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Working Paper 88-17

August 25, 1988
Institute of Governmental Studies
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From Crisis to Community: The 1988 Oil Spill in the Pittsburgh Metropolitan Region

Louise Comfort, Joel Abrams, John Camillus and Edmund Ricci
with
Marcel Dennert, Steven Shussett, Gabriella Lombardi and Art Ting

Interdependence in Community: Strength vs Vulnerability

The complexity of our metropolitan communities generates a stubborn paradox in crisis. The interdependence of the infrastructure systems created to foster productivity in technical, organizational, economic and social functions operates, with equal facility, to transmit distortion, error or neglect. When coupled with a sudden failure in any one system, the interdependence between systems generates a cumulative progression of stress which, unalleviated, can lead to crisis. The characteristics that build strength in an interdependent metropolitan community also create vulnerability to failure. Unrecognized, these points of interconnection between technical, organizational, economic and social systems tend to escalate ordinary error to crisis proportions in contemporary communities. As Charles Perrow (1984) writes, "it is the cascade of ordinary events" that, like dominoes falling in sequence, leads to crisis.

This chain reaction of failure in one system precipitating crisis in related systems was vividly illustrated in the January 2, 1988 oil spill on the Monongahela River. In Floreffe, Pennsylvania, an unincorporated community on the Monongahela River 27 miles upstream from Pittsburgh, a massive storage tank containing nearly four million gallons of diesel fuel collapsed at the Ashland Oil Company's storage site on January 2, 1988.

The incident occurred at 5:10 p.m on Saturday night in the holiday weekend. Dusk was gathering; minimal work shifts were on duty; temperatures were sub-freezing. Assuming normal conditions, the attention of the community had shifted to family and friends.

The spillage of nearly four million gallons of diesel fuel, no ordinary event, triggered subsequent reactions that generated a crisis spanning two weeks, three states and affecting adversely the lives of approximately 830,000 people.[1] No lives were lost and no injuries occurred as a result of the spill. Yet, the cost in hours, equipment and materials, respectively, is tallied in tens of millions of dollars, with a full accounting not yet completed eight months after the event.[2]

Understanding how and where to interrupt the progressive chain of adverse impact in the complex, often tightly coupled system (Perrow, 1984) of metropolitan infrastructure becomes the responsibility of managers of multiple organizations, public, private and non-profit. No single person or organization can do it alone. Each organization is limited in authority, resources and skills. The capacity to respond effectively to a metropolitan event becomes a function of communication and coordination between multiple organizations in the community, many of whom have had no previous experience of common action and have not anticipated the possible requirements for such action.

The burden of effective response shifts from command to coordination in interdependent environments, as managers of

multiple organizations seek to contain damage, generated by a current of events outside their defined areas of control, within their respective arenas of operation. Accustomed to performance in separate arenas, the relevant organizations -- public, private and non-profit -- are able to mobilize the resources, equipment and knowledge needed in response to such a complex event only through combined efforts and reciprocal, professional commitment.[3] Although military tradition prevails in the concept of command espoused for disaster operations, in practice most agencies operate on the basis of shared professional standards, mutual respect and a willing exchange of resources and skills.[4] A critical blend of shared goals, recognition of professional performance, prior experience and personal trust facilitates cooperation among the responsible actors in the uncertain environment of disaster operations.[5] With this basic orientation toward responsible action established, the desired interorganizational coordination is achieved more effectively through providing valid information that allows informed choice than through mandatory or coercive means (Argyris, 1984; Comfort, 1987).

In the dynamic environment of disaster operations, a basic resource for the participating organizations is accurate, timely information, requisite for appropriate action. Access to accurate information and knowledge of the affected environment become critical to the conduct of operations to contain the event, for actions taken to minimize damage in one area of operations may create damage to another, related sector of the

community.[6] Consequently, the impact of failure in a single system spreads in a metropolitan community through the very interconnections established to link organizations and people in a functioning environment.

