# Paperless Hazard Communications Pilot Program

## Moving Ahead for Progress in the 21st Century Act (MAP-21): Congressional Report


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## Disclaimer

The HM-ACCESS Project described in this report was conducted over a four-year period from 2011 to 2015. While PHMSA has attempted to verify that the information collected during this project is accurate as of the date of this report, some of the information in this report was collected earlier in the project and may not reflect the current status of stakeholder e-system initiatives and activities.

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# List of Abbreviations

| Abbreviation | Term |
|---|---|
| AAR | Association of American Railroads |
| ACC | American Chemistry Council |
| AEI | Automatic Equipment Identification |
| ANSI | American National Standards Institute |
| ANSI X12 | ANSI EDI Standards |
| APCO | Association of Public-Safety Communications Officials |
| API | American Petroleum Institute |
| APL | APL Limited |
| ATA | American Trucking Associations |
| CAD | Computer Aid Dispatch |
| CAPRI | Compliance Analysis and Performance Review Information |
| CCTV | Closed-Circuit Television |
| CFR | Code of Federal Regulations |
| CGA | Compressed Gas Association |
| CG-FAC | Cargo and Facilities Division (USCG) |
| CI | The Chlorine Institute |
| COSTHA | Council on Safe Transportation of Hazardous Articles, Inc. |
| COTS | Commercial Off the Shelf |
| CSA | Compliance, Safety, and Accountability (an FMCSA program) |
| CVSA | Commercial Vehicle Safety Alliance |
| DFAS | Defense Finance and Accounting Services |
| DGRs | Dangerous Goods Regulations |
| DLA | Defense Logistics Agency |
| DOD | Department of Defense |
| DOE | Department of Energy |
| DOT | Department of Transportation |
| DTEB | Defense Transportation Electronic Business |
| E-COMMERCE | Electronic Commerce |
| E-DATA | Electronic Data |
| EDI | Electronic Data Interchange |
| E-HM | Paperless Hazardous Materials |
| E-MANIFEST | Electronic Hazardous Waste Manifest |
| EMS | Emergency Medical Service |
| EPA | Environmental Protection Agency |
| ER | Emergency Response |
| ERO | Emergency Response Organization |
| E-SYSTEM | Paperless Hazardous Materials Communication System |
| FAA | Federal Aviation Administration |
| FAX | Facsimile |
| FMCSA | Federal Motor Carrier Safety Administration |
| FO | Flight Object |
| FR | Federal Register |
| FRA | Federal Railroad Administration |
| FTE | Full-Time Equivalent |
| GSA | General Services Administration |

| Abbreviation | Term |
|---|---|
| HM | Hazardous Material(s) |
| HM-ACCESS | Hazardous Materials Automated Cargo Communications for Efficient and Safe Shipments |
| HMCRP | Hazardous Materials Cooperative Research Program (TRB) |
| HMPIP | Hazardous Materials Package Inspection Program |
| HMR | Hazardous Materials Regulations |
| HW | Hazardous Waste |
| IAFC | International Association of Fire Chiefs |
| IAFF | International Association of Fire Fighters |
| IATA | International Air Transport Association |
| ICAO | International Civil Aviation Organization |
| ICP | Information Collection Package |
| IMDG | International Maritime Dangerous Goods |
| IME | Institute of Makers of Explosives |
| IP | Internet Protocol |
| IVODGA | International Vessel Operators Dangerous Goods Association |
| JPEG | Joint Photographic Experts Group |
| LEIO | Law Enforcement Inspection Organization |
| LTL | Less than Truckload |
| MAP-21 | Moving Ahead for Progress in the 21st Century Act |
| MCMIS | Motor Carrier Management Information System (FMCSA) |
| MCSAP | Motor Carrier Safety Assistance Program |
| MDT | Mobile Data Terminal |
| NAFTD | North American Fire Training Directors |
| NFPA | National Fire Protection Agency |
| NOPIC | Notification of Pilot–in-Command |
| NPRM | Notice of Proposed Rulemaking |
| NTSB | National Transportation Safety Board |
| NTTC | National Tank Truck Carriers |
| NVFC | National Volunteer Fire Council |
| OMB | Office of Management and Budget |
| OOIDA | Owner-Operator Independent Drivers Association |
| OREIS | Operation Respond Emergency Information System |
| ORI | Operation Respond Institute |
| ORNL | Oak Ridge National Laboratory |
| PDA | Personal Digital Assistant |
| PDF | Portable Document Format |
| PHMSA | Pipeline and Hazardous Materials Safety Administration |
| POC | Point-of-Contact |
| PRA | Paperwork Reduction Act |
| PSAP | Public Service Answering Point |
| RFID | Radio Frequency Identification |
| RITS | Radio Frequency Identification Transportation System |
| S/C | Shipper/Carrier |
| SAFER | Safety and Fitness Electronic Records |
| SDDG | Shipper's Declaration for Dangerous Goods |
| SDS | Safety Data Sheet |
| SP | Special Permit |

| Abbreviation | Term |
|---|---|
| TRB | Transportation Research Board |
| TURNKEY | Turnkey Technical Services, LLC |
| UCOR | URS—CH2M Oak Ridge LLC |
| UN | United Nations |
| UPS | United Parcel Service |
| URL | Uniform Resource Locator |
| USCG | The United States Coast Guard |
| USTRANSCOM | United States Transportation Command |
| WATCO | Watco Companies, LLC |
| XML | Extensible Markup Language |

# Executive Summary

The Hazardous Materials Regulations (HMR)—49 Code of Federal Regulations, Parts 171–180—require persons who offer hazardous materials (HM) for transportation in commerce to describe key hazard communication information on a shipping paper. Currently, the HMR requires a paper copy of the shipping paper to accompany HM in transport. After the HM is no longer in transport, shippers and carriers must retain and make accessible the hardcopy shipping paper or an electronic image of it for one year. For a hazardous waste, the shipping paper copy must be retained for three years after the material is accepted by the initial carrier. For all other HM, the shipping paper must be retained for two years after the material is accepted by the initial carrier. Consideration for allowing the use of electronic communication while HM is in transport is the next step in the evolution of hazard communication.

Section 33005 of the Moving Ahead for Progress in the 21st Century Act (MAP-21) authorizes the Secretary to conduct pilot projects to evaluate the feasibility and effectiveness of using paperless hazard communications systems. In support of this authority, PHMSA conducted pilot projects in 2015 to test the feasibility and effectiveness of using paperless hazardous materials (e-HM) communication systems (e-systems) to communicate HM shipping paper information while the HM is in transport. In accordance with MAP-21, this report provides a summation of the information and feedback obtained regarding the feasibility and effectiveness of using e-systems and provides a recommendation on whether e-systems should be incorporated into the Federal hazardous material transportation safety program permanently under Chapter 51 of Title 49, of the United States Code.

Information and feedback presented within this report were obtained from:

- Consultation activities (between 2012 and 2015) with HM stakeholders, including Federal and State authorities, emergency responders, law enforcement, and the HM industry (shippers and carriers), with the objective of obtaining feedback on the priorities, gaps, concerns, and operational requirements associated with using e-systems;
- Execution of 21 pilot tests (between February 17, 2015 to May 15, 2015) with volunteer entities who prepare HM for shipment (i.e., shippers), transport HM (i.e., carriers), inspect HM shipments (i.e., law enforcement investigators), and respond to accidents involving HM (i.e., emergency responders). The pilot tests were conducted within five U.S. regions (Western, Central, Southwestern, Southern, and Eastern) and included one rural area (in accordance with MAP-21). The objective of the tests was to collect data regarding the feasibility, effectiveness, and safety associated with the electronic transfer of HM shipping paper data during inspection and emergency response simulations utilizing pilot test participants' existing equipment and resources. Hard copies of HM shipping papers still accompanied each HM shipment, as required by current regulations; and
- A voluntary impact analysis, collected from a data question set completed online by 92 respondents (between February 17, 2015, and May 15, 2015). The respondents represented different HM stakeholders, including Federal and State authorities, emergency responders, law enforcement officials, and different segments of the industry (shippers, carriers, freight forwarders, HM trainers, HM equipment vendors, etc.). The objective of the question set was to collect information to aid in a qualitative assessment of potential impacts associated with using e-

systems to communicate HM shipping paper information.

## Findings and Conclusions

***Modal Shippers and Carriers***

Many shippers in all modes already have e-systems containing HM shipping information, and Air, Maritime, and Rail Mode carriers have e-systems in place for communicating HM shipping paper information. As long as they are allowed to use performance-based e-systems that provide them with flexibility to conduct their businesses in a cost-effective and efficient manner, these shippers and carriers should be able to use e-systems effectively for communicating HM shipping paper information.

In general, HM transport by roadway carriers is significantly different from, and in some cases more complex than, their modal counterparts. Although some roadway carriers already have established e-systems, the feasibility and effectiveness of communicating HM shipping paper information may be difficult or impractical for other roadway carriers. For example, those who require an HM paper documentation trail, cannot afford to purchase or invest in an e-system; do not have the onboard technology for receiving and transmitting e-HM information; or transport HM in areas with poor Internet connectivity.

Shippers and carriers looking to utilize e-systems for sending and receiving e-HM data need to ensure that accurate and complete e-HM data can be accessed at all times and shared promptly and that permission protocols for authorizing shipper and carrier personnel to provide e-HM information to inspectors, and emergency responders are developed and implemented. Furthermore, shippers and carriers will need to be able to communicate the e-HM information in an open, easily transferable and readable e-data format.

Carriers in all modes utilizing e-systems will need to apply a visual aid (such as a placard) to indicate HM shipping paper information is being communicated electronically and a visual indication of how to obtain the e-HM information [such as a point-of-contact (POC) telephone number or website] to the exterior of HM transportation conveyances. These visual signals are important for inspectors and emergency responders to recognize conveyances transporting HM using e-HM shipping papers and know how to obtain the e-HM data. Carriers who want to participate in e-HM data sharing need to ensure their operators are provided with devices capable of receiving, storing, and transmitting electronic HM information, for quick access and sharing of HM information with inspectors and emergency responders. Operators need to be provided with a device to provide e-HM data directly to inspectors and emergency responders when HM is being transported within areas of known Internet connectivity issues.

***Law Enforcement Inspectors***

The Air and Rail Mode industry practices require the HM shipping paper information be provided electronically before the HM is accepted by the carrier for transport. Industry practices in both modes require operations personnel to compare the hardcopy HM shipping paper information with the physical HM before transport. As the HM shipping paper information is currently required to be provided electronically, inspectors in these modes should be able to use e-systems effectively to receive and review the e-HM information. Many inspectors in these modes already possess electronic devices capable of receiving e-HM data; however, these devices are not standardized and as such devices may need to be procured for some inspectors.

Currently, many HM inspectors in the Maritime Mode (the USCG container inspectors) are not equipped with electronic devices either capable of or permitted to be used for, receiving e-HM shipping paper information during the administration of HM container inspections. The USCG purchased electronic tablets in 2014 for inspectors to use for accessing reference materials while conducting field activities. The USCG recommends that the use of such devices be expanded in the future; these devices could potentially be used by maritime container inspectors to access e-HM shipping paper information during container inspection activities.

Roadway inspectors are provided laptops and have access to a variety of databases for searching and storing HM information. These roadway inspectors should be able to receive e-HM shipping paper information effectively from shippers and carriers who have e-systems capable transmitting the e-HM information.

***Emergency Responders***

Emergency responders in urban areas with existing response systems and networks should be capable of effectively receiving and transmitting HM shipping paper information via e-systems. However, some emergency response organizations are volunteer-based or exist in rural or geographically challenging areas with limited Internet connectivity. Some of these challenged areas may also have limited access to the electronic devices needed not be able to obtain e-HM data at the scene of an accident or incident, and directly from the carrier or shipper until solutions to these issues are identified and implemented. These emergency response organizations will need to rely on verbal communication of HM data to on-scene emergency responders using their other existing layered and redundant backup systems to receive HM shipping paper information from shipper's and carrier's e-systems.

***E-systems' Impacts, Benefits, and Costs***

The e-system concept requires, at least, an equivalent level of safety and security as compared to the current hardcopy-based system of hazard communication. The following pieces of evidence provide some insight into e-systems' potential safety and security impacts:

- Some e-systems may be able to provide improved safety by increasing the accuracy and timeliness of information received by first responders;
- E-systems can reduce the possibility of HM shipping documents being lost or damaged, and software interfaces can contribute to reducing data source errors, such as misspellings;
- E-systems that have redundancy capabilities are potentially more robust than hardcopy shipping papers in the event of an accident or incident;
- In the case of a serious vehicle crash or fire, the ability to obtain HM information electronically—and without having to approach the vehicle—may improve safety for responders and improve the effectiveness of their efforts; and
- E-systems that have been verified and tested as being protected from unauthorized access may provide better security of HM information, by requiring vetted, authorized users to provide user authentication information before gaining access to HM information.

Additional e-systems' safety and security impact considerations include impacts associated with outages or telecommunications problems; impacts if an e-system is hacked, and associated HM data is

compromised/altered/deleted; and e-system limitations associated with situations such as occasional system outages. The full magnitude of these safety and security impacts is difficult to quantify until more operational experience with e-systems is gained.

The cost-benefits of electronic hazard communication for shippers and carriers are variable across modes, but may have commonalities in administrative areas, such as decreasing redundant data entries—which in turn reduces data entry errors and associated delays. More direct administrative cost savings would vary across different organizations, industries, and e-system formats, the reduction in time required to prepare shipping papers electronically is expected to be more pronounced for shippers than for carriers, and for larger firms than for smaller firms. There may also be significant cost-benefits for companies that can decrease HM transit times, which could lead to broader supply chain benefits (e.g., lower inventory costs).

Transitioning from the current paper-based system to an e-system may entail substantial implementation costs. These costs are likely to vary among transportation modes, due to differences in their existing use of e-systems and the nature of their HM operations. Even within particular modes, the impacts will vary based on factors such as business type and size; the range of HM commodities transported; whether an e-system is already being utilized; whether HM information can be accessed via or added to the e-system's data fields; and if the business can sustain profitability while, and/or identify a dual-benefit for, implementing an e-system. Development, implementation, operation, and maintenance costs need to be considered, as these costs will vary widely depending on the number of employees requiring training on, and the complexity of, the e-system. Conversion to an e-HM approach will likely be less costly for shippers and carriers that are already using e-systems and will provide more immediate business benefits in terms of reduced administrative costs.

Another cost-benefit consideration is that hardcopy shipping papers are used in some modes and industries for purposes other than HM communication. As such, the additional business processes covered by the hardcopy shipping papers could potentially be affected by transitioning to an e-system. Also, companies, especially those in the Roadway Mode, facing challenges such as e-system implementation impediments, problems with electronic communication mechanisms, and the existence of "dead spots" in wireless communication will likely face additional technological costs and complexities in transitioning to an e-system.

## Recommendations

Based on the findings and information collected under this study, Volpe believes e-systems can be a feasible and effective alternative to hardcopy documentation for communicating HM shipping paper information during the transport of HM. Volpe also believes e-systems can provide an equivalent level of safety and security already provided by hardcopy shipping papers if certain performance standards are met.

Consequently, Volpe recommends considering a rulemaking to modify the HMR to permit the use of e-systems for communicating e-HM shipping paper information if a set of minimum performance-based standards are met. Recommended performance criteria to be evaluated and defined during the rulemaking process include requiring:

- An identified POC is available for providing the e-HM information 24 hours per day, seven days per week;
- All HM shipping paper information is provided electronically on-demand within a defined time interval after the initial request (***Note:*** DOT-SP 15747 in Appendix H: UPS Special Permit 15747 requires that the e-HM shipping paper information be provided "without delay" to emergency responders and inspectors in a single transmission within five minutes from when the initial request is received by the UPS call center);
- Shippers and carriers develop, document and train (initial and refresher) affected staff on their equipment, procedures, and security protocols associated with providing e-HM communications in HM transportation;
- A performance definition for paperless communication that is flexible; permits the use of different technologies (because of variations in existing systems, across industry, modes, and continually evolving technologies); and provides the e-HM information in an open, easily transferable and readable e-data format (such as, but not limited to, pdf) is developed;
- A standardized defined visual aid (such as a placard) indicating that the HM shipping paper information will be communicated electronically, along with a means to obtain the e-HM information (such as a POC telephone number or website) is visible on the exterior of the transportation conveyance; and
- In areas with known Internet connectivity issues, transportation conveyance operators must have the means to directly provide the e-HM information to local HM inspectors and emergency responders (e.g., print the HM shipping paper information directly from a device in the transportation conveyance, show the HM shipping paper information on a laptop/tablet screen, etc.), and are provided with a backup procedure for obtaining the HM shipping paper information and providing the HM shipping paper information to local HM inspectors and emergency responders.

PHMSA also recommends that additional pilot tests/research studies involving a larger diverse set of stakeholders in all modes under various conditions and using a variety of electronic devices and scenarios be conducted to test and examine the recommended minimum e-system performance standards. These additional pilot tests/research studies will provide data to support rulemaking considerations to allow the use of e-systems for communicating e-HM shipping paper information while the HM is in transport.

In addition, the DOT, the EPA, and other agencies should continue to coordinate efforts for developing and implementing electronic communications, including EPA's E-Manifest Program.

# 1. Introduction

The Hazardous Materials Regulations (HMR)—49 Code of Federal Regulations (CFR), Parts 171–180—require a person who offers HM for transportation in commerce to describe the HM on a shipping paper in the manner required in 49 CFR Part 172, Subpart C. The shipping paper requirements identify key hazard communication information [i.e., United Nations (UN) number, proper shipping name, hazard class, Packing Group, type and quantity of packaging, and emergency response telephone number]. Unless an exception from the shipping paper requirements is provided in the regulations, a paper copy of the shipping paper must accompany HM during transportation. A shipping paper includes ‘‘a shipping order, bill of lading, manifest or other shipping document serving a similar purpose and containing the information required by §§ 172.202, 172.203, and 172.204’’ (49 CFR 171.8, the definition of ‘‘shipping paper’’). Hazardous waste (HW) manifest ‘‘may be used as the shipping paper’’ if it contains all the information required by Part 172, Subpart C [49 CFR 172.205(h)]. The rationale behind a paper-based system is to convey the necessary information in a consistent manner that is widely understood and accepted by all regulated entities, law enforcement, and emergency responders.

In 1994, Congress amended the Federal HM transportation law to require that, after an HM ‘‘is no longer in transportation,’’ all offerors and carriers of a HM must retain the shipping paper ‘‘or electronic image thereof for a period of one year to be accessible through their respective principal places of business’’ [49 U.S.C. 5110(e), added by Pub. L. 103–311, Title I, § 115, 108 Stat. 1678 (Aug. 26, 1994)]. An electronic image includes an image transmitted by a facsimile (Fax) machine, an image on the screen of a computer, or an image generated by an optical imaging machine. In 2002, the Research and Special Programs Administration (the predecessor to PHMSA) issued final rules (67 FR 46123 and 67 FR 66571) further amending Parts 172, 174, 175, and 176 of the HMR regarding the retention and information requirements associated with shipping papers; these final rules require shippers and carriers to retain a copy of each HM shipping paper, or an electronic image thereof, for a period of 375 days[1] after the date the HM is accepted by the initial carrier. In 67 FR 66571, stipulates that HM shipping papers must be accessible at or through the shippers’ and carriers’ principal places of business and must be made available, upon request, to an authorized official of a Federal, State, or local government agency at reasonable times and locations. For a hazardous waste, the shipping paper copy must be retained for three years after the material is accepted by the initial carrier. For all other HM, the shipping paper must be retained for two years after the material is accepted by the initial carrier. Consideration for allowing the use of electronic communication (e-communication) while HM is actually in transportation is the next step in the evolution of hazard communication.

Title III—Hazardous Materials Transportation Safety Improvement Act of 2012, Section 33005, “Paperless Hazard Communications Pilot Program” of the “Moving Ahead for Progress in the 21st Century Act” (MAP-21) provided PHMSA the authority to conduct pilot projects to test the feasibility and effectiveness of using paperless hazardous materials (e-HM) communication systems (e-systems) to communicate HM shipping paper information. MAP-21, Section 33005 is provided in Appendix A: MAP-21, Section 33005.

[1] If the HM is an HW, the shipping paper, or an electronic image thereof, must be maintained by the shippers and carriers for three years after the material is accepted by the initial carrier (67 FR 46123 and 67 FR 66571).

The purpose of this report is to communicate information and feedback obtained to date regarding the feasibility and effectiveness of using e-systems to provide HM shipping paper information during the transport of HM, and to provide a recommendation to Congress as to whether e-systems should be offered as an alternative to hardcopy shipping papers for HM stakeholders whose e-systems meet minimum performance standard metrics.

Chapter 2 provides historical and background information regarding PHMSA's responsibilities associated with HM shipments (Section 2.1) and its paperless hazard communications efforts (Section 2.3). It also includes the MAP-21 paperless hazard communication requirements for PHMSA (Section 2.2).

Chapter 3 identifies consultation activities between PHMSA and HM stakeholders conducted between 2012 and 2015. These activities included communicating with Federal and private companies currently using e-systems (Section 3.2) and holding discussions and meetings with HM stakeholders (i.e., shippers, carriers, law enforcement inspectors, and emergency responders) (Section 3.3). This chapter also includes assessments by mode regarding e-communication (Section 3.1).

Chapter 4 describes the pilot test planning and implementation activities, including facilitating meetings to discuss pilot test emergency response and inspection simulation procedures (Section 4.1); publishing pilot test 60-Day and 30-Day *Federal Register* Notices (Section 4.2); developing pilot test participant, simulation, and impact analysis question sets (Section 4.3); submitting a pilot test information collection package (ICP) to, and obtaining approval from, the Office of Management and Budget (OMB) (Section 0); selecting pilot test participants (Section 4.5); developing and organizing regional pilot test participant webinar orientation sessions (Section 4.6); and conducting pilot test coordination and implementation activities (Section 4.7).

The pilot test inspection and emergency response simulation question sets (Appendix L: Pilot Test Inspection Simulation Question Set and Appendix M: Pilot Test Emergency Response Simulation Question Set, respectively) were designed to evaluate the use of e-systems during actual HM shipments to transfer HM information between HM stakeholders (i.e., shippers, carriers, law enforcement inspection personnel, and emergency responders); the pilot test data is provided in Chapter 5. The objective of the pilot test simulations was to gather limited, non-generalizable data on the benefits and limitations of using e-systems to communicate HM shipping paper information in all transportation modes (Air, Maritime, Rail, and Roadway) and to assess whether e-systems offer an equivalent or better level of safety as currently provided by hardcopy shipping papers.

In conjunction with the pilot test simulations, PHMSA developed a voluntary impact analysis question set (Appendix N: Pilot Test Impact Analysis Question Set) for the wider HM community (HM stakeholders; Federal, state, and local government agencies; HM/emergency response training companies/educational associations; HM/emergency response equipment/software developers/vendors; trade associations; freight forwarders/brokers; and media companies) to report their experiences regarding the use, development, cost, benefits, and challenges associations with e-systems. Chapter 6 includes the impact analysis.

Analysis and evaluation of the pilot test and impact analysis data are provided in Chapter 7. This chapter provides stakeholder and PHMSA's viewpoints and opinions on the safety and security impacts, as well as cost/benefits considerations, of using e-communications and e-systems to convey HM shipping paper information.

Some stakeholders provided viewpoints on information that should be required on a shipping paper and the mandate of a specific shipping paper form/order of information. While this information is beyond the scope of this report, it is provided in Appendix C: Information Collected Outside Scope of Report but Related to Project as related information for potential consideration.

Chapter 8 provides PHMSA's conclusions regarding the feasibility and effectiveness of using e-systems to provide HM shipping paper information to all HM stakeholders (i.e., shippers, carriers, law enforcement inspectors, and emergency responders) during the transport of HM in all modes.

Chapter 9 provides PHMSA's recommendations to Congress as to whether e-systems should be offered as an alternative to hardcopy shipping papers for HM stakeholders whose e-systems meet minimum performance standard metrics.

# 2. History and Background

This chapter provides information on PHMSA's regulatory role with HM shipments; MAP-21 requirements for paperless hazard communications; PHMSA's paperless hazard communications activities starting in 2007; and PHMSA's activities supporting MAP-21 requirements before conducting the 2015 pilot tests.

## 2.1 PHMSA's Regulatory Responsibility for HM Shipments

The HMR (49 CFR, Parts 171-180) establish PHMSA as the Federal agency responsible for regulating the safe and secure transportation of HM in commerce. The HMR require a person who offers HM for transportation in commerce to describe the HM on a shipping paper in the manner required in 49 CFR Part 172, Subpart C. The shipping paper requirements identify key hazard communication information [i.e., UN number, proper shipping name, hazard class or division number, Packing Group, total quantity of HM (except for HM transported by aircraft), total net mass per package (for HM transported on aircraft), number and type of packages, shipper's certification statement, and emergency response telephone number]. Unless an exception from the shipping paper requirements is provided in the regulations, a paper copy of the shipping paper must accompany HM during transportation. A shipping paper includes ''a shipping order, bill of lading, manifest or other shipping document serving a similar purpose and containing the information required by §§ 172.202, 172.203, and 172.204'' (49 CFR 171.8, the definition of ''shipping paper''). An HW manifest may be used as the shipping paper if it contains all the information required by Part 172, Subpart C [49 CFR 172.205(h)].

Copies of shipping papers, or an electronic image thereof, must be retained for two years (three years if the HM is an HW) after the HM is accepted by the initial carrier by each person who provides a shipping paper [49 CFR 172.201(e)].[2]

## 2.2 MAP-21 Paperless Hazard Communications Requirements

The "Moving Ahead for Progress in the 21st Century Act" (MAP-21)[3], defines "paperless hazard communications system" as "the use of advanced communications methods, such as wireless communications devices, to convey hazard information between all parties in the transportation chain, including emergency responders and law enforcement personnel." The format of communication may be equivalent to that used by the carrier." Section 33005 of MAP-21 also indicates that PHMSA may conduct pilot projects to evaluate the feasibility and effectiveness of using e-systems to communicate HM shipping paper information. MAP-21 specifies that the pilot projects conducted by PHMSA:

- Include at least one rural area;

[2] Each shipping paper must include the date of acceptance by the initial carrier. For Rail, vessel, and Air shipments, the initial carrier may use the date of the shipment's waybill, airbill, or bill of lading in place of the date of acceptance. See 49 CFR 172.201(e).
[3] Public Law 112-141, Division C—Transportation Safety and Surface Transportation Policy, Title III—Hazardous Materials Transportation Safety Improvement Act of 2012, Section 33005, "Paperless Hazard Communications Pilot Program"

- Include consultation with organizations representing fire services personnel, law enforcement and other appropriate enforcement personnel, other emergency response providers, HM shippers, HM carriers in all modes [Air, Maritime (water), Rail, and Roadway], and employees of shipper and carriers; and
- Cannot waive the current shipping paper requirements.[4]

Additionally, MAP-21 requires PHMSA to submit a final report to the Committee on Commerce, Science, and Transportation (U.S. Senate) and the Committee on Transportation and Infrastructure (U.S. House of Representatives) by October 1, 2014,[5] that includes the following information:

- A detailed description of the pilot projects;
- An evaluation of each pilot project, including an evaluation of the performance of each paperless hazard communications system;
- An assessment of the safety and security impact of using e-systems, including any impact on the public, emergency response, law enforcement, and the execution of inspections and investigations;
- An analysis of the associated benefits and costs of using e-systems for each mode of transportation; and
- A recommendation that incorporates the information above as to whether e-systems should be incorporated into the Federal HM transportation safety program permanently under Chapter 51 of Title 49, United States Code.

This report is intended to satisfy the Map-21 final report requirement to these Congressional committees. Refer to Appendix A: MAP-21, Section33005 for Section 33005 of MAP 21, Paperless Hazard Communications Pilot Program.

[4] See 49 CFR Part 172, Subpart C (Shipping Papers); 174.24 (Carriage by Rail—Shipping Papers); 175.30 and 175.33 (Carriage by Aircraft—Inspecting Shipments and Shipping Paper and Notification of Pilot-in-Command); 176.24 (Carriage by Vessel—Shipping Papers); and 177.817 (Carriage by Public Highway—Shipping Papers) to carry hardcopy shipping papers on all HM transportation conveyances while the HM is in transport.

[5] In letters submitted to members of the Committee on Commerce, Science, and Transportation, the Committee on Transportation and Infrastructure, and the Committee on Energy and Commerce on September 30, 2014 by PHMSA Administrator Cynthia L. Quarterman, PHMSA provided a status update on its MAP-21, Section 33005 activities conducted to-date, including obtaining Office of Management and Budget (OMB) approvals under the Paperwork Reduction Act (PRA) and a revised anticipated report submittal date to Congress in 2015. Copies of these letters are provided in Appendix D: Letters to Congressional Committees.

## 2.3 PHMSA's Activities Supporting Paperless Hazard Communications (before MAP-21)

In 2007, PHMSA began conducting activities to improve understanding of paperless hazard communications. These activities included:

- Building a cooperative effort between transportation entities and regulatory agencies;
- Publishing a public meeting notice in 2008 on the use of electronic data (e-data) sharing; and
- Collaborating with two Transportation Research Board (TRB) Hazardous Materials Cooperative Research Program (HMCRP) reports (Reports 4[6] and 8[7]) to examine better approaches to communicating HM information to emergency responders during transportation.

These activities laid the groundwork for PHMSA to begin understanding the challenges and opportunities in the HM community regarding paperless hazard communications, and allowed PHMSA to build upon similar efforts conducted, and information learned, by other reputable organizations as it began conducting efforts in support of the MAP-21 requirements.

[6] Report 4, Project HM-04: Emerging Technologies Applicable to Hazardous Materials Transportation Safety and Security, 2011. http://onlinepubs.trb.org/onlinepubs/hmcrp/hmcrp_rpt_004.pdf.
[7] Report 8, Project HM-05: Evaluation of the Use of Electronic Shipping Papers for Hazardous Materials Shipments, 2012. http://onlinepubs.trb.org/onlinepubs/hmcrp/hmcrp_rpt_008.pdf.

# 3. Consultation Activities with HM Stakeholders

PHMSA began conducting activities in support of the MAP-21 requirements in 2012. These activities included conducting:

- Assessments of general e-communications used within each transportation mode;
- Communications with Federal stakeholders and private companies using e-systems; and
- Discussions and meetings with HM shippers, carriers, law enforcement inspectors, and emergency responders.

