



TERRATHERM

151 Suffolk Lane
Gardner, MA 01440
Phone: (978) 730-1200
Fax: (978) 632-3422

jgalligan@terraetherm.com
www.terraetherm.com

JAMES P. GALLIGAN, P.E.

Chief Operating Officer

PROFESSIONAL HISTORY

TerraTherm, Inc.	2000 – present
ENSR Consulting and Engineering	1994-2000
Coneco Environmental Corporation	1991-1994
ANEPTEK Corporation	1989-1991

EDUCATION

M.B.A. Northeastern University, 2011
B.S. Mechanical Engineering, Boston University, 1991

REGISTRATIONS AND TRAINING

Professional Engineer: Massachusetts, Colorado, Tennessee
40-Hour OSHA HAZWOPER & HAZWOPER Supervisor w/current 8-Hour Annual Refresher
National Fire Fighter I/II (NFPA 1001) Operational Certification
First Responder & IAFF Haz-Mat First Responder Certifications
Electrical Power System Design Training; NFPA 70E Electrical Safety Training

SUMMARY OF EXPERIENCE

Mr. Galligan has over 25 years experience with in-situ and ex-situ remediation system design, installation, operation and troubleshooting, including over 15 years' experience with designing, installing and operating in-situ thermal treatment projects. He has conducted numerous remedial technology pilot tests, feasibility studies and life-cycle cost evaluations. In addition, Mr. Galligan has managed dozens of remediation projects from design and bidding through construction, start-up and operation. He also has extensive experience in cost estimating and health and safety management and has led both of these functions for TerraTherm.

TerraTherm, Inc., Gardner, MA. Chief Operating Officer (2000 – present)

Mr. Galligan has been with TerraTherm since the company was founded in February 2000, serving as Lead Engineer, Engineering Manager, VP of Engineering, VP of Projects and now Chief Operating Officer. He has been involved in a technical or management capacity in nearly every project implemented by TerraTherm. As COO, Mr. Galligan leads the company's team of Project Managers, the Project Supply Department (including the procurement department and fabrication shop), the Field Services Department, including all of TerraTherm's field construction

and operation staff, and the Safety department. In his current role, Mr. Galligan is responsible for ensuring that projects are successfully completed from a technical, economic and safety standpoint and for directing the project management, field service and project supply teams to ensure that projects are provided with the necessary personnel, material and equipment resources. He also leads several important corporate initiatives aimed at improving TerraTherm's service delivery. In his prior roles as Engineering Manager and VP of Engineering, Mr. Galligan was responsible for building and directing TerraTherm's staff of engineers and technicians for over a decade from the time of the company's founding to an eventual group of over 15 individuals. For many years, Mr. Galligan had overall responsibility for TerraTherm's engineering and design work, including selection of materials and methods, review of design work products and specification/selection of company-owned capital equipment. In addition, Mr. Galligan is co-developer of 2 patents related to thermal remediation.

SELECTED PROJECTS

- Danang, Vietnam – Project manager for large-scale, multi-year implementation of in-pile thermal desorption (IPTD) to remediate approximately 90,000 m³ of dioxin and herbicide impacted soil and sediment from historic use and storage of Agent Orange at a former US military base in Danang, Vietnam. Successfully constructed and treated this high-profile, first-of-its-kind IPTD system to achieve very stringent dioxin clean up levels. Design: 2012-2013; Phase 1 Implementation 2013–2015, Phase 2 implementation 2016-2017; Project value: \$36.8MM.
- Solvent Recovery Systems of New England (SRSNE) Superfund Site – Southington, CT – Served in a variety of roles from senior engineering support to principal-in-charge for this multi-year design-build-operate remediation project, where thermal conduction heating (TCH) was used to remediate a major source of chlorinated solvent DNAPL and miscellaneous hydrocarbon constituents in overburden soil. Successfully treated and achieved cleanup criteria, removing over 400,000 pounds of contaminant mass. Project duration: Design: 2009/2012; Implementation 2013/2015; Project value: \$9.8MM.
- Arnold AFB, Tennessee – Project Manager and lead engineer for design and implementation utilizing a combination of thermal conduction heating (TCH) and steam enhanced extraction (SEE) to remediate a highly contaminated source zone consisting of PCE DNAPL and other chlorinated solvents to a depth of 90 ft bgs. TCH was used to remediate a low permeability zone from 15 to 75 ft bgs, and steam enhanced extraction was used to remediate a high permeability zone above the bedrock to a depth of approximately 90 ft bgs. Over 160,000 pounds of chlorinated solvent contaminants were removed during the thermal remediation program. Design: 2009/2010; Implementation 2010/2011; Project value: \$7.4MM.
- Former Manufacturing Site, Danville, PA – Provided senior engineering support for a Steam Enhanced Extraction (SEE) system for the remediation of 68,000 cy of soil containing hydrocarbon LNAPL and CVOCs. Treatment depth to 42 feet, with dual level steam injection intervals. Project was performed in partnership with a local remedial contractor who provided drilling services, as well as vapor and groundwater extraction. Post-thermal groundwater results achieved site closure. Project duration: November 2006 to May 2009. Total TerraTherm project value: \$2.7M

