LESSONS LEARNED FROM CEDAR HILLS
10,000 SCFM High BTU Project
Maple Valley, Washington
Cedar Hills Landfill

- Cedar Hills is a county landfill serving King County, Washington
- Total area 920 acres
- Over 1,000 gas collection wells
- > 800,000 tons waste added per year
- Flowing ~ 10,000 SCFM landfill gas
Interstate/LDC Pipeline Quality Issues

- Northwest Pipeline spec:
  - 985 BTU/cu ft
  - <3% total Inerts
  - <0.2% Oxygen

- Typical spec for total Inerts is 33% higher
High BTU
Development Parameters

- Landfill Gas accepted as normally collected
- Maximum equipment redundancy
- Use INGENCO dual-fuel electric generators for tail gas
ORIGINAL DESIGN

FEED 200 psig

Sulfur Media
H2S

Pre-Treat
H2O VOCs

Membrane
CO2 O2

DEOXO
O2 + CH4 = CO2 + H2O

TSA DRYER
H2O

NRU
To Genset CO2, N2, Lost C1

PRODUCT
CH4 = 97%
N2 = 3%
CO2 = Nil
O2 PPM
Initial Startup – MAY 2009

- Worked through normal start-up issues
- H2S removal and compressor issues
- Additional membranes added for CO2 removal to handle volume
Early Operation

- Media in NRU began degrading and turning into dust upon startup

- Discovered low PH condensate downstream of De-Oxo converter and corroded heat exchanger

- Added amine and water injection to control PH
INTERIM SOLUTION

FEED 200 psig

Sulfur Media

Pre-Treat

Membrane

DEOXO

O2 + CH4 = CO2 + H2O

PRODUCT
CH4 = 97%
N2 = 3%
CO2 = Nil
O2 PPM

Amine injection for PH control

TSA DRYER

NRU

To Generators
CO2, N2, CH4
NRU FAILURE

- Extra filtration installed to trap dust

- In first 3 months media replenishment required

- Consequential failures caused additional dusting and eventual total plant shutdown and replacement of all media
Filters changed again and again and . . .

Bought so many filters manufacturer ran out of components
Missing media found!
FIRST 22 MONTHS OUTPUT
Failure analysis and repair plan

- Outside expert evaluations
- Re-evaluated media alternatives
- Existing NRU vendor guaranteed media performance contingent on reconfiguration
Implementation

- Relocated oxygen removal catalyst and TSA dryer downstream of NRU at request of NRU vendor to preclude any possibility of acid-gas damage to media.

- Disassembled and cleaned entire plant back end.

- NRU vendor implemented software and hardware modifications to reduce possibility of media fluidization.
**FINAL SOLUTION**

FEED 200 psig

- **Sulfur Media**
  - FEED
  - H2S

- **Pre-Treat**
  - H2O
  - VOCs

- **Membrane**
  - CO2
  - O2

- **NRU**
  - To Genset
  - CO2, N2, Lost C1

- **DEOXO**
  - O2 + CH4 = CO2 + H2O

- **WATER WASH**

- **TSA DRYER**
  - Amine injection for PH control
  - H2O

**PRODUCT**
- CH4 = 97%
- N2 = 2.7%
- CO2 = 0.3%
- O2 PPM
August 2012 Restart

- NRU vendor provided good support for re-commissioning and improved control system for easier operation

- Overall monthly performance much better than initial operating period
Results Much Improved
21% greater monthly output
Restart Results

- Methane recovery appears consistent but below expected original pro forma.

- No degradation of media has been observed to date but will be monitored closely.
Conclusions

- Turnkey EPC contract no guarantee of success
- Cause of original media failure not fully resolved
- Strong vendor commitment critical
- Reconfigured plant working well