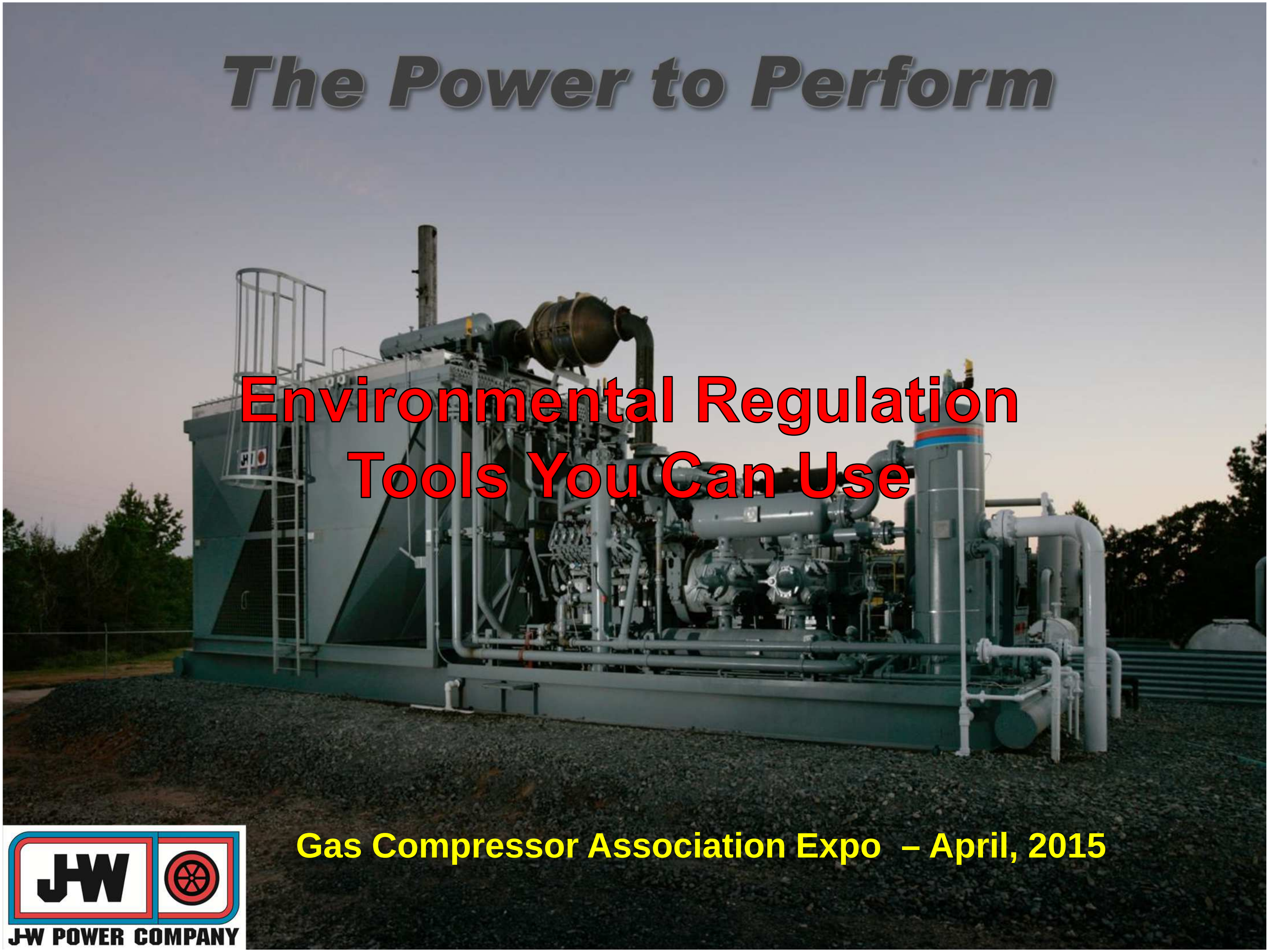
The Power to Perform



Environmental Regulation
Tools You Can Use

Gas Compressor Association Expo – April, 2015

J-W POWER COMPANY

GAS COMPRESSOR ASSOCIATION

Environmental Tools & Documents

2015 GCA Comments to the DOE - Compressor Efficiency Standards

2014 Summary of Emissions Requirements

2014 NSPS Subpart 0000

2014 Reconstruction Calculation Methodology

2014 TCEQ Regulatory Update

2014 ZZZZ & JJJJ Emissions Rules

2012 GCA NESHAP Comments

2011 GCA Comments Regarding NSPS for VOC's for Oil & Gas Industry

2011 Reconstruction Guidance

2011 Reconstruction Guidance Worksheet

American O & G Reporter State Regulatory Agencies

Emissions Flowchart

IC Engine NESHAP - GCA Comments to EPA - Part 1 of 3

IC Engine NESHAP - GCA Comments to EPA - Part 2 of 3

IC Engine NESHAP - GCA Comments to EPA - Part 3 of 3

Discussion Points

- Reconstruction Calculation Methodology for NSPS (JJJJ)
- Compressor Blowdown Model
- Emissions Guidance Document
- Engine Emissions Applicability Flow Chart

Reconstruction Guidance and Calculation Method

- Regulatory Issues / Reconstruction Basics
- The “Facility”
- GCA Guidance Document
- Example Calculation
- Summary

"Reconstructed" Units are subject to 40 CFR 60 Subpart JJJJ

- "Reconstruction" is defined in 40 CFR 60.15

- Section 60.15 of the New Source Performance Standards (NSPS) specifies that reconstruction occurs if the <u>fixed capital cost</u> of the new components exceeds 50% of the <u>fixed capital cost</u> of a <u>comparable entirely new facility</u>

- The December 16, 1975 preamble to the reconstruction regulations defines <u>fixed capital cost</u> as the capital needed to provide all the depreciable components, including the costs of engineering, purchase and installation of major process equipment, contractor fees, instrumentation, auxiliary facilities, building and structures

