

FGI Webinar: Part 2: Subsurface Elevated Temperature (SET) Events in Landfills



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Presenters:

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- Expertise: Geotechnical engineering, landfill stability, and SET event mitigation.

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- Expertise: Regulatory compliance, landfill gas management, and SET event root-cause analysis.

Dr. Navid Jafari, P.E. (Texas A&M University)

- Expertise: Waste mechanics, thermal modeling, and landfill containment strategies.

Core Content Summary

1. SET Event Fundamentals

- **Definition:** Subsurface reactions causing sustained temperatures $>131^{\circ}\text{F}$ (55°C), exceeding landfill design thresholds.
- **Primary Causes:**
 - Chemical reactions: Aluminum waste oxidation, metal corrosion, exothermic hydration/carbonation.
 - Aerobic decomposition: Oxygen intrusion via cracked covers, over-pulled gas wells ($>2\% \text{O}_2$), or leachate recirculation-induced pressure changes.
- **Insight:** SET events are self-sustaining via a “disaster loop” (increased $\text{O}_2 \rightarrow$ elevated heat $\rightarrow$ expanded aerobic zones $\rightarrow$ further O_2 ingress).

2. Early Warning Signs & Progression

- **Initial Indicators:** Odor complaints and off-site gas migration (earliest symptoms).
- **Progressive Symptoms:**
 - Temperature spikes ($>20^{\circ}\text{F}/24$ hrs) measured via downhole thermocouples (surface probes lag).
 - Leachate outbreaks (hazardous at $>180^{\circ}\text{F}$ due to benzene/Mek contamination).

- Surface settlement (a *delayed* indicator; post-thermal degradation).
- **Case Study:** 90 ft waste column consumed in 6 years; thermal imaging showed 120°F differentials between surface/shallow probes.

3. Mitigation & Containment Strategies

- **Small-Scale SET (<40 ft depth):**
 - Excavation: Removal of smoldering waste (e.g., 4 ft-wide trenches).
 - Foam Suppression: Structural Class A foam (preferred over water).
- **Large-Scale SET:**
 - Air Breaks: Isolation zones (e.g., 65 ft-deep berms) to halt lateral spread.
 - Vertical Cutoffs: Bentonite-cement slurry barriers installed via augered borings (3–4 ft diameter).
- **Best Practices:**
 - Increase gas well density (5–6 wells/acre, shallower depths).
 - Repair interim covers (≥12" soil or intact geomembranes) to minimize O₂ ingress.

4. Regulatory & Engineering Recommendations

- **Temperature Thresholds:** Revert action threshold to 131°F (55°C) from 145°F (63°C) to align with PVC geomembrane design limits (140°F max).
- **Real-Time Monitoring:** Mandate continuous O₂/temperature telemetry; monthly sampling inadequate.
- **O₂ Concentration Limits:**

Temperature Threshold	Max O ₂ Concentration
>140°F	≤3%
>170°F	≤2%
>200°F	≤1%

5. Critical Research Gaps

- Quarry-fill landfills act as thermal sinks, prolonging SET events (e.g., 200°F persists 15+ years post-containment).
 - Need to define leachate temperature thresholds for hazardous classification (~180°F preliminarily).
 - Evaluate CPVC vs. PVC well casing resilience at elevated temperatures.
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Assessment Highlights (NY PDH Credit)

1. Primary SET causes: All chemical/aerobic factors, not just waste placement.
 2. Settlement is a *delayed* indicator, not an early locator.
 3. First signs: Odor complaints (87% of cases).
 4. Containment feasible via trenches/barriers.
 5. Heat extraction wells ineffective due to negligible BTU removal.
 6. 2021 removal of 5% O₂ standard from NSPS is correct.
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Key Takeaway: Early intervention (<131°F) with aggressive root-cause analysis is critical. Current regulatory thresholds (145°F) violate material design limits and exacerbate SET risks.

Appendix

- Figures: Thermal gradients, air break schematics, O₂/temperature curves.
 - Citations: NSPS Commentary (2021), California Title 27 (interim cover standards), FGI containment guidelines.
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Notice: This report synthesizes technical content for academic and regulatory dissemination. For detailed data, consult webinar slides or contact presenters.