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Journal of Hazardous Materials A114 (2004) 15–25

Journal of Hazardous Materials

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Social and political amplification of technological hazards The case of the PEPCON explosion

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Received 3 December 2003; received in revised form 20 August 2004; accepted 23 August 2004
Available online 28 September 2004

Abstract

Using an industrial explosion in Henderson, Nevada, as a case study, this paper examines three main issues: the efficacy of a technological hazard event in amplifying otherwise latent issues, the extent to which the hazard event can serve as a focusing event for substantive local and state policy initiatives, and the effect of fragmentation of political authority in managing technological hazards. The findings indicate that the explosion amplified several public safety issues and galvanized the public into pressing for major policy initiatives. However, notwithstanding the amplification of several otherwise latent issues, and the flurry of activities by the state and local governments, the hazard event did not seem to be an effective focusing event or trigger mechanism for substantive state and local policy initiatives. In addition, the study provides evidence of the need for a stronger nexus between political authority, land-use planning and technological hazard management.

Keywords: Focusing event; Risk amplification; Technological hazards; PEPCON; Industrial explosion

1. Introduction

This paper investigates the public behavioral responses to an explosion at the Pacific Engineering and Production Company (PEPCON) facility in Henderson, Nevada, the social and psychological effects of the explosion and how these and other factors served to amplify the risk of the explosion, and other public safety issues. Also, the study investigates the role of the explosion as a focusing event or trigger mechanism for the amplification of otherwise latent issues and the consequent public demand for substantive legislative action. Finally, the study addresses the implications of the explosion, a technological hazard event, on the relationship between land-use planning and disaster management. In exploring these issues, the paper is guided by three interrelated themes: social and political amplification of risk; the extent to which a local technological hazard event can serve as a focusing event for substantive state and local government policy-making; and the effect of fragmentation of jurisdictional authority in the management of technological hazards.

The disaster at the PEPCON facility in Henderson, Nevada, began at about 11:50 A.M. on May 4, 1988, when workers in the facility's batch house noticed a small fire. The workers attempted to suppress the fire but it rapidly grew out of control. Soon after, three massive explosions occurred that leveled the entire PEPCON facility and the neighboring plant. The explosion was so powerful that it registered 3.2 on the Richter scale on seismographs in California. The explosion killed two people, injured more than 300, and caused widespread damage to many homes in the City of Henderson. Several buildings including schools within or

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doi:10.1016/j.jhazmat.2004.08.020

close to the industrial complex, in which the PEPCON facility was located, experienced substantial structural and non-structural damage. A 20-block area around the PEPCON site and the schools within and adjacent to the industrial site in which PEPCON was located were evacuated. The cloud of toxic smoke emitted from the explosion was fortunately blown high into the air by the force of the explosion, and therefore resulted only in minor breathing problems. However, the uncertainty regarding the toxicity and possible long-term effects of the plume constituted major public concerns in the aftermath of the explosion.

The PEPCON explosion was supposedly caused by ammonium perchlorate, a critical component of solid rocket fuel used in missiles and in the commercial Challenger programs. At that time PEPCON was the sole supplier of the solid fuel oxidizer for the then largest unmanned rocket, Titan IV. PEPCON and Kerr McGee, the only two facilities that produced ammonium perchlorate in the U.S. were located in the same industrial complex in the City of Henderson, Nevada. Henderson once known as Basic Townsite, was a cluster of workers' homes built near the factories that produced war materials and chemicals in the 1940s. After the Second World War, the factories remained and the city grew around it. The industrial complex where several other potentially hazardous facilities were located became an "island" of unincorporated Clark County land surrounded by the City of Henderson.

During the year prior to the PEPCON explosion, several studies were carried out under the direction of the Nevada Nuclear Waste Project Office to assess the potential public/social response to hypothetical accidents at the proposed Yucca Mountain nuclear waste repository in the State of Nevada. While the PEPCON explosion is not a radiological incident, the explosion provided an in situ opportunity for investigating how community residents, the media, government agencies including emergency response organizations would respond to industrial accidents/explosions within the metropolitan area of Clark county, Nevada. This was largely the motivation behind the selection of the PEPCON explosion for this study.

2. Need for the study

The concept of social amplification of risk, developed and expanded upon by several researchers [1–5] implies that public assessment of the magnitude of a risk depends not so much on the objective or actual scale but on subjective perceptions. The seriousness of the risk of a hazard event is therefore amplified or attenuated depending on how the public perceives the risk. Hence an involuntary risk, such as exposure of a non-smoker to tobacco smoke, may be amplified while a voluntary risk of indoor application of methyl parathion by the homeowner may be attenuated [6]. However, most of the recent research on amplification of risk focuses on the direct and indirect consequences – political, economic, and social of that particular hazard event. There is little information on the role of technological hazard events as trigger mechanisms for amplifying otherwise latent issues that are not even related to the event.

