The National Academies of
SCIENCES • ENGINEERING • MEDICINE

TRB
TRANSPORTATION RESEARCH BOARD

AGENDA

Committee for Safe Transportation of Liquefied Natural Gas by Railroad Tank Car

Meeting 1
Remote meeting via Zoom

Monday, July 20, 2020

OPEN SESSION

10:00 *Welcome and introductions*
Staff and chair introductions — **Craig Philip**, Chair
Cover purpose of meeting and briefly describe study process
Review of statement of task, meeting objectives, and agenda

PHMSA/FRA present study charge and background

10:30 **William Schoonover**, Associate Administrator of Hazardous Materials Safety, PHMSA

10:40 **Mark Maday**, Staff Director, Hazardous Materials Division, Office of Technical Oversight, FRA

10:50 **Yolanda Braxton**, Director, Program Management, Data, and Statics Division, Office of Hazardous Materials Safety, PHMSA

11:00 **Robert Starin**, Division Chief for Risk, Data, and Program Management, Office of Hazardous Materials Safety (Michael Klem, PHMSA and Phani Raj, FRA as support)

11:30 *Open discussion between committee and PHMSA/FRA*

12:30 Adjourn

Safe Transportation of Liquefied Natural Gas by Railroad Tank Car

STATEMENT OF TASK

An ad hoc committee appointed by the National Academies of Sciences, Engineering, and Medicine will review, per request of Congress, current U.S. Department of Transportation (USDOT) plans and activities to inform government and industry decisions about the transportation of liquefied natural gas (LNG) by rail and consider ways to ensure the continued safety of these shipments over the longer-term. The committee's review will be carried out in two phases, each producing a report with findings and recommendations as appropriate.

Phase 1
The committee will review ongoing and planned USDOT efforts, as documented and reported by the Pipeline and Hazardous Materials Administration (PHMSA) and Federal Railroad Administration (FRA), that are intended to inform pending decisions about whether and how bulk shipments of LNG can be safely transported by railroad tank car. The review will focus specifically on the plans and progress of the PHMSA-FRA LNG Task Force, which has developed and begun executing a multi-task program of research, data gathering, analysis, testing, modeling, and risk assessment. Based on the expert judgment of its members, and drawing largely on the Task Force's reports of results, ongoing and planned tasks, and other relevant information, the committee will produce a report with findings on specific tasks and the program overall with regard to quality, completeness, and relevance to the agencies' near-term decision making needs. The committee may make recommendations in this first report that can be acted upon quickly to strengthen the program.

Phase 2
The committee will engage in information-gathering and analysis to conduct an in-depth study of topics relevant to ensuring the safe movement of LNG by rail if allowed by special permit or regulatory authorization. At a minimum, the committee will examine:

- The experience transporting LNG in bulk shipments by other modes, including by water and truck, to identify basic principles applied for safety assurance that can inform measures taken by government and industry to ensure the safe movement of LNG by rail;
- What is known about the effectiveness of special regulatory and industry measures intended to assure the safe transportation of other relevant bulk rail shipments of hazardous materials, especially any routing, speed, and other operational controls applied to high-hazard flammable trains and accompanying enhanced track inspection regimes; and,
- The applicability to bulk rail transportation of LNG of current emergency response plans, protocols, and guides for responding to LNG transportation incidents, such as in PHMSA's Emergency Response Guidebook.

In carrying out its review of these topics, the committee may determine that there are other topics directly relevant to the safe transportation of LNG by rail that warrant examination, and it may elect to do so. Based on findings from the study, the committee will issue a second report containing recommendations as appropriate to Congress, PHMSA, FRA, industry, emergency responders, and other relevant parties on actions, both nearer- and longer-term, that are warranted to improve understanding of the risks associated with transporting LNG by rail, mitigate risks, and prevent and prepare for potential incidents.

