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ABSTRACT

Renewed focus on nuclear power—as evidenced by the August 2005 Energy Policy Act—in addition to the recent attention in the legal community to catastrophes—including Judge Posner's 2004 book *Catastrophe: Risk and Response*—set the stage for this evaluation of how our regulatory system reacts to catastrophes such as Three Mile Island and Love Canal. Legal commentators have devised several models to evaluate and describe risk regulation in the United States, and catastrophes provide ideal case studies to test such regulatory models. Unlike the intangible risks and results regulatory agencies normally face, catastrophes produce measurable consequences based on patent failures of the regulatory system. Existing models effectively account for many aspects of the regulatory system's behavior before and after catastrophes. However, the unifying regulatory model proposed herein—the Catastrophe Model of Risk Regulation—provides a more concise approach for regulators, legislators, and legal commentators attempting to understand the tendencies of risk regulation in dealing with catastrophes. Drawing from an analysis of the two catastrophes that are the archetypes of this Catastrophe Model (*i.e.*, the accident at Three Mile Island and the Love Canal incident) and previous risk regulation models, this paper describes the characteristics of the Catastrophe Model of Risk Regulation. The paper also recommends a governmental course of

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action to mitigate the negative effects highlighted by the model. For example, the current regulatory system's tendency to misappropriate personnel and financial resources in the aftermath of a catastrophe may have the unintended consequence of causing a net increase in the risk to the public's health and safety. This result could be avoided if government decision-makers understood the effects of the Catastrophe Model and took proactive measures to create independent bodies to deal with the aftermath of tragedies, in lieu of leaving the affected agencies with the majority of post-catastrophe responsibilities and the burden of internalizing the response cost.

I. Introduction

Although the twenty-fifth anniversary of the accident at Three Mile Island (TMI) has come and gone and the U.S. Environmental Protection Agency (EPA) has completed remediation activities at the Love Canal site and released the site from the Superfund program,[1] both of these sites remain the currency in our society and government for the problems and fears associated with nuclear power and toxic waste.[2] Because the agencies responsible for the regulation of both of these sites, the U.S. Nuclear Regulatory Commission (NRC) at TMI and the EPA at Love Canal, continue to focus on these catastrophes[3] and because nuclear power is again in the spotlight due to the Energy Policy Act of 2005,[4] it is an opportune time to evaluate the regulatory legacy of both events. This paper argues that these events had, and continue to have, far reaching effects on the NRC and EPA's regulatory programs due to a

1. Notice of deletion of the Love Canal Superfund site from the National Priorities List, 69 Fed. Reg. 189 (Sep. 30, 2004).

2. *See, e.g.*, ALLAN MAZUR, A HAZARDOUS INQUIRY: THE RASHOMON EFFECT AT LOVE CANAL at 127 (1998) ("Just as Three Mile Island became the paradigmatic nuclear accident, so Love Canal became the exemplar of the toxic waste dump.").

3. *See, e.g.*, NRC Press Release, NRC Schedules Public Presentation and Webcast on March 3 on Three Mile Island Accident, 25 Years Later (Feb. 18, 2004); Transcript of U.S. Nuclear Regulatory Commission 25th Anniversary of Three Mile Island Unit 2 Presentation (Mar. 3, 2004); EPA's 25th Anniversary Report Appendix: *Disaster Averted: Love Canal on the Road to Recovery*; EPA Press Release, EPA Proposes to Remove Three Niagara County Sites from the Superfund List, (Mar. 17, 2004) ("By taking the Love Canal site off the Superfund List, we will mark a turning point for the nation . . . this was the site that really started Superfund.") (internal citation omitted).

4. *See, e.g., Bush Addresses Nuclear Safety Concerns*, THE ENERGY DAILY, Jun. 23, 2005, at 1 (explaining that President Bush stated, in a speech supporting new energy legislation and new nuclear power plants, that "some Americans remember the problems of the nuclear plants—that the nuclear plants had back in the 1970s. We all remember those days. . . . One of the reasons I've come to this plant is to help people understand the difference between fact and fiction. . . . It is time for this country to start building nuclear power plants again.").

phenomena of risk regulation proposed herein, termed the *Catastrophe Model of Risk Regulation*.

A. The Catastrophe Model

Risk regulation typically occurs at a very deliberate and measured pace; however, when the government is presented with a catastrophe like the TMI and Love Canal incidents, it reacts with a flurry of responses to the risk that caused the catastrophe. Observing the government's reaction to catastrophes over time demonstrates that regulatory advancements often fail to develop along a steady, straight-line trajectory, but instead occur in sporadic leaps, which correspond to notable catastrophes.[5] The Catastrophe Model attempts to describe this phenomenon whereby risk regulation stagnates before a catastrophe and then advances rapidly and haphazardly in the years following the catastrophe.

The negative effects of the Catastrophe Model include a misappropriation of government resources and the distortion of the risk regulation framework. At best, such effects result in wasted assets; at worse, such effects can have the unintended consequence of increasing the likelihood of subsequent catastrophes. To prevent such negative effects government decision-makers need to first acknowledge the behavioral tendencies of risk-regulation depicted herein as the Catastrophe Model. Although it may be impossible to eliminate all of the negative features of the Catastrophe Model, such as those attributable to human nature, it is possible to mitigate the negative effects. For example, Congress should adopt a practice of creating independent bodies with independent funding to deal with the aftermath of catastrophes, rather than letting existing agencies internalize the resource burden of coping with the fallout of a catastrophe, in addition to maintaining their pre-catastrophe regulatory load.

B. The TMI and Love Canal Incidents

As discussed in the body of this paper, the 1979 accident at TMI and the events that played-out over several years at Love Canal were "catastrophes" in that they involved a complete breakdown of the risk regulation systems that were put in place to protect the public health and safety from the dangerous properties of nuclear power and chemical

5. For example, commentators discuss regulation of the environment in terms of *before* and *after* Love Canal. *See, e.g.*, CRAIG E. COLTEN & PETER N. SKINNER, THE ROAD TO LOVE CANAL: MANAGING INDUSTRIAL WASTES BEFORE THE EPA at 1 (1996) (explaining that Love Canal is viewed as a "watershed event").

wastes. The accident at TMI involved a combination of mechanical and human errors, which led to a partial meltdown of the reactor—an outcome that was once believed impossible for a commercial reactor in the United States. At Love Canal, the local government purchased a dumpsite from a chemical company and developed a residential neighborhood and even a public school on the contaminated property. In the years that followed, the chemical wastes including known carcinogens, which were buried at the site, resurfaced in the yards and basements of the Love Canal Community. Although both the TMI and Love Canal incidents resulted in hundreds of millions of dollars in environmental remediation costs and placed individuals in harm's way, essentially no harmful health effects are directly known to be attributable to either incident.

While both events occurred over twenty-five years ago and neither is directly responsible for any physical human injuries, the terms: nuclear accident, meltdown, and NRC remain synonymous with TMI for many,[6] just as the words: toxic dump, Superfund, and EPA are forever associated in people's memories with the incident at Love Canal.[7] Similar to this lasting public memory of TMI and Love Canal, and more pertinent to a regulatory analysis of the two events, is the fact that both the NRC and EPA continue to actively contemplate the incidents in the context of their *current* regulatory programs. In addition to the immediate and near term regulatory changes made in reaction to both incidents, after more than twenty-five years both agencies' regulatory programs continue to embrace the TMI and Love Canal incidents.[8]

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6. *See CNN Sunday Morning, Transcript # 032803CN.V46* (CNN television broadcast, Mar. 28, 2004) ("the words meltdown and Three Mile Island became practically synonymous"); Arthur H. Purcell, *The Lessons Haven't Been Learned; Three Mile Island Didn't Alter Thinking; Will Chernobyl*, L.A. TIMES, Apr. 30, 1986, at 5 ("'Three Mile Island' became the buzzword for nuclear fallibility. . . .").

7. *See* MAZUR, *supra* note 2, at 6 ("Like Three Mile Island, Bhopal, and Chernobyl, Love Canal has become an emblem of technological disaster in the modern industrial age. It is the paradigm example of a community poisoned by toxic industrial waste."); Don Behm, *EPA Says Ackerville Landfill Isn't Likely Source of Pollution*, MILWAUKEE J. SENTINEL, Feb. 19, 2001, at 01B ("Love Canal, a massive industrial waste disposal area near Niagara Falls, N.Y., became synonymous with cleanups of hazardous chemicals. . . ."); Jennifer Shriver, *HAZWOPER Compliance: What It Means to Employers; Hazardous Waste Operations and Emergency Response Standard*, OCCUPATIONAL HAZARDS, Oct. 1, 2000, at 113 ("The Love Canal disaster became synonymous with toxic waste. . . .").

