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THE NEAR-MISS EXPERIENCE: ORGANIZATION CHANGE IN THE MARITIME BRIDGE-WATCH

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THE UNION INSTITUTE

THE NEAR-MISS EXPERIENCE:
ORGANIZATION CHANGE IN THE MARITIME BRIDGE-WATCH

A PROJECT DEMONSTRATING EXCELLENCE
SUBMITTED TO
THE COMMITTEE
IN CANDIDACY FOR THE DEGREE OF
DOCTOR OF PHILOSOPHY

BY
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ABSTRACT

This thesis describes twenty-seven near-miss experiences by ten merchant marine officers on the U.S. Great Lakes. The experiences are related in the first person and include actions by self, other bridge watch members, and other vessels. The focus of the work is on the relationship between the near-miss experience and the organizational implications related to those experiences.

The survey of the literature defines the near-miss experience and two major previous efforts to obtain and record maritime near-misses. The conceptual context places the near-miss in the traditional maritime organization which is defined through analysis of boundary and environment, horizontal and vertical differentiation, integration, conflict resolution, information generation, and reward structures. The conceptual context also describes three alternative perspectives of organization; systemic, social-political and architectural.

The thesis is exploratory in nature: how and why the near-miss occurred and remained a near-miss rather than becoming an accident. Five propositions relating to anticipated changes in the organization structure are used as the basis for case-study analysis. These propositions relate to the changing of the organization structure by one or more persons on the bridge watch. The propositions are supported by about one-fifth of the related experiences. An additional proposition is also supported by about one-fifth of the related experiences.

Recommendations include the continued collection and codification of near-miss experiences, experimentation using full-mission simulation, and research into the potential for near-misses under the one-person bridge organization structure.

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To Nancy

"This field is so spacious that it were easy for a man to lose himself in it; and if I should spend all my pilgrimage in this walk, my time would sooner end than my way."

*Bishop Joseph Hall
1574-1656*

CHAPTER 1

INTRODUCTION

This Project Demonstrating Excellence is about the relationship between the near-miss experience in the maritime environment and the organizational implications related to those experiences. The near-miss may be a universal experience in the maritime industry (Drager 1980, 20). Near-miss stories are the fodder for casual conversation and the substance for personal learning. Every mariner remembers near-misses in which he was an active player, a participant, or an observer and "what happened might be more objectively remembered" (Drager 1979, 13). The near-miss encompasses the range of maritime casualties: collisions, groundings, strandings, fire, rammings, etc.

The near-miss has been the subject of some research. In 1979-1981 Det norske Veritas included the near-miss experience in its groundbreaking study *Cause Relationships of Collisions and Groundings* (Drager and others 1980, Drager 1979, Drager 1980, Drager 1981). In 1985-86 the United States Department of Transportation included near-miss research in its experimental maritime safety reporting program (U. S. Department of Transportation 1986). The purpose of both projects was to reduce or prevent groundings, collisions, contact damage, and so forth, within the marine environment. The Det norske Veritas final report, in describing its work in the near-miss experience said, "The number of near-misses at sea is not generally known, but on the basis of comments from ship masters and navigators it is presumed that a certain number of situations arise that could lead to collisions and groundings. These near-misses represent a

valuable base of empirical data, from which worthwhile knowledge can be gained as to how the casualty was avoided, or information about hazardous areas of fairway, or inadequate marking of the area, etc.. The project's initiative of introducing a general reporting form for near-misses was met with a large amount of skepticism from the navigators, and the original aim of this sub-task has not been realized" (Drager 1979, 31).

The United States Department of Transportation, Marine Safety Reporting Program 1984-86 was designed to solicit anonymous observations of unsafe situations or unsafe acts in US waters. The response rate of 221 (during the course of program) was less than half of the expected and desired rate of 500. The final report (29) says, "Comparatively few of the reports dealt with internally-induced threats to safety--that is, cases in which a vessel's operation breached some defined 'safe operating envelope' and in which the actions or inactions of the reporter were a significant factor in that breach." Rather, the reports pointed to situations external to the reporter and/or his/her operations but generally viewed as hazardous. Examples would be: recurring reckless pleasure-boat operation in a particular harbor, floating debris in the vicinity of a specific drilling rig, or the ambiguity of an individual navigation aid. The results with regard to categories of reported hazards fell far short of one MSRP objective, which was to stimulate self-reporting and/or reports pertaining to deficiencies in performance by the personnel involved.

Thus, the two precedent major studies conclude that there is a skepticism or reluctance to report near-miss situations, at least to an official or quasi-official body. There seems to be agreement in these studies that the near-miss experience might be a source of professional learning within the international maritime community.

The Det norske Veritas summary analysis (Drager 1980, 35) showed that human error was a significant causal factor in between 75% and 85% of the accidents analyzed. This analysis of 2742 collisions and grounding accidents and their causes was, and continues to be, the primary source of data in the field today.

The United States Coast Guard marine investigation division analysis methodology lists 176 possible causes for maritime accidents. These range from auxiliary power failure through unknown to vandalism (U. S. Coast Guard 1989). An unpublished study for the Maritime Training and Research Center in Toledo, Ohio, examined collision and grounding data in U.S. waters for vessels greater than 1000 tons from 1984-88 inclusive. Four causes produced nearly 50% of the accidents: error in judgement, lack of knowledge, carelessness, and operator error.

As these two major studies demonstrate, it is difficult to obtain written documentation of the near-miss experience. The near-miss experience could be construed as a negative statement about one's shiphandling capability (U. S. Department of Transportation 1986, 32; Drager 1980, 23) and thus have potential impact on one's professional license. And, although the experience seems to be universal, many are reluctant to describe it for others. There is however, potential for learning and understanding in the near-miss experience if those experiences can be carefully described and analyzed.

This Project Demonstrating Excellence is a step toward such description and analysis. The research methodology is "descriptive" (Simon and Burstein 1985, 37) or "exploratory" (Crano and Brewer 1986, 330). The focus of the research is on 'how' and 'why' a near-miss situation remained a near-miss rather than becoming an accident.

The study was conducted through case study methodology in interviews with first class pilots and masters on the Great Lakes who volunteered to tell their near-miss experiences in an attempt to provide learning for their peers. The research protocol, interview questions, and format were pre-tested with Great Lakes, military, and deep-sea captains prior to interviewing the Great Lakes population. Those pilot data are not included in the study.

The near-miss under exploration occurs within the context of a vessel operating at a location, with a cargo or in ballast, and a crew. The principal focus of the study is the bridge-watch responsible for the navigation and safe handling of the vessel. On the US Great Lakes in close waters, a typical bridge-watch will include the captain, a qualified watch officer, a seaman trained as helmsman, and one or more look-outs (watchmen), generally either officers or skilled ratings.

The bridge-watch is a small self-contained unit of an organization. It meets the general structural and process elements which have been articulated by organization theorists including Bolman and Deal (1984), Champion (1975), Dessler (1980), Gerloff (1985), Hall (1982), and Mackenzie (1986). Thus, the field of organization is the larger framework in which the study has been conducted.

Gerloff defines organization theory as "...an assemblage of concepts, principles, and practices which have been (and are being) codified to explain organizational phenomena" (10).

Organization theory includes as structural elements: boundary, size, technology, differentiation, integration, information and power. A critical assumption to this Project Demonstrating Excellence is that the near-miss occurs only when someone or something takes the situation out of the

normal organization structure or process. Without such occurrence the consequence of the situation is an accident rather than a near-miss. The work addresses the following questions through interviews with ten professional mariners:

- * In what ways, and,
- * To what degree, and
- * Why did you (or another person) step out of the normal structure or process and turn the accident into a near-miss.

This is a multiple case design (Yin 1989, 53) in that multiple masters are included and the purpose of the case study is not to *survey* "have you had a near-miss experience - and how many" but to *replicate* how and why a potential accident became a near-miss. All masters and first class pilots who are members of District 2 MEBA-AMO sailing on the Great Lakes, were provided the opportunity to participate in the research. All those who replied in the affirmative and were available for a personal conversation with the researcher have been included in this case study. The presentation of the stories in Chapter 4, includes all of the near-miss experiences which those reporters described. The data are in the words of the reporters with only minimal editing for clarity and sequencing of events.

Criteria for analysis and interpretation will be to establish the propositions as independent variables and match the case data to these propositions. It is assumed that these variables are mutually exclusive (Yin 1989, 111). It is proposed that one or more of the following (independent and mutually exclusive) events occurred which took the situation out of the normal organization structure.

- 1) The captain or another watch officer opened the door for an alternative structure. That is, the captain or senior watch officer present turned to another member of the bridge-watch and said (words to the effect) "What do you think is happening, what should we do"?
- 2) Someone else on the bridge-watch stepped forward and stepped out of role required by the vertical or horizontal differentiation and drew the attention of the watch officer or captain to the situation.
- 3) The fear of the potential accident overcame the fear of the master's reprisal (see Hershey 1988) and someone stepped out of the typical structure.
- 4) A peer relationship between captains or watch officers was the foundation for the change.
- 5) A prior relationship existed between one or more members of the bridge-watch and that prior relationship was the foundation for change.

If there are patterns of communication and coordination or changes in the structure of the organization which lead to near-misses, then technically and by ideation, it should be possible to train masters and first class pilots in those practices and means of communication and coordination. Such training should contribute to the reduced frequency or severity of accidents; the loss of life, cargoes, or the vessel; or the pollution of the environment within the global village. Such accident reduction is the social meaning of the project and the driving motivator for the researcher.

Chapter 2 describes the theoretical and conceptual context of the work; the field of organization. Chapter 3 describes the methodology; a multiple case study. Chapter 4 contains the maritime descriptions of twenty-seven near-miss experiences related by ten professional mariners. Chapter 5 describes the analysis of the near-miss experiences and the conclusions reached by the study. Chapter 6 describes appropriate future research and methodologies.

CHAPTER 2

THEORETICAL AND CONCEPTUAL CONTEXT

Introduction

"Organization theory is the body of thinking and writing which addresses itself to the problem of how to organize. (It) can be defined as the study of the structure, functioning, and performance of organizations and the behavior of groups and individuals within them" (Pugh 1984, 9).

There is no universally accepted taxonomy of organization, structure, and process (Bolman and Deal 1984, Champion 1975, Gerloff 1985, Hall 1982, Miller 1978, Mackenzie 1986). In contrast to the physical sciences, the science of organization has a range of perspectives and taxonomies. Each theorist emphasizes different elements and considers each element as having differing importance in the resolution of the problem: how to organize.

This contextual framework sets out three perspectives of organization theory: system, social complexity, and architectural. These perspectives accentuate the differences in viewpoint expressed by the theorists. The framework reviews the contributions made by Burns and Stalker (Gerloff 1985), Mackenzie 1986, Miller 1978, Mintzberg 1979, 1989, Pasmore 1988, Perrow 1970, 1984, 1986, Pfeffer 1978, Pugh 1984, and Woodward 1965. Seven common elements of organization are described: boundary, technology, differentiation, integration, rewards, information, and size. This description of these elements emphasizes the similarities in the theoretical

positions. The typical merchant marine organization, at the shipboard level, is described using this list of elements. Finally, the literature describing the maritime near miss experience is reviewed.

This contextual framework positions the research in the field of organization; the structural elements which influence shipboard decision making and actions in situations involving a near-miss.

It is important to note that there are three common, often implicit, assumptions in the study of human organization. They have been articulated by J. March (Pugh 1984), by H. Simon (Pugh and Hickson 1980), and by Gerloff (1985).

The first assumption is that human organizations are goal-seeking entities and that flexibility, change, and adaptation are the natural consequence of reacting to changing internal or external demands. Goals in human organization are of special interest (Donaldson 1985, 22). He says:

Whilst it is true that only humans can define goals (ideal future states), and that organizational goals are defined by humans, what makes the goals organizational is the process of their authorization and institutionalization. This latter process ensures that goals, once understood and shared, and perhaps backed by detailed plans and schedules, can survive the death of most of their architects. The process of authorization involves the organization giving its legitimacy to the objectives (just like the University of Oxford grants degrees). This makes the objectives the property of a supra-individual 'entity'. This institutionalization process, similarly, makes the objectives the property of the supra-individual collectivity.

James March (Pugh 1984, 225) says: "Whether we are talking about individuals or about organizations, purpose is an obvious presumption of the discussion. An organization is often defined in terms of its purpose. It is seen by some as the largest collectivity directed by a purpose. Action within an organization is justified (or criticized) in terms of the purpose."

The second implicit assumption about human organizations is that they are not self-destructive but have an on-going consistency. According to March (Pugh, 225) "...consistency is a cultural and theoretical virtue. Action should be made consistent with belief. Actions taken by different parts of an organization should be consistent with each other. Individual and organizational activities are seen as connected with each other in terms of their consequences for some consistent set of purposes."

The third assumption has been defined by March (Pugh 1984) and by Simon (Pugh and Hickson 1989) as a "primacy of rationality." There is "... a procedure for deciding what is correct behavior by relating consequences systematically to objectives" (Pugh 1984, 225).

Simon (Pugh and Hickson 1989, 120) continues the discussion:

The traditional theory of economists assumed complete rationality. Their model was of 'economic man' (which, of course, embraced woman) who deals with the real world in all its complexity. He selects the rationally determined best course of action from among all those available to him in order to maximize his returns. In place of 'economic man' (we) propose a model of 'administrative man'. While economic man maximizes (i.e. selects the best course from those available), administrative man 'satisfices' - looking for a course of action that is satisfactory or 'good enough'. In this process decision-makers are content with gross simplifications, taking into account only those comparatively few relevant factors which their minds can manage to encompass. Thus administrators who 'satisfice' can make decisions without searching for all the possible alternatives and can use relatively simple rules of thumb. In business terms they do not look for 'maximum profit' but 'adequate profit'; not 'optimum price' but 'fair price'.

Thus, there are limits, or bounds, to the rationality based upon "... a limited-capacity information-processing system..." (Pugh, 225) and the limitations of satisficing in contrast to maximizing.

Perspectives

The selection of perspective of organization which follows has been chosen as a method to demonstrate the bounds of the work. The three perspectives - system, social complexity, and architectural - capture three levels of the field: the conceptual, the social science orientation, and the application.

The system perspective is based on the conceptions of general system theory. James G. Miller (1978) has produced the most comprehensive conceptual statement of the living system (open system) field of that theory. *Brain of the Firm* by Stafford Beer (1981) is a conceptual outline of how systems should establish control and structure recursion in order to manage inputs, throughputs, and outputs.

The social complexity perspective defines the work in the social sciences. The author's undergraduate perspectives in economics and political science are reinforced by references from sociology and psychology. Pfeffer (1978), Tuggle (1978), Kotter (1979), and Perrow (1986) capture the themes of this perspective.

The architectural perspective is somewhat harder to visualize. There is recognition in the field that "... (we) have not (yet) produced perfect organizations ..." (Pasmore 1988, 88). Rather, there are a number of approaches which have been developed to assist in the design process. Neither Galbraith and Kazanjian (1986) nor Mintzberg (1989) set out to demonstrate such a perspective; yet their work raised important questions for the organization architect about the environmental location of the organization (Galbraith and Kazanjian) and the configuration or general shape of the organization (Mintzberg). Mackenzie (1986) and Pasmore (1988), on the other hand, set out to describe the fundamental principles and

practices in designing an organization. Pasmore is more generalized, Mackenzie is quite specific.

The systemic perspective is nearly universal in current thought. The concepts of system wholeness, boundary, and environment are included or implied in all current theoretical or expository writings. This review describes two levels of the perspective: the living systems view of Miller (1978) and the cybernetic views of Beer (1981, 1985).

Miller (1978) places organization midway in the hierarchy of living systems: cell, organ, organism, group, organization, society, and supranational society. His conceptual framework describes each of these seven levels from a consistent perspective: structure, process, subsystems, relationships, system-wide process, and models and simulation. It is his view that all levels have, or are able to obtain, the same kinds of requirements for continued existence. *Living Systems* is "... an effort to integrate all the social, biological, and physical sciences that apply to structure or process at any of the seven levels. Physiology, biochemistry, genetics, pharmacology, medicine, economics, political science, anthropology, sociology, and psychology are all almost entirely relevant" (4).

Organizations are systems with multiechelon deciders whose components and subsystems may be subsidiary organizations, groups, and (uncommonly) single persons. In my conceptual system they are concrete living systems with components that are also concrete living systems rather than abstracted systems whose units are actions or roles. Organizations are subsystems, components, or subcomponents of societies, sometimes of more than one society. Some societies have single organisms or groups, as well as organizations, as principal components. International and supranational systems, such as General Motors and Interpol, have organizational components which exist in more than one society. Organizational components can also be inclusions in societies other than the one to whose subsystem structure they belong, e.g., Japanese marketing organizations in Australia and Canada. The critical difference between organizations and groups is in the structure of the decider. Organizations always have at least two

echelons in their deciders, even when they are so small that each person can interact in a face-to-face relationship with all the others. Group deciders have no formally designated echelons (595).

Groups, the next smaller level, is described:

A group is a set of single organisms, commonly called *members*, which, over a period of time or multiple interrupted periods, relate to one another face-to-face, processing matter-energy and information. The components of groups are animals - human and subhuman. Monerans, protistans, fungi, and plants do not form groups.

Groups differ from organizations, the next higher level of living systems, in three ways: (a) the members, though ordinarily mobile, are usually near enough together to see and hear one another; (b) each one potentially can communicate directly with every other one over two-way channels, although some of these may not be open at all times; and (c) there are no echelons, since by definition an organization is a system with echelons composed chiefly of groups (and perhaps some single individual organisms) (515).

About societies, he says:

A society is a large, living, concrete system with organizations and lower levels of living systems as subsystems and components. Ancient city-states and kingdoms were societies, as are modern nation-states and empires that are not supranational systems. Small, primitive, totipotent communities are also societies if they are not components of another society. ... Unlike most organizations, all societies, as Parsons and his associates noted, are totipotent. They have a complete set of matter-energy and information processing subsystems (747).

Thus, Miller differentiates organizations from groups and societies on the basis of the decider "...the executive subsystem which receives information inputs from all other subsystems and transmits to them information outputs that control the entire organization" (642).

The organization decider is multi-echelon and time-space dispersed in structure. The group decider is a single echelon and operates face-to-face. Organization deciders are "...limited by the past and present decisions of their society. Organizations, in fact, are much like organs in their parasitism upon, or symbiosis with, the supra system of which they are a part. There are no free-living organs as there are free-living cells. If an

organization is to exist independently...it must atypically develop all the critical subsystems, or it will disappear" (595-596).

Miller uses a modern ocean liner (604-605) to demonstrate the system characteristics of organization. In addition to the 'decider' he clearly identifies the system boundary (the hull), the system environment (the "ocean and the atmosphere) and the system's subsystems.

The cybernetic view of systems (organizations) is predicated upon the establishment of goals and parameters of performance and the formulation of self-correcting mechanisms through multi-layered feedback loops which sense a position of the system in its environment and stimulate responses within the system. Stafford Beer (1985, 1) defines such a system as "...viable, able to maintain a separate existence." The viable system is characterized by control; by "...becoming aware of itself..." (Beer 1981, 25), and by its ability to "...measure its own internal tendency to depart from stability, and a set of rules for experimenting with responses which will tend back to an internal equilibrium" (27).

Control is exemplified by the electronic computer. The computer has been used by organizations (and managers) to "...soup-up the ways of regulating matters with which managers are already familiar" (Beer 1985, 14). Beer argues that the 'more and quicker' approach of computer operators and managers has led to our "...replacing one thing by another which is indeed more effective, and now we have a great vision whereby all these bits and pieces (of organizational information) will be *integrated* in a vast informational network. The whole firm will be run on a basis of 'instant fact', because managers will draw any item of knowledge they require from a huge data base into which all the facts about the business will be poured" (Beer 1985, 16).

But control is based on information - meaning - and facts "...become information only when something is changed" (16). The demand is for a control system and not more or faster information. Control also is concerned with "...complexity beyond the capacity of those senior people to absorb and interpret it. Therefore it has to do with the structure of information flows, with the method of information handling, with techniques for information reduction, and so forth" (80).

There is, today, a capability to deal with data in excess of the ability of human capacity alone. The function of control must be delegated to the computer - as other functions have been delegated to other people (i.e. finance, marketing, operations). "The manager no more abdicates in favor of computers because they are more sophisticated in control than he, than in favor of maintenance men because they can keep the plant working and he cannot. But he has to know how to organize the maintenance men to keep the plant working, and he has to know how to organize computers to effect the firm's control. Moreover, he has to organize the plant so that it can be maintained; he has also to organize the firm so that it can be computed with" (80).

From a living systems foundation (see Miller), Beer proposes that control can be perceived as "...part of the system under control...not something stuck on by higher authority which is then accorded managerial prerogatives" (25). This leads to the second requirement that the organization be "...aware of itself..." (27).

In order to be aware of itself, the system (organization) only needs

...a way of measuring its own internal tendency to depart from stability, and a set of rules for experimenting with responses which will tend back to an internal equilibrium. There is no need to know in advance what might cause a disturbance; there is no need to know

what has caused a disturbance. To be aware of something happening and label it disturbance, and to be able to alter internal states until effects of the disturbance are offset, is enough (27).

Given this 'self-awareness', the system needs a means of "...finding out..." - an heuristic method. Such an heuristic "...specifies a method of behaving which will tend towards a goal which cannot be precisely specified because we know *what* it is but not *where* it is" (52). For example, from Dayton, Ohio one can reach Florida by driving southeast. Such organization heuristics describe general rules toward a goal but not a specific route and may be incorporated into computer (or control mechanism) logic structures.

A viable organization, then, is one which is structured around information flows (inputs), control mechanisms (of outputs), an awareness of self in an environment (disturbances from the expected), and heuristics (rules) for determining means to return to a steady state. As a conceptual framework rather than an architectural framework (see Galbraith and Kazanjian, Mackenzie, Mintzberg, and Pasmore) the systemic/cybernetic perspective describes what the organization should contain but not how that should be created.

The socio-political or social complexity perspective is a way to balance the forces of naivete and cynicism. "Most of us, to be blunt, are remarkably naive when it comes to understanding power dynamics in complex organizations. At the same time, others of us are incredibly cynical. Both distort social reality and thus act on bad information..." (Kotter 1985, 1989).

A social complexity perspective would argue that it is not by chance that the economists' traditional model of a firm, where only "rational" economic decision making occurred, and where power struggles and politics were nonexistent, was a small and technologically simple organization that operated in an environment without large customers, suppliers, unions, or governmental regulators, and that

employed a relatively homogeneous labor force in a simple organization structure (21).

Social complexity is made up of the issues of goals, coalitions, control, power and politics, action, and conflict.

An organization goal (or its synonym, objective) is a "...description of a desired future state of the organization or its environment" (Tuggle 1978, Miller 1978). Such goals are institutionalized and provide a focus for action (Donaldson 1985, 22). The need for goals is based on "...a lack of consensus. If everybody's individual preference function were the same, there would be no need for goals to guide, unify, explain, direct, coordinate, and control behavior; there would be no need to do so because no one would disagree or vary from the template. But people *are* different, and so goals are necessary" (Tuggle, 24).

Pfeffer (1978, 2-3) suggests that "...control itself, not control as a means of ensuring the efficient production of output, becomes the objective of action." Surely these coalitions are engaged in controlling the specific output of goods and services which the organization provides to its environment. At the same time, these coalitions seek to control the behavior in organizations through "...organizational rules, systems of evaluation, and structure. The techniques of control are prominent in the social, psychological, and sociological literature on organizations - socialization, social influence, conformity, social learning, and role behavior" (2-3).

Handy (1985, 120-127) describes six forms of power within the organization. Physical power is the superior force of the bully: in the school yard, on the picket line, in the police force, in the developing nation, and in the dictatorial boss. Resource or reward power is implicit in contractual

situations when one party has control of the resources and the other party desires use or access to those resources. Position or legitimate power comes from a role or position in the organization and is backed up by physical or resource power: manager, supervisor, legal counsel. Expert power is vested based upon an acknowledged expertise: doctor, legal counsel, production consultant. Personal power or charisma is that which comes from within the person or his personality: sports stars, corporate chairman (Iacocca), cult leaders. Negative power is the ability to halt or to disrupt the flow of activities: mail clerk, personnel officer, secretary.

Perrow (1986, 259) describes power in the organization as:

...the ability of persons or groups to extract for themselves valued outputs from a system in which other persons or groups either seek the same outputs for themselves or would prefer to expend their effort toward other outputs. Power is exercised to alter the initial distribution of outputs, to establish an unequal distribution, or to change the outputs. We could put it in terms of goals: there is a struggle over either the content of the output or the distribution of it. This is a 'power over' rather than a 'power with' view; it deals with the type of pie and the division of the pie, not its size. The question of the size of the pie, increasing the output no matter who gets it, is an important one, but it cannot operate independently of the distribution issue and the content issue, which are prior and thus the more important concerns.

"Organizations are political systems, coalitions of interests, and rationality is defined only with respect to unitary and consistent orderings of preferences. If every person can get all he wants, or what he wants, then there is no need to use social power and influence because everyone can be satisfied simultaneously" (Pfeffer, 12).

It is implicit in these analyses and conclusions that at some point the organization will be required to take action internally to produce goods or services or to export those products to the environment. Tuggle (1978, 42) says:

For an organization to take action, scarce resources (e.g. dollars) must be consumed. Before they are used, resources must be authorized to be expended - the two major forms of authorization are budgets and contracts. When an organization creates an action goal (or modifies an old action goal) which requires a change in resource level, that nonoperational goal is made more operational through its budget or contract level.

Power flows to departments - or individuals or groups - which cope with uncertainty or which are central to the work-flow of the organization (Gerloff, 170). Thus, reducing the uncertainty of another's position, or taking-on critical organizational functions, or making one's own work more complex will all lead to a potential increase in organization power and influence over the use of resources and control.

Conflict is the inevitable result of this social complexity in organizations. Beginning with the establishment and institutionalization of goals, to the forming and reforming of coalitions and the exercise of control and influence, to the distribution of insufficient resources to do everything, social complexity is the spice of organization theory. One need not be a cynic nor be naive as he/she works within social complexity; one can recognize the world of organization as it is and live within its confines.