Theoretical Assumptions

Five basic assumptions underly this analysis of crisis in metropolitan communities. First, crisis in a metropolitan community generates shared risk, as well as shared responsibility to mitigate that risk. Failure in the activities of one organization, pursuing its particular objectives, may threaten the lives, livelihood and well-being of others living in the same community. Consequently, the mitigation of risk becomes the active responsibility of all organizations in the community which benefit from the common facilities and infrastructure established to promote the development of community life.

Second, the interdependence of organizations in a community increases the importance of information in triggering appropriate action in response to crisis. Organizations are both limited and enhanced in their capacity for response through the reciprocal effect of their actions upon other organizations and, conversely, the actions of other organizations upon them (Axelrod, 1985).

Third, timely, accurate information enables multiple actors to take action simultaneously for their own safety and well-being. Without information, the respective organizations are unable to mobilize their resources for prompt action, plan strategically for the most effective use of those resources or

anticipate the likely consequences of the actions of other organizations upon their clientele or areas of responsibility.

Fourth, structuring the content and exchange of information within and between organizations in a community increases the efficiency of response in crisis operations (Comfort, 1988; Cohen, 1981; 1984.) Creating effective information processes is a function of conscious design (Simon, 1969, 1981; Comfort, 1988b:3-21.) Left to chance, multiple opportunities for individual choice tend to engender social entropy in a set of interconnected systems (Bardach, 1977.) Decisions which may be reasonable and justified from a single or immediate perspective may be costly or unjustifiable when viewed from multiple perspectives or over the long term (Linstone, 1986.) Coordinating the action of multiple participants in effective response to crisis, while preserving the opportunity for voluntary choice, is likely to occur only by design (Argyris, Putnam and Smith, 1985.)

Finally, lack of structure in information functions reduces the capacity of community organizations to respond appropriately in crisis situations (Cohen, 1984; Comfort, 1988a.) Left to chance, distortion, inaccuracy and human fallibility compound error in communication in complex systems. Like the childhood game of "telephone," messages sent through multiple parties return to the sender in almost unrecognizable form. Actions based upon miscommunication may be unnecessary, inappropriate, untimely and almost certainly costly to the parties involved. Without design, performance drops in crisis situations under the

urgent constraint of time (Mitchell, 1988.)

These five premises, drawn from the literature and direct observation of disaster operations, inform the following analysis of interaction within and between community organizations in the metropolitan community of Pittsburgh following the January 2, 1988 oil spill.

Interactive Crisis Management in a Metropolitan Community: Three Vignettes of Action in the January 2, 1988 Oil Spill

The phenomenon of interdependence triggering crisis in a metropolitan community is observed in the sequence of emergencies generated by the failure of a single storage tank of diesel fuel at a relatively isolated site on the Monongahela River on January 2. Not one, but at least three major threats to the metropolitan community of Pittsburgh, each requiring separate but simultaneous emergency response actions, were triggered by the tank failure. The cumulative effect of the interactive events upon the community produced crisis, which in turn was mitigated through coordinated action among the participating organizations. The serial progression of crisis through an interdependent community is illustrated by the three separate, but related emergency operations, each with its own command post, personnel, response and information requirements, described briefly below.

The Tank Collapse and Clean-up Problem

When the storage tank collapsed, four million gallons of diesel fuel spilled into the required containment area, splashing over the dikes and into the surrounding environment. Although

the containment moat was built to hold the full amount of fuel stored in the tank, the force of the collapse caused fuel to splash outside the designated area and against the adjoining tanks. Declining daylight masked the enormity of the spill, and sub-freezing temperatures inhibited the clean-up efforts. Response efforts focused on recovery of the fuel, restoration of utilities and prevention of related problems in traffic or transportation in the immediate area. The sub-freezing temperatures ensured that there was little likelihood of fire from the contents of the tank, diesel fuel #2 with a flash point of 50 degrees. The clean-up effort would be massive, but at first assessment, the threat to the immediate population and surrounding area appeared limited. Emergency operations personnel, with cautious relief, began to organize the clean-up activities, expecting to contain the spill at the tank farm site and adjacent properties.