8. *See, e.g.*, NRC Chairman Nils Diaz, Transcript: NRC 25th Anniversary of the Three Mile Island Unit 2 Presentation, Mar. 3, 2004, at 7 ("science and technology revolutionizes our life, but memory, tradition, and myth frame our response. Consequently the 25th anniversary of the TMI accident offers all of us a unique opportunity to revisit the causes and consequences of the accident. It is also a fitting point in time to renew our commitment to the . . . protection of the public's health and safety, and to remind ourselves once again that we have new challenges to meet and old

C. *Overview*

Part II of the paper discusses the TMI and the Love Canal catastrophes and describes the regulatory environment before and after the incidents. Drawing from the TMI and Love Canal catastrophes, which are archetypes of the Catastrophe Model, Part III defines the model in more detail. In addition, Part III provides an overview of other models used to assess risk regulation, including: the old-new division, the public-private division, the availability cascade model, and the concept of agency capture. Part IV discusses *why* agencies follow the Catastrophe Model. In Part V, the paper analyzes the effects of the model. Again drawing from the TMI and Love Canal examples, Part VI of the paper identifies several positive and negative results, which can be attributed to risk regulation influenced by the Catastrophe Model. Finally, the paper concludes with recommendations for overcoming the negative effects of the model.

II. Case Studies

A. *Three Mile Island*

1. Regulation of the Industry before the TMI Accident

When the TMI accident occurred, the NRC had only been in existence for approximately four years.[9] The regulation of nuclear power, along with other related nuclear activities such as the nuclear weapons program were previously the responsibility of the NRC's predecessor agency, the Atomic Energy Commission (AEC). Because the mission of the AEC included promoting the development of nuclear power, it had a stake in nuclear power's success and was not an independent regulator.[10] Similarly, because the AEC was also responsible for the U.S. nuclear weapons program, the agency had an

promises to keep to the American people) (citation omitted). EPA's 25th Anniversary Report Appendix: *Disaster Averted: Love Canal on the Road to Recovery*; EPA Press Release, EPA Proposes to Remove Three Niagara County Sites from the Superfund List, (Mar. 17, 2004) ("By taking the Love Canal site off the Superfund List, we will mark a turning point for the nation . . . this was the site that really started Superfund.") (citation omitted).

9. *See* Atomic Energy Act of 1954, as amended.

10. *See* ROGER J. DUFFY, NUCLEAR POLITICS IN AMERICA at 37 (1997) ("although the AEA of 1954 gave the AEC the responsibility of balancing the goal of stimulating industry growth with the need to assure public health and safety, its actions during the 1950s and 1960s displayed a consistent emphasis on promotional rather than regulatory issues.").

engrained culture of secrecy dating back to the Manhattan Project, substantial independence from other branches of government, and a monopoly over the regulation of the nuclear industry.[11]

Because of these problematic characteristics, the Energy Reorganization Act of 1974 abolished the AEC and divided its responsibilities of promoting nuclear power and regulating nuclear power into two separate organizations, the Energy Research and Development Administration—responsible for the future promotion of nuclear power—and the NRC—responsible only for the regulation of nuclear power.[12] A combination of this new structure and statutory changes focused the NRC on environmental and safety issues and gave more access to the antinuclear movement. Despite these developments, the NRC was slow to evolve into a *new* agency.[13] Many features of the pre-TMI regulatory regime for nuclear reactors were surprisingly lax as viewed from a post-TMI mindset. For example, emergency response plans relied heavily on local action and at the time of the accident at TMI local detailed plans were almost entirely lacking.[14] Similarly, in 1979 the

11. *Id.* at 22 ("from its birth in the highly secretive Manhattan Project, atomic energy was defined and perceived in military terms, which naturally meant that information regarding the bomb was subject to elaborate security precautions. This concern with maintaining the 'secret' of the atom set the tone for the atomic program far into the future."); *id.* at 24 (during the AEC's early years the "Commission had exercised its extraordinary powers almost in a vacuum . . . the Commission's staff and its contractors lived in a world of their own, a world unknown to most of the nation. The President caught only fleeting glimpses of this world, and the Congress was almost totally excluded. The structure and position of the AEC . . . indicated congressional intent that the AEC be independent of the president . . . indeed, lack of presidential interest and involvement was a staple of the atomic program throughout much of its history."); *id.* at 104 (explaining until the late 1960's and 1970's the regulation of nuclear power was completely under the control of the AEC. This changed with laws including the Fish and Wildlife Act in 1966; National Environmental Policy Act in 1969, Endangered Species Act in 1973; and the Clean Air Act of 1977).

12. *See* Atomic Energy Act of 1954, as amended.

13. *See The Report of the President's Commission on the Accident at Three Mile Island, The Need for Change: The Legacy of TMI*, at 19 (Oct. 1979) ("we have seen evidence that some of the old promotional philosophy still influences the regulatory practices of the NRC . . . evidence suggests that the NRC has sometimes erred on the side of the industry's convenience, rather than . . . assuring safety."); DUFFY, *supra* note 9, at 170 ("the NRC was not really a new agency . . . [the Energy Reorganization Act] never entirely displaced the commission's deeply entrenched belief in the value of nuclear power. Part of the explanation stems from the fact that the NRC was essentially a carryover from the AEC in terms of personnel, regulations, and attitudes . . . the NRC's first major policy action was to adopt all of the AEC's rules, regulations, and standards."); *id.* at 235 ("although the Energy Reorganization Act of 1974 replaced the AEC with the NRC, it was unable to completely displace the promotional mindset. Hence, despite significant changes in its political environment, the NRC never became an aggressive regulator.").

14. *See The Report of the President's Commission on the Accident at Three Mile Island, The Need for Change: The Legacy of TMI*, at 15 (Oct. 1979) ("we found an

NRC did not have on-site inspectors, nor did the NRC have direct communication links between its incident response center and the control rooms of operating plants.[15]

In the years preceding the accident at TMI, several minor incidents occurred at commercial power plants. Some of the more notable incidents include: the 1972 discovery of damaged and collapsed fuel rods at the Robert E. Ginna Nuclear Power Plant that could have impaired core cooling in the event of an accident; the 1974 discovery of cracked pipes in Dresden-2 which were leaking emergency coolant; a 1975 fire at Browns Ferry that disabled the emergency cooling units for both reactors at the plant; and a 1977 loss of coolant accident at the Davis Besse plant due to a combination of a stuck valve and operator error.[16] None of these incidents were of the magnitude of the TMI accident nor did they create the political or public outcries for reform, which were later invoked by TMI. However, in hindsight these accidents were very similar to the TMI accident,[17] and should have focused the agency on problems that led to the TMI accident, *before* the accident.

2. The Accident

Beginning on March 28, 1979, a series of events unfolded at the TMI Unit 2 nuclear power plant near Middletown, Pennsylvania, that resulted in the most serious accident in the history of commercial nuclear power in the United States. The accident began with a failure of feed water pumps in the non-nuclear section of the plant, and through a combination of subsequent mechanical and human errors, the initial pump failure led to a loss of coolant in the reactor.[18] A misunderstanding of the conditions inside the reactor containment building and the effects of the failures on March 28 resulted in several days of well-publicized confusion during which the end state of the accident remained unknown by the reactor operators and the government regulators.[19] After a partial

almost total lack of detailed plans in the local communities around Three Mile Island.").

15. *See* NRC Commissioner Jeffrey Merrifield, Transcript: *NRC 25th Anniversary of the Three Mile Island Unit 2 Presentation*, opening remarks (Mar. 3, 2004).

16. *See* J. SAMUEL WALKER, A NUCLEAR CRISIS IN HISTORICAL PERSPECTIVE: THREE MILE ISLAND 63, 66, 68 (2004).

17. *See id.* at 68 (explaining the similarities between the Davis Besse accident and TMI).

18. *See, e.g.*, NRC Fact Sheet on the Accident at Three Mile Island; WALKER, *supra* note 15, at 71-189.

19. For example there was at one time a fear that a "hydrogen bubble" in the containment building would lead to an explosion and a release of deadly radioactive gasses. There was also a similar fear of the "China Syndrome," in which a molten reactor core would have melted through the bottom of the containment building and vaporized the groundwater table. *See, e.g.*, WALKER, *supra* note 15.

meltdown, a release of radioactive gasses, and a partial evacuation of the surrounding town, the accident generally ended on April 1, 1979, when the fear of an explosion of a "hydrogen bubble" was finally resolved and reactor operators and the NRC turned their attention toward completing a cold shutdown of the reactor.[20]

There were no deaths or injuries sustained by plant workers or residents of the nearby community as a result of the TMI accident.[21] The President's Commission on the Accident at TMI later concluded, "the most serious health effect of the accident was severe mental stress, which was short lived."[22] Despite a partial meltdown of the reactor vessel, there were no significant environmental effects of the accident other than minimal radioactive gas releases.[23] The real toll of the accident took the form of property damage. Approximately a billion dollars has already been spent on the cleanup of the TMI facility,[24] and a significant amount of site remediation work and expenditures remain to this day.