The architectural perspective of organization theory is that human organizations may be designed or engineered in such a way as to make them more effective within their given environment. The process is based upon a "center of gravity" (Galbraith and Kazanjian), "configurations" (Mintzberg), "socio-technical systems" (Pasmore) or building blocks of "task processes and task process resources" (Mackenzie). In all cases there is an arrangement of patterns to facilitate the accomplishment of organizational goals.

A principal assumption of the perspective is that "... every organization has the problem of continually organizing itself to achieve its goals in the face of change, much of which it does not control..." (Mackenzie 1984, 5). Since organizations are "... invented social mechanisms to convert goals into results..." (4) the architectural perspective requires the organization have knowable goals and means of assessment of external (environmental) limitations and that it not knowingly engage in self-destructive activities.

Galbraith and Kazanjian (1986, 51) approach organization from a more global view. Rather than looking inward as do Mintzberg and Mackenzie, they see organization as a function of "center of gravity". They say:

A company establishes its center of gravity by starting operations in a particular industry at a particular stage of that industry. If and when it is successful, the company learns the management lessons of that stage and that industry. This point is important, because each stage of any industry has different success factors. Thus, the organization and its management are shaped by the lessons learned at their stage in an industry. Their values, their management systems, their business lessons, their organization, their path of succession, and their mind sets are all shaped by the stage of initial success. They have established an anchor, a center of gravity.

The center of gravity is seen as a position or series of positions occupied by the organization on a continuum or flow from raw materials to consumer purchase in the given industry. Figure 1 depicts this flow for typical manufacturing firms. An organization may change its center of gravity over time. As it does so, the nature of the organization must be changed (designed) in "...all of the organization dimensions..." (65).

"A center of gravity shift requires a dismantling of the current power structure, rejection of the old culture, and establishing all new systems" (65-67). Since the organization is industry - and center of gravity - specific, the new organization can be designed using related or competitive

organizations as the guide until the new position begins to produce learning.

Mintzberg (1989) describes six common parts to all organizations: an ideology (also referred to as culture), a strategic apex, a middle line, an operating core, a support staff, and a technostructure. The relative size of each of these parts (elements) determines the nature (architecture) of the organization (see figure 2).

The ideology (or culture) includes the "... traditions and beliefs of an organization that distinguish it from other organizations and infuse a certain life into the skeleton of its structure" (98). The middle line is the "... hierarchy of authority...between the operating core... where the products or services are created... and the strategic apex from whence the ...whole system is overseen" (98). The support staff provides "...various internal services including legal and public relation..." and the technostructure "...plans and coordinates..." the work of others as well as providing "...analysis..." (98). Both the technostructure and the support staff are outside the direct hierarchy from strategic apex through middle line to the operating core.

These six parts of the organization can be designed into seven different configurations which lead to "...consistency and the achievement of organizational goals" (110). The configurations, and attendant primary part of the organization, are: Entrepreneurial, the strategic apex; Machine/bureaucratic, the technostructure; Professional, the operating core; Diversified, the middle line; Innovative, the support staff; Missionary, the ideology; and Political, none.

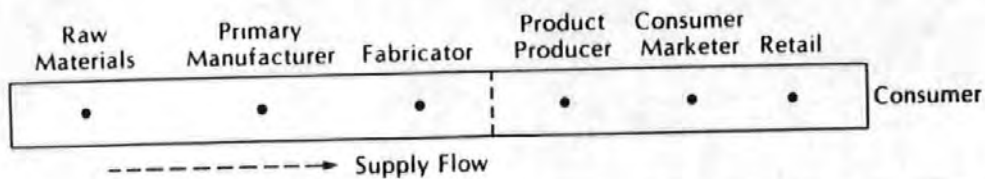


Figure 1 **Supply Stages in a Manufacturing Industry**
 Reprinted from Jay R. Galbraith and Robert K. Kazanjian,
Strategy Implementation: Structure, Systems and Process,
 Second Edition, (West Publishing Company, New York, 1986),
 p. 51.

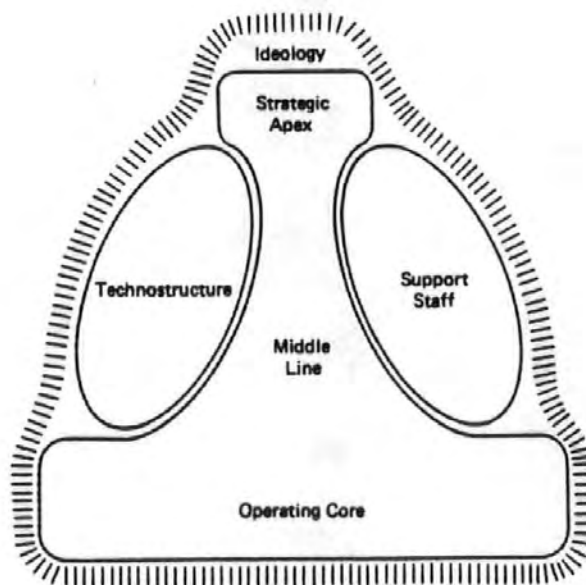


Figure 2 **Six Basic Parts of the Organization**
 Reprinted from Henry Mintzberg, Mintzberg on Management,
 (The Free Press, New York, 1989), p. 99.

Each of these configurations is developed from the generalized shape shown in Figure 2. For each configuration, the associated primary part is larger in "pulls" (111); size or influence. "When conditions favor one of these pulls, the organization is drawn to design itself as a particular configuration..." (110). This design may be accomplished "...way up there... or as the result of convergence into patterns..., deliberate and then legitimized" (31).

The socio-technical systems approach is based on the work of Eric Trist and the Tavistock Institute of the 1950's and 1960's (Pasmore 1988, ix). The approach has been used to design or redesign many organizations of different size, in different industries, and in all parts of the world.

The fundamental principle of socio-technical systems is that organizations are open systems, made up of a social (human) network and a technology (a means of transformation of goods or services), interacting fully with an environment. The environment limits the "freedom" of the systems such that the organization cannot do "everything" but at the same time provides resources to allow the organization to do "something". The architectural task is to balance the requirements of the environment within its resources and to balance the internal social and technological networks into a cohesive whole (Pasmore, 7-23).

The first requirement for an organization design/redesign is to conduct a full analysis of the environment. Since the environment presents both constraints and opportunities, these must be carefully articulated so that the internal networks produce acceptable (to the environment) results. The product of this analysis is a clear description of the boundary of the organization, the expectations of the environment, and a clarification of the

organizational goals i.e. how it will respond to the demands of the environment (Pasmore, 113-119; Williamson 1986, 105).

The social network is made up of individuals and groups which interact. The focus of the perspective is at these levels, rather than at Miller's organization level, since all work efforts are described, by this perspective, in terms of individuals or groups.

The macro-level of the social network is concerned with culture and structure. According to Schein (1985, 9), organization culture is: "... a pattern of basic assumptions - invented, discovered, or developed by a given group as it learns to cope with its problems of external adaptation and internal integration - that has worked well enough to be considered valid and, therefore, to be taught to new members as the correct way to perceive, think, and feel in relation to those problems."

Culture is neither static nor precisely measurable. It changes as new people or new technologies are introduced inside the organization. It changes as the environment shifts and adapts to the changing cultures of other organizations. Because culture is based on individual and group perceptions, it is ambiguous. Thus, the "reflections of culture" (Schein, 6) may be measured - although the results may be transitory - but the culture itself is not measurable.

The socio-technical perspective outlines twelve elements of organization structure: "...reporting relationships, rights of office, departmental boundaries, reward systems, policies, procedures, legal constraints, the size of organizational units, control systems, rules, information systems, and physical artifacts which help shape behavior" (Pasmore, 39).

"There is no single structural constellation that is innately right or wrong from a sociotechnical systems perspective. Instead, the fit of the structure with the desired social system dynamics is more important to consider" (Pasmore, 41).

There are three basic principles in creating the technical network in a socio-technical system design. First is variance and the control of variance in the technical processes. This perspective, as does the cybernetic (Beer 1981), includes reference to Ashby's law of requisite variety in that the variability of output must equal the variability of input (Pasmore, 64). The second principle is that the "...effectiveness of the whole is more important than the effectiveness of the parts" (Pasmore, 67). Berrien (1968) discusses this at the general and at the social level in part as a conflict to maintain subsystem autonomy (85-87 and 170-176). The third principle is that "Boundaries between units should be drawn to facilitate variance control and to reduce group interdependencies" (Pasmore, 63).

Pasmore (94-103) describes six advantages of the socio-technical systems design process:

1. Innovation versus preserving the status quo.
2. Development of human resources.
3. Awareness of the external environment.
4. Maximizing cooperative effort.
5. Developing commitment and energy.
6. Utilizing social and technical resources effectively.

Mackenzie (1986, 3) approaches the architecture of the organization as a process which "...involves intervening to design the entire organization [emphasis in original]. It must consider the environments in which the organization operates, the goals and strategies, the underlying assumptions, the organization of all the task processes, the assignment of people and task processes to positions, how it actually operates, and the

results produced. It must be done while the organization operates and continues the change. The results of an organization design can determine success or failure of the organization as well as the impacts on individual careers. ... Organizational design is the natural study of princes, commanders, and leaders. It is concerned with the age-old issues of who governs the organization and for whose benefit does the organization exist to serve."

For Mackenzie (43), the principal element of organization engineering is the work of the organization. He contrasts the economic view as one "...unconcerned about *how* [emphasis in original] inputs can be converted to outputs..." and the organizational psychologist's view which "... believes that proper leadership and motivation will help the individual be more productive...."

All work may be described as a task process which requires the use of task process resources. There are three levels of task process: execution; directing, controlling and coordinating; and planning (50-51). Task processes may be aggregated at five levels: activities, modules, bundles, and areas which, taken together, form the organization logic.

Activities are the lowest level and represent the "how" of the transformation process of producing goods and services. Activities can be aggregated by time and/or space similarities into modules. Bundles are formed from related modules and represent the first level of the "coordination process" (58). Bundles are then formed into groups which are further aggregated into areas of work. The summation of the aggregation yields an organization logic which describes the work to be done and the levels of coordination and planning required.

Related activities are placed contiguous to each other in such a way that coordination can occur. Unrelated activities are separated by time and/or space such that the integration processes become more formalized. This designed set of relationships results in an organization responsibility grouping or ORG chart (76-77).

The final consideration is to design the "...organizational interdependencies..." (133). These dependencies describe the larger relationships and the requirements for broad-view coordination and planning.

Organization Structure

In defining the field of organization in 1966, Rubenstein and Haberstroh (2) characterized the field as one of "...growth... which has led to ...a large amount of fragmentary and unintegrated ideas about how organizations do and should behave." They defined organizational structure as "... the pattern of beliefs about the organization that are shared by those individuals who take the coordinated action that we define as *organizational behavior*" [emphasis in original], (64).

They continue "...one seeks for characteristics of these institutions sufficiently general to describe a wide range of specific organizations and yet useful for the purposes of explaining, predicting, and controlling the behavior of an individual organization" (64).

Perrow (1970, 18-19) addressed the need for a single theory of organizations, thus [emphasis in original]:

Can there be one theory of *organization* or should there be many *theories* of organization?...there are various types of organizations and... we may legitimately have theories that only apply to some types and not to others. We know enough about organizations now to recognize that most generalizations that are applicable to all

organizations are too obvious, or too general, to be of much use for specific predictions. This was not true in the past when there was less organizational knowledge, fewer complex organizations, and fewer organizational varieties. One of the dominant themes... will be that today organizations come in great variety and that organizational theory must be varied to be useful.

Mintzberg states "...structure (is the) pattern of formal relationships that determines how work is to be divided and coordinated" (1989, 20-21).

This review examines the principal descriptors of structure in organization theory and the elements which are used to describe organizations. The review includes the essential, related contributions of Max Weber, T. Burns and G. M. Stalker, Joan Woodward, D. S. Pugh, Paul Lawrence and Jay W. Lorsch, Charles Perrow, Gerald Hage, and Henry Mintzberg.

The classical description of organization structure was developed by Max Weber. He did not use the term "...bureaucracy in a pejorative sense..." (Rubenstein and Haberstroh, 64) but rather as a description of what he considered to be the "ideal type of organization, the most modern and technically efficient yet developed" (64). His focus was on the structure of the type, its interrelationships, and consequences.

Weber, as quoted in Rubenstein and Haberstroh (70-81) defined six "functions of modern officialdom" which defined the structure of the ideal organization. They are:

I. "...fixed and official jurisdictional areas, which are generally ordered by rules, that is, by laws or administrative regulations" (70). These areas might be geographical, physical, or pertain to a defined administrative function. In government this was "bureaucratic authority" and in private enterprise it was "bureaucratic management."

II. "... a firmly ordered system of super- and sub-ordinates in which there is a supervision of the lower offices by the higher ones" (70). Such a system provides two identified advantages. First, there is the opportunity of appealing the decision of a lower office (or officer) to a higher level office in a "regulated manner". The second advantage is that offices continue their existence after the departure (by elevation, death, promotion) of the incumbent.

III. "...management is based on written documents, 'the files', which are preserved in their original or draught forms" (71). Such records form an on-going memory of events and decisions which serve as precedent in future situations. Rules of procedure or administration need not cover all contingencies as long as precedent has also the strength of specific rules.

IV. "...usually presupposes thorough and expert training" (71). In order to know all the rules and procedures, each bureaucratic administrator or manager, at each level must be extensively trained to perform his duties to the expectations of the enterprise. Such training would require on-going and frequent up-grading.

V. "...activity demands the full working capacity of the official..." (71). Bureaucratic officials could not be expected to have either time or energy to pursue other forms of occupation or vocation. The official duties of each incumbent were to be sufficiently large and complex to require the full efforts of all officials. This distinguishes between "bureaucratic and honorific" endeavors.

VI. "...the management...follows general rules, which are more or less stable, more or less exhaustive, and which can be learned" (71). The bureaucratic enterprise is long lived, permanent according to Weber (79). As such the rules of procedure (given, established, or based on precedent)

become more and more all-encompassing and create stability within the organization. Such an organization can be learned, as can the rules of procedure (see IV, above).

Richard Hall (1982, 28-30), re-casts Weber's elements of structure into more current concept and language. He states that Weber established seven criteria for the organization:

- social relationships
- boundary
- order by design or purpose
- hierarchy of authority
- division of labor (differentiation)
- associative (rather than communal interactions)
- continuous purposive activities

Burns and Stalker were interested in how organizations were affected by their environment. Of particular interest were changes in the marketplace in which the organization operated and in the technology employed within the firm (Gerloff 1985, 51).

Their conclusion was that bureaucratic structures are particularly appropriate in times of environmental stability. However, in times of environmental, marketplace, or technological instability, they conclude that the organization should change the nature of its structure. These forms of organizations they labelled "...mechanistic and organismic" [later changed to organic]. Although they spoke of the mix of these as a continuum they did not identify any positions on that continuum (Handy 1985, 444).

The distinctive features of the two forms of organization are shown in Figure 3.

DISTINCTIVE FEATURES OF MECHANISTIC AND ORGANIC MANAGEMENT SYSTEMS

Mechanistic systems	Organic systems
1. High emphasis is placed on subdivision of task and differentiation.	1. Low emphasis is placed on specialization or standardization except as they realistically contribute to overall tasks and goals.
2. Functional specialists are concerned with improving technical means of their tasks.	2. Emphasis is placed on special knowledge and experience and their contribution to overall tasks and goals.
3. Supervisors at each hierarchical level seek to integrate and reconcile performance of functions reporting to them.	3. Individual task activities are continuously redefined through interaction with others.
4. Rights, obligations, and technical methods of each functional position are precisely defined and assigned.	4. Responsibility and obligation are loosely defined; problems cannot be passed up, down, or laterally.
5. Authority, control, and communication are legitimate and hierarchical in nature.	5. Commitment to the organization is broadly defined, not narrow and technical.
6. It is assumed that the necessary knowledge for ultimate reconciliation of functions is at the top of the hierarchy.	6. Authority, control, and communication are derived from common interests and needs and are not based strictly on contractual obligations.
7. High levels of vertical interaction patterns exist between superior and subordinate.	7. Knowledge and competence are equally distributed throughout the hierarchy. Exact location is contingent on the nature of problem.
8. Communication content emphasizes directions and orders.	8. High levels of lateral interaction patterns exist between participants: consultation instead of command.
9. Loyalty to the organization and obedience to superiors is a condition of employment.	9. Communication content emphasizes information and advice.
10. Prestige is attached to achievement of position in the organization (local).	10. Commitment to goals is more important than loyalty and obedience.
	11. Prestige is attached to external technical and professional affiliations (cosmopolitan).

Figure 3 Reprinted from Edwin A. Gerloff, Organizational Theory and Design, (McGraw-Hill, New York, 1985), p. 52. Source: T. Burns and G. M. Stalker, The Management of Innovation, (London: Tavistock Publications, Ltd., 1961), pp. 119-122.

A critique of the Burns and Stalker model by Gerloff (54), is based on the later research by Bourgeois *et al* in 1978 which suggests that, in practice, individuals faced with environmental instability tend to favor more mechanistic rather than less mechanistic systems. Further, it is only in periods of environmental stability when they choose organic systems.

Joan Woodward (1965, 17-49) and her colleagues studied one hundred firms of various sizes and products over a period of nearly ten years. The initial research was designed to measure the classical theory concerns with organization: line organization, functional organization, and line-staff organization. The research reached no conclusions until the issue of the technology employed in each of the firms was incorporated into the analysis. Eventually the data were grouped into eleven categories of technology employed, roughly: unit/one-off production, batch/mass production, and process/continuous production.

Her conclusion was that "...it might be possible... to build stabilized variable models of the kind used by economists" (248).

Although not all the Woodward conclusions have been confirmed (Gerloff 1985, 86-90; Handy 1985, 445; Pugh 1987, 82-85), her work remains a major contribution to the question of structure.

Her conclusions were (Woodward 1965):

...the main conclusion reached through this research project was that the existence of the link between technology and social structure first postulated by Thorstein Veblen (1904) can be demonstrated empirically. It is not suggested that the research proved technology to be the only important variable in determining organizational structure, or that such factors as the history and background of a firm and the personalities of the people who built it up and subsequently managed it were unimportant (50).

...in firms where two systems of production are combined there was a tendency to organize each system independently (51).

...as production technology advanced, moving towards continuous-flow and process systems, the distinction between line roles and staff roles became less clear-cut, and specialist skills (although of greater importance) became increasingly incorporated into the line and linked with executive (decision making) responsibility (96).

...in the technically advanced firms (process) the co-ordination of work does not depend upon organizational structure or on co-operation between people....the design or mechanism for the co-ordinating of work is intrinsic in the plant itself (123).

...the senior executives responsible for development, production, and marketing were more autonomous (in batch and mass production) than their counterparts in unit production (144).

Further,

"...Woodward believed that her data clearly demonstrated the presence of several direct relationships between technology and structure. ...as the level of technology advanced (from unit through mass to continuous production) there were corresponding increases in the number of levels in the scalar chain; the span of control of the chief executive; the ratio of managers and supervisors to nonsupervisory personnel; the size of the clerical and administrative group; and the proportion of indirect to direct workers" (Gerloff 1985, 86).

The Aston Studies, of Pugh, Hickson, and others, provide a dissenting perspective from that of Woodward. These studies developed a comparative scale "...so that positions of particular organization on those scales form a profile of the organization" (Pugh 1984, 70).

Six dimensions were created for research involving fifty-two organizations both private and public (municipal and central government ownership). The dimensions were: functional specialization, standardization, standardization of employment practices, formalization, centralization, and configuration (Pugh 71).

The conclusions of the Aston Studies suggested that technology (defined by Woodward) as determinant to structure was limited to only the

smaller sized firms. Size, in the Aston analysis, was a greater determinant in larger firms in part because the size of the entity provides buffers within the system. These buffers include specialists, structures, and formalization (Gerloff, 91).

Lawrence and Lorsch (1967) identified two significant elements of organization structure in their work involving high performing organizations. The original study compared and contrasted high-performing organizations in different environments. The result was "...an increased understanding of a complex set of interrelationships among internal organizational states and processes and external environmental demands" (Pugh 1984, 87). The two identified elements were differentiation and integration.

"Differentiation is the difference in cognitive and emotional orientations among managers in different functional departments, and the differences in formal structure among those departments" (Lawrence and Lorsch 1967, 8).

"Integration is the quality of the state of collaboration that exists among the departments that are required to achieve unity of effort by the environment" (8).

Thus, while there are departmental differences both in the managers as well as the purposes (e.g. finance, manufacturing, research), there are both formal and informal "mechanisms" which, by design, integrate the efforts of otherwise contrary (or dissimilar) perspectives. These devices, summarized in Figure 4, provide a means to meet organizational goals, reduce or resolve internal conflict, and foster the ability of the organization to meet the demands and limitations of its environment.

Fig. 4 Integrative Devices in Three High -performing Organizations

Plastics	Food	Container
1. Integrative department	1. Individual integrators	1. Direct managerial contact
2. Permanent cross-functional teams at three levels of management	2. Temporary cross-functional teams	2. Managerial hierarchy
3. Direct managerial contact	3. Direct managerial contact	3. Paper system
4. Managerial hierarchy	4. Managerial hierarchy	
5. Paper system	5. Paper system	

Figure 4 Reprinted from D. S. Pugh, Editor, Organization Theory, Second Edition,(Penguin Books, London, 1984), p. 91.

It may be that the most significant aspect of the work by Lawrence and Lorsh involved the articulation of a contingency approach within a systems framework. As contemporaries of James G. Miller (1965), they summarize their work: "These findings suggest a contingency theory of organization which recognizes their systemic nature. The basic assumption underlying such a theory, which the findings of this study strongly support, is that organizational variables are in a complex interrelationship with one another and with conditions in the environment" (Pugh 1984, 104).

Perrow (1970, 66-85) proposes a technology-based analysis of organization structure based on two considerations: variability of input and understanding of the employed process.

Variability of the input is divided into two kinds: uniform and stable or non-uniform and unstable. If the input from the environment is assumed to be always the same in nature, kind, size, composition, frequency of arrival, and so forth, then it is deemed to be uniform and stable. If it is subject to variance in these ways, it is assumed to be unstable.

If the process employed in transforming those inputs into outputs is well understood then the "search" for methods is analyzable. If, however, the process is subject to significant variation or is one-off in nature (see Woodward), then the process must be "created" anew each time and the search is considered unanalyzable.

The resulting four box diagram from this analysis is shown in Figure 5. The Weberian bureaucracy occupies the lower left corner of the diagram, the Woodward one-off firm occupies the upper right position. Between these two poles can be seen the possibilities for positions available on the Burns and Stalker continuum between mechanistic and organic forms of organization.

In his later work (1986, 259), Perrow posits a power conception of organization, "Power, as used here, is zero-sum, relational (over someone), exercised both inside and outside the organization, an output of organized activity that is valued and an output that is produced only at some cost".

PROCESS NOT WELL (PERFECTLY) UNDERSTOOD UNANALYZABLE SEARCH	VARIABILITY OF RAW MATERIAL INPUT							
	FEW EXCEPTIONS UNIFORM & STABLE				MANY EXCEPTIONS NON-UNIFORM & UNSTABLE			
	DISCRE- TION	POWER	COORD W/N GROUPS	INTERDEPEN- DENCE OF GROUPS	D	P	C	I
TECHNO- CRATS	LOW	LOW	PLAN	LOW	HIGH	HIGH	FEED BACK	HIGH
SUPER- VISORS	HIGH	HIGH	FEED- BACK	DECENTRALIZED	HIGH	HIGH	FEED BACK	FLEXIBLE POLYCEPHALOUS
TECHNO- CRATS	LOW	HIGH	PLAN	LOW	HIGH	HIGH	FEED BACK	LOW
SUPER- VISORS	LOW	LOW	PLAN	FORMAL CENTRALIZED	LOW	LOW	PLAN	FLEXIBLE CENTRALIZED

Figure 5 Technology and Organization Structure
From: C. Perrow, Organizational Analysis: A Sociological View. Brooks/Cole, 1970.

He summarizes his arguments (260-262) within three propositions:

1. Basically, an organization is a tool that masters use to generate valued outputs that they can appropriate. The most essential theory to explicate this is bureaucratic theory.... This theory emphasizes hierarchy, specialization, formalization, and standardization. Nothing is as important as the master's ability to imperatively specify and coordinate the work of employees. The formal structure of the organization is the single most important key to its functioning, no matter how much it may be violated in practice, the violations themselves reflect the constraints of the formal structure. Imperative coordination is achieved primarily through direct controls (orders, associated with hierarchy) and bureaucratic controls (standardization, specialization, and formalization). Bureaucratic theory, based on the work of Max Weber... is the single most essential element of a theory of organization.

2. The first and most major *qualification* of the bureaucratic model is, as discussed in Chapter 4, bounded rationality: shifting and unclear preferences, limited information, and limited knowledge of cause and effect relationships.

3. Given bureaucracy with bounded rationality, the next most important qualification is group usage, as distinct from individual usage of the organization by masters and employees. Group usages are internal and external (and may reside inside or outside of the organization).

Hage (1980) continues the systemic notions articulated by Lawrence and Lorsch by examining organizations based on the variables of means and output. His work is focused on establishing propositions and corollaries which may be examined at multiple levels, cross-culturally, or inter-organizationally.

These propositions are based on the analysis of the means and output variables. The organizational means variables are (265):

Complexity (specialization): The number of occupational specialties, level of training required.

Centralization (hierarchy of authority): Proportion of jobs that participate in decision making, Number of areas in which decisions are made by decision makers.

Formalization (standardization): Proportion of jobs that are codified, Range of variation allowed within jobs.

Stratification(status system): Differences in income and prestige among jobs, Rate of mobility between low- and high-ranking jobs or status levels.

The organizational ends variables are (265):

Adaptiveness (flexibility): Number of new programs in a year,
Number of new techniques in a year.

Production (effectiveness): Number of units produced per year,
Rate of increase in units produced per year.

Efficiency (cost): Cost of output per unit per year, Amount of idle
resources per year.

Job Satisfaction (morale): Satisfaction with working conditions,
Rate of turnover in job occupants per year.

Mintzberg (1979, 2) says "The structure of an organization can be defined simply as the sum total of the ways in which it divides the labor into distinct tasks and then achieves coordination among them".

