1.10 Report barge deficiencies
1.11 Check for spill response
1.12 Review barge specific transfer procedures and COI

2.1 Decide which devices hooked up
2.2 Inspect hoses
2.3 Inspect gaskets
2.4 Hook-up
2.5 Inspect all connections
2.6 Ensure proper slack
2.7 Inspect vapor recovery hook-up (same steps as above)

3.1 Conduct line samples/one foot samples
3.2 Check valve alignment
3.3 Meet static accumulator requirements
3.4 Determine nitrogen purge requirements
3.5 Tankerman/ facility and surveyors concur
3.6 Start transfer
3.7 Check headers, valves, etc.
3.8 Verify cargo being received

4.1 Monitor operations-tank levels, moorings, valves, trim; ensure PIC in attendance
4.2 Maintain communication during transfer
4.3 Conduct change-of-watch conference
4.4 Sign DOI at change-of-watch

5.1 Notify dock when at top-off stage
5.2 Monitor tank levels/trim; adjust valves
5.3 Slow rate of transfer
5.4 Give final top-off notice
5.5 Shutdown

6.1 Clear lines
6.2 Close valves
6.3 Disconnect hose/load arm, blind headers
6.4 Secure hoses/ arms

7.1 Undergo inspection of barge/facility tanks
7.2 Conduct pre-voyage inspection
7.3 Receive facility release

Discharging Barge

1.1 Gauge vessel and facility tanks
1.2 Conduct inspection and testing
1.3 Hold pre-transfer conference, plan transfer and DOI

2.1 Verify transfer device is product-free
2.1.1 Position device
2.1.1.1 Insulate flange or connect bonding cable
2.2 Remove blanks over containment area
2.3 Ensure all elements for positive connection are present
2.4 Perform connection with positive seal
2.5 Ensure proper support of transfer device

3.1 Align valves
3.2 Start pump engine
3.3 Agree to begin transfer
3.4 Start product flow
3.5 Check for leaks
3.6 Agree to increase rate to max flow

4.1 Increase rate
4.2 Monitor & adjust as necessary: Moorings; Product levels, temp, pressure; Trim & list; Leaks in transfer system; Pump & tank valves; Machinery & engine; Periodic communication on status w/other PICs
4.3 Shift change inspection & completion of DOI (both copies); Update on transfer status

5.1 Pre-shut notification (facility & others as needed)
5.2 Decrease rate; throttle valve; slow pump engine
5.3 Monitor & adjust product level, temp & pressure
5.4 Communicate shutdown complete
5.5 Secure pumps & valve

6.1 Drain transfer device (or blowdown or depressurize)
6.2 Adjust support/ transfer device
6.3 Disconnect transfer device
6.4 Disconnect bonding cable
6.5 Reinstall blanks
6.6 Secure transfer device

7.1 Gauge/inspect tanks
7.2 Close valves & hatches & secure barge
7.3 Complete paperwork & obtain release

APPENDIX J. References

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11. Results of Pollution Prevention Regulations Study; Quality Action Team on Pollution Prevention Regulations, November 1995.

12. Human Factor Analysis of Human Reliability in Marine Systems; University of Miami (Report to be published/released in Summer 1997).

13. AWO Survey on Tank Barge Transfer Spills, American Waterways Operators, December 1996.

14. Prevention Trough People; Quality Action Team Report; Office of Marine Safety, Security, and Environmental Protection; Office of Navigation, Safety and Waterways Services; July 15, 1995.

APPENDIX K

Glossary of Terms

Spill	Any cargo or operating fluid that escapes the designed containment system.
Deck Spill	Any spill that does not reach the water or is below the reportable quantity.
Water Spill	Any spill into the water that must be reported in accordance with the regulations.
Arrival & Pre-Transfer	Vessel or Barge is secured at the dock prior to hose/loading arm connection.
Hose/Arm Hookup	Preparation to receive dock hose or loading arm up to the point at which the hose/arm is secured to the manifold.
Startup	From agreement between the barge and shoreside PIC to begin the flow of product up to reaching the agreed maximum flow rate.
Loading/ Discharging	From reaching the maximum flow rate up to reaching the topoff or stripping point on the first compartment.
Topoff	From topoff of first compartment up to the topoff of the last compartment being loaded.
Hose/Arm Disconnect	Completion of load/discharge up to removal, securing & bleeding of the hose, loading arm, and manifold.
Post Transfer	Completion of disconnect up to release from the dock.
Topoff Level	A level established by company policy (e.g. 95% of tank capacity or 15 minutes prior to reaching a set level, etc.).

Appendix L

PROBLEM STATEMENT re: Tank Barge Transfer Spills

AWO/USCG QAT on Tank Barge Transfer Oil Spills

Element	Conclusion	Data	Company Data
Frequency	Frequency of tank barge transfer spills is about 1.4 spills per 1,000 transfers. For all vessels, the number of reported spills have been rising during the last ten years.	***API 1986 - 1995*** # of spills rising each year: 1986 = 3,018 spills reported 1995 = 5,546 spills reported Note: tank barge transfer spills not specified/ no data available on spills per 1,000 transfers or deck spills.	***AWO Survey - 1995*** - 23 Liquid only respondents - 1.35 spills per 1,000 transfers. ***QAT Survey - 1995*** - 26 respondents - 1.41 reportable spills per 1,000 transfers. In addition, 0.66 deck spills per 1,000 transfers reported.
Volume	Most tank barge transfer spills are small volume spills and account for a small portion of the total spill volume. Non-transfer spills account for the majority of spill volume.	***API 1986 - 1995*** In 1995, barges accounted for 36% (0.4 million of the 1.1 million) gallons reported spilled from vessels and facilities. Note: subset of barge transfer spills not specified. Volume of spills has been dropping dramatically in 1990s. 1986 - 1990 avg vol per year: • barges = 1,612 gallons. • all vessels = 6,393 gallons. 1991 - 1995 avg vol per year: • barges = 477 gallons. • all vessels = 939 gallons.	***AWO - 1995*** 23 Liquid only respondents/results of tank barge cargo spills: • 1.9 gallons spilled per 100,000 barrels transferred. • 0.01 spills per 100,000 barrels transferred. • 19.4 gallons average volume spilled.

		Number of large spills dropping: • 1986-1990: almost 10 spills per year • 1991-1995: less than 4 spills per year. Note: subset of barge spills from transfer operations not specified. ***QAT Inquiry - 1991 to 6/1996*** Tank Barge Transfer Spills: • 100% = 962 spills • 57% spills: 11 or less gallons (0.8% of total volume spilled) • 28% at 11-100 gallons (5% of total volume spilled) • median = 10 gallons • average = 235 gallons Volume vs. Process • loading: 5% of volume • discharging: 2% of volume • non-transfer operations = 60% of spill volume. ***QAT Inquiry - 1994 & 1995*** 284 spills involving transfer of bulk liquid cargo or fuel: 58% of spills: Less than 11 gallons.	