Each of these activities is further described in the following sections.

## 3.1 High-Level Modal-Specific Assessments Regarding E-communication

### 3.1.1 Air Mode

The Air Mode currently has sophisticated security protocols for other e-records (e.g., passenger information), so e-HM communication should fit within its existing protocols. In addition, international air shipments already allow for e-dangerous goods records via the International Civil Aviation Organization (ICAO) Technical Instructions for the Safe Transport of Dangerous Goods by Air[8] and the International Air Transport Association's (IATA's) Dangerous Goods Regulations (DGRs), the global reference for shipping dangerous goods, including HM, by air and the standard recognized by airlines,[9] so it should be possible to leverage these international allowances for e-HM shipping papers. While the main type of HM transported on airplanes is medical grade Class 7 radioactive substances;[10] all HM are required to be declared before shipment.

49 CFR 175.33 requires that a copy of the shipping paper accompany the HM shipment it covers during its transportation aboard the aircraft and that the aircraft operator provides the pilot-in-command with the following accurate and legible *written* information (i.e., the notification of pilot–in-command, or NOPIC) before the aircraft departs:

- Proper shipping name, hazard class, and HM identification number, as specified in 49 CFR 172.101 or the ICAO Technical Instructions for the Safe Transport of Dangerous Goods by Air;
- Total number of packages;
- Net quantity or gross weight for each package [except those containing Class 7 (radioactive)

[8] http://www.icao.int/safety/dangerousgoods/pages/technical-instructions.aspx.
[9] http://www.iata.org/whatwedo/cargo/dgr/.
[10] Hazardous Materials Cooperative Research Program, Transportation Research Board, Project HM-05.

materials];

- Location of the packages aboard the aircraft;
- Confirmation that no damaged or leaking packages have been loaded on the aircraft;
- For Class 7 (radioactive) materials, the number of packages, overpacks or freight containers, their category, transport index (if applicable), and their location aboard the aircraft;
- Date of the flight;
- Telephone number of a person not aboard the aircraft from whom the information contained in the notification of pilot-in-command can be obtained;[11]
- Confirmation that the package must be carried only on cargo aircraft if its transportation aboard passenger-carrying aircraft is forbidden; and
- An indication, when applicable, that HM is being carried under terms of a special permit.

Also, a copy of the written NOPIC shall be readily available to the pilot-in-command during flight, and emergency response information required by 49 CFR 172, Subpart G must be maintained in the same manner as the written NOPIC during HM transport aboard the aircraft. This information must be readily accessible at the airport of departure and the intended airport of arrival for the duration of the flight leg.

The airlines historically used electronic data interchange (EDI) language for inputting cargo booking and related financial accounting information, as EDI provides a structured message defined for teletype. Some air carriers began using extensible markup language (XML) in 2014; this language provides the benefit of using the Internet to allow for the free movement of e-HM shipping paper information.

### 3.1.2 Maritime Mode

Maritime vessels can carry over 6,000 containers with many HM at a time, and most vessel operators have developed electronic business systems to manage HM shipping documents. Most international maritime commerce is currently performed electronically; these vessel operators need to be granted authority by the U.S. Government to exchange HM information electronically for U.S. shipments. Most maritime vessel operators have already developed electronic business systems to manage HM shipping documents, and most international maritime commerce is performed electronically.

Most maritime carriers use EDI as their data exchange language because of their interaction with railroad carriers. To be able to perform intermodal transfers with rail carriers, and because a regulatory requirement for e-data does not exist, maritime carriers have been using EDI for e-HM shipping paper communication. EDI currently has all the HM data elements required by 49 CFR 172 and the International Maritime Dangerous Goods (IMDG) Code. Using EDI instead of hardcopy shipping papers for exports would present a business benefit for many maritime carriers.

[11] The aircraft operator must ensure the telephone number is monitored at all times the aircraft is in flight. The telephone number is not required to be placed on the notification of pilot-in-command if the phone number is in a location in the cockpit available and known to the flight crew.

In June 2014, the United States Coast Guard's (USCG's) Cargo and Facilities Division (CG-FAC) purchased tablets for field units to use in conducting facility safety and security operations. These devices are authorized to store open source information, Internet releasable, and/or non-USCG sensitive data. While the current use of the tablets is to make reference materials accessible to examiners, inspectors, and investigators while conducting field activities without needing to carry volumes of paper copies of reference materials, the use of such devices may be expanded in the future.[12]

### 3.1.3 Rail Mode

The Rail Mode transports HM in box and tank cars; all shipment data is received electronically in EDI language. Hardcopy HM shipping papers are required to be carried by the train crew for use by emergency responders in the event of an incident and to meet the existing regulatory requirement.

Also, Section II of the United States Hazardous Materials Instructions for Rail[13] document specifies that no person may accept HM for shipment by rail transportation or transport HM in a train unless a crew member has the following documents:

- Acceptable shipping papers;[14]
- Acceptable emergency response information; and
- A paper document that is showing the current position of the HM shipment in the train (i.e., a consist).

PHMSA and the Federal Railroad Administration (FRA) issued a notice of proposed rulemaking (NPRM) on August 18, 2011 [76 FR 51324][15] to amend the HMR (49 CFR Parts 171-180) to incorporate requirements based on seven existing special permits,[16] including DOT-SP 7616.[17] The special permit, DOT-SP 7616, authorizes rail carriers granted approval by PHMSA to accept shipping paper information for HM shipments via telephone (voice communications) and to authorize certification requirements when transmitted through voice communications or EDI. The Hazardous Materials: Incorporating Rail SPs into the HMR; Final Rule,[18] published in the *Federal Register* on June 25, 2012, made the following regulatory changes to the HMR:

- 49 CFR 172.201(a)(5)—*Electronic shipping papers.* For transportation by rail, a rail carrier may accept shipping paper information either telephonically (i.e., voice communications and facsimiles) or electronically (via EDI) from an offeror of an HM shipment in accordance with the following provisions:
  - When the information applicable to the consignment is provided under this requirement, the information must be available to the offeror and carrier at all times during transport, and the carrier must have and maintain a printed copy of this information until delivery of

[12] USCG Memorandum 13480, 30 June 2014, from A.E. Tucci, CAPT COMDT (CG-FAC) to LANT-54, PAC-54.
[13] http://boe.aar.com/boe/download/US_HMI.pdf.
[14] "Acceptable shipping papers" must be printed and legible and include railroad-produced documents, customer-produced documents, connecting carrier documents, hand-printed documents, and HW manifests.
[15] under Docket Number PHMSA 2010-0018 (HM-216B)
[16] *Federal Register* Volume 76, No. 160, August 18, 2011 [Docket No. PHMSA-2010-0018 (HM-216B)].
[17] http://www.phmsa.dot.gov/pv_obj_cache/pv_obj_id_D59F5CA11D8EE7F6DEDA5032AF33874E709E0100/filename/SP7616_2005120931.pdf.
[18] *FR* Volume 77, No. 122, June 25, 2012 9 FR Doc. 2012-13960, filed June 22, 2012).

the HM on the shipping paper is complete. When a paper document is produced, the data must be presented as required by this subpart;

  - The offeror must forward the shipping paper (record) for a loaded movement to the carrier before shipment unless the carrier prepares the shipping paper on behalf of the offeror. The offeror is only relieved of the duty to forward the shipping paper once the offeror has received a copy of the shipping paper from the carrier;
  - A carrier that generates a residue shipping paper using information from the previously loaded movement of HM packaging must ensure the description of the HM that accompanies the shipment complies with the offeror's request; and
  - Verification: the carrier and the offeror must have a procedure by which the offeror can verify the accuracy of the transmitted hazard communication information that will accompany the shipment.

- 49 CFR 171.8 defines EDI as the computer-to-computer exchange of business data in standard formats. In EDI, information is organized according to a specific format (electronic transmission protocol) agreed upon by the sender and receiver of this information and transmitted through a computer transaction that requires no human intervention or retyping at either end of the transmission.
- 49 CFR 172.202(b) allows shipping descriptions for HM offered or intended for transportation by rail that contain all the information required in 49 CFR 172.202 and that are formatted and ordered in accordance with recognized EDI and, to the extent possible, in the order and manner required by 49 CFR 172.202 are deemed to comply with 49 CFR 172.202(b).
- 49 CFR 172.204(a)(3) and (d)(3) allow for shipping paper certifications for HM shipments via rail to be accomplished by one of the following methods:
  - Verbal Certification—When received telephonically, by the carrier reading the complete shipping description that will accompany the shipment back to the offeror and receiving verbal acknowledgment that the description is as required. This verbal acknowledgment must be recorded, either on the shipping document or in a separate record, e.g., the waybill, by 49 CFR 174.24, and must include the date and name of the person who provided this information; or
  - Electronic Signature Certification—When transmitted electronically, by completing the field designated for the shipper's signature, the shipper is also certifying its compliance with the certification specified in 49 CFR 172.204(a). The name of the principal partner, officer, or employee of the offeror or their agent must be substituted for the asterisks.
  - When transmitted by telephone or electronically, the signature must be in one of the following forms: the name of the principal person, partner, officer, or employee of the offeror or his agent in a computer field defined for that purpose.

### 3.1.4 Roadway Mode

Transport of HM by roadway carriers is significantly different from their modal counterparts; roadway vehicles travel shorter distances and thus have more individual transportation trips. Also, many variations

exist among roadway carriers: some transport a single commodity along defined transportation routes, while others pick up and deliver multiple commodities along routes that change based on delivery needs.

The following list provides information from the motor carrier industry regarding HM communications:

- The motor carrier industry emphasizes the importance of having an HM paper documentation trail (for billing purposes, delivery receipts, driver payment records, etc.), and most motor carriers receive HM manifests and bills of lading in hardcopy.
- Some motor carriers have electronic or automatic onboard recording devices and use them for activities such as tracking drivers' hours of service and locations; commodity delivery confirmation; etc. The owner-operators pay the installation costs and a monthly fee for these devices. The possibility exists for additional capabilities to be added to these devices for additional costs.
- Existing electronic and automatic onboard recording devices do not function in some areas of the U.S. and Canada with Internet connectivity dead spots; the same issue would likely exist for an e-HM communication system.
- Motor carriers that transport fuel do not invest in electronic devices, because fuel pick-ups and deliveries are typically direct and routine shipments, and fuel companies have a lower profit margin than other carriers.
- Some trucking companies either cannot afford to purchase an electronic system or do not see a business reason to invest in one; the carrier stakeholders recommend PHMSA establish the performance standard for e-HM communication and keep the existing requirements for hard copy HM shipping papers.
- Implementation of e-HM shipping papers may also be difficult for smaller motor carrier companies that transport a wide variety of products; that do not have set delivery schedules; or that make multiple stops on a transport route delivering various HM contained in trailers with multiple compartments, because of the complexity of these HM shipments.
- Motor carriers who do not have onboard technology are concerned that they will be unable to provide e-HM information directly and readily to inspection and emergency response personnel, scenarios that could delay shipments; cause loss of revenue for the driver and the carrier, and potentially contribute to incident liabilities.
- An electronic means does not currently exist for the motor carriers to receive HM shipping documents from, or to send HM shipping documents to, any of the other carrier modes. Roadway carriers serve a critical function in the HM transportation chain, and provisions for ensuring continuity of commodity as well as information flow within the roadway carrier stakeholder group need to be addressed.

## 3.2 Communications with Federal Agencies and Private Companies Using E-systems

Between 2011 and 2014, PHMSA met or participated in teleconferences with the U.S. Federal Aviation Administration (FAA) its contractor, MITRE, and IATA; the U.S. Department of Defense (DOD) and the U.S. Transportation Command (USTRANSCOM); the U.S. Department of Energy's (DOE's) Oak Ridge National Laboratory (ORNL) and its contractors, Turnkey Technical Services, LLC (Turnkey), and URS—CH2M Oak Ridge LLC (UCOR); the U.S. FRA, the Association of American Railroads (AAR), Operation Respond Institute (ORI), and Watco Companies, LLC (Watco); the U.S. Environmental Protection Agency (EPA); and the United Parcel Service (UPS) regarding their e-system activities. The following subsections summarize the information regarding these e-systems.

### 3.2.1 U.S. Federal Aviation Administration, MITRE, and the International Air Transport Association E-Initiatives

PHMSA learned about the following Air Mode electronic initiatives during consultation activities conducted between 2011 and 2014:

- FAA and MITRE were developing an electronic initiative called Flight Object (FO) Concept. FO was conceived to be part of FAA's next generation concept for electronically collecting about ten different information types, one of which is HM information. The-HM component of FO was intended to include data elements currently required by the Shipper's Declaration for Dangerous Goods (SDDG) document. In 2011, the FO team was working with IATA, which developed a data schema for international hazardous cargo messaging systems.
- FAA and MITRE reported that FO stakeholder benefits include faster receipt of HM information for emergency responders and better ability for FAA security personnel to identify and track hazardous cargo logistics. FAA and MITRE also reported that some shippers are reluctant to participate in the FO initiative because they already provide the required information in hardcopy; these shippers do not want to provide electronic information for privacy concerns and other reasons. FAA and MITRE were trying to develop incentives for such shippers.
- IATA's E-Freight Project that allows for the movement of air cargo via the use of e-data instead of some hardcopy information. The project operates according to the provisions of the Montreal Convention, Protocol 4, which eliminated the need for consignors of cargo to complete detailed air waybills before consigning goods to a carrier, and allowed for consignors to use simplified electronic records in place of such detailed air waybills.
- IATA stated that airlines currently have sophisticated security protocols for other e-records (e.g., passenger information), so e-HM should fit in with these existing protocols. Also, because international air shipments already allow for e-dangerous goods records, IATA believes HM-ACCESS should be able to leverage these international allowances for e-HM shipping papers.
- IATA reported that airlines historically used EDI for inputting cargo booking and related financial accounting information, as EDI provides a structured message defined for teletype; however, the airlines were due to move to XML in 2014. IATA reported that XML provides the benefit of the Internet to allow for the free movement of information. IATA reported it would facilitate the use of available data standard interfaces to transfer existing EDI data to XML.
- IATA explained that an interface needs to be developed for air and road carriers before the

Dangerous Goods Manifest can be transmitted electronically; until then, the air carrier e-information needs to be transformed into hard copy when air cargo is transferred to trucks.

### 3.2.2 U.S. Department of Defense and U.S. Transportation Command E-systems

On January 17, 2012, PHMSA met with DOD USTRANSCOM's Defense Transportation Electronic Business (DTEB) Committee to learn about DTEB's implementation of the American National Standards Institute (ANSI) EDI standards (ANSI X12) for use within DOD transportation.

DOD is a very large military entity that transports HM both domestically and internationally. DOD's system supports single mode and intermodal transfers. The DTEB Committee is a volunteer consensus-based group with input from the military services, Defense Logistics Agency (DLA), Defense Finance and Accounting Services (DFAS), General Services Administration (GSA), and USTRANSCOM. The DTEB committee provides a forum where the defense transportation activities can coordinate the development and implementation of their e-business projects. The DTEB Committee also works on establishing EDI standards for transportation processes throughout DOD that follows the ANSI X12 schema. USTRANSCOM chairs the DTEB committee.

USTRANSCOM does not have one e-HM system; rather, the DTEB Committee works to ensure that the various e-HM systems are compliant with the X12 standards. USTRANSCOM is responsible for transportation-related processes in DOD; DLA has oversight of DOD's supply side (warehouse). USTRANSCOM primarily uses legacy EDI systems; DLA uses EDI as well as other legacy systems (e.g., flat file). These stovepiped systems communicate via "translators;" i.e., software that provides the interface between internal systems and the EDI format sent/received. USTRANSCOM uses the X12 standards as a base for its data elements, and then adds information to them to customize for its systems. Shippers, carriers, and governmental officials can utilize these systems directly, and emergency responders can call upon a particular process to access needed HM data. Access to the data is vetted by third-party logistics companies or the material owner.

The USTRANSCOM staff shared the following challenges[19] related to e-HM:

- System integration can be difficult;
- Data translation can introduce data integrity-related issues;
- XML, by its very nature of being extensible, at times may not work well with standardization (e.g., the X12 standards or similar protocols);
- Sometimes translators act as a crutch, because they can discourage organizations from developing new standard systems, thus causing functional requirements "creep"; and
- The current requirement in 49 CFR 172, Part C for a signature on the certification section of the shipping paper will be difficult to address on an e-HM document without a regulatory change/exemption.

[19] According to USTRANSCOM staff, while the X12-based codes are known in the transportation community, the emergency response community may not be familiar with them.

The USTRANSCOM staff shared the following benefits of related to e-HM over a paper-based system:

- Reduced time required for data exchange;
- Near to instant gratification in obtaining data;
- Date is editable and able to be validated;
- Data is more storable; and
- Data is often more acceptable to other systems/the e-environment.

The USTRANSCOM staff shared the following "lessons learned" related to developing an e-HM:

- Establish a process;
- Use standardized data;
- Use equipment and software with the capability to be modernized;
- Wherever possible, conform to what is already in place; and
- Be aware that pushing in/pulling out data are different activities that require distinct processes.

### 3.2.3 U.S. Department of Energy E-System

On January 18-19, 2012, PHMSA met with staff from DOE's ORNL and its contractors Turnkey and UCOR[20] at the Oak Ridge Reservation in Tennessee, a research and manufacturing complex established in the early 1940s to produce enriched uranium for the World War II Manhattan Project. A private road on the property connects multiple Oak Ridge operations that deal with all nine HM classes.

Turnkey is a small business in Oak Ridge that supports DOE's Oak Ridge HM operations. The company has developed an e-system, the Radio Frequency Identification Transportation System (RITIS), in partnership with DOE. RITIS came online in March 2009. It uses a passive radio frequency identification (RFID) system composed of interrogators (i.e., readers) and tags (i.e., labels) to integrate HW operations, transportation logistics, and information technology, and is currently being used for tracking HM transported on the Oak Ridge Reservation. RITIS uses commercial off the shelf (COTS) hardware and software and supports multiple open-source technologies. Information is backed up on two databases simultaneously, allowing for fail-safe operation.

RITIS equipment includes handheld devices, weigh scales, servers (applications and data), web browsers, and RFID external towers (readers). Each truck has a tag (non-battery) enclosed in a hard case; this non-battery, passive tag option was selected when the system was created to provide an "intrinsically safe" RITIS. A uniform resource locator (URL) is assigned to all codes that point to tracking information. Date and time information is added to the URL and also tracked. The information goes to "the Cloud," and shippers, drivers, and other vetted personnel can update the Cloud information based on the URL. "Mashups," combinations of data from two different fields, are allowed. Because Wi-Fi is not allowed in classified Oak Ridge Reservation areas, the data is written to the tag; once the vehicle passes a portal, the data is uploaded from the tag to the system, and the official internal activity record begins.

[20] UCOR is DOE's cleanup contractor for the Oak Ridge Reservation.

The DOE, their contractors (Oak Ridge), UCOR, and Turnkey staff have access to RITIS. RITIS is also loaded with acceptable parameters, which reduces the chance for input errors and quickly highlight any data anomalies or errors. Checks on the RITIS occur multiple times each day, and data can be accessed 24/7.

In a 2011 test of RFITS's efficiency, Turnkey staff found that, for each truck transporting HW, the RFITS reduced eight pieces of paper information to zero. As reported in October 2011, more than 25 DOE Oak Ridge projects totaling almost 55,000 e-shipments have shipped via the RITIS Program, with a corresponding cost savings of more than $16 million.[21] Turnkey reported that approximately 1.5 full-time equivalent (FTE)/year in labor are required to maintain RITIS. As of the beginning of 2012, approximately $1M had been spent on RITIS (hardware, labor); $300K of this cost was associated with initial one-time setup fees. Annual operation and maintenance costs (including labor) are approximately $250K.

DOE/Turkey staff shared the following "lessons learned" perspectives for developing an e-system:

- Prefer COTS systems and open source architecture over proprietary systems and closed architecture;
- Design infrastructure that can change/grow with the business;
- Develop an e-system that is open, modular, and expandable (allows for integration of new technology into system);
- Use a variety of vendors;
- Define all the business rules at the beginning, and ensure that all affected staff are involved;
- Project business development out one, five, and ten years, and ensure the system is robust and diverse to support the business plan;

[21] Source: *Nuclear Decommissioning Report*, October 2011, Issue 6, Volume 1; "RFITS Takes Shipping to the Next Level."

- Make the system framework as simple as possible, thereby eliminating barriers and allowing more entities to participate in e-HM;
- Encourage the public/stakeholders to freely give data, with the e-system owner responsible for providing security/anonymity;
- Make the design modular, allowing services to be added later and identifying data meeting points;
- Require authentication information whenever a person attempts to access any data; and
- Consider the space needed for data storage and the resolution and battery life of e-system handheld devices during the design phase.

Turnkey staff shared the following considerations for any e-system:

- Determine where the minimum needed information resides (at the base company level, with the shipper, etc.);
- Determine how the minimum information can be provided to emergency responders/inspection personnel in a timely manner (via cellular, radio, computer, other);
- Remember the HM information should travel with the conveyance transporting it; and
- Consider technology on the vehicle vs. information residing at the office.

DOE/Turnkey staff listed the following benefits of using the e-system RFITS over a paper-based system:

- Reduced time required for data exchange;
- Increased data quality;
- Integration of operations reduced overall cost of data collection activities;
- Fixed costs of monitoring performance and predicting supply and demand;
- Increase in driver output without increasing labor (32 manual HM shipments vs. 139 e-shipments in an eight-hour shift); and
- Reduced greenhouse gas emissions (trucks no longer left idling during paperwork completion and security inspections).

DOE/Turnkey staff also expressed a preference for XML over EDI, citing XML's flexibility and readability by both humans and machines as benefits over EDI's expensive legacy language.

DOE staff shared information about its contract with FedEx, which manages all of DOE's continental U.S. radioactive isotope air shipments (approximately 2% of DOE's total HM). DOE has its own shipping manifest form ("ATMS"), but FedEx wants DOE to use its form. FedEx instructs DOE to "EDI the DOE ATMS to FedEx;" once this action is complete, FedEx does not allow DOE to then have a copy of the FedEx manifest. This real scenario presents one example of the complexities associated with data security and ownership.

### 3.2.4 U.S. Federal Railroad Administration, Association of American Railroads, and Affiliates E-HM Emergency Responder Communication Initiatives

In the Summer 2012, PHMSA participated in a teleconference with FRA, AAR, ORI, and Watco[22] to discuss work these organizations were performing to comply with National Transportation Safety Board (NTSB) recommendation R-07-2, which calls for FRA[23] to "assist PHMSA in developing regulations to require that railroads immediately provide to emergency responders accurate, real-time information regarding the identity and location of all HM on a train." The NTSB recommendation is provided for reference in Appendix E: NTSB Recommendation R-07-2.

ORI is a not-for-profit company that developed the Operation Respond Emergency Information System (OREIS™), a software program made available only to emergency response organizations. The system offers response guidance for dealing with specific chemicals under varying conditions, contains other responder resource information, and has a wireless version called OREIS™ Mobile. Through OREIS™, vetted emergency responders can directly access a rail carrier's files (via an identification and password application) to identify whether HM are being transported on a specific railcar; if HM are present, OREIS™ provides a verification of the contents and initial guidance as to the appropriate response.

Challenges associated with OREIS™ for emergency responders include the following:

- To learn information about multiple cars involved in a derailment, each car must be researched individually via OREIS, which can be inefficient for large derailments; and
- OREIS does not have information regarding the location of the car in the train (i.e., OREIS lacks consist information).

As of Spring 2015, CSX Class I Railroad was completing the test phase of its "Operation Respond" mobile emergency information system, a collaborative product from CXS and ORI. The system has been designed to provide emergency responders with mobile access (via iPhone, Android devices and most browsers) to information regarding HM traveling on CSX rails. In the event of a rail emergency, CSX Operation Respond quickly locates and identifies the contents of rail cars carrying HM. Through the app, responders can securely access:

- Real-time information on the contents of rail cars;
- Real-time complete train list information; and
- Other useful emergency response information designed to assist in responding to a rail-related transportation emergency.[24]

[22] Watco is an international transportation company based in Kansas offering a variety of rail, container-shipping, intermodal, and trucking services. Watco operates 27 shortline railroads (small or mid-sized Class II and Class III railroad companies which operate over short distances) in the U.S. and Australia, is one of the largest U.S. shortline railroad companies, and operates several transloading railcar facilities.
[23] FRA is responsible for promulgating and enforcing rail safety regulations and conducting research and development in support of improved railroad safety and national rail transportation policy. (www.fra.dot.gov)
[24] http://www.beyondourrails.org/safety/respond

FRA reported in September 2015 that all Class 1 railroads use systems similar to OREIS™ for providing emergency responders with mobile access to information on HM travelling by rail. FRA reported that, while these systems make access to HM information easier for emergency responders, they do not provide updated, accurate consist information in scenarios where a derailment or other incident occurs after cars are added or removed from the train but before the train moving to an automatic equipment identification (AEI) reader.[25] In these scenarios, the train consist available at the railroad headquarters and on the train (if available and intact after the incident) will only account for the consist that was in place when the train passed the last AEI reader.

### 3.2.5 U.S. Environmental Protection Agency E-Manifest System

PHMSA had an initial teleconference with EPA in late Summer 2012 to discuss the process the EPA followed to determine the need for, and draft regulations pertaining to, the use of electronic HW manifests (e-manifests) in lieu of hardcopy manifests for tracking the generation, treatment, storage, and disposal of HW. The EPA's E-Manifest System has evolved from a 2001 decentralized system concept to an actual system via legislation signed into law on October 5, 2012 directing EPA to establish and implement a single, national, vendor-developed system for e-manifest information, with users paying fees to use the E-Manifest System. The E-Manifest System must be fully established and operational by October 5, 2015 for use by any user. PHMSA and EPA communicated regularly regarding the status of both projects between 2012 and 2015. Such changes to the HW regulations may necessitate an HMR revision allowing an e-manifest to be an acceptable shipping paper.

More information on the current status of EPA's e-manifest system is provided in Appendix G: Information on EPA's E-Manifest System.

### 3.2.6 United Parcel Service E-HM Communication

In a discussion with PHMSA during Summer 2012, UPS employees indicated that the biggest challenge to successful e-HM shipping paper implementation will be changing perceptions of HM stakeholders (shippers, carriers, emergency responders, and law enforcement personnel) regarding the ease and benefits of using e-HM shipping papers versus hardcopy documents.

In January 2014, UPS and PHMSA began coordinating outreach efforts to educate and inform first responders and inspectors about the changes in HM communications document accessibility for UPS feeder trucks. With the new procedure, when an inspector or emergency responder requires HM shipping papers, drivers will provide a toll-free number to call for access to documents containing a manifest of any HM contained in the shipment. This new process will streamline the sharing of information with inspectors and first responders.[26] PHMSA authorized UPS to begin transmitting HM shipping paper information electronically, by phone, or fax as of June 1, 2014, via, Hazardous Materials SP 15747. This authorization applies only to UPS small package tractor-trailer operations, the movement of small package shipments between UPS facilities, and deliveries by tractor-trailer; UPS Freight and all other

[25] AEI readers are trackside-mounted devices that are part of an electronic recognition system using radio frequency technology to communicate train information, including consist information, with passive tags mounted on railcars and locomotives (www.aar.org).
[26] http://www.pahazmat.com/news/ups-article/

UPS operations will continue to carry hardcopy HM shipping papers. This UPS SP (DOT-SP 15747) was updated on May 13, 2015 (fifth revision); refer to Appendix H: UPS Special Permit 15747.

Since June 1, 2014, the UPS Call Center has been contacted 143 times under the provisions of DOT-SP 15747, and there have been zero instances where the caller has been unable to receive the required information. One of the calls took longer than five minutes to transmit the information; however, the average length of time for the information to be transmitted is approximately 2 minutes and 30 seconds. The one call more than five minutes was caused by issues with Adobe Reader on the receiver's end of the transmission. Thirteen calls were emergency situations including six trailer fires and four rollovers; the type of emergency was not detailed for the other three calls. During the emergency situations, it was found that first responders benefitted from obtaining the shipping paper information while staying a distance away from the vehicle.[27]

## 3.3 Discussions with HM Shippers, Carriers, Law Enforcement Inspectors, and Emergency Responders

Information in this section was provided to PHMSA during 2012-2015 stakeholder discussions and at the four stakeholder workshops for shippers, carriers, law enforcement inspectors, and emergency responders PHMSA hosted in September 2012. The workshops' objectives were to:

- Share with participants stakeholder information provided to PHMSA to-date;
- Obtain further information and feedback from workshop participants as they relate to facilitating e-HM communication; and
- Prepare white papers[28] to document feedback, opinions, concerns, gaps, and vulnerabilities from both prior stakeholder consultation efforts and workshop participant discussions.

### 3.3.1 Discussions with HM Shippers

The HM shipper industry includes a wide variety of chemical companies and manufacturers that make and/or ship materials such as oil and natural gas; chlorine gas and solutions; compressed and liquefied gases; specialty gases; explosives; and various other chemicals. Many of these chemicals are listed as HM under 49 CFR Part 172 and other regulatory guidance documents. The 49 CFR 172.200(a) states, "each person who offers a hazardous material for transportation shall describe the hazardous material on the shipping paper in the manner required by 49 CFR Part 172, Subpart C—Shipping Papers." Thus, all HM shippers are required to prepare and provide hardcopy HM shipping papers for HM that are in transportation, in accordance with 49 CFR Part 172.

27 Information on the effectiveness of DOT-SP 15747 is current as of July 31, 2015.

[28] The two white papers summarizing the information obtained during the September 2012 workshops are provided on PHMSA's HM-ACCESS website: http://phmsa.dot.gov/hazmat/hm-access/stakeholder-information-papers. These papers highlight the collective HM transportation community's priorities, gaps, and concerns for implementing paperless hazard communications.

In the Summer of 2012, PHMSA participated in teleconferences with the following HM shipper associations, organizations, and private companies:

- American Chemistry Council (ACC)
- American Petroleum Institute (API)
- Compressed Gas Association (CGA)
- Council on Safe Transportation of Hazardous Materials, Inc. (COSTHA)
- Institute of Makers of Explosives (IME)
- The Chlorine Institute (CI)
- Magellan Midstream Partners, L.P.
- Procter & Gamble
- United Parcel Service (UPS)

#### 3.3.1.1 Shipper Feedback on E-systems

Some HM shipping companies have e-systems that are used for business purposes (driver payment, HM invoices, etc.). These systems have some/all of the HM information fields currently required on the HM shipping paper. The majority of these companies print shipping papers by pulling information from these e-systems. Also, many companies that already have e-systems containing HM shipping information should be able to transition easily to an e-HM shipping paper.

