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Professional Profile

Dr. Filippo Gavelli is a Principal Engineer and the Head of the Dispersion Consulting group at GexCon US, Inc. and is responsible for GexCon's LNG safety consulting business worldwide. He specializes in the analysis of heat transfer and fluid flow phenomena, including multiphase flows and cryogenic fluids. He has 14 years of engineering consulting experience and over 20 years of experience in computational fluid dynamics (CFD) modeling, using several research and commercial codes. He applies his expertise to modeling the atmospheric dispersion of hazardous gaseous releases, and has over 12 years of experience with modeling hazard scenarios for Liquefied Natural Gas (LNG) facilities, including vapor cloud dispersion, pool fires and vapor cloud deflagrations; his experience includes more than 50 LNG installations worldwide, including onshore, offshore and floating (FLNG) facilities for LNG import, export (liquefaction), peakshaving, truck loading and bunkering. He was the lead in the model validation effort that led to FLACS' approval by the U.S. Department of Transportation under 49 CFR 193 and is the project manager for numerous DOT-jurisdictional LNG facility hazard analyses.

Dr. Gavelli is part of technical committees for the development and update of various safety standards – specifically, NFPA 59A (the standard for land-based LNG facilities) and NFPA 2 (the standard for hydrogen technologies). He is also involved in the review and development of safety standards in different countries.

Dr. Gavelli is the lead author of numerous gas dispersion and explosion safety-related papers and has been a regular contributor to LNG-related technical committees and expert panels for several years. He is a member of the GexCon docents group, which develops and delivers safety seminars to facility owners and operators, safety engineers, and regulatory agencies, on the hazards associated with gas explosions, dust explosions and LNG. Dr. Gavelli is also responsible for software technical support and training for FLACS customers in North America and has provided training to numerous users, including staff from regulatory and government agencies.

Dr. Gavelli is responsible for GexCon US' dispersion modeling activities, which include risk assessments and consequence modeling for chemical and petrochemical facilities, offshore installations, hazardous materials transportation and various other applications. Dr. Gavelli's work has also been applied to accident investigations and in the forensic arena.

Dr. Gavelli also applies his expertise to the investigation of fires and explosions. He investigated numerous residential fires involving electrically powered consumer products, as well as fires involving all major modes of transportation. He also has performed several studies modeling fires in buildings as well as outdoors, for the purpose of evaluating fire growth, temperature distribution, and the spread of smoke, toxic gases and particulates.

Prior to his consulting career, Dr. Gavelli held a faculty position in the Department of Mechanical Engineering at the Catholic University of America, where he was primarily responsible for teaching undergraduate and graduate level courses in fluid mechanics, heat transfer, computational fluid dynamics and related topics. His doctoral and post-doctoral research focused on the study of multiphase flows in Pressurized Water Reactors during a Loss-Of-Coolant-Accident (LOCA) and the modeling and analysis of

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turbulent flows in complex geometries. He developed and performed experimental campaigns to examine boiling and rapid condensation phenomena in nuclear reactor piping and to perform high-resolution measurements of fluid mixing in the reactor downcomer.

Academic Credentials

Ph.D., Mechanical Engineering, University of Maryland, College Park (USA), 1997

B.S., Nuclear Engineering (cum laude), University of Bologna (Italy), 1993

Licenses and Certifications

Licensed Professional Engineer, Maryland (USA)

Licensed Professional Engineer, Italy

Certified Fire and Explosion Investigator (CFEI) in accordance with the National Association of Fire Investigators (NAFI) National Certification Board per NFPA 921 Section 11.6.4

Fire Investigation 1A Certification accredited by the California State Fire Marshal

Professional Affiliations

Member, NFPA Technical Committee on Liquefied Natural Gas, responsible for NFPA 59A (*Standard for the Production, Storage and Handling of Liquefied Natural Gas*)

Member, NFPA Technical Committee on Hydrogen Technologies, responsible for NFPA 2 (*Hydrogen Technologies Code*)

Languages

Italian (native); English

Publications

Hendrickson, B., Marsegan, C. & Gavelli, F. (2015). Where to begin – A parametric study for vapor barriers at LNG export facilities. 2015 Mary Kay O'Connor Process Safety Center International Symposium, College Station, Texas, 27-29 October 2015: 1038-1062.