Type of Cargo	QAT predicts chemical spill performance would be similar to oil spill performance. Data examined was either oil only or contained both oil and chemical but did not break out data by cargo.	***QAT Inquiry - 1994 & 1995*** All spills involving movement of bulk liquid cargo or fuel: Oil = 266 (94%) Hazmat = 18 (6%) Total = 284 (100%) ***API - 1986 to 1995*** Petroleum only data	No information on oil vs. chemical spills.
Operation Underway	Transfer spills account for the majority of spills associated with barges. The loading and discharge processes account for the majority of spills during transfer operations. The loading process is associated with more spills than the discharge process. Spills occur most frequently at loading and topoff steps of the loading process and discharge step of the discharging process.	***QAT Inquiry - 1994 & 1995*** * Loading = 155 spills (55%) * Discharge = 117 (42%) * Other = 12 (3%) Total = 284 (100%) ***QAT Inquiry - 1991 to 6/1996*** * Loading - 466 (33%) * Discharging - 319 (22%) * Other Xfr operation 286 (20%) * All Xfr operations: 1071 (75%) * Non Transfer Ops: 354 (25%) Total = 1425 (100%)	***AWO Survey - 1995*** Liquid only respondents (23) # of USCG reportable spills Tank barge cargo spills = 98 (77%) Tow vessel fuel & other = 29 (23%) Total = 127 (100%) ***QAT Survey - 1995*** 26 respondents • loading = 77 (69%) • discharge = 35 (31%) • both processes = 112 (100%) Note: only spills associated w/ loading and discharge process included in survey. Loading vs. Discharging 1. Arrival: 0 — 1. Arrival: 1 2. Hookup: 3 — 2. Hookup: 3 3. Startup: 3 — 3. Startup: 5 4. Loading: 28 — 4. Discharge: 19 5. Topoff: 27 — 5. Shut/Strip: 4 6. Disconnect: 4 — 6. Disconnect: 3 7.Post Load: 12 — 7. Post Disc: 0 Total = 77 spills — Total = 35 spills

Time of Day	Spills peak at midday (36 avg spills at 1400) and drop off during evening hours (9 at 2000). Sharp drops in spills occur at the times commonly used for shift changes (0400, 1200, and 2000).	***QAT Inquiry - 1991 to 6/1996*** See Figure in Chapter 3.	
Time of Year	Spills occur at an even rate throughout the seasons in the country overall. Regions of the country showed more variability by season.	***QAT Inquiry - 1991 to 6/1996*** All regions/ Oil & petroleum/ tank barge/all operations/# spills Spring = 260 spills (27%) Summer = 233 (24%) Fall = 206 (21%) Winter = 263 (27%) Total = 962 spills (100%)	

Cost			
Need for Change	There is a wide spread consensus that spills from barges represent an unacceptable risk to the public, environment, and employees and that the costs associated with reducing spills is less than the cost of maintaining the status quo.	USCG has limited resources. Reducing the number of spills would reduce the workload associated with investigating and following up on spills and release USCG resources for more productive uses.	Proactive approach by the industry to reducing spills will reduce the costs associated with spills, enhance workplace health and safety, help to preserve the environment and possibly avert additional costly regulatory requirements.
Desired State	Zero spills from tank barge transfer operations.	No resources expended to correct spills - only to prevent spills/prevention costs lower than correction costs.	No resources expended to correct spills--only to prevent spills/ prevention costs lower than correction costs.
Benefits of Desired State		Enhanced workplace and public health and safety, reduced cost of operations for spill correction activity .	Enhanced workplace health and safety, reduced cost of operations, improved customer service.

ACTION PLAN 1

CAUSE	Inadequate Procedures
SOLUTION	PROCESS SAFETY REVIEW

Possible Solution: Develop generic Hazard Analysis, Job Instructional Training (J.I.T.) etc. on critical operations of the transfer, i.e., start-up, top-off, etc.

Recommended Action(s):

What	Who	Impact	Cost
• Breakdown critical task step by step to illustrate what could go wrong if that step is performed incorrectly or omitted.	USCG (PTP)	Medium	Medium
• Include in Responsible Carrier Program as part of PIC training in classroom environment or as material for onboard training.	AWO	Medium	Medium

Communication Plan

What	Who	When
Publicize these generic training goals	USCG/AWO	1998

Discussion: Training only in proper procedures just tells transfer personnel what to do and does not illustrate what could happen or how severe an incident could be if the procedures are not followed. Incorporating the "what ifs" into training programs would help to better get the point across, how important each individual step in a procedure really is. This idea echoes the Prevention Through People initiative by focusing safety improvements on the people involved in the operations.

Benefits: Increase awareness of PICs.

Feasibility: Good.

ACTION PLAN 2

CAUSE	Inadequate Procedures
SOLUTION	SHARE BEST PRACTICES

Possible Solution: Some system put in place to disseminate best practices information via the Internet or other hard copy route.

Recommended Action(s):

What	Who	Impact	Cost
• Incorporate best practices section on Coast Guard Internet bulletin board and hard copy dissemination	USCG/AWO	Medium	Low

Communication Plan:

What	Who	When
• Publicize information availability to industry @ national, district and COTP level to reach all who could benefit.	USCG/AWO	1998

Discussion: Many companies have best practices that have helped them to reduce frequency and/or severity of spills. There has not been an "official" compilation of best practices circulated to industry. If one company can prevent a spill, the entire industry benefits. Therefore, it is in our industry's best interest if we work together and share whatever tools we have to prevent spills.

Benefits: Medium.

Feasibility: High - Gather, compile and add to the best practices as companies share theirs.

Instances of idea already in place: USCG Marine Safety Newsletter/Bulletin Board, AWO Newsletter/publication

ACTION PLAN 3

CAUSE	Equipment not functioning/ Equipment not maintained properly
SOLUTION	PREVENTIVE MAINTENANCE

Possible Solution: Implement routine preventive maintenance programs; provide adequate funding for preventive maintenance programs; receive support from upper management to ensure successful development and execution of a preventive maintenance program.

Recommended Action(s):

What	Impact	Cost
AP 3.1 Develop and implement a detailed computerized maintenance management and inventory system (CMMS) database to track individual vessel maintenance history and requirements.	Medium	Medium
AP 3.2 Develop and implement standardized maintenance performance written procedures for all equipment.	Medium	Medium
AP 3.3 Provide each vessel with onboard computer equipment and software to be able to tie in to company's CMMS.	Medium	High
AP 3.4 Ensure maintenance/engineering departments are adequately staffed to perform required tasks. Ensure personnel in these department are properly trained to perform their tasks.	Medium	Medium
AP 3.5 Provide adequate funding to carry out requirements contained in company's preventive maintenance program.	High	Medium
AP 3.6 Ensure upper management considers the input, recommendations, and suggestions of all organizational members associated with preventive maintenance, including vessel Captains and PICs, when considering budgets and maintenance practices.	High	Medium
AP 3.7 Repairs should be accomplished as needed, instead of waiting for schedules shipyard overhauls.	Medium	Low
AP 3.8 Equipment should be inspected/serviced as per manufacturer's recommendations. Do not defer maintenance on older equipment with the rationale that the equipment will be out of service soon.	Medium	Medium

ACTION PLAN 3

AP 3.9 Companies should implement internally and externally conducted vessel audits which include review of maintenance practices and procedures. External audits should be performed at least biennially and internal audits should be performed at least semi-annually.	High	Medium
AP 3.10 Identify specific maintenance concerns associated with older vessels and those vessels identified as higher risks (i.e. due to type of service or location of operation), and develop special policies/procedures for these vessels.	Medium	Medium
AP 3.11 Develop a fleetwide "safety alert" notification system to rapidly notify vessel operators and maintenance personnel of recent equipment malfunctions/failures that pose imminent safety or environmental threats.	High	Low

Who:
1. Engineering/Maintenance/Safety Managers.
2. Upper Management.