#### 3.3.1.2 Shipper-Specific Concerns, Gaps, and Vulnerabilities with E-communication

Shippers provided the following thoughts on e-communication:

- E-HM should be performance-based, and allow for e-HM communication flexibility.
- E-HM implementation should not make compliance requirements more complicated.
- Companies currently capable of performing e-HM communication have developed these capabilities for business reasons. If the government requires e-HM, some companies would be at a disadvantage because of the costs associated with implementation.
- Business purposes drive technology; innovation will be hindered, lost, or stifled if the government requires a particular technology be used to satisfy e-HM.
- The development of a shipper/HM industry e-HM system may not be helpful or useful to emergency responders and law enforcement, and vice versa.
- The capability of emergency responders to receive/access the e-HM information in certain situations (e.g., coverage issues in rural and geographically challenged areas; availability of technology; current operating procedures, etc.) may be compromised.
- The potential for data errors and omissions exists (for both e-communication and current hardcopy format).

### 3.3.2 Discussions with HM Carriers

The carrier industry includes companies that transport all types of HM in various quantities (bulk and non-bulk) in assorted containers and other packagings in all modes on different types of vehicles, including vessels, planes, trailers, trucks, and railcars. Some carriers transport HM intramodal others transport HM both intra- and inter- modal. A shipping paper, prepared by the HM offeror (shipper), is required for the transportation of the HM. HM carriers are required to maintain the HM shipping paper when the HM is in transportation and for a certain period after delivery is completed. Shippers must create a Dangerous Goods Manifest for each HM transported internationally in addition to the HM shipping paper requirements identified in 49 CFR 172 for U.S. HM shipments.

In the Summer of 2012, PHMSA participated in teleconferences with the following HM carrier associations, organizations, and private companies:

- International Air Transport Association (IATA)
- APL Limited (APL)
- Hapag-Lloyd America
- Hyundai American Shipping Agency
- International Vessel Operators Dangerous Goods Association (IVODGA)
- American Trucking Associations (ATA)
- National Tank Truck Carriers (NTTC)
- Owner-Operator Independent Drivers Association (OOIDA)

#### 3.3.2.1 Carrier Opinions and Feedback—All Modes

Carriers provided the following feedback regarding e-HM communication:

- Because of the wide variation among modal carriers, means for e-HM communication will vary by carrier and by mode.
- Accuracy and completeness are the two most important e-HM information requirements for carriers.
- Allowing rather than mandating the use of e-HM information would be accepted among the carrier industry.
- The Air Mode currently has sophisticated security protocols for other e-records, and international air shipments already allow for e-dangerous goods records.
- The Rail Mode transports HM in box and tank cars; all HM shipment data is received electronically in EDI format.
- Most maritime vessel operators have already developed electronic business systems to manage HM shipping documents, and most international maritime commerce is performed electronically.
- Most maritime and air carriers use EDI because of their interaction with railroad carriers.
- Roadway HM carriers always receive HM manifests and bills of lading in hardcopy.
- Some motor carriers have electronic or automatic onboard recording devices. Additional capabilities may be able to be added to these devices for additional costs.

- E-HM communication should be easy to implement for motor carriers who deliver a single HM or who always deliver the same HM to the same locations.
- An e-HM system may provide a dual benefit for motor carriers who load HM from multiple sites, as it could help the driver determine HM compatibilities and segregation requirements before loading the HM.

#### 3.3.2.2 Carrier-Specific Concerns, Gaps, and Vulnerabilities with E-communication—All Modes

Modal carriers shared the following common concerns regarding e-communication:

- Carriers want the Federal government to ensure that e-HM communication is allowed rather than mandated.
- Carriers are concerned about security and business-related issues once e-HM communication is conducted outside of a controlled environment.
- Carriers see a difference in the need for electronic information for business purposes and the need for information that accompanies HM shipments for emergency response purposes.
- HM technical names can be difficult for carriers to determine, and trade names are currently not authorized for use by 49 CFR 172.
- An electronic means does not exist for motor carriers to receive HM shipping documents from, or to send HM shipping documents to, carriers in other modes.

#### 3.3.2.3 Specific Concerns, Gaps, and Vulnerabilities with E-communication—Roadway Carriers

Roadway carriers shared the following concerns regarding e-communication:

- The motor carrier industry emphasizes the importance of having an HM paper documentation trail (for billing purposes, delivery receipts, driver payment records, etc.), and most motor carriers receive HM manifests and bills of lading in hardcopy.
- Some trucking companies either cannot afford to purchase an electronic system or do not see a business reason to invest in one.
- They recommend PHMSA establish a performance standard for e-HM communication and keep existing requirements for hardcopy HM shipping papers.
- Implementation of e-HM shipping papers may be difficult for small motor carriers.
- Existing electronic onboard recording devices do not function in areas with Internet connectivity dead spots; the same issue would likely exist for an e-system.
- Motor carriers who do not have onboard technology are concerned that they will be unable to provide e-HM information to inspectors and emergency responders.

#### 3.3.2.4 Specific Concerns, Gaps, and Vulnerabilities with E-communication—Air and Maritime Carriers

Air and maritime carriers shared the following concerns regarding e-communication:

- Air and maritime carriers have been using EDI to perform intermodal transfers with rail carriers, and require e-HM shipping paper data be provided to them in EDI format.
- EDI elements may be different between individual carriers.
- Each of the four major Class I rail carriers has different EDI requirements for rail billing.
- EDI is not organized as a required sequence of information or fields, and data standardization is an issue, as is how and the order in which emergency response information is presented.
- Paperwork for imports is often missing information and often contains incorrect data; these issues provide additional challenges for verifying data accuracy provided in import EDI systems.
- Different requirements of e-HM communication information for domestic and international HM shipments may need to be developed.
- The airlines historically used EDI for inputting cargo booking and financial accounting information, but the industry may be moving to XML.
- Some rail carriers insist each HM shipment have a Standard Transportation Commodity Code (STCC)[29] before the rail's acceptance of the HM from intermodal carriers.

### 3.3.3 Discussions with HM Law Enforcement Inspectors

The HM law enforcement community consists of trained HM inspectors who are organized by transportation mode. Regardless of mode, all HM inspectors will request a copy of the HM shipping papers as part of the inspection process.

#### 3.3.3.1 Air Mode Inspector Feedback and Opinions

Discussions with FAA employees during 2013-2015 revealed that, per 49 CFR 175.30(a)(2) and (b), aircraft operations personnel are required to inspect HM shipments to ensure that HM accepted aboard an aircraft for transportation are "described and certified on a shipping paper prepared in duplicate in accordance with 49 CFR Part 172," and that aircraft operators inspect all HM in packages, outside containers, and overpacks immediately before placing them aboard an aircraft or in a unit load device or on a pallet prior to loading aboard an aircraft.

The FAA HM inspectors also conduct after-shipment inspections at shipper facilities and airport carrier locations. They review HM shipping papers (required to be maintained by aircraft operators in hardcopy or via electronic image at or through its principal place of business per 49 CFR 175.33(c) for one year after the material is accepted by the initial carrier) and NOPICs (required to be maintained by aircraft operators in hardcopy or via electronic image at or through its principal place of business per 49 CFR 175.33(c) for 90 days at the airport of departure or the operator's principal place of business) to determine

[29] The STCC is a rail publication containing specific product information used on waybills and other shipping documents, is now being used by rail carriers for HM transport. According to Maritime and Air Mode carriers, STCC codes are not specific to a particular material; are not used or understood internationally; and have no use for emergency response purposes.

compliance with the HMR.

#### 3.3.3.2 Maritime Mode Inspector Feedback and Opinions

PHMSA held teleconferences with USCG inspectors from the following sectors during the Summer of 2012:

- Sector Baltimore (Maryland)
- Sector Boston (Massachusetts)
- Sector Houston-Galveston (Texas)
- Sector Juneau (Alaska)
- Sector Los Angeles/Long Beach (California)
- Sector Portland (Oregon)

These sectors explained that port container inspections are conducted by USCG inspectors; enforcement personnel inspect samples of declared HM containers randomly (i.e., containers with manifests identifying HM as contained in them). Container inspections are usually announced and planned in advance. Typically, USCG inspectors at small and medium ports receive hardcopy HM shipping papers from the terminal/yard office; at the large ports, they request shipping papers from the shipper via email or telephone. The shipping papers are usually provided to them, via email or facsimile, 20 minutes to 48 hours after the request is made.

The USCG Inspectors shared the following regarding e-systems:

- Electronic shipping papers would be more convenient but are not a necessity for inspectors at small and most medium container ports.
- Because shipping papers requested by inspectors at some medium and most large container ports can result in a 48-hour wait time, an e-system that could provide the shipping papers quicker would add convenience and reduce inspector wait time.
- An e-HM system that provides the information directly to inspectors would streamline the shipping paper request process and shorten the container inspection selection time for inspectors at many large container ports.

The USCG inspectors shared the following concerns over information gaps and vulnerabilities:

- Allowing shippers a choice between hardcopy and electronic shipping papers may lead to confusion as to where and how inspectors can obtain the documents.
- Altering a process for inspectors at small and medium container ports that already fits their needs.
- Ports that transmit shipping paper information between yard and USCG offices could experience an unnecessary duplication of information.
- If the system crashes, electronic information could be lost or unavailable.
- Some of the remote ports do not have wireless capability.
- Electronic shipping papers may present data entry errors and inaccuracies.
- The U.S. cannot regulate the use of electronic shipping papers internationally.

#### 3.3.3.3 Rail Mode Inspector Feedback and Opinions

The Rail Mode has very specific inspection procedures for HM shipments on railcars; these procedures are detailed in *United States Hazardous Materials Instructions for Rail*, Section III.[30] Important policy excerpts from this document are as follows:

- All loaded and residue/empty hazardous material shipments must be visually inspected before accepting them from the shipper; when receiving them in interchange; when placing them in a train; and at other points where an inspection is required (e.g., 1,000-mile inspection) for the following conditions/items:
  - Leakage;
  - Required placards and markings;
  - Secure fastening of closures; and
  - Signs of tampering.
- If an indication of tampering or a foreign object is found, rail personnel are instructed to take the following actions:
  - Do not accept or move the rail car.
  - Immediately move yourself and others to a safe location away from the rail car before using radios and cell phones to make notifications.
  - For cars at a customer's facility, immediately contact local plant personnel. If local plant personnel are not available or cannot explain what you see, immediately contact the train dispatcher.
  - For cars on interchange tracks or in the yard, immediately contact the yardmaster or train dispatcher.
- If an HM shipment does not appear to be prepared for transportation, rail personnel are instructed to:
  - Not accept/pull the HM shipment or allow it to continue in transportation; and
  - Notify the customer, train dispatcher, yardmaster, or immediate supervisor of the problem.

In addition, Section II of the document specifies that no person may accept HM for shipment by rail transportation or transport HM in a train unless a crew member has the following documents:

- Acceptable shipping papers;[31]
- Acceptable emergency response information; and
- A paper document showing the current position of the HM shipment in the train (i.e., train consist).

[30] http://boe.aar.com/boe/download/US_HMI.pdf.
[31] "Acceptable shipping papers" must be printed and legible and include railroad-produced documents, customer-produced documents, connecting carrier documents, hand-printed documents, and HW manifests. Refer to United States Hazardous Materials Instructions for Rail, Section II.2 (http://boe.aar.com/boe/download/US_HMI.pdf) for more information.

#### 3.3.3.4 Roadway Mode Inspector Feedback and Opinions

PHMSA held teleconferences with the following HM roadway law enforcement agencies and organizations during the Summer of 2012 and in 2015:

- Federal Motor Carrier Safety Administration (FMCSA);
- Commercial Vehicle Safety Alliance (CVSA); and
- Idaho State Police.

These agencies and organizations explained that inspections on motor vehicles transporting HM are usually on demand; i.e., triggered by a particular scenario (such as a traffic violation or routine roadside inspection) that causes an inspector (a police officer or trained civilian) to select a vehicle for inspection. Motor carrier inspectors [usually Federal or State Motor Carrier Safety Assistance Program (MCSAP) Officers] ask the driver for the HM shipping papers at the time of the inspection.

If the driver of a motor vehicle transporting HM cannot produce the HM shipping papers for the inspector, he/she is cited and receives a violation; the shipping papers must be produced before the vehicle is allowed to proceed on its journey.

Motor carrier inspectors provided the following information regarding e-HM documentation in the motor carrier law enforcement arena:

- An e-HM system that allows inspectors to view the shipping paper information as one record instantaneously during the actual inspection (such as on a tablet provided by the driver) would be acceptable to most inspectors.
- FMCSA motor carrier law enforcement inspectors have laptop computers. They enter inspection data (including HM information) electronically into Aspen, a field system laptop application that collects all the commercial driver/vehicle roadside inspection details. Aspen utilizes several other applications that pull data from remote sources. Aspen also includes communication features to electronically transfer inspection details to SAFER[32] and/or SAFETYNET.[33] The Aspen data feeds into FMCSA's Motor Carrier Management Information System (MCMIS[34]), a source for FMCSA inspection, crash, compliance review, safety audit, and registration data that is used in FMCSA's Compliance, Safety, and Accountability (CSA) Program.
- FMCSA inspectors also use other field system laptop applications, including CAPRI,[35] used for preparing investigations, as well as some safety audits, specialized cargo tank facility reviews, and HM shipper reviews, and HMPIP,[36] a browser-based application used during dock and vehicle inspections to record compliance problems with hazardous material packages.

[32] SAFER, or Safety and Fitness Electronic Records, is a website that displays carrier information available to the public, a store and forward mailbox system, secondary databases, and communication links. See http://safer.fmcsa.dot.gov/.
[33] SAFETYNET is an Oracle based client-server application operated at state safety agencies and Federal divisions that runs on MS Windows servers as a database management system and allows entry, access, analysis, and reporting of data from driver/vehicle inspections, crashes, compliance reviews, assignments, and complaints.
[34] http://www.fmcsa.dot.gov/mission/information-systems/information-systems#sthash.zqB3mIk6.dpuf.
[35] Compliance Analysis and Performance Review Information.
[36] Hazardous Materials Package Inspection Program.

- FMCSA has a portal[37] providing single sign-on access to many of its databases (MCMIS, SAFER, and others). This portal provides access for companies to view their data directly, in real-time or near-real-time. The ultimate goal of FMCSA is to use the portal to implement an information technology (IT) solution that improves FMCSA's ability to save lives and improves the safety of commercial motor vehicles.
- Motor carrier law enforcement inspectors prefer a performance standard to a technological system.
-

The motor carrier inspection community shared the following concerns regarding information gaps, and vulnerabilities:

- Inspectors in rural or geographically-challenged areas may have Internet connectivity issues; and
- Inspectors must be given a copy of the shipping paper for documenting inconsistencies between the shipping paper information and the HM onboard a vehicle.

### 3.3.4 Discussions with Emergency Responders

The emergency responder stakeholder group includes public service answering points (PSAPs), firefighting officials, emergency medical service (EMS) providers, and private companies that provide emergency response-related services and information for HM incidents. These emergency response professionals are the first to be notified of, and respond to, incidents involving HM.

In Spring and Summer 2012, PHMSA interviewed personnel from the following emergency response organizations:

- International Association of Fire Chiefs (IAFC);
- International Association of Fire Fighters (IAFF);
- National Fire Protection Agency (NFPA) 472 Committee;
- National Volunteer Fire Council (NVFC);
- North American Fire Training Directors (NAFTD);
- Association of Public-Safety Communications Officials (APCO) International;
- Alexandria, Virginia PSAP;
- Bell County, Texas 9-1-1 District;
- Dane County, Wisconsin Public Safety Communications Center;
- Fairfax County, Virginia 9-1-1;
- Fairfax County, Virginia Fire and Rescue Department, HM Response Team;
- James City County 9-1-1 Emergency Communications (Toano, Virginia);
- Laramie, Wyoming Police Department;
- Richmond, Virginia PSAP;
- Richmond, Virginia HM Response Team;
- St. Tammany Parish Communications District (Covington, Louisiana);
- Steuben County, New York 9-1-1 Center;

[37] https://portal.fmcsa.dot.gov/login.

- York, Poquoson, Williamsburg Regional Emergency Communications Center (York County, Virginia); and
- CHEMTREC.

#### 3.3.4.1 Emergency Responders' Feedback and Opinions

Regarding their specific organizational capabilities and needs, PSAPs and emergency responders provided the following information:

- PSAP personnel training and professional experiences regarding HM vary greatly. Most PSAP personnel are not familiar with the look and content of an HM shipping paper, and those at small rural PSAPs may not know about placarding information.
- Specific HM information is needed immediately by PSAP dispatchers and first responders; this information is the "minimum information" initially needed to determine necessary response actions:
  - PSAP dispatchers initially ask callers for a variety of situational information, including:
    - The incident location;
    - Incident and logistical/environmental/sensory details (e.g., "what's the emergency," what's happening around you," "what do you smell/hear/see," etc.);
    - Placard information on vehicle;
    - Name and quantity of products, including HM, involved in the incident;
    - Manifest information;
    - Caller's callback number;
    - Driver's name and contact information; and
    - Truck and trailer information (e.g., number) and condition.
  - On-scene first responders need, or prefer to have, the following HM information immediately:
    - Basic description of the HM (boiling point, density, specific gravity, etc.);
    - Technical and proper shipping name of the HM;
    - Immediate hazards to health (threshold limit value and immediately dangerous to life and health information);
    - Risks of fire or explosion;
    - Immediate precautions to be taken in the event of an accident or incident;
    - Immediate methods for handling fires, spills, or leaks;
    - Preliminary first aid measures;
    - UN identification number;
    - Hazard class or division number;
    - Packing Group;
    - Emergency contact telephone number; and
    - The truck and trailer numbers.

The PSAPs and emergency responders shared the following information regarding e-HM communication:

- Specific HM information is needed immediately;
- E-HM communication needs to be scalable;
- It is important to have layered and redundant systems;
- Accurate information is preferred over quick unverified information;
- Pulling", rather than "pushing," information is preferred;
- E-HM information needs to have the capability to be sent to an Internet protocol (IP) address;
- Create and mandate standard format and fields for e-HM information; and
- HM trade names are important, and would be useful to add as a required shipping paper field.

#### 3.3.4.2 Emergency Responder-Specific Concerns, Gaps, and Vulnerabilities with E-communication

Emergency responders shared the following information regarding e-communication concerns, gaps, and vulnerabilities:

- Limited Internet connectivity access exists in some rural areas;
- First responder capabilities regarding access to electronic information vary;
- Responder community is lacking training on the use of available electronic tools for e-HM communication;
- It is difficult to obtain information on complex HM shipments (e.g., mixed and less than truckload (LTL) shipments) in an e-HM system;
- A link between the conveyance and the e-HM shipping papers is needed; and
- Existing challenges associated with current HM product and shipping paper information need to be addressed.

#### 3.3.4.3 Emergency Responders Views Regarding Challenges with Current HM Product and Shipping Paper Information:

Emergency responders shared the following information regarding their views of challenges with current HM product and shipping paper information:

- A "many-to-one" relationship between trade names and proper shipping name exists.
- Products with the same proper shipping name may have different response requirements.
- MSDS data is rarely titled and/or indexed by proper shipping name or technical name.
- Trade name information may not be transmitted, retained, mapped, and/or captured in the transfer of EDI data across networks.
- Trade name information may not be readily apparent to responder or caller even if it is shown on the shipping documents.
- Shipping documents are often complex, and the lack of a standardized form and field layout adds confusion. Because most callers who place emergency calls are not familiar with shipping

documents and HM information, many are confused about providing the requested information to emergency responders.

- Better information on defining and distinguishing the shipper and the carrier is needed.
- Having too much information is almost as bad as having too little.

#### 3.3.4.4 Discussions with CHEMTREC, a Private Nationwide U.S. Emergency Response Company

CHEMTREC was established in 1971 by the chemical industry as a public service hotline for emergency responders to obtain information and assistance for emergency incidents involving chemicals and HM. Registration with CHEMTREC authorizes HM shippers the right to portray the CHEMTREC phone number(s) on their shipping documents, Safety Data Sheets (SDSs), and hazard communications labels. The portrayal of the CHEMTREC telephone numbers(s) helps registrants comply with regulations such as 49 CFR Part 172.604, which requires HM shippers to provide a 24-hour emergency telephone number on shipping documents for use in emergency events involving HM. Additional resources provided by CHEMTREC include:

- A round-the-clock communications center staffed by trained and experienced emergency service specialists;
- Immediate access to thousands of chemical product specialists and HM experts through CHEMTREC's database of over 30,000 manufacturers, shippers, carriers, public organizations, and private resources;
- A state-of-the-art telecommunications system that supports the virtual emergency response team, seamlessly linking on-scene responders with chemical experts, transportation companies, and medical experts;
- An expansive electronic library of over 5 million SDSs;
- A database of medical experts and chemical toxicologists who provide advice and emergency medical treatment assistance to on-scene medical professionals treating victims of product exposure; and
- Interpretation capabilities for more than 180 languages in the event of an emergency involving non-English speaking stakeholders.[38]

For the approximately 1.2 million daily HM shipments[39] in the U.S., CHEMTREC receives an average of 325 calls, about 125 of which are HM incidents from shippers and carriers.

CHEMTREC shared the following information regarding e-communication concerns, gaps, and vulnerabilities:

- A "many-to-one" relationship between trade names and proper shipping name exists.
- Products with the same proper shipping name may have different response requirements.
- MSDS date is rarely titled and/or indexed by proper shipping name or technical name.
- Trade name information may not be transmitted, retained, mapped, and/or captured in the transfer

[38] www.chemtrec.com/about/Pages/default.aspx.
[39] Estimate was provided via conversation with CHEMTREC staff in 2012 and was based on 2011 HM shipments.

of EDI data across networks.

- Trade name information may not be readily apparent to responder or caller even if it is shown on the shipping documents.
- Shipping documents are often complex. Many shippers use an ANSI form or their shipping form. The lack of a required HM form and format causes confusion for some callers. CHEMTREC suggests the use of a specific HM shipping paper format that has exact fields for entering specific information about each HM, regardless of the shipper.
- Originating shipper information may be "masked" or not readily apparent on the on-scene shipping documents.
- The shipper's name may have been changed, or may be shown differently, on HM shipments that undergo multiple transport movements.
- CHEMTREC also mentioned that some carriers are often reluctant to let other carriers, and intermodal carriers, know the identity of their shippers; this scenario is an impediment to providing timely and accurate information to emergency responders.

# 4. Pilot Test Planning and Implementation Activities

PHMSA conducted the following pilot test planning and implementation activities during 2013-2015:

- Held meetings with emergency responder and HM inspectors discussing procedures for emergency response and inspection simulations during the pilot tests;
- Published 60- and 30-day notices regarding the execution of paperless HM communication pilot tests to evaluate the use of e-systems during actual HM shipments to transfer HM information between HM stakeholders (i.e., shippers, carriers, emergency responders, and law enforcement inspection personnel) in all transportation modes (air, maritime, rail, and roadway);
- Developed data collection forms (pilot test participant selection, inspection, and emergency response simulation, and impact analysis question sets);
- Submitted information collection package (ICP) to OMB in accordance with PRA requirements and obtained necessary OMB approval;
- Evaluated volunteer qualifications and selected pilot test participants;
- Developed and conducted pilot test participant regional orientation webinars; and
- Coordinated and implemented pilot tests with volunteer participants, including holding weekly pilot test participant teleconferences.

Each of these activities is further described in the following sections.

## 4.1 Discussion Meetings on Emergency Response and Inspection Simulation Procedures

On March 13, 2014, PHMSA held two separate roundtable discussions[40] with DOT emergency response representatives and law enforcement inspection entities who had either expressed interest in participating in, or had previously consulted with PHMSA regarding, the HM-ACCESS Project. The purpose of the discussions was to obtain feedback regarding their operations for coordinating emergency response and inspection pilot test simulations in accordance with the specifications identified in the 60-Day, and 30-Day *Federal Register* Notices published on July 19, 2013 (78 FR 43263) and November 25, 2013 (78 FR 70399), respectively. PHMSA provided the following simulation instructions to the participants:

- Simulations will be limited to testing e-communication of shipping paper information.
- Simulations will be conducted following each agency's/company's/organization's established emergency response/inspection protocols using their equipment and resources.
- One simulation question set should be completed for each emergency response/inspection simulation conducted during the pilot test, preferably within 24 hours of conducting the actual simulation.
- Emergency responders and inspectors are requested to submit a copy of the e-HM shipping paper receipt to PHMSA's HM-ACCESS website inbox.

During the roundtable discussions, PHMSA demonstrated features of the online tool (FluidSurveys™[41]) that would be used by pilot test emergency responders and law enforcement inspectors to enter simulation information electronically. The team also provided examples of the types of data that would be requested by the simulation question sets.

Participants shared information on their procedures for responding to HM transportation emergencies and conducting modal HM inspections and provided insightful questions, comments, and suggestions regarding pilot test simulation implementation.

## 4.2 60- and 30-Day Notices Regarding the Paperless HM Communications Pilot Tests

PHMSA published a 60-Day *Federal Register* Notice entitled "Paperless Hazard Communications Pilot Program," on July 19, 2013 (78 FR 43263) in support of MAP-21, Section 33005. This notice described the HM-ACCESS initiative and planned information collection activities associated with conducting pilot projects and evaluating potential impacts. The notice also provided an opportunity for stakeholders to comment on the information collection activities and to volunteer as a potential participant in the pilot projects. The comment period for the 60-Day Notice closed on September 17, 2013.

[40] The details of the March 2014 roundtable discussion meetings are summarized in two documents on PHMSA's HM-ACCESS website: http://phmsa.dot.gov/hazmat/hm-access/stakeholder-information-papers.
[41] More information on this tool can be found at www.fluidsurveys.com.

A copy of the 60-Day Notice is provided in Appendix I: PHMSA's Paperless Hazard Communications Pilot Program—60-Day Notice.

PHMSA published a 30-Day *Federal Register* Notice entitled "Paperless Hazard Communications Pilot Program," on November 25, 2013 (78 FR 70399) as a follow-up to its Federal Register 60-Day Notice (posted on July 19, 2013). This notice addressed stakeholder comments received in response to the 60-Day Notice and identified the specific questions that would be used for the information collection effort associated with the pilot projects and for the evaluation of potential impacts (refer to Section 4.3.). The comment period for the 30-Day Notice closed on December 26, 2013.

A copy of the 30-Day Notice is provided in Appendix J: PHMSA's Paperless Hazard Communications Pilot Program, 30-Day Notice.

In addition to being posted in the *Federal Register*, information regarding both notices was sent via email to PHMSA's HM-ACCESS "Serve List," a compilation of approximately 5,600 individuals and companies interested in receiving information on the HM-ACCESS Project.

## 4.3 Pilot Test Participant Selection, Inspection and Emergency Response Simulation, and Impact Analysis Question Sets

PHMSA developed the following four online question sets to collect project-related information:

- Pilot Test Shipper and Carrier Participant Selection Question Set
- Pilot Test Inspection Simulation Question Set
- Pilot Test Emergency Response Question Set
- Impact Analysis Question Set

The Pilot Test Shipper and Carrier Participant Selection Question Set was used to collect information from potential pilot test shipper and carrier volunteers regarding their ability to meet the criteria identified in Section 4.5 of this report. A hardcopy of this question set is provided in Appendix K: Pilot Test Participant Selection Question Set.

The Pilot Test Inspection and Emergency Response Simulation Question Sets were used by pilot test inspectors and emergency responders to document the pilot test data described in Chapter 5 of this report. Hard copies of these question sets are provided in Appendix L: Pilot Test Inspection Simulation Question Set and Appendix M: Pilot Test Emergency Response Simulation Question Set, respectively.

The Impact Analysis Question Set was provided to pilot test volunteers and approximately 3,000 interested parties in the HM community (shippers, carriers, emergency responders, law enforcement inspectors); Federal, state, and local government agencies; HM/emergency response training companies/educational associations; HM/emergency response equipment/software developers/vendors; trade associations; freight forwarders/brokers; and media companies representing all transportation modes

(air, maritime, rail, and roadway) who had subscribed to receive HM-ACCESS updates to voluntarily provide input on the costs, benefits, and challenges associated with implementing e-communication systems for HM shipping paper information. This data is presented in Chapter 6 of this report. A hardcopy of this question set is provided in Appendix N: Pilot Test Impact Analysis Question Set.

All four question sets were developed using FluidSurveys™[42] online data collection software.

[42] https://fluidsurveys.com/

## 4.4 Submitting Pilot Test Information Collection Package to OMB and Obtaining Approval

PHMSA submitted an ICP on December 19, 2013, to OMB for review and approval, in accordance with the PRA. PHMSA received OMB approval on the ICP on September 8, 2014, thus enabling PHMSA to proceed with conducting the inspections and emergency response simulation pilot tests in multiple U.S. regions (including one rural area as required by MAP-21) and collecting impact analysis information related to e-HM communications and e-systems.

## 4.5 Pilot Test Participant Selection

The pilot test participants encompassed representatives from the four major stakeholder categories: shippers, carriers, emergency responders, and law enforcement inspectors. All other HM interested parties, such as vendors of e-communication technologies or products, were excluded from pilot test participation. As indicated within the 60-Day and 30-Day Notices, pilot test participation was voluntary and volunteering did not guarantee participation.

PHMSA selected shippers and carriers for participation in the pilot tests who met the following qualifications:

- Volunteering entity cannot be an association, but rather needs to an individual entity, as an association cannot volunteer for its members.
- Volunteering entity must qualify as an HM shipper and/or carrier (i.e., the entity must ship and/or transport HM).
- Volunteering entity must have returned to PHMSA within the allotted time a completed Shipper and Carrier Participant Selection Question Set. Refer to Appendix K: Pilot Test Participant Selection Question Set for the Shipper and Carrier Participant Selection Question Set.
- Volunteering entity must have answered "YES" to questions 4, 6, 7, 10, 11 and 12 of the Shipper and Carrier Participant Selection Question Set (refer to Appendix K: Pilot Test Participant Selection Question Set), acknowledging a: (1) willingness to participate; (2) ability to identify a single coordinating POC; (3) willingness to participate in a pre-pilot orientation meeting; (4) willingness to participate in inspection and emergency response simulations;[43] (5) willingness to provide feedback and e-HM communication data during pilot tests, as well as information on the basic function and capabilities of their e-system(s); and (6) understanding the intended use of collected information and that PHMSA cannot guarantee their company/organization's identity will be kept confidential.
- Volunteering entity must currently possess an e-system(s) and resources capable of managing and

[43] For purposes of these pilot tests, "simulation" refers to planned exercises designed solely to test the feasibility and effectiveness of using e-systems to communicate the needed HM shipping paper information during project-related HM emergency response and inspection scenarios among pilot test participants. The scope of the simulations was defined by project data collection needs for testing e-communication of shipping paper information. Emergency response simulations did not involve testing first responder procedures, equipment, or resources not related to the communication of shipping paper information. (30-Day Notice, Section 3).

communicating HM shipping paper information at their own expense.

