VALERO, Houston
FCCU Power Recovery
Train Rerate and
Upgrade
FCC Unit Flow Diagram

- Isolation Valve
- Expansion Joint
- Universal Expansion Joint
- Existing Line
- Regenerator
- Flue Gas Steam Generation
- Orifice Chamber
- Slide Valve Actuation System
- Existing Line
- 3rd Stage Separator
- Inlet Trip Valve
- Universal Expansion Joint
- Inlet Control Valve
- Critical Flow Orifice
- 4th Stage Separator
- Catalyst Dump
- Expander
- Bypass Control Valve
- Universal Expansion Joint
- Isolation Valve
- Existing Line
Typical Power Recovery Train

Steam turbine – Axial compressor – Motor/generator - Expander
Valero Houston PRT Rerate/upgrade
Key Job Considerations

- FCCU plant expansion requires more air flow and pressure
- Train power increase can be accommodated by rerating expander for increased flue gas.
- Steam turbine can be rerated to accommodate higher starting power requirement while increasing reliability.
- Equipment foot prints and shaft end spacing must not change.
- Reapplied surplus axial.
- Redesigned from 15 to 17 stages.
- Rerated for additional 30% flow capability.

Unit during final assembly
AXIAL COMPRESSOR ESTIMATED PERFORMANCE
ORIGINAL VS. RERATE

MAP CONDITIONS
P inlet 14.5 psia
T inlet 86F
60% Rel Humidity
3,600 RPM

RERATED COMPRESSOR

ORIGINAL COMPRESSOR

Volume Flow (Thousands of ICFM)

60K BPD
65K BPD
70K BPD
75K BPD
➢ Expander/axial/motor/steam turbine
➢ Originally 6,000 HP at 3,600 RPM
Rerated to 12,000 HP
100% increase in power
Integral rotor in lieu of original

Built up rotor
CONMEC FEX-125 INTAKE ASSEMBLY

- Reapplication of surplus/unused unit
- Increased HP by over 50%
- Upgraded rotor design for increased HP
ESTIMATED EXPANDER PERFORMANCE MAP

FEX-125 Expander Re-rate/Upgrade

RED - Re-rated Unit
BLUE - Original Unit
FCC expanders operating conditions:
- Low pressures (< 30 psig)
- High temperatures (1100 to 1400 degrees F)
- High volume flow (> 1,000,000 lbs/hr)
- High power density turbines (1,000 Hp per blade)
- Unique installation requirements (such as large ducting)
- Must operate continually for long periods of time > 32,0000 hours
Installation Options

- **Expander Installation Options:**
  - Addition of an expander to the current air blower train
  - Expander
  - Motor/generator
  - Installation of a stand along expander / generator set
Installation Requirements

- Plot Space
- Third stage separator
- Piping
  - Stainless steel unlined piping
  - Expander inlet
  - Expander bypass
- Control system
  - Hot Valving
  - Isolation
  - Process controls
  - Generator controls
Tollgate 1: Feasibility Review

- (Customer to provide the following information)
  - Regenerator temperature
  - Regenerator pressure
  - Regenerator flue gas flow rate
  - Electricity costs
  - Steam costs

From this information GE CONMEC can estimate

- Power recovery
- Frame size of expander
- Reduction in annual energy costs
Expander Payback
Average Size FCCU

$/kW-Hr

$/year

$0

$5,000,000

$10,000,000

$15,000,000

$20,000,000

$25,000,000
Valero/GE Conmec projects in production:
- Corpus Christi expander power upgrade
- Wilmington expander reliability upgrade
- Wilmington axial compressor reliability upgrade
- Ardmore FCCU wet gas train upgrade
- Paulsboro Hydrogen recycle compressor upgrade
GEPS Oil & Gas

Oil & Gas Industry Value Chain

Drivers
- GT Efficiency & Fuel Flexibility
- Environmental Compliance
- Increasing Gas Production
- Service Response Time
- Reduced Life Cycle Cost

Offerings:
- Fuel Conversions & Upgrades
- Emission Reduction Technology
- Turbo-Compressor Upgrade
- Local Presence … US Footprint
- CSAs & RM&D

Proprietary Information - Privileged and Confidential
GEPS Oil & Gas Services Leadership

- **Nuovo Pignone**
  - Center Of Excellence for:
    - Compressors
    - Gas & Steam Turbines
    - Reactors
    - Air-Coolers
    - Pumps - Valves
    - Metering Systems
    - Fuel Dispensers (L & G)

- **Rotoflow**
  - Center Of Excellence for:
    - TurboExpanders

- **AC Compressor**
  - Center Of Excellence for:
    - Screw Compressors
    - Single Stage Centrifugal
    - Custom Centrifugal
    - Rotary Vanes

- **CONMEC**
  - Center Of Excellence for:
    - Multi-vendor Services:
      - Power Turbines
      - Hot Gas Expanders
      - Centrifugal & Axial Compressors
      - Steam Turbines

- **Thermodypn**
  - Center Of Excellence for:
    - Low to Medium Pressure Compressors
    - Low to Medium Power Steam Turbines

- **Gemini**
  - Center Of Excellence for:
    - 3rd Party GT Service

- **Odessa**
  - Center Of Excellence for:
    - High Speed Recip

*Proprietary Information - Privileged and Confidential*