Also, most of the research that examined the agenda-setting capability of hazard events, focused on natural hazards, and on federal response [7], thereby excluding the role of technological hazard events as "windows of opportunity" for substantive state and local governments' disaster management policies. While highly publicized disasters such as Love Canal, Bhopal, the Exxon Valdez oil spill, and the Three Mile Island incident serve as focusing events for substantive national policies [8–10], little is known about the impact of technological hazards in spurring substantive state and local policy initiatives. This dearth of information is unfortunate because the cost of technological hazards is immense, and the placement of industries and the subsequent potential public exposure to toxic hazards is based on land-use planning and local safety regulations that are usually the prerogatives of state and local governments.

Finally, the potential exposure of the public to technological hazards is influenced by the allocation of authorities and/or responsibilities within the intergovernmental system. As Mushkatel and Weschler [11, p. 49] argued "If we want . . . to understand the constraints upon successful implementation of emergency management, we cannot divorce the policy process from the intergovernmental system". While Dillion's rule holds that municipal governments exist only at the discretion of state governments, the constitutional home rule enacted by most states provides substantial autonomy to the local governments.

The autonomy of the responsibility of land-use planning decisions resides almost entirely with local government except for states that have reclaimed part of the plenary powers. This autonomy enhances the ability of local governments to determine the allocation of land for various types of use or activities. The municipal and county governments therefore have the discretion to prevent or allow the juxtaposition of residential and industrial developments, and thereby influence the off-site consequences of technological hazard events. However, within the intergovernmental hierarchy of authorities, the policies or regulations enacted by state governments often supercede those of municipal governments. This implies that irrespective of the efforts of the local government, the stringency of state policy or the level of state implementation of safety regulations may be a major determinant of the efficacy of municipal government's land-use planning decisions.

While formal zoning power is most often exercised by local governments, state governments are pivotal in regulating the activities of industries regarding the protection of public health and safety [12]. The enactment of environmental policies by state governments tend to follow three patterns: (i) state governments may enact policies and/or regulations independent of federal directives, especially in the absence of federal directives, (ii) enact policies based on federal guidelines, implement and/or monitor industry compliance with federal

policies, or (iii) enact policies that are more stringent than federal policies. However, several factors such as interstate competition for industry, inadequate institutional capacity, the financial burden of federal unfunded or under-funded environmental mandates, and complex environmental program requirements may weaken the enthusiasm of states to enact, or enforce stringent environmental regulations [9]. Also, the formal zoning power exercised by the local governments is reduced considerably by extra-governmental influences such as business and other pro-growth interests [13].

3. Review of the literature

3.1. Disasters as focusing events

Past research [7,14,15] pointed out that disaster management has a low political priority and public salience until a disaster occurs. Each of the 128 laws passed by Congress between 1803 and 1950 was enacted after a specific disaster [16], and as much as two-thirds of the principal disaster relief laws passed since 1950 have been direct results of specific disasters [17]. Even when a disaster of technological origin occurs, Lawless [18] argued that unless the technological risk event is exceptionally threatening, public concern over the event is rarely intense enough to lead to the enactment of a new regulation or a substantial amendment to an old one. Birkland [7] argued that the interest generated as an aftermath of a disaster fades rather quickly until the next disaster rekindles the interest. Birkland [7, p. 224] drew an analogy and stated that "If generals are said to be ready to fight the last war, disaster policy seems to be geared to respond to the last disaster".

Nonetheless, a disaster can serve as a focusing event and thereby provide a window of opportunity for enhancing the salience of a particular issue or other issues in the public safety domain [19]. Such focusing events may subsequently trigger intense demand from the public, public interest groups, and the mass media for institutional responses to the disaster and to public safety. As an example, the 1984 chemical plant leak that killed more than 2000 people in Bhopal, India, spurred the enactment of a community-right-to-know law as part of Superfund Amendment and Reauthorization Act [9]. Also, the accident at Three Mile Island in 1979 served as a strong focusing event for nuclear safety initiatives [8]. Different types of disasters, however, generate different levels of public interest and therefore have different amount of impact on the institutional agenda. Even, similar types of disasters may exert different influences on the congressional agenda. The analysis of the agenda dynamics of hurricanes and earthquakes, both natural and apparently similar types of disasters, showed that earthquakes for which less information is available have a greater influence in generating public policy outputs [7].

However, unlike natural hazards that are viewed as "acts of God", technological hazards are perceived by the public as being more controllable or avoidable through governmental public safety programs [20]. Consequently, technological hazards tend to generate more public activism and greater demand for government action. Within this context, Rogers [21] observed that public concern and activism over a chemical plant fire ignited by lightning – "an act of God", was relatively lower than the controversy and citizen political activism over a proposed hazardous waste facility – a technological hazard. Furthermore, the public often identifies a perpetrator with a technological hazard, often resulting in an adversarial relationship between the "perpetrator" and the victims of the hazard [13,22]. Such adversarial relationships often lead to heightened emotional response and sustained political activity, and public demand for governmental regulatory action.