- Volunteering entity must ship and/or transport HM within a test region in proximity of participating emergency response and/or law enforcement organizations.
- Volunteering entity must be in good standing with all levels of government and demonstrate compliance with applicable regulations governing the safe and secure transportation of HM.

Selected emergency responder and law enforcement inspector pilot test participants were those willing to assist in the collection of information during the inspection and emergency response simulations by following their established response/inspection protocols using their own equipment and resources and by completing online Inspection or Emergency Responder Question Sets (refer to Appendix L: Pilot Test Inspection Simulation Question Set and Appendix M: Pilot Test Emergency Response Simulation Question Set, respectively, for these question sets). Such entities also were expected to operate within the regions of the pilot tests where the participating shippers and carriers operate.

Thirty-five different entities across different stakeholder groups were selected as pilot test participants. The participant numbers by stakeholder group are shown in Table 1.

**Table 1. Pilot Test Participants**

| Stakeholder Group | Number of Entities Vetted to Participate |
|---|---|
| Shippers | 7 |
| Carriers | 4 |
| Shippers/Carriers | 5 |
| Emergency Responders | 6 |
| Emergency Responders/Law Enforcement Inspectors (Non-Federal) | 2 |
| Law Enforcement Inspectors (Non-Federal) | 7 |
| Law Enforcement Inspectors (Federal) | 4 |
| **Total:** | **35** |

## 4.6 Orientation Webinars for Pilot Test Participants

PHMSA held six pilot test participant orientation webinars in January and February 2015; one for each pilot test region (Southwestern, Western, Eastern, Southern, and Central),[44] and a makeup session for participants unable to attend their respective regional webinar. All regional pilot test shippers, carriers, emergency responders, and law enforcement inspectors were invited to attend at least one regional webinar. During these webinars, the following information was shared with pilot test participants:

- Introductions (PHMSA's HM-ACCESS Team members and other regional pilot test participants);
- Goals of the HM-ACCESS Project;
- Objectives and expectations of the pilot tests;
- Pilot test roles, responsibilities, and schedule;
- How to access and complete the online emergency response and inspection simulation question sets;
- Emergency response and inspection simulation expectations;
- Format and intended content of final report;
- Point-of-contact information for PHMSA's HM-ACCESS Team members and pilot test participants; and
- Communication procedures during pilot tests.

## 4.7 Pilot Test Coordination and Implementation

Pilot tests were conducted from February 17, 2015 to May 15, 2015[45] with selected participants within five U.S. Regions (Western, Central, Southwestern, Southern, and Eastern) corresponding to PHMSA field service areas, included, at least, one rural area, as required by MAP-21.The pilot tests collected data regarding the feasibility, effectiveness, and safety associated with the electronic transfer of HM shipping paper data between HM stakeholders (shippers, carriers, law enforcement inspectors, and emergency response personnel) during inspection and emergency response simulations utilizing participants' existing equipment and resources.

During the pilot test period, PHMSA invited pilot test participants to take part in weekly teleconferences to discuss recent emergency response and inspection simulations, including process, efficiencies, and constraints associated with the e-HM shipping paper data transmissions.

[44] The five U.S. Regions correspond to PHMSA's Field Service Regions. The Central Region includes Nebraska, North Dakota, South Dakota, Kansas, Minnesota, Iowa, Missouri, Wisconsin, Illinois, Michigan, Indiana, and Ohio. The Eastern Region includes Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, Connecticut, New York, New Jersey, Pennsylvania, Maryland, Delaware, Virginia, and West Virginia. The Southern Region includes Kentucky, Tennessee, South Carolina, North Carolina, Alabama, Mississippi, Florida, and Georgia. The Southwestern Region includes Texas, New Mexico, Oklahoma, Arkansas, and Louisiana. The Western Region includes California, Nevada, Utah, Colorado, Arizona, Washington, Oregon, Idaho, Montana, and Wyoming.

[45] The pilot tests began on February 17, 2015 and originally were planned to continue for 10 ½ weeks, concluding on April 30, 2015; however, the test period was extended to May 15, 2015 to allow more time to conduct additional simulations and to satisfy the MAP-21 requirement that at least one test be conducted in a rural area.

# 5. Pilot Test Data

Pilot tests were conducted from February 17, 2015, to May 15, 2015,[46] with selected participants within five U.S. Regions (Western, Central, Southwestern, Southern, and Eastern). The data was collected via inspectors and emergency responders entering simulation data in the online Pilot Test Inspection (Appendix L: Pilot Test Inspection Simulation Question Set) and Emergency Response (Appendix M: Pilot Test Emergency Response Simulation Question Set) Simulation Question Sets. As shown in Table 2, a total of 21 simulations, 16 inspection, and 5 emergency response simulations, were completed during the pilot test period, including one rural roadway inspection.

**Table 2. Total Pilot Test Simulations**

| Mode | Inspection Simulations | Emergency Response (ER) Simulations | Total Modal Simulations Completed |
|---|---|---|---|
| Roadway | 13 (1 in a rural area) | 1 | **14** |
| Rail | 0 | 2 | **2** |
| Maritime | 3 | 1 | **4** |
| Air | 0 | 1 | **1** |
| **Total Simulations—All Modes:** | **16** | **5** | **21** |

Table 3 presents the pilot test simulations by region.

**Table 3. Pilot Test Simulations by Region[47]**

| | Inspection Simulations | | ER Simulations | | | | Totals by Region |
|---|---|---|---|---|---|---|---|
| Region | Roadway | Maritime | Roadway | Rail | Maritime | Air | |
| Southwestern | 2 | 0 | 0 | 0 | 0 | 0 | **2** |
| Central | 1 | 0 | 0 | 0 | 0 | 0 | **1** |
| Eastern | 8 | 0 | 1 | 1 | 0 | 0 | **10** |
| Southern | 2 (1 in a rural area) | 1 | 0 | 0 | 0 | 1 | **4** |
| Western | 0 | 2 | 0 | 1 | 1 | 0 | **4** |
| **Totals:** | **13** | **3** | **1** | **2** | **1** | **1** | **21** |

[46] The pilot tests began on February 17, 2015, and originally were planned to continue for ten and a half weeks, concluding on April 30, 2015. However, the test period was extended to May 15, 2015, to allow more time to conduct additional simulations and to satisfy the MAP-21 requirement that at least one test be conducted in a rural area.

[47] The five U.S. Regions correspond to PHMSA's Field Service Regions. The Central Region includes Nebraska, North Dakota, South Dakota, Kansas, Minnesota, Iowa, Missouri, Wisconsin, Illinois, Michigan, Indiana, and Ohio. The Eastern Region includes Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, Connecticut, New York, New Jersey, Pennsylvania, Maryland, Delaware, Virginia, and West Virginia. The Southern Region includes Kentucky, Tennessee, South Carolina, North Carolina, Alabama, Mississippi, Florida, and Georgia. The Southwestern Region includes Texas, New Mexico, Oklahoma, Arkansas, and Louisiana. The Western Region includes California, Nevada, Utah, Colorado, Arizona, Washington, Oregon, Idaho, Montana, and Wyoming.

## 5.1 Pilot Test Volunteer Participants

The 35 entities were vetted to participate in the pilot tests (refer to Table 1), and more than 20 of these entities participated in the pilot program's weekly pilot test teleconferences. Due to the availability and location of vetted shipper and carrier, HM shipments during the pilot test period (February 17, 2015 to May 15, 2015), only 20 entities had an opportunity to participate in a pilot test simulation. Table 4 identifies the number of entities, by stakeholder group, who actually participated in one or more of the 21 pilot test simulations.

**Table 4. Number of Actual Pilot Test Participants by Stakeholder Group**

| Stakeholder Group | Number of Entities Vetted to Participate in Pilot Tests | Number of Entities Who Actually Participated in Pilot Test Simulations |
|---|---|---|
| Shippers | 7 | 4 |
| Carriers | 4 | 4 |
| Shippers/Carriers | 5 | 3 |
| Emergency Responders | 6 | 3 |
| Emergency Responders/Law Enforcement Inspectors (Non-Federal) | 2 | 2 |
| Law Enforcement Inspectors (Non-Federal) | 7 | 2 |
| Law Enforcement Inspectors (Federal) | 4 | 2 |
| **Totals:** | **35** | **20** |

In coordinating simulation logistics, PHMSA sought to find vetted inspectors and emergency responders available to participate within their operational jurisdictions where vetted shippers and carriers were shipping/transporting HM during the pilot test period. While many pilot test shippers and carriers adjusted their HM transport routes to coordinate with inspectors' and emergency responders' operational jurisdictions, some HM transport routes for vetted shippers and carriers did not correspond with vetted inspector/emergency responder jurisdictional areas, so not all 35 vetted entities were able to participate in pilot test simulations. Also, as provided in participant description paragraphs in Sections 5.1.1 and 5.1.2, single vetted entities often participated in multiple pilot test simulations, which increased the amount of available pilot test data but sometimes provided narrower or skewed results when the data was grouped and analyzed.

### 5.1.1 Participating Shippers and Carriers

Descriptions of the four shippers who participated in pilot test simulations are as follows:

- Shipper (ID 1) operates primarily in the Western Region of the U.S. and ships HM via air, maritime, and roadway. Shipper ID 1 participated in one roadway inspection simulation and offered Class 1 (explosives) in non-bulk packaging (boxes) transported on trucks as HM for the pilot test inspection simulation.

- Shipper (ID 2) operates in all five U.S. regions[48] and ships HM via air and roadway. Shipper ID 2 participated in one roadway inspection simulation, and offered Class 5 (oxidizing substances and organic peroxides) in non-bulk packaging (plastic pails) transported on trucks as HM for the pilot test inspection simulation.
- Shipper (ID 3) operates primarily in the Southern Region of the U.S. and ships HM via air, maritime, rail, and roadway. Shipper ID 3 participated in one maritime inspection simulation and one emergency response simulation, and offered Class 3 (flammable liquids—100°F or less, closed cup) in non-bulk packaging (drums and pails), transported via truck on chassis on terminal as HM for the maritime inspection simulation, and transported on a rail car as HM for the emergency response simulation.
- Shipper (ID 4) operates in all five U.S. regions and ships HM via air, maritime, rail, and roadway. Shipper ID 4 participated in one emergency response simulation, and offered Class 4 (other flammable substances) and Class 6 [toxic (poisonous) and infectious substances] transported on a truck and an airplane as HM for the emergency response simulation.

Descriptions of the four carriers who participated in pilot test simulations are as follows:

- Carrier (ID 5) operates in all five U.S. regions and transports HM via roadway. Carrier ID 5 participated in one roadway inspection simulation, and transported Class 3 (flammable liquids—100°F or less, closed cup) in cargo tanks during the roadway inspection simulation.
- Carrier (ID 6) operates in the Western Region of the U.S. and transports HM via maritime and rail. Carrier ID 6 participated in one maritime inspection simulation and transported Class 3 (flammable liquids—100°F or less, closed cup) in bulk freight containers during the maritime inspection simulation.
- Carrier (ID 7) operates in the Western Region of the U.S. and transports HM via maritime and rail. Carrier ID 7 participated in two emergency response simulations: during the maritime emergency response simulation, Carrier ID 7 transported Class 2 (gases) and Class 3 (flammable liquids—100°F or less, closed cup) on a ship; during the rail emergency response simulation, Carrier ID 7 transported Class 3 (flammable liquids—100°F or less, closed cup), Class 4 (other flammable substances), and Class 8 (corrosives) on straddle carriers, rail cars, and ships. This carrier is a department of an organization that operates as a non-Federal emergency response/law enforcement inspection organization (refer to emergency response organization (ERO)/law enforcement inspection organization (LEIO) ID 16).
- Carrier (ID 8) operates in the Eastern, Southern, and Southwestern Regions of the U.S. and transports HM via rail. Carrier ID 8 participated in one emergency response simulation, and transported Class 3 (flammable liquids—100°F or less, closed cup) on railcars. This carrier has a department that operates as an emergency responder (refer to ERO ID 14).

[48] The five U.S. Regions correspond to PHMSA's Field Service Regions. The Central Region includes Nebraska, North Dakota, South Dakota, Kansas, Minnesota, Iowa, Missouri, Wisconsin, Illinois, Michigan, Indiana, and Ohio. The Eastern Region includes Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, Connecticut, New York, New Jersey, Pennsylvania, Maryland, Delaware, Virginia, and West Virginia. The Southern Region includes Kentucky, Tennessee, South Carolina, North Carolina, Alabama, Mississippi, Florida, and Georgia. The Southwestern Region includes Texas, New Mexico, Oklahoma, Arkansas, and Louisiana. The Western Region includes California, Nevada, Utah, Colorado, Arizona, Washington, Oregon, Idaho, Montana, and Wyoming.

Descriptions of the three shippers/carriers (S/Cs) who participated in pilot test simulations are as follows:

- S/C (ID 9) operates in all U.S. regions and transports HM via roadway. S/C ID 9 participated in two roadway inspection simulations, and transported Class 2 (gases), Class 3 (flammable liquids—100°F or less, closed cup), Class 9 (miscellaneous dangerous materials) in bulk packaging (drums, pails, barrels, and boxes) on trucks during the first roadway inspection simulation. S/C ID 9 transported Class 2 (gases), Class 3 (flammable liquids—100°F or less, closed cup), Class 6 [toxic (poisonous) and infectious substances], Class 8 (corrosives), and Class 9 (miscellaneous dangerous materials) in bulk packaging (drums, pails, barrels, boxes, and cylinders) on trucks during the second roadway inspection simulation.
- S/C (ID 10) operates in all U.S. regions and transports HM via air and roadway. S/C ID 10 participated in seven roadway inspection simulations and transported Class 7 (radioactive materials) in non-bulk packaging (Type A for Class 7 radioactive materials) on trucks and a passenger car during the roadway inspection simulations.
- S/C (ID 11) operates in all five U.S. regions and transports HM via air and roadway. S/C ID 11 participated in one roadway inspection and one emergency response simulation, and transported Class 2 (gases), Class 7 (radioactive materials), Class 8 (corrosives), and Class 9 (miscellaneous dangerous goods) in non-bulk packaging (boxes) on trucks during the roadway inspection simulation and Class 4 (other flammable substances) and Class 6 [toxic (poisonous) and infectious substances] on a truck and an airplane during the emergency response simulation.

### 5.1.2 Participating Emergency Response and Law Enforcement Inspection Organizations

Descriptions of the three EROs who participated in pilot test simulations are as follows:

- ERO (ID 12) is a large-sized state organization in the Southern Region that coordinates emergency response operations at the state level and serves as the initial response element for emergencies and disasters impacting the state. ERO ID 12 participated in the air emergency response simulation.
- ERO (ID 13) is one of the largest fire departments in the U.S., is located in the Eastern Region, and responds to more than one million emergencies annually. ERO ID 13 participated in the roadway emergency response simulation.
- ERO (ID 14) is a Class I railroad emergency response department, with operations located in the Eastern, Southern, and parts of the Central Regions. ERO ID 14 participated in one of the rail emergency response simulations. This ERO is a division of an HM carrier company (refer to Carrier ID 8).

Descriptions of the two non-Federal EROs/LEIOs who participated in pilot test simulations are as follows:

- ERO/LEIO (ID 15) is a medium-sized state organization in the Eastern Region chartered to protect and preserve the state's air, water, and land resources, to enforce environmental laws and

regulations, to respond to environmental emergencies. ERO/LEIO ID 15 participated in one roadway simulation.

- ERO/LEIO (ID 16) is a private company in the Western Region responsible for public safety and security at one of the largest U.S. container ports for shipping automotives, bulk, breakbulk, and heavy lift cargoes. ERO/LEIO ID 16 participated in one maritime inspection simulation and two emergency response simulations (one rail and one maritime). This ERO/LEIO also has a division that operates as a carrier at the port (refer to Carrier ID 7).

Descriptions of the two non-Federal LEIOs who participated in pilot test simulations are as follows:

- LEIO (ID 17) is a medium-sized state government inspection agency in the Central Region responsible for safeguarding the security of the state's regulated motor carrier and rail operations through inspection and monitoring programs and for enhancing safety at all public highway-railroad grade crossings. LEIO ID 17 participated in one roadway simulation.
- LEIO (ID 18) is a medium-sized state government inspection agency in the Southern Region responsible for conducting enforcement activities such as inspecting commercial vehicles and driver logs and patrolling highways for identifying and mitigating truck traffic violations. LEIO ID 18 participated in two roadway inspection simulations.

Descriptions of the two Federal LEIOs who participated in pilot test simulations are as follows:

- LEIO (ID 19) is a division within a Federal agency responsible for inspecting entities who offer HM for transport and/or transport HM and enforcing current HM transportation laws. LEIO ID 19 participated in nine roadway inspection simulations.
- LEIO (ID 20) is a Federal agency whose responsibilities include inspecting containers at ports for compliance with proper labeling, stowage, and content requirements. LEIO ID 20 participated in two maritime inspection simulations.

## 5.2 Inspection Simulations

Sixteen inspection simulations were completed during the pilot test period; thirteen in the Roadway Mode and three in the Maritime Mode. One of the Roadway inspection simulations was performed in a rural area. No inspection simulations were performed in the Air and Rail Modes due to the unavailability of HM shipments in these modes during the pilot test period. General inspection simulation information is provided in Table 5.

**Table 5. Pilot Test Inspection Simulation Information**

| | Region[49] | Simulation Date | Simulation Number | Venue | City | State | Participants Involved |
|---|---|---|---|---|---|---|---|
| Roadway | Southwestern | 02/26/15 | 11 | Home Depot Parking Lot | Houston | Texas | ID 19, ID 9 |
| | Central | 03/13/15 | 13 | Manufacturing Facility | Cincinnati | Ohio | ID 17, ID 1 |
| | Eastern | 03/18/15 | 8 | Weigh and Inspection Station at Highway Park and Ride Site | Beltsville | Maryland | ID 15, ID 10 |
| | Southwestern | 03/18/15 | 12 | Home Depot Parking Lot | Katy | Texas | ID 19, ID 9 |
| | Eastern | 03/18/15 | 1 | Shipper/Carrier Facility | Bel Air | Maryland | ID 19, ID 10 |
| | Eastern | 03/18/15 | 2 | Hospital | Havre de Grace | Maryland | ID 19, ID 10 |
| | Eastern | 03/18/15 | 3 | Shipper/Carrier Facility | Bel Air | Maryland | ID 19, ID 10 |
| | Eastern | 03/18/15 | 4 | Hospital | Havre de Grace | Maryland | ID 19, ID 10 |
| | Southern | 03/24/15 | 9 | Weigh Station | Greeneville | Tennessee | ID 18, ID 11 |
| | Southern | 04/24/15[50] | 10 | State Road in Rural Area | Greeneville | Tennessee | ID 18, ID 2 |
| | Eastern | 04/27/15 | 7 | Tank Farm adjacent to Port | Philadelphia | Pennsylvania | ID 19, ID 5 |
| | Eastern | 05/08/15 | 5 | Shipper/Carrier Facility | Bel Air | Maryland | ID 19, ID 10 |
| | Eastern | 05/08/15 | 6 | Hospital | Havre de Grace | Maryland | ID 19, ID 10 |
| | **Region[51]** | **Simulation Date** | **Simulation Number** | **Venue** | **City** | **State** | **Participants Involved** |
| Maritime | Western | 03/24/15 | 14 | Road inside Port | Tacoma | Washington | ID 16, ID 6 |
| | Western | 04/13/15 | 15 | Pier | Los Angeles | California | ID 20 (no Shipper or Carrier was involved) |
| | Southern | 04/23/15 | 16 | Street inside Port | Garden City | Georgia | ID 20, ID 3 |

[49] Regions are based on PHMSA's field services locations.
[50] The inspection simulation conducted on April 24, 2015 in Greeneville, TN, was on a roadway located in a rural area where wireless connectivity, according to pilot test participants, is not always fully functioning.
[51] Regions are based on PHMSA's field services locations.

### 5.2.1 Description of Roadway Inspection Simulations

LEIO ID 19 conducted 9 of the 13 roadway inspections simulations; LEIO ID 18 conducted 2; ERO/LEIO ID 15 conducted 1; and LEIO ID 17 conducted 1. Eighty-five percent of these inspection organizations conduct roadway inspections daily. The other 15% conduct 90 days of compliance inspections per year or per rating period. Eighty-five percent of roadway inspection simulations were pre-scheduled; the remaining 15% were unannounced, compared to an average of 27% normally pre-planned (i.e., conducted as part of a routine inspection program at a checkpoint, waystation, etc.). Also, 73% normally conducted impromptu (i.e., conducted on the spot based on an observed potential safety risk on a transportation conveyance) during actual inspection activities. One hundred percent of the 13 roadway inspectors reported they collected the inspection simulation information electronically from the shipper/carrier.

S/C ID 10 participated in seven of the roadway inspection simulations, S/C ID 9 participated in two, and Shipper ID 1, Shipper ID 2, Carrier ID 5, and S/C ID 11 each participated in one. Drivers of the vehicles carrying the HM were present during all 13 roadway inspection simulations. Drums/pails, barrels, boxes, cylinders, cargo tanks, and Type A radioactive packages containing Class 1, 2, 3, 5, 6, 7, 8, and 9 HM[52] were inspected during the roadway inspection simulations. None of the HM shipments were involved in intramodal (i.e., transfers between conveyances within a single transportation mode; in these simulations, roadway) or intermodal (i.e., transfers between transportation modes) transfers. Five of the 13 roadway inspection simulation shipments were less-than-truckload[53] HM shipments.

#### 5.2.1.1 Eastern Region Roadway Inspection Simulations

Six of eight Eastern Region roadway inspection simulations involved the same participants (i.e., LEIO ID 19 and S/C ID 10). These six inspection simulations were conducted on March 18, 2015 (Simulations 1 to 4) and May 8, 2015 (Simulations 5 and 6), and involved Class 7 (radioactive materials) HM packaged in non-bulk Type A radioactive packages transported on trucks, and all inspection simulations were performed at fixed sites (shipper/carrier facility or hospital). The inspection information for all six simulations was collected electronically (driver used cellular/smartphone to contact the S/C; S/C used cellular/smartphone/tablet to email a pdf copy of shipping paper to inspector's cellular/smartphone); matched that recorded on the hardcopy HM shipping papers; and accurately reflected the HM being transported. Simulation 4 took five minutes or less, Simulations 5 and 6 took 6- to 15 minutes, Simulations 1 and 3 took 16 to 30 minutes, and Simulation 2 took 31 to 60 minutes to receive the e-HM information from the time of the request.

[52] HM are classified as follows: Class 1—Explosives, Class 2—Gases, Class 3—Flammable Liquids (100°F or less, closed cup), Class 4—Other Flammable Substances, Class 5—Oxidizing Substances and Organic Peroxides, Class 6—Toxic (Poisonous) and Infectious Substances, Class 7—Radioactive Materials, Class 8—Corrosives, and Class 9—Miscellaneous Dangerous Materials. Refer to 49 CFR 172.101 for more information.
[53] Less than truckload (LTL) is the transportation of a relatively small quantity of freight, usually less than 10,000 pounds, and less than that required for the application of a truckload rate. LTL carriers use terminal facilities to break and consolidate shipments. (http://www.transportation-dictionary.org/Less_Than _Truckload, Bureau of Transportation Statistics)

| | LEIO ID 19 and S/C ID 10 Roadway Simulations 1-6 | |
|---|---|---|
| **Time from Request to Receipt of E-HM Information** | **Simulation Number** | **Count** |
| 5 minutes or less | 4 | 1 |
| 6 to 15 minutes | 5 and 6 | 2 |
| 16 to 30 minutes | 1 and 3 | 2 |
| 31 to 60 minutes | 2 | 1 |

One of the eight Eastern Region roadway inspection simulations involved LEIO ID 19 and Carrier ID 5. This inspection simulation was conducted on April 27, 2015 (Simulation 7), and involved Class 3 (flammable liquids—100°F or less, closed cup) HM contained and transported in a cargo truck, which was inspected at a fixed site (tank farm). The inspection information was collected electronically (carrier used cellular phone to contact its dispatcher, who used a workplace computer to email a pdf copy of the shipping paper to the inspector's cellular/smartphone); matched that recorded on the hardcopy HM shipping papers; accurately reflected the HM being transported; and took 16 to 30 minutes to receive the e-HM information from the time of request.

| | LEIO ID 19 and Carrier ID 5 Roadway Simulation 7 | |
|---|---|---|
| **Time from Request to Receipt of E-HM Information** | **Simulation Number** | **Count** |
| 16 to 30 minutes | 7 | 1 |

One of the eight Eastern Region roadway inspection simulations involved ERO/LEIO ID 15 and S/C ID 10. This inspection simulation was conducted on March 18, 2015 (Simulation 8), and involved Class 7 (radioactive materials) HM packaged in non-bulk Type A radioactive packages transported in a passenger car, which was inspected at a weigh-and-inspection station at a highway park and ride site. The inspection information was collected electronically (carrier used workplace computer to email a pdf copy of the shipping paper to the inspector's vehicle laptop computer); matched that recorded on the hardcopy HM shipping papers; accurately reflected the HM being transported; and took 10 minutes to receive the e-HM information from the time of request.

| | ERO/LEIO ID 15 and S/C ID 10 Roadway Simulation 8 | |
|---|---|---|
| **Time from Request to Receipt of E-HM Information** | **Simulation Number** | **Count** |
| 6 to 15 minutes | 8 | 1 |

#### 5.2.1.2 Southern Region Roadway Inspection Simulations

Both of the Southern Region roadway inspection simulations were conducted by LEIO ID 18. The simulation conducted on March 24, 2015 (Simulation 9) involved S/C ID 11, who transported Class 2 (gases), Class 7 (radioactive materials), Class 8 (corrosives), and Class 9 (miscellaneous dangerous goods) HM in non-bulk packaging (boxes) on trucks; this conveyance and HM was inspected at a temporary roadside weigh station. The inspection information was collected electronically (driver contacted S/C at the office; S/C used workplace computer to email a pdf copy of the shipping paper to the inspector's workplace computer; the inspector had a laptop computer with him, and was able to plug it into the scale at the weigh station to upload the pdf shipping paper to his laptop for viewing during the inspection); matched that recorded on the hardcopy HM shipping papers; accurately reflected the HM being transported; and took 5 minutes or less to receive the e-HM information from the time of request.

| | **LEIO ID 18 and S/C ID 11 Roadway Simulation 9** | |
|---|---|---|
| **Time from Request to Receipt of E-HM Information** | **Simulation Number** | **Count** |
| 5 minutes or less | 9 | 1 |

#### 5.2.1.2.1 *Southern Region Rural Roadway Inspection Simulation*

The simulation conducted on April 24, 2015 (Simulation 10) involved Shipper ID 2, who offered Class 5 (oxidizing substances and organic peroxides) HM in non-bulk packaging (plastic pails) transported on trucks. This inspection occurred on a state road in a rural area of Tennessee. The inspection information was collected electronically (shipper attempted to use landline phone, computer aid dispatch (CAD) terminal, and vehicle laptop to send e-shipping papers to inspector's cellular phone and vehicle laptop computer, but was unsuccessful; shipper and inspector moved locations multiple times to attempt to get electronic connectivity; shipper emailed a pdf copy of the shipping paper to the inspector's vehicle laptop computer and CAD terminal); matched that recorded on the hardcopy HM shipping papers; accurately reflected the HM being transported; and took about 45 minutes to receive the e-HM information from the time of request.

| | LEIO ID 18 and Shipper ID 2 Roadway Simulation 10 | |
|---|---|---|
| **Time from Request to Receipt of E-HM Information** | **Simulation Number** | **Count** |
| 31 to 60 minutes | 10 | 1 |

### 5.2.1.3 Southwestern Region Roadway Inspection Simulations

Both Southwestern Region roadway inspection simulations involved the same participants (i.e., LEIO ID 19 and S/C ID 9). These inspection simulations were conducted on February 26, 2015 (Simulation 11) and March 18, 2015 (Simulation 12). S/C ID 9 transported Class 2 (gases), Class 3 (flammable liquids—100°F or less, closed cup), and Class 9 (miscellaneous dangerous materials) HM in bulk packaging (drums, pails, barrels, and boxes) on trucks during Simulation 11, and Class 2 (gases), Class 3 (flammable liquids—100°F or less, closed cup), Class 6 [toxic (poisonous) and infectious substances], Class 8 (corrosives), and Class 9 (miscellaneous dangerous materials) HM in bulk packaging (drums, pails, barrels, boxes, and cylinders) on trucks during Simulation 12. Both inspection simulations occurred in a construction supply store parking lot. The inspection information was collected electronically (for Simulation 11, the driver used cellular/smartphone/personal digital assistant (PDA) to contact the S/C; the S/C used a workplace computer to email a pdf copy of the shipping paper to the driver's laptop computer and to the inspector's cellular/smartphone and workplace computer; driver used in-cab printer to print a copy of the shipping paper; inspector was able to view the shipping paper via both his cellular/smartphone and the printed copy.