Given the magnitude of the spill, federal action in the clean-up was required. An immediate question arose over which federal agency had jurisdiction to direct the clean-up operations. Federal policy was unclear. If the spill occurred on land, the Environmental Protection Agency, with Region III headquarters in Philadelphia, had responsibility for directing clean-up operations. If the spill affected navigable waters, the U.S. Coast Guard, with a local base in Pittsburgh, would assume direction. In this case, the spill occurred on land, but the fuel was entering the navigable waters of the Monongahela River.

The jurisdictional issue was resolved at 9:15 p.m. when the Coast Guard assumed direction of the clean-up operations as the first federal agency on scene, with the understanding that the Environmental Protection Agency would take over direction when their operations personnel arrived the next morning.[7]

Single digit temperatures indicated that oil entering the river would float. Consequently, emergency operations personnel assumed that current techniques in the clean-up of oil spills on water could be employed. These techniques included the use of booms to trap floating oil in pools, coupled with suction pumps to vacuum the oil into barges on the river. With the entry of fuel into the river, the technology, organization and economic costs of the emergency shifted to a more complex level, requiring different professional skills, equipment, personnel and knowledge than for a land spill only. The Coast Guard, in conjunction with Ashland Oil Company, began to mobilize resources for this operation with the information available to them.

The Gasoline Leak and Evacuation Problem.

Approximately an hour later, a routine check of the spill area at 10:00 p.m. revealed a leak from an adjacent gasoline tank. The force of the collapse had apparently ruptured a pipe from the tank, causing gasoline to mix with the diesel fuel. With a much lower flash point, the leaking gasoline generated a threat of fire to the population in the immediate area. Cautionary action compelled the responsible officials to order an evacuation of Floreffe, a community of 700 residents, and

adjacent areas until the gasoline leak could be stopped.[8] A total of 242 families, or approximately 1200 persons, was asked to evacuate their homes until the threat had been removed (Pittsburgh Post Gazette, January 4, 1988).

At that point, all action on the clean-up of fuel virtually stopped, as local officials sought to place first priority on the protection of the population placed at risk by the heightened possibility of fire. Efforts to determine the appropriate means of plugging the gasoline leak and to carry out that task under extremely adverse conditions continued throughout the night. The leak was finally plugged and residents were allowed to return to their homes by noon on Sunday, January 3, 1988.

With the discovery of the gasoline leak and the ensuing decision to evacuate, a different set of organizational actors assumed active roles in the disaster operations process. An Allegheny County Hazardous Materials Team identified the leak and carried out the plugging operation. Local volunteer fire companies already on scene stood by, prepared for action while Ashland Oil off-loaded the contents of the gasoline tank into a barge on the river. The Pennsylvania Emergency Management Agency activated its disaster assistance procedures. The State Police and Pennsylvania National Guard assisted with the evacuation. The Red Cross set up shelters, and other volunteers arranged food for emergency operations personnel. As the demands of the emergency shifted, so did the information requirements necessary to support response actions and to coordinate the activities of

the multiple organizations and jurisdictions involved.

The Water Contamination and Shortage Problem.

During the ten hours that the attention of the emergency responders was focused on the gasoline leak and evacuation problem, the containment of the spilled fuel lapsed. During this period of time, an undiscovered storm sewer from the adjoining Duquesne Light plant was sucking fuel from the containment pool into the Monongahela River at a steady rate.[9] By daylight Sunday morning, January 3, 1988, an estimated 1,000,000 gallons of fuel had entered the Monongahela River, covering the river with a slick that was bank to bank, six inches deep and seventeen miles long. The fuel had now traveled downriver over two locks and dams, and the tumbling action of the water had emulsified it into the water. The fuel was no longer floating on top of the water, accessible for recovery through booming and suction pumps. It now was emulsified to a depth of eighteen feet into the river.[10] This situation created a new threat to the population of the larger metropolitan area, as two major water authorities for suburbs and sections of Pittsburgh drew their supplies of drinking water from the Monongahela and Ohio Rivers.

