U. S. Army Corps of Engineers
Landfill Off-Gas Treatment, Thermal Oxidation Checklist

Installation Name	_____
Site Name / I.D.	_____
Evaluation Team	_____
Site Visit Date	_____

This checklist is designed to facilitate the performance evaluation of a thermal oxidizer used to remove organic compounds from landfill off-gas. The checklist is designed for evaluation of a flare system, the most common type of thermal oxidizer used at military landfills. The checklist may, however, be adapted for evaluation of other thermal oxidizers. The checklist is divided into the following sections:

1) Evaluation team composition
2) Typical treatment objectives
3) References
4) Data collection requirements
5) Performance analysis calculations
6) Adequacy of operations and maintenance
7) Typical performance problems
8) Alternatives for possible cost savings
9) Effects on Human Health and the Environment
10) Supplemental notes and data

The checklist provides suggestions for information gathering, and space has been provided to record data and notes from the site visit. Supplementary notes, if required, should be numbered to correspond to the appropriate checklist sections.

1) Evaluation Team Composition

The following disciplines should be included in the evaluation team for the landfill off-gas thermal oxidation system.

- Process Engineer (site visit, treatment system evaluation)
- Chemist (treatment chemistry)
- Regulatory Specialist (regulatory requirements)
- Cost Engineer (cost of alternatives)
- Risk Assessor (risk from alternatives or operating changes)

2) Typical Treatment Objectives

Review the treatment objectives established when the thermal oxidation system was designed and installed to verify that the objectives are clear and still valid.

Thermal oxidation is used to destroy organic contaminants from a gas stream. Non-energy recovery systems include flares and thermal oxidizers. Energy may be recovered by using landfill off-gas as fuel in gas turbines, internal combustion engines, boilers; or the gas may be upgraded to pipeline quality for delivery to a utility distribution system.

3) References

This checklist should be coordinated with the Process Instrumentation and Control and Blowers and Piping Systems for Air, Off-Gas or Vapor checklists. The following references may also be helpful:

CEGS 11378 [1]: *Thermal (Catalytic) Oxidation System.*
ETL 1110-1-160 [2]: *Landfill Off-Gas Collection and Treatment Systems.*

4) Data Collection Requirements

The following is information needed to assess the performance of the thermal oxidation treatment system. Record the appropriate units with each value.

a) What type of thermal oxidation unit is at this site (e.g., flare, catalytic)?

_____
_____

b) Sketch a process flow diagram (PFD), including valves and instrument locations, on the back of this sheet or on a separate sheet.

_____

c) Record the nameplate information from thermal oxidizers, flares, , , flame arrestors, carbon adsorbers, compressors, pumps, and other mechanical equipment for future reference.

_____
_____
_____

d) Has the process been changed since start-up? Are the process changes recorded on the as-built drawings?

_____
_____

e) Are all federal (e.g., RCRA, CAA), state, and local regulatory requirements being met? Attach copies of permits, notices of violation, and monitoring reports.

_____
_____

(This can include source and ambient monitoring, emission limits, and permits.)

4.1) Gas Volume and Composition

The analyses of volatile compounds in the landfill gas and thermal oxidation influent and effluent are typically performed by gas chromatography/mass spectrometry using EPA method TO-14. Analyses of permanent and fixed gases (e.g., oxygen, nitrogen, carbon monoxide,

carbon dioxide, methane, and non-methane hydrocarbons) are typically performed by ASTM Method 3416.

a) Landfill Gas Generation Rate and Composition (Record units with data)

Date	Rate of Gas Generation	Methane (CH_4)	Carbon Dioxide (CO_2)	Oxygen	(Other) _____	(Other) _____

(Record gas generation and composition data from one recent and at least three previous sampling dates for use in determining the trends of gas composition and generation from the landfill.)

b) Operating Conditions (Record units with data)

	Present Operating Conditions			Manufacturer's Specification	
	Minimum	Maximum	Average	Minimum	Maximum
Gas Inlet Flow Rate					
Gas Inlet Pressure					
Operating Temperature					

c) Thermal Oxidation Inlet Gas Composition (Record units with data)

	CH_4	O_2	CO_2	_____	_____	_____
Average Measured Value						
Manufacturer's Specifications						

d) Thermal Oxidation Exhaust Gas Composition (Record units with data)

Date	Temper-ature	CH_4	O_2	CO	NOx	Non-CH_4 VOC	_____
Current Values							
Manuf's Spec.							