3.2. Risk amplification

In many instances, public outrage and demand for governmental action may go far beyond the actual magnitude of the impacts of the hazard event. The "crude" output measures – fatalities and property damage – of a hazard event may be less relevant than the subjective social and cultural factors in spurring outbursts of public concern [2,23]. In the parlance of the social theory of risk, the process of the disproportionate public reaction is referred to as the social amplification of risk [2]. The phenomenon implies that a relatively minor risk or hazard event may elicit much stronger public reaction and consequent public demand for substantive political actions than is warranted by the "actual" consequence of the event. Slovic [4, p. 230] posited that the "minor" hazard event can be likened to a pebble dropped in a pond whereby "the ripples spread outward, encompassing first, the directly affected victims, then the responsible company or agency, and, in the extreme, reaching other companies, agencies or industries". The policy implication is that the amplification of the risk of a relatively minor event can serve as a trigger for significant institutional agenda activity, and active and serious consideration of political decision-makers.

Past research suggests that several factors may account for the disproportionate public reaction to technological risk. These factors include the disruption of people's valued social fabric, and the perception that the event is the beginning of a sinister trend and a signal for future catastrophes [2,4]. Other factors include public perception of incompetence, ineptitude and negligence on the part of public and private risk managers responsible for preventing or controlling the hazard event [25], and the perception of betrayal of public trust by the public and private institutions charged with controlling risk [25]. Amplification of the risk of a technological hazard event and of public concern may be due to the uncertainty about the cause of the hazard event, the quantity of the substance and the level of its toxicity. The uncertainty regarding the quantity and toxicity of the chemical involved in a PCB warehouse fire not only amplified public perception of the risk, but also engendered the community residents' anger at the government [26].

Other factors that may amplify risk include extensive media coverage of the hazard event and the dissemination of inconsistent, conflicting, and inaccurate information to the public [27,28]. Barnes [29] contended that inaccuracies and inconsistencies in the communication process may lead to rumors and speculations, and subsequently increase public sensitivity and anxiety over a hazard event. Also, failure to disclose key pieces of information may create a credibility gap and public mistrust that may amplify public perceptions of the risk of a hazard event [29].

With respect to the impact of mass media coverage, Horlick-Jones [23] argued that since disasters are rare events, they tend to become newsworthy, and attract substantial number of readers, listeners and viewers. The ensuing public's thirst for information about a disaster provides the media with opportunities to substantially influence and shape public attitudes about the disaster.

Extensive and sensational post-disaster media coverage can heighten public perceptions and amplify the issue of public safety, and may serve as leverage for expanded or new disaster planning policies and programs [30]. Readers of newspapers characterized by higher coverage of technological hazards were observed to have not only more negative attitudes towards these risks, but were also more concerned [31]. The significance of the media in the dissemination of hazard information, and facilitating the movement the issue on to the institutional agenda should not be underestimated. Sood's [32] contention that many decision-makers rely heavily on the mass media as a critical source of information about hazard events seems validated by Birkland's [7] observation of a link between news media coverage of earthquake disasters and congressional activity on this natural hazard.

3.3. Behavioral response to hazard events

Some of the major determinants of public behavioral response to a hazard event are the characteristics of the hazard [33–35], and the characteristics and the extent of public belief in the warning information [36–38]. The characteristics of hazard events that are relevant to public response and behavior include speed of onset, scope, intensity and duration of impact, and the existence of environmental or physical cues such as smoke and explosion [34]. Hazard events with rapid speed of onset and visual or physical manifestations tend to result in high levels of perceived risk, public concern for health and safety, and immediate and extensive public response [34]. Such events may therefore serve as focusing events for public activism and demand for government action.

The characteristics of warning information that affect public reactions are: specificity [27], consistency [28], frequency of delivery of warning messages, availability of avenues for information confirmation [37], and level of public trust in the information source [38]. Technological hazard event information that is specific, consistent, frequently repeated, confirmed, and comes from a trusted source tends to generate a higher level of public belief. On the other hand, inconsistent and uncertain information about a hazard event has been identified as a factor of risk amplification [26].

3.4. Information seeking and information sharing

Public reactions to a hazard event include seeking and/or sharing information about the nature of the hazard, the severity of its impact, and where and why the hazard event occurred. Public response to a hazard event depends in part on the information received about the event, the credibility of the information source, and the extent to which the information source can be trusted. Major sources of such information include mass media, social network groups such as friends, family members and neighbors, emergency management officials and first responders such as firefighters, police and other law enforcement officials [34,36,39]. Past research, however, suggests that the relevant sources of information depend in part on the characteristics of the hazard event [34,36], and that social network groups are major initial sources of information about hazard events that develop fast and occurs in a focused area [39].

4. Methodology

This paper utilizes both qualitative and quantitative research methods to examine the amplification of risk emanating from the PEPCON explosion, to analyze public perception of the risk, the extent to which the explosion serves as a focusing event and subsequent public demand for public policy action, and to investigate the effect of fragmentation of jurisdictional authority on the management of technological hazards. The quantitative component comprises a telephone survey of a random sample of the residents of the City of Henderson, Nevada, completed on June 10, 1988, about 5 weeks after the hazard event.