Within two hours of the spill, the decision had been taken in consultation with the Allegheny County Health Department to close the water intakes for the Western Pennsylvania and West View Water Companies on the Monongahela and Ohio Rivers. In the early stages of the emergency, officials had anticipated a relatively efficient clean-up of the fuel from the top of the

river. Water intakes, located well below the surface, might be reopened safely when the slick had passed overhead.

The emulsification of fuel through the depths of the river, however, intensified the problem. With oil mixed into the water well below the intake levels, the water companies feared contamination of their filtration systems. Forced to close their intakes to meet odor and purification standards, the water companies faced the rapid exhaustion of their reserves and almost certain loss of water to nearly 400,000 residents in the Pittsburgh Region.

With the threatened loss of water, the issue of public safety re-emerged, as fire departments confronted the consequent restriction in their capacity to fight fire. A new set of actors, agents and policies came into play, as organizations within the metropolitan community struggled to mitigate the newly perceived risk of operating without water. The water districts confronted a major interruption in service and sizeable costs in protecting their clientele from unwarranted risk. Hospitals, schools, businesses, convalescent homes, all dependent upon water to maintain their daily operations, were forced to find alternate sources of water or curtail their operations severely. Governor Casey of Pennsylvania issued an executive order to make water conservation mandatory in areas served by the West View and Western Pennsylvania Water Companies (Pittsburgh Post Gazette, January 6, 1988). The City of Pittsburgh played a major role in assisting its neighboring communities with water supplies and

fire prevention procedures.[11] The media became major actors in the dissemination of public information regarding water conservation and safety. Private companies donated the use of tankers and canned water as a public service.[12] The Pennsylvania Department of Environmental Resources initiated action to assess the impact of the spill on the fish and wildlife in the area. The incident had now broadened its impact to affect hundreds of thousands of people. By any definition, it had escalated to a crisis for the Pittsburgh Metropolitan Region.

Interactive Requirements for Information in Emergency Management

Reviewing the requirements for action within and among the evolving sets of organizations participating in disaster operations, the content and exchange of information become critical for efficient response operations. In particular, the demands for action, and accordingly the information requirements to support that action, shift significantly with respect to the differing decision perspectives involved in the three sets of emergency operations described above.

Five principal decision perspectives are present in each of the three problems addressed. These perspectives are: technological, organizational, economic, legal and ethical. Each of these perspectives will be addressed briefly to illustrate the dynamic processing of information that is required of operations chiefs during the disaster operations process.

The Technological Perspective

The technological perspective is the easiest to identify in the disaster operations process, but it is also very rigorous in terms of information requirements. In the initial spill, it was essential to identify what the material was, how much material was in the collapsed tank, what type of equipment and protective gear were required for safe containment operations, what was in the adjacent tanks and what was the flash point of the spilled fuel. This information was needed to assess the threat to the immediate area and population. Accordingly, the requirements for action engendered by this information mobilized the set of organizations capable of responding to this stage of disaster operations, primarily the local volunteer fire companies, the Mt. Lebanon Hazardous Materials Team and the Allegheny County Emergency Management Agency.

The technical information requirements shifted dramatically as the disaster operations focused on the entry of the fuel into the river. Information regarding the functioning of the water intakes, the water purification standards, the procedures for setting boom and suction operations in place became vital for effective operations. As the requirements for information and action changed, so did the agencies involved. The U.S. Coast Guard, the U.S. Army Corps of Engineers, the Environmental Protection Agency, the contractors engaged by Ashland Oil Company, the local water districts were the organizations activated by the identified needs in the effort to recoup the oil

from the river through the clean-up operations.