When:
1. Continuous.

Communication Plan:
1. Publish throughout company.

What:
1. Preventive maintenance program.
2. Written procedures.
3. Request for input on maintenance budget and practices.
4. Results of internal/external vessel audits.
5. Maintenance/engineering personnel training folders.

Who:
1. Maintenance/Engineering/Safety Managers.
2. Upper Management.

When:
1. Continuous

ACTION PLAN 3

Discussion:
1. In order for this program to be successful, there must be complete buy-in at all levels of the company. Upper management must support the program, both philosophically and through commitment of resources. There must be inter-departmental cooperation and support - no parochialism or "turf" wars.
2. All personnel who will utilize the CMMS must be trained in its operation.
3. Middle managers and staffs must actively participate-their input is essential. Upper management must encourage and support their participation, and must provide feedback on suggestions and recommendations.

Cost:
1. Initially higher costs to develop, implement, and execute program. Costs include personnel and fiscal resources. However, implementation of a proper program will ultimately lead to improved maintenance practices and safer vessel operations.
2. Costs to train personnel.

Benefits:
1. Fewer spills. This results in an improved public image, less personnel resource hours lost to spill cleanup activities and a safer operation environment for company personnel.
2. Increased revenue. Vessel downtime can be planned out. Improved maintenance should reduce the amount of "out-of service" time for a vessel.

Feasibility:
1. Absolutely must have buy-in and support/commitment from upper management for program to work. Upper management must convey observable support and commitment to mid-level managers and staffs.
2. Upper management must be willing to commit the resources necessary to effectively implement this program.
3. Inter-departmental cooperation is a necessity.

Instances of idea already in place:
1. Most companies already have some type of PMS program in place. However, not all programs are created equal. Barge companies could use AWO or a similar third party as a clearinghouse to explain what is done in their own company, and then compare existing practices against those of other companies.

Related consulting/industry groups:
1. AWO/CMA/API

ACTION PLAN 4

Who:
1. Upper management.
2. Maintenance & Repair/Engineering/Safety Managers.
3. Vessel Captains and PICs.
4. Maintenance & Repair staff.
5. Third parties.

When:
1. Prior to transfer operations.
2. While vessel underway.

Communication Plan:

What:
1. Company policy and procedures.
2. Company safety meetings.
3. Publishing audit results throughout company.

Who:
1. Same as above.

When:
1. Continuous.

Discussion:
1. Vessel Captains and PICs must be included in the development of this system.
2. Upper management must support their operating personnel if a "no transfer" decision is made or recommended due to defective equipment.

Costs:
1. Increased time at the dock prior to commencement of transfer operations.
2. Use of third parties to conduct audits.
3. Basic equipment training for vessel operations personnel.

Benefits:
1. Improved equipment reliability.
2. Decreased probability of spill during transfer operations.
3. Improved equipment casualty reporting procedures.

Feasibility:
1. Requires upper management support and commitment.
2. Critical for vessel operations personnel to b properly trained.

ACTION PLAN 4

CAUSE	Equipment not functioning/ Equipment not maintained properly
SOLUTION	PRE TRANSFER TESTS

Possible Solution: Conduct pre-transfer test of equipment.

Recommended Action(s):

What	Impact	Cost
AP 4.1 Develop and implement company-wide policy to require equipment tests on vital cargo transfer system equipment prior to transfer operations.	High	Low
AP 4.2 Develop written test procedures for cargo transfer system equipment and maintain on board all vessels.	Medium	Low
AP 4.3 Periodically conduct audits of personnel conducting pre-transfer equipment tests. Audits should be conducted by both upper management company personnel and by third party non-company personnel.	Medium	Medium
AP 4.4 Routinely provide barge crew with backup communications for transfer operations such as second radio.	Medium	Medium
AP 4.5 Institute a corporate "no transfer" policy if vital cargo transfer system equipment is inoperative or functioning improperly. This must have full management support to reduce pressure on PIC to conduct transfer with potentially faulty equipment.	Medium	Low
AP 4.6 Ensure operating personnel receive training to conduct basic system checks, trouble shooting, and repairs while underway.	Medium	Medium
AP 4.7 Develop system for reporting results of pre-transfer equipment testing, tracking repetitive failures, conducting root cause failure analyses.	High	Medium

ACTION PLAN 4

Instances of idea already in place:

1. Certain equipment pre-transfer tests are already required by regulation. However, these are minimum standards. Companies must conduct a self-analysis to determine critical systems and conduct tests on these systems, not just those required by regulation.

Related consulting/industry groups:

1. AWO/CMA/API

ACTION PLAN 5

CAUSE	Equipment not functioning/ Equipment not maintained properly
SOLUTION	DEFECT CORRECTION

Possible Solution: Improve system for reporting and following up on equipment defects.

Recommended Action(s):

What	Impact	Cost
AP 5.1 Institute mandatory reporting system throughout company, to include a "no defects" report after each transfer operation.	Medium	Medium
AP 5.2 Develop a fleetwide "safety alert" notification system to rapidly notify vessel operators and maintenance personnel of recent equipment malfunctions/failures that pose imminent safety or environmental threats.	High	Low
AP 5.3 Schedule mandatory semi-annual company safety conferences to include maintenance personnel, engineering staffs, vessel Captains and PICs. Capture meeting minutes and document follow-up action.	High	Medium
AP 5.4 Develop computerized database to track equipment defects/failures on all vessels, to include status of failure (i.e., casualty outstanding/corrected, estimated time of repair). Ideally, the computerized maintenance management system would be sufficiently robust to handle this type of entry.	Medium	Low
AP 5.5 Create a multi-disciplinary corporate "failure analysis team" to conduct root cause failure analyses. Team leaders should report directly to an individual with the authority to implement team recommendations.	Medium	Medium

Who:

1. Upper management.
2. Maintenance & Repair/Engineering/Safety managers.
3. Failure analysis team leaders.
4. Maintenance & Repair/Safety departments staffs.
5. Vessel Captains and PICs.

ACTION PLAN 5

When:
1. Continuous.