The most basic elements of structure are: "... mutual adjustment, direct supervision, standardization of work processes, standardization of work outputs, and standardization of worker skills..." (3). The "organigram" [organization chart] represents the "...division of labor..." and the "... boundary.." of the entity (37).

"Span of control (unit size) seems to me to be a function of the variability and analyzability of the work at hand" (40). [See also Perrow, 1970]. "...we would expect the operating core of the organization to assume a flat shape, the middle line to appear as a cone with progressively steepening sides, and the technostructure and more professional support units to be tall in shape" (147).

The ideas are represented in his later work (Mintzberg 1989) as the fundamental shapes of an organization typology. Configurations of the strategic apex, the middle line, the operating core, the support staff, and the technostructure define the nature of each organization (1989, 95-115).

In reviewing the literature, Hall (1982) identifies the following elements of organizational structure:

- size (53)
- technology (53)
- environment (53)
- choice and strategic choice (53, 73)
- division of labor (54)
- hierarchy (54)
- medium of control (54)
- practices and procedures (54)
- complexity (horizontal and vertical differentiation, spatial dispersion) (82-87)
- formalization (95)
- centralization (114-118)
- power and conflict (131-138, 152-153)
- decision making (158-159)
- communications (185-199)
- change and innovation (208-210)

He summarizes: "... (structure) is task allocation, exercise of authority, and coordination of activity..." (310).

In his review of the literature, Dessler (1980) identifies the following elements of structure:

- environment, technology and size (Chapter 4)
- decision making and communication (Chapter 5)
- departmentation and coordination (Chapter 6)
- hierarchy and delegation (Chapter 7)
- authority, control, and rewards (Chapter 9)

Hicks and Gullett (1975, 45-102), in their review of the literature, identify these elements of structure:

- boundary
- defined structure of activities
- authority
- centralization/decentralization
- span of management
- power
- environment
- differentiation
- technology
- interdependence
- integration

Thus, we may say that the following represent a generic and at least minimal definition of the elements of organization structure:

1) **Boundary.** Boundary represents a concrete, actual, or conceptual/abstract separation between the organization under examination (or of interest) and its environment. Such a boundary must be permeable (open) so that matter-energy and information may be exchanged between the system and the environment. An environment is a prerequisite for a boundary (Miller 1965, 1978).

2) **Differentiation.** Horizontal differentiation occurs when the organization requires the performance of more than one task or more than one task at a time. Tasks, functions, geographies, markets, time, and populations all serve as foundations for horizontal differentiation [not necessarily in one organization, however]. The architectural perspective conducts its examination of organization structure through such building blocks as horizontal differentiation of task processes.

Vertical differentiation refers to the distinctions in the scope of authority and responsibility within a group, unit, or department. Registered nurses, registered practical nurses, licensed practical nurses, and nurse assistants represent vertically differentiated roles, responsibilities, rates of pay, and organizational power (influence). In the maritime industry, vertical distinctions are made between those who achieve licensure (officers) and those who do not (ratings).

3) **Integration.** Integration is the cost of organizational differentiation (Lawrence and Lorsch, 1967). Differentiation permits each individual, group, unit, and department to perform at a higher level through specialized education, training, or experience. The cybernetic perspective is that integration takes place through variety (of input available or output

accepted by the environment) amplification and/or reduction and through internal and external feedback.

Centralization is the integrative process which places the locus of decision making in such a position that the decider (Miller, 1978) has all or most of the requisite information available. Centralization reinforces the ideas of supervision and vertical differentiation. An added cost to centralization is that caused by the time lags inherent in generating, processing, filtering, and forwarding appropriate information.

Formalization is the integrative process whereby rules, procedures, and patterns are established so as to distribute the decision making process. Formalization reinforces both horizontal and vertical differentiation through pre-established parameters governing individual, group, unit, and departmental choice. An associated cost of formalization is that dispersed decisions do not always support the goals of related, but differentiated, subunits.

4) Conflict resolution. Every differentiated system at the group level or higher, will eventually require a conflict-resolving structure. Differentiation produces incompatible goals between horizontal and vertical elements. In some instances the decider is the conflict reducer mechanism; in others, the structure includes designed elements (teams, task forces, departments, and so forth) to resolve conflict (Lawrence and Lorsch, 1967).

5) Information generation and ownership. This element is related to the integrative processes of centralization and formalization in the nature of information transmitted vertically and horizontally. Information levels and flows represent data concerning plans, goals, anticipated use of resources, and the exercise of power (choice).

6) Rewards. Rewards, and the distribution of rewards represent the power element in organization structure. Rewards are made for long term and short term performance. Rewards may be at the individual, group, unit, or departmental levels and may consist of financial, psychic, or personal perquisites. Rewards represent the appropriation and expenditure of such resources as funds, equipment, personnel, information, time, access to others, and distribution. Participation refers to the degree of shared decision making in establishing and distributing rewards.

The Maritime Organization

This generic listing of organization structure can be used to describe the modern merchant vessel. There is a horizontal differentiation, a vertical differentiation, a boundary, two primary integrating mechanisms, a power format, information flows, and a conflict resolving methodology. At the bridge-watch level, these same organization structures apply. This application of the elements is brief and does not include some of the experimental organization structures now being developed in Europe, Japan, and to a very limited degree, the United States. There have been few instances of change in the vertical dimension over the last 50 years. There have been a number of changes in the horizontal dimensions, particularly in Europe and in Japan, as alternative manning structures are developed and applied.

Up until about 1850 all merchant marine vessels were powered by sail and the organization structure was based upon a vertical differentiation. There were officers, petty officers or skilled sail-handlers and vessel crew members (Moreby 1975). An horizontal differentiation was

initiated in the age of steam when technical experts, capable of managing, operating, and maintaining steam boilers and propellers were needed aboard vessels and navigating officers did not have those skills. This horizontal differentiation has since been institutionalized through unions, Coast Guard regulations, ship ownership organizations, and other national and international structures.

The modern vessel in the United States is differentiated into four horizontal departments. The deck or navigation department is responsible for navigation, ship handling, loading and unloading, and general ship-keeping. The engine or technical department is responsible for the propulsion system, deck and allied machinery, and the maintenance of those systems and machines. The hotel or steward's department is responsible for food service and laundry. Many vessels continue to carry a radio officer as the fourth department, responsible for external communications.

The modern vessel is differentiated into three or four vertical levels. The highest level consists of the captain, or master, who bears the legal responsibility for the safety and efficiency of the vessel. Each of the departments is led and managed by officers who have received specialized training, completed the required levels of experience, and have been examined and licensed by a governmental body. The third vertical level includes skilled and experienced individuals in each department (wheelmen, bosuns, engine repair specialists, etc.) who perform specialized duties under the direction of the officer group. Typically there are also some unskilled or semi-skilled ratings in each of the three departments who work under the direction of the skilled, non-officer, cadre.

The boundary in the operations of the merchant marine is clear. It is a physical, concrete boundary: the skin of the ship. It is permeable through the acceptance and discharge of cargo, fuel, stores, and personnel. It bounds a relatively self-contained system interacting with its immediate physical environment (wind and wave) and its societal environment (marketplace, ship owner, cargo owner, etc.).

The vessel itself, when underway, also performs part of the integrating function (as well as serving as the boundary). The freedom of all on board is circumscribed by the vessel. No one can go home at the end of the day, bowl with another social group, or avoid an intolerable work-mate through a spatial separation. Rather, the vessel precludes these opportunities and forces the crew to rely upon its resources except in the most unusual circumstances (coastal grounding or the like).

The captain is the human integrating force, supported by the chief engineer and the officer cadre. His [there are still very few women in this position] role is to coordinate the activities of the horizontal differentiation and to assure safe passage of the vessel, its cargo, and crew.

Information flows in many informal as well as formal patterns. As with many small groups of people, the rumor mill is always active. Since the vessel is both boundary and integrator, information may flow swiftly to all through alarms and other devices.

There are three levels of reward (power). There are specific and detailed legal requirements demanded by various international and national organizations regarding standards of watch-keeping, pilotage, and acceptable norms of ship-keeping and operation; many recent additions concern the discharge of pollutants into the world's oceans, rivers, and harbors. The vessel owner has established a reward structure which is

carried out by the captain, and to a lesser extent by the chief engineer. The captain also produces a level of power which is absolute within the limitations established by the owner, the national regulatory agencies, and the international regulatory agencies.

Conflict is resolved through decisions in the vertical hierarchy. Differences of opinion or disagreements are carefully managed by the parties involved. They are not brought to the surface except in unusual circumstances. Resolution is almost always through the vertical hierarchy: skilled rating, officer, chief engineer (if in the technical department), captain, owner/union representative, national/international regulatory agency. There are limited structures available for conflict resolution at the horizontal interfaces; these conflicts are usually also resolved through the vertical hierarchy.

The bridge-watch of today's vessel is clearly bounded by the physical limitations of the bridge (or pilothouse) as a physical structure. Differentiation is by role, typically one or more watch officers, perhaps a master, a pilot, one helmsman and one or more look-outs. Military vessels will have additional personnel on board. Smaller coastal trading vessels would likely have a captain, a helmsman and perhaps a watch officer. A tug or ferry may have only one person standing the bridge-watch.

Integration is through the tasks to be performed; under pilotage conditions the captain is the integrating mechanism when he has the conn [piloting control of the vessel]. Information may be differentially spread among the bridge-watch. In pilotage waters the pilot has the expertise of the geography and waters, the master has the expertise of the vessel. Power resides with the master with the exception of the Panama Canal in which the power resides with the pilot.

The Near-miss Experience

The near-miss experience has been identified as a potential source of learning in the maritime industry for a number of years. The first attempt to codify the near-miss experience from the perspective of the bridge organization was conducted during 1979-80 by Det norske Veritas, the vessel classification and inspection society in Norway. The framework for the project, which was entitled *Cause Relationships of Collisions and Groundings*, established the near-miss experience as an included part of the primary research (Drager 1979).

Specifically the project established a near-miss reporting form (Drager 1980) as a means for members of the merchant marine and the maritime community to report near-misses as a source of data to the project team.

The response to that request was "uninspiring". Drager (1989), in the final report for the Det norske Veritas project in collisions and groundings on page 31 provides an analysis of near-misses.

The number of near-misses at sea is not generally known, but on the basis of comments from ship masters and navigators it is presumed that a certain number of situations arise that could lead to collisions and groundings:

These near-misses represent a valuable base of empirical data from which worthwhile knowledge can be gained as to how the casualty was avoided or information about hazardous areas of fairway or inadequate marking of the area, etc.

Near misses also constitute an important data basis for the understanding of the casualty process. Potential causal factors contributing to the casualty are often factors or conditions that are present to a greater or lesser degree during all marine transport operations and not only in the cases where a casualty takes place. Collection of data on near-misses can therefore provide insight into the potential causal factors, and if one makes a comparison with situations that led to the casualty one can possibly identify with the most critical factors or conditions that lead to the casualty.

The project team received twenty-four near-miss reports and the results were similar to those of the over-all project statistics. The section on the near-miss concludes by saying, (31) "Near-miss reporting ought to be viewed in connection with the recommended reporting system outlined previously, where the need for such reporting is pointed out. In the meantime, however, it is important that such near-misses ought to be discussed more systematically among the navigators, so that they can learn from the errors that have been made."

The near-miss phenomena was clearly seen as an important contributor to understanding the causes of collisions and groundings in that project. Unfortunately the response rate was so low that no data was published about the nature of the near-miss phenomena or its frequency. Nor was there a methodology established to continue near-miss reporting and to share the results with the maritime community-at-large.

The United States Department of Transportation in 1984 determined that a maritime safety reporting program patterned after the aircraft safety reporting program [both voluntary] might be an appropriate tool for assisting in improving safety and reducing hazards to navigation. The Department of Transportation at the Transportation Safety Center in Cambridge, Massachusetts established a one year trial program to solicit observations of errors from the industry as reported in *Safety at Sea*, August 1985, p. 3. Two types of errors were solicited: hazards (aids to navigation) and practices (operating situations). The one year experimental project was terminated on May 31, 1986 and a project report was issued that fall.

One near-miss story is reported on page E2 of that final report:

The following summarizes the particularly poignant situation. It seems that two vessels had been navigating on the high-seas after midnight on nearly parallel tracks, within sight of each other, for a few hours when the reporter determined the tracks were on a collision course. The vessels closed to the point where the other mate could be clearly seen on the port bridge. The reporter signaled the other vessel twice to fall astern with a negative reply each time. The situation ended with emergency action on the part of both vessels. The impact apparently was so imminent that the reporter has relived it many times -- prompting the following closing comment in his report: ... instructed helmsman to ease course to port 1 degree or 2 degree at a time to prevent throwing stern into opposing vessel ... other vessel was seen belching smoke with sharp turn to starboard and stopped. I then resumed and continued on course (and worried over this for the next ten years) ...

While the report may be stale, the reporter has certainly captured the intent of MSRP (Maritime Safety Reporting Program).

The reporter added that he was hesitant to change course or speed because this would require notifying (and therefore waking) the master or chief engineer. He wondered if the mate on the other vessel was operating with similar motives.

The project framers had hoped to generate between 250 and 500 responses in a twelve month period. Only 220 responses were received and of those some forty were not usable (26). The project was terminated by the Department of Transportation and has not been reinstituted.

Olf Mamholt (1983, 44) says:

There have been several attempts to solve the problem of how to collect more useful information on risk through incident or "near-miss" reporting systems of various kinds. These systems have in almost all cases failed to operate for any significant period of time. Some of the reasons for this are:

- * The person involved in the incident or the near-miss situation must himself take the initiative to write a report, which might concern, for him, embarrassing situations or admissions.

- * The person who reports has prejudices. In a national reporting scheme, out of forty reported cases of bad conduct of other ships all but one were of foreign nationality.

- * It is impossible to verify the statements made.

These other attempts are not identified nor cited by Mamholt.

The most recent references to the near-miss experience were in 1988-89. Robert Hershey, writing in *Maritime Policy and Management* (April-June 1988, 141-146) reports an incident in his research of the "... intimidation effect in near-collision. The chief mate and master were conning the vessel through an anchorage near the entrance to the Sabine River, Port Arthur, Texas. The chief mate, deferred to the master even though the mate clearly knew the vessel was out of the anchorage and cutting across the ship channel thereby nearly colliding with a vessel in the channel. The master mistook the vessel's lights for something else" (143-144).

Hershey also describes a second near-miss, in this case a near-grounding. "The second mate knew the charts were in error; channel buoys had been moved but the chart had not been corrected. The mate deferred to the master who did not believe the mate thereby ignoring the mate's knowledge. The mate remained silent" (144).

Habberly (1989, 10) describes as a near-miss situation the circumstances in which action by one ship can cause a collision when no collision would have occurred but for the action of the first ship. This suggests that vessel actions cause near-misses. He conducted a number of interviews with mariners in a study of collision avoidance behavior and was told "a near-miss can shake you up a lot", "you have to learn from near-misses every one tells you something", "I'm probably a lot more conscious as a result of near-misses and surprises" (10).

The near-miss is apparently a regular and personal experience in the maritime industry. Near-misses are remembered over a long period of time and form the background for one's professional development. There is some agreement in the industry that near-misses could be the source of learning and improvement in the industry but that the two formal attempts

have not been able to carry-on or provide much useful data. The near-miss phenomena, as examined in this thesis, is based upon an organizational structure within a bridge-watch, within an industry, within the framework of a large organization. The critical elements have been identified and placed within that overall context.

CHAPTER 3

METHODOLOGY

In the beginning there is description. Detailed, descriptive case studies are usually the jumping-off point for the study of new areas in the social sciences. ... much anthropological research is descriptive, deliberately setting out to create a rounded picture of the entire culture or some broad aspect of it. In economics the industry case study continues to be done long after economics has left its infancy.... Descriptive research does not create laws and conclusions that apply beyond the subject matter described (Simon and Burstein 1985, 37).

Yin (1989, 16-20) identifies five alternative research strategies: experiment, survey, archival analysis, history, and case study. He suggests that a case study is appropriate for research questions asking "how" and "why", when no control over behavioral events is required and when the focus is on contemporary activity.

The purpose of this research is to describe the near-miss experience in the words of those involved; to identify ways in which the organization may have changed to produce a near-miss rather than an accident. The research recognizes the richness of the experience and does not find fault or blame regarding shiphandling or pilotage performance. It does not require control over behavioral events nor does it require internal experimental replication.

Yin defines a case study as an empirical inquiry that "...investigates a contemporary phenomena within its real-life context; when the boundaries between phenomenon and context are not clearly evident; and in which multiple sources of evidence are used" (23).

According to Yin (46-59), case studies may be either single or multiple case designs and either holistic or embedded. A multiple case, holistic design (type 3) involves multiple cases, each one independent (not embedded) in the others. The unit of analysis remains the same for all the case descriptions.

Yin describes the multiple case design as one which includes replication rather than sampling logic. He compares replication logic to multiple experiments (53). He says, "The logic underlying the use of multiple case studies is ... selected so that it either (a) predicts similar results (*a literal replication*) or (b) produces contrary results but for predictable reasons (*a theoretical replication*). Thus, the ability to conduct six or ten case studies, arranged effectively within a multiple case design, is analogous to the ability to conduct six to ten experiments on related topics; a few cases (two or three) would be literal replications, whereas a few other cases (four to six) might be designed to pursue two different patterns of theoretical replication. If all the cases turn out as predicted, these six to ten cases, in the aggregate, would have provided compelling support for the initial set of propositions. If the cases are in some way contradictory, the initial propositions must be revised and retested with another set of cases. Again, this logic is similar to the way scientists deal with contradictory experimental finding (53-54).

The case study research described herein is based on the near-miss experiences of ten professional mariners. These do not necessarily include all of the possible experiences of any of the individuals, nor do they include all of the possible near-misses at a particular location or given time. The experiences are not expected to be representative of experiences of those persons nor of that location.

The objectives of the study are to identify and capture the detail of near-miss stories in such a way that the organization structure and process of the bridge-watch and the individual mariner might be examined. The study's basic question is to determine in what ways, to what degree, and why did the reporter, as a professional mariner, step out of the normal structure of the organization of the bridge-watch and do something different that turned a potential accident into a near-miss. It is proposed that one or more of the following (independent and mutually exclusive) events occurred which took the situation out of the normal organization structure.

1) The captain or another watch officer opened the door for an alternative structure. That is, the captain or senior watch officer present turned to another member of the bridge-watch and said words to the effect: "What do you think is happening, what should we do"?

2) Someone else on the bridge-watch stepped forward and stepped out of the role required by the vertical or horizontal differentiation and drew the attention of the watch officer or captain to the situation.

3) The fear of the potential accident overcame the fear of the master's reprisal (see Hershey 1988) and someone stepped out of the typical structure.

4) A peer relationship between captains or watch officers was the foundation for the change.

5) A prior relationship existed between one or more members of the bridge-watch and that prior relationship was the foundation for change.

The unit of analysis for this research is a given bridge-watch in a given situation. It is assumed that there was a higher than normal degree

of stress in the situation which required changed or modified patterns of communication and coordination. The content of the study includes the bridge-watch itself; its composition, number of people, skills, background, the instrumentation and electronics available to that bridge-watch, and the vessel itself. The context includes other vessels, shore structures, other environmental objects, and the weather.

Crano and Brewer (1986, 324) in discussing the American Psychological Association Committee on ethical standards say "... recruiting subjects for such research (social science) on the basis of 'informed consent' - (must be such that) the participation be voluntary, and with the volunteers' full knowledge of what participation will involve." Nachmias and Nachmias (1981, 487) say "Adherence to the principle of informed consent will enhance the freedom of participants to choose whether or not to take part in a research project and will guarantee that exposure to known risks is undertaken voluntarily."

A second ethical consideration is described by Crano and Brewer (334), "Thus, the ethical consideration of any researcher in this area (social science) must include *who* will be privy to this knowledge in the long run, and what are the chances that it will come under the exclusive control of one segment of the social system." Nachmias and Nachmias (490-491) suggest that this consideration is part of a greater issue of privacy. They provide three perspectives of privacy "... the sensitivity of information being given, the setting being observed, and dissemination of the information."

A third ethical consideration is anonymity which according to Nachmias and Nachmias (492) "... requires that the identity of individuals be separated from the information they give. In other words, a participant is considered anonymous when the researcher or other persons cannot

identify particular information with a particular participant. If the information is given anonymously with the researcher unable to associate a name with the data, then the privacy of the participant is secured even though sensitive information may be revealed."

The final ethical consideration concerns confidentiality which Nachmias and Nachmias (393-394) discuss: "...participants in social science research are commonly told that the information they provide will be treated as confidential; that is, that even though researchers are able to identify a particular participant's information, they would not reveal it publicly. Although investigators have a strict moral and professional obligation to keep the promise of confidentiality, there are circumstances in which it may be difficult or even impossible to do so. One of the most important of such situations is when information is subpoenaed by judicial authorities or legislative committees. In the data collection stage participants should be given clear, accurate statements about the meaning and limits of confidentiality."

These four issues are fully addressed in this methodology. First, all participant respondents are volunteers. The original request for volunteers was sent to all current masters and first class pilots who are members of MEBA-AMO District 2 (AFL-CIO) and are sailing on the United States Great Lakes. Those who responded in the affirmative were provided a second opportunity to decline to relate their near-miss experiences. During the interview the researcher reiterated the voluntary nature of the conversation and all reporters were given the opportunity to decline to participate. Copies of the correspondence are included in appendix 1.

All data generated by this project will be available under appropriate circumstances for use by other researchers. It will, however, not be

available by name of individual to protect confidentiality. Data will not be made available to any governmental or judicial body regarding practices, actions, or thoughts of any of the participants.

Anonymity cannot be offered to the participants since the data require that the researcher know their identity and some of their background and experience. The researcher is pledged to keep those data confidential and to report all near-miss situations under code names and/or numbers which are not available to others. Confidentiality will be maintained and data will not be made available to legislative or judicial bodies.

The willingness of individuals to participate and to fully share their experience is indicative of the trust in which they hold the researcher and the importance to which they give to the project. Such trusts are accepted with humility and understanding of their fullest meaning.

The methodology employed in this case study is of the guided interview type (Patton 1982, 162-169). The basic framework for the interviews is the same and is described in the protocol as *interview format*.. There are seven major topic areas to be covered: 1) the introduction and purposes, 2) the demographics of the interviewee, 3) the environment at the time of the near-miss, 4) the organization of the bridge-watch including current and past practices, 5) the technology and equipment in use, 6) a narrative of the situation itself, and, 7) personal conclusions by the interviewee.

Patten strongly recommends that data from an interview be tape recorded, transcribed, and reviewed and commented upon immediately following the interview. Concerning the recording of data he says (179) "The purpose of qualitative interviewing is to understand the perspective

and the experience of the people being interviewed. But no matter what style of interviewing is used and no matter how carefully one words interview questions, it all comes to naught if the interviewer fails to capture the actual words of the person being interviewed. The raw data of interviews are the actual quotations spoken by the interviewees. There is no substitute for this data."

All ten reporters agreed to the use of the tape recorder. Concurrent notes were made including drawings, descriptions of events, and points of emphasis by the reporters. The tape recorder malfunctioned during the interview with the tenth reporter and an expansion of the researcher's notes was immediately made. The recordings have been transcribed and are reproduced, after editing for clarity, accuracy, and extra comment, in Chapter 4. The cases are presented in the order they were given by the reporters. No attempt has been made to delete cases, nor to arrange them in any particular pattern.

Three pilot interviews were conducted in preparing for the data gathering. The first pilot interview was conducted with a senior Great Lakes master. The purpose of that pilot was to review question formats and to test the use of the tape recorder. The second pilot interview was conducted with a former naval captain. The interview was not tape recorded but extensive notes and charts were developed. The third interview was conducted using the final draft of the interview format and record-keeping form. It was not taped at the request of the interviewee who is a senior Coast Guard officer. The three pilot interviews have created an interview format which is open and flexible yet covers the essential elements needed. The results of the pilot interviews are not included in the research report.

The protocol for the research, including the interview format and questions is in appendix 2.

CHAPTER 4

CASE REPORTS

Ten professional mariners related near-miss situations for this work. They are identified as First through Tenth Reporter. The experiences of each are identified as stories and are numbered beginning with First for each reporter. The stories are presented in the order they were told. Some of the reporters made explanatory or aside comments which are recorded in parenthesis. In a few instances brackets have been used to supply additional detail of a technical nature or to clarify a point. In order to maintain confidentiality, only limited biographical data is included for each reporter. Where appropriate, photocopies of NOAA charts are reproduced as Figures 6 - 23 and are located at the end of this chapter.

First Reporter

This reporter is 43 years of age and has been a mariner for 19 years. He was licensed as a First Class Pilot in 1975 and as a Master in 1989. He most recently sailed as a relief captain/first mate.

First Reporter, First Story

My first near-miss experience was as a brand new third mate in 1976. I had probably only been on my license a week; maybe only three or

four days. We were north bound from Burns Harbor in Lake Michigan. I was brand new and scared to death.

We left the breakwall and the captain left the bridge. It hit me like a ton of bricks. BANG - you've got it. The responsibility of it all really hit me - I was scared to death - I was responsible for the whole thing.

Well, about three hours into the watch a car ferry was crossing the lake ahead of me. I went "Oh my god, there's one out there!" I got him on the radar, about twenty-eight miles away, and I plotted him. He was showing me the 'green light' so I had the right of way.

I couldn't touch the Chadburn [engine order telegraph/speed control]. If I had checked her down [slowed] the Captain would have been in the pilothouse, grabbed me by the scruff of the neck, and thrown me over the side. I could have changed course two or three degrees but that would have made no difference; a course change of ten or fifteen degrees, or even more, is required in a close situation.

He crossed our bow and probably cleared by three or four miles. I just had my heart in my mouth because from up there three or four miles doesn't look like anything at all. I had an experienced wheelsman and he didn't pay any attention to it (he may have been laughing at me the whole time) - I was sweating it out by myself.

Now that I'm a Captain, I lay out the ground rules right away to the new guys. I say: "Look, if there's any situation at all check the boat down immediately. Don't be afraid" - and I tell them the story of my first watch. I tell them check it down to neutral if you need to, and if it still looks bad to start a significant maneuver and then to call me.

First Reporter, Second Story

Light 13 in the St. Clair River is bad in that it is the first turn into the River proper. The Sailing Directions, (McSweeney 3rd Edition, 8) say: "Do not meet anyone at Southeast Bend (light 13)".

