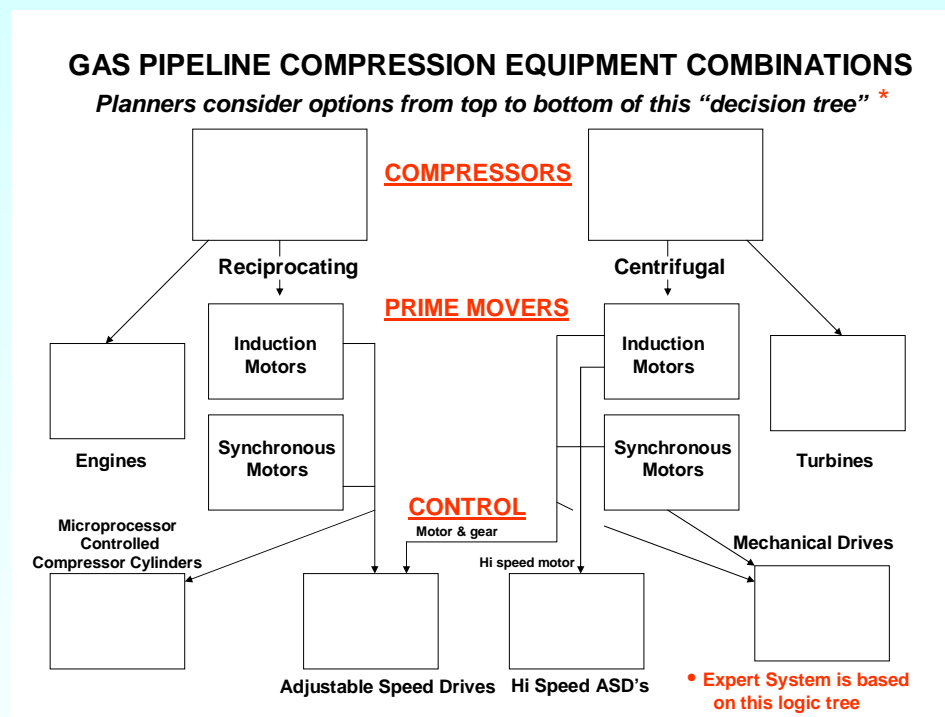


COMPRESSION MASTER PLANNER

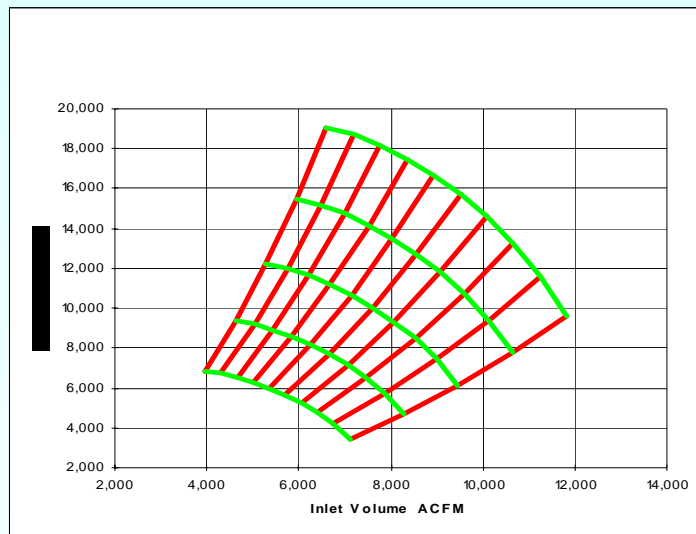
An Expert System for Evaluation of
Gas Pipeline Compressor Station Equipment Options



- Allows users to find reasonable equipment combinations from specification database of suppliers' models
- Evaluates and compares performance and life cycle costs
- Speeds up and improves the decision making process
- Makes broad industry experience from many companies available to all staff members

What Does Compression Master Planner Do?

