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CENTENNIAL PAPERS

Standing Committee on the Transportation of Hazardous Materials (AT040)
David O. Willauer, Chair

Ensuring Safe and Secure Transportation of Hazardous Materials

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OVERVIEW

This paper describes past, present and future activities of the Standing Committee on the Transportation of Hazardous Materials (AT040). The paper is organized in three sections. The first section details the history of hazardous materials transportation beginning in the late 1800s, including the early work of the Hazardous Materials Transportation Committee, which was formed in 1964. The second section describes the present work of the committee. The final section outlines future committee work that is being planned in response to recent trends, including emerging technologies, energy trends, and assessing new risks that come with new technologies.

INTRODUCTION – WHAT IS HAZARDOUS MATERIALS TRANSPORTATION AND WHY IS IT IMPORTANT?

Hazardous materials, often abbreviated as "hazmat" are substances or materials that when transported are capable of posing risk to health, safety, property and the environment (Pipeline and Hazardous Materials Safety Administration). Also known worldwide as "Dangerous Goods," such products are inherently dangerous whether or not they are in transport (Transport Canada). Up to one million daily hazmat shipments transit the United States every day, or more than 2.2 billion tons by all modes of transportation. This represents 12% of all freight tonnage shipped annually (Bureau of Transportation Statistics).

Chemicals are used every day by industries to ensure the safety of our water and food supply. From chlorine to crude oil, America's freight railroads transport essential hazardous materials, 99.999% of which reach their destination without a release caused by an incident (Association of American Railroads). These include fertilizers, fuels, medical isotopes, and industrial chemicals that are essential to U.S. manufacturing, agriculture, healthcare, food production, and energy production. Petroleum products fuel our nation's growing economy and are transported primarily by pipelines across the United States every day and by truck to their final destinations at the gas pump (American Petroleum Institute). Ethanol has become the largest biofuel transported by rail and an important US export (Renewable Fuels Association). Due in part to the recent shale oil and gas revolution in the United States, natural gas is now exported from the United States more than imported, and the United States. is the leading exporter of refined petroleum products in the world (Energy Information Administration).

HAZARDOUS MATERIALS TRANSPORTATION HISTORY

Early Years – 1860-1910

Hazardous materials have been transported in large quantities since the rapid industrialization of the late nineteenth century. In 1866, the first Federal law was passed regulating the transportation of hazardous materials, specifically shipments of explosives and flammable materials such as nitroglycerin. In 1887, Congress established the Interstate Commerce Commission (ICC) to provide federal regulation of transportation between the states. Several railroad accidents prompted the railroads to create the Bureau of Explosives (BOE) in 1907. In 1908, Congress authorized the ICC to regulate the transport of explosives and other hazardous cargoes. As a result, Congress passed the Explosives Act of 1917 to standardize requirements for li-censing, manufacturing, storing, and distributing explosives prior to World War I.

1910-1960

In 1917, a French cargo ship carrying explosives collided with another vessel in Nova Scotia, Canada, killing 2,000 and injuring 9,000 persons. Later known as the Halifax explosion, it was the largest man-made accidental explosion at the time. In 1937, the London School Explosion in New London, Texas brought attention to the need for odorants in natural gas. The explosion killed 300 people when undetected natural gas was ignited from a leak in an industrial arts classroom. By the start of World War I, significant amounts of hazardous materials were being transported on the nation's highways, waterways, and railroads. Tank trucks delivered gasoline and home heating fuel, steel tank cars were outfitted to carry dozens of petroleum products and chemicals, and steam-powered tankers and barges were carrying such cargoes on the inland and coastal waterways. In 1947, the Texas City Disaster would become the deadliest industrial accident in U.S. history, and one of the largest non-nuclear explosions. Approximately 2,300 tons of ammonium nitrate detonated aboard a vessel docked in the Port of Texas City, killing more than 500 people. In 1956, the United Nations economic and social council published the first version of the UN Model Regulations, marking the beginning of UN Code. Congress passed legislation in 1958 to regulate hazardous material shipments via air and in 1963, the Clean Air Act (CCA) required new regulations to protect the general public from airborne contaminants. The Act was passed in 1963, later amended in 1970, 1977, and 1990.