Gavelli, F., Marsegan, C. & Hendrickson, B. (2015). CFD modelling of LNG pool fires. 2015 AIChE Spring National Meeting, Austin, Texas

Gavelli, F., Botwinick, D. & Davis, S. (2014). CFD-based QRA of an LNG liquefaction facility. 2014 Mary Kay O'Connor Process Safety Center International Symposium, College Station, Texas, 28-30 October 2014: 968-979.

Gavelli, F. & Marsegan, C. (2014). Advanced modelling for cryogenic spill risk assessments of Floating LNG. 2014 AIChE Spring National Meeting, 30 March-3 April 2014, New Orleans, Louisiana

Wilson, J., Ransome, A. & Gavelli, F. (2014). Design considerations for Small-Scale LNG facilities. 2014 AIChE Spring National Meeting, 30 March-3 April 2014, New Orleans, Louisiana

Hansen, O.R, Davis, S.G., Gavelli, F. & Middha, P. (2013). Onshore explosion studies - benefits of CFD-modelling. Fourteenth International Symposium on Loss Prevention and Safety Promotion in the Process Industries, 12-15 May 2013, Florence, Italy. Chemical Engineering Transactions, 31: 205-210

Chosnek, J., Gavelli, F. & Edwards, V. (2013). HSE evolution in conversion of LNG import terminals to export. 2013 AIChE Spring National Meeting, 28 April-2 May 2013, San Antonio, Texas

Gavelli, F. & Davis, S.G. (2013). The mitigation conundrum: when reducing one hazard may increase another. 2013 AIChE Spring National Meeting, 28 April-2 May 2013, San Antonio, Texas

- Davis, S.G., Martini, R. & Gavelli, F. (2013). CFD-based probabilistic explosion hazard analysis as an early tool to improve FLNG design. 2013 AIChE Spring National Meeting, 28 April-2 May 2013, San Antonio, Texas
- Hansen, O.R., Gavelli, F., Davis, S.G. & Middha, P. (2013). Equivalent cloud methods used for explosion risk and consequence studies. *Journal of Loss Prevention in the Process Industries*, 26: 511-527
- Gavelli, F., Hinze, P.C. & Davis, S.G. (2012). CFD analysis of the accumulation and deflagration of a flammable gas release in a closed environment. Fifth International Symposium on Fire Investigation Science and Technology (ISFI 2012). University of Maryland, USA, 15-17 October 2012: 253-264.
- Geiser, J., Davis, S.G. & Gavelli, F. (2012). Carbon monoxide accumulation from sidewall vents in screened enclosures. Fifth International Symposium on Fire Investigation Science and Technology (ISFI 2012). University of Maryland, USA, 15-17 October 2012: 273-284.
- Davis, S.G., van Wingerden, K., Hinze, P.C., Hansen, O.R. & Gavelli, F. (2012). Dust explosions: Case study of dryer explosions and poor explosion vent design. 8th Global Congress on Process Safety, 1-4 April 2012, Houston, Texas
- Ichard, M. & Gavelli, F. (2012). CFD Simulation of the Falcon Tests Using the Homogeneous Equilibrium Model in FLACS. 2012 AIChE Spring National Meeting, 1-4 April 2012, Houston, Texas
- Hansen, O.R., Davis, S.G., Gavelli, F. & Richardson, J (2012). Benefits of CFD for Onshore Facilities. 8th Global Congress on Process Safety, 1-4 April 2012, Houston, Texas
- Gavelli, F, Davis, SG, Hansen, OR. (2011) Evaluating the Potential for Overpressures from the Ignition of an LNG Vapor Cloud during Offloading, *J Loss Prev Proc Ind*, 24(6): 908-915, 2011
- Gavelli, F., Davis, S.G., Ichard, M. & Hansen, O.R., CFD simulation of gas dispersion from large-scale toxic chemical releases in complex environments (2011), 14th Mary Kay O'Connor Process Safety Center International Symposium, 2011: 132-148
- Bratteteig, A., Hansen, O.R., Gavelli, F. & Davis, S.G. (2011). Using CFD to analyze gas detector placement in process facilities. 2011 Mary Kay O'Connor Process Safety Center, International Symposium, College Station, Texas, 25-27 October 2011: 735-753.
- Hansen, O.R., Gavelli, F., Davis, S.G. & Middha, P. (2011), Equivalent cloud methods used for explosion risk and consequence studies, 14th Mary Kay O'Connor Process Safety Center International Symposium, 2011:78-106
- Gavelli, F, Davis, S.G., Hinze, P. & Hansen, O.R. (2011), CFD modeling of hydrogen releases and explosions, 7th Global Congress on Process Safety, AIChE 2011 Spring Meeting,
- Ichard, M., Hansen, O.R., Middha, P., Royle, M., Willoughby, D. & Gavelli, F. (2011). CFD computations of liquid hydrogen releases. Fourth International Conference on Hydrogen Safety, San Francisco, California, 12-14 September 2011
- Hansen, O. R.; Davis, S. G. & Gavelli, F. Use of CFD in onshore facility explosion siting studies *Hazards XII*, 2011, IChemE Symposium Series No. 156: 20-27
- Hansen, OR, Gavelli, F, Ichard, M, Davis, SG, Validation of FLACS against experimental data sets from the model evaluation database for LNG vapor dispersion, *J Loss Prev Proc Ind*, 23:867-877, 2010.
- Gavelli, F, Computational fluid dynamics simulation of fog clouds due to ambient air vaporizers, *J Loss Prev Proc Ind*, 23(6): 773-780, 2010.
- Hansen, OR, Gavelli, F, Abiven, R, Xian-Sheng, S, Huan, L, LNG safety study using FLACS CFD-tool. Proceedings, 3rd World Conference on Safety of Oil and Gas Industry (WCOGI 2010), Beijing, China, Sept. 26-27, 2010.