Communication Plan:

What:
1. Company safety meetings.
2. Company safety alert notifications.
3. Computerized maintenance and management system.
4. Company written policies and procedures.

Who:
1. Same as above personnel.

When:
1. Continuous.

Discussion:
1. Upper management will need to provide their full support and commitment for this program to work. The purpose of root cause analysis should be to determine the cause of a failure, and develop and implement solutions. It should not be witch hunt to place blame.

2. Problems can only be corrected if they are known. Encourage reporting equipment failures. Track outstanding failures and follow-up on corrective actions.

Costs:
1. Higher costs to initially implement. However, maintenance and operating costs should decrease in the long run due to improved equipment reliability, better awareness for the prevention of future casualties/failures, and a lower probability of a spill occurring.

Benefits:
1. Fewer spills.
2. More reliable equipment.
3. Better tracking and follow-up of equipment failures.
4. Development of a comprehensive computerized maintenance management system.

Feasibility:
1. Can be implemented fairly easily provided upper management supports philosophy and there is full commitment from operating personnel to participate.

ACTION PLAN 6

CAUSE	**Equipment not functioning/ Equipment not maintained properly**
SOLUTION	**EQUIPMENT SELECTION/ DESIGN**

Possible Solution: Improved equipment selection/design.

Recommended Action(s):

What	Impact	Cost
AP 6.1 Conduct fleetwide vessel audits/surveys to ensure barges properly outfitted and equipped for their intended service. Audits/surveys should look beyond regulatory or classification society requirements only, since these are minimum safety standards.	Medium	Medium
AP 6.2 Consideration should be given to standardizing equipment on vessels of similar class to facilitate vessel maintenance and repair operations.	Medium	High
AP 6.3 AWO should sponsor/organize an annual tank barge industry conference/symposium on vessel design, construction, and operation.	Medium	Medium
AP 6.4 Companies should conduct periodic written surveys of tug/barge crews to solicit input on existing equipment and vessel design (i.e. can the probability and frequency of equipment failures and spill be reduced by using different equipment or by a redesign of a particular vessel system?).	Medium	Low
AP 6.5 Ensure all root cause analysis and other casualty investigative reports and recommendations are reviewed by key Engineering Department personnel. Use analyses and reports to improve the safety of vessel systems and equipment and make them more user friendly.	Medium	Medium

ACTION PLAN 6

Who:
1. Upper management.
2. Maintenance & Repair/Engineering/Safety managers.
3. Maintenance & Repair/Engineering/Safety department staffs.
4. Vessel Captains and PICs.
5. AWO Executive Committee.

When:
1. Continuous.
2. Root cause analyses after a casualty.
3. Annual conference.

Communication Plan:

What:
1. Vessel audit/survey results.
2. Surveys to vessel crews.
3. Company safety meetings.

Who:
1. Same personnel as above.

When:
1. Continuous.

Discussion:
1. Plan ahead-do it right the first time! Determine vessel requirements for its intended service. Go beyond minimum regulatory and classification society standards.
2. Learn from mistakes - yours and others. Ensure widest dissemination of root cause analyses and casualty investigation reports. Share the reports within the industry - use AWO or another third party as a clearinghouse for the reports.
3. Solicit vessel/system design input from those who use the vessel and its equipment such as Vessel Captains and PICs. Consider their recommendations when conducting system safety analyses.

Costs:
1. Could be expensive to retrofit or replace obsolete, but functioning equipment. However, it is even more expensive if equipment which is inadequate for its intended service fails, causing a large spill or major vessel casualty.

ACTION PLAN 6

Benefits:

1. Improved vessel/system design from both a mechanical and operator point of view.
2. Safer transfer operations.
3. Reduced long-term operating and maintenance costs.

Feasibility:

1. Can provide long-term benefits, but will incur high initial expenses. Upper management must be willing to provide their support to this philosophy.
2. Input from vessel operators must be given serious consideration, not automatically dismissed.
3. Barge conference/symposium would need to be sponsored/coordinated by third party such as AWO.

Related consulting/industry groups:

1. AWO/CMA/API
2. Commercial naval architecture firms.

ACTION PLAN 7

CAUSE	**Equipment not functioning/ Equipment not maintained properly**
SOLUTION	**EQUIPMENT FAILURE RATE DATABASE**

Possible Solution: Develop voluntary industry-wide equipment failure rate database.

Recommended Action(s):

What	Impact	Cost
AP 7.1 Develop a generic industry-wide equipment failure rate database to capture equipment failure rates on barges. The database should be administered by a third party such as AWO or ABS utilizing data provided by barge companies. The information in the database can then be used by participating companies to determine equipment reliability based on historical performance. Barge companies can then optimize the design of vital systems which should reduce the probability of spills and system failures.	Medium	High
AP 7.2 Barge companies should establish a root cause failure analysis program to conduct thorough investigations of every major equipment or vessel casualty.	Medium	Medium

Who:
1. Barge companies.
2. Third parties, i.e., AWO, ABS, etc.

When:
1. Continuous.

Communication Plan:

What:
1. Generic industry-wide equipment failure rate database.

Who:
1. Barge companies.
2. Third parties, i.e., AWO, ABS.

ACTION PLAN 7

When:
1. Continuous.

Discussion:
1. A generic industry-wide equipment failure rate database would go a long way towards reducing future equipment casualties and optimizing the design of vital systems on barges. This type of database has been used successfully for a number of years in both the nuclear power and chemical process industries.

Costs:
1. Participating companies would have to share expenses for having a third party set up and maintain the database. Participating companies would also have to implement a tracking and reporting system internally to develop the data necessary for the national database.

Benefits:
1. Improved design of vital systems on barges.
2. Ability to review barge systems and predict the highest probability of system failure.
3. Improved vessel equipment maintenance based on historical data for failure frequencies.

Feasibility:
1. The nuclear power and chemical process industries have proven it can be developed and successfully implemented. However, it would take a significant commitment by barge companies to provide the required data to initially develop the data base. Additionally, it will require a firm, long-term commitment on the part of a third party such as AWO or ABS to correlate the data, develop and maintain the database, and provide the information to participating companies.

Instances of idea already in place:
1. Nuclear power industry.
2. Chemical process industry.

Related consulting/industry groups:
1. Nuclear Regulatory Commission
2. Nuclear Power Industry
3. American Institute of Chemical Engineers--Center for Chemical Process Safety

ACTION PLAN 8

CAUSE	Equipment not functioning/ Equipment not maintained properly
SOLUTION	ENHANCED INSPECTIONS

Possible Solution: Implement enhanced inspection and survey program.