The survey covered issues such as public awareness and response to the explosion, and social and psychological impacts of the hazard event, the amplification of the risks associated with the explosion and the subsequent amplification of otherwise latent issues. Factors of issue amplification included in the survey relate to: the interpretation of event as a cue for further and even worse catastrophes, the inconsistency of media information, and public perception of negligence and ineptitude on the part of PEPCON and public officials.

The survey utilized a random digit dialing (RDD) procedure method to select households included in the study. The RDD method produces a proportionate stratified sample based on the distribution of residential telephones by exchange and geographical areas. A screening call was made to each telephone number in the sample to determine whether or not the number was legitimate. A legitimate number was one that represented a residential household. Screening calls that yielded busy signals or no answers were not automatically replaced. Instead, at least 10 calls were placed to each of such numbers. Once a telephone number was determined as being

legitimate, an adult (18 years or older) from within that household was selected using a modified version of Kish Selection Tables. The Kish Selection Tables allowed for randomization thereby eliminating gender or any other demographic bias. A random sample of 250 persons was selected, and from this sample, 171 completed interviews were obtained, a response rate of 68%. The sampling error was ±4.5.

The qualitative element of the research focused on the extent to which the hazard event serves as a trigger for the amplification of otherwise latent issues such as the limitations of state health and safety regulations, inter-jurisdictional authority over the industrial complex in which PEPCON is located, and on the role of the federal government in the management of the local technological disaster. This phase of the research involved extensive interviews with key public agency personnel and elected officials that were integrally involved in management of issues that developed as a result of the explosion. The qualitative phase also included reviews of documents such as public meetings, city council meetings and the findings and recommendations of the Commission set up after the explosion. Other information sources include relevant articles that appeared over a 20-week period in the Las Vegas Review-Journal – a major newspaper in Las Vegas metropolitan area. The newspaper articles that appeared after the explosion were particularly useful in the identifying issues that were raised, how and by whom the issues were raised, as well as providing information regarding issue resolution.

The use of the media for this phase of the study was considered appropriate in view of the observation by Lindell and Perry [30] that the media provides a substantial amount of documentation of disaster events and the aftermaths. Also, content analysis of media coverage was used by past research to determine sources of amplification of risk [2], to define stages of post-disaster recovery [40], and to investigate the amplification and the attenuation of the issues that emerged subsequent to a technological toxic event in Central Phoenix [13].

5. Results and discussion

About 39% of the respondents have resided in Henderson between 1 and 5 years while 25.1% have lived in Henderson between 6 and 10 years. Almost 16% have lived in Henderson between 11 and 20 years, and as much as 20% have lived in Henderson for more than 20 years.

5.1. Information seeking and/or sharing

The survey instrument asked respondents to indicate the contacts made with various individuals and/or institutions during the first 15 minutes after the explosion. The responses to this question show that 81.3% of the respondents attempted to contact friends, family members and other relatives to share and to seek information about the explosion. Only 8% turned on the television or radio for information about the explosion first, about 5% contacted the police department and about 4% contacted a hospital. These reported actions suggest that immediately after this explosion, information exchange was predominantly between friends, neighbors and relatives, and that reliance on the mass media was minimal. These findings are similar to past research [34–36,39] which noted that hazard events that occur suddenly and rapidly, usually set in motion direct dissemination of information through social network groups rather than through the mass media.

5.2. The explosion as a focusing event

Several factors that may facilitate the focusing event capability of a hazard event were investigated in the questionnaire. Such factors include physical manifestations of the event, type of public concern, and public perception of ineptitude of public and private officials regarding the protection of public health and safety. The level of public perception of officials' ineptitude was investigated by finding out public viewpoints regarding whether or not the explosion could have been prevented, and also, how the explosion could have been prevented.

The PEPCON explosion was characterized by a rapid onset, i.e., minimum time elapsed between the event and its manifestation, and was accompanied by strong physical cues such as the smoke and loud and earth-shaking sound. These physical manifestations seemed quite strong as most (91.9%) of the respondents became aware of the explosion because they either saw the smoke or heard the sound. Also, most of the respondents (90%) were aware of the blast within 15 min of its occurrence and almost all (98.9%) were aware of the blast within 30 min, notwithstanding that 52 of the 171 respondents were in Las Vegas, 12 miles away, at the time of the explosion. Hazard events that are characterized by rapid onset and accompanied by visual and physical cues usually engender immediate and extensive public response and can serve as focusing events for public demand for action [34,35].

Regarding the type of public concerns within the first few minutes of the explosion, Table 1 shows that the con-

Table 1
Issues mentioned by the respondents as first concerns

Issue of first concern	Frequency	Percent[a]
Safety of self/family	96	57.5
Safety of others	24	14.4
Information on explosion	15	9.0
Damage to home	12	7.2
Toxicity of cloud	7	4.2
Safety of animals	4	2.4
Other consequences of explosion	4	2.4
Possibility of more explosions	2	1.2
Other safety issues	2	1.2
Effect on air quality	1	.6
Total	167	100.1

Percent exceeds 100 due to rounding.
[a] Percent of responses to the question.