- Davis, SG, Engel, D, Gavelli, F, Hinze, PC, Hansen, OR. Advanced Methods for Determining the Origin of Vapor Cloud Explosions Case Study: 2006 Danvers Explosion Investigation. Proceedings, International Symposium on Fire Investigation Science and Technology, Hyattsville, MD, 2010.
- Gavelli, F, Davis, SG, Hansen, OR. A Modern Tool for the Investigation of Indoor Flammable Gas Migration. Proceedings, International Symposium on Fire Investigation Science and Technology, Hyattsville, MD, 2010.
- Gavelli, F, Chernovsky, M, Bullister E, Kytomaa H, Modeling of LNG spills into trenches, J Hazard Mat 2010; 180(1-3):332-339.
- Gavelli, F, Davis, SG, Hansen, OR, A Unified Model for LNG Pool Spread and Vapor Dispersion: Is Wind Scooping Really A Factor?, AIChE Spring National Meeting, 2010.
- Gavelli, F, Davis, SG, Hansen, OR, Ichard, M, CFD Simulation of Vapor Dispersion from LNG Jetting and Flashing Releases, AIChE Spring National Meeting, 2010.
- Gavelli, F, Computational Fluid Dynamics Simulation of Fog Clouds due to Ambient Air Vaporizers, Proceedings of 2009 Mary Kay O'Connor Process Safety Center International Symposium.
- Gavelli F, Chernovsky, M, Kytomaa H. Quantification of Source-Level Turbulence during LNG Spills onto a Water Pond. J Loss Prev Proc Ind, 2009; 22(6):809-819
- Gavelli F, Liquefied Natural Gas explosion hazards: are they real? Hydrocarbon World, 2009; 4(1).
- Ponchaut, N, Chernovsky MK, Gavelli F, Kytomaa H. Modeling the spreading of large LNG spills on water. AIChE Spring National Meeting, 2009.
- Gavelli F, Chernovsky MK, Kytomaa H. Modeling pool fire hazards from large-scale LNG spills. Explor Prod Mag 2008; 6(2).
- Gavelli F, Bullister E, Kytomaa H. Applications of CFD to LNG spills into geometrically complex environments. J Hazard Mat 2008; 159:158–168. Also in : Proceedings, 2006 Mary Kay O'Connor Process Safety Center International Symposium, pp. 468–485.
- Gavelli, F., Large Eddy Simulation of LNG vapor dispersion, Proceedings, 26th UIT National Heat Transfer Conference, Palermo, Italy, June 2008.
- Kytomaa H, Chernovsky MK, Gavelli F. A new experimental study on the spreading of liquefied nitrogen over water. Proceedings, 2008 Offshore Technology Conference, May 2008.
- Gavelli F, Chernovsky MK, Kytomaa H. LNG pool fire models: Similarities and differences. Proceedings of the 2008 AIChE Spring National Meeting, April 2008.
- Gavelli F, Kytomaa H. Liquefied Natural Gas transportation. Proceedings, Marine Safety & Security Council, the Coast Guard Journal of Safety at Sea, Fall 2005; 62(3):33–36.
- Kytomaa H, Gavelli F Studies of LNG spills over water point up need for improvement. Oil and Gas Journal, May 9, 2005.
- Gavelli F, Clarke C, Tsuji J, Long RT. Fire and toxicity aspects of polyurethane foams. Proceedings, Polyurethane Foam Association Spring Meeting and Technical Program, Washington, DC, 2005.
- Gavelli F, Foulds J, Sire R, Kytomaa H. Root cause analysis of a gas turbine compressor stator blade failure. ASME Power Conference, Chicago, IL, 2005.
- Gavelli F, Kiger KT. Boron mixing in complex geometries: Flow structure details. Nuclear Engineering and Design 2001; 208:67–85.
- Kiger KT, Gavelli F. Optical measurements of boron dilution transients in the downcomer of a pressurized water reactor. 19th Nat. Conference on Heat Transfer (UIT), Modena, Italy, 2001.