Recommended Actions(s):

What	Impact	Cost
AP 8.1 Identify older vessels and those considered to be at higher risk (due to type of service/location of operations). Conduct enhanced periodic surveys of these vessels and their equipment. Surveys can be conducted by either company personnel or by third parties. If company personnel are utilized, surveys should include vessel crews and upper management as well as shoreside maintenance personnel.	Medium	Medium
AP 8.2 Develop an enhanced survey check list for vessel structural examinations and for equipment condition. Ensure results of the enhanced survey are entered into the company's computerized maintenance management system.	Medium	Medium
AP 8.3 If the enhanced survey includes an internal inspection of the barge: • Conduct a thorough structural inspection of all tanks and void spaces; • Review the condition of previous repairs and modifications; and • Audiogage areas suspected of high corrosion.	Medium	Medium

Who:

1. Upper Management.
2. General Managers of Maintenance & Repair and Engineering Departments.
3. Port Captains and Port Engineers.
4. Vessel Operating Personnel.
5. Maintenance & Repair and Engineering Department Personnel.
6. Contract Personnel (i.e.-Third Party Surveyors).

ACTION PLAN 8

When:

1. Enhanced surveys should be conducted fleet-wide on a continuous basis. Each older/high risk vessel should be surveyed at least annually, preferably when the vessel is available and scheduled to be out-of-service.
2. An enhanced survey should also be conducted when a discrepancy that could result in significant safety or environmental problems is discovered.

Communications Plan:

What:

1. Development of enhanced survey checklists.
2. Use of computerized maintenance management system to track survey results and integrate into company's preventive maintenance system.

Discussion:

1. For this program to work, there must be buy-in, support and participation from upper management. Management must accept the costs associated with the allocation of personnel and fiscal resources to implement changes.
2. Personnel participating in the program must be properly trained and have sufficient experience in vessel operations, maintenance, and repair.
3. Identification of potential target vessels must be conducted on a regular basis.

Cost:

1. Initially higher cost dues to program implementation. However, lower costs in the long run resulting from improved maintenance and operations. There is also the potential for savings resulting from the cost associated with a vessel casualty or pollution incident through prevention.

Benefits:

1. Reduced long range operating and maintenance costs.
2. Safer operations.
3. Better public image.

Feasibility:

1. Requires buy-in and support from upper management.
2. Requires interdepartmental cooperation within the company.

ACTION PLAN 9

CAUSE	Inadequate Procedures
SOLUTION	MINIMUM PROCEDURES & QUALITY ASSURANCE PROGRAMS

Possible Solution: Require that the owner or operator provide barge specific "topping off" procedures.

Recommended Action(s):

What:	Who:	When:	Impact	Cost
AP 9.1 Include "topping off" as a specific procedure in the AWO Responsible Carrier Program.	AWO	Jan 1999	Medium	Low

Communication Plan:

What:	Who:	When:
• AWO to communicate the required elements of the plan to members.	AWO	1998
• Propose information clearinghouse.	USCG	1998

Discussion: The Responsible Carrier Program lumps loading and discharging operations together. There is not specific requirement that participants have a topping off procedure. There is no criteria requiring that certain elements be in the topping off procedure.

Tank overflow is a primary cause of transfer spills. The recent USCG requirement for high level indicators is bound to have a positive impact on reducing this type of spill. However, it alone will not eliminate spills due to lack of adequate procedures. An adequate topping off procedure contains certain essential elements. Requiring owners and operators to establish procedures containing these essential elements should lead to a reduction in tank overflow incidents.

ACTION PLAN 9

Essential elements of an adequate "Topping off" procedure are as follows:

- Regulation of product flow to prevent different tanks from having the same fluid levels when the "toping off" level is approached.
- Method of reducing the flow rate quickly during the topping off stage.
- Each person involved in topping off must give the operation their undivided attention.
- Method of monitoring level in closed tanks to ensure that there is no gain or loss in fluid level.
- Method of communication with dock personnel during this phase of the loading process.
- Maximum fill level is established.

Benefits: Ensures uniformity among AWO members.

Feasibility: High - Incorporate as part of the AWO Responsible Carrier Program.

ACTION PLAN 10

CAUSE	Inadequate Procedures
SOLUTION	COMMUNICATION

Possible Solution: Require the use of two-way radios or other sound enhancing device, such as sound powered phones, to ensure adequate communication between PIC's.

Recommended Action(s):

What	Who	When	Impact	Cost
AP 10.1 Recommend a change in 33 CFR 154 to require facilities to provide either radios or other emergency sounding devices to ensure adequate communication at all time during the transfer operation.	AWO	1/1/99	Medium	Low

Discussion:

Current best industry practices include facilities providing radios with a separate channel for vessel and facility PIC's to use to ensure no interference during critical phases of the transfer. Other facilities require radio silence, leaving the channel clear when the vessel PIC announces that he is 3 minutes from top off as a safety practice. When this announcement is made, the facility shuts down the loading pump as soon as they hear the microphone keyed and do not wait for the transmission. In the event that someone breaks the radio silence, the pumps are not restarted and the job is called complete. Other emergency sounding devices that may be used would be bullhorns, whistles, air horns.

Feasibility: High - currently, approximately 75% of facilities already provide radios to the vessel PIC. Therefore, only 25% of remaining facilities would be affected. These facilities currently provide radios to facility personnel. Extra radios would only need to be provided to vessel PIC.

Instances of idea already in place: Marathon at Garyville, Louisiana and Chevron at Pascagoula, Mississippi currently use the radio silence procedure to top off.

Related consulting/industry groups: ILTA, CMA, API, USCG, AWO

ACTION PLAN 11

CAUSE	Inadequate procedures
SOLUTION	CERTIFICATION

Possible Solution: Certify company under an accepted quality assurance standard, ex., ISO 9002, ISM, CMA, AWO's Responsible Carrier Program.

Recommended Action(s):

What	Who	When	Impact	Cost
AP 11.1 USCG policy recognizes certification to stringent management/quality standards.	USCG Headquarters or District Offices	1998	Medium	Low
AP 11.2 Companies certify and maintain compliance with recognized quality standard.	Company QA	1998	High	High
AP 11.3 Reduced examination length/frequency.	Partnerships w/USCG MSO's	1998	Medium	Low

Communication Plan:

What	Who	When
Highlight in newsletters, etc.	All	Summer 1997
PTP implementation	All through TQ/TQM	New hires/Summer 1997

Discussion: Inconsistent or inadequate internal quality audits reduce effectiveness of good procedures. Belief or by-in of processes and quality must come from all levels. Compliance with recognized quality processes provide better self-responsibility and pride as well as standardized procedures.

Benefits: Improved customer service. Reduced regulatory oversight. Stronger industry voice. Marketing appeal and positive public image.

Feasibility: Good, harder for smaller companies.

Instances of ideas already in place: AWO member companies. International standards, Baldrige companies, USCG Benkert award winners.

Related Consulting Groups: AWO, ISM, STCW, ISO 9000, Baldrige.

ACTION PLAN 12

CAUSE	Persons not knowledgeable and/or skilled
SOLUTION	TRAINING

Possible Solution: New employees receive orientation and training on procedures. Existing employees receive training on new procedures and refresher training. Improve training by adding hazard assessment, lessons learned, best practices and practical skills assessment. Management commits time and money.