Table 2
Respondents' viewpoints as to whether explosion was preventable

Viewpoints	Frequency	Percent
Explosion was preventable	128	74.9
Not sure if explosion was preventable	38	22.2
Explosion was not preventable	5	2.9
Total	171	100

cerns mentioned are their own safety or the safety of members of their immediate families (57.5%), the safety of others (14.4%), cause of explosion (9.0%), and damage to homes (7.2%). Other concerns mentioned are the toxicity of the cloud (4.2%) and secondary effects of the explosion (2.4%). Overall, the respondents' concern for human health and safety accounted for almost 80% of the total responses. Also, almost 65% of the respondents who had children in schools at the time of the explosion physically tried to find their way to their children's schools, while 30% tried to contact the school by phone immediately after the explosion.

These responses indicate that the public seemed to be highly concerned about personal safety and the safety of family members and that the PEPCON explosion is perceived as being highly threatening. Issues such as the cause of the explosion, and property damage were of secondary importance as the most immediate concerns. Hazard events that generate public health and safety concerns often serve as focusing events and subsequent public demand for government action [34].

When asked whether or not the explosion could have been prevented, Table 2 shows that 128 respondents (74.9%) stated that the accident could have been prevented, 22.2% indicated they were not sure while only 2.9% stated that accident was not preventable. Another question requested for respondents' viewpoints as to how the accident could have been prevented. The responses depicted in Table 3 show that of the 125 who responded to this question, 95 (76%) mentioned better or stricter safety procedures/inspection, 13 (10.4%) mentioned better equipments, five respondents (4%) mentioned contingency plan while relocation of plants was mentioned by three respondents.

These responses suggest that the respondents perceived the explosion as a patently human error and that the explosion could have been prevented through better safety procedures, and stricter inspection standards and procedures, thus implying a public perception of negligence and ineptitude on the part of PEPCON and government officials. Public perception of negligence and ineptitude of private and public risk managers will not only facilitate the focusing event capability of a hazard event, but also serve as a factor in issue amplification [24] (see Table 4).

Table 3
Respondents' viewpoints regarding how the accident could have been prevented

Viewpoints/suggestions	Frequency	Percent[a]
Better/stricter safety inspection procedures	95	76
Better equipment	13	10.4
Contingency plan (not specified)	5	4.0
Relocation of plant	3	2.4
Others	9	7.2
Total	125	100.0

[a] Percent of responses to the question.

Table 4
Respondents perception of the possibility of another explosion

Level of possibility	Frequency of mention	Percent
Certain	9	5.3
Highly likely	41	24.0
Likely	53	31.0
Highly unlikely	12	7.0
Unlikely	47	27.5
Never	3	1.8
Do not know	6	3.5
Total	171	100.1

Percent exceeds 100 due to rounding.

5.3. Issue amplification

Some of the factors of issue amplification investigated in the questionnaire include whether or not the public perceives the explosion as a signal for future catastrophes, public perception of incompetence, ineptitude and negligence on the part of PEPCON and public officials, and whether or not media information is perceived as being consistent. Most (60.3%) of the respondents indicated the possibility of another explosion as "certain", "highly likely" or "likely", while 36.3% thought that the possibility of another explosion was "unlikely", "highly unlikely" or would "never" occur, while 3.5% indicated that they were not sure. These observations depicted in Table 4 suggest that a majority of the public perceived the explosion as a signal of future explosions or mishaps.

To reiterate earlier discussions in this paper, media information that are inaccurate, inconsistent, and conflicting have been identified as factors of issue amplification [27,28]. The survey instrument includes an investigation of respondents' assessment of the information received from the media about the explosion. The result (Table 5) shows that of the 169 respondents to this item, a majority (108 or 64%) of the respondents indicated that media information changed or changed a great deal, 36.1% indicated that the information did not change much, none of the respondents indicated that the in-

Table 5
Respondents' perception of the extent of change of media information

Extent of change	Frequency of mention	Percent[a]
Changed a great deal	54	32
Changed	54	32
Changed but not much	61	36.1
Did not change at all	0	0.0
Total	169	100.0

[a] Percent of responses to question.

formation did not change at all. These results suggest that the information received from the media is inconsistent, and could therefore not be relied upon. The inconsistency of media information may have left the public confused and also amplified the public perception of the risk of the explosion.

5.4. Qualitative analysis

The qualitative analysis component of this study shows that the explosion quickly amplified three major, although latent issues that had the potential for triggering substantive policy changes. These were: the controversy regarding the political jurisdictional authority over the industrial complex, the perceived deficiencies of the State of Nevada's safety regulations and standards, and the acrimony between the federal government and the State of Nevada regarding the proposed siting of nuclear waste repository in Yucca Mountain. The jurisdictional authority over the industrial complex where PEPCON was located belongs to Clark County even though Henderson completely encircles the complex. The City of Henderson lacked the legitimacy or authority for land-use planning and for disaster management regarding the industrial "island", and therefore, could not enact nor enforce any zoning, health or safety regulations on any building within the industrial complex.