- Muscio A, Tartarini P, Gavelli F. Measurement of the thermal diffusivity of thin slab specimens by the lock-in heating-cooling method. 19th Nat. Conference on Heat Transfer (UIT), Modena, Italy, 2001.
- Muscio A, Gavelli F, Tartarini P. Numerical simulation of the cooling effect of multiple droplets on a hot solid surface. International Conference on Multiphase Flows, New Orleans, LA, 2001.
- Kiger KT, Gavelli F. Boron mixing experiments using a laser induced fluorescence technique. Nuclear Engineering and Design 2000; 195:13–25.
- Muscio A, Tartarini P, Gavelli F. On-site measurement of thermal diffusivity by infrared thermography and thermoelectric equipment. 18th National Conference on Heat Transfer (UIT), Torino, Italy, 2000.
- Boyd C, Gavelli F, Kiger KT. CFD predictions and experimental data for downcomer mixing of an infinite slug in a rapid boron dilution transient. 8th International Conference on Nuclear Engineering (ICONE-8), Baltimore, MD, 2000.
- Gavelli F, Ruffino P, Anderson G, diMarzo M. Evaporative cooling and thermal fire detectors response. 17th National Conference on Heat Transfer (UIT), Ferrara, Italy, 1999.
- Gavelli F, diMarzo M. Effect of condensing surface on the pressurization rate of a PWR during HPI refilling. 16th National Conference on Heat Transfer (UIT), Siena, Italy, 1998.
- Gavelli F, diMarzo M. Effects of a geometric discontinuity on the mixing of a pumped liquid volume in PWR geometry. 6th Int'l Conference on Nuclear Engineering (ICONE-6), San Diego, CA, 1998.
- Gavelli F, diMarzo M, Almenas K. Resumption of natural circulation during post-BCM refilling in a B&W raised-loop PWR. National Heat Transfer Conference, Baltimore, MD, 1997.
- Almenas K, diMarzo M, Gavrilas M, Tafreshi A, Gavelli F. Scaling of thermally differentiated flows in primary system flow geometries. National Heat Transfer Conference, Baltimore, MD, 1997.
- Tartarini P, Gavelli F, Lorenzini G. Numerical analysis of air pressure waves in railroad tunnels. *Tecnica Italiana* 1994; 94(3):183–193 (in Italian).