Recommended Action(s):

AP 12.1 Develop a comprehensive advancement plan that:

1. Encourages continued education and development of skills.
2. Rewards good performance and consistency.
3. Requires skills to be documented.
4. Promotes retention to company, industry and job classification (tankerman).
5. Clearly defines steps required to advance.
6. Allows for discipline for failure to meet standards, but encourages retraining rather than termination.

What	Who	When	Impact	Cost
Expand AWO Responsible Carrier Program to include advancement plans and require the above mentioned steps to be part of the program.	Carrier/ AWO	1/1/2000	High	Medium

Discussion: Retention and continued training are key elements in a successful company. Better trained and experienced tankerman will reduce spills.

Costs: High - this program will require employer to share cost of training and reward tankerman with higher compensation.

Benefits: High - more skilled tankermen will result in more consistent performance.

Feasibility: High - several companies have already implemented a tiered compensation program and have improved retention of experienced tankermen.

Related consulting/industry groups: AWO, CMA, USCG.

ACTION PLAN 13

CAUSE	Persons not knowledgeable and/or skilled
SOLUTION	READING SKILL

Possible Solution: Verify that all PIC's have minimum reading and comprehension levels needed to perform job tasks.

Recommended Action(s): Implement Reading and Comprehension skills testing in both current employees and applicants and develop a program to increase skills in employees that do not have adequate skills.

What	Who	When	Impact	Cost
13.1 Add to the AWO Responsible Carrier Program minimum Reading and Comprehension Level requirements. Require companies to develop written policy and to develop a training plan to address employees that are below the standard.	Carrier/ AWO	1/1/2000	Medium	Low

Discussions: Reading and comprehension skills are quickly becoming a more critical requirement for tankermen. Reading skills are needed to complete DOI, read MSDS, calculate vapor drops, etc.

Benefits: Low - reading skills of new employees have risen in recent years and tankermen with unacceptable level of reading skills are not common.

Feasibility: Medium - difficult to implement.

ACTION PLAN 14

CAUSE	Persons not knowledgeable and/or skilled
SOLUTION	WORK/REST CYCLE FOR PIC's

Possible Solution: Develop documented policy on watch standing and hours allowed to stand watch. Make sure policy, as a minimum, meets regulatory requirements.

Recommended Action(s):

What	Who	When	Impact	Cost
AP 14.1 AWO Responsible Carrier Program should be expanded to not only cover work hours but to cover personnel required on watch and minimum manning requirements. The carrier should also be required to have a documented and verifiable policy.	Carrier/ AWO	1/1/99	Medium	Low

Discussion: Fatigue and manning are common problems when investigating incidents. PIC's attention to the transfer is critical and being over tired or trying to perform other non-transfer duties (cooking lunch, calling traffic to office, etc.) can lead to mistakes in the transfer operation.

Costs: Low, Regulations already limit work hours of PIC and mandate the PIC be on the barge with no secondary duties.

Benefits: Medium, if distractions and fatigue can be eliminated from the transfer operation, the PICs focus can be on the task at hand.

Feasibility: High.

Best Practices: Many carriers already have a practice in place.

Related consulting/industry groups: AWO, CMA, USCG.

ACTION PLAN 15

CAUSE	Persons not knowledgeable and/or skilled
SOLUTION	COMMUNICATION

Possible Solution: Improve sharing of information between shore and vessel PICs and crews (or between vessels). Improve dissemination of information from facility.

Recommended Action(s):

AP 15.1 Develop policy, procedures and training on the proper performance of a pre-transfer and watch change conference. Stress the importance of the pre-transfer and watch change conference sighting examples of the consequences of improper pre-transfer and watch change conferences.

What	Who	When	Impact	Cost
Expand AWO Responsible Carrier Program to specifically include the pre-transfer and watch change conference. Including the critical areas to be reviewed during pretransfer and watch change conferences. All policy, procedures and training concerning pretransfer and watch change should be required to be documented and verifiable. Include recommendation that watch change should not occur during critical times in the transfer.	AWO Carrier Facility	1/99	High	Low

Discussion: Pretransfer and watch conferences are extremely critical to a successful transfer operation, but most tankerman perform very limited and hurried pretransfer and watch change conferences.

Costs: Low - documented procedures with Guidelines and/or checklist to guide the tankerman through this process would allow for higher level of consistency.

Benefits: High - Pretransfer conference is a critical transfer planning meeting and many spills could be prevented by both parties understanding the transfer process. Watch Change conferences are the formal hand off of responsibility from the relieving PIC to the arriving PIC. By giving arriving PIC complete information on the transfer in progress, the arriving PIC can properly plan the rest of the transfer operation.

ACTION PLAN 15

Feasibility: High - easy to implement and verify, can be made part of AWO Responsible Carrier Program.

Best Practices: Many companies have already formalized this process.

Related consulting/industry groups: USCG, AWO, CMA.

ACTION PLAN 16

CAUSE	People Not Following Procedures
SOLUTION	VERIFICATION

Possible Solution: Use periodic oversight and audits to verify PIC (facility & vessel) are knowledgeable of procedures. Use both formal and informal approaches and conduct on both an announced & unannounced basis. Share results with company PIC's.

Recommended Action(s):

What	Impact	Cost
AP 16.1 Implement audit/oversight program for PIC's. Provide constructive feedback on improvements needed and best practices observed. Let employees know there input is welcome and valued in procedural improvements.	High	Medium
AP 16.2 Develop a fleetwide/company wide system to notify PIC's of problems identified, lessons learned and best practices discovered as a result of the audits.	Medium	Low
AP 16.3 Consider annual company safety conferences to include vessel Captains and PICs. Capture meeting minutes and document follow-up action.	Medium	Medium
AP 16.4 Create a multi-disciplinary corporate "procedural analysis team" to conduct root cause analyses. Team leaders should report directly to an individual with the authority to implement team recommendations.	High	Medium

Who:
1. Upper management.
2. Procedural analysis team leaders.
3. Vessel Captains, Facility Operators and PICs.

When:
1. Continuous.

ACTION PLAN 16

Communication Plan:

What:
1. Company safety meetings.
2. Company safety alert notifications
3. Company written policies and procedures.

Who:
1. Same as above personnel.

When:
1. Continuous.

Discussion:
1. Upper management will need to provide their full support and commitment for this program to work. The purpose of root cause analysis should be to determine the cause of a failure, and develop and implement solutions. It should not be witch hunt to place blame.

2. Problems can only be corrected if they are known. Encourage reporting by company personnel without fear of reprisal.

Costs: Higher costs to initially implement. However, operating costs should decrease in the long run due to better awareness for the prevention of future spills, and a lower probability of a spill occurring.

Benefits:
1. Fewer spills.
2. Corporate/Industry image enhanced.

Feasibility: Can be implemented fairly easily provided upper management supports philosophy and there is full commitment from operating personnel to participate.

Industry Best Practices: Some companies already have internal audit, third party or self audit programs in place.