After the explosion, the issue of political jurisdiction over the industrial complex surfaced in at least two ways. First there was confusion as to which fire department had jurisdiction over the PEPCON site. Eventually, the city's fire department that arrived first at the scene of the explosion had to defer to their county's counterparts. Second, the lack of city authority over the "island" proved frustrating to the Henderson city council in its efforts to keep Kerr-McGee closed in the days following the explosion.

In the aftermath of the PEPCON explosion, and in response to public concerns about the possibility of another accident involving ammonium perchlorate, Kerr-McGee, decided to temporarily close its operations. However, the company wanted to resume operations 1 week after the explosion, because the company officials determined that their own plant was safe. The company's announcement to re-open was met with intense public protest. The Henderson city council held an emergency meeting to discuss the option of taking legal steps to at least temporarily stop Kerr-McGee from producing ammonium perchlorate at its Henderson plant [41]. More than 100 angry and vocal members of the public showed up at the 30-min emergency meeting, and more than 200 showed up at the council's regular meeting 5 days later [41]. Also, Gov. Bryan threatened legal action to stop the company from resuming production of ammonium perchlorate until the cause of the PEPCON explosion is determined [42].

Aside from the threat of a legal suit, the lack of political authority on the part of the Henderson city council precluded the council from taking any action against the company's decision. Even the option of declaring the plant a "nuisance" and possibly forcing it to shut down requires the cooperation and support of the Clark County Commission to set up a hearing to determine the future of the plant [41]. The explosion therefore brought to the surface the City of Henderson's lack of authority on the industrial complex as a handicap to local decision-making.

The PEPCON explosion also triggered and highly amplified public concern about the perceived limitations of the state's safety regulations and inspections. The most obvious of such limitations was the Nevada state law otherwise known as the confidentiality law that prevents public officials from revealing companies' safety records to a third party including the media and the general public. The Nevada confidentiality law negated the intent of Title III of the 1986 Superfund Amendment and Reauthorization Act (SARA), otherwise known as the Emergency Planning and Community-Right-to-Know Act. The Act requires industries to provide public access to information regarding toxic materials manufactured, used or stored and to report the annual emission (chemical releases into the air, discharge to surface water, and on-site land disposal) as toxic release inventory (TRI) [9].

The TRI, a public right-to-know policy, has been acclaimed as providing a strong incentive for companies to voluntarily devise strategies designed to reduce accidental and incidental release of hazardous chemicals [9]. This "voluntary" effort on the part of industries may have been due to the fear of exposure to public scrutiny, and a potential for subsequent negative public relations. The confidentiality law not only removes the incentive for voluntary self-regulation, but also precludes public pressure that may result from exposing companies with negative safety records. The law thereby deprives the Nevada residents the sense of public control associated with Title III of SARA. Using the loophole provided by the law, PEPCON refused to release its safety records requested by the workers' union, the media and the general public, after the explosion. The records were not released until the Federal government entered into the local safety issue and made the records available to any interested parties. Non-disclosure of key information about a hazard or hazard event creates a credibility gap and public mistrust and a subsequent amplification of the risk of the hazard or of the hazard event [29].

Also, the confidentiality law compromises public safety by preventing the release of information that may be needed to make informed decisions by other government agencies and public decision-makers. For example, following a United Steel Workers' Union complaint in 1983, the state inspectors found dangerously high levels of hydrogen gas at PEPCON. Because of the confidentiality law, this information – high levels of hydrogen gas – was not made available to the county commissioners when they approved a plan to build 1200 homes near the plant. As it turned out, however, the homes were never built and a potentially dangerous situation was unknowingly averted [43].

Also, the unearthing of the confidentiality law shows that at the time of the explosion, both the state and county or local governments had not complied with another requirement of

SARA Title III – that states and local governments must establish State Emergency Response Commission (SERC), and Local Emergency Planning Committee (LEPC), respectively, to evaluate and act on extremely hazardous substance (EHS) reports obtained from industries. Other state safety regulatory deficiencies amplified by the explosion included the fact that detailed fire and evacuation plans and comprehensive safety inspections of industries were not required by state law.

Safety inspections of industries were usually undertaken as "walk throughs". A comprehensive safety inspection at Kerr-McGee after the explosion exposed problems that could not have been detected by merely a "walk through". A U.S. EPA inspection carried out after the explosion uncovered excessively high levels of lead at the PEPCON plant site [44]. These revelations of the deficiencies of the state public safety system designed for inspection of industrial facilities are likely to generate lack of public trust in public officials' ability and/or inclination to protect public health and safety.