3. Response to the Accident

Company officials, state agencies, the Pennsylvania Governor's office, and the NRC performed near-term response actions (*e.g.*, mitigating the damage from the accident and notifying the public) as would ordinarily be expected in such a situation. One aspect of the government's response to the TMI accident, which was extraordinary and undoubtedly shaped the long-term regulatory response to the accident as it transcended the normal response protocol, was President Carter's involvement both during[25] and after the accident.[26] The long-term effects of Carter's involvement include: reinforcing the public perception of the significance of the event and facilitating the development of direct recommendations for industry and regulators through a Presidential Commission.[27] The Presidential Commission's overall conclusion was:

To prevent nuclear accidents as serious as Three Mile Island,

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20. *See id.* at 189.

21. NRC Fact Sheet on the Accident at Three Mile Island.

22. *The Report of the President's Commission on the Accident at Three Mile Island, The Need for Change: The Legacy of TMI*, at 13 (Oct. 1979).

23. *See, e.g.*, NRC Fact Sheet on the Accident at Three Mile Island; WALKER, *supra* note 15, at 71-189.

24. WALKER, *supra* note 15, at 230.

25. *See id.* at 179-83 (discussing Carter's visit to the site).

26. *See, e.g.*, Exec. Order No. 12,130 *President's Commission on the Accident at Three Mile Island* (Apr. 11. 1979); *The Report of the President's Commission on the Accident at Three Mile Island, The Need for Change: The Legacy of TMI* (October 1979).

27. *See The Report of the President's Commission on the Accident at Three Mile Island, The Need for Change: The Legacy of TMI* (Oct. 1979).

> fundamental changes will be necessary in the organization, procedures, and practices–and above all–in the attitudes of the Nuclear Regulatory Commission and . . . the nuclear industry.[28]

Encouraged by these formal recommendations from the President's Commission, along with a more active anti-nuclear movement, which even included members of Congress,[29] the NRC set out on a new regulatory course in the years following the accident. Areas affected by the NRC's widespread regulatory revisions included, *inter alia*, emergency response planning, reactor operator training, human factors engineering, radiation protection, and a general increase and tightening in the regulatory oversight of safety issues.[30] Many of NRC's far-reaching changes were needed, unfortunately *before* the accident, and the agency's decision break from the ways of its predecessor agency was also long overdue.[31] However, the agency's decision to "embrace" the TMI accident as part of its regulatory identity[32] and to make sweeping changes on the basis of a single event[33] are far from the measured growth of a regulatory agency that one might expect under "normal" circumstances.[34] The result of the accident and the subsequent regulatory

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28. *Id.* at 7.

29. *See, e.g.*, DUFFY, *supra* note 9, at 142 ("a number of antinuclear initiatives were introduced in Congress after TMI. . . .").

30. *See* NRC Fact Sheet on the Accident at Three Mile Island, *available at* www.nrc.gov/reading -rm/doc-collections/fact-sheets.

31. Interestingly, the TMI catastrophe had the positive effect of finally forcing the NRC to evolve into a new agency—distinct from its predecessor agency, the AEC.

32. *See, e.g.*, NRC Press Release 2004-23 "NRC Schedules Public Presentation and Webcast on March 3 on Three Mile Island Accident, 25 Years Later" Feb. 18, 2004 (inviting members of the public to a presentation on the Three Mile Island which included speeches by the NRC Commissioners and the NRC's Historian, who recently published a book about Three Mile Island in the context of NRC's history); NRC Chairman Nils Diaz, Transcript: *NRC 25th Anniversary of the Three Mile Island Unit 2 Presentation*, Mar. 3, 2004, at 7 ("the 25th anniversary of the TMI accident offers all of us a unique opportunity to revisit the causes and consequences of the accident. It is also a fitting point in time to renew our commitment to . . . the protection of the public's health and safety, and to remind ourselves once again that we have new challenges to meet and old promises to keep to the American people.").

33. *See, e.g.*, NRC Chairman Nils Diaz, Transcript: *NRC 25th Anniversary of the Three Mile Island Unit 2 Presentation*, Mar. 3, 2004, opening remarks ("Both safety management and emergency preparedness represent areas that were addressed in the post TMI environment and require the licensees' management and our attention. Both have been ***event driven***, but should not have been.") (emphasis added).

34. *See, e.g.*, JOSEPH V. REES, HOSTAGES OF EACH OTHER: THE TRANSFORMATION OF NUCLEAR SAFETY SINCE THREE MILE ISLAND at 32 (1994) (noting the "proliferation of regulatory requirements since the TMI accident" and "how the TMI accident changed the NRC's regulatory posture in some very significant ways"); *see also* Joseph P. Tomain & Constance Dowd Burton, *Nuclear Transition from Three Mile Island to Chernobyl*, 28 WM AND MARY L. REV 363, 414 (1987) ("The NRC's immediate response to TMI was similar to everyone else's—it became alarmed and began to tighten safety

environment was an end to the expansion of the nuclear power industry[35] and a lore[36] that continues to the present day.

B. Love Canal

1. Regulation of the Industry Before Love Canal

Chemical wastes were buried at Love Canal from 1942 through 1953. Although the idea of pouring chemical wastes into unlined trenches in the ground seems unacceptable in the current environmental climate, when the wastes were originally disposed at Love Canal such a disposal method was common practice.[37] Although the beginning of environmental awareness and regulation is commonly held to be 1970,[38] many of the harmful effects of chemical contamination on the environment and public health were understood long before 1970.[39] Similarly, regulations and legal remedies, although not standardized or centralized within federal statutes, also existed prior to 1970.[40]

The Resource, Conservation and Recovery Act (RCRA), passed by Congress in 1976 to regulate a growing solid waste problem, was the most relevant environmental statute in place at the time the problems at Love Canal came to the nation's attention. RCRA primarily focuses on the handling of toxic waste from cradle to grave, with the goal of preventing damage to the environment and human health and limiting

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requirements.").

35. Tomain & Burton, *supra* note 33, at 363-64 ("for nearly a decade, no one has invested in new domestic nuclear plants . . . the transition dates from March 28, 1979, the date of the incident at Three Mile Island. . . ."); *but see* WALKER, *supra* note 15, at 9 (discussing a 1978 business outlook for the nuclear industry which was "so bleak that within ten years it was expected to contract dramatically and it may collapse altogether.") (*citation omitted*).

36. WALKER, *supra* note 33, at 243 ("the accident did not increase rates of cancer or other diseases. . . . Except for the plant itself, it did not destroy or damage property in the region. Nevertheless [because of] the memories of the tension, uncertainty, and confusion . . . the accident is widely recalled as a major catastrophe.").

37. PERCIVAL ET. AL., ENVIRONMENTAL REGULATION: LAW, SCIENCE, AND POLICY, at 166 (2003) ("Many people may have assumed that the ground could act as a kind of bottomless sponge, absorbing without consequences any chemical compounds poured into it. The prevailing philosophy throughout the 1950s and 1960s was out of sight out of mind); *see also* COLTEN & SKINNER, *supra* note 4.

38. *See* COLTEN & SKINNER, *supra* note 4, at 2 ("Before 1970 and the passage of the National Environmental Protection Act, there was no uniform regulation of chemical waste disposal."); PERCIVAL ET. AL., *supra* note 36, at 5 ("The first Earth Day, April 22, 1970, symbolically mark[s] the beginning of the modern environmental era.").

39. *See, e.g.*, COLTEN & SKINNER, *supra* note 4, at 2.

40. *See e.g.*, PERCIVAL ET. AL., *supra* note 36, at 5 ("it is important to understand that in many respects CERCLA represents a natural adaptation of centuries of common law developments as extended by modern environmental statutes").

land disposal to a very narrow set of controlled circumstances. Although it was no secret that a myriad of pre-existing waste sites existed in 1976, the EPA's authority and regulations under RCRA were only designed to prevent future environmental problems and the federal government was generally not equipped to direct remedial cleanups from past operations, on the eve of the Love Canal incident.

2. The Love Canal Incident

In 1892, William T. Love began work on a canal in Niagara County, New York, which was intended to connect the lower and upper Niagara River and create inexpensive hydroelectric power.[41] The project was never completed and the abandoned property was sold at auction in 1920.[42] The area eventually became a dump site when the Hooker Chemicals and Plastics Corporation disposed of approximately 22,000 tons of drummed liquid and chemical wastes in the abandoned canal from 1942 to 1952.[43] In 1953 the Hooker Chemicals and Plastics Corporation capped the canal with soil and sold the property to the Niagara County Board of Education for a single dollar.[44] In the 1950's and in subsequent years, a school and approximately 100 homes were built on the landfill and the immediately surrounding area.[45] Approximately twenty-five years later in 1978, after a period of heavy rains, chemicals began seeping out of the canal and their odor and residues were noticed in the soil and basements of residents.[46] Shortly thereafter, the residents began to associate the chemical residues with health problems from which their children and families were suffering.