1960s

In 1964, the Committee on Hazardous Materials was formed under the National Research Council's Division of Chemistry and Chemical Technology. This early advisory committee was formed to address scientific and technical questions relating to the safe maritime transportation of hazardous materials at the request of the Commandant of the U.S. Coast Guard in December 1963. This first committee was chaired by Dr. Donald L. Katz of the University of Michigan.

Safety regulation authority over the transportation of hazardous materials was transferred from the ICC to the United States Department of Transportation (USDOT) when it was created as a cabinet-level agency in 1966. A series of fatal tank car accidents beginning in the late 1960s was one factor prompting Congress to reform the federal hazardous materials safety program.

In 1969, a special ninety person task force met in Warrenton, Virginia, and experts from the Committee on Hazardous Materials and from the Highway Research Board discussed a new "systems" approach to hazardous materials transportation and made recommendations to the Department of Transportation for collaborative research across all modes. By the end of this

meeting, an agreement was made to form a Committee on Transportation of Hazardous Materials under the Highway Research Board.

1970s

Congress passed the Hazardous Materials Transportation Control Act in 1970, which required USDOT to collect information about hazardous materials incidents across all modes and to report annually on the activities and accomplishments of the various regulatory agencies responsible for safety in each mode.

Two major incidents in 1973 brought attention to hazardous materials transportation by air and by rail. Pan Am Flight 160, a Boeing 707 cargo jet hauling several tons of hazardous materials, crashed at Boston-Logan International Airport. All three crewmembers perished when improperly packaged acid leaked and caused heavy smoke to accumulate in the cockpit. That same year, a catastrophic boiling liquid expanding vapor explosion (BLEVE) occurred during a transfer of 33,000 gallons of liquid propane gas from a railcar to storage tanks in Kingman, Arizona.

In 1974, the Materials Transportation Bureau (MTB) was created within the Research and Special Programs Administration (RSPA), which was designated as the lead USDOT agency for hazardous materials regulation. That same year, the Highway Research Board became the Transportation Research Board, and its Standing Committee on Transportation of Hazardous Materials was designated as A3C10 within the Traffic Safety and Maintenance Group. Clyde Perry served as Chair.

The 1970s was also a period of time in which more attention was brought to chemical company protocols and the disposal of hazardous waste. What later became known as the Love Canal Incident was the result of such chemical disposal practices, which led to the passage of the Superfund Act.

1980s

The Bhopal disaster in 1984 was a watershed event for the chemical community worldwide. A gas leak at the Union Carbide India Limited pesticide plant in Bhopal, Madhya Pradesh, India exposed over 500,000 people to methyl isocyanate gas. The official death toll was 2,500, but subsequent deaths from the effects of the exposure are in the tens of thousands.

As a result of this disaster, the U.S. Environmental Protection Agency developed the Chemical Emergency Preparedness Program strategy to deal with air toxins in the environment, including addressing accidental releases of acutely toxic chemicals. In addition, chemical companies joined forces to create the Transportation Community Awareness Emergency Response (TRANSCAER) program. Supported by shippers, carriers, and their trade associations, TRANSCAER promotes transportation safety by assisting communities in preparing for and responding to hazardous materials transportation incidents.

In that same year, the National Association of SARA Title III Program Officials (NASTTPO) was established, comprising a coalition of members of State Emergency Response Commissions (SERCs), Tribal Emergency Response Commissions (TERCs), Local Emergency Planning Committees (LEPCs), federal and state agencies, industry, and other individuals interested in Emergency Planning and Community Right-to-Know Act implementation.

1990s

In 1996, ValuJet Flight 592 crashed in the Florida Everglades, killing 110 passengers and crew. The cause of the crash was an in-flight fire in an undeclared, improperly hazardous materials shipment (chemical oxygen generators) in the cargo area. This incident led to further Federal Aviation Administration restrictions for hazardous materials transported in passenger aircraft.