In addition to these limitations in the state's safety regulations and inspections, there was much confusion and uncertainty regarding the flammability of ammonium perchlorate. PEPCON officials insisted that ammonium perchlorate was not flammable while two chemistry professors at the University of Nevada, Las Vegas, contended that the chemical is flammable. Beall [45] cited a December 1955 edition of Chemical Engineering that the compound (ammonium perchlorate) "is relatively unstable and highly flammable". Nevada state laws only required that companies reveal the names of the chemicals being stored or used by industries; hence the state had no idea as to the characteristics of ammonium perchlorate, and several other chemicals that were being used by industries in the state. The uncertainty regarding the hazardous characteristics of ammonium perchlorate was a factor in the inconsistent information given to the public in the aftermath of the explosion.

Overall, the revelations of infrequent and inadequate inspection of chemical facilities in the state, the state's non-compliance with SARA Title III, and the uncertainty regarding the inflammability of ammonium perchlorate (and probably of several other chemicals produced/stored by industries in the state) are likely to generate public mistrust of public institutions responsible for protecting public health and safety. Public perception of betrayal of trust has been identified as a factor in risk amplification [25].

Apart from the political amplification of the issues regarding jurisdictional authority and the inadequacy of the state safety regulations, the explosion may also have amplified the on-going conflict between the State of Nevada and Federal government regarding the proposed nuclear waste repository at Yucca Mountain in Nevada (Editorial Opinion, 1988). PEPCON and Kerr-McGee, located within the same industrial complex, were the nation's only two producers of ammonium perchlorate required in nuclear missiles. The explosion as earlier noted leveled PEPCON while public protest forced Kerr-McGee to temporarily close its operations and thereby disrupted the nation's production of ammonium perchlorate. Subsequently, the federal government provided economic support for the two companies to restore the production of the chemical by guaranteeing the purchase of at least 20 million pounds of the chemical per year over a 5-year period. In addition, a surcharge estimated at $90 million was provided to help in financing PEPCON's recovery and the anticipated expansion of Kerr-McGee.

While the federal government provided substantial direct and indirect financial assistance to these companies, the Federal Emergency Management Agency (FEMA) denied federal aid to the victims of the explosion because, according to the agency, private insurance companies covered at least 90% of the damages. A rare second damage assessment and an almost unprecedented third assessment still resulted in a denial of the disaster aid. The denial of federal assistance to Henderson households coupled with the federal assistance to the two industries PEPCON and Kerr-McGee amplified the on-going conflict between the Federal government and the State of Nevada regarding the proposed siting of a nuclear waste repository in the state.

The issue was characterized as follows: the state (of Nevada) had for several years borne the burden of the risks associated with federal defense projects — nuclear tests at the Nevada Proving Ground, the location of the nation's two rocket fuel plants, and a proposal to site the nation's nuclear waste repository in Nevada. Notwithstanding these "burdens", the same federal government had now seemingly turned its back on the citizens who needed some assistance for recovery as a result of the damage caused by one of the nation's "defense projects". Also, Henderson residents seemed upset that the federal government provided financial assistance to PEPCON and Kerr Mc-Gee without stipulating any safety factors for the community residents. The feeling of betrayal is best summed up by the following extract from the Las Vegas Review-Journal, "The whole scenario smacked of the same kind of cavalier treatment Nevadans have come to expect from the same federal government that wants to stick us with a nuclear waste dump" [46].

This media link between the nuclear waste repository and federal government's denial of financial assistance to Henderson residents affected by the explosion may have directed public attention to the issue of the repository thereby amplifying the issue and increasing its visibility.

5.5. *Policy response to the explosion*

In the aftermath of the explosion, the Governor established a blue ribbon commission referred to as "Henderson Commission" 'to examine the adequacy of existing regulations pertaining to the manufacture, storage and transportation of highly combustible materials in the State'. The 9-member commission included the Lieutenant Governor as chairperson, representatives of workers' union, and industry, fire department officials, a Clark county commissioner, a U.S. Environmental Protection Agency (EPA) official, and a city manager.

The commission held nine hearings and received testimonies about public health and safety, fire prevention, zoning, insurance, and transportation. The subsequent report emphasized the need for comprehensive information about the use, storage, and transportation of hazardous materials in the state and the need for more frequent facility inspection. The report also condemned the confidentiality law that limited public access to inspection reports and citations for breaching health and safety regulations. Other issues that were emphasized in the report included the need to maintain safe distances or buffer zones between residential areas and hazardous industries and to modify existing laws in order to annex "islands" zoned for industrial facilities.

The City of Henderson set aside $25,000 to train its firefighters to be better prepared for toxic and explosive emergencies. The Clark County commissioners endorsed several proposals including rezoning of hazardous industries away from residential areas, and requiring hazardous industries to obtain conditional use permits to be issued only after comprehensive safety studies. The county immediately began weekly inspection of plants within the industrial complex. In addition, the county earmarked $900,000 for a computerized material database for the storage and transportation of hazardous materials, and $750,000 to be used to create a GIS to inform County departments about land uses. Another positive development was that Kerr Mc-Gee invited the media to tour its facilities, hired an advertisement agency to facilitate the company's involvement with community, and stated that this was only the first step towards openness and disclosure.