- Memphis Depot – Memphis, TN – Provided senior engineering support for a full-scale ISTD treatment system at a former Department of Defense (Defense Logistics Agency) storage facility to treat CVOC contaminated soils. Treatment depth to 30 feet. 48,000 cubic yards. Project Duration: October 2007 to April 2009. Total project value: \$3.5M
- Confidential Client, Sao Paulo, Brazil – Oversaw ISTD “micro-pilot” demonstration test at a former industrial/chemical landfill in Sao Paulo, Brazil. Contaminants included a wide range of CVOCs, aliphatic and aromatic hydrocarbons and heavy-end hydrocarbons present as LNAPLs and DNAPLs. Oversaw development of detailed design work plans, equipment specifications and pilot implementation. Project value: \$350K, 2009.
- Krüger, Various Sites, Denmark – Engineering support for ongoing pilot-scale and full-scale projects treating CVOCs in saturated and unsaturated silty/clay soils using thermal conduction heating (TCH) and steam enhanced extraction (SEE). Treatment depths to >40 ft. Project Duration: Fall 2005 to Present.
- U.K. Atomic Energy Authority, Harwell, U.K. – Primary technical contact and engineering support for multi-year project to treat CVOCs in saturated and unsaturated chalk bedrock underlying former waste disposal pits. Worked with partners in the UK for seven seasonal treatment phases. Treatment depth to ~65 ft. Project Duration: August 2005 to 2011.
- Pioneer Companies, Syracuse, NY – Provided senior engineering support for a full scale ISTD system for the remediation of 16,200 cy of soil containing CVOCs. Site soils consisted of low-permeability silts and clays located below the water table. TerraTherm installed and operated over 200 ISTD wells to a treatment depth to 30 feet. Achieved all remedial goals. Project duration: July 2006 to August 2007. Total project value: \$2.6M.
- NASA Marshall Space Flight Center, Huntsville, AL – Project engineer for an ISTD Pilot Test to treat 1,000 cy of TCE contaminated soils. Soils consisted of clay over rubble over limestone. Treatment depth to 37 feet, with TCH wells extending into the underlying bedrock. Pilot test utilized condensing system to remove CVOCs from the subsurface and a high-vacuum multi-phase extraction (MPE) system for groundwater control. The project achieved all remedial goals. Project Duration: September 2006 to May 2007. Total project value \$650K.
- Confidential Client, Taunton, MA – Provided senior engineering support for ISTD remediation of a former drum disposal area contaminated with chlorobenzenes, BTEX, and CVOCs, including a significant amount of tarry DNAPL. Total volume of treatment zone was ~3,000 cy to 20 ft depth. Achieved client’s remedial goals of mass reduction in the treatment zone and thermally enhanced biodegradation in downgradient zone. Period of performance: April 2006 to January 2007. Total project value: \$1.2M
- Confidential Client, SE US – Project engineer for remediation of former solvent tank area contaminated with CVOCs (TCE) using ISTD. ISTD heaters extended to a depth of 95 ft through weathered saprolite rock and approximately 10 ft into the underlying competent bedrock. Total treatment volume 9,000 cy. Met all clean-up goals: TCE ≤ 0.6 mg/kg. Period of performance: July 2006 – June 2007. Total project value: \$1.3M