For Simulation 12, the driver used cellular/smartphone/PDA to contact the S/C; the S/C used a workplace computer to email a pdf copy of the shipping paper to the driver's laptop computer and to the inspector's cellular/smartphone, workplace computer, and FAX machine. Inspector used the pdf shipping paper on his cellular/smartphone to conduct the inspection simulation); matched that recorded on the hardcopy HM shipping papers; accurately reflected the HM being transported; and took five minutes or less to receive the e-HM information from the time of the request.

| | LEIO ID 19 and S/C ID 9 Roadway Simulations 11 and 12 | |
|---|---|---|
| **Time from Request to Receipt of E-HM Information** | **Simulation Number** | **Count** |
| 5 minutes or less | 11 and 12 | 2 |

#### 5.2.1.4 Central Region Roadway Inspection Simulation

The Central Region roadway inspection simulation, conducted on March 13, 2015 (Simulation 13), involved LEIO ID 17 and Shipper ID 1, who offered Class 1 (explosives) HM in non-bulk packaging (boxes) transported on trucks; this inspection simulation was performed at a manufacturing facility. The inspection information was collected electronically (shipper was contacted via cellular phone, contact was made outside of shipper's normal hours of business, and shipper was not set up for e-shipping paper transfer outside of normal business hours during pilot test; shipper faxed a pdf copy of the shipping paper to the inspector's vehicle laptop computer and office FAX machine); matched that recorded on the hardcopy HM shipping papers; accurately reflected the HM being transported; and took 4 hours and 3 minutes to receive the e-HM information from the time of the request.[54]

| | LEIO ID 17 and Shipper ID 1 Roadway Simulation 13 | |
|---|---|---|
| **Time from Request to Receipt of E-HM Information** | **Simulation Number** | **Count** |
| More than one hour | 13 | 1 |

### 5.2.2 Description of Maritime Inspection Simulations

Two maritime inspection simulations were conducted by LEIO ID 20, and the third was conducted by ERO/LEIO ID 16. Thirty-three percent of these organizations conduct daily inspections, 33% conduct weekly inspections, and 33% conduct inspections as needed. Pilot test shippers/carriers participated in two of these inspections; terminal personnel participated in the third inspection simulation. All three (100%) maritime inspection simulations were pre-scheduled, compared to an average of 60% normally pre-planned and 40% normally conducted impromptu during actual inspection activities.

[54] The delay in receipt of the e-shipping paper resulted because initial contact for the e-shipping paper was made outside of shipper's normal hours of business, and shipper was not set up for e-shipping paper transfer outside of normal business hours during the pilot test period.

Carrier ID 6 and Shipper ID 3 each participated in one of the maritime inspection simulations; the third maritime inspection simulation did not involve any vetted shippers or carriers; rather, this inspection simulation involved personnel at the terminal where the HM container was located. No vehicle drivers or ship captains responsible for the HM containers were present during the simulations. Drums/pails, boxes, and freight containers containing Class 1 and 3 HM were inspected during the maritime inspection simulations. One HM shipment was involved in an intramodal transfer; HM shipping paper information was communicated via the Internet during the transfer. The inspectors did not know if any intermodal transfers had occurred prior to the inspection simulations.

#### 5.2.2.1 Western Region Maritime Inspection Simulations

Two Western Region, maritime-inspection simulations were conducted. The first, conducted on March 24, 2015 (Simulation 14), involved ERO/LEIO ID 16 and Carrier ID 6, who transported Class 3 (flammable liquids—100°F or less, closed cup) HM in bulk freight containers; this inspection simulation was performed on a road in the port. The inspection information was collected electronically (carrier used cellular/smart/landline phone and workplace computer to email a pdf copy of the shipping paper in EDI language to the inspector's workplace computer and cellular/smartphone); matched that recorded on the hardcopy HM shipping papers; accurately reflected the HM being transported; and took five minutes or less to receive the e-HM information from the time of request.

| | ERO/LEIO ID 16 and Carrier ID 6 Maritime Simulation 14 | |
|---|---|---|
| **Time from Request to Receipt of E-HM Information** | **Simulation Number** | **Count** |
| 5 minutes or less | 14 | 1 |

The second Western Region maritime inspection simulation was conducted on April 13, 2015 (Simulation 15) by LEIO ID 20; no shipper or carrier was involved in this simulation. LEIO ID 20 inspected Class 1 (explosives) HM in non-bulk packaging (boxes) at a pier at one of the port's terminals. The inspection information was collected electronically (inspector called the terminal prior to the inspection using a landline phone to request the HM shipping paper; terminal personnel emailed a pdf copy of the shipping paper to the inspector's workplace computer; inspector then printed a copy of the shipping paper and brought it to the inspection location); matched that recorded on the hardcopy HM shipping papers; accurately reflected the HM being transported; no information was provided on how long it took for the LEIO to receive the e-HM information from the time of request.[55]

#### 5.2.2.2 Southern Region Maritime Inspection Simulation

The Southern Region maritime inspection simulation, conducted on April 23, 2015 (Simulation 16), involved LEIO ID 20 and Shipper ID 3, who offered Class 3 (flammable liquids—100°F or less, closed cup) HM in non-bulk packaging (drums and pails), transported via truck on chassis. This inspection was

[55] The inspector who conducted Simulation 15 transferred from the LEIO and cannot be reached for clarifying how long it took for receipt of the e-HM information from the time of request. In addition, no vetted shipper or carrier was involved in this simulation, so PHMSA could not contact a shipper or carrier to obtain this information.

performed on a street in the port. The inspection information was collected electronically (shipper used workplace computer to email a pdf copy of the shipping paper to the inspector's workplace computer; inspector then printed a copy of the shipping paper and brought it to the inspection location); matched that recorded on the hardcopy HM shipping papers; accurately reflected the HM being transported; and took 26 minutes to receive the e-HM information from the time of request.

| | LEIO ID 20 and Shipper ID 3 Maritime Simulation 16 | |
|---|---|---|
| **Time from Request to Receipt of E-HM Information** | **Simulation Number** | **Count** |
| 16 to 30 minutes | 16 | 1 |

### 5.2.3 Inspection Simulation Data

The 13 roadway and three maritime inspectors who received the HM shipping paper information electronically from the shippers/carriers during the simulations reported the following receipt times listed in Table 6.

**Table 6. Inspection Simulations—E-data Receipt Times**

| | Roadway Inspection Simulations | | | Maritime Inspection Simulation[56] | | |
|---|---|---|---|---|---|---|
| **Time from Request to Receipt of E-HM Information** | **Simulation Number** | **Count** | **Percent of Total by Mode** | **Simulation Number** | **Count** | **Percent of Total by Mode** |
| 5 minutes or less | 4, 9, 11, 12 | 4 | 31% | 14 | 1 | 50%[57] |
| 6 to 15 minutes | 5, 6, 8 | 3 | 23% | -- | 0 | 0% |
| 16 to 30 minutes | 1, 3, 7 | 3 | 23% | 16 | 1 | 50%[58] |
| 31 to 60 minutes | 2, 10 | 2 | 15% | -- | 0 | 0% |
| More than one hour[59] | 13 | 1 | 8% | -- | 0 | 0% |

From the time of the request, in almost all cases it took less than 60 minutes to receive the e-HM information; the majority of the time it took less than 30 minutes, and approximately half the time it took less than 15 minutes. The one roadway simulation where it took more than one hour to receive the e-HM information was due to the shipper not being prepared to provide e-HM information during non-working hours (simulation was conducted in a different time zone than where the shipper's business was located).

[56] Time from request to receipt of e-HM information was not provided for the April 13, 2015 Maritime Inspection Simulation (Simulation 15). The inspector that conducted the simulation switched jobs and no current contact information is available. In addition, no vetted shipper or carrier was involved in this simulation, so PHMSA could not contact a shipper or carrier to obtain this information.
[57] This percent represents known receipt times, based on inspector responses to the inspection simulation question sets.
[58] Ibid.
[59] The roadway inspector reported an e-HM information receipt time of 4 hours, 3 minutes. The inspector indicated that the delay was a result of the shipper not currently being set up for electronic information transfer outside of normal business hours. In addition, several staff were involved in faxing the shipping paper, which contributed to the delay in the inspector's receipt of the HM information. The maritime inspector reported an e-HM information receipt time of approximately one business day; no reason for the delay in receiving the information was provided.

No information was provided on how long it took to receive the e-HM information in the third maritime simulation (Simulation 15). Table 7 summarizes the documentation reviewed by the inspectors.

**Table 7. Documentation Reviewed During Inspection Simulations**

| | Roadway Simulations | | Maritime Simulations | |
|---|---|---|---|---|
| **Documentation** | **Count[60]** | **Percentage** | **Count** | **Percentage** |
| HM shipping papers | 11 | 85% | 3 | 100% |
| Bill of lading | 2 | 15% | 1 | 33% |
| Other[61] | 3 | 23% | 2 | 67% |
| Emergency response information | 4 | 31% | 2 | 67% |
| **Total Responses:** | **Roadway: 13** | | **Maritime: 3** | |

The shipping paper elements requested by the inspectors during the inspection simulations are identified in Appendix B: HM Shipping Paper Elements.

The inspectors reported that the shippers/carriers used the devices and e-data exchange languages identified in Table 8 to send the HM shipping paper information to them in support of the inspection simulations.

**Table 8. Devices and Electronic Data Exchange Languages Used by Shippers/Carriers to Send HM Shipping Paper Information to Inspectors**

| | Roadway Simulations | | Maritime Simulations | |
|---|---|---|---|---|
| **Device** | **Count** | **Percentage** | **Count** | **Percentage** |
| PDAs | 2 | 15% | 0 | 0% |
| Vehicle laptops | 1 | 8% | 0 | 0% |
| Workplace computers | 3 | 23% | 2 | 67% |
| CAD terminals | 1 | 8% | 0 | 0% |
| Landline telephones | 1 | 8% | 1 | 33% |
| Cellular telephones | 9 | 69% | 1 | 33% |
| Smartphones | 6 | 46% | 1 | 33% |
| FAX machines | 1 | 8% | 0 | 0% |

[60] The sum of the "Counts" value column is often higher that the "Total Responses" number in Table 7, Table 8, and Table 9 because each inspector may look at more than one document and use multiple devices, communication methods, etc.
[61] The "Other" documentation reviewed by the roadway inspectors included universal HM manifests, commercial driver's licenses, log books, and vehicle registrations. The "Other" documentation reviewed by the maritime inspectors included internal port vessel terminal reports and dangerous goods declarations.

| | Roadway Simulations | | Maritime Simulations | |
|---|---|---|---|---|
| Tablets | 6 | 46% | 0 | 0% |
| Unknown | 0 | 0% | 1 | 33% |
| Other[62] | 1 | 8% | 0 | 0% |
| **Total Responses:** | **Roadway: 13** | | **Maritime: 3** | |
| **Data Exchange Language** | **Count** | **Percentage** | **Count** | **Percentage** |
| Unknown | 12 | 92% | 3 | 100% |
| Other[63] | 1 | 8% | 0 | 0% |
| **Total Responses:** | **Roadway: 13** | | **Maritime: 3** | |

The inspectors used the devices, e-data exchange languages, communication mechanisms, and e-data formats identified in

Table 9 to receive the HM shipping paper information during the inspection simulations.

**Table 9. Devices, Electronic Data Exchange Languages, Communication Mechanisms, and Electronic Data Formats Used by Inspectors to Receive the HM Shipping Paper Information**

| | Roadway Simulations | | Maritime Simulations | |
|---|---|---|---|---|
| **Device** | **Count** | **Percentage** | **Count** | **Percentage** |
| PDAs | 1 | 8% | 0 | 0% |
| Vehicle laptops | 3 | 23% | 0 | 0% |
| Workplace computers | 1 | 8% | 2 | 67% |
| CAD terminals | 1 | 8% | 0 | 0% |
| Landline telephones | 1 | 8% | 1 | 33% |
| Cellular telephones | 6 | 46% | 1 | 33% |
| Smartphones | 8 | 62% | 1 | 33% |
| FAX machines | 1 | 8% | 0 | 0% |
| Two-way radios | 0 | 0% | 1 | 33% |
| None, no technology available | 0 | 0% | 1 | 33% |

[62] The roadway inspector indicated that the shipper/carrier used a printer as the "Other" device to send the HM information.
[63] The roadway inspector indicated that the shipper/carrier used cloud/sky technology as the "Other" data exchange language to send the HM information.

| | Roadway Simulations | | Maritime Simulations | |
|---|---|---|---|---|
| Other[64] | 1 | 8% | 2 | 67% |
| **Total Responses:** | **Roadway: 13** | | **Maritime: 3** | |
| **Data Exchange Language** | **Count** | **Percentage** | **Count** | **Percentage** |
| EDI | 0 | 0% | 1 | 33% |
| None, no electronic data was exchanged | 0 | 0% | 0 | 0% |
| Unknown | 12 | 92% | 2 | 67% |
| Other[65] | 1 | 8% | 0 | 0% |
| **Total Responses:** | **Roadway: 13** | | **Maritime: 3** | |
| **Communication Mechanism** | **Count** | **Percentage** | **Count** | **Percentage** |
| Email | 12 | 92% | 3 | 100% |
| Direct device-to-device transmission | 0 | 0% | 1 | 33% |
| FAX document | 2 | 16% | 0 | 0% |
| Audio transmission (via phone, radio, etc.) | 2 | 15% | 2 | 67% |
| Other[66] | 0 | 0% | 1 | 33% |
| **Total Responses:** | **Roadway: 13** | | **Maritime: 3** | |
| **Electronic Data Format** | **Count** | **Percentage** | **Count** | **Percentage** |
| Portable Document Format (pdf) | 10 | 77% | 3 | 100% |
| Joint Photographic Experts Group (jpeg) | 1 | 8% | 0 | 0% |
| None, no electronic data was exchanged | 1 | 8% | 0 | 0% |
| Unknown | 1 | 8% | 0 | 0% |
| **Total Responses:** | **Roadway: 13** | | **Maritime: 3** | |

## 5.3 Emergency Response Simulations

[64] "Other" device use by a roadway simulation inspector was a laser printer. "Other" device use by maritime simulation inspectors was a printed hardcopy of an emailed pdf shipping paper.
[65] "Other" data exchange language used by a roadway inspector was a mobile device using cloud/sky technology.
[66] "Other" communication mechanism used by a maritime inspector was a hardcopy paper document provided prior to the inspection simulation.

Five emergency response (ER) simulations were completed during the pilot test period; one each in the Air, Maritime, and Roadway Modes, and two in the Rail Mode. General ER simulation information is provided in Table 10.

**Table 10. Pilot Test Emergency Response Simulation Locations**

| Mode | Region | Simulation Date | Simulation Number | Venue | City | State | Participants Involved |
|---|---|---|---|---|---|---|---|
| Air | Southern | 03/11/15 | 17 | Road on airport | Fort Lauderdale | Florida | ID 12, ID 4, ID 11 |
| Rail | Western | 03/31/15 | 18 | Rail track in Intermodal yard at a port | Tacoma | Washington | ID 16, ID 7 |
| Roadway | Eastern | 04/21/15 | 20 | Shipper terminal | Brooklyn | New York | ID 13, ID 5 |
| Maritime | Western | 04/27/15 | 19 | Pier at a port | Tacoma | Washington | ID 16, ID 7 |
| Rail | Eastern | 05/06/15 | 21 | Class 1 rail yard | Selkirk | New York | ID 14, ID 8, ID 3 |

### 5.3.1 Description of Emergency Response Simulations

ERO ID 12 conducted the March 11, 2015 Air Mode ER simulation, ERO/LEIO ID 16 conducted the March 31, 2015 Rail Mode and the April 27, 2015 Maritime Mode ER simulations, ERO ID 13 conducted the April 21, 2015 Roadway Mode ER simulation, and ERO ID 14 conducted the May 6, 2015 Rail Mode ER simulation. All five ER organizations have public safety answering points (PSAPs) with jurisdiction for the locations where the ER simulations were conducted. 40% of these ER organizations respond to HM incidents daily, and respond to over 100 HM incidents annually (ERO ID 12 and ERO ID 13); 20% respond to HM incidents weekly, and respond to 51 to 100 HM incident annually (ERO ID 14); and 40% respond to HM incidents approximately four times each year, and respond to zero to five HM Rail Mode incidents and 11 to 50 Maritime Mode HM incidents annually (ERO/LEIO ID 16).

Shipper ID 4 and S/C ID 11 participated in the March 11, 2015 Air Mode ER simulation, Carrier ID 7 participated in the March 31, 2015 Rail Mode and April 27, 2015 Maritime Mode ER simulations, Carrier ID 5 participated in the April 21, 2015 Roadway Mode ER simulation, and Shipper ID 3 and Carrier ID 8 participated in the May 6, 2015 Rail Mode ER simulation.

All five ER simulations were pre-scheduled and included the following mock responses to ER scenarios rather than immediate responses to actual HM transportation emergencies:

- An HM emergency on an airplane
- An HM emergency aboard a marine vessel
- An HM emergency on a roadway
- An HM emergency on a railcar (two Rail Mode ER simulations)

The emergency responders indicated that the ER simulation information was collected electronically for at least part of all five ER simulations (100%).

Drivers/vessel agents were present during the air, maritime, and roadway ER simulations (60%). Planes, ships, railcars, trucks, and straddle carrier HM transportation conveyances carrying Class 2, 3, 4, 6, and 8 HM were involved in the ER simulations. The Air Mode ER simulation involved a less-than-truckload HM shipment.

#### 5.3.1.1 Southern Region ER Simulation

The Southern Region Air Mode ER simulation, conducted on March 11, 2015 (Simulation 17), involved ERO ID 12, Shipper ID 4, and S/C ID 11, who offered Class 4 (other flammable substances) and Class 6 [toxic (poisonous) and infectious substances] HM transported on trucks and planes; this ER simulation was conducted at a road inside an airport. The HM shipping paper information was collected electronically (the shipper used a cellular/ smartphone to call the ERO's and the S/C's cellular/smartphone and notify them of the simulated emergency; the ERO requested HM shipping paper information; the shipper and the S/C emailed a pdf copy of the shipping paper in XML to the ERO's cellular/smartphone, PDA, and vehicle laptop computer; the local county HM team were first to arrive at the scene); matched that recorded on the hardcopy HM shipping papers; accurately reflected the HM being transported; and was received instantaneously by the responder upon request.

| | ERO ID 12, Shipper ID 4, and S/C ID 11 ER Simulation 17 | |
|---|---|---|
| **Time from Request to Receipt of E-HM Information** | **Simulation Number** | **Count** |
| Instantaneously | 17 | 1 |

#### 5.3.1.2 Western Region ER Simulations

The Western Region Rail Mode ER simulation, conducted on March 31, 2015 (Simulation 18), involved ERO/LEIO ID 16 and Carrier ID 7, who offered Class 3 (flammable liquids—100°F or less, closed cup), Class 4 (other flammable substances), and Class 8 (corrosives) HM transported on straddle carriers, railcars, and ships; this ER simulation was conducted at a rail track in an Intermodal yard at a port. The HM shipping paper information was collected electronically (Simulation 18 involved PSAP dispatch, police, port patrol/security, and internal port dispatch personnel; port patrol personnel arrived on scene first, and contacted the police via landline/cellular/smartphone; police officer then contacted the intermodal yard rail coordinator via two-way radio/smartphone to request the HM shipping paper; intermodal yard rail coordinator emailed police officer the HM shipping paper in jpeg format from his workplace computer/PDA to the police officer, who received the e-shipping paper via PDA/workplace computer; port patrol/security received the e-shipping paper via PDA, workplace computer, and cellular/smartphone); matched that recorded on the hardcopy HM shipping papers; accurately reflected the HM being transported; and took 6 to 15 minutes for the ERO/LEIO to receive the e-HM information from the time of request.

| | ERO/LEIO ID 16 and Carrier ID 7 ER Simulation 18 | |
|---|---|---|
| **Time from Request to Receipt of E-HM Information** | **Simulation Number** | **Count** |
| 6 to 15 minutes | 18 | 1 |

The Western Region Maritime Mode ER simulation, conducted on April 27, 2015 (Simulation 19), also involved ERO/LEIO ID 16 and Carrier ID 7, who offered Class 2 (gases) and Class 3 (flammable liquids—100°F or less, closed cup) HM transported on ships; this ER simulation was conducted at a pier at a port. The HM shipping paper information was collected electronically (Simulation 19 involved PSAP dispatch, fire, and Port of Tacoma patrol personnel; the shipper contacted port patrol personnel, who arrived on scene first; port PSAP dispatch used workplace computer, cellular/smartphone, and video to email shipping paper in pdf format to port patrol personnel; PDAs and two-way radios were also used for audio communications);matched that recorded on the hardcopy HM shipping papers; accurately reflected the HM being transported; and took 5 minutes or less for the ERO/LEIO to receive the e-HM information from the time of request.

| | ERO/LEIO ID 16 and Carrier ID 7 ER Simulation 19 | |
|---|---|---|
| **Time from Request to Receipt of E-HM Information** | **Simulation Number** | **Count** |
| 5 minutes or less | 19 | 1 |

#### 5.3.1.3 Eastern Region ER Simulations

The Eastern Region Roadway Mode ER simulation, conducted on April 21, 2015 (Simulation 20), involved ERO ID 13 and Carrier ID 5, who offered Class 3 (flammable liquids—100°F or less, closed cup) HM transported on trucks; this ER simulation was conducted at a shipper terminal. The HM shipping paper information was collected electronically (fire personnel arrived on-scene first; driver used cellular phone to call terminal manager and request the HM shipping paper; terminal manager used cellular phone to call carrier and request permission to send HM shipping paper to driver; carrier granted permission, so terminal manager emailed a pdf copy of the shipping paper to the driver's cellular phone; driver then emailed the pdf shipping paper to the fire emergency responder's tablet); matched that recorded on the hardcopy HM shipping papers; accurately reflected the HM being transported; and took 23 minutes for the ERO to receive the e-HM information from the time of request.

| | ERO ID 13 and Carrier ID 5 ER Simulation 20 | |
|---|---|---|
| **Time from Request to Receipt of E-HM Information** | **Simulation Number** | **Count** |
| 16 to 30 minutes | 20 | 1 |

The Eastern Region Rail Mode ER simulation, conducted on May 6, 2015 (Simulation 21), involved ERO ID 14, Shipper ID 3, and Carrier ID 8, who transported Class 3 (flammable liquids—100°F or less, closed cup) HM on railcars; this ER simulation was conducted at a Class 1 rail yard. The HM shipping paper information was collected electronically (carrier field personnel arrived on-scene first, acted in a PSAP capacity, and used PDA/smartphone to call ERO to report the incident; ERO used smartphone to call CHEMTREC; CHEMTREC used workplace computer to email a pdf copy of the shipping paper to the ERO's smartphone and workplace computer; ERO used smartphone/workplace computer to email shipping paper to the carrier field personnel's smartphone and I-Pad; CHEMTREC then used landline phone to call shipper, and requested shipper call ERO; shipper used smartphone to call ERO's smartphone to confirm shipping paper emailed by CHEMTREC was correct); matched that recorded on the hardcopy HM shipping papers; accurately reflected the HM being transported; and took 5 minutes or less for the ERO to receive the e-HM information from the time of request.

| | ERO ID 14, Shipper ID 3, and Carrier ID 8<br>ER Simulation 21 | |
|---|---|---|
| **Time from Request to Receipt of E-HM Information** | **Simulation Number** | **Count** |
| 5 minutes or less | 21 | 1 |

### 5.3.2 Emergency Response Simulation Data

The emergency response personnel who received the HM shipping paper information electronically during the simulations reported the receipt times listed in Table 11.

**Table 11. ER Simulations—E-data Receipt Times**

| | | Totals | |
|---|---|---|---|
| **Time from Request to Receipt of E-HM Information** | **Simulation Number** | **Count** | **Percentage** |
| Instantaneous | 17 | 1 | 20% |
| 5 minutes or less | 19, 21 | 2 | 40% |
| 6 to 15 minutes | 18 | 1 | 20% |
| 16 to 30 minutes | 20 | 1 | 20% |

The shipping paper elements requested by and provided to emergency response personnel during the ER simulations are identified in Appendix B: HM Shipping Paper Elements.

#### 5.3.2.1 Initial E-HM Information Requested by PSAP Dispatchers (or Equivalent Personnel)

No attempt was made to electronically transmit HM information to the PSAP dispatcher during the April 21, 2015 Roadway ER simulation (Simulation 20). The devices and e-data exchange languages identified in
Table 12 were used to send the HM shipping paper information to the PSAP dispatchers (or equivalent personnel) during the four ER simulations that had e-communication with the PSAP dispatchers (or equivalent personnel).

**Table 12. Devices and Electronic Data Exchange Languages Used to Send E-Information to the Dispatchers**

| | Air Simulation 17 | Rail Simulation 18 | Maritime Simulation 19 | Rail Simulation 21 | Totals | |
|---|---|---|---|---|---|---|
| **Device** | **Count** | **Count** | **Count** | **Count** | **Count** | **%** |
| Workplace computers | 0 | 1 | 1 | 1 | 3 | 75% |
| Cellular telephones | 0 | 1 | 1 | 0 | 2 | 50% |
| Smartphones | 0 | 1 | 1 | 0 | 2 | 50% |
| Landline telephones | 0 | 1 | 0 | 0 | 1 | 25% |
| Videos | 0 | 0 | 1 | 0 | 1 | 25% |
| Two-way radios | 0 | 1 | 0 | 0 | 1 | 25% |
| Unknown | 1 | 0 | 0 | 0 | 1 | 25% |
| Other | 0 | 0 | 0 | 0 | 0 | 0% |
| **Data Exchange Language** | **Count** | **Count** | **Count** | **Count** | **Count** | **%** |
| XML | 1 | 0 | 0 | 0 | 1 | 25% |
| Unknown | 0 | 1 | 1 | 1 | 3 | 75% |
| Other | 0 | 0 | 0 | 0 | 0 | 0% |

Table 13 lists the devices, e-data exchange languages, communication mechanisms, and data formats used by the PSAP dispatchers (or equivalent personnel) to receive the HM shipping paper information during the ER simulations.

**Table 13. Devices, Electronic Data Exchange languages, Communication Mechanisms, and Electronic Data Formats Used by PSAP Dispatchers to Receive E-Information**

| | Air Simulation 17 | Rail Simulation 18 | Maritime Simulation 19 | Rail Simulation 21 | Totals | |
|---|---|---|---|---|---|---|
| **Device** | **Count** | **Count** | **Count** | **Count** | **Count** | **%** |
| Cellular telephones | 1 | 1 | 1 | 0 | 3 | 75% |
| Workplace computers | 0 | 1 | 1 | 1 | 3 | 75% |
| PDAs | 1 | 0 | 0 | 0 | 1 | 25% |
| Vehicle laptops | 1 | 0 | 0 | 0 | 1 | 25% |
| Landline telephones | 0 | 1 | 0 | 0 | 1 | 25% |
| Smartphones | 0 | 1 | 0 | 1 | 2 | 50% |
| Videos | 0 | 0 | 1 | 0 | 1 | 25% |
| Two-way radios | 0 | 1 | 0 | 0 | 1 | 25% |
| Other | 0 | 0 | 0 | 0 | 0 | 0% |
| **Data Exchange Language** | **Count** | **Count** | **Count** | **Count** | **Count** | **%** |
| XML | 1 | 0 | 0 | 0 | 1 | 25% |
| Unknown | 0 | 1 | 1 | 1 | 3 | 75% |
| Other | 0 | 0 | 0 | 0 | 0 | 0% |
| **Communication Mechanism** | **Count** | **Count** | **Count** | **Count** | **Count** | **%** |
| Email | 1 | 1 | 1 | 1 | 4 | 100% |
| Direct device-to-device transmission | 0 | 0 | 1 | 0 | 1 | 25% |
| Internet reference/link | 0 | 0 | 1 | 0 | 1 | 25% |
| Audio transmission (e.g., via phone, radio, etc.( | 0 | 0 | 1 | 0 | 1 | 25% |
| Other | 0 | 1[67] | 1[68] | 0 | 2 | 50% |
| **Electronic Data Format** | **Count** | **Count** | **Count** | **Count** | **Count** | **%** |
| PDF | 1 | 0 | 1 | 1 | 3 | 75% |

[67] "Other" communication mechanism used by a maritime inspector was a hardcopy paper document provided prior to the inspection simulation. mentation.
[68] "Other" communication mechanism used in Maritime ER Simulation was face-to-face communication and hardcopy backup of e-HM information.

| | | | | | | |
|---|---|---|---|---|---|---|
| JPEG | 0 | 1 | 0 | 0 | 1 | 25% |
| Other | 0 | 0 | 0 | 0 | 0 | 0% |

PSAP dispatchers (or equivalent personnel) conducted follow-up activities for four of the ER simulations. These activities are described in Table 14.

**Table 14. Follow-Up Dispatch Actions**

| Simulation Number and Date | Mode | Dispatch Follow-up Activity |
|---|---|---|
| 17<br>March 11, 2015 | Air | Obtained entire aircraft cargo manifest. |
| 18<br>March 31, 2015 | Rail | Responding patrol officer contacted North Intermodal Tower to obtain electronic copy of "Dangerous Goods for Multimodal Transport" HM info. Also received hardcopy of same document. |
| 19<br>April 27, 2015 | Maritime | Port of Tacoma Patrol Communications had already received an electronic copy of the amount of vehicles/trucks being offloaded from the vessel. The electronic copy was also made available to Responding port officer. |
| 21<br>May 6, 2015 | Rail | Contacted shipper to obtain bill of lading, SDS, and other HM documentation |

#### 5.3.2.2 Communications with Emergency Responders Prior to Their Arrival On-Scene

No attempt was made by any entity to provide emergency responders with e-HM information prior to their arrival on-scene during the April 21, 2015 Roadway ER simulation (Simulation 20). The other four ER simulations did include some attempts at providing e-HM information to emergency responders prior to their arrival on-scene during the ER simulation. These communication attempts are summarized in Table 15.

**Table 15. E-HM Communications with Emergency Responders Prior to On-Scene Arrival**

| | Air Simulation 17 | Rail Simulation 18 | Maritime Simulation 19 | Rail Simulation 21 | Totals | |
|---|---|---|---|---|---|---|
| **Did Entity Attempt to Provide E-HM Information to Emergency Responder?** | **Answer** | **Answer** | **Answer** | **Answer** | **YES Count** | **%** |
| Driver/pilot/captain/conductor | Yes | Yes | Yes | No | 3 | 75% |
| PSAP dispatcher (or equivalent) | Yes | Yes | Yes | Yes | 4 | 100% |
| Shipper | No | Yes | Yes | Yes | 3 | 75% |
| Carrier | No | Yes | Yes | Yes | 3 | 75% |
| Other entity | No | Yes | Yes | No | 2 | 50% |
| **"Yes" Totals by Simulation:** | 2 | 5 | 5 | 3 | | |

#### 5.3.2.2.1 *Air Mode ER Simulation Data*

The March 11, 2015 Air ER simulation (Simulation 17) e-HM communication devices, languages, mechanisms, and formats used to communicate with emergency responders prior to their arrival on-scene is provided in Table 16.