(Record exhaust gas temperature and composition data for current operations and at least three previous sampling dates for use in determining the trends of gas temperature and composition.)

5) Performance Analysis Calculations

a) Review the current and historical gas generation rates and gas composition to determine if the volume or composition is changing over time.

_____
_____

b) Compare gas flow rate, supply pressure, minimum operating temperature, and gas composition (including CH_4, CO_2, and O_2) at the thermal oxidizer's gas inlet to the manufacturer's recommendations. Identify parameters that do not meet recommendations.

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c) Compare the emission rates with the emission limits and historical inlet gas data to calculate the destruction removal efficiency (DRE).

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6) Adequacy of Operations and Maintenance

a) Verify that the thermal oxidizer has the following interlocks (if applicable) and that they are tested regularly. Find test frequency, schedule or dates:

- ☐ High oxygen concentration in the landfill gas
- ☐ High thermal oxidizer exhaust stack temperature
- ☐ Low fire protection water pressure
- ☐ High blower outlet pressure
- ☐ High temperature in carbon adsorption vessels
- ☐ Ambient gas sensors inside the gas treatment building (e.g., combustibles, H_2S, CO, low O_2)

b) Summarize the available data showing the composition of any condensate that may be generated during landfill gas collection or combustion. Is the condensate hazardous as defined under RCRA? How is the condensate being collected, treated, and disposed?

_____
_____
_____

c) Identify high cost maintenance equipment items. Do any items require frequent repairs?

_____
_____
_____

d) Identify high cost operating supplies (auxiliary fuel, power, etc.).

_____
_____

e) Identify any corrosion problems.

_____
_____

7) Typical Performance Problems

a) Determine if the blower is operating within a safe range. *(This can be determined by comparing daily blower flow rates and pressure data to a standard performance curve developed by the manufacturer.)*

_____
_____

b) Confirm that a flame arrestor is installed on the thermal oxidizer inlet line to reduce the potential for a flashback and explosion. Compare the pressure loss through the flame arrestor with manufacturer's specifications.

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8) Alternatives for Possible Cost Savings

Determine if any of the following alternatives are cost-effective:

a) If the landfill gas supplied to the thermal oxidation unit is approaching the lower operating limit for methane concentration or if the gas generation rate has decreased significantly, consider the following alternatives:

- Vent the landfill gas to the atmosphere if permissible
- Replace the thermal oxidizer with a smaller and/or more efficient unit
- Determine if it is feasible to retrofit and replace the burner with a smaller unit
- Determine if the carbon units are still required or if the flare unit alone can provide the required destructive rate efficiency.

b) If the volume and heat content of the off-gas is sufficient, consider whether the present thermal oxidizer can be decommissioned and the gas used as fuel in gas turbines, internal combustion engines, or boilers; or upgrade the gas quality for sale to a utility distribution system.

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_____

9) Effects on Human Health and the Environment

a) Determine if ambient concentrations of off-gases are sufficiently high to be ignitable or pose a health threat inside buildings or at the fence line. Are odors detectable at the fence line?

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10) Supplemental notes and data

There are __ pages of supplemental notes, figures, and data attached to this checklist

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[1] CEGS: USACE Guide Specifications for Construction, available at www.usace.army.mil/inet/usace-docs/

2 ETL: USACE Engineering Technical letters, available at www.usace.army.mil/inet/usace-docs/