2000s

In 2000, the TRB Hazardous Materials Committee moved to the Freight Systems Group and was designated A1B14. On September 11, 2001, the World Trade Center was hit by two hijacked U.S. passenger aircraft, an event that would forever change the landscape of Americans' attitudes about terrorism, evacuations, and emergency response. In response to this attack, Congress passed the Aviation and Transportation Security Act of 2001, creating the Transportation Security Administration with powers to identify security threats in all modes of transportation and to take actions to address them.

The Homeland Security Act of 2002 created the Department of Homeland Security (DHS) "to protect the territory of the United States and protectorates from and responding to terrorist attacks, man-made accidents, and natural disasters." Other agencies placed under DHS authority included the United States Coast Guard, the Transportation Security Administration, the Bureau of Customs and Border Protection, and the Federal Emergency Management Agency.

In the wake of 9/11, the Hazardous Materials Transportation Committee sponsored numerous sessions and workshops on security, industry perspectives on hazardous materials, and transportation safety. This included applications of risk factors for hazardous materials transportation by all modes. Meanwhile, USDOT and industry took steps to enhance the security of hazardous materials transportation. These steps included the development of guidelines to improve security awareness in the hiring of personnel, the conduct of on-site security reviews targeting shippers and carriers of very hazardous materials, and the evaluation of common hazardous materials routes from a security perspective.

The Pipeline and Hazardous Materials Safety Administration (PHMSA) was established in 2004, replacing the Research and Special Programs Administration (RSPA). That same year, the TRB Hazardous Materials Transportation Committee was re-designated as AT040 with the complete overhaul of the TRB Committee structure.

PHMSA, together with Pipeline Research Council International, Inc and the Gas Technology Institute, hosted the first Research and Development (R&D) Forum on the Role of the Pipeline Safety Improvement Act of 2002 in the development of Energy Pipeline Technology. The Office of Hazardous Materials Safety also initiated an annual Research and Development Forum to get input on emerging hazardous materials research ideas and to present the results of research conducted in support of PHMSA's mission.

Members of the Hazardous Materials Transportation Committee led the development of the DOT's first comprehensive national routing regulations, HM-164. Also, FMCSA developed a field operational test to assess the potential for new technology to improve the safety and security of hazmat transportation in a post-9/11 environment. On January 1, 2004, the International Maritime Dangerous Goods (IMDG) Code became mandatory for the first time, marking the start of the current cycle of globalization.

Chemical Facility Anti-Terrorism Standards were established by DHS in 2005 to impose comprehensive federal security regulations for high-risk chemical facilities. These regulations established risk-based performance standards for chemical facility security.

A significant series of natural disasters occurred in 2005, including Hurricanes Katrina and Rita, prompting major Gulf Coast evacuations and emergency response to mitigate effects on chemical facilities located in Louisiana and Texas.

In 2005, the Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU) authorized PHMSA to contract with the National Academies of Sciences to conduct the pilot stage of a Hazardous Materials Cooperative Research Program (HMCRP), addressing research topics discussed in *Cooperative Research for Hazardous Materials Transportation: Defining the Need, Converging on Solutions TRB Special Report 283*. The HMCRP sponsored 18 studies between 2005 and 2017. Due to a of program authorization in the Moving Ahead for Progress in the 21st Century Act (MAP-21) legislation, TRB discontinued the HMCRP but reinstated it in 2018. MAP-21 legislation reinstated the HMCRP; however, no appropriations were committed. To date, eighteen hazardous materials research projects have been funded through the HMCRP.

Beginning in 2008, shale oil and gas reserves were discovered and hydraulic fracking techniques allowed for large scale extraction of crude oil and natural gas in North Dakota, Texas, Pennsylvania, Ohio, and West Virginia. In 2008, PHMSA, working in close consultation with the U.S. DOT Federal Railroad Administration, issued regulations requiring railroads that transport certain hazardous commodities to perform a comprehensive safety and security risk analysis in order to determine and select routes which pose the least overall risk. These analyses must consider a minimum of 27 specific risk factors including input provided by state, local and tribal governments..