**Table 16. Air (Simulation 17)—Devices, Electronic Data Exchange Languages, Communication Mechanisms, and Electronic Data Formats Used to Communicate with Emergency Responders Prior to On-Scene Arrival**

| Device | Used by Driver, etc. | Received by Emergency Responder | Used by PSAP | Received by Emergency Responder |
|---|---|---|---|---|
| PDAs | | | X | |
| Vehicle laptops | | √ | | √ |
| Smartphones | | √ | | √ |
| Unknown | X | | | |
| **Data Exchange Language** | **Used by Driver, etc.** | **Received by Emergency Responder** | **Used by PSAP** | **Received by Emergency Responder** |
| XML | X | √ | X | √ |
| **Communication Mechanism** | **Used by Driver, etc.** | **Received by Emergency Responder** | **Used by PSAP** | **Received by Emergency Responder** |
| Email | | | X | √ |
| None | X | √ | | |
| **Electronic Data Format** | **Used by Driver, etc.** | **Received by Emergency Responder** | **Used by PSAP** | **Received by Emergency Responder** |
| PDF | | | X | √ |
| None, no electronic data was exchanged | X | √ | | |

#### 5.3.2.2.2 *Rail Mode ER Simulations Data*

The March 31, 2015 and May 6, 2015 Rail ER simulations (Simulations 18 and 21) e-HM communication devices, languages, mechanisms, and formats used to communicate with emergency responders prior to their arrival on-scene is provided in Table 17.

**Table 17. Rail (Simulations 18 and 21)—Devices, Electronic Data Exchange Languages, Communication Mechanisms, and Electronic Data Formats Used to Communicate with Emergency Responders Prior to On-Scene Arrival**

| Device | Used by Driver, etc. | Received by ER | Used by PSAP | Received by ER | Used by Shipper | Received by ER | Used by Carrier | Received by ER | Used by Other | Received by ER | Used by PSAP | Received by ER |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PDAs | X | | | √ | | | X | √ | X | √ | | |
| Workplace computers | X | √ | | √ | X | √ | X | √ | X | √ | X | √ |
| Landline telephones | | √ | | √ | | | X | √ | | √ | | |
| Cellular phones | X | √ | | √ | X | √ | X | √ | X | √ | | |
| Smartphones | | √ | | √ | X | √ | X | √ | X | √ | X | √ |
| FAX machines | | √ | | | X | √ | X | √ | X | √ | | |
| Two-way radios | | √ | X | √ | X | √ | | | | | | |
| Unknown | | | X | | | | | | | | | |
| Other[69] | X | √ | | √ | | √ | X | √ | | √ | | |
| **Data Exchange Language** | **Used by Driver, etc.** | **Received by ER** | **Used by PSAP** | **Received by ER** | **Used by Shipper** | **Received by ER** | **Used by Carrier** | **Received by ER** | **Used by Other** | **Received by ER** | **Used by PSAP** | **Received by ER** |
| Unknown | | √ | X | √ | X | √ | X | √ | X | √ | X | √ |
| None | X | | | | | | | | | | | |
| **Communication Mechanism** | **Used by Driver, etc.** | **Received by ER** | **Used by PSAP** | **Received by ER** | **Used by Shipper** | **Received by ER** | **Used by Carrier** | **Received by ER** | **Used by Other** | **Received by ER** | **Used by PSAP** | **Received by ER** |
| Email | | | X | √ | X | √ | X | √ | X | √ | X | √ |
| Internet reference/link | | | | | X | √ | X | √ | X | √ | | |
| FAX document | | | | | X | √ | X | √ | X | √ | | |
| Audio transmission | | | X | √ | X | √ | | | X | √ | | |
| None | X | √ | | | | | | | | | | |
| Other[70] | | | X | √ | X | √ | X | √ | | | | |
| **Electronic Data Format** | **Used by Driver, etc.** | **Received by ER** | **Used by PSAP** | **Received by ER** | **Used by Shipper** | **Received by ER** | **Used by Carrier** | **Received by ER** | **Used by Other** | **Received by ER** | **Used by PSAP** | **Received by ER** |
| PDF | | | | | X | √ | | | | | X | √ |
| JPEG | | | | | | | | | X | √ | | |

[69] "Other" device used by the driver and the carrier was a copy machine to make a hardcopy of the HM documentation. "Other" device used by the responder to receive the e-HM information from all entities was internal port closed-circuit televisions (CCTVs).
[70] "Other" communication mechanism between PSAP and responders was the CCTVs. Face-to-face verbal communication was used between the shipper's port agent and the responders, and between the carrier's port agent and the responders.

| Device | Used by Driver, etc. | Received by ER | Used by PSAP | Received by ER | Used by Shipper | Received by ER | Used by Carrier | Received by ER | Used by Other | Received by ER | Used by PSAP | Received by ER |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| None, no electronic data was exchanged | X | √ | X | √ | | | | | | | | |
| Unknown | | | | | | | X | √ | | | | |

#### 5.3.2.2.3 *Maritime Mode ER Simulation Data*

The April 27, 2015 Maritime ER simulation (Simulation 19) e-HM communication devices, languages, mechanisms, and formats used to communicate with emergency responders prior to their arrival on-scene is provided in

Table 18.

**Table 18. Maritime (Simulation 19)—Devices, Electronic Data Exchange Languages, Communication Mechanisms, and Electronic Data Formats Used to Communicate with Emergency Responders Prior to On-Scene Arrival**

| Device | Used by Driver, etc. | Received by ER | Used by PSAP | Received by ER | Used by Shipper | Received by ER | Used by Carrier | Received by ER | Used by Other | Received by ER |
|---|---|---|---|---|---|---|---|---|---|---|
| PDAs | | √ | | | | | | | | |
| Vehicle laptops | | | | | | | | √ | | |
| Workplace computers | X | √ | X | √ | X | √ | X | √ | X | √ |
| Landline telephones | | | | √ | | | | | | |
| Cellular phones | X | √ | | √ | | √ | X | √ | X | √ |
| Smartphones | | √ | X | √ | X | √ | X | √ | X | √ |
| Videos | | √ | | | | √ | | √ | | |
| Live web cameras | | | | | | | | | X | √ |
| Two-way radios | | √ | X | √ | | | | √ | | |
| Other[71] | | | | √ | | | | | X | |
| **Data Exchange Language** | **Used by Driver, etc.** | **Received by ER** | **Used by PSAP** | **Received by ER** | **Used by Shipper** | **Received by ER** | **Used by Carrier** | **Received by ER** | **Used by Other** | **Received by ER** |
| Unknown | X | √ | X | √ | X | √ | X | √ | X | √ |
| **Communication Mechanism** | **Used by Driver, etc.** | **Received by ER** | **Used by PSAP** | **Received by ER** | **Used by Shipper** | **Received by ER** | **Used by Carrier** | **Received by ER** | **Used by Other** | **Received by ER** |
| Email | X | √ | X | √ | X | √ | X | √ | X | √ |
| Direct device-to-device transmission | X | √ | | | | | | | X | √ |

[71] "Other" devices used between PSAP dispatchers and responders, and between other entity and responders to communicate HM information included face-to-face verbal communication with port operations personnel.

| Device | Used by Driver, etc. | Received by ER | Used by PSAP | Received by ER | Used by Shipper | Received by ER | Used by Carrier | Received by ER | Used by Other | Received by ER |
|---|---|---|---|---|---|---|---|---|---|---|
| Internet reference/link | | | X | √ | | | | | | |
| Audio transmission | | | X | √ | X | √ | | | X | √ |
| Other[72] | | | | | | | X | √ | X | √ |
| **Electronic Data Format** | **Used by Driver, etc.** | **Received by ER** | **Used by PSAP** | **Received by ER** | **Used by Shipper** | **Received by ER** | **Used by Carrier** | **Received by ER** | **Used by Other** | **Received by ER** |
| Unknown | X | √ | X | √ | X | √ | X | √ | X | √ |

#### 5.3.2.3 On-Scene Communications with Emergency Responders

No attempt was made by any entity to provide emergency responders with e-HM information while they were on-scene during the March 11, 2015 Air and March 31, 2015 Rail simulations (Simulations 17 and 18). The other three ER simulations did include some attempts at providing e-HM information to emergency responders while on-scene during the ER simulation. These communication attempts are summarized in Table 19.

**Table 19. E-HM Communications with Emergency Responders While On-Scene**

| | | Maritime Simulation 19 | Roadway Simulation 20 | Rail Simulation 21 | Totals | |
|---|---|---|---|---|---|---|
| **Did Entity Attempt to Provide E-HM Information to Emergency Responder?** | | **Answer** | **Answer** | **Answer** | **YES[73] Count** | **%** |
| Driver/pilot/captain/conductor | | Yes | Yes, but unsuccessful[74] | Yes | 2 | 50% |
| PSAP dispatcher (or equivalent) | | Yes | No | Yes | 2 | 67% |
| Shipper | | Yes | Yes | No | 2 | 67% |
| Carrier | | Yes | Yes | Yes | 3 | 100% |
| Other entity | | Yes | Yes | No | 2 | 67% |
| **"Yes" Totals by Simulation:** | | 5 | 3 | 3 | | |

[72] "Other" communication mechanisms used between the carrier and the responders and the other entity and responders was face-to-face verbal communication.
[73] Only successful attempts are included in totals.
[74] The only electronic capability the driver had was a driver log terminal device. This device was unable to access HM shipping documents and SDS information. The log terminal device was hard wired into the cab and could not be removed to share HM information (if such information could be accessed via the device) with responders during emergencies.

#### 5.3.2.3.1 *Maritime Mode ER Simulations Data*

The April 27, 2015 Maritime ER simulation (Simulation 19) e-HM communication devices, languages, mechanisms, and formats used to communicate with emergency responders on-scene is provided in Table 20.

**Table 20. Maritime (Simulation 19)—Devices, Electronic Data Exchange Languages, Communication Mechanisms, and Electronic Data Formats Used to Communicate with Emergency Responders On-Scene**

| Device | Used by Driver, etc. | Received by ER | Used by PSAP | Received by ER | Used by Shipper | Received by ER | Used by Carrier | Received by ER | Used by Other | Received by ER |
|---|---|---|---|---|---|---|---|---|---|---|
| PDAs | | | X | √ | | | | √ | | |
| Workplace computers | X | √ | X | √ | X | √ | X | √ | X | √ |
| Landline telephones | | | X | | X | | | | | |
| Cellular phones | | | X | √ | X | √ | | √ | X | √ |
| Smartphones | X | √ | | √ | X | √ | X | √ | X | √ |
| Live web cameras | | √ | X | √ | | | | √ | | √ |
| Two-way radios | | | | | | | | | | √ |
| **Data Exchange Language** | **Used by Driver, etc.** | **Received by ER** | **Used by PSAP** | **Received by ER** | **Used by Shipper** | **Received by ER** | **Used by Carrier** | **Received by ER** | **Used by Other** | **Received by ER** |
| Unknown | X | √ | X | √ | X | √ | X | √ | X | √ |
| **Communication Mechanism** | **Used by Driver, etc.** | **Received by ER** | **Used by PSAP** | **Received by ER** | **Used by Shipper** | **Received by ER** | **Used by Carrier** | **Received by ER** | **Used by Other** | **Received by ER** |
| Email | X | √ | X | √ | X | √ | X | √ | X | √ |
| Direct device-to-device transmission | | | X | √ | | | | | X | √ |
| Internet reference/link | X | √ | X | √ | | | | | | |
| Audio transmission | | | X | √ | | | | | | |
| Other[75] | | | | | | | | | X | √ |
| **Electronic Data Format** | **Used by Driver, etc.** | **Received by ER** | **Used by PSAP** | **Received by ER** | **Used by Shipper** | **Received by ER** | **Used by Carrier** | **Received by ER** | **Used by Other** | **Received by ER** |
| None, no electronic data was exchanged | X | √ | | | | | | | | |
| Unknown | | | X | √ | X | √ | X | √ | X | √ |

[75] "Other" communication mechanism used was face-to-face verbal communication.

#### 5.3.2.3.2 *Roadway Mode ER Simulation Data*

The April 21, 2015 Roadway ER simulation (Simulation 20) e-HM communication devices, languages, mechanisms, and formats used to communicate with emergency responders on-scene is provided in Table 21.

**Table 21. Roadway (Simulation 20)—Devices, Electronic Data Exchange Languages, Communication Mechanisms, and Electronic Data Formats Used to Communicate with Emergency Responders On-Scene**

| Device | Used by Shipper | Received by ER | Used by Carrier | Received by ER | Used by Other | Received by ER |
|---|---|---|---|---|---|---|
| Workplace computers | X | | X | | X | |
| Cellular phones | | | | | X | |
| Tablets | X | √ | X | √ | | √[76] |
| **Data Exchange Language** | **Used by Shipper** | **Received by ER** | **Used by Carrier** | **Received by ER** | **Used by Other** | **Received by ER** |
| Unknown | X | √ | X | √ | X | √ |
| **Communication Mechanism** | **Used by Shipper** | **Received by ER** | **Used by Carrier** | **Received by ER** | **Used by Other** | **Received by ER** |
| Email | X | √ | X | √ | X | √ |
| **Electronic Data Format** | **Used by Shipper** | **Received by ER** | **Used by Carrier** | **Received by ER** | **Used by Other** | **Received by ER** |
| PDF | X | √ | X | √ | X | √ |

#### 5.3.2.3.3 *Rail Mode ER Simulation Data*

The May 6, 2015 Rail ER simulation (Simulation 21) e-HM communication devices, languages, mechanisms, and formats used to communicate with emergency responders on-scene is provided in Table 22.

**Table 22. Rail (Simulation 21)—Devices, Electronic Data Exchange Languages, Communication Mechanisms, and Electronic Data Formats Used to Communicate with Emergency Responders On-Scene**

| Device | Used by Driver, etc. | Received by ER | Used by PSAP | Received by ER | Used by Carrier | Received by ER |
|---|---|---|---|---|---|---|
| PDAs | | √ | | √ | | √ |
| Vehicle laptops | | √ | | √ | | √ |
| Workplace computers | X | | X | | X | √ |
| Smartphones | | √ | | √ | | √ |

[76] Driver used cellular phone to call the terminal manager and gave the manager the officer's email address. The terminal manager then emailed the HM documents to the officer's email address, and the officer assessed the HM information from the tablet.

| Data Exchange Language | Used by Driver, etc. | Received by ER | Used by PSAP | Received by ER | Used by Carrier | Received by ER |
|---|---|---|---|---|---|---|
| Unknown | X | √ | X | √ | X | √ |
| **Communication Mechanism** | **Used by Driver, etc.** | **Received by ER** | **Used by PSAP** | **Received by ER** | **Used by Carrier** | **Received by ER** |
| Email | X | √ | X | √ | X | √ |
| **Electronic Data Format** | **Used by Driver, etc.** | **Received by ER** | **Used by PSAP** | **Received by ER** | **Used by Carrier** | **Received by ER** |
| PDF | X | √ | X | √ | X | √ |

# 6. Impact Analysis Data

## 6.1 Description of Data Collection Activity and Volunteer Participant Stakeholders

Concurrent with conducting the pilot tests, PHMSA collected impact analysis data from the HM community during February 17, 2015 to May 15, 2015 to analyze the impacts of using e-systems for communicating HM shipping paper information. Refer to Appendix N: Pilot Test Impact Analysis Question Set for a copy of the Impact Analysis Question Set.

A total of 92 useable responses were received, including 82 fully completed question sets and 10 partially completed question sets; these totals are reflected in Table 23. Approximately 41 percent of responses were from inspectors and responders, with the majority of those being from the emergency responder community. The other 59 percent of responses were from different segments of industry (shippers, carriers, freight forwarders, HM trainers, equipment vendors, etc.).

**Table 23. Impact Analysis Question Set Responses by Stakeholder Type**

| | Responses | | | | |
|---|---|---|---|---|---|
| **Stakeholder Type** | **Fully Completed** | **Partially Completed** | **Total** | **Stakeholder Percentage** | |
| Emergency Responders | 20 | 1 | **21** | 23% | **41%** |
| HM Inspectors | 5 | 0 | **5** | 5% | |
| Federal and State Governments (undefined functions) | 3 | 0 | **3** | 3% | |
| State/Local Governments—Emergency Responders and HM Inspectors | 8 | 1 | **9** | 10% | |
| HM Shippers | 7 | 1 | **8** | 9% | **59%** |
| HM Carriers | 18 | 2 | **20** | 22% | |
| HM Shippers and Carriers | 4 | 1 | **5** | 5% | |
| HM Shippers/Carriers and Emergency Responders | 1 | 0 | **1** | 1% | |
| Other (Freight Forwarders, HM Trainers, Equipment Vendors, Software Developers, Pipeline Transporters, HM Manufacturers, Trade Associations, LEPCs, Media, etc.) | 16 | 4 | **20** | 22% | |
| **Totals:** | **82** | **10** | **92** | **100%** | **100%** |

## 6.2 Impact Analysis Data

Tables in this section provide responses to wireless/e-communication/e-systems questions in the Impact Analysis Question Set (refer to Appendix N: Pilot Test Impact Analysis Question Set).

Stakeholders provided answers listed in Table 24 when asked, "Has your agency/company/organization ever used wireless or e-communication to provide law enforcement or emergency response personnel with HM information for an HM shipment involved in an inspection or incident?"

**Table 24. Use of Wireless or E-communication to Provide HM Information to Law Enforcement or Emergency Response Personnel**

| | Responses | | | |
|---|---|---|---|---|
| **Stakeholder Type** | **Yes** | **No** | **Unknown** | **Not Applicable** |
| Emergency Responders | 7 | 4 | 2 | 8 |
| HM Inspectors | 2 | 0 | 0 | 3 |
| Federal and State Governments (undefined functions) | 0 | 1 | 0 | 2 |
| State/Local Governments—Emergency Responders and HM Inspectors | 4 | 1 | 1 | 3 |
| HM Shippers | 1 | 5 | 1 | 1 |
| HM Carriers | 4 | 14 | 2 | 0 |
| HM Shippers and Carriers | 3 | 1 | 0 | 1 |
| HM Shippers/Carriers and Emergency Responders | 0 | 1 | 0 | 0 |
| Other (Freight Forwarders, HM Trainers, Equipment Vendors, Software Developers, Pipeline Transporters, HM Manufacturers, Trade Associations, LEPCs, Media, etc.) | 4 | 6 | 5 | 5 |
| **Totals:** | **25** | **33** | **11** | **23** |

Stakeholders provided answers listed in Table 25 when asked, "Has your agency/company/organization ever received wireless or e-communication of HM information for an HM shipment involved in an inspection or incident?"

**Table 25. Receipt of Inspection or Incident HM Information via Wireless or E-communication**

| | Responses | | | |
|---|---|---|---|---|
| **Stakeholder Type** | **Yes** | **No** | **Unknown** | **Not Applicable** |
| Emergency Responders | 10 | 5 | 3 | 3 |
| HM Inspectors | 2 | 1 | 1 | 1 |
| Federal and State Governments (undefined functions) | 1 | 2 | 0 | 0 |
| State/Local Governments—Emergency Responders and HM Inspectors | 5 | 2 | 1 | 1 |
| HM Shippers | 0 | 7 | 1 | 0 |
| HM Carriers | 1 | 15 | 4 | 0 |
| HM Shippers and Carriers | 2 | 2 | 1 | 0 |
| HM Shippers/Carriers and Emergency Responders | 0 | 1 | 0 | 0 |
| Other (Freight Forwarders, HM Trainers, Equipment Vendors, Software Developers, Pipeline Transporters, HM Manufacturers, Trade Associations, LEPCs, Media, etc.) | 3 | 8 | 4 | 5 |
| **Totals:** | **24** | **43** | **15** | **10** |

Stakeholders provided answers listed in Table 26 when asked, "Does your agency/company/organization currently have an e-system capable of managing and communicating HM shipping paper information?"

**Table 26. Agency/Company/Organization Currently Has E-System Capable of Managing and Communicating HM Shipping Paper Information**

| | Responses | | | |
|---|---|---|---|---|
| **Stakeholder Type** | **Yes** | **No** | **Unknown** | **Not Applicable** |
| Emergency Responders | 3 | 12 | 4 | 2 |
| HM Inspectors | 1 | 2 | 0 | 2 |
| Federal and State Governments (undefined functions) | 0 | 2 | 1 | 0 |
| State/Local Governments—Emergency Responders and HM Inspectors | 1 | 4 | 1 | 3 |
| HM Shippers | 1 | 7 | 0 | 0 |
| HM Carriers | 4 | 9 | 7 | 0 |
| HM Shippers and Carriers | 2 | 3 | 0 | 0 |
| HM Shippers/Carriers and Emergency Responders | 0 | 1 | 0 | 0 |
| Other (Freight Forwarders, HM Trainers, Equipment Vendors, Software Developers, Pipeline Transporters, HM Manufacturers, Trade Associations, LEPCs, Media, etc.) | 7 | 4 | 2 | 7 |
| **Totals:** | **19** | **44** | **15** | **14** |

# 7. Data Evaluation

## 7.1 Stakeholder Group Findings

### 7.1.1 Shippers

As described in Section 3.3.1, all HM shippers are required to prepare hardcopy HM shipping papers for HM that are in transport and provide them to carriers who will transport the HM. Many HM shippers already have e-systems containing HM shipping paper information. Shippers are also required to provide the HM shipping paper information to the carriers who will transport the HM.

### 7.1.2 Carriers

As described in Section 3.3.2, HM carriers are required to maintain the HM shipping paper when the HM is in transport. Air, Maritime, and Rail Mode carriers have e-systems in place for communicating HM shipping paper information, and most use EDI as the data exchange language because of their interaction with the Rail Mode for intermodal transfers, as the Rail Mode requires e-HM shipping paper data be provided to them in EDI format.

Transport of HM by roadway carriers is significantly different from their modal counterparts. The motor carrier industry places importance of having an HM paper documentation trail (for billing purposes, delivery receipts, driver payment records, etc.). Some trucking companies either cannot afford to purchase an e-system or do not see a business reason to invest in one, and carriers would prefer that PHMSA establish a performance standard for e-HM communication and keep the existing requirements for hardcopy HM shipping papers. Implementation of e-systems may also be difficult for smaller motor carrier companies that transport a wide variety of products; that do not have set delivery schedules; or that make multiple stops on a transport route delivering various HM contained in trailers with multiple compartments, because of the complexity of these HM shipments. Also, existing electronic and automatic onboard recording devices do not function in some areas of the U.S. and Canada with Internet connectivity dead spots; the same issue would likely exist for an e-system. Motor carriers who do not have onboard technology are also concerned that they will be unable to provide e-HM information directly and readily to inspection and emergency response personnel, scenarios that could delay shipments; cause loss of revenue for the driver and the carrier, and potentially contribute to incident liabilities.

An electronic means does not currently exist for the motor carriers to receive HM shipping documents from, or to send HM shipping documents to, any of the other carrier modes.

### 7.1.3 Law Enforcement Inspectors

The HM law enforcement community consists of trained HM inspectors who are organized by transportation mode. Regardless of mode, all HM inspectors will request a copy of the HM shipping papers as part of the inspection process. Some inspectors, particularly those in the Air, Maritime, and Rail Modes may not be equipped with electronic devices able to receive e-HM shipping paper information while they are conducting HM inspections.

### 7.1.4 Emergency Responders

Section 3.3.4 describes the emergency responder stakeholder group as various professionals who are the first to be notified of, and respond to, incidents involving HM. Some emergency response organizations are volunteer-based, exist in rural areas with limited Internet connectivity, and are not provided with electronic devices.

PSAP personnel training and professional experiences regarding HM vary greatly. Most PSAP personnel are not familiar with the look and content of an HM shipping paper, and those at small rural PSAPs may not know about placarding information.

Emergency responders need specific HM information immediately, based on the type of emergency and the needed response. Responders indicated their capabilities regarding access to electronic information varies; e-HM communication needs to be scalable; and they generally prefer to pull HM information from its source rather than have it pushed to them. Accurate HM information is preferred over receiving quick, unverified information, and responders want to have layered and redundant HM information systems, to ensure responders can obtain the needed HM information as soon as possible. They also prefer to have a link between the HM transportation conveyance and the e-HM shipping papers.

Emergency responders also desire a standard format and fields for e-HM information be created and mandated, and that HM trade names be added as a required shipping paper field.

## 7.2 Performance of Pilot Test Paperless Hazard Communications Systems

It is important to note that e-systems are still largely in the developing stages and that the data from the 21 pilot tests and the 92 impact analysis question sets completed by volunteer HM stakeholders constitute a small, non-random sample of the HM transportation community. As such, it is not possible to draw statistically valid conclusions from this limited data or to estimate costs and benefits with any quantitative precision. Findings in this section should therefore be viewed as initial, qualitative insights on the *types* of benefits and costs that may be associated with e-HM systems and their *relative* magnitudes and importance to HM stakeholders. Benefit and cost impacts may also vary significantly by transportation mode and by business type; for example, the impacts on Class I railroads may be very different from those on owner-operator trucking firms. While the pilot tests and completed impact analysis question sets allowed for some examination of differences by transportation mode and other characteristics, not all organization types were necessarily represented.

### 7.2.1 E-communication Systems Used During Pilot Tests

Table 27 describes the e-communication systems, organized by time from initial request to receipt of HM information, for each of the pilot test simulations.

**Table 27. Pilot Test E-communication Systems**

| Simulation Number | Time from Request to Receipt of HM Information | E-system Description |
|---|---|---|
| 17 | Instantaneously | S/C contacted the ERO, who requested HM shipping paper information; the S/C emailed a pdf copy of the shipping paper in XML to the responder's cellular/smartphone, PDA, and vehicle laptop computer; the local county HM team were first to arrive at the scene. |
| 4 | ≤ 5 minutes | Driver used cellular/smartphone to contact S/C; S/C used cellular/smartphone/tablet to email pdf copy of shipping paper to LEIO's cellular/smartphone. |
| 9 | ≤ 5 minutes | S/C used workplace computer to email a pdf copy of the shipping paper to the LEIO's workplace computer. |
| 11 | ≤ 5 minutes | S/C used cellular/smartphone/PDA to email a pdf copy of the shipping paper to the LEIO's cellular/smartphone/PDA; LEIO was then able to print a copy of the shipping paper. |
| 12 | ≤ 5 minutes | S/C used cellular/smartphone/PDA to email a pdf copy of the shipping paper to the LEIO's cellular/smartphone and FAX machine. |
| 14 | ≤ 5 minutes | Carrier used cellular/smart/landline phone and workplace computer to email a pdf copy of the shipping paper in EDI language to the ERO's/LEIO's workplace computer and cellular/smartphone. |
| 19 | ≤ 5 minutes | Shipper contacted port patrol personnel, who arrived on scene first; port PSAP dispatch used workplace computer, cellular/smartphone, and video to email shipping paper in pdf format to port patrol personnel; PDAs and two-way radios were also used for audio communications. |
| 21 | ≤ 5 minutes | Carrier field personnel arrived on-scene first, acted in a PSAP capacity, and used PDA/smartphone to call ERO to report the incident; ERO used smartphone to call CHEMTREC; CHEMTREC used workplace computer to email a pdf copy of the shipping paper to the ERO's smartphone and workplace computer; ERO used smartphone/workplace computer to email shipping paper to the carrier field personnel's smartphone and I-Pad; CHEMTREC then used landline phone to call shipper, and requested shipper call ERO; shipper used smartphone to call ERO's smartphone to confirm shipping paper emailed by CHEMTREC was correct. |
| 5 | 6 to 15 minutes | Driver used cellular/smartphone to contact S/C; S/C used cellular/smartphone/tablet to email pdf copy of shipping paper to LEIO's cellular/smartphone. |
| 6 | 6 to 15 minutes | Driver used cellular/smartphone to contact S/C; S/C used cellular/smartphone/tablet to email pdf copy of shipping paper to LEIO's cellular/smartphone. |
| 8 | 6 to 15 minutes | S/C used workplace computer to email a pdf copy of the shipping paper to the ERO's/LEIO's vehicle laptop computer. |
| 18 | 6 to 15 minutes | Port patrol personnel arrived on scene first, and contacted the police via landline/cellular/smartphone; police officer then contacted the intermodal yard rail coordinator via two-way radio/smartphone to request the HM |

| Simulation Number | Time from Request to Receipt of HM Information | E-system Description |
|---|---|---|
| | | shipping paper; intermodal yard rail coordinator emailed police officer the HM shipping paper in jpeg format from his workplace computer/PDA, who received the e-shipping paper via PDA/workplace computer; port patrol/security received the e-shipping paper via PDA, workplace computer, and cellular/smartphone. |
| 1 | 16 to 30 minutes | Driver used cellular/smartphone to contact S/C; S/C used cellular/smartphone/tablet to email pdf copy of shipping paper to LEIO's cellular/smartphone. |
| 3 | 16 to 30 minutes | Driver used cellular/smartphone to contact S/C; S/C used cellular/smartphone/tablet to email pdf copy of shipping paper to LEIO's cellular/smartphone. |
| 7 | 16 to 30 minutes | Carrier used cellular phone to contact its dispatcher, who used a workplace computer to email a pdf copy of the shipping paper to the LEIO's cellular/smartphone. |
| 16 | 16 to 30 minutes | Shipper used workplace computer to email a pdf copy of the shipping paper to the inspector's workplace computer. |
| 20 | 16 to 30 minutes | Fire personnel arrived on-scene first; driver used cellular phone to call terminal manager and request the HM shipping paper; terminal manager used cellular phone to call carrier and request permission to send HM shipping paper to driver; carrier granted permission, so terminal manager emailed a pdf copy of the shipping paper to the driver's cellular phone; driver then emailed the pdf shipping paper to the fire emergency responder's tablet. |
| 2 | 31 to 60 minutes | Driver used cellular/smartphone to contact S/C; S/C used cellular/smartphone/tablet to email pdf copy of shipping paper to LEIO's cellular/smartphone. |
| 10 (rural roadway inspection simulation) | 31 to 60 minutes | Shipper attempted to use landline phone, CAD terminal, and vehicle laptop to send e-shipping papers to inspector's cellular phone and vehicle laptop computer, but was unsuccessful; shipper and inspector moved locations multiple times to attempt to get electronic connectivity; shipper emailed a pdf copy of the shipping paper to the inspector's vehicle laptop computer and CAD terminal. |
| 13 | More than one hour | Shipper was contacted by LEIO via cellular phone, contact was made outside of shipper's normal hours of business, and shipper was not set up for e-shipping paper transfer outside of normal business hours during pilot test; shipper faxed a pdf copy of the shipping paper to the LEIO's vehicle laptop computer and office FAX machine |
| 15 | No time reported | LEIO called the terminal using a landline phone to request the HM shipping paper; terminal personnel emailed a pdf copy of the shipping paper to the inspector's workplace computer |

#### 7.2.1.1 Evaluation of Pilot Test E-communication Systems by Time for HM Data Receipt

Inspectors and emergency responders want to receive accurate and complete HM information as soon as possible, preferably within five minutes from time of request. The eight simulations (38%) where inspectors/emergency responders received the HM information instantaneously or within five minutes or less (i.e., Simulations 17, 4, 9, 11, 12, 14, 19, and 21) used cellular and smartphones, tablets, PDAs, laptop computers, and/or workplace computers to send and receive the e-HM information. These inspectors and emergency responders reported that the e-information matched that on the hardcopy shipping papers and accurately reflected the HM being transported.