Safe Transportation of Liquefied Natural Gas by Railroad Tank Car

Chair

Craig E. Philip (NAE)
Research Professor and Director, VECTOR
Department of Civil and Environmental Engineering
Vanderbilt University

Members

H. Norman Abramson (NAE)
Retired Executive Vice President
Southwest Research Institute

Nii Attoh-Okine
Professor and Interim Academic Director
(Cybersecurity Initiative)
Dept. of Civil & Environmental Engineering
University of Delaware

Amos A. Avidan (NAE)
Retired Senior Vice President
Bechtel Corporation

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Jorge A. Carrasco
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Ambipar Response USA

Anay Luketa
Principal Member of Technical Staff
Sandia National Laboratories

Gregory G. Noll
Principal
GGN Technical Resources, LLC

Dimitris Rizos
Director, Advanced Railway Technology
Group and Associate Professor
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Committee Member Bios
Safe Transportation of Liquefied Natural Gas by Railroad Tank Car

Chair

Craig E. Philip (NAE) is Research Professor and Director of the Vanderbilt Center for Transportation and Operational Resiliency (VECTOR). He spent 30 years with Ingram Barge Company, serving as President and CEO from 1993 to 2014. He began his career at Consolidated Rail Corporation and later served with Southern Pacific Railroad where he was Vice President of their Intermodal Division. His research focuses on the application of systems engineering to complex transport network problems, especially those with uncertain and unpredictable production functions, and organizational responses to these problems in the maritime sector and for multimodal logistics. He has been actively engaged in transportation and logistics industry leadership, serving as chairman of the American Waterways Operators, the National Waterways Conference, and the U.S. Chamber of Commerce's Transportation and Infrastructure Committee. He was a member of TRB's Executive Committee and currently serves on the Marine Board. He served on the TRB Committee for a Study of the Domestic Transportation of Petroleum, Natural Gas, and Ethanol, as well as a reviewer for several TRB special reports including "Modernizing Freight Rail Regulation." He also serves as a U.S. Commissioner of the World Association for Waterborne Transport Infrastructure and on the US. Department of Transportation's first National Freight Advisory Committee. He serves on the boards of the ArcBest Corporation, Red Cross of Tennessee, Nashville Civic Design Center, and Seamen's Church Institute, which presented him with a Lifetime Achievement Award in 2015. In 2010, he was designated a Distinguished Diplomate in the Academy of Coastal, Ocean, Port and Navigation Engineers. He was elected to the National Academy of Engineering in 2014. He earned a B.S. in civil engineering from Princeton and a Ph.D. in civil engineering from the Massachusetts Institute of Technology.

Members

H. Norman Abramson (NAE) is former Executive Vice President of Southwest Research Institute. He is internationally known in the field of theoretical and applied mechanics. His specific area of expertise is in the dynamics of contained liquids in astronautical, nuclear, and marine systems. He began his career as an Associate Professor of Aeronautical Engineering at Texas A&M University and has served as Vice President and Governor of the American Society of Mechanical Engineers and Director of the American Institute of Aeronautics and Astronautics (AIAA). As a member of the National Academy of Engineering (NAE), he served on its council from 1984 to 1990. He has been appointed to many other NAE and National Research Council (NRC) committees, including the Transportation Research Board's (TRB) Research and Technology Coordinating Committee, and Committee on the Federal Transportation R&D Strategic Planning Process, all of which he served as chair. He served as a member of the U.S. Air Force Scientific Advisory Board from 1986 to 1990. He earned a B.S. in mechanical engineering and an M.S. in engineering mechanics from Stanford University and a Ph.D. in engineering mechanics from The University of Texas at Austin.

Nii Attoh-Okine is professor of civil and environmental engineering at the University of Delaware and interim academic director of the university's Cybersecurity Initiative. He is an expert in data analytics as applied to railroad safety and engineering. His research areas include railway engineering and safety, machine intelligence in railway condition data, image and signal processing. He has published extensively in cross-disciplinary areas and authored two books of which, Big Data and Differential Privacy in Railway Track Engineering (Wiley, 2017) introduces researchers and railway track engineers to the emerging areas of the book's title. He holds professional society memberships in the ASCE as the chair of the Committee on Risk and Vulnerability (2011-Present) and on the Committee on Technical Council Computing; as a senior member of the IEEE Institute of Electrical and Electronics Engineers; and as a past member of the TRB committees on Artificial Intelligence (A5008) and Application of Emerging Technology (A2F09). He was a founding associate editor for ASCE/ASME's Journal of Risk and Uncertainty in Engineering Systems, which he still serves. He earned a B.S. in civil engineering from Rostov State Institute of Civil Engineering, Russia and a Ph.D. in Civil and environmental engineering from the University of Kansas