- **Planner inputs station design requirements & up to ten more operating points**
- **Program sorts through database of specifications of available equipment models to find reasonable combos of
Compressors
Turbines/engines/motors
Drives & capacity control**
- **Compares gas vs. electric and centrifugal vs. reciprocating compression**
- **Provides performance data & charts on the fly!**



- **Provides life cycle cost comparison of up to six equipment options.**
- **200-500 combinations of equipment selections and operating conditions can be evaluated in one fast analysis. Provides results in minutes, not weeks.**

COMPRESSION MASTER PLANNER is overseen by a Compression Review Team made up of gas pipeline planners. Subscribing suppliers will be able to participate.

What are the Benefits?

For gas pipeline planners and engineers

- Provides faster & more thorough evaluations for asset decisions
- Flushes out options & equipment combinations which may not be considered otherwise
- Equipment options can be scoped in minutes, not weeks
- Allows preliminary screens to be provided to business development, facilities planning, & engineering
- Makes broad industry experience available to newer staff members

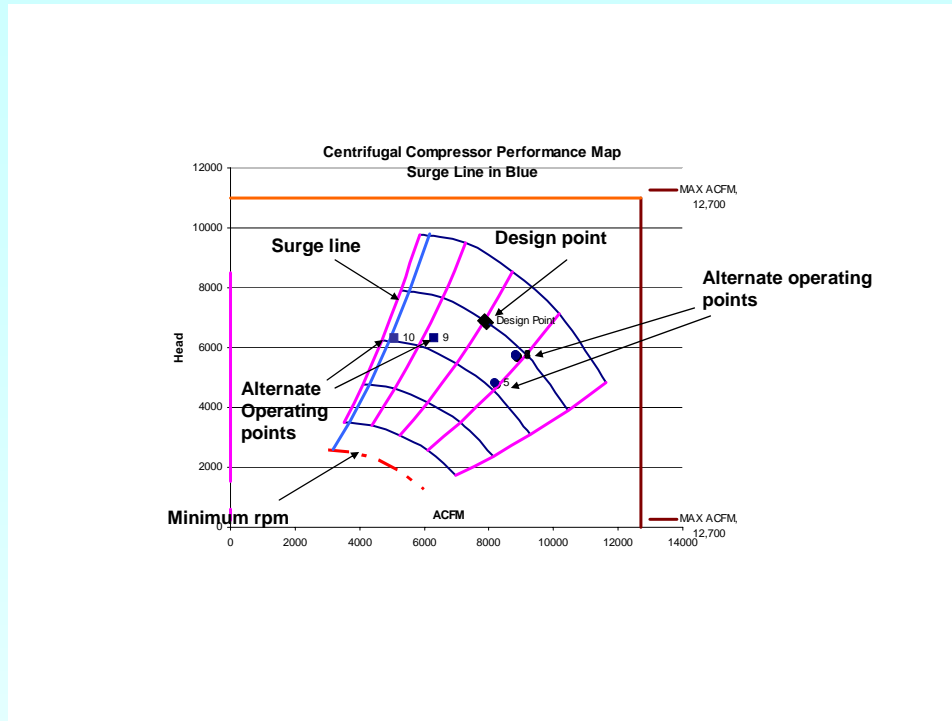
For equipment, service, power suppliers

- Integrates and links product/service offerings and their advantages into platform viewed by customers
- Enhances sales opportunities thru early exposure
- Makes marketing interactive via 24/7 links with customers
- Provides direct customer interaction via Compression Review Team meetings.