This near miss situation happened in December 1990 between a 700 foot vessel upbound and a 630 foot vessel downbound at Southeast Bend (see Figure 6). I was sailing as first mate on the downbound vessel. It was at night, with reduced visibility due to haze; visibility of a mile or two, I suppose.

The vessel reporting system gives us advance notice of other nearby traffic in the St. Clair River. We can plot about what time another vessel should be at a location and he can do the same for us. Thus, close calls can be managed between the involved vessels. As the downbound vessel, we had the right-of-way.

He reported at the St. Clair light and at 'Light 2' (X32). We assumed it would take him about twenty-five minutes to clear the Bend at Light 13. Well, either he had lied about when he was at Light 2 or they had checked down or something because I was absolutely sure that I had planned it to let him come out ahead of me.

As long as he's not in the turn itself (has completed the turn) and is on the next straight stretch, meeting is no problem. So to assure that, I checked my vessel down. I reported at the Salt Dock which is about an hour before we would normally get there. I knew we were going to be down there pretty close to the same time so just to make sure I checked it down at the Salt Dock to make sure he gets out of the way.

Well at Light 23 it only takes me twelve to fifteen minutes to get there

down-bound. I don't know what happened - maybe he did the same thing on his part. Until we could see each other, it was too late to do anything and we knew we were going to meet right there where it's not good. And basically that's what happened.

I had a brand new wheelsman - it was his second or third trip. He didn't know the river at all and was going strictly on my rudder commands. It would have been easier to grab the wheel myself rather than try to give him direction. We met right there at Southeast Bend and we couldn't have missed him by more than fifty feet. Instead of hugging the red buoys up-bound, which would have given us a little room, he was pretty much center channel - as if nobody was there. This forced me to darn near swap paint with the green buoys coming down that side. I had to go way over toward the American side - way off-center. My concern as I started my turn to the right to go down the cut-off was that my port-quarter [stern] was going to swing into him and that's what we just cleared. I got on the channel and said "Thanks a lot (vessel name)." He never responded.

First Reporter, Third Story

Southeast Shoal is the traffic hub of Lake Erie. Near misses occur on a daily basis. You don't use the radio at Southeast Shoal- nobody talks to each other. Some of the newer guys (since 1985) will communicate but 75% of the people won't call. You are embarrassed to use the radio.

There are some twenty courses that converge at the Shoal. I've seen as many as seven vessels there within two minutes of each other. And, of course, there are usually a number of smaller fishing boats there, too. You are supposed to be able to handle it without radio communication, without talking.

This is my 1976 story: we were west bound from Buffalo (Long Point) through Southeast Shoal (see Figure 7). The visibility was horrendous- less than a mile. It was summer, hazy, misty, night time of course. This is the southeast shoal where you don't call anybody. If you can't take it through the southeast shoal, you aren't a navigator.

There wasn't a whole lot of traffic around. From the way I was coming it really didn't matter a whole lot for anybody else that was upbound because I was showing them the red light - I was far to the north on the approaching course. We were running a good fifteen minutes ahead of two following boats. I didn't see anybody coming downbound.

Then, at twelve miles I picked up another target on the radar, right at southeast shoal and the target was too big to be the traffic buoy. I thought it was a downbound vessel at the buoy making his haul right there at the buoy, so I watched him. Keep in mind that radars work best in clear weather. In heavy fog they only work for three to six miles and it was one of those nights. I wasn't trusting the radar at all until I got at least inside the twelve mile range.

Time passed and the target hasn't moved - it's still there. Whatever it is, it's dead in the water but its too big to be the buoy. I was under tremendous pressure not to call 'the old man'; I had to prove myself. (There was very little communication with the captain and myself as a new third mate. After all, he had his own side of the boat- the starboard- and you couldn't walk down that side. That started to change with the 'baby boomers' in the late 1970's and early 1980's. Now it's mostly all gone).

We got within about six miles and I flipped the radar to the closer range [from twelve to six miles]. I was sure it was another boat- it had moved a little from the twenty-four and eighteen mile scales but I couldn't

be sure if it was underway or not. I *broke the code of silence*. I called and called and called- at least four times - probably more-no answer. We were close enough to flip the radar to the six mile scale. I was sure it was a boat - it had moved a little from the other scales (twenty-four and eighteen miles). I didn't know if it was under way or not - couldn't tell, couldn't raise them on the radio.

Now I didn't know which way to go around the guy. I didn't know if I should haul up a little and go around the outside of him or just assume he was stationary and squeeze between him and the one red buoy that's there. So I gave up and I called the 'old man'. He knew we had to be in some trouble. I told him there was a situation I didn't understand - he was there *right now!*

(When you call the captain to the bridge you give him the facts and shut-up, you don't offer suggestions. There can only be one captain of the boat. He might ask your opinion on options and you should respond truthfully. But when a mate calls the captain to the bridge you have given up control of the bridge to the captain and you speak when you are spoken to. The chain of command, the things that maintain some semblance of order have to remain intact or there would be total chaos. The slightest argument over a navigation situation when timing is critical - there just can't be any of that, we can't have that at all. One person - one chief. He has the ultimate responsibility so he makes the decision. Even if you are 100% absolutely sure that you have the solution - you keep that solution inside you unless he asks.

(There is only one exception. That is when the mate has sailed as a captain he can judiciously offer suggestions when a captain is stewing about what to do. The first time I did this it was very tentative and I was

glad that I didn't get chewed out over it. Even today, after I've sailed as captain, another captain will never ask what I think. I expect him to take my suggestion with respect, but not necessarily to act on it.

(Sometimes as Captain, I will think out loud about my alternatives; as much to help me hear the solutions as to receive ideas from others. Then I would look at a mate and ---- nah, I wouldn't ask them. Once last year I was first mate and a captain asked what I thought about a non-critical situation. My reaction was: "Why ask me? You are the Captain." Of course, he had bumped me from the captain's job on that vessel.)

The captain looked at the situation and the target on the radar and he couldn't figure it out either. He tried to call - no answer. He said: "Head [steer] right up on it" - so we headed right on this thing. We were probably about a mile and a quarter from them, going full-speed; the vessel I was on is no longer in service but she was faster than most. He said: "Let's check it out - let's see what it is".

We got less than a mile from him and the captain was in the radar and I was in the window with the binoculars. I saw his anchor lights and saw no running lights. I blurted out: *It's a vessel!*

It was a salt-water vessel at anchor. Apparently he had some sort of trouble or something. We never did find out why he anchored on the east side of the traffic buoy so he was blocking the buoy's radar return from upbound vessels.

We passed so close to him that I was afraid of the angle of the anchor chain - the water is only thirty feet deep there. We passed within one hundred feet - you could have thrown a baseball over. My hair was standing straight up.

I would have gone left and given a wide berth around him, but the old man after he made sure that it was an anchored vessel, hauled right and squeezed in-between him and the red buoy. After being out there for twenty years I would do the same thing today but I would have checked the boat down to half -speed at five miles away and down to neutral at three miles to check out the situation, especially his anchor chain. I can no longer remember what the wind might have been, South would have been okay, but North and we could have gone over his anchor chain.

First Reporter, Fourth Story

In 1986 or 87 we were upbound in the St. Clair River just past Stokes Point coming up to Recors Point (see Figure 8). It was a Saturday afternoon, just after lunch, perfect visibility, not a cloud in the sky. I was at the conn of a 630 foot vessel. We had been following another vessel that was going well below the speed limit in the river so we wanted to pass. This is one of the very few places in the St. Clair River where it is safe to pass another vessel. It's critical that there be no downbound traffic and that you are up to date on the traffic situation.

Everyone in the pilothouse had been monitoring the channels for the river traffic and we were absolutely convinced that there was nobody coming downbound. You can just 'blow the whistle' to pass and that's all you legally have to do. But you always call the guy up and tell him you'd like to pass because most everyone will usually get over to the side and give you a little more room. Also when you do that you usually ask them, "What's it look like up around the corner?" You try to verify from him that you can make it.

First of all he has to let you pass because he can make it miserable for you by going just as fast as he can to make the passage as long and drawn-out as possible. Or nine times out of ten they'll check-down and let you get passed and then they go back up to their regular speed. And then if there's anything that looks as if it may be dangerous they will let you know, they can see farther up the river. This guy that we were passing also thought that there was no one coming downbound. So he ok's and says he'll get over on the right side and let us get by. We asked about downbound traffic and he indicated that there was none in sight.

Now we're committed and we're going upbound right smack in the middle of the downbound course, going as fast as we can to get around. Right at the critical point when our bow is up and in-past his stern so we can't drop in behind him there's another freighter coming around the corner downbound. (The Recors Power Plant blocks any view of any downbound traffic.)

Who ever this vessel was it's unbelievable that both us and the vessel we were passing missed any calls of his to the traffic information center at Sarnia. I can't believe that we both missed it, so our thought is that he never called in or perhaps he left one of the docks in the area headed downbound and never called Sarnia and let them know. Rather than a regular downbound passage off of Lake Huron, he may have been in the river system already.

At any rate neither one of us knew he was coming and neither one of us could see him. The river is fairly wide at that point but when you get three boats abreast all at once it's a *lot of boats* plus, you never know what the other guy is going to do because the downbound vessel has got to make a snap decision *right now* as to which way he's going to go. The most

prudent thing is to split the two of us. That minimizes the effect of sucking, prop wash, etc. Nobody knows what he is going to do. All the decisions are made and there's no communication. What we tried to do at that point was to wait to make sure what he's going to do. It's the downbound vessel that makes the split-second decision because he's looking at two boats coming up at him and nowhere to go. You have to go with your gut feeling right now.

When the downbound vessel (who had the right of way) saw the two of us coming he blurted out, "I'll split between you." It was instantaneous on his part - he probably had a heart attack when he saw us! But, at the moment he decided to split between us we were too close together, he would *not have fit*. So we had to alter *our* course closer to the American side just to give him some room to get between us. We hauled left and the over-taken vessel was already right as far as he could get. The downbound vessel could have hauled hard right and taken us both on one whistle; he had room to do that.

We got so close to Recors Point at the north end of the power plant dock there - within fifty feet of the shore. None of us could believe that there was that much water there! We were giving him as much room as possible and it was on a turn so all the boats were turning at the same time. I would say we came within 175 feet of him and he got within less than 100 feet of the boat that we were passing. We were absolutely amazed nothing happened.

Maybe the downbound vessel wasn't monitoring the channel. I don't know what caused this because we were talking back and forth about passing and he should have been monitoring the traffic information system. He was a lake vessel, not a salty. He should have gotten on the

radio so there wouldn't have been two of us coming at him. He didn't even have his radio set to Channel 11. He was just as surprised as we were. It was very, very close all the way around because of the swing on the curve. It was just coincidence that we should meet there, but good luck that the downbound boat made an immediate decision - it avoided a wreck.

Second Reporter

This reporter is 49 years of age and has been a mariner 30 for years. He was licensed as a First Class Pilot in 1965 and as a Master in 1971. He most recently sailed as a captain.

Second Reporter, First Story

Last year I had a near-miss coming downbound through the ice, toward the Poe Lock (see Figure 9). We were between Big Point buoy and the coal dock. It was daytime, the weather was clear on a bright day in early spring. I was captain of a 1000 foot vessel. We had slowed down and were waiting for an upbound salt water vessel who was coming out of the locks.

We had it pretty well timed for him to get out clear and then we would be following his track going in. The 1000 foot vessels do not always penetrate ice very well. Many times they will shear right or left along the face of the ice depending on the thickness of the ice and the forward momentum of the vessel. This is a somewhat unpredictable event.

I had my vessel moving quite slowly and he was building speed to get through the ice and get out to the Lake [Superior]. We got within two thousand feet of each other and he was trying to get out of that slush ice when both of us started shearing left. We went left. He went left. He got clear of the ice the same time we did and talk about close, we came bow to

bow within fifty feet. We were in contact with the pilot on the other boat and we both cut her back and stopped.

I said, "Are you backing, are you backing?" and he said, "Yeah, I'm backing, I'm backing." Then we both started to back up and I sat and waited for him to go around me. It was just pure luck that we were both going slow enough that we were able to get stopped.

Second Reporter, Second Story

It was mid-October at about 1700 [5:00 P.M.] and just starting to get dark but not yet dark. We were upbound on a 1000 footer with an after-end pilot-house approaching the Blue Water Bridge at Port Huron/Sarnia (see Figure 10). The watchman in the bow (with a walkie-talkie) let me know that there were two small boats downbound under the center span of the bridge. They were about sixteen to eighteen feet long and in the middle of the bridge.

I started my right turn and sounded a danger signal. They didn't move so I slowed up the rate of turn a little bit, turning right a little bit more slowly and blew them another danger signal and they started waving. I blew them a third danger signal and at that point I had to steady the boat up [stop the rate of turn] and when I steadied the boat up the current got her and took her left.

The boat came left because of the current coming in from Lake Huron and caught the bow and swung it over to the American side. According to the bow watchman, the bow was grinding on the bottom on the other side of the bridge by the motel. The after end came within six to twelve feet of the walkway along there. The antennas on the roof of the pilothouse 'clicked' on the bottom of the bridge we were so far over from the center.

A few seconds later I got her to come right. I kept her hard left to swing the stern out into the current and she walked right away and right out in the river. We let out the anchor after we reached Lake Huron and waited until we were sure we were making no extra ballast, then went on up to Taconite Harbor for an ABS and Coast Guard inspection. There was no damage.

There were two hundred to three hundred people out on that pier [walkway]. We came into that bank at seven to eight mph. One minute we were out in the middle of the river and the next we were coming right onto that pier. We were one hundred feet off and the next minute we were twenty-four feet off, then twelve, then six, and then she stopped coming in; *and people just stayed on that pier.*

We had a description of the two boats and their names but not their numbers. There were eight or nine people aboard those two boats. They went right under our bow; they expect us to get around them but we can't. The Coast Guard did not pursue it as far as I know.

I could talk all afternoon about sail boats and fishing boats in the Detroit River. One time they had the entrance completely blocked and I had to circle around because I couldn't get into the river.

Second Reporter, Third Story

Another one at the Blue Water Bridge (see Figure 11) on a 1000 footer. I had a second mate that sailed for years. Downbound, one time he waited too long to start the turn - up underneath the bridge, the left hand turn there. I was on the bridge. It was a typically foggy day. My mind just wasn't on what he was doing; maybe he was talking. But as soon as I saw the problem I jumped right into the action.

By the time we got it under control we were thirty-six to forty-eight feet off that bank that goes around by the pilot office where the light ship is. We were right off that and the current took us down to the right to the American shore. We were getting bank suction so we just shut the starboard engine off. Anytime you're too close on one side or the other like at Rock Cut you just shut the close side engine off and your main propulsion is right down the middle of the vessel, almost.

At Rock Cut by the green rock pile I've had my stern off the bank by only eighteen feet. We just shut down the one engine. That always helps us move away from the bank and into the middle of the river.

When I have control of the boat and I wait too long to start a turn some mates (even third mates) will speak up and say something like: "I never wait this long to start this turn" while others won't say a word. I sailed up through the hawse-pipe with a captain who would act as mate while I made the dock- but he was an unusual captain and I sailed with him for many years and learned a lot from him. It depends on who they are but that's why we have two guys up there - to watch for things like that.

Second Reporter, Fourth Story

Another real close one: coming into Two Harbors (see Figure 12), 1000 footer, wind southwest twenty-five to thirty, and a five to six foot sea coming right into the harbor. It had not been blowing that long [in time] because the swell was still quite small. We were getting a pretty good swell inside. I was talking to a guy on another 1000 footer and he says in that case just back in. Take it up into the wind, get the wind on the bow, and start your turn to the right a bit early. Turn early - the sea should knock you down right to the dock.

We came in there okay; backed in beautifully. As soon as I started her right I knew there was something wrong because we started coming out - the swell wasn't pushing us in any more, it was pushing us out. She just kept coming right, we couldn't get her to go left at all even with the thruster or reverse engine it didn't matter she just kept coming right.

The swell has an effect - it comes in, goes around and goes back out that breakwall. There is no other place for the swell to escape that enclosed harbor. Well, we darn near came back through that breakwall sideways! We missed the number one dock by six feet. It was as close as I ever want to come; my whole body was shaking and I was physically drained.

We let her keep coming right and when she came around we went in forward, aimed for the dock, dropped an anchor and just pivoted on that anchor in a hard left to the dock. After we made the dock, my mate said, "Captain, I never saw a more beautiful dock than that. How did you plan all that?" I just started laughing. I looked at the green side of the breakwall and the waves were moving parallel instead of being calm on the inner face.

Second Reporter, Fifth Story

Another near-miss I had was at the Mackinac Bridge. We were downbound, toward Chicago on a 1000 footer in mid-summer (June or July) with zero visibility due to fog. Just past the Mackinac bridge we got a call that there was a diver down, doing survey work, between the bridge and White Shoal see Figure 13). So we caught him on the radar and came to the left to clear him.

We had another target come on the radar to the left of him. It was something coming real fast, like a small airplane and it bounced - boom,

boom, boom right across the radar set. He was clearing us by a lot and all of a sudden he stopped. Dead. Then all of a sudden he started coming toward us. We were coming left and kept coming left cutting in front of another downbound boat, a 630 footer.

It was a twenty foot aluminum Coast Guard boat with two ninety horsepower outboard engines. It was not the 'crash boat' but it has radar and a radio. We kept trying to call him from the first time we saw him but there was no answer.

When my lookout saw him from the bow, he was right down below our bow and our bow wave pushed him to the side. The two guys that were with him were out on the stern ready to jump. He was so scared he couldn't get the engines going to get away from us. As soon as he was clear of us we had to come hard right to clear the other large vessel.

After we had gone on a couple of miles he called us and said, "I wanted to come on over and hear your whistle real close." I reported this to St. Ignace Coast Guard and they would do nothing so I called Group Soo [U. S. Coast Guard]. They said they would do something but I never heard any more about it.

Third Reporter

This reporter is 40 years of age and has been a mariner for 20 years. He was licensed as a First Class Pilot in 1975 and as a Master in 1984. He most recently sailed as a captain.

Third Reporter, First Story

The situation occurred in about 1977 when I was the third mate, standing the 0800 to noon morning watch, aboard a 650 foot vessel. This

occurred in the summer months. It happened within the first fifteen minutes of the watch, about 0755-0805 [7:55-8:05 A.M.]. The vessel was approaching the St. Clair River at Sarnia and the Blue Water Bridge (see Figure 11). The captain was on the bridge and had the conn in Lake Huron summer fog.

The captain was in the front window with his radar off to his left. The mate on watch, me, was maintaining the radar watch. Generally, in fog in the rivers the Captain will stay in the front window and the mate on watch will keep a radar lookout. Then there is an interplay between them to confirm ranges, bearings, contacts, and so forth. It is very hard for a person to go back and forth between radar and fog because of the light patterns and the need for 'night vision' in the fog. (This is less true with some of the new daylight radar screens).

(This incident occurred prior to the establishment of the Sarnia Traffic Center. At the time all vessels were required to make 'security' calls at the Marysville upper dock (Stag Island upper), at the Polymer Plant and at the traffic buoy. It is very possible that this would not have happened if the Sarnia Traffic Center system had been in effect. Although that is not to say that it isn't possible for such a situation to happen even with the Traffic Center as it exists today.)

No traffic had been reported nor had any security calls been heard for upbound traffic. There was no disagreement between captain and first mate, whom I had just relieved, about the traffic situation: no upbound traffic. There were some two or three following downbound vessels behind us.

We were a little above buoys 3 and 4. I observed a radar return on an outbound course moving quite rapidly toward our vessel and I believed that

it was a false echo. Such false echoes, pips, and ghosts are typical in fog and in this area. I begin to be convinced that it is a vessel upbound and not a false return.

But we don't know of any upbound vessels so, with a great amount of caution I *mumble* something about a vessel, in an attempt to get the captain's attention without speaking directly to him about what I thought was a vessel right about at buoys 1 and 2. I just can't be sure. (I was reluctant to tell the captain that there seemed to be an upbound vessel approaching, based on our age difference and the captain-third mate difference. I was questioning my own judgement; I had only been on my license a year or two.)

He looks into the radar and then out the window. Just at that time we can see that it is a saltwater vessel upbound. He is steering across us, not on a 'one whistle [port to port] encounter'. He is steering to the right of us outside the channel. We were on the right side of the channel and couldn't go any more to the right without grounding.

The captain then picks up the radio and just yells, "Hard right, hard right, hard right". At the same time he told our wheelsman to turn hard right. The wheelsman had frozen so I jumped over the rail or went under it, I don't remember. I pushed the wheelsman out of the way and turned the wheel hard right.

Shortly after we saw their range lights start to move to the right - headed back into the channel. Just about the time our bows get right off each other we are steering clear of his stern and he's barely steering clear of our stern and our bows are right next to each other.

The captain picks up the radio again and yells, "Hard left." I believe the other vessel responded, "Hard left." I don't recall him answering the

first hard right but he may have. I then put our wheel to hard left and at that point the wheelsman took over again. In essence we did the Welland Canal movement.

I keep asking myself why wasn't the salty on the radio giving security calls? Three vessel following us never heard him give any calls and were surprised that there was a salty in the area. It was like there was a ship that came out of the fog. I really thought it was a head-on collision. You can't come any closer than this without it being a collision. I was sure that we were going to be involved in a head-on collision.

On reflection we all blamed the salty. Perhaps he had not made the appropriate security calls. Perhaps he had exchanged pilots inside the River and there was confusion between the new pilot and the master. Maybe he didn't have his radio set right and the new pilot discovered it too late.

The only thing that kept this from being an accident was the captain announcing his intentions to the other vessel in such a way that the other vessel could take the appropriate actions. Of course there was a chain of events happening: change of watch, security calls, reduced visibility, radio errors, and so forth.

[At no place in the regulations does it require, or even suggest, that the captain call out steering directions to the approaching vessel or indicate in any way his intention. Quite clearly the captain took command of both vessels when he made the move to signal his own intentions and to encourage the on-coming vessel to make the appropriate simultaneous moves.]

Third Reporter, Second Story

This concerns a downbound trip on a 600 foot vessel in the Detroit River enroute to the Rouge Plant (see Figure 14). It was to be a normal night passage and expected docking. I was the mate on watch but I was not in the pilothouse at the time since my role was to accept the mail from the mailboat and to be port side watch [call off distances during the turning and docking maneuver]. The Captain had the conn. The first point at which I realized that something was amiss was when I looked aft and saw several of the crew members standing around the after cabins with their life jackets on. The captain had blown the general alarm but all I had heard was a little jingling noise. I did notice that we were somewhat close to the American side of the River.

We had checked down and as we passed opposite the Sterling Fuel Dock (on the other side of the River) a tug and barge left the Fuel Dock and attempted to turn down river using left wheel to turn in front of us. Approximately half-way through the turn the current took control of the vessel and its forward movement was perpendicular to us because of the set of the current. We just kept creeping closer to the American shore, initially at several hundred feet to eventually within forty-eight feet of the shore.

He stayed perpendicular to us as he travelled at the same speed we were moving. We reached the point where our bow cushion pushed his bow away and the two vessels started to move parallel down the river at as little as twenty-four and up to fifty feet apart for about half a mile.

I felt that most likely the two captains were in communication with each other and it is likely that the captain of my vessel used the bow-thruster to move our vessel to starboard but at the same time to set up a

cushion with the bow-wave to hold off the tug. The tug came within twenty-four feet of our midships before it began to turn. Our captain checked down further and once control was regained the tug moved to port and then on down river.

A normal maneuver would have been to cross the River and then make the turn on right wheel from the American side. Had he done this, checked it down and then given it a kick it would have gone right around.

A consequence of this situation was that our master produced a written report of the situation and forwarded it to the proper authorities. This was a ship handling mistake on his part. The captain of the tug was relieved of his responsibilities the following season. I do not know under what circumstance, or how, the tug barge was identified nor what may have happened in the pilot house.

Fourth Reporter

This reporter is 40 years of age and has been a mariner for 19 years. He was licensed as a First Class Pilot in 1978. He most recently sailed as a captain.

Fourth Reporter, First Story

This incident occurred during November on Lake Michigan. We were northbound off Rawley Point (see Figure 15) on the Wisconsin side of Lake Michigan heading for the Straits of Mackinac. I was the captain of a 150 foot tug with a 400 foot barge in tow. The barge was in ballast.

The incident began at about 1915 hours [7:15 P.M.] when I came up to the wheelhouse a little early to relieve the first mate. (Tug captains often stand a regular watch. There is no wheelsman on watch). The visibility

was about ten feet (horizontal) on a very dark and foggy November night. I spent a few minutes with the first mate discussing the vessel position, weather, other traffic, the state of the tow and so forth. A 700 foot lake vessel was south and east of our position also heading northbound and outside of our position. We had been following the eastern shore of Wisconsin about three miles off the beach in order to avoid weather on Lake Michigan.

There is a false echo which shows up regularly off Rawley Point . I have seen this return from a number of different positions on the lake and from more than one vessel. The false echo was on our starboard quarter, about six miles away.

I was getting ready to make my move to go across the lake and was concerned that no other traffic would be nearby. The first mate indicates that there has been no radio traffic of nearby vessels and the only return on the radar is the false echo.

At approximately 1930 [7:30 P.M.] we hauled ninety degrees to the right to sail a course 090 degrees for the Michigan side of the Lake. I went to the chart table (which faces aft) to measure off the distance and time to the Michigan landfall and to establish my position with a Loran fix. As I was measuring off distance and time to landfall in Michigan I turned off the red lamp and looked up to my left.

I saw a whole string of white lights which I first thought was the beach. Then I realized there could be no beach because visibility is ten feet and I'm heading for the middle of the Lake and what I saw was the decklights of a vessel passing in front of me.

I was filled with terror; there was no doubt in my mind that I will hit him and I think this is the big one now. He was coming at me at an angle

but enough of him was across my bow and there was no doubt in my mind that I was going to hit him. How in the hell could this have happened?

My immediate thought was to turn hard left to parallel the other vessel and strike it a glancing blow mid-ships. My tug is heavily reinforced forward for ice penetration so I might put a hole in him (causing him to sink) but I would save my own vessel.