The four simulations (19%) where inspectors/emergency responders received the HM information within 6 to 15 minutes (i.e., Simulations 5, 6, 8, and 18) and the five simulations (24%) where the HM information was received within 16 to 30 minutes (i.e., Simulations 1, 3, 7, 16, and 20) used landline, cellular, and smartphones, two-way radios, tablets, PDAs, laptop computers, and/or workplace computers to send and receive the e-HM information. One reason for the delay in receipt of the HM information was the multiple entities that were contacted for granting permission to provide the requested HM information to the simulation participants.

Simulations 2, 10, and 13 (14%) took at least 31 minutes for inspectors/emergency responders to receive the requested HM information. Reasons for the information receipt delay included lack of Internet connectivity (rural area) and request was made outside of shipper's normal hours of business.

No time was reported for the receipt of the HM information for Simulation 15 (5%).[77]

### 7.2.2 Pilot Test Inspectors' Feedback on the Inspection Simulations

Inspectors who participated in the pilot test simulations provided the simulation feedback information in this section.

#### 7.2.2.1 Validity and Accuracy of HM Inspection Simulation Information

The thirteen roadway and three maritime inspectors who reported the inspection simulation HM information was transmitted electronically indicated they checked the validity of the e-HM information received by comparing it with the hardcopy HM shipping paper/bill of lading/Dangerous Goods Declaration, the physical HM packaging, and/or the HMR (49 CFR 172). All 15 inspectors found that the e-HM information they received matched the information recorded on the hardcopy documents and accurately reflected the details of the HM being transported.

[77] PHMSA attempted to contact this inspector to obtain the HM information receipt time, but was informed that the inspector has transferred to a new location and was unreachable for comment. In addition, no vetted shipper or carrier was involved in this simulation, so PHMSA could not contact a shipper or carrier to obtain this information.

Twelve of the roadway inspectors (92%) thought the information included within the e-transmittal was sufficient to determine a passed or failed inspection; the one roadway inspector (8%) who felt the information included within the e-transmittal was insufficient to determine a passed or failed inspection reported that the e-data needed to be delivered in a timely manner (i.e., during the actual inspection simulation).

Two of the maritime inspectors (67%) thought the information included within the e-transmittal was insufficient to determine a passed or failed inspection. These inspectors reported that additional information regarding physical vessel inspections, compliance with 49 CFR HM shipping regulations, and additional container and cargo inspection details (structure details, placarding, proper stowage and marking of cargo, etc.) was needed to determine a pass or fail rating. Some of this additional information can only be verified by a visual inspection of the container and cargo, and would not be found on an HM shipping paper.

Eleven roadway inspectors (85%) and two maritime inspectors (67%) felt the e-information received fully satisfied the HM information currently required to be provided as paper documentation, two roadway inspectors (15%) felt the e-information received partially satisfied the current HM paper-required documentation, and one maritime inspector (33%) felt the e-information mostly satisfied the current HM paper-required documentation. Additional HM information the three inspectors felt was needed to fully satisfy HM inspection needs included:

- Timely delivery of e-data (this inspection was over before the e-data was delivered);
- Vessel inspection information for compliance with 49 CFR HM shipping regulations[78]; and
- Inspection information related to container structure and placarding and proper cargo stowage, blocking, bracing, packaging, marking, and labelling[79].

#### 7.2.2.2 Impact of E-systems on Inspection Completion Times

When asked about their thoughts on how e-HM systems will affect the time needed to conduct inspections, the pilot test inspectors provided the responses listed in Table 28.

**Table 28. E-systems' Impact on Inspection Times**

| | Roadway Simulations | | Maritime Simulations | | Total (all Inspection Simulations) | |
|---|---|---|---|---|---|---|
| **E-systems' Impact on Inspection Times** | **Count** | **Percentage** | **Count** | **Percentage** | **Count** | **Percentage** |
| Positive | 1 | 8% | 1 | 33% | 2 | 12.5% |
| Negative | 10 | 76% | 0 | 0% | 10 | 62.5% |
| No impact | 1 | 8% | 1 | 33% | 2 | 12.5% |

[78] This information is not one of the required 49 CFR 172.202 shipping paper HM descriptions.
[79] Ibid.

| | Roadway Simulations | | Maritime Simulations | | Total (all Inspection Simulations) | |
|---|---|---|---|---|---|---|
| Other:<br>• Roadway inspector believes e-systems will negatively affect the time to conduct inspections in rural areas (negative impact)<br>• Maritime inspector believes e-systems will provide a safer and quicker means of exchanging HM information (positive impact) | 1 | 8% | 1 | 33% | 2 | 12.5% (6.25% positive, 6.25% negative) |

Of the ten "negative" roadway responses, seven were from the same inspector (LEIO ID 19), who reported for the seven inspection simulations inspection completion times of less than five minutes to up to 30 minutes; the e-information fully satisfied inspection information needs; and no impediments or limitations were identified during the simulations. Another inspector who answered "negative" (LEIO ID 18) reported the extensive preparation time needed to *arrange* the simulation; the time spent actually conducting this simulation was "less than 5 minutes." Another inspector who answered "negative" (LEIO ID 17) reported a total inspection time of 4 hours, 3 minutes, but cited the reasons for this lengthy time period as the e-HM information was requested outside of the shipper's normal e-system business hours, so multiple staff had to be contacted for the information. The remaining inspector who answered "negative" (ERO/LEIO ID 15) reported it took ten minutes to receive the requested e-HM information via email.

#### 7.2.2.3 Benefits Associated with E-systems and Associated Components

When asked as to what benefits an e-system would offer over the current paper-based system, pilot test simulation inspectors reported the information in Table 29.

**Table 29. E-system Benefits over Current Paper-Based System**

| | Roadway Simulations | | Maritime Simulations | |
|---|---|---|---|---|
| **E-System Benefits (vs. Paper HM Documentation)** | **Count** | **Percentage** | **Count** | **Percentage** |
| Reduced staff time and/or cost to prepare shipping papers | 1 | 8% | 1 | 33% |
| Reduced costs for transfer between modes or carriers | 1 | 8% | 0 | 0% |
| Reduced error rate in data entry | 1 | 8% | 1 | 33% |
| Ease of data entry | 0 | 0% | 1 | 33% |
| Reduced costs for hardcopy storage and retrieval | 1 | 8% | 0 | 0% |
| Faster transport times for shipments | 0 | 0% | 0 | 0% |
| Improved customer satisfaction | 1 | 8% | 0 | 0% |

| | Roadway Simulations | | Maritime Simulations | |
|---|---|---|---|---|
| Reduced insurance or risk management costs | 0 | 0% | 0 | 0% |
| No benefits | 12 | 92% | 2 | 67% |
| Other:<br>• Quicker access to sharing of information with mutual aid emergency responders entering the port to assist in responding to HM incidents | 0 | 0% | 1 | 33% |
| **Total Responses[80]:** | **Roadway: 17** | | **Maritime: 6** | |

One of the 13 roadway inspectors (8%) and two maritime inspectors (67%) indicated they found e-system components beneficial to HM communication. These inspectors identified the following benefits related to e-system components:

- Benefits regarding electronic/wireless devices used (100%);
- Benefits associated with the data language (e.g., XML, EDI, etc.) used (33%);
- Benefits in the communication mechanism (e.g., email, Internet reference/link, etc.) utilized (33%);
- Benefits associated with the data format (e.g., pdf, jpeg, etc.) used (33%); and
- Benefits associated with the time required to receive the shipping paper information (100%).

#### 7.2.2.4 E-system Impediments/Limitations Identified During Inspection Simulations

Five of the thirteen roadway inspectors (39%) identified e-system impediments/limitations, while the three maritime inspectors did not identify any e-system impediments/limitations. The five roadway inspectors identified the following e-system impediments/limitations:

- Lack of timely electronic access in rural areas (20%);
- Problems with electronic/wireless devices (difficult to verify information on a small screen, and image was upside down) (20%);
- Problems with the communication mechanism (e.g., email, Internet reference/link, etc.) (20%);
- Problems with the data format (e.g., pdf, jpeg, etc.) (20%);
- Communication issues between driver and dispatcher (assumption that e-data had already been received by the inspector; some shipper/carrier e-systems not set up for 24 hours/day, 7 days/week transfer of data) (20%); and
- Limited dispatch assistance due to heavy workload of dispatcher (20%).

#### 7.2.2.5 Training Needs for Conducting Transfers of E-HM Inspection Information

Three of the thirteen roadway inspectors (23%) and two of the three maritime inspectors (67%) believe training on the following is needed to conduct electronic transfers of HM inspection information:

- Drivers need to know inspectors will ask for DOT shipping paper information for HM carried in the vehicle to be sent immediately upon request;

[80] These totals represent the sum of all individual benefits provided, not the total number of inspectors providing a response.

- The process inspectors should use to receive the e-information, including how to request the e-information in the event of injury or death to the driver;
- Dispatchers receiving the e-information need to be trained on the HM information requirement and on the process to relay the needed information to the inspectors/emergency responders;
- While some ports are in the process of updating port officers' vehicle computer Wi-Fi capabilities to include better coverage areas, not all port officers are issued smart type phones capable of getting e-information. Training is needed on how to maintain port inspection officers' safety in areas of the port with high volume of moving heavy equipment while having a quicker means of communicating with long shore foreman to determine the exact location of a specific HM container/truck within the port;
- Use of correct terminology to ensure the correct documentation is sent electronically; and
- Training on how to correct HM paperwork.

#### 7.2.2.6 Equipment Needs for Conducting Transfers of E-HM Inspection Information

All thirteen roadway inspectors (100%) indicated no additional equipment is needed to conduct e-HM information transfers, while one of the three maritime inspectors (33%) recommended that port Wi-Fi connectivity needs to be updated, and inspection officers need to have emergency response guidebook access immediately at all times when conducting port HM inspections.

#### 7.2.2.7 Lessons Learned Information for Improving the Use of E-HM Shipping Papers

Three of the thirteen roadway inspectors (23%) and one of the three maritime inspectors provided the following "lessons learned" information for improving the use of e-HM shipping papers in commerce:

- Send HM shipping papers to the investigator on-site and to a command post via email, fax, or smartphone;
- Regulations need to define the amount of time the shipper/carrier has to provide the e-HM shipping paper information before a violation for accessibility of the information would be documented, with considerations for significant monetary penalties for non-compliance and keeping the vehicle in out-of-service status until the information is provided;
- E-HM information received during one roadway inspection simulation was via email of a pdf shipping paper; which took 10 minutes from request to receive. Such scenarios have the potential to increase inspection times instead of streamlining; and
- Ensure and maintain liaison with longshore workers when doing maritime HM inspections. They are the experts in the field on where the particular HM container/vessel/truck is located and can provide quick specific HM location information.

### 7.2.3 Pilot Test Emergency Responders' Feedback on the ER Simulations

Emergency responders who participated in the pilot test simulations provided the simulation feedback information in this section.

#### 7.2.3.1 Validity and Accuracy of HM Emergency Response Simulation Information

The emergency responders who participated in the five ER simulations indicated they checked the validity of the e-HM information received by comparing it with the hardcopy HM documentation/Dangerous Goods Declaration and/or the physical HM packaging. All emergency responders found that the e-HM information they received matched the information recorded on the hardcopy documents and accurately reflected the details of the HM being transported.

Emergency response entities for all five ER simulations (100%) reported that the information included within the electronic transmittal was sufficient, and equivalent to the hardcopy shipping paper, to identify the hazards and properly respond to the HM simulated incident. Four emergency response entities (80%) felt the e-information received fully satisfied the HM information currently required to be provided as paper documentation. One (20%) felt the e-information partially satisfied the current HM paper-required documentation, and reported that the driver's lack of a removable electronic device in the truck cab that could access the e-HM shipping paper information was the reason for this rating.

#### 7.2.3.2 Impact of E-systems on Emergency Response Times

When asked about their thoughts on how e-HM systems will affect the time needed to respond to an HM incident, the pilot test emergency responders provided the responses listed in Table 30.

**Table 30. E-systems' Impact on Emergency Response Times**

| | Emergency Response Simulations | |
|---|---|---|
| **E-systems' Impact on Emergency Response Times** | **Count** | **Percentage** |
| Positive | 3 | 60% |
| Negative | 0 | 0% |
| No impact | 0 | 0% |
| Other:<br>• Benefit would be positive unless incident happened in a dead zone (positive impact)<br>• Response times would not change, but having quicker access to HM information may increase safety for first responders (neutral impact) | 2 | 40% |

#### 7.2.3.3 Benefits Associated with E-systems and Associated Components

When asked as to what benefits an e-system would offer over the current paper-based system, pilot test simulation emergency responders reported the information in Table 31.

**Table 31. E-System Benefits over Current Paper-Based System**

| | Emergency Response Simulations | |
|---|---|---|
| **E-System Benefits (vs. Paper HM Documentation)** | **Count** | **Percentage** |
| Reduced staff time and/or cost to prepare shipping papers | 3 | 60% |
| Reduced costs for transfer between modes or carriers | 3 | 60% |
| Reduced error rate in data entry | 2 | 40% |
| Ease of data entry | 1 | 20% |
| Reduced costs for hardcopy storage and retrieval | 3 | 60% |
| Faster transport times for shipments | 0 | 0% |
| Improved customer satisfaction | 3 | 60% |
| Reduced insurance or risk management costs | 1 | 20% |
| No benefits | 0 | 0% |
| Other:<br>• Reduced time to receive hazard information for quicker decisions on protective actions<br>• Quicker and more accurate information for port and outside mutual aid emergency responders<br>• Capability for multiple devices to access HM information versus one hardcopy, thus providing quick technical assistance to response units<br>• Quicker access for on-scene responders, thus providing a better and safer response | 4 | 80% |
| **Total Responses:**[81] | **20** | |

Three of the emergency response entities (60%) indicated they found the following e-system components beneficial to HM communication:

- Benefits regarding electronic/wireless devices used (100%);
- Benefits associated with the data language (e.g., XML, EDI, etc.) used (33%);
- Benefits in the communication mechanism (e.g., email, Internet reference/link, etc.) utilized (100%);
- Benefits associated with the data format (e.g., pdf, jpeg, etc.) used (67%);
- Benefits associated with the time required to receive the shipping paper information (100%);

[81] This total represents the sum of all individual benefits provided, not the total number of emergency responders providing a response.

- Benefits of quickly receiving the information electronically versus having to contact the port intermodal tower and request that the staff locate hardcopy documentation (33%); and
- Benefits associated with an external fire department's capability to quickly review and immediately share e- HM information during a response to an actual emergency (33%).

#### 7.2.3.4 E-System Impediments/Limitations Identified During Emergency Response Simulations

Two of the emergency response entities (40%) identified the following e-system impediments/limitations:

- Parts of original document were not legible and thus were hard to read (33%); and
- Driver had no carrier-supplied electronic device that could be removed from cab and that had the capability to receive or store e-HM shipping documents. In addition, the majority of fire service field units do not have department assigned tablets and Internet connectivity that can receive e-HM documents (33%).

#### 7.2.3.5 Training Needs for Conducting Transfers of E-HM Emergency Response Information

Three emergency response entities (60%) indicated responders need the following training to conduct electronic transfers of HM emergency response information:

- How to decipher and understand e-information,
- How to use new port electronic capabilities, including how to access and print e-HM information at remote location (e.g., in vehicles); and
- Training for department personnel who are responsible for purchasing and assigning devices with e-capabilities.

In addition, these three emergency response entities recommended that responders receive additional training on the Emergency Response Guidebook[82], to better equip them to respond safely and effectively to HM emergencies.

#### 7.2.3.6 Equipment Needs for Conducting Transfers of E-HM Emergency Response Information

Four emergency response entities (80%) believe the following additional equipment is needed to conduct ER e-HM information transfers:

- Smartphones or other devices capable of receiving, reading, and transmitting pdf documents;
- Mobile data terminals (MDTs)/laptops/toughbook/tablets with Internet connectivity capability and preferably portable/removable in vehicle, possibly with printers, to allow on-site generation of hardcopy HM documentation; and
- Increase built-in capabilities for internal report generation in information management systems.

[82] An electronic version of the 2012 Emergency Response Guidebook can be found at http://www.phmsa.dot.gov/hazmat/library/erg.

#### 7.2.3.7 Lessons Learned Information for Improving the Use of E-HM Shipping Papers

Three emergency response entities (60%) provided the following "lessons learned" information for improving the use of e-HM shipping papers in commerce:

- Ensure HM documentation provided via FAX is legible;
- Ensure a process is in place for quick access to hardcopy documents, as a backup in instances where Internet/power capabilities are compromised; and
- PSAP centers should be able to receive the HM documents from the carrier quickly and be able to transmit via current dispatch devices on most response vehicles. If the information is being transmitted verbally, the dispatcher personnel will require training on shipping documents and SDSs.

### 7.2.4 Additional Pilot Test Findings

E-systems are still largely in the developing stages, and the data from the 21 pilot tests and the 92 impact analysis question sets completed by volunteer HM stakeholders constitute a small, non-random sample of the HM transportation community. While it is not possible to draw statistically valid conclusions from this limited data or to estimate costs and benefits with any quantitative precision, the following general observations can be made from the pilot test data:

- The most frequently used devices to send and receive HM data electronically were landline, cellular, and smartphones, two-way radios, tablets, PDAs, laptop computers, and workplace computers. These devices were used in all 21 pilot test simulations, and resulted in receipt of the HM information within five minutes in 8 of the 21 (38%), and within 15 minutes in 12 of the 21 (57%), simulations. These devices appear to be good candidates for investment by HM stakeholders to share electronic HM information.
- A pdf format of the shipping paper was used in all 21 pilot test simulations. This format was able to be read by all the pilot test inspectors and emergency responders who received the electronic HM information. Regardless of data language used, pdf format appears to be send-able, receivable, and readable on the recommended devices in the previous bullet.
- Some pilot test inspectors and emergency responders had difficulty reading the HM data on their cellular/smartphones, due to the small screen size of the device, the image being presented upside down, and parts of the original hardcopy document being illegible and thus hard to read in the emailed pdf document.
- Delays in receipt of electronic HM data may be caused by requests generated during shippers'/carriers' non-business hours and by permission needs from senior staff/other entities before a stakeholder can electronically transfer the requested HM information.
- Five of the eight pilot test inspectors (63%) felt that e-systems will have a negative effect on inspection times. The time for receipt of the requested electronic HM data in nine of these inspection simulations (82%) ranged from less than 5 to 30 minutes. In addition, four of the five roadway (80%) and two of the three maritime (67%) pilot test inspectors identified that an e-system offers no benefits over the current paper-based system. These negative perceptions may

result from the routine nature of inspections, where many are conducted based on a set frequency rather than to address an emergency situation.

- Four of the five pilot test emergency responders (80%) felt that e-systems will have a positive effect on inspection times, and the fifth pilot test emergency responder indicated that having quicker electronic access to HM information may increase safety for response personnel. All five pilot test emergency responders (100%) identified benefits an e-system offers over the current paper-based system. The positive perceptions of this stakeholder group regarding the use of e-systems may result from their need to access HM information immediately to respond to emergencies, and that any method that can potentially provide accurate HM information quickly while maintaining and enhancing responders' safety is beneficial.

## 7.3 Safety and Security Impacts of Using E-systems

An assessment of the safety and security impact of using e-systems, including any impact on the public, emergency response, law enforcement, and the execution of inspections and investigations, is provided in this section.

The e-system concept requires at least an equivalent level of safety and security as compared to the current hardcopy-based system of hazard communication. Some e-systems may also be able to provide improved safety by increasing the accuracy and timeliness of information received by first responders, notably for information such as commodity, hazard class, quantity, container type, and emergency contact number, as long as procedures are in place to verify the accuracy of the HM data when it is first entered into the e-system. In addition, obtaining HM information electronically rather than having to approach a transportation conveyance involved in an emergency situation may improve safety for responders and improve the effectiveness of their efforts.

E-systems that have been verified and tested as being protected from unauthorized access may also provide better security of HM information, by requiring vetted users to provide user authentication information prior to gaining access to HM information. Because e-systems allow for HM information to be maintained electronically, the possibility of HM shipping documents being lost or damaged can be reduced. E-systems that have redundancy capabilities are also potentially more robust than hardcopy shipping papers in the event of an incident, since conventional hardcopy shipping papers are susceptible to fire damage during an incident or may otherwise be inaccessible to the first responders. Without this information, emergency response may be less effective and incident consequences may be more severe in terms of property damage and injuries.

At the current state of development, not enough real-world data on the performance of e-systems exists to be able to characterize their performance or quantify safety and security benefits relative to the current hardcopy-based system. However, several pieces of evidence are available to provide some insight into potential safety and security impacts.

### 7.3.1 Evidence from Incident Data

PHMSA conducted a review of PHMSA incident data[83] covering the period from 2009 to 2011 to understand the prevalence of impaired hazard communication in serious HM incidents. Based on that review, scenarios involving serious incidents with impaired hazard communication appear to be very rare in comparison to the volume of shipments, but they do occur.[84] Generally, these communication failures can be viewed in three categories: (1) cases where there was no HM information, such as with undeclared shipments; (2) cases where the relevant information was damaged or destroyed during the incident, such as during a fire; and (3) cases where the HM information was incomplete or incorrect and/or necessitated additional steps (such as multiple phone calls) to get full details to emergency responders. The following incident narrative excerpts provide some examples of these issues:

> *"Due to the damage done to the packages due to heat and fire, nothing was identifiable on them as far as packaging information."*[85]

> *"Shipper did not correctly state chemical and after 3 tries provided us with correct (M)SDS."*[86]

> *"Per the telephonic PHMSA report sent to me it advised that the truck was hauling 300 pounds of a corrosive material and an undetermined amount of flammable liquid. There was in fact no corrosive material onboard the trailer."*[87]

While electronic hazard communication would not eliminate each of these issues, it could reduce their likelihood and/or impact. For example, keeping all information electronically, preferably in redundant e-systems, reduces the possibility that HM shipping documents will be lost or damaged, and software interfaces can help reduce misspellings of chemical names and other sources of error, if procedures and processes for ensuring the HM data is entered correctly into the e-system are in place. In the case of a serious vehicle crash or fire, the ability to obtain HM information electronically—and without having to approach the vehicle—may improve safety for responders and improve the effectiveness of their efforts. All of these impacts would tend to improve incident response and reduce the direct costs incurred by HM shippers and carriers. However, the magnitude of all these impacts is difficult to quantify until more operational experience is gained with e-systems. Most e-systems would also have their own limitations, such as occasional system outages or telecommunications problems, that would need to be taken into account when estimating the potential safety and security impacts.

[83] PHMSA OHMS Incident Report Database, https://hazmatonline.phmsa.dot.gov/IncidentReportsSearch/IncrSearch.aspx.
[84] The study team analyzed incident records for the 3-year period from 2009 to 2011. During this period, there were 44,627 incidents, of which 1,418 met one or more PHMSA criteria to be considered a "serious" incident. Of these, the study team identified 92 highway incidents in which hazard communication may have been impaired, based on the incident data and accompanying narrative.
[85] Incident record E-2009040317, 04/21/2009 in Woodstock, VA.
[86] Incident record I-2011090314, 09/02/2011 in Ringgold, GA.
[87] Incident record E-2010050343, 01/13/2010 in Williams, AZ.

### 7.3.2 Other Considerations

Other safety and security considerations regarding the impacts associated with the use of e-systems include:

- Impacts associated with outages or telecommunications problems;
- Impacts if e-system is hacked, and associated HM data is compromised/altered/deleted;
- Authorized users will need to be identified, notified, vetted, and trained on the e-system; and
- Access to some e-systems, especially those that involve multiple stakeholder types, will need password-protection, encryption, or other security access measures to allow access only to authorized users.

## 7.4 Benefits and Cost Considerations

The benefits of-e-systems can be divided into two key areas: public safety benefits and administrative cost savings. Safety benefits are predicated on the idea that paperless hazard communication, by improving the timeliness and quality of the information available to emergency responders, could help to mitigate the consequences of HM incidents, leading to reduced injuries, property damage, environmental damage, and other costs. These benefits would apply to HM shippers and carriers in the form of reduced cargo losses and liability exposure, and to the general public in terms of reduced fatalities and injuries. HM shippers and carriers would realize administrative cost savings primarily in the form of reductions in the expenses currently associated with generating hardcopy HM shipping papers, transferring this information between shippers and carriers, maintaining it during transport, and storing and retrieving these records.

### 7.4.1 Public Safety Benefits

#### 7.4.1.1 Evidence from the 92 Impact Analysis Question Set Responses

Of the 92 respondents to the impact analysis question set, 25 reported having used wireless or e-communication at least once to convey HM shipment information to law enforcement or emergency responders. A slightly smaller number, 21 respondents, reported having an e-system that could manage and communicate HM shipping paper information; in answering a question regarding the impacts and benefits of their e-HM systems, these respondents largely cited operational efficiencies and cost savings but also noted the potential for security- and safety-related benefits. In particular, 60% of those responding (9 of 15) stated that their e-HM system provided "faster delivery of HM information to emergency responders" and "more accurate HM data for emergency preparedness and response." These responses, while limited to the respondents' subjective impressions, indicate that a majority of respondents with actual experience using an e-system believe the e-system provides relevant safety-related advantages compared to the current paper-based system. These findings cannot be generalized to the broader HM shipper and carrier community due to the small sample size, but they are indicative of the potential for benefits in these areas.

#### 7.4.1.2 Evidence from the Pilot Test Simulations

Nineteen percent of inspectors and eighty percent of emergency response organizations who participated in pilot test simulations noted positive impacts on inspection and emergency response times. Refer to Sections 7.2.2.2 and 7.2.3.2 for additional information.

### 7.4.2 Administrative Cost Savings

In analyzing potential administrative cost savings and business process impacts, it is important to make the distinction between electronic hazard communication and the broader concept of electronic commerce (e-commerce). E-commerce refers to a business model whereby a firm is able to conduct a broad range of business functions over an electronic network; for example, by replacing hardcopy business records and manual processes with e-data exchanges. By contrast, electronic hazard communication refers only to the transfer of hazard communication via electronic means rather than through conventional shipping papers.

While an e-commerce approach might include an electronic hazard communication component, it is also possible to implement electronic hazard communication without converting other business processes to electronic means. For example, an HM shipper could implement electronic hazard communication while still sending paper-based invoices to customers and suppliers and using paper-based records for inventory and other business functions. This distinction is important because the benefits that are specific to electronic hazard communication need to be analyzed separately from the wider range of benefits that might accrue from a broader transition to e-commerce.

#### 7.4.2.1 Evidence from Literature Review

Unfortunately, while there is ample information in the literature on e-commerce initiatives in the freight industry, there is little information on the specific business impacts of electronic hazard communication. The best available information comes from the Hazardous Materials Cooperative Research Program, Report 8, which analyzes the prospects for electronic shipping papers in HM transportation.[88] Based on interviews with industry stakeholders, Report 8 notes that electronic hazard communication would produce administrative cost savings in data entry, particularly for shipments that use multiple modes or carriers, since the required data only has to be entered once. This aspect also reduces data-entry errors and associated delays. In addition, stakeholders identified the potential for reduced costs related to handling, tracking, filing, storing, and retrieving hardcopy shipping papers. Estimates of time savings ranged widely, from just a few minutes per HM shipment to up to one hour or more saved per shipment. The authors of Report 8 were not able to identify the reasons for this very wide range of potential administrative time savings.

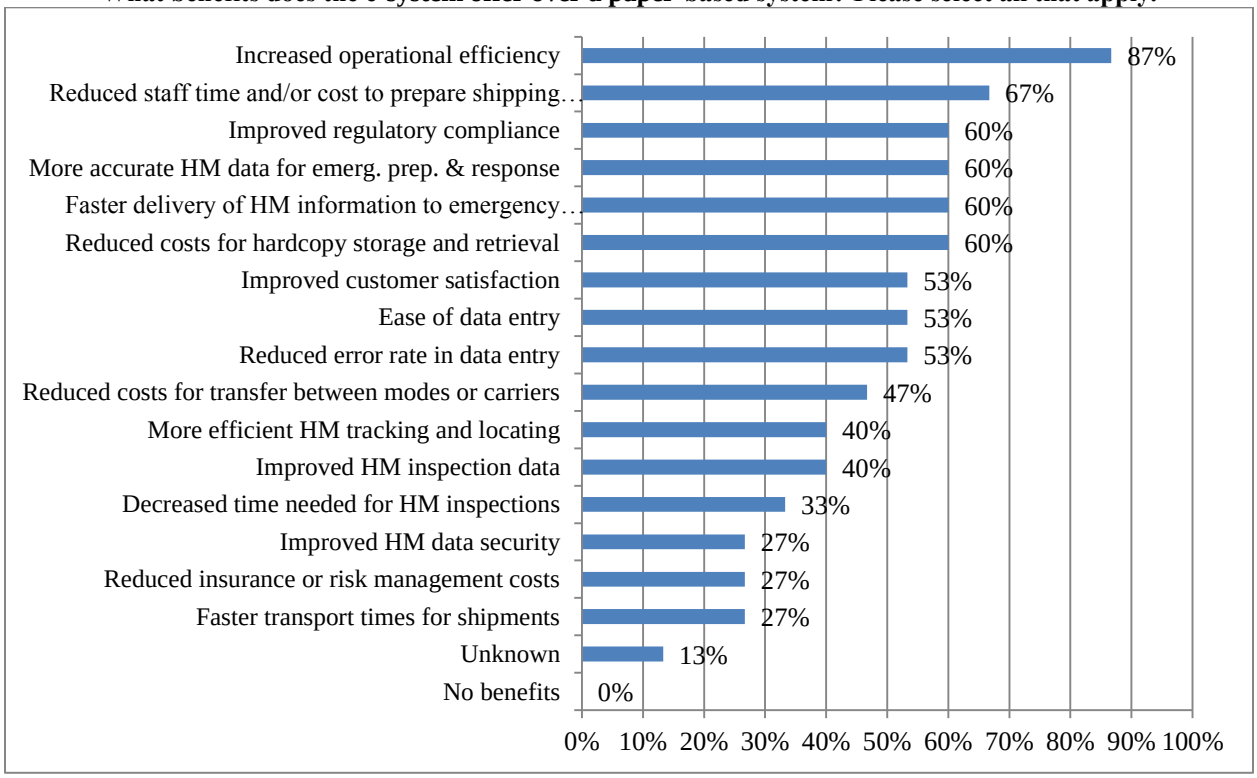
#### 7.4.2.2 Evidence from the 92 Impact Analysis Question Set Responses

Responses to the impact analysis question set largely confirm the initial findings from Report 8 with regard to administrative cost savings. Among respondents who use an e-HM system and responded to a

[88] Transportation Research Board, Hazardous Materials Cooperative Research Program (HMCRP), Report 8, *Evaluation of the Use of Electronic Shipping Papers for Hazardous Materials Shipments*, 2012 (http://onlinepubs.trb.org/onlinepubs/hmcrp/hmcrp_rpt_008.pdf).

question on impacts and benefits, 87% reported that the system led to "increased operational efficiency," and 67% reported "reduced staff time and/or cost to prepare shipping papers. Slightly smaller numbers reported other benefits, such as reduced costs of hardcopy storage and retrieval (60%), as shown in **Error! Reference source not found.**. The breakout of responses was fairly similar between HM shippers nd carriers and across firms of different sizes.