The technical requirements shifted again when the water shortage problem emerged. Knowledge of the municipal water systems, location of the hydrants, information regarding water pressure, couplings and valves, the capacity of the reservoirs and the planned interconnections between water systems were vital in maintaining water supplies to the affected communities. Coordinated actions between the City of Pittsburgh Departments of Public Safety, Water, Public Works and General Services, the Allegheny County Departments of Health, Maintenance, and Emergency Management and the affected water authorities depended upon access to technical information and professional skills to carry out an extraordinary program of water supply within hours of notification of the problem. Conversely, lack of access to these types of information restricts the alternatives for action available to emergency operations personnel. Gaps in the transmission of information between the participating organizations, likewise, hinders the collective capacity for action. Under the constraints of time and resources characteristic of disaster operations, timely, accurate information provides the basis for common action.

The Organizational Perspective

Having determined what action to take based upon informed technical assessments, disaster operations chiefs needed to mobilize the equipment, materials, personnel at the appropriate locations and in sufficient time to reduce the threat to the

community. The information requirements for this perspective shifted to the identification of personnel, resources, materials, locations, and local facilities available for use in disaster operations as well as the means of coordinating multiple actors and agencies in this complex operation.

Returning to the tank collapse and clean-up problem, the organization of this effort was led by a Regional Response Team, composed of representatives from the major participating agencies: the Environmental Protection Agency, the U.S. Coast Guard, the U.S. Army Corps of Engineers, the Pennsylvania Emergency Management Agency, the Pennsylvania Department of Environmental Resources, the Allegheny County Departments of Emergency Management, Maintenance, and Health. Cleaning up the river required a pooling of personnel, equipment, materials, knowledge and skills to perform particular tasks at specific times and locations. Only through the timely, accurate exchange of information among the responsible agencies could these tasks be carried out. Uncertainties or gaps in information caused delays in action that affected the evolving course of the crisis.

As attention shifted to the gasoline leak and evacuation problem, the information requirements for organizing the evacuation also shifted. Where could shelters be set up, what provisions could be made for transportation, what transportation routes would be affected, who would inform the residents by what means? The Pennsylvania Emergency Management Agency, the Red Cross, the local public officials and volunteer organizations needed to

coordinate their actions based upon information shared between the respective agencies. The efficiency of their operations was directly related to the accessibility of essential information.

The information requirements for the organizational perspective changed again as the crisis moved into the water shortage phase. The extraordinary task of mobilizing a water supply network for 80 affected communities was accomplished through the active exchange of information among local fire departments, the City of Pittsburgh Departments of Public Safety, Public Works, Water, the Allegheny County Departments of Emergency Management and Maintenance, the water districts and the media. What alternatives were available, what needed to be done, who could do it, what equipment was available, what additional risks would be incurred all were questions that required the interactive exchange of information among the responsible organizations.

The capacity for taking collective action in the metropolitan community, where time, geographic distance, and resources are crucial factors in determining the effectiveness of crisis response operations, depends upon the timeliness, accuracy and adequacy of information shared among the participants.

The Economic Perspective

Both technical and organizational requirements for action attach specific costs to the disaster operations. The economic perspective is important, for it both limits and facilitates action. An important factor that facilitated rapid action was the statement by Ashland Oil Company that it would pay for the

clean-up costs. Early in the disaster operations process, Ashland announced that it had a $400 million dollar insurance policy that would cover operational costs incurred by organizations as a result of the spill (Pittsburgh Post Gazette, January 7, 1988). This statement, accepted in good faith by participating agencies, enabled them to take action required to restore operations and minimize new threats to the community without jeopardizing their operating budgets for the coming year.

The economic perspective continued throughout the duration of disaster operations and the recovery period, as agencies sought to assess their costs accurately and the Company sought to establish regular procedures for the submission of claims. In August, 1988, accounts were still unpaid to public agencies, as negotiations over appropriate expenses continued between the Company and the participating agencies.[13] The calculation of costs and the reimbursement process function on the basis of valid information, and the acquisition, processing and transmission of information to support these decisions become critical components of the disaster management process.

The Legal Perspective

The critical role of the legal perspective in this case is illustrated most aptly by the negotiations between the U.S. Coast Guard and the U.S. Environmental Protection Agency (EPA) over the coordinating role for the disaster. Each agency was ready to fulfill the legal requirements for its role; neither wanted to infringe on the responsibilities of the other. Each agency would

likely define the operations process within its own framework of procedures, resources and skills. The situation, however, did not fit the action responsibilities as outlined in the law.