From 1978 to 1980 a series of highly publicized events occurred as a result of the community voicing their concerns about the waste buried in Love Canal. Notable events include: President Carter declaring two environmental emergencies at the site, which were the first ever declarations of a man-made disaster; President Carter visiting the site and signing an agreement with the State of New York for the government purchase of hundreds of homes; sensational acts of civil disobedience including the taking of EPA "hostages" and the burning of an EPA effigy; the evacuation of 950 families; and the identification of over eighty chemical compounds including several known carcinogens.[47]

41. LOIS M. GIBBS, LOVE CANAL: THE STORY CONTINUES, at 21 (1998).
42. *Id.*
43. Notice of Intent to Delete the Love Canal Superfund site from the National Priorities List, 69 FR 12,608 (Mar. 17, 2004).
44. GIBBS, *supra* note 40, at 21.
45. PERCIVAL ET. AL., *supra* note 36, at 224.
46. *Id.*
47. *See, e.g.*, EPA Region II Press Release: *EPA Proposes to Remove Three Niagara*

Although early studies at the site indicated that the residents of Love Canal suffered severe health effects due to their exposure to chemicals from the canal,[48] extensive studies conducted in future years demonstrated that no effects attributable to the residents' exposure were statistically detectable.[49] Although Love Canal ultimately caused more than 1000 families to relocate and cost hundreds of millions of dollars in remediation and property damage, as one commentator summarizes: "As things stand, no illness, not even a cold can properly be attributed to living next to Love Canal."[50]

3. Response to the Incident

Similar to the response at TMI, a wide range of government and private interests were involved in response to the discovery of contamination problems at Love Canal. State entities who played a role in the short- and long-term response to citizen complaints included: the New York State Environmental Conservation Department, which conducted environmental air and water sampling;[51] the New York Department of Health, which performed health screenings and environmental testing in homes and declared a public health emergency in 1978;[52] and the Governor of New York, who was actively involved in matters at the site and agreed to finance the initial relocation and state-purchase of several Love Canal homes.[53] As the event picked-up media and political momentum, the federal government's involvement at the site was also widespread, including the EPA; the Department of Health and Human Services; the Office of Technology Assessment; the National Bureau of Standards; and the President and Congress.[54] Similar to the

County Sites from the Superfund List, (Mar. 17, 2004); AARON WILDAVSKY, BUT IS IT TRUE? A CITIZENS GUIDE TO ENVIRONMENTAL HEALTH AND SAFETY ISSUES, at 126-52 (1995); PERCIVAL ET. AL., *supra* note 36, at 224, GIBBS, *supra* note 40, at 172.

48. *See, e.g.*, JUDITH A. LAYZER, THE ENVIRONMENTAL CASE: TRANSLATING VALUES INTO POLICY, at 66 (2002) (discussing a 1980 study that concluded chromosomal aberrations in a high percentage of tested individuals, which could lead to "increased risk of miscarriages, stillborns, birth defects, or cancer.").

49. *See, e.g., id.* at 72-73 (discussing the results of subsequent studies performed by the EPA, the U.S. Public Health Service, and the Department of Health that failed to find increased cancer rates or chromosomal damage amongst Love Canal residents).

Note that community advocates continue to aggressively debate the results of such tests. *See, e.g.*, GIBBS, *supra* note 40, at 22-24 (debating the government's findings and discussing the myriad of health effects truly caused by Love Canal, including a "50-70 percent chance [of birth defects]").

50. *See* WILDAVSKY, *supra* note 46 at 152.

51. *Id.* at 127.

52. *See* LAYZER, *supra* note 47, at 61.

53. *See id.* at 61.

54. *See* WILDAVSKY, *supra* note 46, at 127, 149-50.

accident at TMI, an extraordinary element of the government's response to Love Canal was the extensive involvement of President Carter, who declared two federal emergencies for the Love Canal site and participated in a well-publicized visit to the site.

Despite the sensationalism of many of the elements associated with the aftermath of Love Canal (*e.g.*, a kidnapping and a presidential visit) the most significant government response to the Love Canal accident was the passage of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA). Although CERLA legislation was already underway before the Love Canal incident became national news, Love Canal is universally regarded as the impetus for the passage of the statute and the EPA programs that followed.[55] CERCLA logically expanded EPA's ability to protect the environment from *past* activities rather than just future hazards, filling the statutory gap left after RCRA, which only focused on *present* and *future* hazards. Under the newly passed CERCLA legislation, EPA became the lead agency in the environmental remediation of Love Canal throughout the 1980's and 1990's, and the agency will continue its oversight of the facility well into the twenty-first century with five-year reviews of the now remediated site.[56]

Another key role throughout the Love Canal saga was that played by the Love Canal Homeowners Association, and its leader, Lois Gibbs. It is widely accepted that Ms. Gibbs' involvement in a series of sensational events, including her appearances on national television and before Congress and meetings with President Carter and New York Governor Carey, ultimately gave the Love Canal controversy the momentum to become a national concern.[57] Ms. Gibbs and the residents of Love Canal, with the assistance of the media,[58] created the Love Canal story,[59] which continues to reverberate more than twenty-five years

55. *See, e.g.*, LAYZER, *supra* note 47, at 70 ("Members of Congress, sensitive to the furor caused by Love Canal, responded quickly with an ambitious new law [CERCLA]."); PERCIVAL ET. AL., *supra* note 36, at 224 ("the public response [to Love Canal] contributed to a political climate that produced CERCLA); RICHARD L. REVESZ & RICHARD B. STEWART, ANALYZING SUPERFUND: ECONOMICS, SCIENCE, AND LAW, at 5 (1995).

56. Notice of intent to delete the Love Canal Superfund site from the National Priorities List, 69 Fed. Reg. 12,608 (Mar. 17, 2004).

57. *See generally*, GIBBS, *supra* note 40.

58. *See, e.g.*, Kuran and Sunstein, *Availability Cascades and Risk Regulation*, 51 STAN. L. REV. 683, 695 (1999) (discussing the role of the media at Love Canal, and citing an ABC news story on Love Canal, titled "***the Killing Ground***.") (emphasis added).

59. *See, e.g.*, GIBBS, *supra* note 40, at xiii (1998) (quoting President Carter as stating, "thanks to the grassroots leader of the Love Canal residents, Lois Gibbs. Without her impassioned advocacy and dedication there might never have been a Love Canal emergency declaration.").

later.[60]

Shortly after Love Canal, stories about similar environmental problems arose around the nation.[61] Newly empowered citizen groups working with a re-focused EPA, new legislation, and political forces in their favor were able to shape policy and enact cleanups around the country in hopes of preventing *another* Love Canal. Activist groups such as the Center for Health, Environment, and Justice, which Ms. Gibbs founded,[62] continue to fight for an expansion of programs aimed at preventing another Love Canal. However, on the opposite side of the story, there is a growing criticism of the regulatory and statutory programs, and the widespread fear of toxic waste, which the Love Canal story fostered. Critics of the statutory and regulatory programs point primarily to CERCLA's high price tag, which could be used to address more dangerous risks and to save more lives per dollar.[63]

III. Overview of the Catastrophe Model of Risk Regulation

A. The Catastrophe Model of Risk Regulation

Risk regulation typically occurs at a very deliberate and measured pace. When a new risk arises, the practice in U.S. administrative law is not even to allow the risk into the regime of risk regulation or to set standards for the risk until it passes a deliberate and timely screening process.[64] This deliberate and timely process is the source of great criticism of the U.S. regulatory state, and an abundance of lawsuits are based on regulatory agencies taking too long to develop risk regulations.[65]

60. *See, e.g., Bio' 78*, (Arts and Entertainment Network television broadcast Oct. 3, 2004 (describing Love Canal as the first environmental disaster, and including an interview with Lois Gibbs who explained: "you would smell chemicals every single day. . . . My children got very sick, a liver problem, an immune system problem, skin problems . . . one thing after another.").

61. *See* LAYZER, *supra* note 47, at 70.

62. *See* GIBBS, *supra* note 40, at xiv.

63. LAYZER, *supra* note 47, at 71 ("the U.S. General Accounting Office estimates that cleanups under [CERCLA] will cost the federal government about $300 billion and the private sector hundreds of billions more."); REVESZ & STEWART, *supra* note 55, at 3 (1995) ("the Superfund approach to environmental liability and remediation has become highly controversial . . . its annual costs are in the range of $3-5 billion") Kuran & Sunstein, *supra* note 58, at 697 ("billions [are] spent on the Superfund program . . . had these resources been devoted to the prevention of other risks, there could have been major benefits as measured in, say, life-years saved.").

64. *See, e.g.*, Peter Huber, *The Old-New Division in Risk Regulation*, 69 VA. L. REV. 1025, 1029 (1983).

65. *See, e.g.*, Motor Vehicles Mfg. Assoc. of U.S. v. State Farm Mutual Ins. Co., 463 U.S. 29 (1983) (litigating the Department of Transportation's delay in setting vehicle

This deliberate and slow-moving system is turned on end when the government is faced with a catastrophe like the TMI and Love Canal incidents. NRC's regulatory advancements in control room design, operator training, and human factors engineering did not happen along a steady, straight-line trajectory; instead, there was limited activity before TMI and then a flurry of activity shortly thereafter.[66] Similarly, Love Canal is typically depicted as a "watershed" event in the regulation of hazardous waste.[67] The overall result of this process is that risk regulation proceeds in jumps instead of along a continuum. When catastrophes such as TMI and Love Canal are evaluated in hindsight it is obvious that the government often fails to adequately regulate risks *before* catastrophes (*e.g.,* ignoring the near accidents and growing amounts of engineering data that called for tighter regulation of nuclear plants before the TMI accident) only to overreact *after* catastrophes. The latter effect, overreaction after sensational events, sometimes even goes to the extreme of prescribing regulatory fixes to a problem that never even existed.[68] The Catastrophe Model encompasses the entirety of this phenomenon, whereby advancement in risk regulations are more closely tied to randomly spaced sensational events[69] than steadily accruing genuine health and safety risk data.