Amos A. Avidan (NAE) is a retired senior energy and construction industry executive with 40 years of experience. He served as Senior Vice President and Manager of Engineering and Technology at Bechtel Corporation. He has led people, technology R&D and engineering, large-scale operations, marketing, and large capital projects teams in Mobil Oil and Bechtel. Amos has maintained an interest in a broad range of fields: from leading people and businesses to expand his expertise in all established and emerging energy systems and technologies, sustainability, impacts of economic growth on society, policy, and global climate change mitigation. He has driven people and organizations to think innovatively and consider the broader implications and consequences of energy systems. He earned a B.S. from Technion-Israel Institute of Technology, an M.S., and a Ph.D. from the City University of New York in chemical engineering.

Christina M. Baxter is the CEO of Emergency Response TIPS, LLC that provides practical, evidence-based solutions for emergency response through the development of next-generation tools for enhanced situational awareness and responder safety and instructional design materials for instructor-led and web-based programs in the areas of CBRNE, hazardous materials, and clandestine laboratory response. Prior to forming Emergency Response TIPS, LLC, Dr. Baxter was the program manager over the CBRNE program at the Department of Defense's Combating Terrorism Technical Support Office where she was responsible for managing domestic and international CBRNE research and development programs to combat terrorism on behalf of the U.S. Government, as well as overseeing the international CBRNE agreements with Australia, Canada, Israel, Singapore, and the United Kingdom. She is the chairperson for the National Fire Protection Association standards for CBRNE personal protective equipment and is a committee member for hazardous materials operations arenas with greater than 20 years of experience. She holds B.S. degrees in chemistry and environmental science from the University of Massachusetts at Amherst and a Ph.D. in analytical chemistry from the Georgia Institute of Technology.

Lisa M. Bendixen is an expert in hazardous materials risk and safety and has addressed risk management, risk assessment, security, and resilience challenges across numerous industries, for fixed facilities as well as transportation systems. She is a vice president at ICF, consulting on critical infrastructure security and resilience, mission assurance, and other risk management issues with the Departments of Defense (DOD), Energy (DOE), and Homeland Security (DHS). She served on the Transportation Security Panel for the National Research Council's (NRC's) report Making the Nation Safer: The Role of Science and Technology in Countering Terrorism and was on the NRC committee that produced the report Terrorism and the Chemical Infrastructure: Protecting People and Reducing Vulnerabilities as well as several other national committees focusing on transportation risks, including spent fuel. She was the project manager and primary author of the Guidelines for Chemical Transportation Risk Analysis, published by the American Institute of Chemical Engineers' Center for Chemical Process Safety, and served on the center's technical steering committee. Her work with DHS has included long-term support on critical infrastructure security and resilience, including several versions of the National Infrastructure Protection Plan, development and implementation of the Chemical Facility Anti-Terrorism Standards, and strategic and policy support to the Office of Infrastructure Protection. She has supported DOE on work related to grid security, from natural hazards and adversarial threats. She is also actively supporting DOD on critical energy and communications infrastructure. She has played leading roles in several safety and risk associations. Ms. Bendixen holds a B.S. in applied mathematics and an M.S. in operations research from the Massachusetts Institute of Technology.

Jorge A. Carrasco is Director of Operations of Ambipar Response USA and has more than 40 years of experience in emergency management. He has been providing hazmat response services and specialized training worldwide in the areas of industrial emergencies, weapons of mass destruction (WMD), and emergency management to clients at the chemical producers, railways, mining companies, ports, governments, and emergency responders in Mexico, Chile, Argentina, Brazil, Peru, Venezuela, Colombia, Spain, Northern Africa, and the United States. He began his career as a Vessel Engineer in the Chilean Merchant Marine before moving into the railroad industry as Safety Operations Manager at the Chili and Bolivia Railway Company, where he specialized in hazardous materials and tank car safety. Afterward, he became Manager of International Hazmat Operations at the Security and Emergency Response Training Center, which is based at the Transportation Technology Center, Inc. in Pueblo, Colorado. Since 2012, he is a principal on the technical committee for the Standard for Competence of Responders to Hazardous Materials/Weapons of Mass Destruction Incidents (NFPA 472), as well as serving on three other National Fire Protection Association technical committees concerned with standards for hazardous materials and WMD response. He earned a diploma in solid-state chemistry at the Massachusetts Institute of Technology.