In 2009, the Deepwater Horizon Oil Spill occurred, claiming 11 lives and leading to an 87-day underwater oil spill of 210 million gallons into the Gulf of Mexico. In 2010, UPS Airlines Flight 6 was lost outside of Dubai. The accident was attributed to autoignition of lithium batteries, which led to lithium battery risk analysis and air carrier bans.

2010s

In 2011, a number of significant incidents brought more attention to hazardous material transportation, including a fire at an ammonium nitrate storage and distribution facility in West, Texas and a train derailment in the Province of Quebec, Canada involving crude oil that killed 47 people. In response to the growing number of crude oil and ethanol unit train derailments, the Hazardous Materials Transportation Committee created a Crude Oil Transportation Subcommittee to provide a platform for presentations, sessions, and workshops between 2014 and 2017. Additional derailments and a barge incident occurred in the United States and Canada, bringing more attention to the safety of USDOT 111 tank cars used to transport crude oil and ethanol in unit trains.

In 2012, PHMSA developed a five-year Strategic Plan to describe research and development priorities in five program areas, including package integrity, human factors, technical risk analysis, risk management, communication and emerging technologies risk mitigation. During 2014 there were four more derailments involving unit trains transporting crude oil. The Hazardous Materials Transportation Committee sponsored numerous sessions on crude oil transportation challenges and emergency response, including emerging liquid natural gas (LNG) trends. In 2017, the United States became a net exporter of LNG, creating more demand for natural gas pipeline infrastructure development. (EIA).

Over the next several years, the Hazardous Materials Transportation Committee sponsored sessions and workshops on additional crude oil transportation challenges, operating

safe rail networks, systems thinking in hazmat transportation, and transportation planning for shipping spent nuclear fuel from shutdown reactor sites to interim storage facilities. At the 2019 TRB Annual Meeting, the committee co-sponsored the Fourth Transportation Systems Resilience Exercise: Passenger and Freight Railroads in Sustainable Mobility and Resilient Supply Chains, as well as sessions on emerging technologies and communicating hazardous materials risk. At the 2020 Annual Meeting, the committee sponsored sessions entitled Pipeline Solutions in a Changing North American Energy Landscape, and Building Resilient Ships and Seaports: Toward Cleaner Port Infrastructure (part of Freight Day).

STANDING COMMITTEE ON TRANSPORTATION OF HAZARDOUS MATERIALS (AT040)

Mission

The mission of the TRB Standing Committee on Transportation of Hazardous Materials (AT040) is to serve as a forum for leaders from federal, state, regional, and local government; industry; academia; and the research community to participate in the discussion and analysis of issues related to improving the safe, secure, and efficient transportation of hazardous materials and the identification of specific research needs. The scope of interest includes all aspects of the packaging, handling, storage, emergency response, and transportation of hazardous materials, across all modes of transportation (i.e., highway, rail, air, marine, and pipeline). The Committee seeks to accomplish its mission in three ways: 1) issue identification, 2) issue facilitation, and 3) information dissemination. The Committee will accomplish this through utilization of annual TRB meetings, special issue-oriented subcommittees, hazmat transportation conferences, consensus forums, preparation of Research Needs Statements, and support of joint research projects between industry, government, academia, and the research community.

The committee is concerned with the protection of human health and the environment through the safe and secure packaging, handling, storage and transportation of hazardous materials, and effective response to hazardous materials incidents. Our scope includes:

- risk management and communication including the tools and technologies used to support planning, mapping, and risk assessments to focus efforts on the greatest risks to the public and the environment;
- hazard identification, classification, and preparation of hazardous materials and hazardous articles for transportation;
- identification of conditions and forces encountered during transportation of hazardous materials including mitigation strategies using new technology and packaging;
- consequence assessment, mitigation planning, and response planning in relation to hazardous materials transport incidents;
- legal and regulatory controls affecting hazardous materials;
- support and training at state, regional, and local levels of government including emergency management officials, local emergency planning committees and emergency response personnel;
- support and training for shippers, carriers, handlers, freight forwarders, and other personnel involved in the hazardous materials transportation supply chain to promote compliance, transportation efficiency, safety, and security;
- development of hazardous materials professional educational programs; and

- identification of sources of information to support data analysis, resource planning, and emergency response planning.