Related consulting/industry groups: AWO, AWSC, API.

ACTION PLAN 17

CAUSE	People Not Following Procedures.
SOLUTION	INCENTIVES

Possible Solution: Use incentives to reward positive performance and punitive/corrective action in response to deviations. Stress personal accountability. Consider incentive based compensation.

Recommended Action(s):

What	Impact	Cost
AP 17.1 Institute employee recognition and rewards program. Examples could include company newsletter, employee of the quarter/year, recognize PICs or teams of people who have no spills per 1,000 transfers, etc.	Medium	Medium
AP 17.2 Encourage company management, local regulatory agencies to participate in recognition programs.	Medium	Low
AP 17.3 Encourage employee involvement in recognition program. Solicit nominations at employee level.	Medium	Low

Who:

1. Upper management.
2. Facility Operators and PIC's.
3. Local regulatory agencies.

When:

1. Continuous.

Communication Plan:

What:

1. Company newsletters.
2. Local industry newsletters.
3. Local regulatory agency newsletters.

ACTION PLAN 17

Who:
1. Same as above personnel.

When:
1. Continuous.

Discussion: Management will need to provide their full support and commitment for this program to work. Recognition should be timely and appropriate.

Costs:. Minimal cost to initially implement depending on type of recognition system developed.

Benefits:
1. Fewer spills.
2. Higher employee morale and productivity.
3. Improved industry reputation.

Feasibility:. Can be implemented fairly easily provided upper management supports philosophy and there is full commitment from operating personnel to participate.

Related consulting/industry groups: AWO, API.

ACTION PLAN 18

CAUSE	People Not Following Procedures
SOLUTION	TRAINING

Possible Solution: Provide initial and refresher training and hold frequent safety meetings. Develop Job Safety Analysis (JSA) for transfers. Distribute JSA for transfers to industry. Use simulation of loading and discharge process in training. Train both office and vessel personnel including new hires. Use mentoring program.

Recommended Action(s):

What	Impact	Cost
AP 18.1 Provide initial and refresher training to employees and hold frequent safety meetings. Include lessons learned, results of investigations, cause analysis and root causes with all employees. Solicit employee input for process improvements.	High	High
AP 18.2 Develop Job Safety Analysis (JSA) for transfer operations focusing on critical phases of the transfer; topping off, discharging, etc.	Medium	Low
AP 18.3 Distribute JSA to industry via AWO, ILTA, API newsletters, USCG Marine Safety Newsletter, etc.	Medium	Medium
AP 18.4 Use simulation of loading and discharge process in training. Incorporate "what ifs" into training programs and emphasize importance of each step in the process describing what could happen if procedures are not followed. Focus simulations on key phases of the transfer process where spills are most likely to occur.	High	High
AP 18.5 Train both office and vessel personnel including new hires. Ensure all company personnel understand the transfer process and the critical role the PIC plays in the process.	High	High
AP 18.6 Use mentoring program. Utilize experienced personnel to ensure new hires understand and follow proper procedures and corporate policies. Solicit employee involvement in improving procedures.	Medium	Low

ACTION PLAN 18

Who:
1. Upper management.
2. Vessel Captains, Facility Operators and PICs.

When:
1. Continuous.

Communication Plan:

What:
1. Company safety meetings.
2. Company safety alert notifications/newsletters.
3. Company written policies and procedures.

Who:
1. Same as above personnel.

When:
1. Continuous.

Discussion:
1. Upper management will need to provide their full support and commitment for this program to work.
2. Problems can only be corrected if they are known. Encourage all level of employees to report problems and recommend improvements.

Costs:. High cost to initially implement if not already part of company program.

Benefits:
1. Fewer spills.
2. Less employee turnover.
3. Better industry image and reputation.

Feasibility: Can be implemented fairly easily provided upper management supports philosophy and there is full commitment from operating personnel to participate.

ACTION PLAN 19

CAUSE	People Not Following Procedures
SOLUTION	EMPLOYEE EMPOWERMENT

Possible Solution: Employee empowerment to develop and change procedures.

Recommended Action(s):

What	Impact	Cost
AP 19.1 Institute company wide program empowering employees to recommend changes and improvements to procedures. Involve employees in internal working groups. Share results company wide. Recognize employees for there input.	High	Low

Who:
1. Upper management.
2. Vessel Captains, Facility Operators and PICs.

When:
1. Continuous.

Communication Plan:

What:
1. Company newsletters.
2. Company written policies and procedures.

Who:
1. Same as above personnel.

When:
1. Continuous.

Discussion:. Employees who realize they have corporate support for their ideas and recommendations will respond in a positive manner.

Benefits:
1. Fewer spills.
2. Less employee turnover.
3. Higher employee morale and productivity.

ACTION PLAN 20

CAUSE	People Not Following Procedures
SOLUTION	MANPOWER

Possible Solution: Use additional manpower where process requires. Ex., extra tankerman/PIC for split loads, dangerous cargoes. Vessel management on barge during critical times.

Recommended Action(s):

What	Impact	Cost
AP 20.1 Ensure corporate policies/procedures provide for sufficient manpower for complex or unusual transfer operations. Wheelman on Watch (WOW) is on the barge during critical stages of the transfer to assist the PIC.	Medium	Low
AP 20.2 Implement policies for vessel personnel to be licensed tankerman. Ensure vessel & facility personnel understand transfer procedures and critical role PIC plays in the process.	Medium	Medium
AP 20.3 Eliminate work place hurry up. Ensure PIC's are empowered to override dock and vessel personnel for wanting to finish up quickly.	High	Low

Who:
1. Upper management.
2. Vessel Captains, Facility Operators and PICs.

When:
1. Continuous.

Communication Plan:

What:
1. Company written policies and procedures.

Who:
1. Same as above personnel.

When:
1. Continuous.

ACTION PLAN 20

Discussion:

1. Work place hurry up was identified as a major cause of transfer spills. Upper management will need to provide their full support and commitment for this program to work.
2. Problems can only be corrected if they are known. Encourage personnel to report incidents and ensure problems are followed up on.

Benefits: Fewer spills.

ACTION PLAN 21

CAUSE	People Not Following Procedures
SOLUTION	ONE JOB AT A TIME

Possible Solution: Eliminate conflicting duties for both vessel and facility PIC during transfer operations. PICs concentrate on one job at a time during topoff and other critical phases of the transfer process.

Recommended Action(s):

What	Impact	Cost
AP 21.1 Institute corporate policies and procedures empowering PICs to truly be "in charge" of the transfer. PICs have authority to override other personnel attempting to impose additional duties or responsibilities during transfer operations.	Medium	Medium
AP 21.2 Ensure no crew changes or watch changes occur during critical phases of the transfer process.	High	Low

Who:
1. Upper management.
2. Vessel Captains, Facility Operators and PICs.

When:
1. Continuous.

Communication Plan:

What:
1. Company written policies and procedures.

Who:
1. Same as above personnel.

When:
1. Continuous.