**Figure 1. Benefits of E-systems**




By contrast, a relatively small share (27%) of respondents stated that their e-system was leading to outright shorter transport times for shipments. This outcome suggests that the benefits of the e-system may be much more common in administrative areas such as shipping paper preparation, regulatory compliance, and hardcopy retrieval and storage, rather than in operational areas such as vehicle utilization, driver/operator labor costs, and fuel use. However, for the firms who are able to achieve savings in transit times, the savings could be significant and lead to broader benefits through the supply chain, such as lower inventory costs.

One benefit area for which benefits can be quantified somewhat further is in the preparation of shipping papers, which was cited as a benefit by 67% of e-HM users. Impact analysis question set respondents provided information on the time required to prepare hardcopy HM shipping papers under the current system and the time required to prepare e-shipping papers using their e-system. For the hardcopy approach, the median response was just over ten minutes; for the e-system approach, the median response was about five minutes, indicating a rough average of five minutes saved per shipping paper produced.

The reduction in time required was more pronounced for shippers than for carriers, and for larger firms than for small firms, but each category registered an average decrease. In very rough terms, a five-minute savings per shipping paper is the equivalent of approximately $1.80 in labor cost savings per shipment, based on Bureau of Labor Statistics data.[89] Actual cost savings would vary, potentially significantly, across different organizations, industries, and e-system formats. The 92 impact analysis question set responses do not provide enough detail with which to estimate those varying impacts; however, at the economy-wide level, the existence of 800,000[90] to 1.2 million[91] daily HM shipments in the U.S. would mean that the benefits could be substantial.

#### 7.4.2.3 Evidence from the Pilot Test Simulations

Administrative cost benefits identified by pilot test participants include:

- Reduced staff time and/or cost to prepare shipping papers;
- Reduced error rate in data entry;
- Ease of data entry; and
- Reduced costs for hardcopy storage and retrieval.

Refer to Sections 7.2.2.3 and 7.2.3.3 for additional details.

### 7.4.3 E-System Implementation Costs

Moving from the current paper-based system to an e-system may entail substantial transition costs. Report 8 notes that stakeholders expressed concerns regarding the capital and recurring costs associated with converting to e-HM. These could include technology hardware and software costs, licensing, and upgrades, as well as one-time and ongoing costs for training on the new e-system. In addition, costs associated with customer outreach and education need to be considered; these costs could rise if the e-system were to completely replace, rather than supplement, the existing paper-based HM shipping paper. Conversion to an e-HM approach will likely be less costly for shippers and carriers that are already using an EDI system and will provide more immediate business benefits in terms of reduced administrative costs.

#### 7.4.3.1 Evidence from the 92 Impact Analysis Question Set Responses

The impact analysis question set provides limited insight into cost issues due to the small number of respondents who had a fully operational e-system and thus could respond to questions about development costs. Of the 21 respondents with some form of e-system, only ten reported the system to be at Technology Readiness Level 5, i.e., fully operational in real-world environment. Of those ten, all but one respondent either did not have, or preferred not to share, information on the costs to "develop, implement, operate, and maintain" the e-HM system. Estimates of the amount of money invested to date in the e-

[89] Based on BLS Occupational Employment Statistics, May 2015. The average hourly wage for an illustrative job series (cargo/freight agent, 43-5011) and industry (freight transportation arrangement, NAICS 488500) is $21.56.
[90] Estimate from *Hazardous Materials Shipments*, USDOT/RSPA, 1998 (http://phmsa.dot.gov/staticfiles/PHMSA/DownloadableFiles/Files/hmship.pdf).
[91] Estimate was provided via conversation with CHEMTREC staff in 2012 and was based on 2011 HM shipments.

system ranged from $25,000 to $2.5 million.

In addition to information technology and other system development costs, another key cost item is training for employees on the e-system. While none of the impact analysis question set respondents were able to provide direct estimates of the associated training costs, 65% of respondents with functioning e-systems said that employees received initial training on the e-system, suggesting that it is not an uncommon implementation element. The reported length of training varied, with the most common response being "less than two hours" (39%), though that was followed closely by "more than eight hours" (23%). The number of employees who receive training also varied, with some respondents noting that it involved thousands of employees. Ten respondents also stated that employees receive refresher training, with the most common frequency being annual. Customer outreach and education is another potential cost item for organizations transitioning to e-systems, since the move to an e-system may require adjustments to business practices and customer interfaces. However, only 10% of impact analysis question set respondents with an e-system in place said they have included an outreach component, and no specific cost estimates were provided. It is possible that the need for outreach would become greater if the e-system were to completely replace, rather than supplement, the existing paper-based HM shipping paper.

#### 7.4.3.2 Evidence from the Pilot Test Simulations

The pilot tests participants (23% roadway inspectors, 67% maritime inspectors, 60% emergency response organizations) also commented on the need for training on any e-system used to communication the HM shipping papers information (refer to Sections 7.2.2.5 and 7.2.3.5, respectively). In addition, 33% of maritime inspectors and 80% of the emergency response organizations who participated in the pilot tests reported that additional equipment is needed to implement e-HM communication (refer to Sections 7.2.2.6 and 7.2.3.6, respectively).

#### 7.4.3.3 Evidence from Public-Private Partnership

As described in Section 3.2.3, PHMSA met with DOE's ORNL, Turnkey, and UCOR at the Oak Ridge Reservation in Tennessee in January 2012 to learn about RITIS, a TRL 5 e-system Turnkey developed, in partnership with DOE, for tracking HM transported on the Oak Ridge Reservation.

Turnkey inputs data into RITIS for UCOR. Approximately 1.5 full-time equivalent (FTE)/year in labor are required to maintain RITIS. As of January 2012, approximately $1 million had been spent on RITIS (hardware, labor); $300,000 of this cost was associated with initial one-time setup fees. Annual operation and maintenance costs (including labor) are approximately $250,000.

In a test of RFITS's efficiency, Turnkey staff found that, for each truck transporting HW, the RFITS reduced eight pieces of paper information to zero. As reported in October 2011, more than 25 DOE Oak Ridge projects totaling almost 55,000 e-shipments have shipped via the RITIS Program, with a corresponding cost savings of more than $16 million.[92]

[92] Source: *Nuclear Decommissioning Report*, October 2011, Issue 6, Volume 1; "RFITS Takes Shipping to the Next Level."

### 7.4.4 Benefits and Costs by Mode of Transportation

The business impacts, benefits, and costs of a transition from the current paper-based hazard communication approach to an e-system are likely to vary based on the mode of transportation. Even within particular modes, the impacts will also vary based on factors such as business type, size, and the range of HM commodities transported. Benefit and cost impacts may vary significantly by transportation mode and by business type, based on considerations such as:

- Whether an e-system is already being used;
- Whether HM information can be accessed via or added to the e-system's data fields; and
- If the business can sustain profitability while, and/or identify a dual-benefit for, implementing an e-system.

Findings[93] from the pilot tests, stakeholder consultations, and impact analysis question sets together provide the following general information on the nature of these differences:

- Differences across modes exist regarding modal baselines with respect to their existing use of e-systems and the nature of their HM operations. Rail, maritime, and air carriers already make use of the EDI data format with all required HM information. While each company is different, stakeholders in these modes generally described their readiness to use EDI as a substitute for hardcopy shipping papers. By contrast, EDI is used to some extent in the Roadway Mode but it has not become a widespread standard. Conversion to an e-HM approach will likely be less costly for shippers and carriers that are already using an EDI system and will provide more immediate business benefits in terms of reduced administrative costs. The motor carrier industry is also distinct in having many small operators for whom the fixed costs of a technology upgrade may be more difficult to absorb, even if subsequent benefits or savings exist.
- Another consideration is that hardcopy shipping papers are used in some modes and industries for purposes other than HM communication. Roadway Mode impact analysis question set respondents were much more likely than others to say that HM shipping papers serve other business functions, such as delivery confirmation, pay records, or trip logs. This response is consistent with the information that motor carrier stakeholder groups shared with PHMSA (refer to Section 3.3.2.3) about how shipping papers are used in their industry. These firms may thus face additional transition costs in a move to an e-system, because they might need to make other adjustments to their business processes to take on the roles currently performed by hardcopy shipping papers.
- Among respondents who already had experience with an e-system, those in the Roadway Mode were more likely to state that they faced impediments, notably "problems with electronic/wireless devices" and "problems with the communication mechanism (e.g. email, Internet)". This response is also consistent with information received in stakeholder communication (refer to Section 3.3.2.3) that trucking companies face issues with "dead spots" in wireless communication, and from the roadway inspection simulations, where one issue that was noted was lack of electronic access in rural areas. Companies facing these challenges, which appear to be concentrated in the

[93] These findings should be viewed as preliminary due to the small and non-random samples associated with these activities.

Roadway Mode, would thus likely face additional technological costs and complexities in transitioning to an e-system.

Although these differences are important, there are many commonalities that exist across modes, as shown in responses to the impact analysis question set. For example, when asked to identify the benefits of the e-system, "increased operational efficiency" and "reduced staff time and/or cost to prepare shipping papers" were the most common answers overall and for each modal sub-group (i.e., Air, Maritime, Rail, and Roadway). Responses across modes were also fairly consistent in terms of the desired characteristics of an e-system and the potential for time savings in preparing e-shipping papers versus hardcopies.

# 8. Conclusions

## 8.1 Modal Shippers and Carriers Use of E-systems for Communicating HM Shipping Paper Information

Many shippers in all modes already have e-systems containing HM shipping information, and should be able to easily transition to providing shipping paper information electronically to carriers who will transport the HM. In addition, Air, Maritime, and Rail Mode carriers generally have e-systems in place for communicating HM shipping paper information. As long as they are allowed to use performance-based e-systems that provide them with flexibility for running their businesses in a cost-effective and efficient manner, these shippers and carriers should be able to effectively use e-systems for communicating HM shipping paper information.

As described in Section 7.1.2, transport of HM by roadway carriers is significantly different from their modal counterparts for a variety of reasons. The feasibility and effectiveness of communicating HM shipping paper information via e-systems may be difficult for some roadway carriers (e.g., those who require a hardcopy HM paper documentation trail; cannot afford to purchase an e-system or do not see a business reason to invest in one; do not have onboard technology for receiving and transmitting e-HM information; transport HM in areas with Internet connectivity issues; etc.).

Shippers and carriers looking to utilize e-systems for sending and receiving e-HM data need to ensure that accurate and complete e-HM data can be accessed 24 hours per day, seven days per week and shared in a timely manner, and that permission protocols for authorizing shipper and carrier personnel to provide e-HM information to inspectors and emergency responders are developed and implemented.

Carriers in all modes utilizing e-systems will need to visually identify HM transportation conveyances so inspectors and emergency responders can recognize conveyances transporting HM using e-HM shipping papers and know how to obtain the e-HM data.

Carriers who want to participate in e-HM data sharing need to ensure their operators are provided with devices capable of receiving, storing, and transmitting e-HM information. These devices should be removable from the transportation conveyance, for quick access and sharing of HM information with inspectors and emergency responders. It is especially important that operators are provided with a device that is capable of providing e-HM data directly to inspectors and emergency responders when HM is being transported within areas of known Internet connectivity issues.

An electronic means for HM carriers to send/receive e-HM shipping documents to/from carriers in the other modes needs to be considered during the evolution of e-systems. Also, provisions for shippers and carriers to communicate the e-HM information in an open, easily transferrable and readable e-data format to each other and to inspectors and emergency responders should be considered, based on the positive pilot test results reported in Section 7.2.4.

## 8.2 Law Enforcement Inspectors Use of E-systems for Communicating HM Shipping Paper Information

As described in Sections 3.3.3.1 and 3.3.3.3, Air and Rail Mode operations personnel are required to visually examine HM prior to transport. While both modes require the HM shipping paper information be provided electronically, operations personnel are required to compare the hardcopy HM shipping paper information with the physical HM prior to transport. In addition, Air Mode inspectors conduct after-shipment inspections at shipper facilities and at airport carrier locations, where they view HM shipping papers and NOPICs required to be maintained by aircraft operators in hardcopy or via electronic image at or through its principal place of business. As the HM shipping paper information is currently required to be provided electronically, inspectors in these modes should be able to effectively use e-systems if policies are adopted allowing for the use of electronic devices by these inspectors for receiving and reviewing the e-HM information. Many inspectors in these modes already possess electronic devices capable of receiving e-HM data; however, because many of the devices are not standardized within LEIOs, standardized devices may need to be procured for some inspectors.

HM inspectors in the Maritime Mode (USCG container inspectors) may not be equipped with electronic devices either capable of or permitted to be used for receiving e-HM shipping paper information during the conduct of HM container inspections. In 2014, the USCG's CG-FAC purchased tablets for field units to use in conducting facility safety and security operations (refer to Section 3.1.2). While the current use of the tablets is to make reference materials accessible to inspectors while conducting field activities, the CG-FAC recommends that the use of such devices be expanded in the future. These devices could potentially be used by maritime container inspectors to access e-HM shipping paper information during container inspections. In addition, some inspectors at large ports currently receive electronic HM shipping papers directly from the shippers, while inspectors at small and medium ports typically receive hardcopy HM shipping papers from terminal/yard offices; such offices may receive the original HM shipping papers electronically from either the shipper or the carrier (refer to Section 3.3.3.2). While most maritime HM inspectors are currently not using e-systems for accessing the HM shipping paper information while conducting container inspections, use of e-systems for HM container inspections should increase as more ports begin expanding the use of tablets as an inspector tool. Maritime inspection organizations that invest in technology for e-HM communications should ensure that port Wi-Fi connectivity is updated to allow for the technology to work in the best manner possible.

As described in Section 3.3.3.4, HM inspectors in the Roadway Mode are provided with laptops, and have access to a variety of databases for searching and storing HM information; such inspectors should be able to effectively receive e-HM shipping paper information from shippers and carriers who have e-systems with the capability for transmitting this information.

Policies at the Federal or state levels allowing for the purchase and use of electronic devices for conducting HM inspections in the Air, Maritime, and Rail Modes need to be researched and evaluated to determine whether 1) investment in such technologies will benefit the respective inspector agencies/organizations; and 2) the technologies will make inspectors' job responsibilities easier, faster, and/or more efficient while providing for a work environment that is at least as safe and secure as that provided by the current hardcopy HM shipping paper requirement. These determinations should include a

review of the size and display capabilities of the electronic devices purchased for HM inspectors to share and access electronic HM information, to ensure the e-HM information can be easily read within a timely manner. HM inspectors will benefit from training on the use of electronic devices; the process that should be followed for requesting, receiving, and relaying the e-HM data; and the potential benefits and limitations of using e-systems for reviewing HM shipping paper information during HM inspections.

## 8.3 Emergency Responders Use of E-systems for Communicating HM Shipping Paper Information

Generally, emergency responders in urban areas with existing response systems and networks should be capable of effectively receiving and transmitting HM shipping paper information via e-systems. Some EROs that are volunteer-based; exist in rural areas with limited Internet connectivity; reside in geographically-challenged areas and/or areas where seasonal/weather conditions result in Internet connectivity issues; or are not provided with electronic devices will not be able to obtain e-HM data at the scene of an incident directly from the carrier or shipper until solutions to these issues are identified and implemented. EROs currently possess back-up systems for obtaining HM information when shipping papers are not available or accessible; EROs currently incapable of receiving and transmitting HM shipping paper information via e-systems will need to rely on verbal communication of HM data from shippers and carriers to on-scene emergency responders by means of these other layered and redundant backup systems.

Efforts to assist EROs in investing in and understanding the benefits and limitations of using e-systems for HM communications should be continued. Emergency responders will benefit from training on how to use electronic devices for receiving and transmitting e-HM information. In addition, because PSAP personnel training and professional experiences regarding HM vary greatly, providing PSAP personnel with training on the look and content of HM shipping papers and on HM placarding symbols should be considered.

## 8.4 Safety and Security Impacts of Using E-systems

Scenarios involving serious incidents with impaired hazard communication appear to be very rare in comparison to the volume of HM shipments, but they have occurred in transportation scenarios where HM information was lacking (such as undeclared HM shipments); was damaged or destroyed (such as fire incidents); and was incomplete, incorrect, and/or required additional steps (such as multiple phone calls) to provide emergency responders with all needed HM information. While e-communication would not eliminate these scenarios, it could reduce their likelihood and/or impact.

The e-system concept requires at least an equivalent level of safety and security as compared to the current hardcopy-based system of hazard communication. While current real-world data on the performance of e-systems is insufficient to be able to characterize e-systems' performance or quantify their safety and security benefits, the following pieces of evidence provide some insight into e-systems'

potential safety and security impacts:

- Some e-systems may be able to provide improved safety by increasing the accuracy and timeliness of information received by first responders (refer to data in Table 28 and Table 30, which show that 19% of inspectors and 80% of emergency responders, respectively, who participated in pilot test simulations noted positive impacts on inspection and emergency response times).
- Because HM information is maintained electronically, e-systems can reduce the possibility of HM shipping documents being lost or damaged. In addition, software interfaces can help reduce misspellings of chemical names and other potential sources of error.
- E-systems that have redundancy capabilities are potentially more robust than hardcopy shipping papers in the event of an incident (such as a fire that destroys hardcopy shipping papers).
- In the case of a serious vehicle crash or fire, the ability to obtain HM information electronically—and without having to approach the vehicle—may improve safety for responders and improve the effectiveness of their efforts.
- E-systems that have been verified and tested as being protected from unauthorized access may provide better security of HM information, by requiring vetted users to provide user authentication information prior to gaining access to HM information.

Additional safety and security impact considerations regarding the use of e-systems include impacts associated with outages or telecommunications problems; impacts if e-system is hacked, and associated HM data is compromised/altered/deleted; and e-system limitations (such as occasional system outages or telecommunications problems). In addition, authorized users will need to be identified, notified, vetted, and trained on the e-system, and access to some e-systems, especially those that involve multiple stakeholder types, will need security access measures to allow access only to authorized users.

While the benefits associated with these safety and security impacts may improve incident response and reduce the direct costs incurred by HM shippers and carriers in preparing and maintaining HM shipping paper information, the full magnitude of all these impacts is difficult to quantify until more operational experience is gained with e-systems.

## 8.5 Cost-benefits and Impacts of Using E-systems

The administrative and business process cost benefits and impacts of e-systems include both electronic hazard communication and e-commerce. The benefits and impacts specific to electronic hazard communication need to be analyzed separately from the wider range of benefits and impacts that might accrue from e-commerce. Little information on the specific business impacts of electronic hazard communication is known; however, evidence[94] provides some insights into potential cost benefits and impacts associated with electronic hazard communication.

[94] Evidence is from the Hazardous Materials Cooperative Research Program, Report 8, Impact Analysis question set responses, and pilot test simulations. Refer to Sections 7.2 and 7.4 for more information.

While the degree of cost benefits is likely to vary based on the mode of transportation, the cost-benefits of electronic hazard communication for shippers and carriers across modes are expected to be more common in administrative areas (e.g., shipping paper preparation, tracking, filing, maintenance, retrieval, and storage) than in operational areas (e.g., vehicle utilization, driver/operator labor costs, and fuel use). Administrative cost savings could be produced by reducing or eliminating the need for multiple data entry of the same HM information (e.g., shipments that use multiple modes or carriers), which in turn could reduce data entry errors and associated data entry delays. While actual cost savings would vary, potentially significantly, across different organizations, industries, and e-system formats, the reduction in time required to prepare shipping papers electronically is generally expected to be more pronounced for shippers than for carriers, and for larger firms than for small firms. Impact analysis question set data(refer to Section 6.2) suggests a rough average of five minutes saved per shipping paper produced; in very rough terms, a five-minute savings per shipping paper is the equivalent of approximately $1.80 in labor cost savings per shipment, based on Bureau of Labor Statistics data.[95] At the economy-wide level, the existence of 800,000[96] to 1.2 million[97] daily HM shipments in the U.S. would mean that the cost saving benefits could be substantial. Cost savings could also be significant for companies that are able to decrease HM transit times, which could lead to broader supply chain benefits (e.g., lower inventory costs).

Transitioning from the current paper-based system to an e-system may entail substantial implementation costs, and is likely to vary among transportation modes. Even within particular modes, the impacts will vary based on factors such as business type and size; the range of HM commodities transported; whether an e-system is already being used; whether HM information can be accessed via or added to the e-system's data fields; and if the business can sustain profitability while, and/or identify a dual-benefit for, implementing an e-system. Development, implementation, operation, and maintenance costs could include technology hardware and software costs, licensing, and upgrades, personnel e-system initial and refresher training costs, and costs associated with customer outreach and education needs; these costs will vary widely depending on the number employees requiring training and the complexity of the e-system.

Differences in transition costs are expected across modes due to differences with respect to their existing use of e-systems and the nature of their HM operations. Rail, maritime, and air carriers already make use of the EDI data format with all required HM information. While each company is different, stakeholders in these modes are generally ready to use EDI for e-HM communication as a substitute for hardcopy shipping papers. By contrast, EDI use in the Roadway Mode has not become a widespread standard, and the motor carrier industry also has many small operators for whom the fixed costs of a technology upgrade may be difficult to absorb, even if subsequent benefits or savings exist. Conversion to an e-HM approach will likely be less costly for shippers and carriers that are already using an EDI system and will provide more immediate business benefits in terms of reduced administrative costs.

[95] Based on BLS Occupational Employment Statistics, May 2015.
[96] Estimate from Hazardous Materials Shipments, USDOT/RSPA, 1998 (http://phmsa.dot.gov/staticfiles/PHMSA/DownloadableFiles/Files/hmship.pdf).
[97] Estimate was provided via conversation with CHEMTREC staff in 2012 and was based on 2011 HM shipments.

Another benefit and cost consideration is that hardcopy shipping papers are used in some modes and industries for purposes other than HM communication. For example, the Roadway Mode uses HM shipping papers to serve other business functions (e.g., delivery confirmation, pay records, trip logs). These companies may face additional transition costs, because they might need to make other adjustments to their business processes to take on the roles currently performed by hardcopy shipping papers. The Roadway Mode is also more likely to face other implementation impediments, notably problems with electronic/wireless devices, problems with the e-communication mechanism used (e.g. email, Internet), and the existence of "dead spots" in wireless communication. Companies facing these challenges will likely face additional technological costs and complexities in transitioning to an e-system.

# 9. Recommendations

Based on a review and evaluation of stakeholder feedback information and pilot test and impact analysis results, Volpe believes that e-systems can be a feasible and effective alternative to hardcopy documentation for communicating HM shipping paper information during the transport of HM, and can provide an equivalent level of safety and security as provided by hardcopy shipping papers, if certain performance-based standards are met.

## 9.1 Recommendations for Incorporating E-systems into the Federal HM Transportation Safety Program

Based on the findings and information collected in this study, Volpe recommends that rulemaking be considered to amend the HMR to permit the use of e-systems for communicating e-HM shipping paper information if a set of performance-based standards are met. Recommended performance criteria to be evaluated and defined during the rulemaking process include requiring:

- An identified POC is available for providing the e-HM information 24 hours per day, seven days per week;
- All HM shipping paper information is provided electronically on-demand within a defined time interval after the initial request (***Note:*** DOT-SP 15747 in Appendix H: UPS Special Permit 15747 requires that the e-HM shipping paper information be provided "without delay" to emergency responders and inspectors in a single transmission within five minutes from when the initial request is received by the UPS call center);
- Shippers and carriers develop, document, and train (initial and refresher) affected staff on their equipment, procedures, and security protocols associated with providing e-HM communications in HM transportation;
- A performance definition for paperless hazard communication that is flexible; permits the use of different technologies (due to the variations in existing systems, across industry, modes, and continually-evolving technologies); and provides the e-HM information in an open, easily transferrable and readable e-data format is developed;
- A standardized defined visual aid (such as a placard) indicating that the HM shipping paper information will be communicated electronically, along with a means to obtain the e-HM information (such as a POC telephone number or website) is visible on the exterior of the transportation conveyance; and
- In areas with known Internet connectivity issues, transportation conveyance operators must have the means to directly provide the e-HM information to local HM inspectors and emergency responders (e.g., print the HM shipping paper information directly from a device in the transportation conveyance, show the HM shipping paper information on a laptop/tablet screen, etc.), and are provided with a backup procedure for obtaining the HM shipping paper information and providing the HM shipping paper information to local HM inspectors and responders.

## 9.2 Recommendations for Additional E-HM Pilot Tests and Research Studies

Any regulatory change allowing for the use of e-systems to communicate HM shipping paper information needs to define the amount of time the shipper/carrier is allowed to provide the e-HM shipping paper information. Section 9.1 recommends the establishment of a "reasonable time interval" for HM inspectors and emergency responders to receive the HM shipping paper information electronically after the initial request. If additional pilot tests are conducted, reasonable time intervals (e.g., within five minutes, as prescribed in DOT-SP 15747) can be tested to determine if the e-HM information can be successfully communicated to HM inspectors and emergency responders within acceptable timeframes.

Considerations also need to be made for allowing the use of e-systems to communicate e-HM shipping paper information in rural areas, inclement weather conditions, and terrain features (such as mountains and valleys) that may present challenges with Internet connectivity, and which can delay or prevent the timely transmittal of e-HM data. Additional pilot tests are recommended to gain further information regarding these potential barriers to e-HM communications.

Based on the findings and information collected under this study, Volpe recommends additional pilot tests to examine the feasibility and effectiveness of the e-system performance-based standards recommended in Section 9.1. The additional tests should expand on the pilot tests already conducted, involve all modes, and utilize a larger diverse set of participants with an extended test period. These tests should include, but not necessarily be limited to:

- Tests (including backup procedures) in rural and geographically-challenged (e.g., low valleys, high mountains, etc.) areas where Internet connectivity challenges may exist;
- Tests (including backup procedures) in areas with known seasonal inclement weather conditions (e.g., heavy rains, blizzards, etc.) where Internet connectivity challenges may exist;
- Tests involving intermodal transfers;
- Tests using an expanded variety of tablets and other electronic devices to transmit and receive e-HM information to inspectors and emergency responders while they conduct HM inspections and emergency response activities;
- Tests involving international HM shipments; and
- Studies involving the integrity and accuracy of HM shipping paper information during the transfer of data between e-systems using different data exchange languages.

## 9.3 Other Recommendations Related to Use of E-systems

Based on the findings and information collected in this study, the following additional recommendations related to the use of e-systems to communicate e-HM shipping information were identified:

- LEIOs looking to use e-systems should ensure their HM inspectors are provided with electronic

devices capable of accessing the e-HM information in a timely manner and in a state that is easily transferrable and readable (such as in, but not limited to, pdf format). Inspectors should receive training on the use of their electronic devices; the process that should be followed for requesting, receiving, and relaying the e-HM data; and the potential benefits and limitations of using e-systems for reviewing HM shipping paper information during HM inspections.

- EROs looking to use e-systems should ensure their emergency responders are provided with electronic devices capable of receiving, reading, and transmitting e-HM information. Emergency responders should be equipped with layered and redundant capabilities to provide an alternate means for obtaining the HM information during situations where Internet connectivity and/or power capabilities are compromised. Emergency responders should receive training on how to use their electronic devices to receive and transmit e-HM information. PSAP personnel should receive training on the look and content of hardcopy and e-HM shipping papers and on HM placarding symbol meanings.
- DOT, EPA, and other agencies should continue to coordinate efforts for developing and implementing e-communications, including EPA's E-Manifest Program.

## 9.4 Other Shipping Paper Considerations Recommended for Future Study

In the process of conducting discussions with HM stakeholders, Volpe obtained additional feedback related to the presentation and types of information the HMR currently requires to be listed on HM shipping papers. Stakeholders, especially those from the emergency response community, stressed the importance of needed changes to these requirements to improve the accessibility of HM information. Although outside the scope of this study, sufficient and consistent feedback was provided such that Volpe recommends a separate study be considered to develop and evaluate the benefits and impacts of creating a standard, uniform format for providing the 49 CFR 172.202 required HM descriptive information on a shipping paper. A standard format would prescribe a specific field for each descriptive element required under the HMR (e.g., Field 1 contains the HM identification number as shown in Column 4 of the 49 CFR 172.101 Hazardous Materials Table; Field 2 displays the HM's proper shipping name; etc.). This standard format could potentially make e-HM transfers between different data exchange languages and electronic data formats work smoother. During this effort, considerations could also be made for potentially inserting additional hazard communication fields recommended by emergency responders and HM inspectors (refer to Appendix C: Information Collected Outside Scope of Report but Related to Project) into a standardized HM shipping paper format. Depending on the determined benefits and impacts, this standard, uniform format could be applicable solely to e-HM shipping papers or to both hardcopy (paper) and e-HM shipping papers. Any resulting standard format could also potentially be added as a component to a pilot test in Section 9.2.

# 10. References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