Leadership Chair and Vice Chair History

2019-Present David Willauer
2013-2019 Richard Bornhorst (Chair)
2007-2013 Mark Lepofsky (Chair)
2002-2007 Dennis Ashworth (Chair)
1996-2002 John Allen (Chair)
1990-1996 Mark Abkowitz (Chair)
1987-1990 Edith Page (Chair)
1983-1987 Dennis Price (Chair)
1981-1983 Karsten Vieg (Chair)
1978-1981 William Brobst (Chair)
1976-1978 Anthony Schmieg (Chair)
1974-1976 Clyde Perry (Chair)
1964-1974 Donald L. Katz (Chair)

TRB Staff Liaison

2013-Present Scott Babcock
2013 Tom Palmerlee
2011-2012 Ann Purdue
2008-2010 Elaine King
1989-2007 Frank Lisle

Membership

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Erica Bickford	, Vice Chair U.S. Department of Energy (DOE)
Mohamed Ahmed	University of Wyoming
Rob Benedict	American Fuel & Petrochemical Manufacturers (AFPM)
David Bierling	Texas A&M Transportation Institute (TTI)
Rick Boyle	Pipeline and Hazardous Materials Safety Administration (PHMSA)
Michael Bronzini	3 Sigma Consultants
Diedre Carrigan	USDOT Volpe
Brad Darr	North Dakota DOT
Kurt Eichenlaub	Federal Railroad Administration (FRA)
Andy Elkins	Association of American Railroads
Khalid Farrag	Gas Technology Institute
Will Holik	Texas A&M Transportation Institute (TTI)
Bahareh Inaloo	Atkins
Mark Lepofsky	FACTOR, Inc.
Xiang Liu	Rutgers University
Amy Parker	U.S. Coast Guard

Tom Pfitzer	APT Associates
Natalie Peloquin	Transport Canada
Robert Richard	Hazmat Safety Consulting
Ronald Raunikar	PHMSA
Ziqi Song	Utah State University
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International Members

Monica Blaney	Transport Canada
Barbara Di Bacco	Transport Canada
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Young Members

Mohd Rapik Saat	University of Illinois, Urbana Champaign
Marc Fialkoff	Oakridge National Lab

FUTURE TRENDS

The United States' and Canada's continued expansion of energy extraction opportunities and production of additional oil and gas will put more pressure on the U.S. transportation system, with impacts to highways, railroads, pipelines, airports and seaports. The abundance of natural gas in the United States has also resulted in more manufacturing and chemical companies relocating facilities to the United States instead of the previous trend of building plants in other countries. Emerging hazardous materials handling technologies will need to be developed in response to the changing technology landscape. The movement toward the automation of transportation systems, networks and loading and unloading operations will have implications for cyber security threats and will impact hazardous materials storage, handling and transport systems and protocols.

The biggest challenges facing the hazardous materials transportation community are risk management and emergency response. The chemical transportation industry is growing. This growth can be attributed to mining new shale oil reserves (petroleum, natural gas, etc.); the rapid development of communications and power technologies (lithium batteries, fuel cells, etc.), and population growth in general. This growth is also placing strain on aging transportation infrastructure leading to an increase in accidents. In this respect, more research is needed to find cost-effective infrastructure and transport solutions that can be implemented in the near term.

In response to these trends, the committee can serve as a bridge between federal, state, regional, and local government; industry; academia; and the research community to improve the applicability, quality, and usefulness of both data and research to assess risk and address the key issues in the field of hazardous materials transportation.

