

Using Capstone 330s for Combustion of Produced Gas

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Managing Director

Manley Oil Company

- Manley Oil Company – Crude oil production in urban Los Angeles since 1896
- BFGW Urban Partners – Redevelopment of environmentally impacted property
- Union Station Oil Field – High gravity, gaseous crude oil in urban Los Angeles, idled for five years

- Site Location – Approximately 0.5 miles from Los Angeles City Hall
- Site developed by Standard Oil of California (Chevron) in 1969
- Original Production 2000 bbls per day & 8 MMCFD of high heat content natural gas
- Crude Oil (total fluids) removed from lease via pipeline
- Natural Gas, dried (?) and sold to Southern California Gas Company into SCGC infrastructure

- Current Production 80 bbls per day & ~ 85 MCFD natural gas
- Symbiosis with Manley Oil Company
- Gas Disposition Options
 - Sale to SCGC into SCGC infrastructure
 - Refine for sale to SCGC and LNG/CNG storage
 - Combust for electricity and recovered heat
 - Flare

Manley Energy Resources Company, LLC

- Project Manager: John Walton
- Funding Partners: Williams Inc.
- Engineer: John Walton
- Project Plan vs Actual
 - Equipment Delivery 8/2001 10/2001
 - System Commissioned 9/2001 11/2001
 - Monitoring Underway NA NA

System Installation





- Fuel Characteristics
 - High LHV ~ 1400 btu/ft³
 - Fuel Composition
 - Methane ~76%
 - Ethane ~12%
 - Propane ~ 8%
 - Butane ~ 4%
 - Hydrogen Sulfide ~ 0.00 ppm
- State of California Regulations
 - CARB Natural Gas Regulations & CNG Vehicles

Fuel Treatment System

- Scrubbers Two vessels, V-3 & V-5, that remove liquids, both hydrocarbons and water, by droplet agglomeration on stainless steel mesh elements
- Pressure Regulation
 - Manifold Controls
 - Individual Unit Controls
- Flow Meter

Fuel Scrubbers, V-3 & V-5



Pressure Transducer & Regulator



Pressure Regulators & Filters, Individual Units



Utility Requirements

- Local Utility is Los Angeles Department of Water & Power
- Contract to sell power to LADWP
- Connections/Protection to microturbines and the grid
- Site
 - 34.5 kV Transformer
 - Main Switch