Selected Invited Presentations and Courses

- Gavelli, F, Convery, MP, Review of the NFPA 59A Standard for the Production, Storage and Handling of Liquefied Natural Gas. Course offered in Beijing, China (2015)
- Gavelli, F, Davis, SG, Gas Explosion Hazards for LNG Facilities, an Advanced Course. Course offered in: Doha, Qatar (2011, 2012 and 2013); Seoul, Korea, (2012 and 2013); Vaasa, Finland (2012); Kuala Lumpur, Malaysia (2012); Beijing, China (2013); College Station, Texas (2014); Rugby, England (2014).
- Davis, SG, Gavelli, F, Hansen, OR, van Wingerden, K, Rogstadkjernet, L. Gas Explosion Hazards on Offshore Facilities, an Advanced Course. Course offered in: College Station, TX (2010 and 2011).
- Gavelli, F., Advanced tools to improve FLNG design through probabilistic explosion hazard analyses, Presented at FLNG Africa Summit, Accra, Ghana, June 4-5, 2014.
- Gavelli, F. Application of numerical simulation models to explosion investigations. Presented at the University of Trieste, Italy, May 6, 2010.
- Gavelli, F. LNG receiving terminals: separating the truth from myths. Presented at the University of Trieste, Italy, March 25, 2009.
- Gavelli, F. LNG Fire and Vapor Dispersion Hazards. Presented at the workshop “Liquefied Natural Gas Maritime Transportation – Practices and Developments”, Quebec City, Canada, June 4, 2008.
- Gavelli F. Engineering consulting and forensic applications of CFD models. Presented at the University of Trieste, Italy, September 13, 2007.

Gavelli F. New developments in LNG vapor dispersion modeling. Presented at LNG Safety Workshop, LNG Tech Global Summit 2007, Rotterdam, Netherlands, Sep.10, 2007.

Gavelli F. Evaluating risk and damages in fire protection engineering. Presented at 2007 National Fire Protection Day, University of Modena, Italy, June 26, 2007.

Gavelli F. Applications of the fluent model to LNG spills over water. Presented at GTI seminar on LNG Safety: The Status of Computational Fluid Dynamic (CFD) Models for LNG Exclusion Zones, Houston, TX, September 13, 2006.

Gavelli F, Clarke C. Fire and toxicity aspects of polyurethane foams. Presented at 2005 Polyurethane Foam Association Spring Meeting and Technical Program, Washington, DC, May 2005.

Selected Technical Reports

Metz, D.F. et al. Analysis of the Jack Rabbit Field Trials – Modeling Source Term Analysis and Development for Large-Scale Toxic Chemical Transport Releases. Dept. of Homeland Security, Chemical Security Analysis Center, 2012.

Gavelli, F. Sidewall venting into screened enclosures. Fire Protection Research Foundation, 2012.

Gavelli F, Ruffino P, Anderson G, diMarzo M. The effect of minute water droplets on a simulated sprinkler link thermal response. NIST GCR 99-776, 1999.

Prior Experience

Senior Manager, Thermal Sciences practice, Exponent Failure Analysis Associates, Bowie, MD (2002-2009)

Assistant Professor, Department of Mechanical Engineering, The Catholic University of America, Washington, DC (1999-2002)

Lecturer, Department of Mechanical Engineering, The Catholic University of America, Washington, DC (1997-1999)

Research Associate, Department of Mechanical Engineering, University of Maryland, College Park, MD (1997-1999)

Peer Reviewer

Reviewer for Journal of Hazardous Materials, Journal of Loss Prevention in the Process Industry and Journal of Atmospheric Environment, Journal of Industrial and Chemical Engineering.