Future Research Priorities

1. To serve as a catalyst for innovative concepts and new technology that has the potential to improve the planning, safety, security, and efficiency of hazardous materials transportation.
2. To stimulate and synthesize research and technology transfer.
3. To develop liaisons with related TRB committees, government panels, and other technical and industry organizations to identify and disseminate related research that helps to support the goals and mission of the Committee.

Factors

The following factors will influence the direction of committee activities:

- Funding for HMCRP, NCFRP, and other cooperative research programs
- Funding for large transportation projects
- Adoption of recommendations from completed HMCRP work at the UN Subcommittee of Experts on the Transport of Dangerous Goods (UN SCOE TDG), the International Civil Aviation Organization (ICAO), the International Maritime Organization (IMO), and the US DOT
- Implementing recommendations from completed TRB, HMCRP and other studies by industry and academia
- Lithium battery rulemaking
- Next generation rail car rulemaking
- Reverse logistics rulemaking

Implementation Strategies

1. Identify and focus on the most applicable research for the pressing issues confronting government and industry with a focus on the highest risks and the effective use of limited resources.
2. Provide guidance on data needs and supporting analyses that would help both industry and government to improve hazmat transportation safety and security.
3. Promote the development of a forum composed of industry, government academia, and the research community to identify common research needs and share current research plans so as to help avoid duplication or gaps in hazardous materials transportation research being conducted.
4. Promote the development of joint government/industry programs to support and participate in research that will address common areas of interests.
5. Sponsor and/or co-sponsor symposia, workshops, and specialty sessions at the Annual TRB Meetings and at other locations, as appropriate.
6. Review papers presented to TRB within the scope of the Committee activities and assist in publication of these papers in the TRB Research Record (TRR).
7. Promote the development and understanding of the concept of the comprehensive (system-oriented) risk management approach to hazardous material transportation safety, security, and efficiency.
8. Promote the effective use of technology to improve container integrity, emergency response, and other aspects of hazardous materials transportation, which have benefits to safety, security, and the environment.

9. Define critical issues and research needs.
10. Develop state-of-the-art reports and other publications to facilitate implementation of research results.
11. Identify opportunities to improve planning, communication, and information exchange between metropolitan/regional transportation planning organizations (MPOs, RPOs) and local emergency planning committees (LEPCs).
12. Focus on external communications fostering broad participation in discussion and research on emerging hazmat transportation issues.
13. Form subcommittees jointly with TRB committees, government panels, and other technical and industry organizations on emerging hazmat transportation issues.

Conclusion

For more than 150 years hazardous materials transport safety has been a topic of interest for federal regulators, state and local governments, industry, academia, and others. In that period of time the complexities of different hazard classes, transport modes, risk considerations, emergency response needs, and regulations have continued to grow. As the 21st century brings new technologies, new energy sources, and new petrochemical products to markets, it will be more important than ever to ensure there are robust mechanisms in place to address research and development needs, and advise on regulatory matters. The TRB Hazardous Materials Transportation Committee is prepared to support these activities through its diverse membership and investment in addressing a broad range of hazardous materials transport issues.