Unit Disconnects, Meter & Visible Disconnect



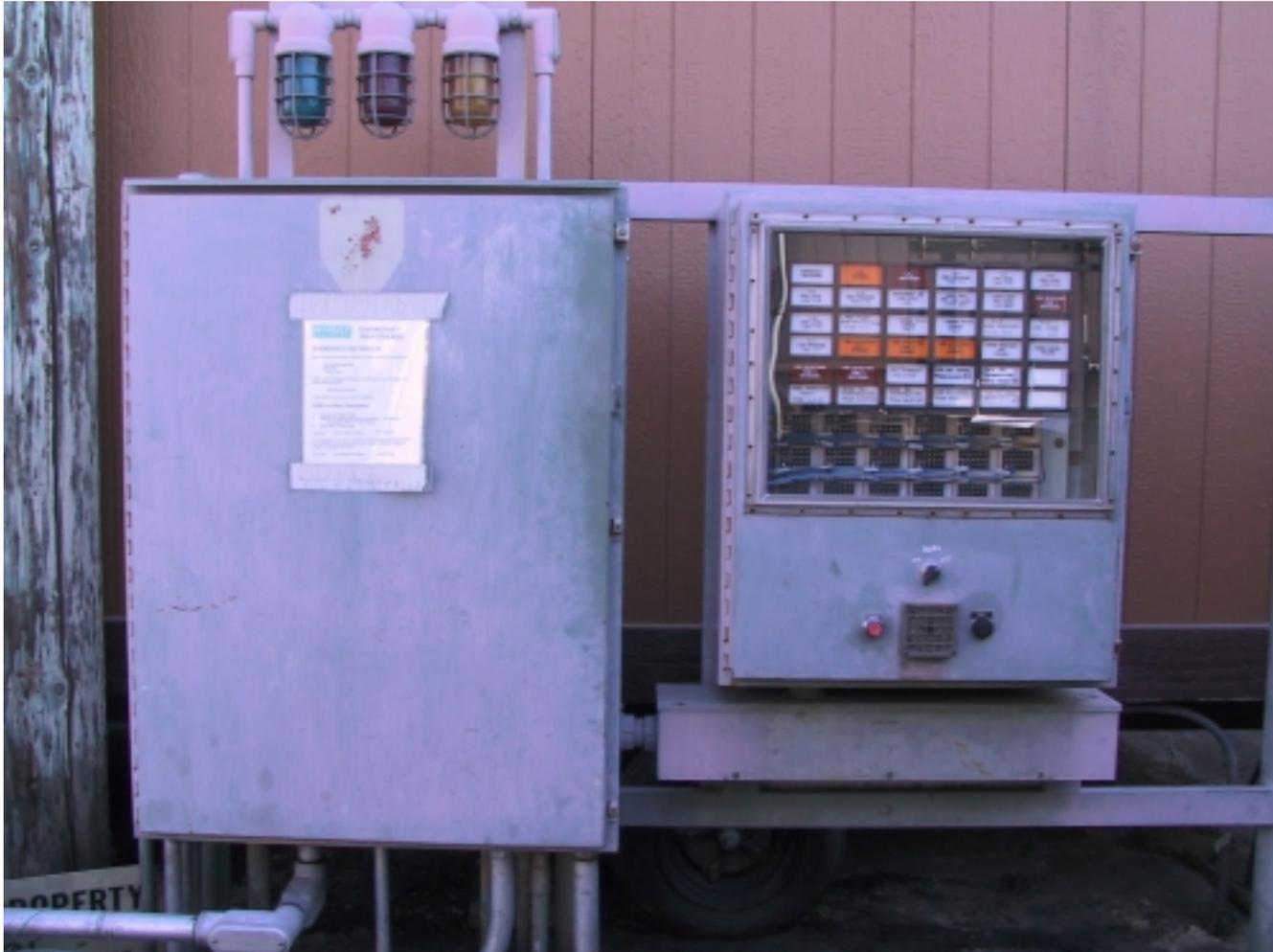
Main Switch & In/Out Meter

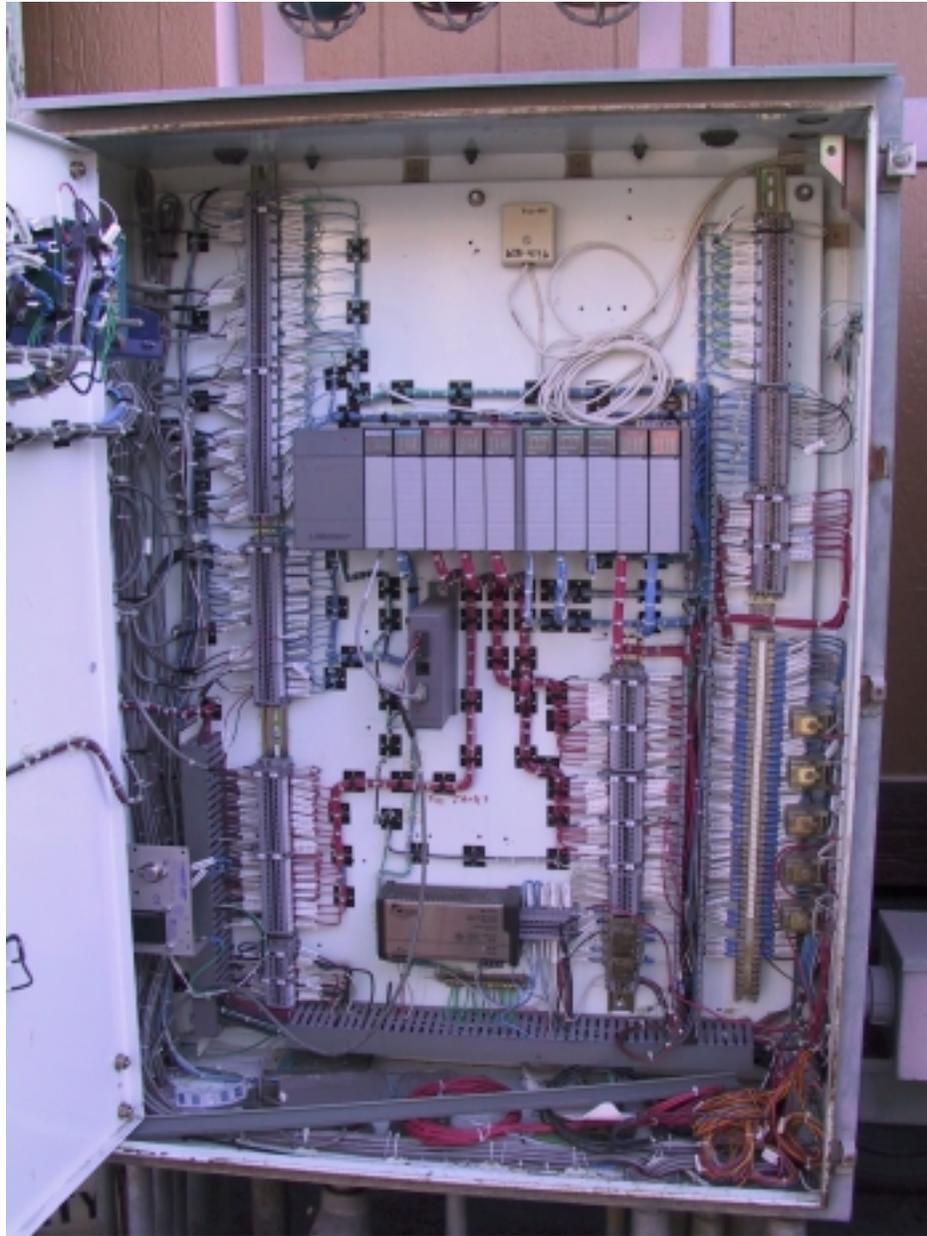


Operational Experiences

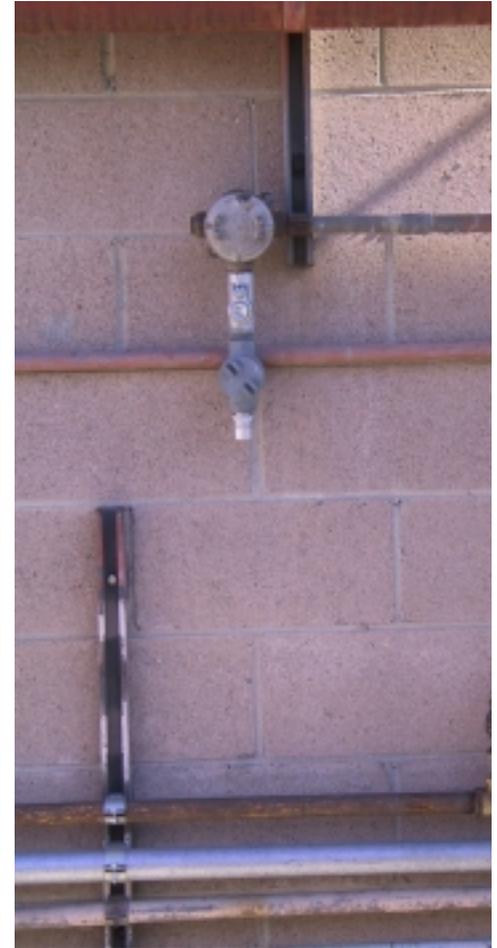
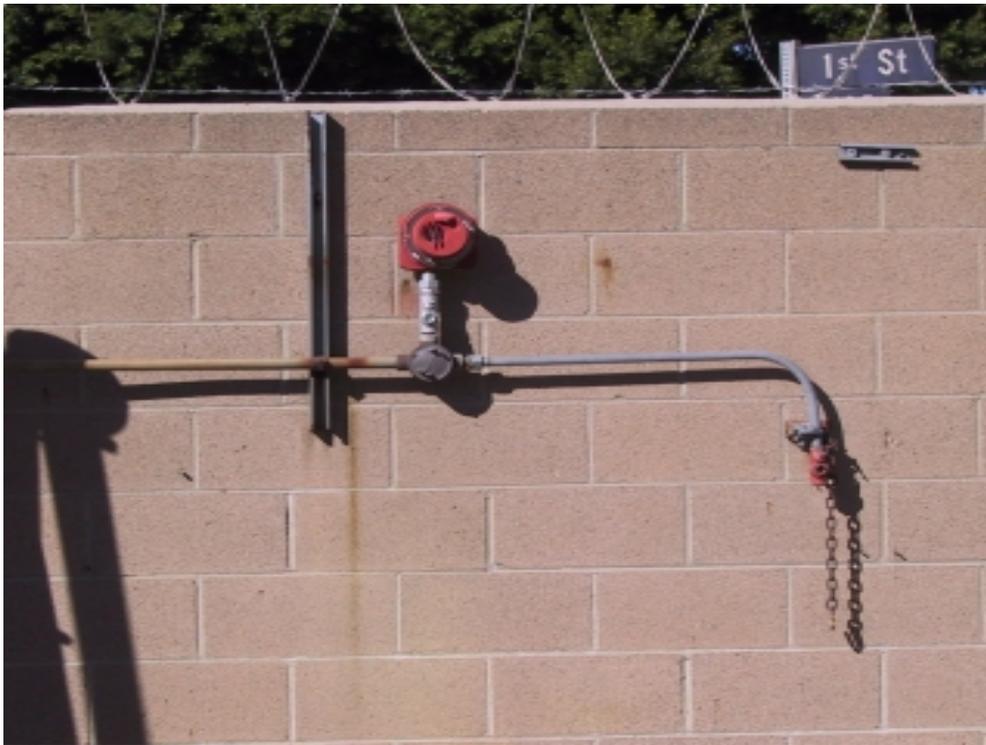
- Gas Production
 - Irregular Rate of Natural Gas Production
 - Impact of Temperature
- Control of Pressure Fluctuations
 - Pressure Transducer to monitor system pressure
 - Programmable Logic Controller (PLC) and program to start and stop microturbines