Sunrise Springs near Albuquerque, one of the sites for Compression Review Team meetings

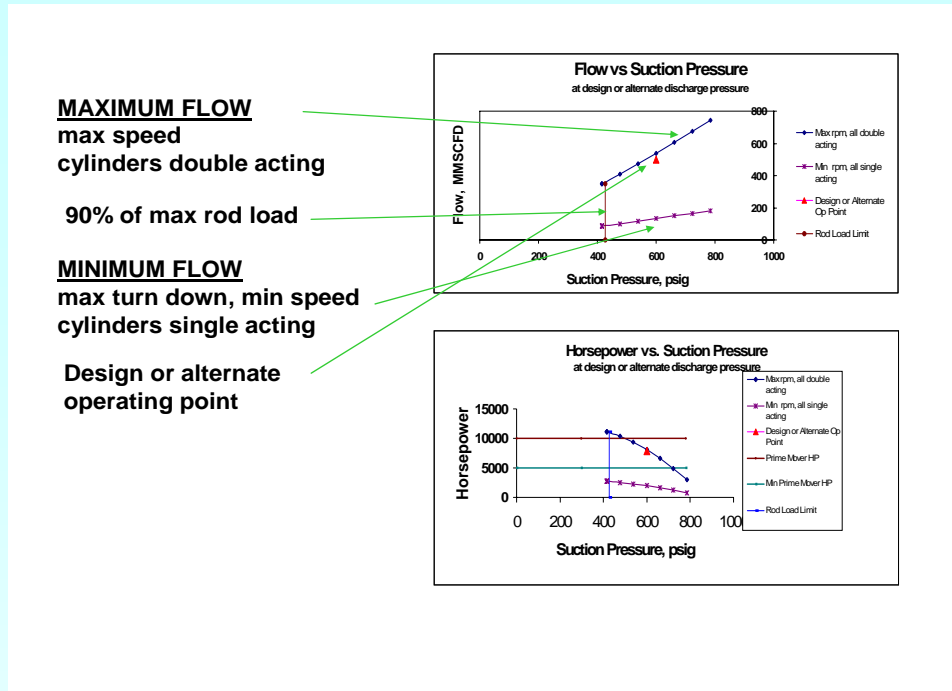
CENTRIFUGAL COMPRESSOR PERFORMANCE



- **USER VIEWS PERFORMANCE CHARTS** such as:
 1. **HEAD vs. ACTUAL CU FT/MIN**
with constant efficiency & speed lines
with surge line and minimum speed line
 2. **SUCTION & DISCHARGE PRESSURES vs. FLOW**
- **USER CLICKS DIALOG BOX TO SELECT BOTH THE CASE & THE OPERATING POINT ON THE FLY**
- **USER CAN EASILY SEE WHICH OPERATING POINTS MAY VIOLATE CONSTRAINTS** such as:
 - Speed too high or too low
 - Actual cubic feet per minute or head too high
 - Proximity to the surge line
- **USER SEES TABLE OF ALL CONSTRAINTS FOR ALL POINTS**

A DECISION CAN BE MADE TO KEEP THE SELECTION, CHANGE COMPRESSOR OR PRIME MOVER, OR MODIFY OPERATIONAL PARAMETERS

RECIPROCATING COMPRESSOR PERFORMANCE



- **USER VIEWS PERFORMANCE CHARTS**

FLOW or HORSEPOWER vs. PRESSURE (suction or discharge)
At maximum flow & minimum flow capability of system
Limit of 90 % of maximum compressive rod load shown