Facility is Reconstructed if…

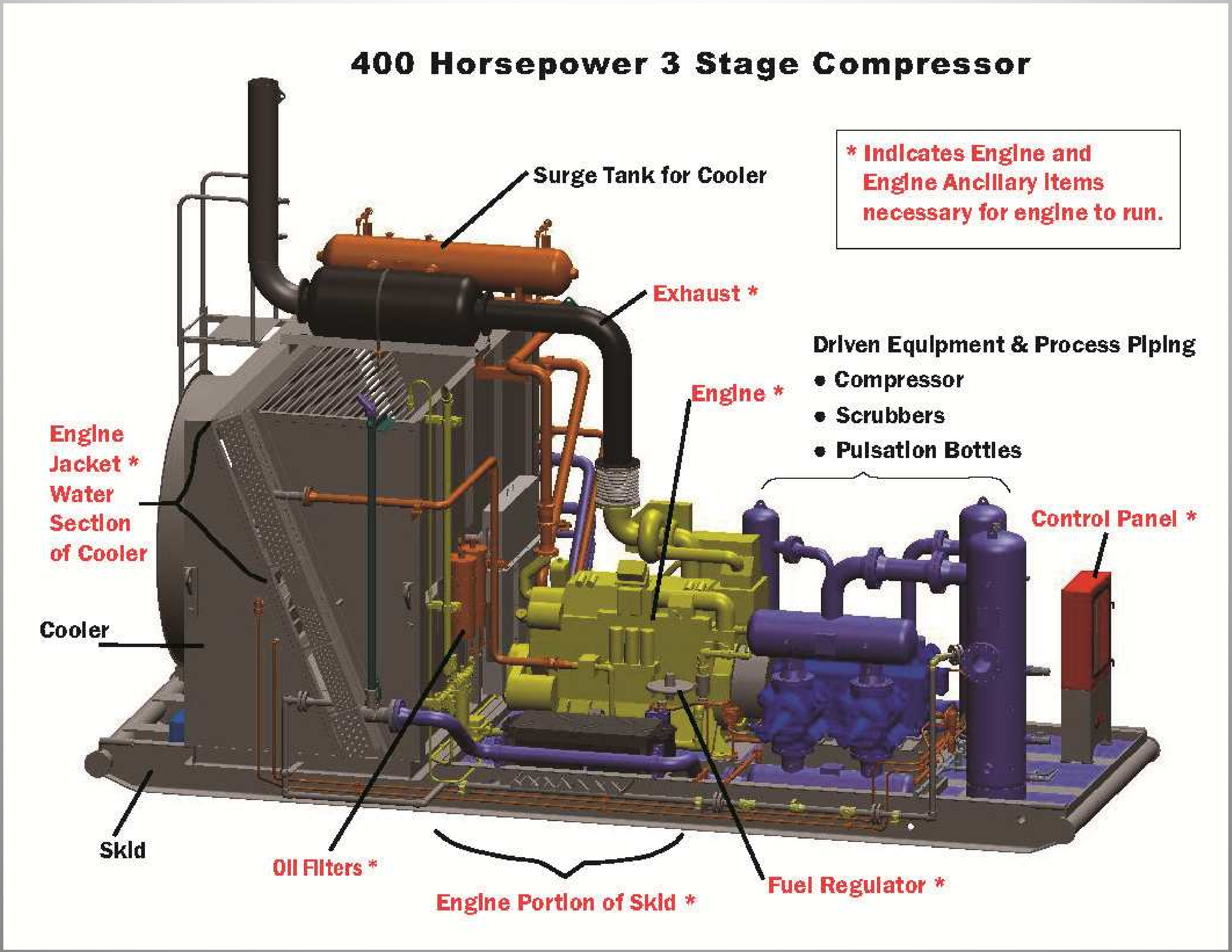
$$\frac{\text{Cost of New Components (overhaul \$'s)}}{\text{Cost of Comparable Entirely New Facility}} > 50\%$$

Facility is Reconstructed if…

$$\frac{\text{Cost of New Components (overhaul \$'s)}}{\text{Cost of Comparable Entirely New Facility}} > 50\%$$

Sounds easy enough…just add up the overhaul cost and divide by the cost of the Comparable Entirely New Facility

What is the Facility???



Definition of Facility

- The individual components to be included in the calculation are restricted to those depreciable components that are part of the affected facility as defined in the relevant subpart (JJJJ in our case).
- Subpart JJJJ does not define the affected facility!
- Assumption: the affected facility is limited to the engine itself <u>and</u> the ancillary components necessary for it to run

Definition of Facility (Cont'd)

Included in Facility

- Engine
- Ancillary Equipment necessary for engine to run
  - Cooling
  - Fuel/Start System
  - Oil System
  - Skid (foundation)
  - Controls (not emissions controls unless necessary for engine to run)

NOT included in Facility

- Driven Equipment (compressor)
- Process equipment not related to engine (gas piping, scrubbers, relief valves)
- Monitoring Equipment
- Buildings

Note: Some Components service both the engine and the driven equipment

“Reconstructed” Units are subject to 40 CFR 60 Subpart JJJJ

- “Reconstruction” is defined in 40 CFR 60.15

- Section 60.15 of the New Source Performance Standards (NSPS) specifies that reconstruction occurs if the fixed capital cost of the new components exceeds 50% of the fixed capital cost of a comparable entirely new facility

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CA-150-2


JOYCE CRANE
OVERSIZE LOAD

Final Assembly

- Install ladders, tanks, catalyst elements, and exhaust system components
- Install separable coolers
- Commission Engine

GCA Guidance Document

Link

- Define the Facility
- Pro-rating components that service both engine and driven equipment (cooler, skid)
- Define basis for pricing
- Factors to use for ancillary items and installation/start up/commissioning on a $/horsepower basis.
- What to include for various types of overhauls