B. Related Models of Risk Regulation

The Catastrophe Model represents the spectrum of regulatory

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safety standards).

66. *See, e.g.,* NRC Fact Sheet on the Accident at Three Mile Island (listing 13 program areas in which NRC completed major changes because of TMI, explaining that "[TMI] permanently changed both the nuclear industry and the NRC . . . ***the events during those days have led to permanent and sweeping changes in how NRC regulates its licensees.*** . . .") (emphasis added) *available at* www.nrc.gov/reading-rm/doc-collections/fact-sheets.

67. *See, e.g.,* COLTEN & SKINNER, *supra* note 4, at 1 ("for environmental activists, [Love Canal] symbolizes a tragedy that finally compelled assertive government action to correct decades of land waste disposal abuses . . . ***it is a watershed event.*** . . .") (emphasis added).

68. *See, e.g.,* ALLAN MAZUR, TRUE WARNINGS AND FALSE ALARMS: EVALUATING FEARS ABOUT THE HEALTH RISKS OF TECHNOLOGY: 1948-1971 (2004) (separating notable safety warnings from genuine risks—such as birth defects caused by thalidomide and the link between mesothelioma and asbestos—from false warnings—such as a 1959 scare over contaminated cranberries and Ralph Nadar's 1969 warning about MSG in baby food. Mazur's study identifies common threads within his groups of true and false alarms. For example, when the initial source of a warning was scientific, 90% of alleged threats were genuine, when the first warning was from government officials it was only genuine 42% of the time, and when the first warning was from citizen activists, only 38% of the warnings turned out to be true.).

69. *See, e.g.,* NRC Chairman Nils Diaz, Transcript: *NRC 25th Anniversary of the Three Mile Island Unit 2 Presentation*, Mar. 3, 2004, opening remarks ("[regulatory reforms] have been ***event driven***, but should not have been.") (emphasis added).

behavior before and after a catastrophe. The model includes government inaction preceding a catastrophe as well as the government's tendency to overreact following catastrophes. Previous models attempted to account for subsets of this behavior. This section provides an overview of these previous regulatory models, which laid the groundwork for this evaluation. Because these models have already captured several elements of the regulatory system's behavior and because they have become part of the currency in the legal discourse surrounding risk regulation, an overview of the models helps set the context for this evaluation.

1. The "Old-New Division"

Under this theory of risk regulation, as put forth by Peter Huber in 1983,[70] targets of risk regulation can be divided into old and new risks. Old risks are defined as "risks which society has already embraced or come to tolerate" such as the hazards presented from coal-fired plants.[71] Old risks are regulated through a process of regulatory standard-setting, whereby existing products are required to meet certain standards developed by regulatory agencies in order to remain in the marketplace.[72] Huber's model describes new risks as entirely new technologies (*e.g.*, nuclear power) or new sources of exposure to old risks that society is not yet comfortable with (*e.g.*, new aircraft designs).[73] Huber explains that new risks receive drastically different regulatory treatment than old risks. Rather than setting standards to mitigate the hazards presented by new risks, as is done with old risks, new risks must pass a stringent screening procedure before they are even permitted into the market place.

Huber considers several explanations for the old-new division (*e.g.*, lack of information and psychological effects) and also discusses the negative effects of the division, including the fact that it discourages new products and processes. Finally, Huber makes generic recommendations for improving the risk regulation based on the perspective of his old-new division model. These recommendations include movement toward a comparative risk regime.[74]

70. Huber, *supra* note 64.
71. *Id.* at 1026.
72. *Id.* at 1029.
73. *Id.* at 1026.
74. *Id.* at 1105 ("comparative regulation of different sources of risk within the same risk market is necessary to bridge the gap between old and new risks. Regulation should not exclude new substitutes if they would replace more hazardous old products.").

2. The Public-Private Division

Another model of risk regulation, which is logically analogous to Huber's old-new division, is the public-private division. Public risks are those risks that are manmade threats to health or safety that are centrally or mass-produced, broadly distributed, and outside of the risk taker's direct understanding and control (*e.g.*, chemical additives, mass-produced vaccines, and nuclear power).[75] In contrast, private risks are of natural origin, or if manmade produced in discrete numbers, and can seemingly be controlled by the risk takers (*e.g.*, automobiles, wood stoves, and disease).[76] Under the public-private model, commentators propose that the members of the public and the legal system itself have an aversion to public risks but not private risks.[77] One explanation of the public-private division is the psychological tendency of people to be less averse to risks they perceive they can control, or are only exposed to voluntarily.[78]

The public-private division raises several of the same policy issues as the old-new division. A bias toward private risks, without quantitatively considering the actual risk posed by an activity, creates an ineffective system of risk regulation. Spending additional resources regulating public risks, and therefore discouraging newer and sometimes safer technology can have the net effect of reducing public safety.

3. Availability Cascades

The effect that "availability cascades" have on risk regulation was explored in Kuran and Sunstein's 1999 article *Availability Cascades and Risk Regulation*.[79] Under the availability cascade model, a self-reinforcing process exists whereby the rising public availability of information about an incident leads to a perception that there is an increased likelihood of the event actually occurring in the future. Kass and Sunstein specifically explore the impact that the media and public officials had in creating an abundance of available information about

75. *See* Clayton P. Gillette and James E. Krier, *Risk, Courts, and Agencies*, 138 U. PA. L. REV. 1027 (1990).

76. *Id.* at 1028-29.

77. *Id.* at 1027.

78. *See, e.g.*, Frank B. Cross, *The Public Role in Risk Control*, 24 ENVTL. L. 888, 914-15 (1994) (discussing the voluntariness effect. "If a given activity is voluntary in nature (e.g., skiing) people will perceive it as relatively less risky than an activity that is essentially involuntary (e.g., breathing polluted air). The voluntariness effect may be substantial. Some studies have found that people will voluntarily expose themselves to risks roughly 1000 times greater than those they are exposed to with no choice in the matter.") (internal citations omitted).

79. Kuran & Sunstein, *supra* note 58.

incidents such as Love Canal, the TWA Flight 800 crash, and the scare over the Alar pesticide. The result in all situations was that government and media overreaction caused a mass scare, which resulted in a long-term distortion of the risk regulation framework.

4. Agency Capture

Another concept discussed by commentators evaluating regulatory law is the idea of agency capture, in which the agenda of a government agency is "captured" by the business interests they are supposed to regulate. Through forces such as lobbying, agencies become closely identified and even dependent on the industries which they regulate.[80] Once the agency is captured, the scheme is perpetuated by the agency, which looks to Congress and the regulated industry for rewards such as future business relations and favorable treatment by appropriations committees, who are themselves captured by lobbyist interests.[81] In the context of the Catastrophe Model, the capture theory is notable in at least two respects: (1) traditional agency capture may be part of the explanation for why agencies are hesitant to regulate adequately before catastrophes; and (2) an agency's overreaction after a catastrophe may be explained by the agency's agenda being captured by the strong political and public sentiment regarding the catastrophe.

IV. Why Does Risk Regulation Follow the Catastrophe Model?

A. Explanation for Government Inaction Before Catastrophes

Explanations for the government's failure to act before catastrophes, include: (1) a lack of information; (2) scientific and technical mistakes; (3) a lack of focus; and (4) agency capture. Each of these is discussed below.

One explanation for inaction before a catastrophe may be that the responsible agency did not have enough information or knowledge about the problem to have possibly acted prior to the tragedy. Although such an explanation may have perhaps been viable in the early years of the use of nuclear materials,[82] it is not clear that this is an appropriate

80. *See generally,* Mark C. Niles, *On the Hijacking of Agencies (and Airplanes): The Federal Aviation Administration, "Agency Capture," and Airline Security*, 10 AM. U. J. GENDER SOC. POL'Y & L. 381, 390-99 (2002) (summarizing previous studies of the agency capture theory).

81. *Id.* at 395.

82. *See Generally*, HERMAN CEMBER, INTRODUCTION TO HEALTH PHYSICS 283 (1996) ("As the usefulness of radiation in medicine was being discovered, reports of harmful radiation effects continued, causing various practitioners to suggest a variety of

justification for the NRC's misunderstanding of TMI, prior to the accident. Prior accidents at commercial reactors should have informed the NRC about many of the TMI issues, *before* the TMI accident. Similarly, if EPA and Congress understood the need for RCRA (*i.e.*, improper handling of hazardous waste) they should have known that legacy wastes would exist from the time period prior to RCRA's enactment and, therefore, should have developed CERCLA-like response program *prior* to the incident at Love Canal.