Anay Luketa is a Principal Member of the Technical Staff of the Fire Science and Technology Department at Sandia National Laboratories. She is currently conducting an evaluation of Computational Fluid Dynamics (CFD) models to predict dispersion and fire hazards for LNG facilities. This evaluation also includes assistance with reviews by PHMSA of hazard modeling

software to comply with the 49 CFR 193. She has provided independent review and analysis of explosion hazards from a natural gas pipeline for the Nuclear Regulatory Commission (NRC) in response to safety concerns identified in the report by NRC Inspector General and evaluated LNG models for fire and dispersion. Her studies of LNG include a safety analysis of large LNG carriers and fire and dispersion analyses of LNG over water. She has also published on models for LNG dispersion about large-scale LNG spills. She earned a B.S. in Mathematics and a B.A. in psychology from Seattle University, an M.S. and a Ph.D. in mechanical engineering from the University of Washington.

Gregory G. Noll is Senior Planning Specialist for the South Central Task Force, a nine-county, all-hazards emergency preparedness organization in southcentral Pennsylvania. He is also the Principal at GGN Technical Resources LLC, a consulting firm specializing in emergency planning, response, and incident management issues. He is the past chair and current member of both the NFPA Technical Committee on Hazardous Materials Response and the InterAgency Board - Training and Exercises SubGroup. He is the recipient of a number of national-level awards, including the 2011 John M. Eversole Lifetime Achievement Award by the International Association of Fire Chiefs (IAFC), which is the highest award given by the IAFC Hazardous Materials Committee. In 2019 he was inducted into the National Fire Heritage Center - Hall of Legends, Leaders and Legacies for his lifetime contributions to the fire service. A Certified Safety Professional and a Certified Emergency Manager, he has been involved in a number of national emergency response initiatives involving hazardous materials and energy products. He earned a B.A. in business administration and management from Kutztown State College and an M.A. in public administration from Iowa State University.

Dimitris Rizos is an Associate Professor and Associate Chair in the Civil and Environmental Engineering Department at the University of South Carolina. His areas of research are in structural mechanics with an emphasis on railway and highway infrastructure, structural dynamics and soil-structure interaction. His current research activities focus on railway structures with emphasis on railway infrastructure monitoring and assessment; railway dynamics; analysis and design of freight, passenger, and high-speed railway structures (bridges, tunnels, and track); and high-performance materials for civilian and military applications. He received a B.S. in civil engineering from the University of Patras, Greece, and an M.S. and a Ph.D. in civil engineering from the University of South Carolina.

William (Bill) C. Shust is an engineering consultant, holding the positon of Mechanical Engineer and Owner of Objective Engineers, Inc., where he performs mechanical testing and analysis for clients in the railroad industry. He has more than 30 years of experience in mechanical and structural engineering and dynamics and has taught courses on vehicle crash testing and mechanical testing and analysis. He has published and presented more than three dozen technical papers in refereed journals and at conferences and authored technical reports for the Association of American Railroads and others. He is active in professional societies such as the American Society of Mechanical Engineers, Society of Automotive Engineers, Society for Experimental Mechanics, and American Railway Engineering and Maintenance of Way Association. He is a registered professional engineer in Colorado and Illinois and earned

bachelor' and master's degrees in mechanical engineering from Michigan Technological University.

Patrick J. Student has more than 40 years of experience with industry regulations governing hazardous materials transportation by rail. Mr. Student currently consults for the Association of American Railroads (AAR) as an editor for the AAR Manual of Standards and Recommended Practices for Interoperable Fuel Tenders for Locomotives, M-1004 Specifications for Fuel Tenders. In 2016, he retired as Director of Hazardous Material and Hazardous Materials Management, Union Pacific Railroad, where he was responsible for interpreting hazardous materials regulations, railroad operating rules for train makeup and powering, and developing systems for compliance with the rules and regulations. While at Union Pacific, he served on the AAR Hazardous Materials Committee, Tank Car Committee, and Electronic Data Interchange Hazardous Materials Technical Advisory Group. He also served on the Next Generation Rail Tank Car Project and Advanced Tank Car Collaborative Research Project. Mr. Student holds a bachelor's degree in chemistry from the University of Missouri at Rolla.