Finally, the situation demanded action, and the agency with the most immediate capability to act, the Coast Guard based in Pittsburgh, assumed the coordinating role, with the agreement that the EPA would take over upon arrival on scene the next day.

The same issue was raised in other phases of the disaster operations, where agencies, with the capability for action, waited for others who had the legal right to act.[14] The cost in time to resolve legal issues of authority is critical in the urgent phase of disaster operations. The information requirements for the legal perspective involve not only what is the law, but what situations differ significantly from the existing law in their demand for immediate action. Determining the legal basis for action in complex metropolitan crises during disaster operations can constrain, as well as facilitate action in disaster operations. The logic of disaster operations requires a flexible interpretation of authority that supports immediate action toward the shared goal of protection of life and property, with provision for careful feedback on performance and correction in process (Comfort, 1987.)[15]

The legal perspective affects the sensitive area of relations between public and private organizations. In this case, questions regarding the degree of compliance by the private organization, Ashland Oil Company, with existing legal codes

enforced by public organizations are further complicated by questions regarding the sufficiency of the codes. Decisions regarding what information to share, what to record and what changes in information processing and dissemination are necessary regarding the storage of hazardous materials in a metropolitan community are critical in the development of constructive relations between public and private organizations in the community. When these questions are unclear or inappropriately defined, information processes may be constrained through fear of legal liability that hinders interorganizational problem solving rather than facilitates it.

The Ethical Perspective

The ethical perspective is at once the dominant perspective and the most difficult to define in disaster operations. The overall goal, protection of life and property in the community, is clear and virtually unanimously shared by all participating organizations, public, private and non-profit. The difficulty lies in translating that general goal into specific choices by particular organizations in the uncertain environment of disaster operations. Much of this difficulty lies in the availability of relevant information to the parties involved, the accuracy and timeliness of that information.

Questions of ethics arise particularly in the uncertain choices regarding the impact of threatening events on the larger community (Douglas and Wildavsky, 1982). In each of the operational problems described above, decisions had to be made

regarding the protection of citizens, other organizations and the environment from the impact of the spill. What information is relevant, necessary and accurate for dissemination to the affected community -- residents, institutions and businesses-- becomes critical in defining the community's capacity for response to disaster.

Towards Community: The Development of an Interactive Information System in the Metropolitan Pittsburgh Region

Responsible action in an interdependent community is informed action, and a vital means of increasing the capacity for action within and between organizations is to increase the content and exchange of information that enables organizations to take action simultaneously to protect their own lives and property. Through the conscious design of an interactive information system, the responsible organizations in a community can increase their collective capacity for informed action in crisis, or better yet, to minimize the conditions that lead to crisis. As our metropolitan communities become more complex and more interdependent, our means of minimizing hazards, or reversing a chain of destructive interaction that may lead to crisis, requires a new mode of organizing community response and a new concept of shared responsibility.

Implicit in the concept of shared risk and responsibility is the premise that as people learn, so do organizations. The design of an interactive information system that addresses the content and exchange of information needed to coordinate action

decision-makers is increased through an interactive information system, the efficiency of decisions made in disaster operations is also likely to increase.

Returning to the Pittsburgh Metropolitan Region, the design and development of an interactive information system, carefully conceived and implemented, would serve as a model in disaster management for other multijurisdictional communities. If the model of a metropolitan emergency management system can be developed successfully in the Pittsburgh Region, with its multihazard vulnerability and complex set of interjurisdictional relationships, it may prove applicable to other metropolitan regions across the nation.

NOTES

We express our appreciation to the Pittsburgh Foundation for its financial support of this study. We also thank the 35 operations service chiefs from local, state and federal agencies who gave their time and insight into disaster operations in a series of interviews conducted in the Pittsburgh Metropolitan Region during late July-August, 1988. For reasons of professional confidentiality, we do not cite them directly, but their experience and thoughtful reflection substantively inform this analysis.