ACTION PLAN 21

Discussion:
1. Upper management will need to provide their full support and commitment for this program.
2. Problems can only be corrected if they are known. Encourage reporting by PIC's of incidents where they were tasked with additional duties during transfers. Ensure reports are followed up on.

Costs: Minimal.

Benefits:
1. Fewer spills.
2. More empowerment of personnel will lead to more employee satisfaction and improved productivity.
3. Improved Industry image and reputation.

Feasibility: Can be implemented fairly easily provided upper management supports philosophy and there is full commitment from operating personnel to participate.

Related consulting/industry groups: AWO, API, ILTA.

ACTION PLAN 22

CAUSE	People Not Following Procedures
SOLUTION	COMMUNICATION

Possible Solution: Make DOI/pretransfer conference more effective. Improve communication between PICs on shore and vessel (or between vessels).

Recommended Action(s):

What	Impact	Cost
AP 22.1 Ensure DOI and pretransfer conference is tailored to specifics of barge being loaded or unloaded. Clear and precise transfer procedures for all classes of barges.	High	Medium
AP 22.2 Share lessons learned and root cause analyses of previous incidents to improve overall transfer process.	Medium	Low
AP 22.3 Involve employees in process to improve transfer procedures.	Medium	Low

Who:
1. Upper management.
2. Cause analysis team leaders.
3. Vessel Captains, Facility Operators and PICs

When:
1. Continuous.

Communication Plan:

What:
1. Company safety meetings.
2. Company safety alert notifications
3. Company written policies and procedures.

Who:
1. Same as above personnel.

When:
1. Continuous.

ACTION PLAN 22

Discussion:

1. Upper management will need to provide their full support and commitment for this program to work.
2. Problems can only be corrected if they are known. Encourage reporting of incidents or best practices and lessons learned.

Benefits:

1. Fewer spills.
2. More reliable equipment.
3. Better industry image and reputation.

Feasibility: Can be implemented fairly easily provided upper management supports philosophy and there is full commitment from operating personnel to participate.

Related consulting/industry groups: AWO, ILTA, API.

ACTION PLAN 23

CAUSE	Inadequate Procedures
SOLUTION	LOAD PLAN

Solution: Develop loading plans for bargès during loading, lightering operations, and transfers (especially those involving multigrade cargoes on a single barge).

Recommended Action(s):

What	Who	When	Impact	Cost
AP 23.1 Adopt loading plan for use with lightering operations and transfers of multigrade cargoes on a single barge.	Carrier	1997	High	Low
AP 23.2 Incorporate requirement for loading plan for all barges into AWO's Responsible Carrier Program.	AWO	1/1/1999	High	Low

Benefits: High - Loading plans and standardized fill procedures can reduce spills by documenting pressure and venting problems (such as during top-off), improving gauging (reduce errors from heel/trim), and identifying known barge/tank loading characteristics (some tanks fill faster etc.). Additionally, load plans, even on smaller barges (less than 300 feet), can reduce structural fatigue. (although deck failures occur infrequently,10 were documented in the last ten years, they are usually sizable pollution incidents).

Feasibility: High - Incorporate as part of the AWO Responsible Carrier Program.

Instances of ideas already in place: The industry routinely uses loading plans today for lightering operations and for transfers on barges 300 feet and longer.

ACTION PLAN 24

CAUSE	Inadequate Procedures
SOLUTION	SCHEMATICS SPECIFIC PROCEDURES DOCUMENT CONTROL

Possible Solutions:

- Improve schematics for piping, stripping, vapor systems and use process flow charts.
- Provide procedures specific to the type of operation and the barge, i.e., split cargo, bunkering. Include load plan information.
- Use a document control system to ensure most current procedures, schematics, etc., are on board.

Recommended Action(s):

Require owners, operators to provide barge specific addendum to "transfer procedures". Specifically, an updated piping diagram indicating the location of bleeders, drains and bypasses. Provide the option of color coding to identify specific items or systems. For example, a legend may be provided in the transfer procedure manual that identifies all bleeders with an orange band, and all bypasses with a yellow band.

What	Who	When	Impact	Cost
AP 24.1 Include barge specific addendum in "transfer procedures".	AWO-RCP	1/1999	Medium	Medium
AP 24.2 Ensure updated and accurate barge specific piping diagram.	AWO-RCP	1/1999	High	Medium
AP 24.3 Ensure that "transfer procedures" are part of the owner, operator's document control system.	AWO-RCP	1/1999	Low	Low

Communication Plan:

What:	Who:	When:
AWO newsletter correspondence	AWO	1998
Proposed information clearinghouse	USCG	1998

ACTION PLAN 24

Discussion: It is imperative that the tankermen assigned to work the barge have the benefit of accurate procedures and piping diagrams that are barge specific. Currently, the USCG allows general procedures and generic piping diagrams to meet transfer procedure manual requirements. The transfer procedure document is the ideal place to locate barge specific information as each barge is required to have it and tankermen are required to be familiar with it.

Small spills occur when tankermen, unfamiliar with a barge, haven't identified the exact location of potential spill sources in the cargo system and checked them prior to commencement of cargo operations. Currently there is no requirement to indicate the location of bleeders, drains, and other such devices on the barge piping diagram. Requiring this specific information on each vessel will help the tankerman locate these devices and check them prior to commencement of cargo operations.

ACTION PLAN 25

CAUSE	Inadequate Procedures
SOLUTION	USCG MONITORING

Possible Solution: Improve consistency of USCG boarding, inspection and monitoring.

Recommended Action(s):

Increase USCG understanding of industry operations and practices and reduce USCG personnel turnover.

What	Who	When	Impact	Cost
AP 25.1 Incorporate boarding techniques less disruptive to operations.	USCG (HQ, District, & MSO's)	1998	Medium	Medium
AP 25.2 Train junior people in operations, not just regulations.	USCG institute & RTC (training centers)	1998	Low	High
AP 25.3 Encourage mini-industry training with barge industry.	AWO - MSO's	1998	Low	High

Communication Plan:

What	Who	When
• Publish all District and COTP policies and procedures for easy industry access (Internet, fax back).	NMC	Spring 1997
• Encourage interactive feedback at industry days.	District (m)	1998
• Publish articles in newsletters (USCG and industry).	District (m)	1998

Discussion: Constant and frequent turnover of USCG personnel at all levels results in changes of COTP policy and inconsistent boarding practices along with a burden on industry to train new personnel. Additionally, newer boarding officers lacking in operational familiarity may inadvertently add more risk (than prevented in exam) by boarding during top off procedures and misdirecting attention of the person in charge.

ACTION PLAN 25

Benefits: Improved customer service.

Feasibility: Good for communications; Moderate for tour lengths.

Instances of ideas already in place: Industry days, joint conferences, partnerships, and industry training programs. NMC maintaining web site. PSIX with 1-800 number to download vessels information.

Related consulting groups: AWO, API, PVA, TSAC, CTAC, NAVSAC, Inland Water Way Users Board (ACOE), etc.