I learned a long time ago that you have to give the guys down below [your own crew] a chance to get out even if it means putting yourself in more peril, you *have* to give them a chance. So rather than making a turn I reached for the alarm - sounded the alarm about ten or fifteen times in rapid succession, yelled down the stairs - you have to give your crew time to get above decks and to get on the survival suits.

I turned and faced forward. In giving my crew a chance to get out on deck in survival suits, the time gave me a new perspective on the situation. The crossing vessel was moving very rapidly from starboard to port. A turn to the left (my original thought) would have produced a square-on hit to his mid-ship position. His stern is now about four points [forty-five degrees] to my starboard [reporter's right] and moving rapidly. My view forward is of deck lights, deck pipes, hand rails, and hull. We are about fifty feet apart.

The first mate came up in time to see the last three or four seconds of the situation and exclaims: "God, it's a ship!" I responded in the vernacular affirmative. I started a left turn which meant a hit square-on and immediately changed my mind to a right turn and turned hard right. We were now fifty feet from him, he is off my starboard bow and we are closing rapidly. I braced myself for the impact. We are now about ten feet apart.

In a flash we are under his stern and clear of him.

A tug is often at the mercy of its tow and a primary rule is to 'always know where the tow is and what it is doing' since about eighty-five percent of all tug accidents involve the tow hitting the tug. I have completely lost sight of the barge; I don't know where it is or what it is doing. I asked the first mate where the tow was to make sure that the tow was not going to turn us turtle. The mate used the search lights and found the barge off our starboard quarter with everything just fine.

There was no communication or coordination between me and other members of the bridge team except to solicit status of the tow. I did not coordinate with the other vessel, nor did I attempt to communicate with that watch officer later.

My first reaction was a great deal of shaking and fear - much adrenalin in the system. The first mate had no matches to light his cigarette so I tried to light his cigarette for him. I was shaking so hard that I set his beard on fire. I was shaking so hard and I told him to light his own cigarette. After a half-hour or so the shaking stopped and I was angry at the other vessel for crossing in front of us; someone was not paying attention. I never spoke to the other vessel about the incident.

This situation stayed a near-miss because I first gave my crew a chance to prepare for a collision. In the time it took for me to warn them, the whole situation changed. My original choice to turn left was obviously wrong and my actual turn to the right was the only safe alternative. Had I turned left, we would have hit the other vessel and likely holed her. The barge would have probably run over the tug a few moments later. The other vessel would likely have suffered a serious breach of her watertight integrity and may have sunk.

Fourth Reporter, Second Story

This second story concerns a situation in which the tug had a loaded barge in tow on Lake Michigan, southbound for Chicago. It was a mid-December morning about 1030. The weather reports this past season have been either early or wrong. This was a wrong weather situation.

The weather forecast was for winds Southwest at ten to twenty and waves of three to six feet. We came out from behind the lee of the Islands (North Manitou) and the actual weather was a southwest wind at about thirty knots with four to eight foot seas as we came out of the lee of the Islands [in northern Lake Michigan]. The barge was approximately twelve hundred feet aft of the tug on a two inch steel cable.

By 1400 [2:00 P.M.] the wind had increased to forty-five mph from the southwest and the seas were at eight feet with a few at ten to twelve feet. The mate on watch called me and we agreed to check down to five miles an hour. By then we were over half-way across the Lake, heading for the lee of the Wisconsin shore, with about four hours of running to the lee shore.

The 'tow machine' is a very large deck winch which controls the cable to the tow. As the tow-line comes from the tow machine there is a frame over the stern of the tug called a 'dutch bar' which the cable rides over. A device called a torpedo is a piece of metal which is attached to the towing cable and rides on the dutch bar to prevent cable wear. The torpedo is attached to the cable by two large cable clamps, one at each end.

At about 1500 [3:00 P.M.] one of the clamps on the torpedo came loose. The torpedo started rattling and banging. By then the waves had risen to twelve to fifteen feet. The third mate called me and so I decided to take a

look. I put on my survival suit and 'work the handrails' to the after steering station where I can look down and see most of the stern and what is happening. Most of the stern is under water, apparently from the pitching.

I decided that we would have to re-clamp the torpedo and then let out the rest of the available working cable, a total of fourteen hundred feet. In order to do that we have to slow down to steerage, bring in ten feet of cable to remove the torpedo, let out two hundred feet more cable, and then re-attach the torpedo at the dutch bar. This was done safely, in spite of the weather.

At the watch change 1930 [7:30 P.M.], I relieved the first officer who indicated that he had been slowly bringing the vessel to the right to get out of the trough and to reach the lee shore of Wisconsin. We were steering about 225 degrees and making about 208 degrees true. As I began my sweep of the situation, I also attempted to keep adding a bit of 'right' to the auto-pilot when I realized that the Loran was indicating 180 degrees; due south.

Obviously something was wrong. The gyro was set to 225 degrees to make 208 degrees good. I turned on the white lights and discovered that the 'steering stick' is in the hard right position. It should have been in the mid-ships position. The gyro indicated steering 170 degrees. Based on the earlier incident, my first act was to alert the crew to the situation; to give them time to prepare for emergency actions.

The first mate immediately returned to the pilothouse, as did the chief engineer. I explained the situation to them: the rudder is hard right, we keep adding right commands, and we keep turning to the left. I turned off the auto-pilot and the non-follow-up and attempted to test the steering. The rudder position indicator answers but it does not stay in position,

apparently there is a malfunction in the hydraulic ram system that holds the rudder.

We were losing steering, at which point I sounded the alarm and called the Milwaukee Coast Guard station to alert them to the difficulty. At that time we were sixteen to twenty miles from the Wisconsin shore. This was an information call which described the situation and our location, we were not requesting help.

The Chief took a detail of men aft to take a look-see. When they got aft, they discovered that the stern water-tight compartment was flooded. There was no way to put a man into the compartment, nor to put a pump in place. There was no water in the engineroom, nor any indication that there was water in any other compartment.

At this point the barge was winning the 'contest' between tug and barge. The barge was dragging the tug into the trough and our motion was changing from pitch to roll. I sent a deckhand aft with a torch to be ready to cut the towing cable if that decision was made. In thirty seconds two things happened: the engineroom called to tell me that there was water entering the engineroom and the mate on watch told me that the steering had been lost.

Instantly I had the deckhand cut the cable; ten seconds later it was gone. Then we used the little steering remaining to 'head for the beach'.

I called the Coast Guard and told them that we were abandoning the tow and would appreciate some help getting into Milwaukee. The crew gathered in the galley, in survival suits, each with his own treasure: walkie-talkies, sandwiches, cigarettes, snickers bars, flares, and so forth. The tug has radio control of the anchors on the barge and I let out 450 feet of chain and an anchor from the forward end of the barge to prevent it

sweeping onto some shore. It also had, of course, fourteen hundred feet of two inch cable trailing from the bow.

At about six miles from the beach, we met with a Coast Guard vessel which took us in tow to Sturgeon Bay. The Coast Guard broadcast the position and description of the barge for other traffic. (The barge has a generator and was fully lighted at the time.) Once tied up at the Coast Guard station we opened the after compartment and pumped it dry in minutes. The packing around the rudder shaft had loosened allowing some water to enter the compartment. The primary source of the water, however, was one of the dogs on the hatch had broken and the other two had loosened in the pounding.

The steering had been lost because a fuel hose, stored in the compartment, had sheared an hydraulic valve which kept 'back pressure' on the steering system. Within thirty seconds the fault had been found and the valve was quickly replaced.

A sister tug went to get the barge while we laid on a new towing cable. Two days later we took the barge back in tow and finished the voyage,

The decision making process included conversations between the captain, the chief engineer and the first mate in establishing the emergency procedures to be followed, the attempts to find the fault with the steering system and the nature of the flooding of the after compartment. Those conversations, of which there were probably several, were primarily between the captain and the chief engineer.

I believe that a vessel needs to be highly organized, efficient; but that it needs to stress continuing personal and organizational education. I conduct a regular weekly meeting with the entire work group (twelve people) to discuss ideas concerning seamanship, safety and practices

aboard the vessel. That meeting is not required and not demanded by the fleet office. I feel that the meeting is descriptive of the characteristic of the vessel as open and accepting of ideas. It is also a vessel on which the crew does not drink nor do drugs on board the vessel.

I feel that part of the difficulty is that the vertical structure can reduce the sharing of observation and experiences between the more experienced and less experienced officers and that reduces the education and learning opportunities. An individual in a very rigidly vertically structured vessel does not have the opportunity to cultivate the learning when working for such an absolute controller.

Fifth Reporter

This reporter is 32 years of age and has been a mariner for 4 years. He was licensed as a First Class Pilot in 1986. He most recently sailed as a 3rd mate.

Fifth Reporter, First Story

At 0745 [7:45 A.M.] I picked up the watch between Pelee Passage and Colchester Reef. We were upbound on a 1000 footer in the spring of the year. Visibility was reduced due to thick, heavy fog. Our unloading boom is two hundred fifty feet long and we could not see the end of it; call the visibility two hundred feet.

We were heading for East Outer Channel (see Figure 16); the captain and the first mate both wanted a half hour notice for the Detroit river system. I had my AB [able-bodied seaman] clear the anchors early - I felt the captain would go to anchor rather than try to make the Amherstber Channel which follows the East Outer Channel in such heavy fog. East

Outer Channel is very wide (700 feet) but the Amherstburg is a very narrow channel, one hundred fifty feet, with a lot of current. With a 1000 footer, or any other vessel, you just can't go straight up the channel, rather you have to crab to allow for the set of the current. Most buoys are cleared by only forty to fifty feet under normal circumstances.

There was a downbound small tanker that would meet us around East Outer Channel, light 1/buoy 2. There was at least one other 1000 footer upbound behind us.

The captain and the first mate came to the bridge and the captain decided he was going to take it up. I was monitoring one radar and the first mate was monitoring the other. The captain would periodically glance at the radars. We informed the captain of bearings, ranges, and approximate time to targets including buoys as we approached the East Outer Channel. The captain got in touch with the downbound tanker and they worked out a one whistle passing, normal procedure.

As we approached the channel, a mile from light 1, the captain took the conn and brought her over about twenty or thirty degrees to starboard from our standard course. This way he approaches the channel on a bit of an angle until the red side (buoys) lines up and then he usually brings the vessel right over on the standard upbound course (McSweeney, 2) and heads up the channel. As we approached the red line-up (we are observing this on radar, which effectiveness diminishes in fog) we had the radar on a low-scale and it was picking up targets fairly well.

As the red side lined up on the radar the first mate informed the captain: "You are on red side line-up"; but the captain didn't start his haul as usual. The mate said, "You are past the red line-up." The captain still didn't make his haul. The 1st mate said, "The middle of the channel is

coming in line" - at this point we were way past our starting point for the turn. The downbound tanker was now about a half mile to three-quarters of a mile away. We were giving the captain all the information about the approach to the channel and the meeting situation at hand and he just wasn't responding. (I don't know what he was thinking - I don't know what he was doing. Sometimes it's easy to get disoriented in the fog.)

The first mate finally said, "You are past the middle of the channel!!!" The captain finally started to bring the vessel over but he only put ten degrees of right rudder on which makes a very slow turn. At this time the captain of the downbound vessel, the tanker, came on the radio in a state of panic and said, "What are you doing? Are you going to make a turn or what?" And our captain replied, "We're starting the turn now" but it was excessively late to start the haul.

We started calculating *feet between the approaching vessel and ours* on the radar because it appeared a collision was imminent. We visually saw the tanker pass our stern at no more than sixty feet away. It may have been closer. The tanker, attempting to avoid a collision, was forced *outside* the channel; he was just trying to get out of our way. Had it been a deeper draught vessel he wouldn't have had that option. Our lookout on the bow claimed that we passed within ten to fifteen feet of the tanker. He was so scared that he started running and sprawled face down on the deck.

Now we still had to go up the Amherstburg Channel and the captain finally realized that he just couldn't do it because the visibility was just too poor. We got half-way up the East Outer channel and he had to make a 180 degree turn and get out of the system. It took a while to turn in the channel, back and fill, to get out of the system and go to anchor.

The Coast Guard had told us the fog was thick and we have trouble enough going up the Amherstburg Channel in broad daylight. It's not hard but you're on your toes all the time because on a 1000 footer you have buoys in front of you that you just don't see (because of the length of the vessel and the position of the pilot's eye), you're fighting current changes, and you have considerable current-induced crab to the vessel. We were all shook up pretty good, even the wheelsman and the AB on the bow. The 'old man' didn't say anything about it and we couldn't say anything to him.

(At what point do I know, as mate, that's it's time to step in and do something, when somebody else has the conn, and I see a serious situation unfolding?

(Immediately, with any other mate. With a captain, there's a very fine line because he is ultimately in charge, he is ultimately responsible. If I pile that vessel up, he is still partially to blame. That's a very hard thing to answer because of the repercussions. If I stepped in and told the wheelsman "hard right" at that time when we were coming in the channel - first of all I'd lose my job immediately and there's a very good chance I'd lose my license because the Coast Guard is going to step in. The captain is ultimately responsible even if he is putting the vessel in danger - he is in charge.

(With this particular captain you don't mention that he is making an error in judgement. He should be taking our input and using it to make the correct decision; it's not the job of the mate to tell him what the information means and to clarify your own concerns. Especially on an uptight vessel with as much animosity such as this one.)

This reporter is 43 years of age and has been a mariner for 25 years. He was licensed as a First Class Pilot in 1976 and as a Master in 1987. He most recently sailed as a 1st mate.

Sixth Reporter, First Story

We almost hit a weather buoy in 1982 up in Lake Superior off Manitou Island (see Figure 17). The Coast Guard and NOAA (National Oceanographic and Atmospheric Administration) placed weather buoys on the Great Lakes to monitor weather.

The Lake Carriers Association a number of years ago developed recommended courses. The one from Whitefish Point to Manitou is steered 279 degrees from Whitefish to Chris Point and then 290 degrees from Chris Point to Manitou. There is a shallow point between Whitefish Point and Chris Point so the 1000 footers don't steer that course. We come around Whitefish and we steer 291 to Manitou so we can stay a mile or two outside the shallow spot. It's a straight course, you save time and also your boat doesn't vibrate going over the shallow spot.

NOAA had a weather buoy placed real close to the course line up near Manitou. So we come around, we punched in our LORAN C for a distance off Manitou of four miles and we steer that course. It was in the summertime on a beautiful sunny day and we could see thirty or forty miles.

I was on the 4 to 8 watch. On this watch if you want to eat supper, you relieve the 12 to 4 mate a half hour early and then he comes back up to the wheel house and relieves you so you can eat. So I relieved the mate on the 12 to 4 at about 3:25 P.M. and then he came back up at 4:20 P.M. and relieved me for supper. It was a deep water watch and everything was

clear - no other boats in the area. When I came back up I glanced at the LORAN C to see what kind of a course we're making; we know the way points plugged in for Manitou. We were right on course and we talked for a few minutes. I glanced out of the corner of my eye and saw that we were heading right on a large square buoy - a weather buoy.

The buoy was seven hundred to eight hundred feet dead ahead of us and I yelled, "Hard left!" The wheelsman was sitting in the chartroom reading a newspaper. He was not within twenty-five feet of his wheel. The mate that relieved me was just getting ready to head downstairs and he was about eight feet from the wheel. He walked over to the wheel and put it about thirty degrees left wheel on it and the ship swung over and we missed the weather buoy by about fifty feet.

That's about a \$100,000 buoy and that's as close as I've ever come to hitting anything. We were actually to the right of our course because the mate I relieved had incorrectly reset the LORAN at the relief time of 3:25 P.M. (The new LORAN systems won't let you make this mistake). I made up my mind from then on to be more aware of everything around me when I come on duty. Situations tend to occur at the relief point. Briefing your relief is important. I did report the weather buoy being in a poor spot. Nothing was done about it.

(Two or three years later was the 100th Annual Convention of Shipmasters in Alpena. I talked to a Coast Guard Lt. Cmdr. who was responsible for the placement of the weather buoys. Two or three days later he called me at home for the position of the buoy and the next year the buoy was moved out about ten miles from the course lines so we don't have to worry about it anymore).

Sixth Reporter, Second Story

I had a situation with a salt-water boat up on Lake Superior about 1986. We were westbound headed for Taconite Harbor (see Figure 18) about five miles off the north shore; it was kind of hazy. I was second mate standing the 12 to 4 day watch. When I first came on watch the radio was on and I checked to make sure the volume was up. (Sometimes they're turned down because of the radio chatter). I heard a salt water boat giving a security call leaving Duluth eastbound. Toward the end of my watch, about three o'clock it was getting foggy and I picked up a target on the radar about twelve or fourteen miles away.

I put the cursor on him to check his line of movement. I watched him for about ten minutes and I saw that we were holding a bearing, so I tried to call him up and I got no answer. I tried to call him again and again there was no answer. At this time he was about eight miles away. I came right five degrees figuring I would go ahead of him. He was over on my left side (I'm showing him my red light) so by pilot rules I should hold my course and he should go underneath my stern. I made my course change to the right and he did the same thing - he made a course change to his left. So I still have my cursor on and the bearing is still the same - he's heading right on me - collision course.

We're down to about six miles distance now. I'm watching him close now and I'm starting to get a little concerned. It's foggy, we're blowing our fog whistles. I tell the wheelsman to come right fifteen degrees more. The target comes right again and matches me and is still coming right on me. I don't know who it is and I try to call him again and there's no answer. Then I recall that on the early part of my watch I heard this salt water boat

leave Duluth and make a security call. I figure from where we're at and from the speed of the salt water vessel it *could* be him.

So I thought to myself, this guy's not answering me, he's acting kind of naive to navigation rules. And I thought to myself, this is a salt water boat and they do not have a pilot in the wheelhouse - they have someone in the wheelhouse who does not understand English and he is putting me in jeopardy. I'm about three and a half to four miles from him now, it's about 3:20 in the afternoon and I ring the old man's room and tell him to come on up.

He comes up to the pilothouse and I explain to him in a minute or two what's happened here since I first picked up this vessel at twelve miles. We are at 1 1/2 miles now. The captain then assumed command and he told the wheelsman to come right ninety degrees - a dramatic alteration of course. We did that and we missed the salt water vessel by approximately a half a mile as he went underneath our stern. We were still going full-speed; we did not check.

After he got by us I was still plotting him on the radar and at that time whoever was in the wheelhouse of that boat checked his boat down. He almost came to a dead stop in the water within ten minutes after we passed him. I'm glad I called the skipper because the small course alterations weren't working - it took decisive action from the skipper.

I learned that if this ever happens to me when I'm in charge I will probably take the same type of action. Sometimes you have to deviate from pilot rules to get out of a situation. The skippers give us more latitude now. They tell us if you have to check it down to avoid a situation then do it. Or if you have to make a course change to save the boat then do it. They tell us to

use our discretion. It didn't used to be that way. But with something drastic, I call the skipper.

Sixth Reporter, Third Story

One night, my second year on a license, at about 12:30 in the morning in the summer of 1979 I was on a 600 foot ship, upbound passing Presque Isle (see Figure 19) toward Poe Reef going westbound through the Straits [of Mackinac]. A ship came up on my port side who was downbound from Poe Reef. We were out far enough so he wasn't restricted by the shoals so he could have obeyed the pilot rules and gone right and under my stern.

But he wouldn't go under my stern and he held a course right on me. I was showing him a red light. I tried calling him about six times and he never answered. Finally when he was about a mile and a half from me I rang the old man's room because I knew he was up. I was a pretty green third mate. The old man came up to the pilot house and I told him I tried to call this guy and he was holding a bearing on me and I was showing him a red light. The other vessel had plenty of room to maneuver and get out of my way. He wasn't answering and he was holding his course. The old man tried calling him and he didn't answer.

The old man took our ship, deviated from pilot rules and went to the left with a lot of turn on the wheel and we went underneath his stern.

If one of the two parties involved is not sure what the other guy is doing, that's a close call. If he would have gone right at the time we were going left, *we* would have been in violation. Had there been a collision, because of the pilot rules, we would have been at fault. These days you can deviate from pilot rules to prevent an accident but you had better be able to

substantiate what you are doing. I think the old man made a good move for the circumstances we were in. We did avoid a collision.

It's kind of scary because you're facing a big legal problem if something happens. You don't know why they don't answer the radio, maybe it's off or broken. Sometimes there's reading material in the pilothouse. I've talked to three captains about this and none of them approve of reading in the pilothouse but they don't say anything because they don't want to offend anyone. I've made up my mind that when I make skipper I'm not going to allow that up there. It's going to be a place of business. I don't care if they want to talk or read a navigation publication but I think it's wrong to have all this reading material up there.

Someday there's going to be a collision or a grounding on the Great Lakes and they're going to attribute it to reading a *Time* magazine or something like that. That's going to happen, there's no doubt in my mind. Sometimes my wheelmen get upset with me because they see the other wheelmen reading magazines or newspapers or writing letters and I don't allow it on my watch.

Sixth Reporter, Fourth Story

I had a situation with a sailboat on Lake Michigan in August, 1985. We were southbound on the lake on a 700 footer about three o'clock in the morning. Visibility was probably one mile to three miles; kind of a hazy morning. I had an uneventful watch. I was watching the radar because when it's foggy or hazy you start paying more attention to the radar.

I watched the radar all morning and about three o'clock I saw a target on the radar at about two and a half miles. It was a small target, not very discernable. It was on my port side about ten degrees. I got my

bearing cursor on it and it looked like it was holding a bearing. Being a small target I knew it wasn't a lake freighter. I thought it was a small power boat or a sailboat because it was the middle of the summer. I held my course remembering that a sailboat under sail always has the right-of-way no matter what the circumstances.

At about a mile I picked up two more sailboats on the radar coming in approximately the same direction as the first one I saw. They had no night lights; they had no navigation lights - a white light or anything that I could see at this time. I had to make a decision to either come left or to come right. At a mile I had determined that they were sailboats. I wasn't sure if I had a whole pack of sailboats, like ten or fifteen, or if it was just these three that I was seeing on the radar. I had my radar down a three mile range trying to find these guys and they were just barely discernable.

I told my wheelsman to stand-by his wheel, put her on hand and he did that. I checked her down about ten to fifteen rpm's. I probably should have checked her down more as I look at it in retrospect. When we were one half mile from these guys I had my wheelsman come right about thirty-five to forty degrees. The way they were heading I actually should have come left, but I didn't have enough time to come left without swinging my ship broadside to all three of these guys. I thought with their angle that I had a better opportunity to get out of their way by coming right. So we came right about thirty-five to forty degrees.

When I just got her steadied up on the new course, steering about 220 degrees, the sailboats had gotten closer. They were on my portside amidship about three hundred feet off, heading at the midship part of my boat. I told the wheelsman to come back to the left to get my stern swinging to the right to clear them - they would go underneath my stern. My only

thought at that time was that they had their sailboats on auto-pilot or maybe they had an inexperienced look-out.

But these people think, "I'm a sailboat and everybody's got to get out of my way." That's their *modus operandi*. We cleared them and when the lead sailboat was abeam of my stern, I was coming back on a slow swing to the left to get my stern away from him, he was seventy-five feet off and I saw his sails collapse because we took the wind away from him. I put a search light on him, too. In retrospect, I should have blown a whistle when we were at a mile and a half. In that poor visibility I should have blown the whistle and woke them up. But at three o'clock in the morning you're kind of hesitant about blowing the whistle. The old man would call the pilot-house asking why we're blowing the whistle out on the middle of the lake. I think the captain would have understood in that case so that was a little stupidity on my part.

Seventh Reporter

This reporter is 39 years of age and has been a mariner for 18 years. He was licensed as a First Class Pilot in 1986. He most recently sailed as a 2nd mate.

Seventh Reporter, First Story

The near-miss situation that I recall most vividly happened in January of 1989 on a 700 footer. It was about 10 pm and we were going to a dock and planning to make one more trip yet that season. The buoys had been removed in the Maumee channel (see Figure 20). We were going to the C&O number four dock.

The incident happened out at the place where buoys 9 and 10 in the Maumee River approach are usually placed. The regular buoys had been removed for winter. We only had buoys 14 and 15 still in place as markers. I was third mate and I was informing the captain quite regularly that we were outside the channel. The captain just sort of pooh-poohed me and said, "What the hell is this third mate trying to tell me. I'm the captain of the boat and he's telling me where my boat is?"

I put the spotlight on buoy 5 that we had already passed. At that point we could feel the vibration so we knew we were very close to the bottom. The captain said, "Oh my God! You're right." and then he stopped the engine. The wheelsman said, "I'm having a hard time steering cap." Instead of having five or six feet of water under us we had a foot. We had a plus thirty-three inches water factor at that time which saved us from grounding. (The next day following such a strong westerly wind we would have been hard aground at the same location). We were about two hundred yards outside the channel at the farthest point.

We got back into the channel about where buoys 9 and 10 should have been after spotting buoy 14. We turned the boat around and went back out and anchored for the evening.

We did have bad visibility, about a quarter of a mile because of snow. The westerly wind was blowing twenty to twenty-five knots. We were going in without aids. Because of the reduced visibility, the ranges were coming in and out, we could see one but not both lights. I talked to the chief later on and he said he knew something was up when the old man ordered stop engine so quickly after being given Maumee channel entrance. The chief immediately took the throttle (to the surprise of the third assistant) because he assumed something was up. This was the one time that I worried about

my license and my career and I've been sailing for eighteen years with five years on the license. I like what I do.

The captain and I talked briefly afterwards. He said, "I'm sorry I doubted your radar skills." And he mentioned being thankful that we had thirty-three inches above water datum. I spoke up to the captain and I would again because part of my job is for the boat to be safe and I want them to be aware of my observations. I trust my skills and hopefully someone else will trust my skills also but if they don't, let them use their skills and recheck mine. My job is to make sure everyone on the boat is safe, and then that the boat is safe and then I worry about my feelings.

Eighth Reporter

This reporter is 59 years of age and has been a mariner for 42 years. He was licensed as a Master in 1972. He most recently sailed as a master.

Eighth Reporter, First Story

It was a summer morning in 1967 and I was third mate. We were proceeding upbound on Lake Superior on the 292 degree course in dense, dense fog. Dense fog, seventy-five feet, or so. The vessel was a converted C-4 so in normal ballast we would make about eighteen and a half miles an hour. When we blow the whistle for fog we automatically dropped the steam to the main engines several pounds for ease of maneuverability. That also meant that the operating engineers could not leave the console; they were ready for engine orders should they be needed.