Appendix A
Chronology of Historical Hazmat Events - 1866 to Present

1866 A nitroglycerin explosion in San Francisco killed 14 people
1871 Legislation is passed to limit the amount of hazardous materials transported on ships
1887 The establishment of the Interstate Commerce Commission (ICC)
1903 Freight car explosion in Ohio brought attention to hazardous material shipments
1907 The Bureau of Explosives (BOE) of the Association of American Railroads is formed
1908 Explosives and Combustibles Act, authorizing ICC to issue regulations
1909 Legislation expanded to include ground transportation of hazardous goods
1917 The Halifax Explosion, a collision involving a French cargo ship carrying war explosives
1917 Explosives Act of 1917, to standardize requirements for storing explosives
1937 The London School Explosion, TX, (natural gas) leading to an odorization law
1947 Texas City Disaster: 2,300 tons of ammonium nitrate detonates on a ship, killing 580
1958 Legislation passed to regulate hazardous material shipments via air
1963 Congress enacts the Clean Air Act (CAA) to protect from airborne contaminants
1964 Committee on Hazardous Materials is formed under the National Research Council
1966 Hazardous materials regulation authority was transferred from ICC to the DOT
1966 NTSB was created as an arm of the Department of Transportation
1969 Committee on Transportation of Hazardous Materials formed
1970 Hazardous Material Transportation Control Act passed by Congress
1973 Crash of a 707 cargo jet hauling several tons of hazardous materials
1973 Kingman, AZ BLEVE, a catastrophic propane gas explosion 33,000 gallons of LPG
1974 Committee on Transportation of Hazardous Materials was designated as A3C10
1975 NTSB becomes an independent agency that reports directly to Congress
1976 Love Canal (Niagara NY): Toxic Industrial Site problems result in Superfund Act
1976 Environmental Response Compensation and Liability Act (CERCLA)
1976 Anhydrous Ammonia Release, Houston, TX, involving a truck tanker, killing six people
1978 Waverly, TN BLEVE: 23 cars of a freight train derailed and killed 16 people
1979 Mississauga, ON Train Derailment: 23 cars derail, evacuation of over 218,000 people
1979 The Federal Emergency Management Agency (FEMA) was established
1980 U.S. Department of Commerce: Commodity Flow Study includes Hazardous Materials
1982 International Civil Aviation Organization, air transportation of dangerous goods
1982 DOE responsible for moving high-level nuclear waste (Nuclear Waste Policy Act)
1984 Bhopal disaster, over 500,000 people were exposed to methyl isocyanate (MIC) gas
1985 EPA develops the Chemical Emergency Preparedness Program strategy
1985 Molten Sulfur Release, Benicia, CA, Two tractor trailers burn, two people killed
1986 Congress passes Emergency Planning and Community Right-to-Know Act (EPCRA)
1987 The National Response Team issues “Hazardous Materials Emergency Planning Guide”
1987 Governors designate State Emergency Response Commissions (SERCs)
1987 NRT issues Emergency Planning for Extremely Hazardous Substances Guidebook

1988 EPA and NOAA develop Computer-Aided Management of Emergency Operations
1988 National Association of SARA Title III Program Officials (NASTTPO) established
1989 EPA publishes “The Toxics Release Inventory” (TRI) report for 1987 data
1989 Congress passes the Toxic Substances Control Act (TSCA) to regulate toxic substances
1989 Toxic and Hazardous Substances, Title III and Communities Guidebook is published
1989 Oil Tanker Exxon Valdez, runs aground in Alaska, spilling 11 million gallons of crude oil
1990 Congress passes the Pollution Prevention Act requiring pollution data reporting
1990 Congress amends Clean Air Act (CAA) to include the EPA Risk Management Program
1990 “Hazardous Materials Exercise Program Handbook for Local Officials” published
1991 EPA develops the “Consolidated List of Chemicals Subject to the Emergency Planning”
1995 Oklahoma City Federal Building bombed, killing 168 people
1995 Superfund's Emergency Response Program Expands to Address Terrorist Acts
1996 ValuJet Flight 592 crashed in the Florida Everglades, killing 110 passengers and crew
1996 Train derailment, Alberton, Montana with chlorine gas,evacuation of 1,000 people
1996 EPA publishes final rule on requirements for facility Risk Management Plans
1998 Tank fire in Biloxi, Mississippi, ignited while unloading of a tank truck kills five people
1998 Chemical Safety Board established to investigate industrial chemical accidents
1999 Chemical Safety Information, Site Security & Fuels Regulatory Relief Act
2000 Hazmat Committee moved to the Freight Systems Group and was designated A1B14
2001 September 11, World Trade Center and Pentagon Attacks
2001 Congress passes the Aviation and Transportation Security Act of 2001, creating TSA
2002 Congress passes the Homeland Security Act of 2002
2002 Department of Homeland Security (DHS) is created in response to 9-11 attacks
2003 Census publishes Economic Census, Hazardous Materials Commodity Flow Survey
2004 Pipeline and Hazardous Materials Safety Administration (PHMSA) is established
2004 Hazmat Committee renamed AT040 with the overhaul of the TRB Committee structure
2004 DOT’s first comprehensive national routing regulations, HM-164
2004 NRC initiates nationwide transportation program for movement of nuclear waste.
2005 DHS establishes Chemical Facility Anti-Terrorism Standards (CFATS)
2005 Hurricane Katrina, and subsequent Gulf Coast hurricanes
2007 Renewable Fuels Standard passed, requiring ethanol blending in gasoline
2008 Hazmat Routing around urban areas requiring assessing risks using 28 risk factors
2008 Shale Oil and Gas reserves are discovered and hydraulic fracking techniques
2010 UPS Flight 6 crashed outside of Dubai, killing both pilots
2010 Deepwater Horizon Oil Spill results in 11 deaths and 210 million gallons of oil spilled
2013 West, Texas Explosion at an ammonium nitrate facility kills 15, most first responders
2013 Lac Megantic, Quebec Disaster/derailment, releasing crude oil and killing 47 people
2014 New Brunswick, Canada: A 122-car Canadian National Railway train derailed
2014 Philadelphia, PA, Seven rail cars derailed on a bridge over the Schuylkill River
2014 In Lynchburg, VA, 15 cars of a crude oil train derailed next to the James River.