- National Grid USA, North Adams, MA – Provided senior engineering support for design and implementation of ISTD treatment of coal tar-contaminated soil and tarry DNAPL wastes located in a former gasholder at a former Manufactured Gas Plant (MGP). Treatment depth to 18 feet. The project included an initial dewatering and thermally enhanced free-product recovery phase, follow by high temperature ISTD treatment, with extracted vapors treated by thermal oxidation. Achieved all remedial goals. Project Duration: October 2003 to May 2005. Total project value: \$850K
- Richmond Redevelopment Agency, Richmond, CA – Provided senior engineering support for remediation of former tank farm area contaminated with CVOCs (TCE, PCE, DCE, DCA, VC) using ISTD. Total volume of treatment zone was 7,000 cy to 20 ft depth in saturated Bay Mud clays. Successfully achieved clean-up goals, allowing planned residential re-development of property to proceed. Period of performance: January 2005 – November 2005. Total project value: \$2M
- Confidential Client CVOC Site, Carson, CA – Project engineer for implementation of ISTD system for remediation of 6,700 cy of soil containing 1,1-DCA, where cold MPE system had failed to achieve cleanup goals. Site soils consisted of low-permeability, dense clays located above and below the water table to a depth of ~37 ft. The ISTD system was installed within the operating MPE system that had reached asymptotic removal limits. Clean up objectives included attaining 1 mg/kg of 1,1-DCA in soil within treatment zone and reducing concentrations in groundwater in the underlying permeable aquifer. Remedial goals were met, and COCs have been below detection limits in subsequent groundwater sampling events. Project duration: November 2003 to June 2005. Total project value: \$1M
- Confidential Client CVOC Site, Midwest US - Project engineer for an ISTD system for remediation of 11,500 cy of TCE, 1,1,1-TCA, and PCE impacted soil. Site soils consisted of low-permeability, dense clays that were partially to fully saturated with water. Achieved clean up objectives of less than 1 mg/kg of TCE in soil within treatment zone. Project duration: September 2002 to December 2003. Total project value: \$1.4M
- Southern California Edison (SCE), Alhambra, CA – Senior engineering support for a design/build/operate ISTD system at a former wood-treating plant contaminated with creosote, diesel, pentachlorophenol (PCP) and dioxin. Successfully remediated 16,500 cy of soil in 2 treatment phases to achieve stringent clean-up goals. Site received “No further action” letter from CA DTSC after remediation, clearing the site for unrestricted use. Treatment depth to 105 feet. Project Duration: November 2002 to March 2006. Total project value: \$13.7M

ENSR Corporation, Acton, MA. Senior Project Engineer/Project Engineer (1994-2000)

- Designed and implemented over 35 soil and groundwater remediation systems for industrial, military and petroleum sites throughout the eastern and mid-western U.S. Remediation technologies included multi-phase extraction, air sparging, soil vapor extraction, bioventing, bioslurping and groundwater extraction coupled with a variety of above-ground treatment technologies.

- Managed various remediation projects from conceptual design through construction and start-up. Selected and procured equipment and managed construction subcontractors to ensure that projects were completed on-time and on-budget.
- Provided hands-on engineering and construction support for remediation projects. Diagnosed and repaired mechanical, electrical and operational problems with operating remediation systems. Recommended adjustments and modifications as needed to optimize system performance and reduce life-cycle costs.
- Acted as the process/mechanical engineer for preparation of an Engineer Manual on multi-phase extraction technology (*U.S. Army Corps of Engineers, Multi-Phase Extraction Engineer Manual [EM1110-1-4010]*). Responsible for authoring sections on piping and above-ground components, including sections on design and selection of piping, valves, manifolds, blowers, pumps, motors, oil-water and multi-phase separators. Also authored sections on electrical power requirements, electrostatic charge hazards, instrumentation and process control systems, waste treatment alternatives, and design documentation requirements.
- Responsible for mentoring and training junior engineers, presenting “brown bag” seminars on a variety of topics for in-house technical staff, and acting as in-house resource for information on *in-situ* thermal remediation technologies.

OTHER PROFESSIONAL EXPERIENCE

- ***Town of Medway - Fire Department, 2000-2014***
Call Firefighter
- ***US Army Reserve/Massachusetts Army National Guard, 1992-1998***
Sergeant (E-5), Infantry, Team Leader

SELECTED PUBLICATIONS

Thompson, B.R., Hunt, J., Gefell, M., LaChance, J., Kueper, B.H., Heron, G., Galligan, J. and Swift, R. “In-Situ Thermal Remediation at a Major Multi-PRP CERCLA Site – Establishing Clean Up Levels, Design, and Implementation.” *Remediation of Chlorinated and Recalcitrant Compounds-2014*. Proceedings of the Ninth International Conference on Remediation of Chlorinated and Recalcitrant Compounds (Monterey, CA; May 2014) Battelle Memorial Institute, Columbus, OH (in press).