Between Manitou Island and Keweenaw Point (see Figure 17) I noticed on the radar that a contact was leaving Copper Harbor. From my observations in the past there were only two or three things that used to

leave Copper Harbor: the U.S.C.G. cutter *Woodrush*, the passenger ferry, and perhaps a fish tug. I gave a security call and nobody answered. The radar showed this contact still coming on a steady bearing, on a closing range.

As we got down around eight miles I called: "the vessel outbound from Copper Harbor". The passenger ferry answered. I identified my vessel and gave our location and intentions. He had us on the radar and said that he was heading for Isle Royal. Since we were the privileged ship he said that he would go under our stern. I gave him our speed and estimated time of arrival at 5 miles off Copper Harbor bearing South.

We worked down to six miles and I continued to watch the radar as the range was closing. Then it was five miles and I called him again. He had me on the radar. It was down to three miles and the bearing wasn't changing a nickel's worth.

At two miles I called him a third time and told him we were still holding his bearing. I asked if he understood our one whistle meeting. He said fine, no problem.

We continued to close and finally at one mile I called again and told him to "stop his engines or come hard right or a combination of both or we're going to have a collision". I told him that he was walking right into me and was at less than a mile. All of a sudden the watchman on the bow yells up to me, "I can hear a guy blowing out there." (This was the old three blasts in the fog signal).

Then over our bow on the port side just forty-eight feet off comes the passenger ferry. She's a *passenger boat* - carries about fifty people. The passengers looked like baby birds in the nest, watching us pass, with their mouths wide open. We're in 700 to 800 feet of water, in dense fog, at about

forty-eight feet. I can close my eyes right now and still see it, all these years later. Right about then the old man came up (the radio transmissions were messing up his TV reception) to ask what was going on. I never thought to call the old man earlier, there was nothing he would have done differently.

About that time the ferry calls us and apologizes. He said: "Gosh, that was close." He said he got talking to one of the passengers about how they run things on the bridge.

Fortunately nothing happened but the conversations were heard by other ships in the area. One skipper from another line called and asked where the ferry was located. He was downbound off Eagle Harbor and didn't want to get tangled up with the same vessel. That's the closest I've ever, ever come. In that fog and deep water there would have been a terrible loss of life. You've got to tend your net.

Been sailing forty-two years; got my masters license in '72 and my first masters job in '79. I expect my mates to make a cut on the chart every half hour when in six miles of land and every hour if in twelve miles; and a DR [dead reckoning plot] at the start of the watch.

Eighth Reporter, Second Story

It was in 1968 coming downbound, two and a half miles off Whitefish Point, bearing 210 degrees. I picked up an intermittent contact coming from the vicinity of Copper Mine Point (see Figure 21) that showed a definite course and speed; range closing, bearing holding steady. The fog had just set in. I gave a security call identifying my ship and location. Nobody answered.

Just from the time of day it was I guessed the target was the fish tug *No Name*. He fishes over at Brown's Fishery on Whitefish Point. We are loaded and making 16.5 miles an hour and that *No Name* might make 12 loaded with fish. I watched him for awhile and he's headed right for Whitefish Point. He's closing but I've got room to the left, I can come over towards Copper Mine Point; I have room to maneuver. The visibility was a bit better at this time - we could see about 600 feet.

I have him plotted and we got to within about three miles. I called him to see if it was the *No Name*. I called him by name and he came back on channel 6. He had me on the radar and was trying to get across and felt he could make it - I could hear that old diesel just straining right up on the governors. I pulled her left a little bit to let him come ahead of me.

That's another one where you're holding the bearings and have no contact with the target but I had the room to make a substantial course alteration if I had to and I only would have lost five minutes. We have anti-collision systems on the radar and plotting systems on the radar. I tell my mates when you pick up a contact at twelve miles, plot them. At eight miles know what he is: small craft, freighter, etc. And at eight miles know if you are on a collision course so you can call him. By five miles you can both make your alteration for a safe crossing. Don't wait until five miles to call because maybe you can't get him on the radio until three. Then before you take action you're at one mile.

Eighth Reporter, Third Story

This is the closest I've ever come to losing a ship. Two years ago we're coming from Detour going through Round Island Passage (see Figure 22) headed for Lake Michigan on an 800 foot vessel. We had a poor

passage coming down Lake Superior and through the river - we had ice and snow and poor visibility. I had been up for a long, long time; hours and hours. I had had only cat-naps for thirty-six hours and I was beat. I had a good mate with a lot of experience, had a Masters ticket - had been master of tugs, etc. It was early December so the Coast Guard had already started to take the buoys out for the winter.

I told (the mate) that I was going to bed; our location was outbound Detour. I said he should give me a call twenty minutes from Round Island Passage and I told him to be sure and give a security call thirty minutes from Round Island Passage. When they give me a call it takes me three to four minutes to get to the pilothouse but in an emergency I can be there in thirty seconds. So John called and said he didn't have anything other than a 1000 footer ahead of us about sixteen to seventeen miles. Visibility was poor, snowing and blowing southwest gale force. It had been blowing Southwest at gale force for about three days.

John said he had requested the other vessel to give us a call as soon as they were clear of Mackinac to let us know how the sea was. I pulled on my pants and grabbed a cup of coffee and went to the radars. We had two, a good one and an old one. I looked into the radar and asked John, "Are you steering on Mission Point Buoy?" He said yes, I'm steering on what should be the Mission Point Buoy but I'm not sure if there's a winter mark there or not and I'm not sure if there's winter markers in the Round Island Passage proper.

I didn't know either so I told him to look and see if anybody had marked it on the chart. I tell the mates if the Coast Guard takes the buoys out to mark 'WM' on the chart so we know if they have a winter marker there or not.

We are progressing and we have to check down going through there and we call the engineers because of the draft [shallow water causes considerable vessel vibration] going through Round Island passage. John called for the check and I check at one mile.

We can't see the buoys yet - she's snowing and it's a foul night. The other vessel called and said there's current under that bridge that you would not believe - it's coming through there like crazy. He said that they had been under the bridge for five minutes but I thought they were wrong. I'm watching our speed on the LORAN and I'm watching the radar and we can't pick up the buoys going through Round Island Passage - the two green buoys. Occasionally I could pick up the Mission Point buoy but I couldn't pick it up all the time. I thought it was because of sea and snow effect. We could see the lights of Mackinac Island and I could see Round Island Passage light. I figured we're in good shape.

We continued along and I got both search lights going, trying to see the buoys. We seem to be picking them up intermittently on the small radar. We're getting closer, about a length from the passage proper and the watchman in the pilot house says, "Captain, there's one. Right there." So I look down and it's just four points [45 degrees] on the port bow close aboard!

And about that time the current grabbed hold of us and took the whole ship and was setting her to the left. An 800 foot ship making about twelve mph - it just picked her up sideways and pushed her to the left through the passage. We've got Mackinac Island to the right, Bois Blanc Island to the left, and all the shoals around and ahead. Your thoughts are on the set to the left. So I think I've got to bring her to the right. If I'd have

brought her to the right it would have brought her stern right over the shoal water and we would have lost her.

I put her hard left just momentarily until her stern was clear and then put her hard right and brought her back - and then here's the part that blew my mind - the watchman says, "Captain there's a buoy right there!"

So I called the engineroom and I said give me lake-gate [full power and speed] right now. He answered, "It'll be a few minutes." I said, "I want lake-gate right now or we're going to go aground." I watched the rpm indicator and it didn't move a bit. I put her hard left and she came left very sluggishly, the current hit her, just got her stern clear of where the buoy should be right off the old light. Brought her back hard right and we're virtually stopped - the current's got her. We had all this way on - twelve miles an hour or so and I can't believe it happened.

I can't look that engineer in the face today. I talked to him later and said, "I told you we must have lake-gate." He said, "Well, I had somebody working on one of the blowers." I thought it doesn't make any difference, this is the unwritten trust between the pilothouse and the engineroom. I'm not a throttle jockey. When I want lake-gate I want it *NOW*. I told him we were going to go aground.

Only by the grace of God did we not go on that shoal and founder. If we had gone left only several hundred feet we've have lost the boat, we've have lost the whole crew. Below freezing, gale force winds, nobody to pick you up, we'd have lost her. The thing that has come through my mind many times is that I had been up for so long that I almost let the mate take her through. If the mate had taken her through we'd have lost her. The mate's a nice guy, but he's not an assertive master. Had a lot of experience

but he was on blood pressure medication and sometimes he didn't think too fast.

Another thing is that when we were getting those buoys that intermittent , I should have put two and two together and figured maybe it's sea return, maybe it's snow, maybe it's current. We couldn't see that buoy because *the current was pulling it right under!* It was like a tidal rip, that's how much current there was. I had been up for so long - if I had had more rest I maybe would have figured out that the current was pulling those buoys under. That's a lot of current. I've never seen that before or since. Made up my mind then that never, ever will I go through Round Island Passage again unless I am up there on the bridge. From now on, summer, winter, clear as a bell, anytime, I'm going to be there. If it ever happens again I want to observe it.

Ninth Reporter

This reporter is 54 years of age and has been a mariner for 33 years. He was licensed as a Master in 1966. He most recently sailed as a 1st mate.

Ninth Reporter, First Story

We were upbound on a 500 footer one summer night, about two o'clock in the morning in the St. Clair River approaching Russell Island (see Figure 23). I was second mate. Just the wheelsman and myself were on the bridge and there was a watchman on the bow. There was a salt water vessel downbound.

He didn't blow the passing signal so I blew one whistle as we prepared to pass port to port. He was so far over on my side of the river that I was afraid I was going to hit him. I felt that I had a choice of either

hitting him or putting it aground. Fortunately we were in ballast so we were in light draft and we were able to pass at about six feet but he had me way out of the channel. We were about twenty feet out of the channel.

That was the first close-call I ever had with a vessel. My knees were knocking. It was in 1971. We had never established radio contact. Salt water vessels have American pilots in the river and he should have known what he was doing.

Ninth Reporter, Second Story

We were out on Lake Huron. We had hauled down out of Harbor Beach and we were between Harbor Beach and Port Sanilac. We were ten miles off steering a course of 180 (south) through the Huron Cut buoys. It was foggy and about seven o'clock in the morning. I spotted a vessel coming upbound through the fog.

I just took it for granted when I first spotted him that he was on the northbound course 353 degrees on the inside of us. As he kept getting closer the bearing wasn't changing so I notified the captain who was in the pilothouse for coffee and his first look of the morning.

We were now only three miles away. We tried calling him and he wouldn't answer. The captain took the window then and by the time we backed down and stopped we cleared him by only sixty feet. We could see him in the dense fog. We had both been blowing our fog signal. This was in 1980.

I was on a maritime vessel about 620 feet long and 60 feet beam. The other vessel was a Canadian boat heading for the Canadian shore.

Tenth Reporter

This reporter is 58 years of age and has been a mariner for 35 years. He was licensed as a Master in 1974. He most recently sailed as a master.

Tenth reporter, First story

The one that scared me the most happened downbound from Lake Superior to the locks. This situation occurred in the fall, September or October during daylight hours. We had the normal complement of myself, a watch officer and a wheelsman in the pilothouse and a watchman on the bow.

I was approaching Point Louise (see Figure 9) on the green side of the channel, my side of the channel. There was an up-bound tanker being sailed by a Canadian on a B license. There was a sand barge also downbound that had been doing some work just above Point Louise and was heading for the dock near the locks. The sand barge and crane was downbound at the same time I was. He of course only drew about six feet of water so he could stay well outside the channel with perfect safety.

As I came around the first left turn, swinging wide, the upbound tanker was on my side of the channel and moving slowly straight at me. I had assumed that all traffic would be in the proper location and that this would be a one whistle pass. I had to call him and tell him to get it over because he was moving so slowly and so hesitantly. He seemed reluctant to give it a kick to get it over to the correct side of the channel.

Apparently what had happened, the sand barge and he had been talking on another channel and I didn't realize it. The sand barge had asked for a two whistle passing and the tanker had agreed to that. The tanker did not realize that the sand barge was the *first of two* vessels downbound and assumed that *I* had asked for a two whistle passing so he

was well over to the left in the channel to accommodate me. We moved as far right as we could in the channel and checked it down so that the tanker could complete his turn.

At the second turn there is a rock pile and a buoy right where I first saw him. The tanker and I missed by some thirty feet or less from my bow to his stern.

It seemed to me that the non-standard passing of the sand barge was critical in this case as was the use of non-standard radio channels for the communication pattern. Had they been on the correct channel I probably would have heard and realized what was going on and gotten involved into the situation.

Tenth Reporter, Second Story

The second situation occurred when I was approaching the Blue Water Bridge (see Figure 11). The passage underneath the bridge is one vessel, one-way traffic so we need to coordinate with other traffic who is to proceed first. In pilotage rules the downbound vessel is the privileged vessel and the upbound vessel is required to give way. This situation occurred in daytime in summer with a north, northeast wind blowing around twenty-eight to thirty knots. I was downbound in a 640 foot vessel approaching the Blue Water Passage.

An upbound vessel called and said that he was at the Black River and would be making the Blue Water Passage in about eighteen to twenty minutes. I agreed to allow him to come through first since he was closer to the bridge than I was. As time passed and it got to be almost twenty minutes, we could see the bridge but could see no vessel, neither visually or on radar. So I checked down some.

I couldn't check down a whole lot because of the north, northeast wind which would set me outside the channel and also was driving me down toward the bridge. There's not enough room for me to make a 360 degree turn and stay inside the channel, particularly with that wind condition. Eventually he came through the bridge thirty-eight minutes after the call. At the time he came through the bridge I was already past the two buoys and we met on the right hand turn just prior to the bridge.

I was not able to slow it down anymore. I was in a position of having to proceed forward. He made the turn keeping to the middle of the channel, his normal turn, as if I wasn't there and that put me hard on the right side of the channel. The Coast Guard called me to remind that's a one-way passage. I told them that the other vessel had informed me that he was at Black River and eighteen minutes out and did not come out for thirty-eight minutes and I had given him as much time and space as I could possibly do without putting my vessel in jeopardy also. There were no formal written documents although I know the Coast Guard did inform the other vessel of his error.

Tenth Reporter, Third Story

The third and final story concerns *my very first watch* as a third mate. I was downbound in the St. Clair River many years ago, on the morning watch. Our company had a retired captain who owned a home along the river near Marine City (see Figure 8) and so my captain took me onto the wing to wave to that old retired captain. I don't know why, but from the wing I suddenly moved to the front window and discovered two men swimming in the middle of the St. Clair River and we were bearing down hard on them.

I called to the wheelsman, "Hard left" to swing the bow away from them just as a power boat put out from shore to pick them up. When I looked up there was an upbound vessel coming right toward me. The first swimmer was picked up in a 'Zodiac lift', the second swimmer was closer to me so I swung hard right in order to swing the stern away from him and to begin to prepare for a one whistle passage. The power boat picked up the second swimmer and I steadied her up very far to the right to allow a one whistle passage with the upbound vessel.

An hour or so later as we came through the new cut-off [St. Clair Cutoff] (see Figure 6) and an upbound vessel was crossing on a constant bearing. We were showing red and downbound. He was showing green and upbound but he did not make the haul for the new cut-off channel and seemed to be going toward the old channel. I finally was able to raise him on the radio and he made a hard right. We passed within six feet of each other at the end of the cut-off between Lake St. Clair and the St. Clair River.

We were delivering a load of moulding sand to the Windsor side of the Detroit River that day and during unloading operations I was again on watch. Toward the end of my evening watch (8:00 P.M. to midnight) the unloading crew included one sailor who had been uptown drinking a little too long. The captain asked him if he was able to work and he said, "Yes sir, just let me change my clothes." Moulding sand is very, very fine powdery sand. It has a fine, dust-like consistency. The sailor changed his clothes and came forward to where the hatch was open and the sand was being pulled onto the belt for unloading. For reasons unknown he proceeded to jump into the hold and instantly he was in sand up to his neck.

I signaled for the conveyorman to stop the machines. You have to imagine the sand going down in a conical shape, down through the gate, to

the belt, and then out. He was now vertical in this sand with just his head showing. He hollered out that he could not breathe and I realized that the sand around him was pressing on him and was keeping him from breathing. I told one of the deck hands to reach down and tie a t-shirt over his head to keep the sand out of his mouth and nose.

I could think of only one way to get him out of there. If we had waited until we could open gates and clear the sand slowly and safely he would have suffocated before we could get half the sand away from him. We could not have dug it out because of the weight of men standing on it would have suffocated him.

So I told the conveyorman to turn on the conveyor and run it as fast as he could. The sailor with the t-shirt around his head disappeared down through the pile of sand because he was heavier than the sand and after a moment I signaled a stop and he was down and through the four foot clearance on the belt, covered with sand, but otherwise unhurt.

That sailor and I played poker many times over the years together and everyday we sailed together he thanked me for saving his life.

When I got home I was not sure sailing on a license was a good idea. I had almost run over two swimmers, had two near collisions, and almost lost a sailor in the course of my first watch.

