

FGI Webinar: Part 1: Sub-Surface Elevated Temperature (SET) Events in Landfills



Presented by:

Todd Thalhamer (President, Hammer Consulting Services; Former Fire Lieutenant)
Dr. Navid Jafari (Associate Professor, Texas A&M University)
Dr. Timothy D. Stark (Professor, University of Illinois; Technical Director, FGI)

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Introduction & Background

The webinar addressed the critical and increasingly prevalent issue of subsurface elevated temperature (SET) events in modern landfill operations. As landfills age and waste compositions evolve, these thermal phenomena pose significant operational, environmental, and financial risks. Dr. Tim Stark (University of Illinois) opened the session by emphasizing the need for standardized terminology, moving away from ambiguous terms like "ETLF" (Elevated Temperature Landfill) toward the more precise "SET event" framework. This shift reflects the industry's growing understanding that these are distinct sub-surface phenomena requiring specialized monitoring and mitigation approaches, separate from surface fires or routine landfill gas generation.

The regulatory context was thoroughly examined, particularly the controversial 2021 U.S. EPA decision to remove oxygen concentration standards from landfill monitoring requirements. Presenters argued this has created a dangerous gap in early SET detection, as oxygen intrusion remains a primary catalyst for exothermic reactions. The 131°F well-head temperature threshold was established as the baseline SET indicator, though presenters cautioned that subsurface temperatures often exceed surface measurements by 120°F or more, necessitating more sophisticated monitoring protocols.

Mechanisms & Root Causes

Todd Thalhamer (Hammer Consulting) presented a detailed analysis of SET causation mechanisms, structured around three primary pathways:

1. Air Intrusion Systems

- Cover system failures (cracks, erosion rills, poor seam integrity)
- Gas collection system over-drafting
- Interface failures at penetrations (gas wells, leachate pipes)
Case Example: A Pennsylvania landfill demonstrated how final cover systems can fail, with thermal imaging showing 150°F+ hotspots despite geomembrane installation.

2. Reactive Waste Streams

- Aluminum processing wastes (dross, salt cake)
- Incinerator ash with high metal content
- Industrial byproducts with exothermic potential
Case Example: Ohio facility where aluminum waste reactions reached 1,500°F, requiring \$500M remediation.

3. Smoldering Combustion

- Pyrolysis initiation in low-moisture waste zones
- Spontaneous ignition thresholds
- Subsurface fire migration patterns
Case Example: Excavation at a Michigan site revealed 480°F smoldering zones with no surface smoke due to active gas extraction.

Detection & Monitoring

Dr. Navid Jafari (Texas A&M) systematically reviewed monitoring methodologies:

Gas Monitoring

- The "15/15 Rule": $\text{CH}_4 < 15\% + \text{CO} > 1,500 \text{ ppm}$ as combustion indicator
- Hydrogen spikes as secondary validation
- Down-well vs. well-head measurement disparities

Physical Indicators

- Settlement patterns (normal 1-2 ft/yr vs. SET-induced 18+ ft/yr)
- Leachate outbreak locations and chemistry changes
- Surface fissure mapping and thermal imaging correlation

Advanced Techniques

- Distributed temperature sensing systems
- Pressure monitoring arrays
- UAV-based thermal surveys

Mitigation Strategies

Presenters collectively outlined a phased response framework:

Immediate Actions

- Hotspot isolation via targeted gas well adjustment
- Oxygen exclusion measures (clay seals, foam injections)
- Pressure relief venting protocols

Intermediate Measures

- Shallow well installations to avoid leachate interference
- Geomembrane cover deployment considerations
- Leachate management system upgrades

Long-term Solutions

- Waste stream characterization programs
- Enhanced cover system designs
- Predictive modeling development

Case Study Analysis

Two detailed case histories were presented:

1. Midwestern Bioreactor Landfill

- Timeline: 3-year SET progression
- Key indicators: CH₄ decline (50% → 8%), CO spike (0 → 8,000 ppm)
- Corrective actions: 60-mil HDPE cap, gas system redesign
- Outcome: 90% reduction in elevated temperature zones

2. Eastern U.S. Industrial Waste Site

- Unique challenges: Aluminum waste + alkaline leachate
- Failure modes: Melted HDPE pipes (160°F+), slope instability
- Remediation: Excavation, grouting, \$14M capital costs

Conclusions & Future Directions

The webinar concluded with five consensus recommendations:

1. Terminology Standardization

- Industry-wide adoption of SET event framework
- Clear differentiation from surface thermal phenomena

2. Monitoring Enhancements

- Mandatory down-well temperature profiling
- Revised oxygen monitoring standards
- Advanced gas composition tracking

3. Design Improvements

- Reactive waste isolation cells
- Robust cover system specifications
- Material temperature ratings review

4. Research Priorities

- Long-term geomembrane performance studies
- Predictive modeling validation
- Best practice development for extreme SET events

5. Regulatory Engagement

- Revisiting 2021 oxygen standard changes
- Developing SET-specific guidance documents
- Standardized reporting frameworks

Additional Resources

Attendees were directed to:

- FGI Technical Guidance Document #47 (SET Event Response)
- ASTM Committee D35 ongoing research initiatives

- Part 2 webinar (July 22, 2025) focusing on root cause analysis methodologies