A related explanation could be a purely technical error. It is possible that in some cases the government may have just improperly assessed a risk. Under this explanation, even if an agency had adequate information about its regulatory targets, and was properly focused and not controlled by industry, scientific or technological errors could lead to agencies failing to recognize the true risk of a situation. Hypothetically this could explain Love Canal if scientists and engineers had evaluated the site before the late 1970's and concluded that the contaminants were immobile and safely stored as is.

Another explanation may be that the agencies are not focused on the appropriate issues until a sensational incident occurs. Blame for this lack of focus likely goes beyond the agency level. The RCRA statute that passed through Congress just years before Love Canal was shortsighted in that it failed to account for legacy waste sites. This is a clear example of Congress failing to adequately focus the EPA. Similarly, the statutory reorganization of the AEC into the NRC, which permitted the new NRC to keep the same Commissioners and regulations, seems to have failed to adequately refocus the new agency away from the mission of its predecessor agency. The basis behind Congress' lack of focus extends far beyond the scope of this paper (*e.g.*, political influences and budgetary constraints). However, regulatory agencies cannot completely escape the blame. Even if Congress failed to redirect the NRC after its reorganization, staff and managers at the NRC should have still realized regulatory changes were needed based on the accidents predating TMI. Similarly, common sense should have put the EPA on notice that if there was a waste handling problem pre-dating the enactment of RCRA, then there would be sites like Love Canal, which required identification and

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radiation safety rules."); JACOB SHAPIRO, RADIATION PROTECTION 6 (1990) ("the development of a radiation technology left its occupational casualties ... without appreciating their capacity for destructive effects in living manner. ... Governments [eventually] realized that extraordinary measures were necessary to protect radiation workers and the public from excessive exposure to radiation. The result ... was the enactment of extensive legislation, the establishment of regulatory bodies. ..."); *see also* JAMES E. TURNER, ATOMS, RADIATION, AND RADIATION PROTECTION 6 (1986) (explaining that it was not immediately clear that X-rays could cause harm, but following widespread reports of x-ray "skin burns" the need for x-ray protection was identified).

remediation.

Agency capture theories may offer another explanation for the government's lack of focus prior to catastrophes. If agencies are truly captured by the interests of those they regulate, their behavior before a catastrophe (*e.g.*, NRC ignoring pre-TMI warnings and EPA developing a short-sighted environmental program based on RCRA) may be rooted in the motives of the parties being regulated. The fact that agencies drastically break from their past practices and focus on an issue after a catastrophe, may further evidence the fact that the agency was captured before the catastrophe. Perhaps the sudden change in behavior after a catastrophe is evidence of the fact that catastrophes can break agencies free from their captors.

B. Explanation for Government Overreaction After Catastrophes

The explanations for the government's overreaction to catastrophes include: (1) a genuine need for regulatory reform; (2) after a catastrophe the risk reverts to a new risk under Huber's model, which invokes a tougher regulatory regime; (3) availability cascades cause a response disproportionate to the risk; and (4) regulatory agencies become captured by parties interested in post-catastrophe reform. Each of these is discussed below.

A simple explanation may be that the catastrophe demonstrated a genuine need for reform. One could argue that the government's response just seems to be an overreaction relative to the state of severe inaction pre-dating the catastrophe. Opponents of nuclear power would argue that the response to TMI shows how poorly the industry was regulated before the TMI accident. Similarly, community activists would argue that the post Love Canal regulatory environment demonstrates how lacking previous environmental protection programs were.

Agencies' post-catastrophe reactions could be explained by the fact that risks are treated differently after a catastrophe. Under Huber's model of old and new risks, a risk may have advanced to the old category before the catastrophe and then been demoted back to the old category after the catastrophe. Consistent with Huber's model, these risks would then have to pass a screening test before being allowed back into the regulatory system. For example, new nuclear plants after the TMI accident were logically analogous to the new-application-of-old-technology risks discussed by Huber as new risks. This is consistent with the difficultly encountered by the owners of TMI, when they fought for permission to restart the undamaged unit some years after the

accident.[83] Also, control, which is a factor in the public-private division, may also come into play after an accident. If people and the legal system are more averse to risks they cannot control, a live demonstration of how buried chemical waste cannot be controlled and a nuclear reactor cannot be controlled would clearly create a risk aversion to chemical wastes and nuclear power after Love Canal and TMI.

Availability cascades, as discussed above in the "Comparison to Other Models Section," may also offer an explanation for the regulatory overreaction that occurs after a catastrophe. This model seems to nicely account for the psychological aspects of why people and the government may perceive a greater risk of a certain event or technology after a catastrophe. Kuran and Sunstein's article directly speaks to the government's overreaction to the Love Canal incident. The article explains that the billions of dollars expended "to prevent more Love Canals" were spent in response to an availability cascade set-up by media stories and the government's active involvement at the site. As the article explains, post Love Canal spending on the environment is an overreaction in that the money could save more lives if it were focused toward more dangerous activities (*e.g.*, tobacco use and obesity).[84]

Similar to the concept that agencies can be captured by industry, an explanation for the zealous regulation of industry after a catastrophe may be that the agency's become captured by the interest groups that are against the industry they regulate. For example, after TMI the position of the anti-nuclear groups was validated and they clearly had more influence over the NRC and their elected representatives. Similarly, at Love Canal, organizations such as Ms. Gibbs' community group who previously had no voice, suddenly had an audience with top government officials (*e.g.*, President Carter) after the incident.

C. Why Is the Model Followed for Some Events and Not Others?

Other catastrophes that come close to the regulatory treatment received by TMI and Love Canal are the Bhopal disaster, the wreck and oil spill from the Exxon Valdez, and the events of September 11, 2001 (September 11). In Bhopal, India, a gas leak at a Union Carbide chemical plant killed more than 3,000 people and injured more than 100,000 people.[85] Just as the incident at Love Canal is largely remembered for Superfund legislation, the Bhopal incident is tied to the

83. *See* WALKER, *supra* note 15, at 232-34 (discussing the uphill battle that the utility faced in trying to have the undamaged reactor at TMI, Unit 1, restarted after the accident in Unit 2).

84. Kuran & Sunstein, *supra* note 58, at 697.

85. *See* PERCIVAL ET. AL., *supra* note 36, at 1102.

Emergency Planning and Community Right to Know Act of 1986. Similarly, the wreck and associated environmental disaster caused by the oil spill from the Exxon Valdez, also spurned a Catastrophe Model response from government decision-makers. Just like Love Canal and Bhopal resulted in statutory reforms, the Exxon Valdez incident was the impetus for the Oil Pollution Control Act of 1990.[86] Another example is September 11, which was undoubtedly a watershed event in the way the U.S. government deals with security. Preceding the events of September 11, the government failed to properly address the risk of terrorism as evidenced by the occurrence of the attacks. After the catastrophe the government has responded with a flurry of activity meant to prevent the same catastrophe from occurring again (*e.g.*, passage of the U.S.A. Patriot Act and development of the Department of Homeland Security). Although some elements of the Catastrophe Model are apparent in the regulatory treatment of most catastrophes, Love Canal and TMI continue to standout as the paradigms for the model.

Two catastrophes, which interestingly failed to develop many of the behaviors described in the Catastrophe Model, are the 2002 events at the Davis Besse Nuclear Power Plant (Davis Besse) in Ohio and the 1978 Cooling Tower Collapse at the Monongahela Power Plant in West Virginia.

In 2002, extensive damage was discovered to the reactor vessel head at the Davis Besse Nuclear Power Plant, which apparently could have led to a severe accident if it had been discovered any later.[87] Despite the fact that the public remains wary of nuclear power after TMI, the Davis Besse story has not invoked widespread concern. Similarly, the effects of this incident on the NRC have not been far-reaching,[88] but instead have been limited to addressing the specific problem at Davis

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86. *See, e.g.*, Joseph J. Chambers, *In Re: Exxon Valdez: Application of Due Process Constraints on Punitive Damages Awards*, 20 ALASKA L. REV. 195, 237 (2003) ("the Federal Oil Pollution Act, which Congress passed as a result of the Exxon Valdez oil spill. . . .").

Interestingly, the Exxon Valdez was not the first oil spill to prompt reactionary legislation. *See, e.g.*, Locke v. United States, 529 U.S. 89,101 (2000) ("responding to the *Torrey Canyon* spill, Congress enacted the Ports and Waterways Safety Act of 1972.").

87. *See Davis Besse Submits Key Document But Is Months Away from Restart*, 24 INSIDE NRC 9, at 1 (providing the comment of a former NRC Commissioner that the Davis Besse incident was the "closest brush with disaster since the 1979 Three Mile Island Accident"); *see also, Davis-Besse Flaw Disclosed*, AKRON BEACON J., Feb. 12, 2003, available at http://www.ohio.com/mld/beaconjournal/business/5162154.htm (explaining that if the damage went undiscovered it could have led to a meltdown).