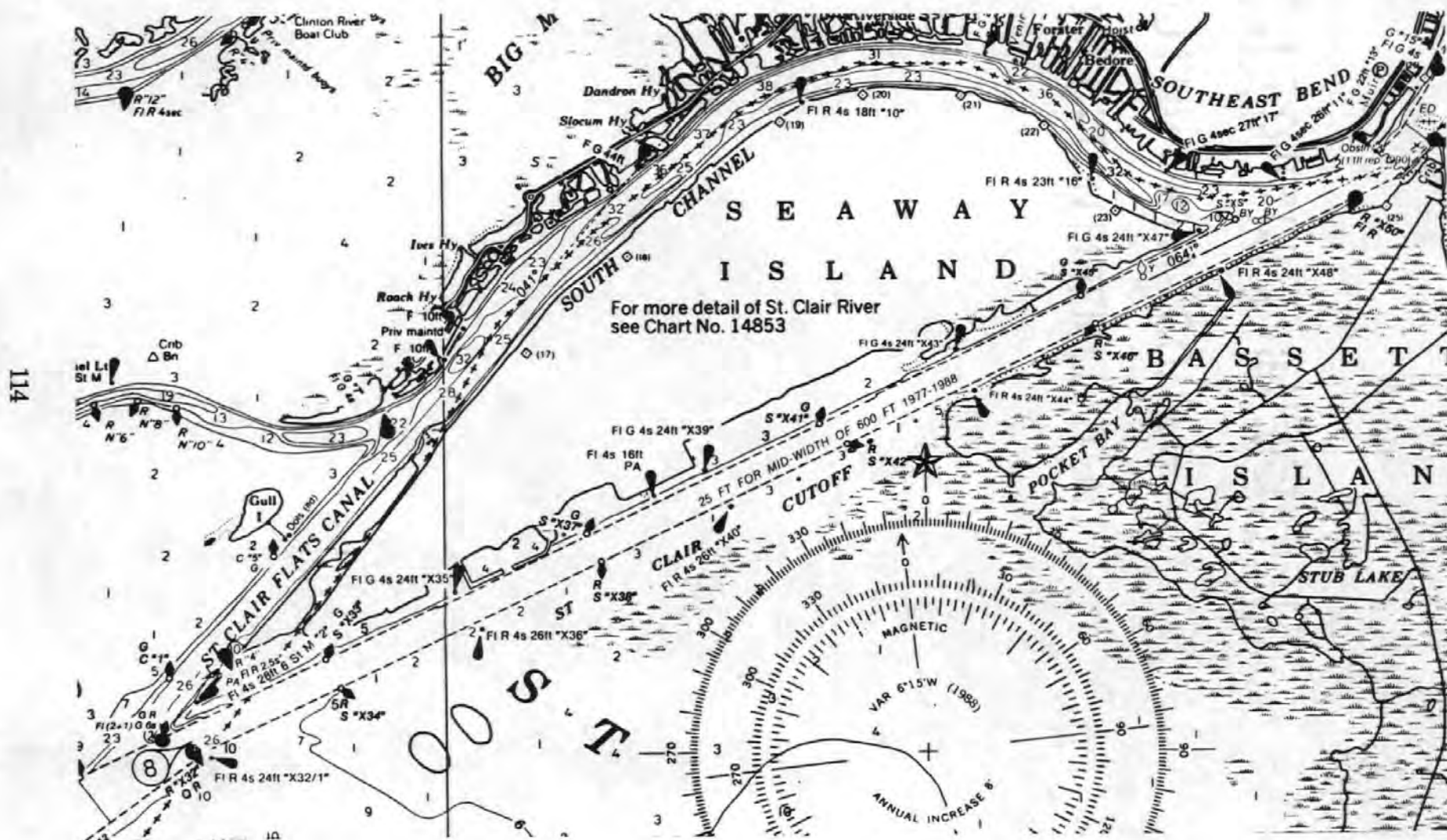


Fig. 6. NOAA Chart #14852 Saint Clair River

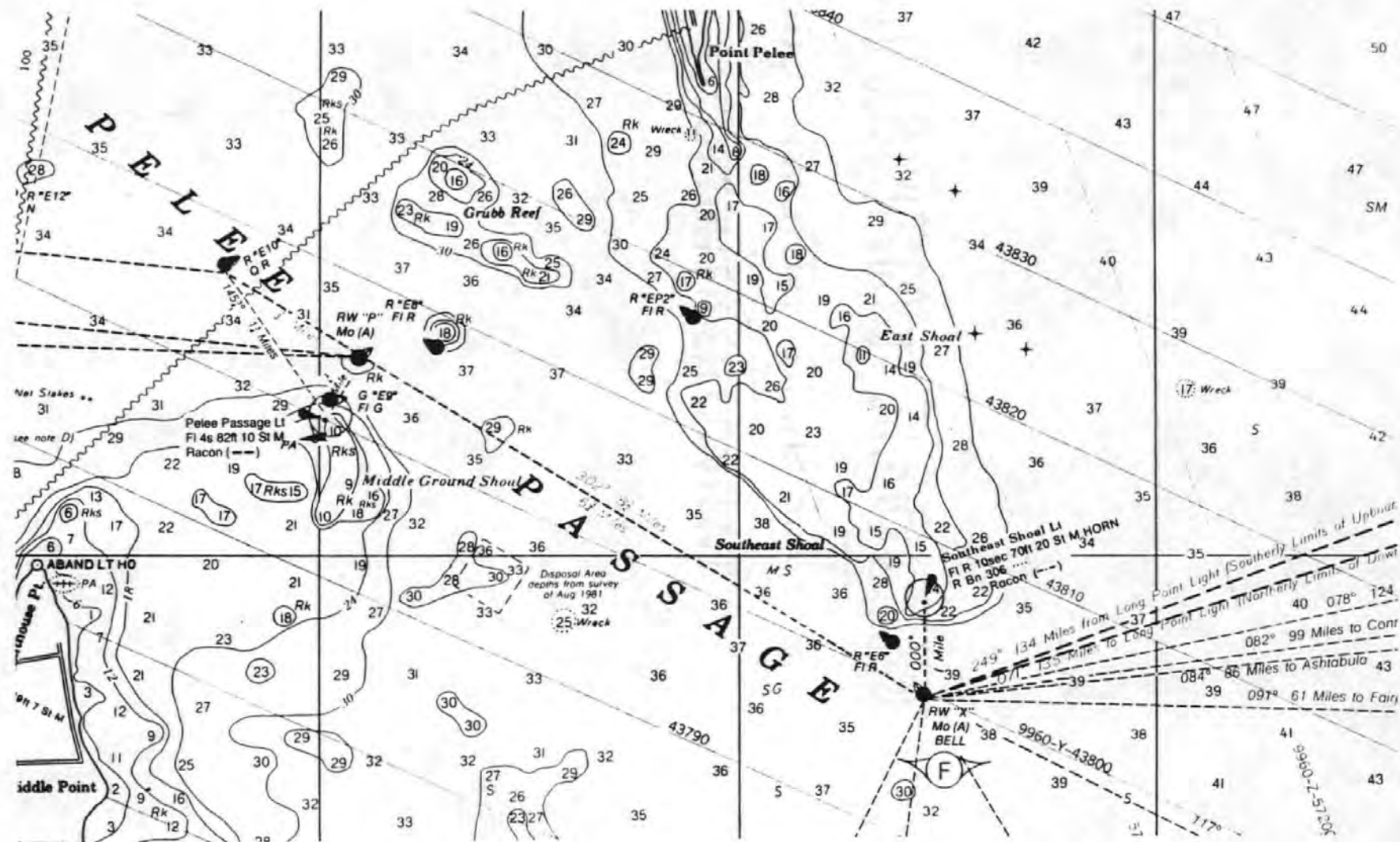


Fig. 7. NOAA Chart #14830 West End of Lake Erie

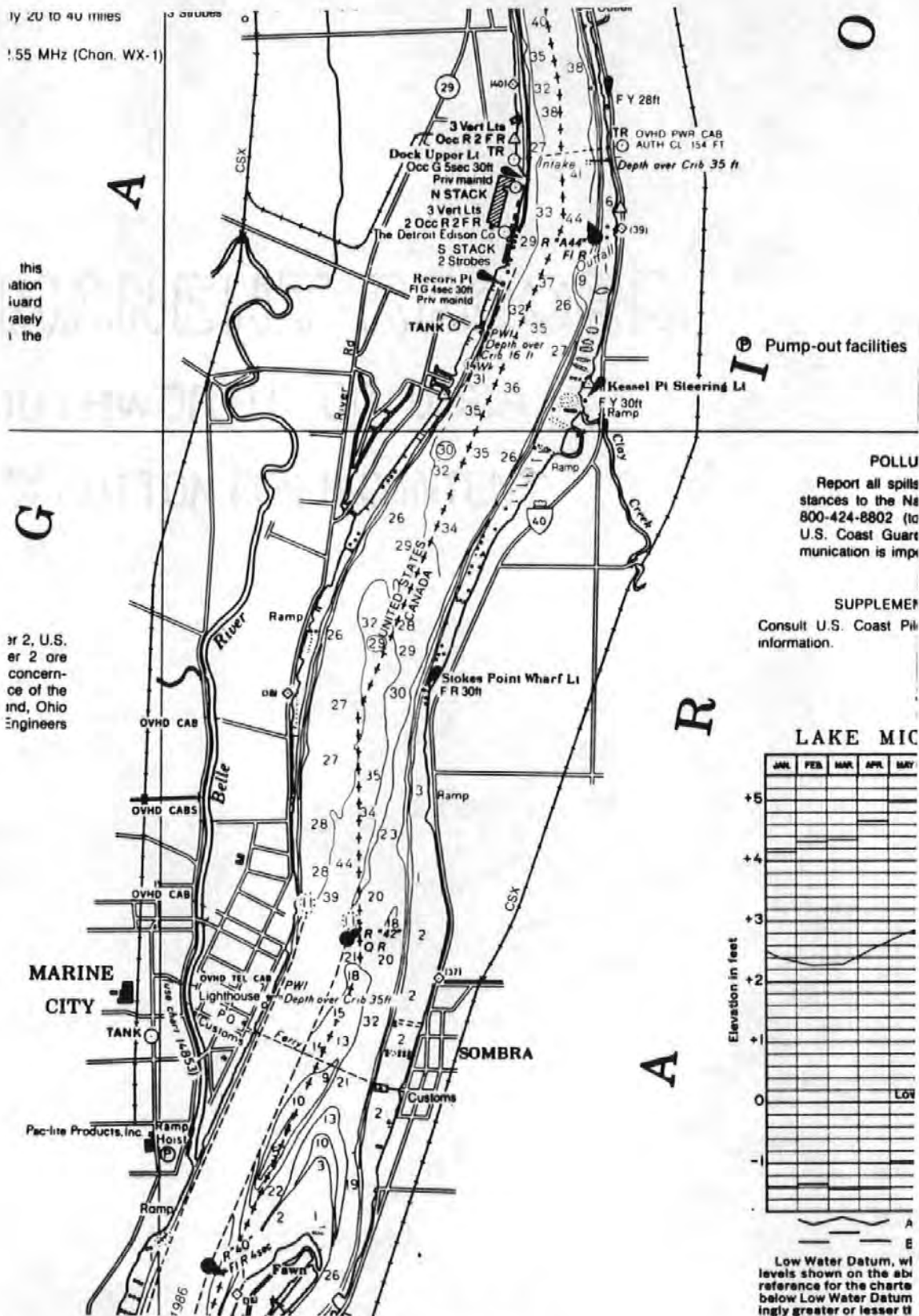


Fig. 9. NOAA Chart #14962 St. Mary's River to AuSable Point

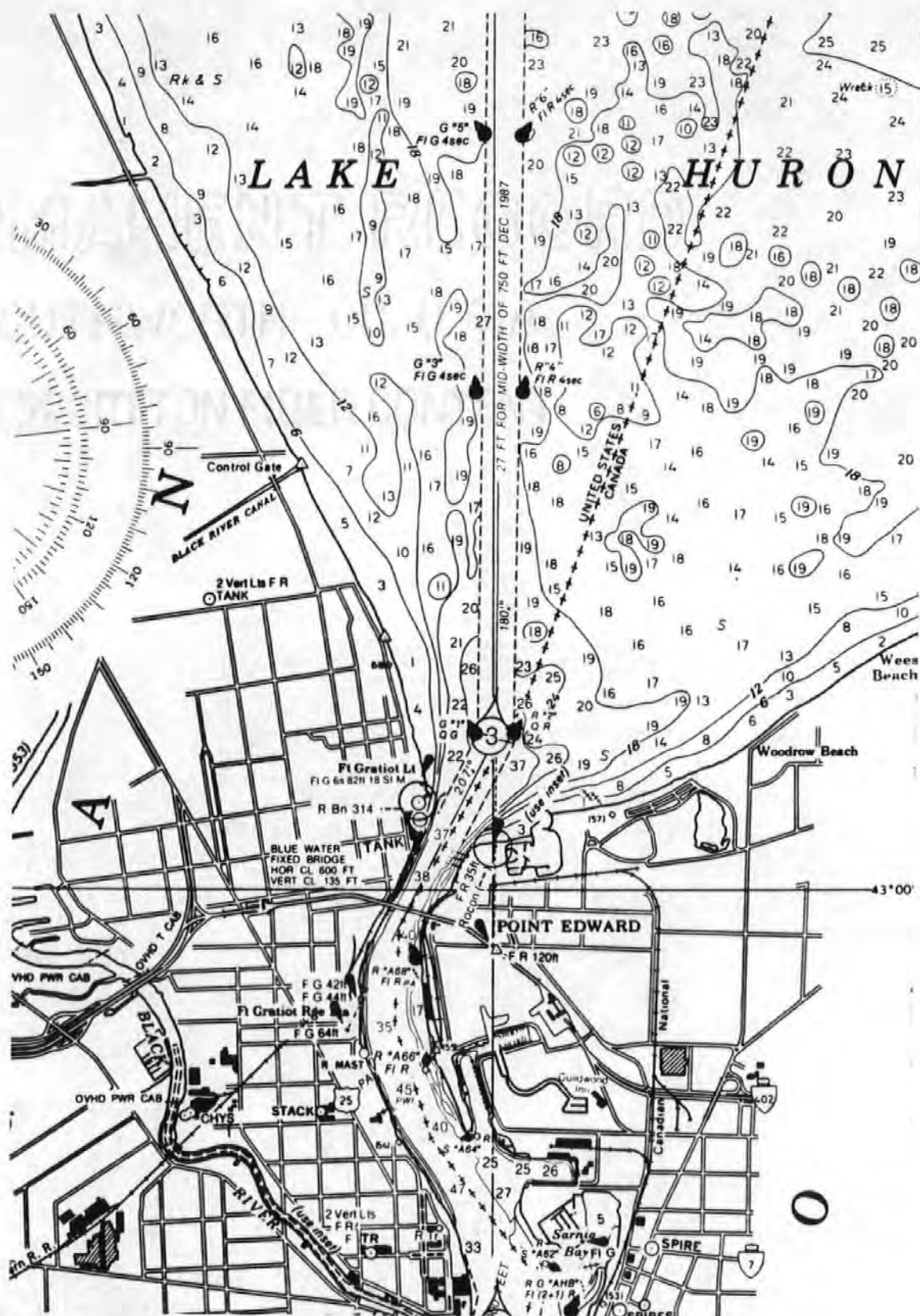


Fig. 11. NOAA Chart #14852 Saint Clair River

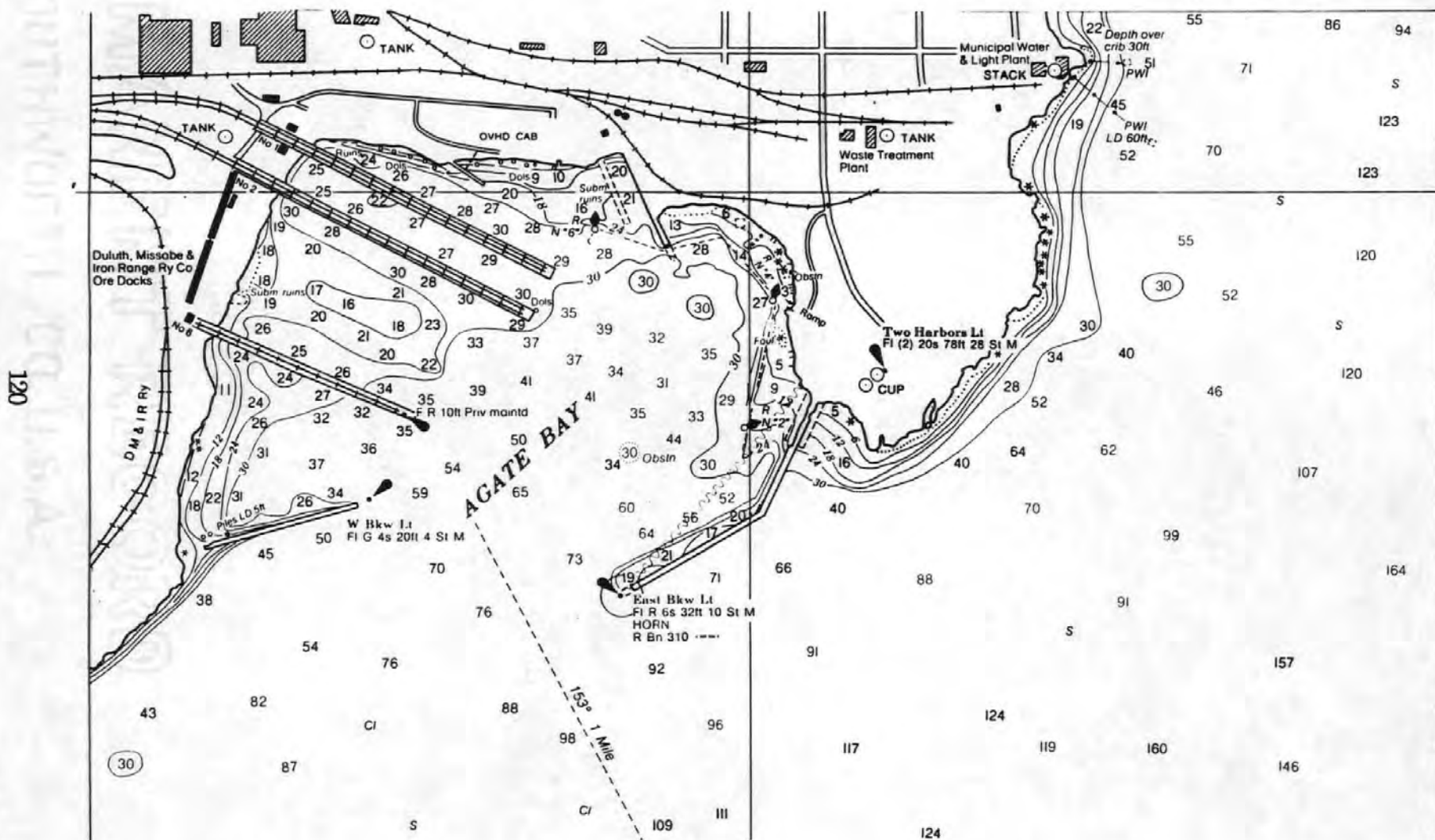


Fig. 12. NOAA Chart #14966 Little Girl's Point to Silver Bay

Fig. 13. NOAA Chart #14880 Straits of Mackinac

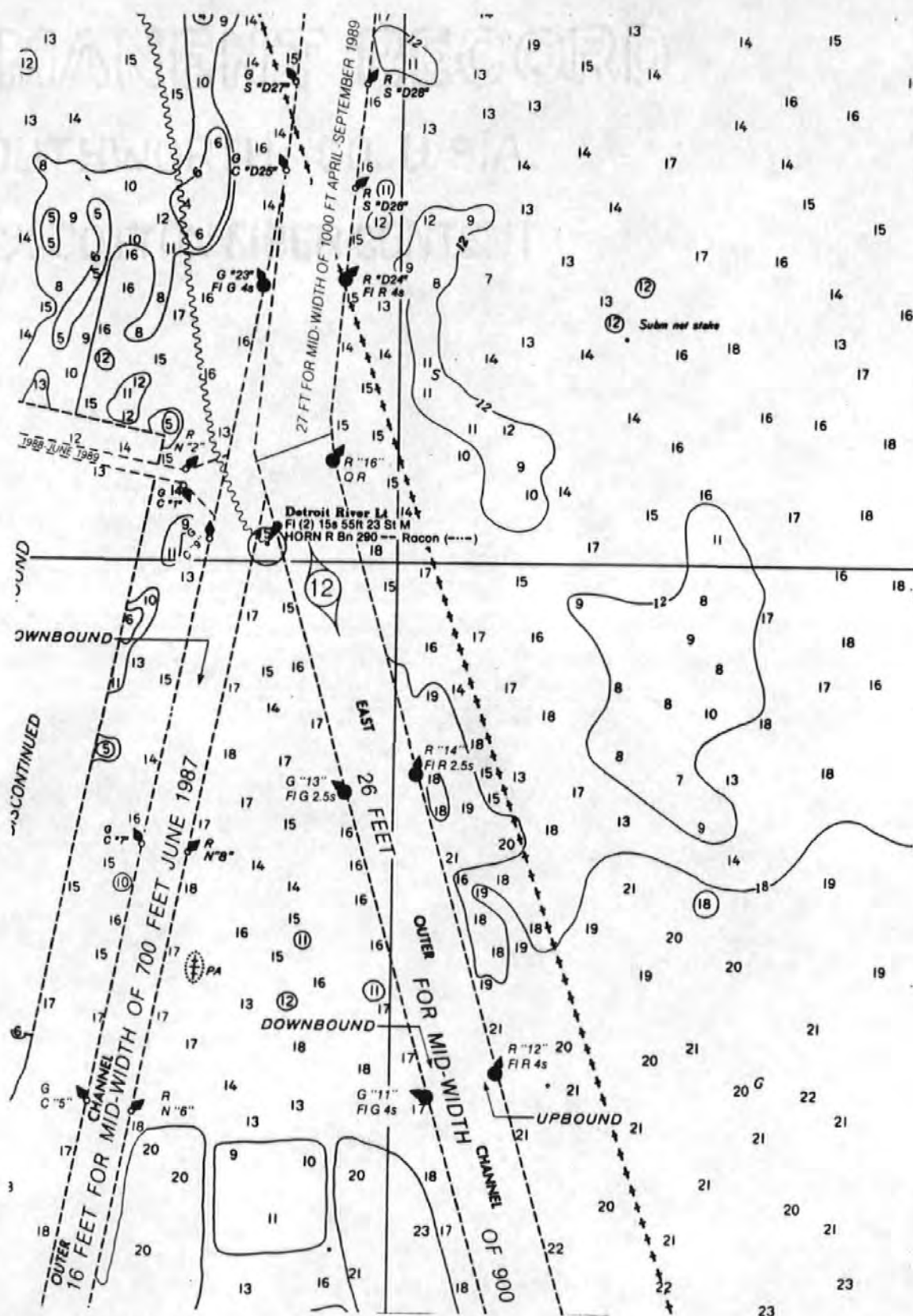


Fig. 16. NOAA Chart #14848 Detroit River

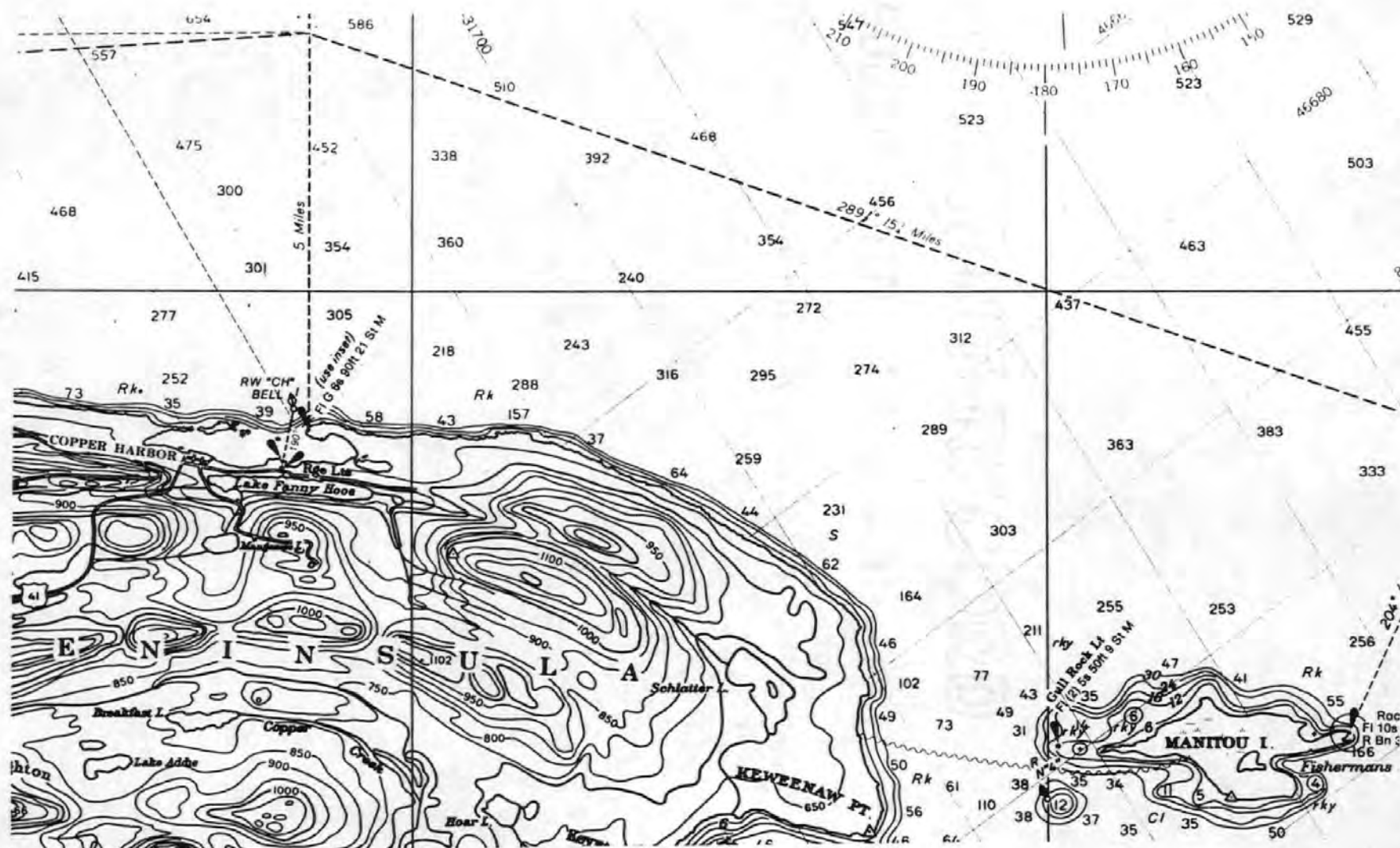


Fig. 17. NOAA Chart #14964 Big Bay Point to Redridge

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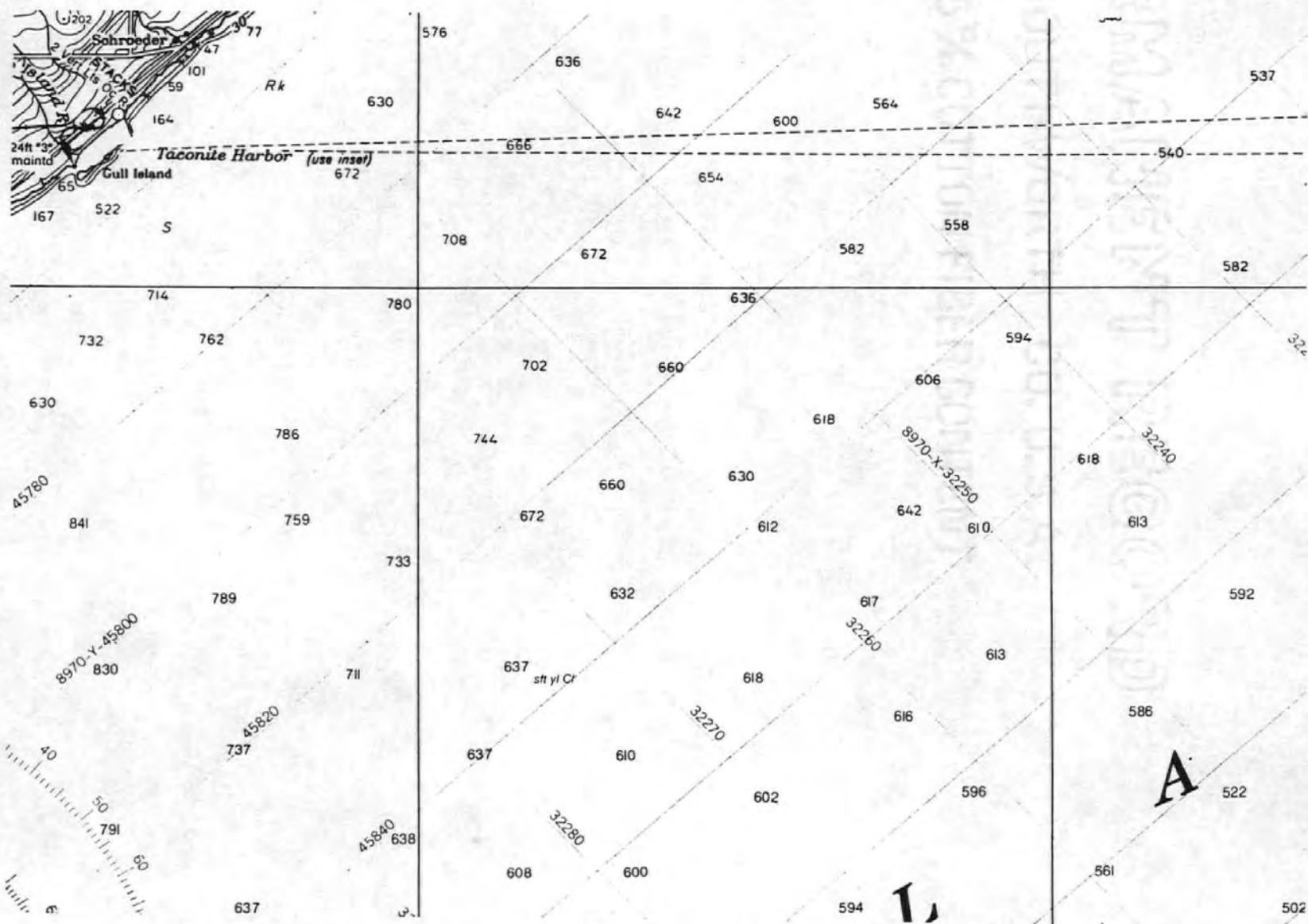
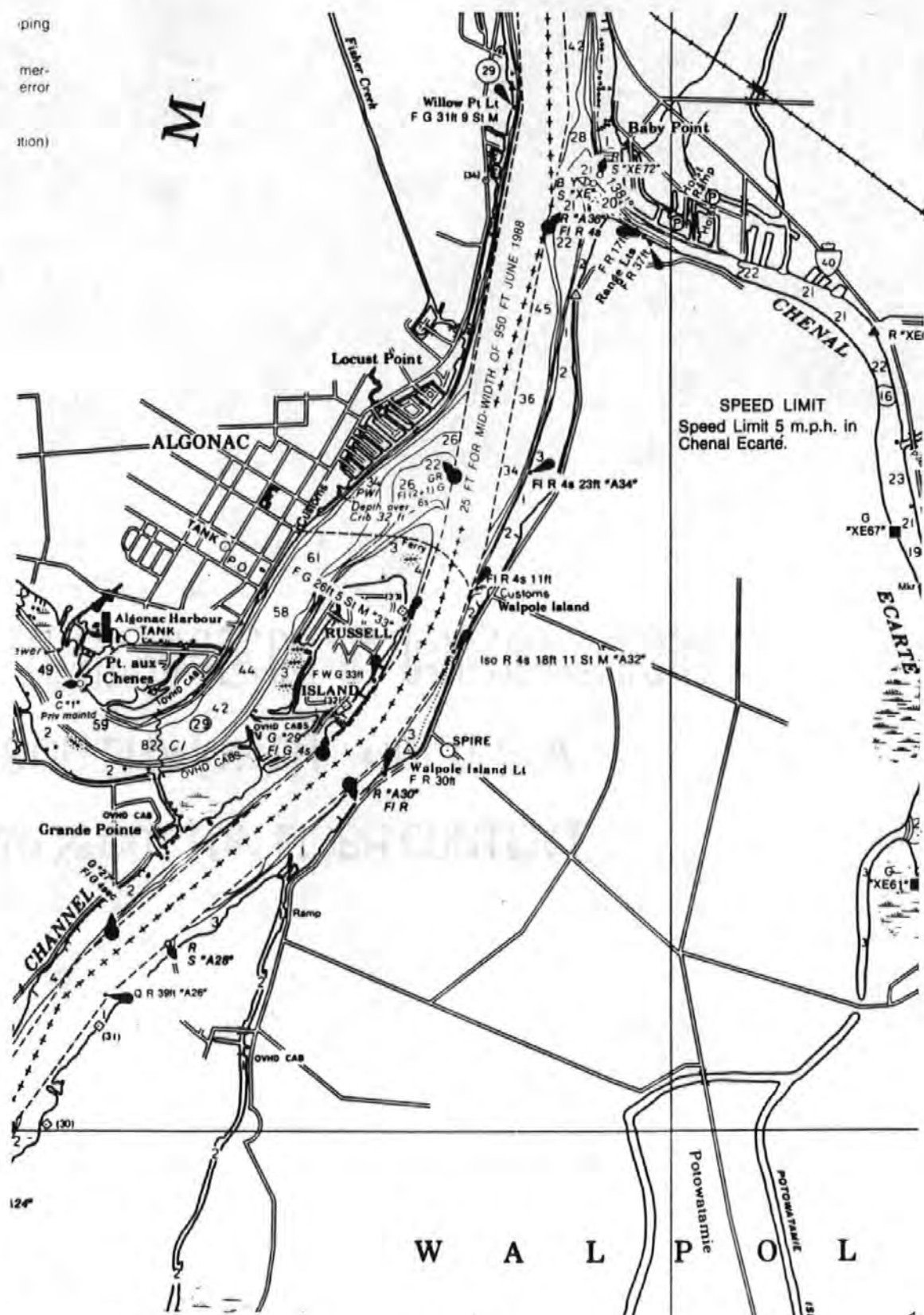


Fig. 20. NOAA Chart #14830 West End of Lake Erie

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CHAPTER 5

ANALYSIS AND CONCLUSIONS

Analysis

This study is an exploration of what and why in the near miss experience. The essential question is: in what ways and to what degree did the typical or traditional maritime organization structure shift or change in a given situation such that a potential accident was turned into a near miss.

The propositions are: one or more of the following events occurred which took the situation out of the normal structure.

1) The captain or another watch officer opened the door for an alternative structure. That is, the captain or senior watch officer present turned to another member of the bridge-watch and said words to the effect: "What do you think is happening, what should we do".

2) Someone else on the bridge-watch stepped forward and stepped out of role required by the vertical or horizontal differentiation and drew the attention of the watch officer or captain to the situation.

3) The fear of the potential accident overcame the fear of the master's reprisal (see Hershey 1988) and someone stepped out of the typical structure.

4) A peer relationship between captains or watch officers was the foundation for the change.

5) A prior relationship existed between one or more members of the bridge-watch and that prior relationship was the foundation for change.