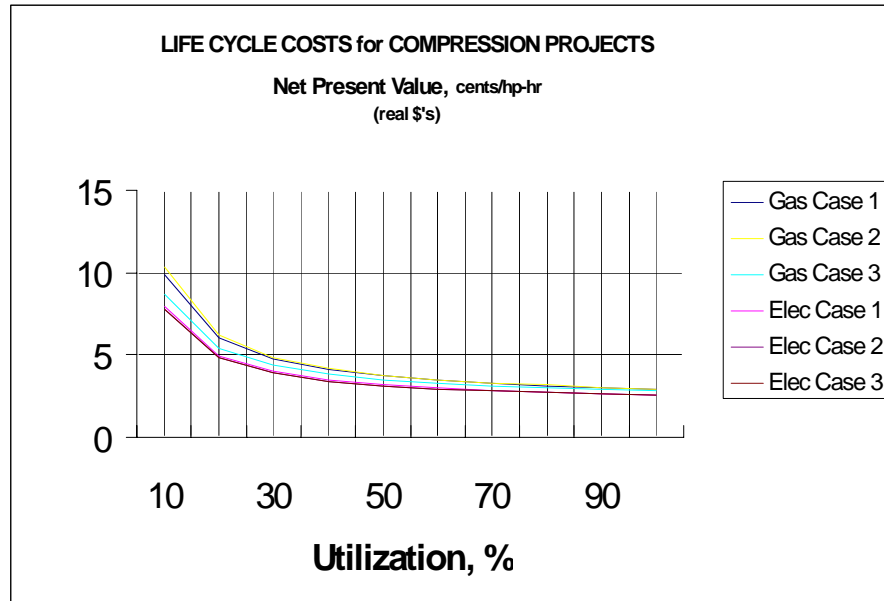
- **USER CLICKS DIALOG BOX TO SELECT BOTH THE CASE & THE OPERATING POINT ON THE FLY**
- **USER CAN EASILY SEE WHICH OPERATING POINTS MAY VIOLATE CONSTRAINTS such as:**

Horsepower needed too high or too low
Flow too high
Rod load too high

- **USER SEES TABLE OF CONSTRAINTS FOR ALL POINTS**
- **BORE, CYLINDER MODEL, or NUMBER OF POCKETS CAN BE ADJUSTED on the fly & THE EFFECT VIEWED**

A DECISION IS MADE TO KEEP THE SELECTION, CHANGE COMPRESSOR OR PRIME MOVER, OR MODIFY OPERATIONAL PARAMETERS

LIFE CYCLE COSTS



- **PROGRAM COMPARES INSTALLED CAPITAL, MAINTENANCE, & FUEL COST** for any and all combinations of equipment.
- **NET PRESENT VALUE IS DISPLAYED vs. UTILIZATION** (fraction of the time the equipment is in use)
- **PROGRAM PROVIDES DEFAULTS FOR ALL ECONOMIC INPUTS**, but the user can override them based on company info or actual bids
- **ELECTRIC and GAS COMPRESSION OPTIONS** are addressed employing user-selected power and gas price forecasts

HOW DOES THE LIFE CYCLE COST MODEL WORK?

- **USER CAN USE DEFAULTS** provided or modify them for
 - INSTALLED CAPITAL**
 - INITIAL MAINTENANCE COSTS & ESCALATION WITH TIME**
 - HEAT RATES & EFFICIENCIES**
 - AVAILABILITY**
 - TURN DOWN RATIOS**
 - RECIP COMPRESSOR BORE, CYLINDERS, POCKETS**
 - SUBSTATION & POWER LINE EXTENSION CAPITAL** if applicable
- **CAPITAL & MAINTENANCE DEFAULT ALGORITHMS** are designed to reflect experience of several gas pipeline firms
- **EFFICIENCIES & HEAT RATES ARE CALCULATED** for each piece of equipment at each operating point based on load or point on performance chart --- then they are weighed according to the time of operation at the point in question
- **RECIPROCATING COMPRESSOR ENERGY USE** is found by calculating valve pressure losses & computing horsepower across the cylinders at the required speed. Pockets are activated or controlled as needed.



From El Paso Corporation presentation at 2001 Gas/Electric Partnership workshop.

The efficient way to compare the multitude of gas pipeline compressor station options. ----- **COMPRESSION MASTER PLANNER**

- ***Compressor Master Planner allows gas pipelines to see all options, evaluate performance, and compare life cycle costs almost instantly.***
- ***Equipment and energy suppliers can link relevant information and algorithms into the basic evaluation program.***
- ***Capability to evaluate both equipment options and multiple operating points provides useful oversight at various stages from screening to operational planning***
- ***Encourages more efficient interactions among business development, facilities planning, & engineering***

The COMPRESSION MASTER PLANNER Team

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