88. *See, e.g.*, Transcript of U.S. Nuclear Regulatory Commission 25th Anniversary of Three Mile Island Unit 2 Presentation, at 99 (Mar. 3, 2004) ("what happens with nuclear power plants is that they have an additional level of inspection, additional level of oversight, both by the licensees, and by the NRC. So we tend to detect these issues very early, ***with the exception of Davis Besse, of course***.").

Besse and inspecting for signs of the same problem at other reactors.

In 1978, a 400-foot cooling tower, which was under construction at a conventional power plant in West Virginia collapsed, resulting in the death of fifty-one workers.[89] Despite the fact that this event ironically occurred on a structure that has become an icon for the events at TMI, and occurred in an adjoining state within a year of the events at TMI, the cooling tower collapse, like the accident at Davis Besse has been seemingly lost in the history books.

Although an in-depth analysis of other catastrophes[90] in light of the Catastrophe Model is beyond the scope of this evaluation, the fact that Love Canal and TMI—which arguably caused no adverse health consequences—have the largest regulatory legacies is worth noting. One explanation may be the relative sensationalism of the events. It seems that incidents that got the most play in the media and by politicians had the most long lasting regulatory effects. Consider President Carter's trips to Love Canal and TMI and news stories about both accidents that continue through today, to the dearth of stories covering issues at Davis Besse and the relatively unknown cooling tower collapse in West Virginia. Another explanation may be traced to the public's fear of the unknown.[91] Both TMI and Love Canal involved an intangible injury, an increased risk of cancer. Also, both events played out over a period of time during which people's fates seemingly hung in the balance (*e.g.*, it was days if not weeks before the fear of a danger passed at TMI and it took years before the evacuation was completed at Love Canal). In contrast, the danger presented by the Davis Besse accident had passed before the damage was discovered[92] and the cooling tower collapse was caused by construction mistakes and an easily comprehendible mode of death—falling from 170 feet.

V. Evaluation of the Model

A. Defending the Behaviors Described by the Catastrophe Model

Before discussing the negative effects of the model or recommending ways to improve the regulatory system, it is worth

89. Helen Dewar, *Labor Department Proposes Fines in Scaffold Collapse*, WASH. POST, June 9, 1978, at A4.

90. Similarly, elements of the catastrophe theory are seen in the government's use and then acknowledgement of the problems with Agent Orange, the Tylenol tampering scare, and the Challenger and Columbia space shuttle catastrophes.

91. This is consistent with the old-new division, the public-private distinction, and the voluntariness effect discussed above.

92. The damage to the reactor was discovered during a cold shutdown, when the reactor posed essentially no risk to the public's health and safety.

considering whether the behaviors described by the model can be defended as sound regulatory decisions. Three arguments defending these behaviors are discussed below, including: (1) the government is appropriately accounting for the emotional aspects of risk regulation; (2) the model is consistent with the agency system; and (3) catastrophes demand a strong regulatory reaction.

One defense for the model is that regulatory agencies' actions in response to catastrophes are appropriate, because they account for the emotional aspects of risk regulation. Although risk *assessment* can be broken down into hard numbers (*e.g.,* the probability of an event of occurring is 1 in "x") and viewed as a math problem or hard science, risk *regulation* incorporates the data from risk assessments into public policy. Such policy decisions should not be made in a vacuum, ignorant of what risks society is willing to endure.[93] Even if it is *unscientific* to be more afraid of nuclear accidents and toxic waste than more statistically dangerous activities like tobacco smoke and car accidents, if human emotion is properly part of the risk calculus, then maybe agencies should be responsive to public and political pressure.

An extension of the idea that the emotional preferences of the public should be considered in risk regulation, is the defense that agencies should be responsive to public and political forces because of the role of agencies in government. If agencies are truly an extension of the Executive branch and should represent the citizens' best interest, then agencies need to react strongly to issues like Love Canal and TMI that catch the public and President's attention. Although agencies are meant to act outside of the traditional political system,[94] Congress clearly did not wish to grant agencies so much independence that they would disregard public and presidential outcries over incidents like TMI and Love Canal.

A third defense for the Catastrophe Model is that catastrophes categorically deserve an extreme response. If catastrophes represent a failure of safety systems and highlight regulatory gaps, those gaps should be filled. If the gaps indicate a systemic failure of the government to recognize risks (*e.g.*, the EPA's concentration on preventing future waste sites through RCRA while largely ignoring existing contaminated properties) then perhaps an extreme regulatory reaction is warranted. Any overreaction that follows a catastrophe may balance out an agency's prior inaction.

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93. *See, e.g.*, Eileen Gay Jones, *Risky Assessments: Uncertainties in Science and the Human Dimensions of Environmental Decisionmaking*, 22 WM. & MARY ENVTL. L. & POL'Y REV. 1 (1997).

94. For example, as an "independent" regulatory agency, a five-member Commission, with a mandatory political composition, heads the NRC.

B. Negative Effects of the Model

The negative effects described by the model include: a misappropriation of government resources, a skewed regulatory program, agency self-promotion of the cascade effect, an erosion of the independent agency system, and hindering the advancement of industry and society. Each of these are discussed below:

The government's exaggerated response to catastrophes has the effect of taking away resources and focus from other risks that deserve more attention. As discussed above, the incident at Love Canal had only negligible health effects on its community.[95] Nonetheless, hundreds of millions of dollars were spent on the cleanup of the Love Canal site. In addition, the fear of "another Love Canal" sparked a nationwide panic of toxic waste and a cleanup of legacy sites around the country that will ultimately cost the government and industry hundreds of billions of dollars.[96] Even if several of these sites do represent a true risk to the communities' health, comparing such hypothetical risks of cancer to other tangible risks (*e.g.*, automobile accidents, obesity, and tobacco use) indicates that the money could be better spent. For example, consider the reduction in automotive deaths if the government were to allocate $100 billion toward mandatory automotive safety improvements.

Closely related to the above disadvantage is the idea that regulatory programs within agencies are skewed as a result of the behavior described by the Catastrophe Model. Agencies must quickly determine whether the catastrophe can occur elsewhere and take appropriate precautions (*e.g.*, inspecting suspect components at other facilities that are the same as components that failed in an accident). However, once this immediate safety determination is made, the government needs to be proactive in separating the conflict from other regulatory responsibilities. Until the new risk information can be incorporated into an agency's comprehensive risk framework, resources should not be allocated away from other aspects of an agency's program. Failing to consider the relative risks of other programs, before diverting resources away from them to deal with a catastrophe, could have the unintended consequence of increasing the overall risk to the public health and safety.

Consider this hypothetical situation involving the NRC in which the

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95. *See, e.g.*, LAYZER, *supra* note 47, at 72 (discussing the results of several government studies that concluded that the residents of Love Canal were "no more likely to suffer chromosomal damage that residents living elsewhere in Niagara Falls" and "failed to find elevated cancer rates among Love Canal residents.").

96. *See, e.g.*, *id* at 71 ("the U.S. General Accounting Office estimates that cleanups under [CERCLA] will cost the federal government about $300 billion and the private sector hundreds of billions more.").

agency's responsibilities are limited to the safety regulation of three program areas: (1) nuclear power reactors; (2) nuclear medicine; and (3) nuclear materials. The baseline, absent a catastrophe, would be a staffing and budget plan based upon each of the program area's relative risks. For simplification, assume each of the three programs has the same safety risk and NRC has 300 employees and a $300 million budget. Also assume that the likelihood of a catastrophe is based only on the resources the NRC devotes to the program (*i.e.*, doubling the resources to a program area cuts the risk in half). The resource plan and catastrophe probability, absent a catastrophe, is depicted in the Table 1:

Table 1: Baseline Resource Allocation and Catastrophe Probability

	Program Area 1 Power Reactors	Program Area 2 Nuclear Medicine	Program Area 3 Nuclear Materials
Personnel	100 employees	100 employees	100 employees
Funding	$100 M	$100 M	$100 M
Catastrophe Probability[97]	X	X	X

If an accident occurs in any of the three areas, NRC's reaction, in accordance with the Catastrophe Model, would be to react by shifting personnel and monetary resources to the program in which the catastrophe occurred.[98] The new staffing and funding plan, along with the resulting catastrophe probability is provided in Table 2:

97. Catastrophe probability represents the likelihood of a catastrophe occurring, based herein solely on the relative resources assigned to the program and each program's relative risk.

98. These additional resources would be needed to, *inter alia*, assess the damage from the immediate problem, prevent the problem from reoccurring, to answer press inquires, to respond to heightened public involvement, and to respond to congressional and even presidential inquires and demands.

Table 2: Post-Catastrophe Resource Allocation and Catastrophe Probability

	Program Area 1 Power Reactors [CATASTROPHE]	Program Area 2 Nuclear Medicine	Program Area 3 Nuclear Materials
Personnel	200 employees	50 employees	50 employees
Funding	$200 M	$50 M	$50 M
Catastrophe Probability	0.5 X	2X	2X

Note that the risk of another power reactor catastrophe is cut in half, whereas the likelihood of a catastrophe doubles in the nuclear medicine and nuclear materials programs.