Yin (1989, 105) in discussing the analysis of case evidence says, "Analysis is one of the least developed and most difficult aspects of doing case studies." He continues, "Unlike statistical analysis, there are few fixed formulas or cookbook recipes to guide the novice. Instead, much depends on an investigator's own style of rigorous thinking, along with the sufficient presentation of evidence and careful consideration of alternative interpretation."

He says (106): "The first and more preferred strategy is to follow the theoretical propositions that led to the case study. The original objects and design of the case study presumably were based on such propositions, which in turn reflected a set of research questions, reviews of the literature, and new insights."

The table (Figure 24) on the next page matches each of the reporters and their stories against the five propositions. The data are portrayed as:

first reporter stories one through four

second reporter stories one through five

third reporter stories one and two

fourth reporter stories one and two

fifth reporter story one

sixth reporter stories one through four

seventh reporter story one

eighth reporter stories one through three

ninth reporter stories one and two

tenth reporter stories one through three

The propositions are arranged in columns.

Proposition 1, that the captain or another watch officer
changed the structure.

Proposition 2, someone else on the bridge watch stepped
forward.

Proposition 3, fear overcame role restrictions.

Proposition 4, peer relationships on the bridge watch
allowed an interaction.

Proposition 5, a prior relationship between members of the
bridge watch permitted this shift.

Column 6 records the stories which do not include an organization
shift. Column 7 is a new finding which will be described briefly below.

Of the twenty-seven stories, five (18.5%) match propositions one, two
or three. Those stories are:

first reporter third story

second reporter third story

fourth reporter second story

fifth reporter first story

seventh reporter first story

The first reporter in his third story, discussed the lack of radio
coordination for vessels passing the southeast shoal light, the hub of traffic
on Lake Erie. He says, "We got within about six miles and *I broke
the code of silence.*" He goes on to say that the captain, once called to the
pilothouse, also broke the code of silence and attempted to reach the target
by radio. Proposition three states that a degree of concern caused this
reporter to break the code initially and for the captain to also break the code.

Figure 24 Pattern Analysis of the Propositions

Propositions:		1	2	3	4	5	6	7
First Reporter								
Story 1							x	
Story 2							x	
Story 3				x				
Story 4								x
Second Reporter								
Story 1							x	
Story 2							x	
Story 3			x					
Story 4							x	
Story 5							x	
Third Reporter								
Story 1								x
Story 2								x
Fourth Reporter								
Story 1							x	
Story 2			x					
Fifth Reporter								
Story 1			x					
Sixth Reporter								
Story 1							x	
Story 2							x	
Story 3							x	
Story 4							x	
Seventh Reporter								
Story 1			x					
Eighth Reporter								
Story 1								x
Story 2								x
Story 3							x	
Ninth Reporter								
Story 1							x	
Story 2							x	
Tenth Reporter								
Story 1							x	
Story 2							x	
Story 3							x	

The reporter goes on "We got less than a mile from him and the captain was in the radar and I was in the window with the binoculars. I saw his anchor lights and saw no running lights. I blurted out *'It's a vessel!'*"

The story as presented by the reporter, the words selected and the emphasis of the voice indicated to the researcher that this was an unusual statement, unusually loudly spoken and declaratory rather than observational in nature.

The third story of the second reporter and the first story of the fifth reporter demonstrate that someone else on the bridge watch stepped forward, out of their role, and took a stronger position than one would normally expect in order to create the near miss.

In his third story the second reporter is describing a situation at the Blue Water Bridge on a 1000 footer. The conn of the vessel was up to the second mate; the captain was on the bridge, but did not have the conn. The second mate delayed in his turn; waited too long for the turn and the captain stepped forward, out of his role of observer [a somewhat unusual role], took the conn and began the turn. It is the right of the captain to do this, but it would be a significant event for him to step forward with a seasoned second mate such as was described in the story.

The first story of the fifth reporter is another illustration of someone else stepping forward out of their role. The mate was providing information to the master who had the conn as to the position of the vessel and the time to begin the haul. The mate said, initially, that the vessel was lined up for the turn. The captain made no movement. The mate indicated then, "You're past the red line-up." The captain, for the second time, failed to start the haul. The mate then said, "The middle of the channel is in line." The captain failed to respond. Finally the mate for the fourth time,

and now rather forcefully said, "You are past the middle of the channel." After the fourth statement, the captain finally started the turn.

The delay of the turn was noted by the on-coming vessel and a conversation took place between the two at that time. The first mate in this case attempted to stay in the role as prescribed, to provide information and to support the eyes of the master with the conn.

At the fourth juncture, according to the reporter, the sense of urgency and the strength of the comment was a much greater indication to the captain: "You must do something. I have stepped out of my role as mate and are requesting that you make a move, NOW!"

In the case of the seventh reporter, first story, the situation was overcome when the third mate was able to, "put the spotlight on the buoy that we had already passed." At that the point the captain said, "Oh my god, you're right." And then he stopped the engines and eventually moved the vessel out of the channel. The third mate informed the captain several times that it was in a position of danger. This third mate kept pushing information at the captain, who has the conn, until the evidence of a mistake is overwhelming. This is in contrast to the previous situation involving a first mate continuing to step forward to the captain.

The final story which indicates a conformance with the propositions is the second story of the fourth reporter in a situation with a tug and barge in a December southwest gale in which the tug lost its steering and also had a flooded after-compartment. The captain, as he relates this story, relies heavily upon much support and many ideas from his chief engineer and his first mate. Although the decisions are clearly the captain's, the organization is very blurred in terms of horizontal or vertical differentiation. This captain, in describing his vessel, suggests that part of

the difficulty in the typical vertical structure is that it reduces the sharing of observations and experiences and thus reduces the education and learning for others.

Five of the twenty-seven stories indicate that a near miss included some degree of change in the traditional vertical and horizontal differentiation; the structure of the maritime organization. None of the stories reported indicated that a peer relationship or a prior relationship was the basis for the shift in the organization. It had been hypothesized that two equal officers would rely upon each other. That issue is addressed by the first reporter in his parenthetical expressions about the third story when he said, "Even today after I've sailed as captain, another captain will never ask what I think. Once last year I was first mate and a captain asked what I thought about a non-critical situation. My reaction was, 'Why ask me, you're the captain'. Of course, he had bumped me from the captain's job on that vessel."

The same expectation applied to the potential for prior relationships, people who have sailed together in the past. The second reporter, third story, in describing such a situation with a second mate with whom he had sailed for a number of years, demonstrated that a prior relationship did not impact the action.

In these twenty-seven stories are five which seem to suggest another proposition. These stories are:

first reporter, fourth story

third reporter, first story

third reporter, second story

eighth reporter, first story

eighth reporter, second story

It is the responsibility of a watch officer of the bridge watch to maintain control of his own vessel. In overtaking, passing, or crossing situations it is common for multiple vessels to communicate by radio and to coordinate the means for their safe transit. Vessels, bridge watch to bridge watch, will agree on a one-whistle passing, or a change in speed or direction to accommodate faster or slower vessels, or an early decision to change heading or speed to accommodate a crossing situation. It is unusual for vessels to be directed in their performance by a bridge watch of another vessel. Yet five of the twenty-seven stories tell of situations in which one bridge watch took control of the entire situation, including the other vessels involved.

The fourth story of the first reporter describes a situation in the St. Clair River in which his vessel was overtaking another vessel and a third vessel appeared downbound which neither of the upbound vessels was expecting. Normally a passing situation such as this would be met on the one-whistle, or port-to-port side. But the downbound vessel, as the privileged vessel, had the choice of whether to meet port-to-port on one whistle or to go between the two upbound vessels. The conning officer of the downbound vessel, "When he saw the two of us coming, he blurted out, 'I'll split between you'. It was instantaneous on his part, he probably had a heart attack when he saw us. But at the moment he decided to split between us we were too close together, he would not have fit."

In essence, the downbound vessel took control of the whole situation, required the overtaking vessel to move as far to the left as possible, and required the overtaken vessel to move as far to the right as possible allowing three vessels to fill the entire channel. There was less than one hundred

feet between the vessels and both of the outside vessels were within approximately fifty feet of the shoreline.

The third reporter described two situations in which a similar organization was created. The first, downbound to Sarnia at the Blue Water Bridge in summer fog in which an upbound vessel suddenly appeared steering toward the right of the reporter's vessel. The captain of the reporter's vessel took control of the situation and without discussion, or commentary, or opportunity for disagreement commanded over the radio: "Hard right, hard right, hard right." The other vessel apparently complied with that demand because moments later the reporter's captain commanded, "Hard left." He had clearly taken control of the entire situation and managed the passing of the two vessels as if they were one organized entity.

The first story of the eighth reporter indicates that it is not only captains who can take such control. At the time of the incident the reporter was a third mate. He says, "We continued to close and finally at one mile I called again and told him to stop his engines or come hard right or some combination of both or we were going to have a collision. I told him that he was walking right into me and was less than a mile away." This commercial vessel and passenger ferry passed less than fifty feet apart. The third mate reached out and with no discussion, nor compromise, nor agreement took control of both the oncoming vessel and his own vessel and managed it as a single organization.

In his second story the eighth reporter describes a crossing situation in which he was the privileged vessel. A smaller vessel was attempting to cross in front of him without giving way as it should have. Other than a series of discussions and commentary about the capacity of the second

vessel, this reporter turned his vessel in such a way as to allow the burdened vessel to have the right of way. The near miss here was not so much in terms of distance but rather that the reporter controlled the entire two-vessel situation outside of the rules of pilotage.

Conclusion

Of this sample of twenty-seven near miss instances, 18.5% of the reporters describe a form of organization change as predicted by the initial propositions. In one instance the captain opened the door for alternative actions and suggestions to be put forward. In three situations another member of the bridge watch, but not the conning officer, stepped forward. In one case it was the captain and the third mate who both stepped forward to break the code of silence.

The reporters do not say that it was these acts which prevented an accident, although all of them reply that these were critical actions and moments in the near miss experience. No reporters specifically described peer or prior relationships as the foundation for an organization change, although several of the reporters discussed these issues, ex-recorder, or in parenthetical commentary. Peer or prior relationships appear not to be germane.

Five of the cases described an unpredicted change in the organization structure. The customary structure in a two or more vessel situation is for each vessel to maintain independent control within the pilotage rules. It is nearly unheard of for a master to even attempt to control or give direction to another vessel. Coordination through a process of discussion and communication may establish non-standard procedures under certain circumstances. This process however, is almost always a two-way flow and

grants equal status to the bridge watch of all vessels involved. In five stories as described in this case study (first reporter, first story; third reporter, first and second stories; and eighth reporter, first and second stories), one master, or watch officer took control of the entire multiple vessel organization and directed the movements of the other vessel, or vessels, as well as his own.

Yin (53-54) states:

(t)hus, the ability to conduct six or ten case studies, arranged effectively within a multiple-case design, is analogous to the ability to conduct six to ten experiments or related topics; a few cases (two or three) would be literal replications, whereas a few other cases (four to six) might be designed to pursue two different patterns of theoretical replications. If all the cases turn out as predicted, these six to ten cases, in the aggregate, would have provided compelling support for the initial set of propositions. If the cases are in some way contradictory, the initial propositions must be revised and retested with another set of cases. Again, this logic is similar to the way scientists deal with contradictory experimental findings.

In some of the cases, a change from the traditional maritime structure occurred but in most of the cases the traditional structure remained intact. Peer or prior relationships probably do not influence a change in the organization structure. In some of the cases the conning officer of one vessel took control of the entire situation and, through communication and coordination, managed the situation to a successful conclusion.

CHAPTER 6

RECOMMENDATIONS

This study has been an exploratory or preliminary research into the how and why of the maritime near miss experience. It is framed from the perspective of the field of organization theory and organization behavior rather than from the technical perspective of maritime shiphandling. Its purpose was to determine the degree to which certain propositions having to do with changes in the organization occurred in near miss situations on the United States Great Lakes waters. Twenty-seven stories of near miss have been recorded and documented. These stories can form the foundation for an on-going review of near-miss experiences.

The research should be continued on the United States Great Lakes and should be extended to United States deep sea vessels, rivers, and pilot associations to develop a near-miss repository of experiences and successes. This could follow the same structure as recommended by the Det norske Veritas study of 1978-81, and the United States Department of Transportation study 1984-86. Such an extension of the study would require the development of a tape library and key phrase data-base developed for computer sorting and matching.

The unexpected proposition referring to a master or bridge-watch taking control of an entire situation without conversation or discussion between vessels should be pursued with some vigor. If such an organization is occurring at a high enough frequency, it should be included in

the training and preparation of masters and mates so that they are better able to manage the entire situation.

A one-person bridge-watch is of much interest in Europe (Beetham and Habberly 1989, Benford 1988, Cross 1990) under a variety of names. There are some suggestions of technology dependence in the situations described by the reporters in this study. Several of them make it clear that radar is not at its best when conditions are at their worst. It may be that the one-person technology is not sufficiently advanced to make the one-person bridge safe at least in some of the situations reported, a second - and sometimes a third or fourth - person in the bridge-watch was required for safe passage.

In order to test single-person control, these near-miss situations could be replicated using the computer generated imagery and ship-handling capability of one or more of the world's maritime simulators. Individuals could be tested on their ability to manage complexity in a single person bridge-watch using the scenarios described by the reporters in this study. Such simulation-based experimentation could include the impact of fatigue and/or boredom upon the capacity of professional mariners to safely operate with a single person bridge-watch.

Furthermore, those simulators should be used to assess the degree to which these stories represent normal or abnormal actions by typical bridge-watch configurations. That is, an experimental design should be established, using a selection of these cases, with sufficient subjects (perhaps ten), to test the degree to which others would react in similar kinds of ways.

Such a study might produce four outcomes. First, how to organize the structure, process, communication and coordination in the bridge-

watch so as to encourage actions within that bridge-watch to cause near-misses rather than accidents. The cases in this research represent glimpses into the real world. A series of simulator based studies of a controlled experimental nature might offer clues to alternative organization structures to prevent accidents.

The second outcome of such simulator experimentation could answer the question: how should the role of captain be structured and played out in such a new organization. A military airlift command report (Orlady and Foushee 1987, 149) suggested that the role of captain be changed to information manager rather than aircraft commander. In such circumstances the captain becomes responsible for evaluating the whole situation and a watch officer (co-pilot in the aircraft) would give steering/speed directions to others on the bridge-watch. A controlled experiment to establish the viability of such a procedure in the maritime industry should be tested.

The appropriate experimental design might also produce data concerning high error rate bridge-watch patterns. It may be that certain organizational structures and practices could be identified as leading to greater numbers of near-misses or higher numbers of technical and performance errors. Simulator studies with appropriate experimental designs could answer such questions formulated from the study at hand. The study has shown that sometimes there is an organizational shift in the unfolding of a near-miss experience. It could be hypothesized for future research that the organization shift could be established as a norm rather than an unusual organization and that master mariners could be trained to operate under such an arrangement.

Finally, such experimentation could explore the unanticipated finding of this research: the process of taking control of the entire situation, including other vessels, by one of the bridge-watches. The simulation experimentation could establish patterns of communication, coordination and organization in multiple-vessel situations to become the foundation for future training of mariners and established rules for safe watch-keeping or navigation.

A recurring theme in many of these near-miss experiences is the lack of communication between members of the bridge-watch, especially between the captain and others. There continues to be a reluctance to disagree with the captain or to offer alternative suggestions. This cultural situation should be of continuing concern, especially to the shipowners and the academies, as they describe and define the requirements for bridge watch-standers.

Lastly, the organization changes noted in those situations where a shift occurred (37%) should be made part of the professional mariner's repertoire. That is, mariners should be trained to recognize the point at which the boundary from one organization form (the normal) has been reached and the new (the shift) is being entered. This training should include situation awareness skills to prepare masters and watch-standers to recognize the need to shift the organization and opportunities to experiment with the changed form. Further, mariners should be encouraged to regularly practice the alternative form much as they already regularly practice other emergency tasks including man overboard drills.

APPENDIX 1

CORRESPONDENCE WITH REPORTERS

May 3, 1990

Dear Captain/First Class Pilot:

As a professional mariner, you may have experienced a close call (or a near miss) sometime during your career. These are the situations where a potential accident (collision, grounding, fire, etc) is prevented within a time frame which made it "almost too late". These are the never-to-be-forgotten incidents which we often keep to ourselves but which guide our careers.

Doward Douwsma (whom you may know as Dow) is a Ph. D. candidate at The Union Institute. His doctoral thesis will be on these near miss situations and he has asked for our help. First, we ask that each of you complete the anonymous questionnaire enclosed (Part A) and return it to him. Second, he has requested that you be given the opportunity to provide him with details about close calls you may have had or observed, in a confidential personal conversation. (Your name will remain confidential and will not be included on any summary report.) These conversations will be held at a mutually convenient time during June, July, August, and September 1990. If you would be willing to talk with him please complete Part B of the questionnaire so that the conversation time may be arranged.

Your Joint Training Advisory Committee believes that this study is important. While all details will be held in strict confidence as required by The Union Institute, the summary results will be made available to all who participate in the study and to all future students at the Training Center. These close calls are a powerful way to learn how to practice professional shiphandling and navigation. We encourage your participation.

Sincerely,

Close Call Study Questionnaire 1990

Part A

1. How many years have you been sailing? _____
How old are you? _____
What is your current license? _____
2. During your career, about how many close calls or near misses have you observed?
1-2 3-5 6-10 11-15 more
3. Which of these factors contribute to the close calls you have observed (check as many as apply):

<input type="checkbox"/> Time of day	<input type="checkbox"/> Mechanical failure
<input type="checkbox"/> Weather conditions	<input type="checkbox"/> Electrical failure
<input type="checkbox"/> Ice	<input type="checkbox"/> Electronic failure
<input type="checkbox"/> Overtaking	<input type="checkbox"/> Inattention
<input type="checkbox"/> Passing	<input type="checkbox"/> Calculated risk
<input type="checkbox"/> Carelessness	<input type="checkbox"/> Lack of experience
<input type="checkbox"/> Fatigue	<input type="checkbox"/> Lack of training
<input type="checkbox"/> Operator error	<input type="checkbox"/> Failure to follow rules
4. In your judgement which of these conditions are the most critical?
 - 1.
 - 2.
 - 3.
5. Have you ever been personally involved in a close call or near miss?
☐ No ☐ Yes
6. Have you told others about your personal experience?
☐ No one ☐ Professional mariners only
☐ A few people ☐ Lots of people
7. Would you be willing to tell about close calls in a confidential conversation with Dow?

☐ No

Thank you for completing this questionnaire. Please mail it in the attached envelope to:

Doward G. Douwsma
531 Belmonte Park N #1005
Dayton, OH 45405.

☐ Yes

Thank you. Please complete Part B of the questionnaire and mail both Parts A and B in the attached envelope to Dow.

Part B

Name: (Print)_____

Vessel:_____

Position:_____

Anticipated vacation dates:_____

Which of these ports do you regularly make: _____ **Cleveland**
_____ **Lorain**
_____ **Toledo**
_____ **Burns Harbor**
_____ **Duluth**
_____ **Rogers City (Calcite)**
_____ **Others (please list)**

Home address and phone:_____

**Dow will be making arrangements to meet with you during
June - September 1990**

August 3, 1990

Dear _____,

Thank you for agreeing to help with my research into "near misses". The response of professional mariners such as you is truly gratifying.

You will recall that we had originally planned to get together during the summer sailing season - June to September. Unfortunately my brother-in-law died in June and we are still working on getting Mom into a satisfactory retirement facility in Wisconsin (she had been living with him in San Diego). It is unlikely that I will be able to meet with you this season.

Therefore, I would like to schedule our visit during February at a site near your home. It's too early to be specific but I am planning a trip through Ohio, Michigan, Minnesota, and Wisconsin to meet with all of you. We can set the actual schedule in January - after the close of the season. In doing the rough planning it would be helpful for me to know if you would be available in February (or do you Motor Home away to Florida?) and if there are any times you know now that you will be unavailable. If we can't schedule a mutual visit I would like to suggest a telephone conversation. Would you please use the enclosed self-addressed stamped envelope to let me know.

Thank you for your continued interest.

Sincerely,

Dow

Dow:

I will _____ will not _____ be available during February.

I expect to be at home from _____ to _____
in February.

I would be willing to talk by telephone (no cost to me) if we can't
schedule another way to do it. Yes _____

Name

531 Belmonte Park North
Dayton, OH 45405
February 4, 1991

Mr. James S
1207 105th Avenue W.
Duluth, MN 55808

Dear Mr. S:

Thank you for being willing to share your "near-miss" experiences with me. Our conversation should take about an hour.

We agreed to meet at _____ on _____ at _____. I will be driving some distance so weather might become a problem. If I get delayed, I will call you. You can reach my answering machine (which I check every day) at 513-445-0530.

Looking forward to our meeting.

Sincerely,

Doward G. Douwsma

APPENDIX 2

THE PROTOCOL

APPENDIX 2

THE PROTOCOL

[The protocol was established to assure consistent data gathering. The protocol was reviewed in brief with each reporter. Emphasis was placed on the purposes of the study, the methods of ensuring confidentiality, and the non-judgemental nature of the research.]

This case study research is undertaken to further our knowledge of the organization structure and process that may occur in a near-miss situation. The data will be developed through a series of interviews with master mariners and first class pilots sailing the Great Lakes. The researcher is an interested observer but is not a qualified mariner. The goal is to identify possible shifts in the organization or in ways of performing the bridge-watch function which can be translated from the data into learning tools for master mariners. If in fact the data supports the propositions, then it should be possible to train people in new skills in order to cause near-misses rather than accidents.

The tasks of the study are to identify and capture the detail of near-miss stories in such a way that the organization structure and process might be clearly articulated following the interviews. Based upon the results of the data we hope to develop training programs which will allow master mariners to use the knowledge gained in shared near-miss experiences.

This research is undertaken under the auspices of the Graduate School of The Union Institute as part of a Doctoral Program; Doward G. Douwsma, Candidate, Barry Heermann, Core Faculty. Issues involved include organization, bridge-watch organization, bridge management, human error, and the near-miss phenomena as described primarily in the maritime industry.

The program of research is supported by the Safety and Education Plan of the District 2 Marine Engineers Benevolent Association-Associated Maritime Officers (AFL-CIO). The reporters are all members of this association and have volunteered after being contacted through the association.

All masters and first class pilots who sail the Great Lakes and are members of the Association were invited to participate in this study. A letter (appendix 1) was sent by name to each of those officers (approximately 250 individuals) in April/May 1990, briefly describing the study and asking them to participate. The material was mailed by the MEBA-AMO Safety and Education Plan. Seventeen officers responded in the affirmative (and nine in the negative) with the expectation that the interviews would be conducted during the summer of 1990. Because of personal problems and organizational logistics those interviews were not conducted at that time and were postponed until February, 1991. In August, 1990 a letter to that effect was sent to all who responded with a request that they reply again in the affirmative if they would be available in February 1991. Of those, twelve responded again in the affirmative. Two individuals were not available, one in Florida and the other in Arizona during the interview process.

Field Procedures

A. The principal interviewer is Doward G. Douwsma who is a former naval officer and who has been responsible for management training of Great Lakes mariners for over fifteen years. He is a candidate for the Ph.D. degree.

B. All interviews will be audio taped provided the subject concurs. Those tapes will be coded by random number and will not be identified as to subject name or city of interview. Access to those tapes will be limited to the researcher, the researcher's associate and members of the doctoral committee. The names of the subjects will not be released to anyone. Anonymity beyond the researcher is guaranteed and confidentiality of data is also assured.

C. Of particular concern in this research is the issue of subject confidentiality and ethics. All subjects have volunteered to tell their stories. All subjects will be given the opportunity to review the general nature of the researcher's notes of their experience prior to completion of the research and its publication. All subjects have been promised a copy of all of the stories following acceptance of the work.

D. All interviews took place at a location acceptable to the reporter. This included their homes, public restaurants, and motel reception areas. The reporter, the researcher, and on occasion the researcher's associate were the only people within hearing distance.

E.. The experiences of the reporters were transcribed from the audio tapes. The only editing was to assure clarity, especially for readers with a non-maritime background.

F. The demographic data, recorded at the time of the interview, has not been included so as to protect the anonymity of the reporters [the community of licensed mariners on the Great Lakes is quite small].

G. The interviews took as little as one hour and as much as two and a half hours. Each reporter was given an unlimited time frame and the freedom to describe his experiences at his own pace.

H. The researcher raised questions to enhance clarity, completeness, and to get the reporters to articulate their thoughts and feelings. Care was taken to prevent the use of leading or influencing questions.

I. Notes and tapes from the interviews are maintained in the office of the researcher. Those notes and tapes are coded and the actual names of the reporters are maintained in a separate, not contiguous file.

Interview Format

1. Introduction and Purposes

- the Master
- Dow
- purposes
 - Ph. D. degree
 - Master's expertise
 - knowledge and skill
 - teaching others
- use of tape recorder (My preference is to use the voice activated, miniature machine but the choice will be unequivocally up to the Master).

2. Demographics of the Master

- age
- experience
 - Master since when
 - years of other experience
- other

3. The Environment at the Time of the Close Call

- location

- physical conditions
 - time of year/day
 - weather
 - vessel conditions
 - cargo type/quantity
 - size of vessel
 - configuration
 - other
 - other vessel(s)
 - other pressures
4. The Organization of the Vessel Team
- bridge-watch composition/background
 - watch officer(s)
 - wheelsman
 - observers
 - engineroom team composition/background
 - nature of past practice
 - "open/closed" system of relationships
 - "respect" expected/given
 - "vertical/horizontal" system of relationships
5. The Technology/Equipment in Use
- bridge equipment operating
 - bridge equipment not operating
 - engine equipment not operating (I presume that the Master would only know of "failures" not of normal operations in the engineroom.)
6. The Situation Itself ("Near-miss or close-call")
- tell me what happened
 - forward chronology (time sequence from start to finish)
 - backward chronology (the event, back to start)
 - the recognition of the potential collision (forward and/or backward)
 - actions taken/not taken
 - by Master

- by others

7. Personal Conclusions

- "rules" of sailing

- what works

- what doesn't work

- when

- why

- prevention in the future

- lesson to "teach" others

8. Why did this stay a near-miss and not become an accident?

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