Galligan, J., D. Rentschler, G. Crisp and G. Heron. 2012. “Treatment of Vapors from In Situ Thermal Remediation: Selecting the Best Option and Operating it Properly.” Submitted to *Remediation of Chlorinated and Recalcitrant Compounds-2012*. Proceedings of the Eight International Conference on Remediation of Chlorinated and Recalcitrant Compounds (Monterey, CA; May 2012) Battelle Memorial Institute, Columbus, OH.

Griepke, N., S., P.J. Jensen, G. Heron, J. LaChance, J. Galligan, N. Plough and P. Johansen. 2012. “Soil Sampling During and After Thermal Remediation: How and When?” Paper 920, In: *Remediation of Chlorinated and Recalcitrant Compounds – 2012*. Eighth International Conference on Remediation of Chlorinated and Recalcitrant Compounds (Monterey, CA; May 2012). Battelle Memorial Institute, Columbus, OH.

Heron, G., K. Parker, J. Galligan, T.C. Holmes. "Thermal Treatment of Eight CVOC Source Zones to Near Non-Detect Concentrations." 2009. *Groundwater Monitoring & Remediation*. National Groundwater Association. Vol. 29, Issue 3, Summer 2009. pp. 56-65.

Baker, R.S., J.M. Bierschenk, J. LaChance, J.P. Galligan, D. Tarmasiewicz, G. Heron and W.R. Leach. 2008. Why In Situ Thermal Desorption Can Be the Most Cost-Effective Remediation Method for Many Sites. Paper N-003, in: Bruce M. Sass (Conference Chair), *Remediation of Chlorinated and Recalcitrant Compounds—2008*. Proceedings of the Sixth International Conference on Remediation of Chlorinated and Recalcitrant Compounds (Monterey, CA; May 2008). Battelle Press, Columbus, OH.

Bierschenk, J.M., J. LaChance, J. Galligan, G. Heron, D. Tully, A.-M. Kozłowska and S. Langford. 2008. Thermally Enhanced Soil Vapor Extraction Closing DNAPL Sites - Case Studies. Paper P-012, in: Bruce M. Sass (Conference Chair), *Remediation of Chlorinated and Recalcitrant Compounds—2008*. Proceedings of the Sixth International Conference on Remediation of Chlorinated and Recalcitrant Compounds (Monterey, CA; May 2008). Battelle Press, Columbus, OH.

LaChance, J.C., R.S. Baker, J.P. Galligan, and J.M. Bierschenk. 2004. "Application of 'Thermal Conductive Heating/In-Situ Thermal Desorption (ISTD)' to the Remediation of Chlorinated Volatile Organic Compounds in Saturated and Unsaturated Settings." Submitted to *4th Int. Conf. on Remediation of Chlorinated and Recalcitrant Compounds, Monterey, CA, May 2004*.

LaChance, J.C., R.S. Baker, J.P. Galligan, and J.M. Bierschenk. 2004. "Application of 'Thermal Conductive Heating/In-Situ Thermal Desorption (ISTD)' to the Remediation of Chlorinated Volatile Organic Compounds in Saturated and Unsaturated Settings." *Proceedings of Gas Technology Institute's Natural Gas Technologies II Conference*, Phoenix, AZ, Feb. 8, 2004.

Baker, R.S., J.C. LaChance, M.W. Kresge, R.J. Bukowski, J.P. Galligan and M. Kuhlman. 2004. "In-Situ Thermal Destruction (ISTD) of MGP Waste in a Former Gasholder: Design and Installation." *Proceedings of Gas Technology Institute's Natural Gas Technologies II Conference*, Phoenix, AZ, Feb. 8, 2004.

Baker, R.S., J.P. Galligan and J.M. Bierschenk. 2004. "In-Situ Thermal Destruction (ISTD) at Rocky Mountain Arsenal Hex Pit" Vendor Report In: Superfund Innovative Technology Evaluation (SITE) Program, *Field Evaluation of TerraTherm In Situ Thermal Destruction Treatment of Hexachlorocyclopentadiene: Final Report*. at the Hex Pit, Rocky Mountain Arsenal, Commerce City, CO. Prepared for: U.S. Environmental Protection Agency, Office of Research and Development, National Risk Management Research Laboratory Cincinnati, Ohio, Prepared by: Tetra Tech EM, Inc., Cincinnati, OH, EPA Contract No. 68-C-00-181, Task Order No. 0019.