6. Conclusions

This case study provides evidence for the contention that a technological hazard event can serve as a trigger mechanism for the amplification of issues that were otherwise latent. Several issues that were amplified by the PEPCON explosion include public safety issues such as the confidentiality law, the fragmentation of political and jurisdictional authority over land use, and the acrimony between the State of Nevada and the federal government over the proposed nuclear waste repository in Yucca Mountain. Public safety issues were amplified by the perceived negligence, and ineptitude of the institutions of state and local governments charged with the protection of public health and safety, and public mistrust of these institutions. Several sources including testimonies at the Henderson Commission, Las Vegas Review-Journal articles, Letters to the Editor and Editorial Opinion, suggest that the confidentiality law was perceived as pro-business and detrimental to public health and safety.

The pro-business stance of Nevada State government is, however, neither an exception nor an isolated case. Subsequent to the explosion, PEPCON decided to relocate, and was considering two locations in Nevada and one location in the State of Utah. Utah aggressively courted PEPCON and the state legislature called a special session and overwhelmingly approved a bill that provided several incentives to PEPCON. The incentives included funds for the improvement of the road leading to the proposed site – Cedar City – sale of the land for the proposed site at below-market price, and a $33 million Industrial Revenue Bond to finance PEPCON reconstruction [47]. Also, residents of Cedar City, the proposed site wholly embraced PEPCON and perceived the company not as a potential hazardous facility, but as an economic blessing. However, in contrast to the city-center location of PEPCON in Henderson, the Cedar City site is 15 miles away from the city. Also, the site is a remote 4800 mountain valley area accessible only by a dirt road and a railroad [48]. The State of Utah and Cedar City residents tend to attenuate the risk of the explosion because of the economic potential of the PEPCON facility and the remote location of the proposed site.

Notwithstanding the amplification of several issues, and the flurry of activities by the state and county governments, the PEPCON explosion did not seem to be an effective "window of opportunity" for enacting substantive state and/or local government policy changes. The confidentiality law, which was the center of controversy and intense media and public concern, was not repealed. Also, the state government did not make any specific statements regarding the full implementation of SARA Title III. However, in contrast to federal risk assessment programs regarding nuclear power plants and natural hazards, the risk assessment under SARA Title III is devolved to state and local governments and as unfunded mandates [8]. In the aftermath of the explosion, the lack of adequate funding and institutional capacity may have hampered the establishment of both SERC and LEPC in Nevada. As noted earlier factors such as interstate competition for industries, inadequate institutional capacity, the financial burden of federal unfunded or under-funded environmental mandates may weaken the enthusiasm of states to enact, or enforce stringent environmental regulations [9]. Such factors may have hampered the capability of the PEPCON explosion in serving as a "window of opportunity" for substantive state and local policies. These observations regarding state and local governments in Nevada are similar to past contention that substantive *federal* policies are rarely enacted regarding a hazard event unless the event is exceptionally threatening.

This case study points to the need to integrate land-use planning with disaster management. The situation whereby a dense urban development, the City of Henderson surrounds existing major hazardous industrial facilities is a disaster waiting to happen. Avoiding the juxtaposition of heavy residential development and major hazard facilities can minimize the off-site consequences of a technological hazard event by reducing the number of citizens exposed to a hazard event [49]. The need to maintain appropriate separation distances between industrial facilities and residential development was also emphasized in the "Seveso II Directive" [50].

However, Henderson residents and the city council were not innocent bystanders as many of the facilities were already in place before the heavy residential development "moved to

the nuisance" thereby contributing immensely to citizens' exposure to technological hazards. While voluntary risks are usually perceived as low [6], the physical manifestations and rapid speed of onset of the PEPCON explosion, and the revelations of the deficiencies of state and local governments' public safety policies may have led to the amplification of the risk of the explosion notwithstanding that these citizens "moved to the nuisance" thereby voluntarily exposing themselves to the risk. In contrast, the observation by Ibitayo [6] of low perceived risk associated with another voluntary risk – indoor application of methyl parathion – was attributed to the insidious and incremental nature of the risk.

Another implication of the PEPCON explosion for land-use planning and disaster management is the adverse effect of locating sensitive land uses such as schools, day care centers and hospitals close to major hazardous facilities. The location of schools within the same complex as PEPCON and other industrial facilities led to convergence as parents flocked to the schools to pick up their children, and jammed the schools' telephone lines in order to obtain information about the welfare of the children. Also, Henderson's lack of political jurisdiction over the "island" ignores the fact that local communities are the ones most at risk and therefore should be involved in decisions that affect their lives. The prevailing arrangement precludes the city emergency management personnel that could conceivably respond faster than the county unit from responding to any hazard event on the "island". The issue of prompt response is critical because in an emergency a swift response may avert more dangerous consequences.

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