2015 Ontario, Canada, a 100-car CN train hauling crude oil and petroleum distillates derails
2015 Mount Carbon, WV, a 109-car CSX oil train derailed and caught fire
2015 Galena, IL, 21 cars of a 105-car BNSF train derailed and burned
2015 Gogama, Ontario, a 94-car CN train derailed and the resulting fire destroyed a bridge
2015 Heimdal, ND, a 109-car BNSF train derails and six cars burn
2015 Culberson, MT, 20 cars from a 108-car BNSF oil train derailed
2015 Watertown, WI, 12 cars derail from a CP train prompting a local evacuation
2016 Columbia River Gorge, OR, a UP train derails in resulting in a large fire
2017 CSX Train with 115 cars derails in Plainfield, LA, 20 cars derail
2018 BNSF freight train derailed 33 DOT-117R tank cars in Doon, Iowa with no release

REFERENCES

1. USDOT Pipeline and Hazardous Materials Safety Administration (PHMSA)
2. American Chemistry Council (ACC)
3. Association of American Railroads (AAR)
4. Bureau of Transportation Statistics (BTS)
5. Energy Information Administration (EIA
6. TRB. 2003. *Special Report 272: Airport Research Needs: Cooperative Solutions.* National
7. Research Council, Washington, D.C.
8. Overview of Hazardous Materials Transportation, Transportation Research Board, Washington, D.C., 2005. *Cooperative Research for Hazardous Materials Transportation: Defining the Need, Converging on Solutions -- Special Report 283*.
9. Vance Bennett, CalEMA/CSTI, vance.bennett@calema.ca.gov
10. Transportation and Hazardous Materials History, PHMSA
11. DGM New York, https://www.dgm-usa-ny.com/hazardous-materials-history
12. Federal Aviation Administration, History of Hazardous Materials Safety Program https://www.faa.gov/about/office_org/headquarters_offices/ash/ash_offices/hazardous_materials_safety/history/
13. Hazardous Materials Transportation Regulations, 1974, Princeton University https://www.princeton.edu/~ota/disk2/1986/8636/863606.PDF
14. Notable Hazardous Materials Incidents – Disaster Preparedness Portal http://disasterpreparednesscourse.com/disaster-hazards/hazmat-incidents/hazardous-materials-hazmat-incidents-notable/
15. A Brief History of USCG Hazardous Materials Management, Final Report, 1998 https://apps.dtic.mil/dtic/tr/fulltext/u2/a345536.pdf
16. The Bhopal Medical Appeal, https://www.bhopal.org/basic-facts-figures-numbers-of-dead-and-injured-bhopal-disaster/