PLC and Annunciator Panel





Safety Equipment – Connected to PLC



- Controlled startup issues
 - Program
 - Connections for “Remote Start”- Relays
 - Monitoring Unit Status

Cost Table

Item	Actual Cost	Perfect Cost	50th Install
Turbine (8)	\$ 37,789	\$ 21,000	\$ 21,000
HR Unit (2)	\$ 8,485	\$ 8,485	\$ 8,485
Mechanical	\$ 9,000	\$ 7,000	\$ 7,000
Electrical	\$ 9,600	\$ 8,000	\$ 7,500
Civil	-0-	-0-	-0-
LADWP	\$ 4,000	\$ 4,000	\$ 2,500
PM	\$ 1,500	\$1,500	\$ 1,000
Misc.	\$ 18,990	\$ 18,990	\$ 18,990
Total	\$ 362,370	\$ 224,460	\$ 221,960

Operational Data

Unit SN	Hours	Starts
1430	6977	474
1432		
1435	38528	425
1434	7471	574
1432	6529	454
1437	5693	500
1331	3770	549
1540	5255	458

Performance

- Average Electrical Performance ~83%
- Power/LHV Ratio Unk.
- Estimated Parasitic Losses 0 kW
- Power Quality No data

Operational Issues

- Hardware Problems
 - Igniter 4-5 failures
 - Excitor Modules 3 failures
 - Smart Proportioning Valves 5 failures
 - Components of Fuel Distribution System
- Wet Fuel Problems
 - Unit #2 Fire
- O & M Costs ~ \$1000/unit-year
- Warranty covered most problems

Starting Problems

- Not All Units
- SPV Problem
- New SPV valve seems to help
- Manually adjust fuel pressure to force SPV to open to effect start

Thermal Performance

- Work in Progress
- Uses of Recovered Heat
 - Effecting oil/water separation
 - HVAC for on-site structures
 - Domestic hot water

Emission Performance

- Approved by SCAQMD
- No inspections or other requirements for site

Institutional Experience

- LADWP does not have a rate structure that results in payment for produced power
- Facility Charge - A charge to cover expenses of distribution system facilities dedicated to a customer. \$1.65/kW
- Demand Charge - A charge related to maximum power measured in kilowatts.
- LADWP working to resolve inequity

Supplier Support

- California Power Partners
 - Excellent Technical Support
 - Good response to problems
- Capstone Turbine Corporation
 - Good Technical Support – rarely used
 - Good response to problems – sometimes slow
- Reasonable Warranty Experience

General Experience

- Starting Problems/Fuel Distribution & Metering System is a significant problem in crude oil application
- Market in the crude oil industry is significant
 - Small units respond to varied production
 - Remotely controllable operation is valuable
- Wouldn't you rather have a fuel cell ??