Presentation Topics

- Elements of Landfill Cover
- Elements of LFG collection and control systems
- Development of LFG beneficial use projects
Objectives for Capping Landfill

- Provide barrier between waste mass and atmosphere, animals, and public
- Reduction of leachate by preventing infiltration of rainwater
- Structural stability for waste mass
- Increase the amount of gas that can be collected and used, increased income stream
Final Cover Design

- Grade
- Drainage
- Cover materials
- Vegetation
- Gas collection considerations
Not Ready for Capping
Correct Grading and Drainage Prior to Capping
Ready for Final Cap
Terraced Slopes That Drain Surface Water
Surface Water Must Go Somewhere

Not through cap...
Final Cover

Closure Cap Detail

- 6" Topsoil
- 13" Cap Cover Soil
- 200 mil Composite Drainage Net
- 40 mil LLDPE Geomembrane
- 6" Gas Collection Sand
- Cap Subbase
- Waste
Landfill Gas Collection and Control Objectives

- Recover and utilize LFG
- Minimize potential environmental impacts
- Control odors
- Control off-site migration
- Greenhouse Gas emission reduction
Elements of an LFG Collection System

- Network of interconnecting piping
- LFG collection points
  - Vertical extraction wells
  - Horizontal collectors/trenches
  - Connection to existing vents, wells, etc.
Elements of an LFG Collection System (continued)

- Condensate management
- Well-field management
- LFG blower/flare system
Vertical Extraction Wells

- Most common approach for recovering LFG
- Install in existing or operational disposal areas
- Waste depth preferable > 10 meters
Gas Well Auger
Vertical Extraction Wells

- Install approx 2.5 wells per hectare
  (~ 1 well per 0.4 hectare)

- Boreholes typically 60 – 90 cm
Vertical Extraction Wells
Design Features

- In-refuse wells - 75% of the refuse depth
- Depth of in-soil wells varies
  - Groundwater level
  - Bottom of refuse
  - Depth of gas migration
Vertical Extraction Wells Design Features (continued)
Typical Vertical Extraction Well

- Bentonite seal prevents air infiltration

- Wellhead incorporates:
  - Flow control valve
  - Pressure monitoring port
  - Flow monitoring device (optional)
  - Thermometer (optional)
Active LFG Control

Gas Well Head - Close Up
Horizontal Collectors

- Alternative approach for LFG recovery
- Install in shallow areas
- Install in existing or operational disposal areas
Laterals and Headers

- Pathway for LFG from wellheads to blowers
- Can be above-grade or underground
- Sized on flow rate and pressure drop
- Pipes sloped to promote condensate drainage
Blower/Flare Station

- Provides vacuum for wellfield
- Combusts methane
- Open or enclosed flame
Blower/Flare Station (continued)

- May be used in combination with beneficial use system
- Needed for methane destruction if beneficial use project is down
Blower/Flare Station - Design Features

- Location should be central to collection system, close to potential end user or utility service, away from trees

- Design with flexibility to handle future gas flows
Example
Development of LFG project

- Why would I consider? Potential Income!
  - $ from destruction of methane
  - $ from energy generation or fuel sales
- Evaluate LFG generation potential
- Evaluate end-use alternatives
- Network with interested parties
- Execute contracts, construct, and operate
Gas Utilization

- Utilization systems consist of:
  - Direct Gas Use/Sale
  - Electricity Generation
  - Pipeline Upgrade
Gas Utilization (cont.)

- **Direct use**
  - Identify local energy users
  - Can provide energy cost savings and stability for the end-user
  - May be used to attract new industry

- **Electrical Use**
  - Distributed generation or on-site use
  - Option for sites without nearby industry
Diversity of Project Types

Direct-Use of LFG

- Direct-use projects are growing!
  - Boiler applications - replace natural gas, coal, fuel oil
  - Combined heat & power (CHP)
  - Direct thermal (dryers, kilns)
  - Natural gas pipeline injection
    - Medium and high Btu
      - Greenhouse
      - Leachate evaporation
      - Vehicle fuel (LNG)
      - Artist studios
      - Hydroponics
      - Aquaculture (fish farming)
Diversity of Project Types

Electricity Generation

Emerging Technologies

Internal Combustion Engine

Gas Turbine

Microturbine

Organic Rankine Cycle Engine

Stirling “External Combustion” Engine
Even in mature markets, issues still exist…

- Significant capital costs
- Transient source of energy
- Slow movement into long-term agreements
- Gas use or power purchase agreements can be complicated
  - Guarantees
  - GHG reduction rights
  - End use stability
  - Environmental compliance responsibility
However, it can be done…..

- Over 400 operating project in US with continuing growth expected
- Remember that M2M can provide assistance
  - Technical information and support
  - Analysis
    - Initial desktop review
    - Pre-feasibility study for promising sites
  - Networking services