The above hypothetical is an extreme oversimplification of the resource and risks that the NRC faces. However, it demonstrates how the overreaction aspect of the Catastrophe Model can have the effect of decreasing the risk of another catastrophe of the same type occurring, while increasing the public's risk with regard to other areas under the purview of the regulatory agency, thereby increasing the overall risk presented by NRC's program areas. The conclusion is not that agencies should never realign resources after a catastrophe. A catastrophe may highlight flaws in previous risk analyses, in which case realignment may be appropriate. However, such realignment should only occur as the result of comprehensive analyses, not in response to the variables discussed in this paper such as media interests and public concern.

Another negative effect of the Catastrophe Model is that agencies' overreaction to catastrophes—including the NRC and EPA's recent activities that seem to embrace the regulatory legacies of both TMI and Love Canal—only serve to promote the availability cascade and its negative effects, which are discussed above. Once an agency gives into political and public outcries over an event, it validates such feelings and the sentiment continues to grow rather than subside.

A counterpoint to the idea that the Catastrophe Model behavior can be defended by the agency system is the idea that agencies' actions under the Catastrophe Model erode their independence. If an agency is immediately responsive to the public and political feelings, especially where such feelings are not scientifically supported,[99] such actions could

99. *See, e.g.*, LAYZER, *supra* note 47, at 72 (explaining that in "hindsight . . . while the initial Love Canal evaluation was necessary, the second was probably an overreaction to citizen activism . . . rather than a product of careful evaluation.").

have the undesired effect of agencies being "captured" and unable to perform their mission independently. Just as an agency captured by a regulated industry can no longer perform as an objective regulator, an agency captured by the fear of a specific type of catastrophe would also fail to accomplish unbiased regulation.

Another negative effect is that the overreaction to catastrophes stifles further development of the industries in which the catastrophes occur. The Catastrophe Model in its application at TMI and Love Canal has had the long-term effect of stifling the chemical and nuclear industries. This negative effect is consistent with the discussion in Huber's article about the old-new division. Just like new risks may be improperly excluded to the disadvantage of society, once a risk is associated with a catastrophe the fear of "another [insert catastrophe]" may unnecessarily stifle its future development.

VI. Recommendations

Although some of the effects of the Catastrophe model can be defended, the negative effects—especially the possibility of increasing the risk of subsequent catastrophes because of skewed regulatory programs and misallocation of resources—outweigh these defenses and require serious consideration. Previous regulatory models laid the groundwork for this evaluation and made significant observations and recommendations. However, the Catastrophe Model provides a better approach for the purpose of effecting regulatory changes by regulators and legislators. The advantages of the Catastrophe Model over the previous models[100] include: (1) the Catastrophe Model encapsulates all the behavior surrounding a catastrophe rather than isolated segments (*e.g.*, "availability cascades" deal only with the crescendo of activity following a catastrophe); (2) the effects of the model are largely measurable (*e.g.*, decision-makers can quantify the effects of the model by comparing resource expenditures before and after a catastrophe, whereas it is difficult to measure the conceptual idea of whether an agency's agenda has been "captured" or whether a risk is "old" or "new" or "public" or "private"); (3) the model is based on a case-study approach;[101] and (4) by definition the model focuses on catastrophic events to which legislators and regulators already devote heightened

100. Note that other models share some of these advantages, but the benefit of the Catastrophe Model is that includes the features of the other models, which facilitate regulatory change.

101. *See, e.g.*, Carrie Menkel-Meadow, *Symposium Case Studies in Legal Ethics: Telling Stories in School: Using Case Studies and Stories to Teach Legal Ethics*, 69 FORDHAM L.REV. 787 (2000) (discussing the advantages of the case-study method).

attention and resources.[102]

A. Separate Catastrophes from Other Regulatory Responsibilities

As discussed above in the Negative Effects of the Model discussion, agencies' overreactions to catastrophes often result in a skewed regulatory program. Until new risk information can be incorporated into an agency's comprehensive risk framework, resources should not be allocated away from other aspects of an agency's program. Failing to consider the relative risks of other programs, before diverting resources away from them to deal with a catastrophe, can have the unintended consequence of increasing the overall risk to the public health and safety. While an immediate short-term reshuffling is clearly explainable, over the long-term these reactionary changes distort a prior staffing and resource plan that is properly based on a comprehensive risk assessment.

To avoid the mistake of a hasty realignment of resources, the government should be proactive in separating catastrophe response actions from the other work of the agency. One solution would be for the Congress to appropriate funding adequate to cover an agency's entire response to a catastrophe, above and beyond that agency's pre-existing budget. This would enable the agency to maintain its current level of attention to other areas and to increase spending and personnel for dealing with the aftermath of a catastrophe. A better alternative is to establish an entity, distinct from the agency, to focus on catastrophe response efforts.[103] Such an entity would resemble the President's Commission on Three Mile Island and the September 11 Commission but would take more of an active role than previous commissions whose duties were limited to an advisory role (*e.g.*, this entity could have a large staff and would takeover agency responsibilities such as inspection activities). The new entity would also be specially trained to deal with the pitfalls of the catastrophe model with which it would be presented. This option would prevent the agency from being captured by the catastrophe and have the added benefit of bringing a new perspective to the problem. In addition, the new entity would not have the bias of trying to protect its reputation by explaining the accident or crafting reforms that deflect past regulatory shortcomings.

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102. Ironically, the overreaction element of the Catastrophe Model, which creates negative consequences, could also provide the momentum for regulators and legislators to mitigate the very same negative consequences.

103. Such efforts do not include overseeing remediation activities, which in the case of Love Canal and Superfund consisted of decades of work. The new entity would be responsible for other response tasks, such as reconstructing the problem, answering inquiries (by Congress, the public, and the media), and recommending regulatory reforms.

Creating a new government entity to deal with the aftermath of the catastrophe would also have the potential of reducing the government's overall response cost. The catastrophe response funding would be entirely isolated from general agency funds from the outset. This isolated account would increase accountability (*e.g.*, Congress would be able to determine exactly how much money was spent) and eliminate the possibility of careless spending or the funding blending into the general budget and overhead of the response agency. The new response entity—which would be able to focus all of its efforts on responding to the catastrophe—relative to an agency responder—which would have to balance pre-existing regulatory responsibilities with catastrophe response efforts—would also lend itself to a cost savings. In addition, the cost of another catastrophe is so enormous[104] that even if forming a separate response agency was more expensive than leaving the response effort with the original agency,[105] the reduced risk of another catastrophe would reduce the government's financial risk enough that the plan discussed herein would still represent the better financial choice for the government.

B. Increased Public Outreach and Education

One way to lessen the public and political outcries, both before and after catastrophes, is to increase the public's understanding of the various technologies and risks. For TMI and Love Canal, the post-catastrophe overreaction could have been limited if the public and politicians genuinely understood the risk that nuclear power and chemical waste sites pose. Similarly, both TMI and Love Canal were exacerbated because of poor communication during the catastrophe. If government officials were more proactive in dealing with the public's concerns at Love Canal and TMI, perhaps they could have limited the public's fear at the time, which has evolved into long-term distrust. Such educational and outreach programs could be as simple as budgeting more resources toward public relations organizations within agencies (*e.g.*, increasing the staffing and monetary resources of NRC's Office of Public Affairs so that its staff members could attend more public meetings and it could develop more outreach materials). More grandiose plans could include

104. *See, e.g.*, WALKER, *supra* note 15, at 230 (explaining that approximately $1 billion has been spent on the TMI cleanup, which is not complete).

105. The increased cost, if any, of the new organization would only come from costs that the agency would not have to incur if it retained post-catastrophe responsibilities (*e.g.*, increased overhead). Therefore, any increased cost would likely be measurable in the thousands rather than millions of dollars. It is anticipated that the new agency would need the same amount of employees dedicated to the catastrophe as an agency would, along with similar other costs (*e.g.*, travel and laboratory expenses).

inserting more real-life technology lessons into school curriculums (*e.g.*, the relative risks between automobiles and nuclear power plants, and the health effects of living next to a coal versus nuclear power plant). Similarly, decision-makers should also be educated on the effects of the Catastrophe Model as discussed herein.[106]

C. Comprehensive/Comparative Risk Regulation

At the root of the Catastrophe Model, is the idea that some risk regulation is not working—agencies fail to act until a catastrophe occurs and then often overreact after the catastrophe. A solution that gets to the tough questions of how to properly regulate risks before and after a tragedy, how to incorporate public interests into risk regulation, and how to regulate risks uniformly across agency lines (*e.g.*, comparing automotive safety spending to CERCLA appropriations) is the idea of comprehensive or comparative risk regulation. Although commentators have called for comparative risk regulations for years, the current state of risk regulation is very far from truly adopting such a drastic reform. Perhaps future studies in the context of the Catastrophe Model can help reinvigorate previous proposals.

106. One way to educate Congress may be to have the Government Accounting Office perform an audit of the wasted resources due to the negative effects of the Catastrophe Model for selected catastrophes. If Congress understood the wasted resources for some notable catastrophes, perhaps it would temper its own tendencies in the event of future catastrophes.