We also thank the University Center for Social and Urban Research, the Graduate School of Public and International Affairs at the University of Pittsburgh and the Institute of Governmental Studies, University of California, Berkeley for administrative support for this study.

within and between public, private and non-profit organizations in a metropolitan community both reduces shared risk and increases informed acceptance of shared responsibilities.

One means of addressing this problem is to develop a demonstration model of an interactive information system in a practicing emergency management context. Such a project would combine geographic data, legal requirements, organizational procedures, demographic characteristics and other relevant data to create a "knowledge base" for use in emergency operations in the metropolitan region. This knowledge base would be activated by a computerized set of inference processes to facilitate the search, processing and transfer of information within and between multiple organizations simultaneously.

The primary effect of such an interactive information system upon interorganizational decision-making is to reduce the uncertainty that characterizes disaster operations. Under conditions of uncertainty, research findings show that decisions are made on the basis of a set of "heuristics" or rules of thumb that enable the decision-makers to select alternatives for action on the basis of incomplete information (Kahneman, Slovic and Tversky, 1982). Decisions made under uncertain conditions are likely to be based upon information that is immediately `available', or accepted as `representative' of a larger universe or `anchored' in a specific set of premises that screens out other information (Kahneman, Slovic and Tversky, 1982.) As the timeliness, accuracy and comprehensiveness of information available to

12. Stroh Breweries of Michigan and Anheuser-Busch of St. Louis, Missouri both send tankers of water to the Pittsburgh Region. Pittsburgh Post Gazette, January 7, 8, 9, 1988.

13. Interviews, Operations Service Chiefs, Pittsburgh Metropolitan Region, PA, August 2 - 15, 1988.

14. Interview, Operations Service Chiefs, Pittsburgh Metropolitan Region, PA, August 2 - 15, 1988.

15. The Incident Command System (ICS) developed by the U.S. Forest Service is an example of flexible organization in disaster operations. The ICS, developed as a means of coping with the dynamic wildland fires that occur annually in California, combines the requirement for immediate response with provision for reorganization in a rapidly expanding operations crew. Authority is accepted on the basis of capacity to act, that is, who is first on scene, and experience in action.

1. Observer-Reporter, Washington, PA, January 16, 1988. See also accounts of the spill and subsequent events in the Pittsburgh Post Gazette and the Pittsburgh Press, Pittsburgh, Pennsylvania, January 3 - January 15, 1988.

2. Ashland Oil Co. reported insurance coverage of $400 million to cover the costs of the spill and clean-up, with $2.5 million deductible in initial costs. Pittsburgh Post Gazette, January 7, 1988.

3. Interviews, Operating Service Chiefs, Local Government Organizations, Pittsburgh Metropolitan Region, PA, July 25-August 15, 1988.

4. Interviews, Operations Service Chiefs, Pittsburgh Metropolitan Region, PA, July 25 - August 15, 1988.

5. The importance of informal personal relationships in establishing a basis for mutual trust in the uncertain conditions of disaster operations is acknowledged by a number of authors (Nelson and Yates, 1977; Dror, 1986; Comfort, forthcoming, 1989.) This factor was confirmed in interviews with jurisdictional service chiefs who had responsibility for disaster operations during the 1988 oil spill, Pittsburgh Metropolitan Region, July 25 - August 15, 1988.

6. Director, Department of Public Safety, City of Pittsburgh, Interview, August 5, 1988.

7. Operations Log, U.S. Coast Guard, Pittsburgh, PA, January 2, 1988.

8. Interview, Operations Service Chief, Floreffe, PA, August 4, 1988.

9. Interview, Operations Service Chief, Jefferson Borough, PA, August 11, 1988. See also On Scene Report, Allegheny County Emergency Management, January 2-3, 1988.

10. Interview, Operations Service Chief, Pittsburgh, PA, August 11, 1988.

11. Interview, Volunteer Fire Chief, Crafton, PA, August 10, 1988.

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