Table 3 – Summary of factors for estimating Ancillary Items and Installation, Start-up and Commissioning Cost

Horsepower Range	Ancillary Items ($/HP) • Cooling system • Skid • Fuel/Start system • Controls (except emissions controls) • Labor to package • Oil system **Note: above pro-rated for engine related portion only**	Installation Costs ($/HP) • Trucking • Cranes • Hookup Labor & Parts • Commissioning • Emissions testing • Connection of Fuel and start gas **Note: above pro-rated for engine portion only**
Under 100 HP	$231 per horsepower	$48 per horsepower
100 to 199 HP	$169 per horsepower	$43 per horsepower
200 to 499 HP	$117 per horsepower	$21 per horsepower
500 to 999 HP	$114 per horsepower	$15 per horsepower
1000 to 1750 HP	$78 per horsepower	$11 per horsepower

Reconstruction analysis using GCA Method

GCA Engine Reconstruction Analysis

Unit # or Project # 1234

Current Date 1/25/2010
Date of Overhaul 1/23/2009

Engine & Package Information: 3 Stage reciprocating compressor package driven by a ACME 400 HP natural gas RICE. Old S/N = 5432, new S/N 2288.

Horsepower @ RPM 400 HP @ 1800 RPM
Type of Overhaul: Engine replacement — Choose from Menu

Cost Calculation: Existing versus New = Engine Overhaul Cost / Comparable Entirely New Facility

Where:
Numerator = engine repair, trucking, crane & startup labor costs included.
Denominator = New Engine + Ancillary + Site Installation & Startup

Actual Cost Calculation: Overhaul versus New $58,975 / $140,200 = 42.1%

Result: Engine is below reconstruction criteria

Numerator = Engine Overhaul Costs	Cost
Engine Repair parts & labor	$55,100
Trucking & Lifting Services	$675
Commissioning & Startup Labor	$3,200
Other	$0
Total Numerator	$58,975

Denominator = Comparable New Facility
Notes:

Component	Method Used	Cost
New OEM Engine Cost at time of overhaul:	Quote - identical engine	$85,000
Ancillary Items (use either method 1 or 2) 1: Generic Factors --> $46,800 2: Model Specific ---> $0	Generic Factors	$46,800
Installation, start-up and commissioning (use either method 1 or 2) 1: Generic Factors --> $8,400 2: Case Specific ------> $0	Generic Factors	$8,400
Sub-total Ancillary and Installation adders prior to PPI adjustment		$55,200
PPI Adjustment on Ancillary and Installation adders		100%
Ancillary and Installation adders after PPI adjustment		$55,200
Total Denominator (Engine cost plus PPI adjusted Ancillary/Install)		$140,200

Optional: Model Specific Ancillary Item Estimate Worksheet (use 2009 dollars)

pro-rated for engine related portion only	Estimated New Cost	% Engine related	Engine Ancillary Adder Costs (New x CGA Pro-rated %)
Engine Ancillary System Adders:			
Skid	$0	0%	$0
Engine Cooler	$0	0%	$0
Control Panel & Wiring/Tubing	$0	0.0%	$0
Fuel, Starter, Exhaust & Oil Systems	$0	0%	$0
Packaging Labor	$0	0%	$0
Total Model specific Ancillary item estimate			$0

Case Specific Installation, start-up and commissioning Estimate Worksheet (use 2009 dollars)

New Package Installation Adders:	Estimated New Cost	% Engine related	Engine Installation, start-up and commissioning Costs
Trucking	$0	25%	$0
Cranes	$0	25%	$0
Hookup Labor & Parts	$0	25%	$0
Commissioning Labor	$0	100%	$0
Fuel/Start gas Reconnection	$0	100%	$0
Emissions Testing	$0	100%	$0
Total case specific Installation, start-up and commissioning estimate			$0

GCA Engine Reconstruction Analysis

Unit # or Project #	1234	Current Date	1/25/2010
		Date of Overhaul	1/23/2009

Engine & Package Information: 3 Stage reciprocating compressor package driven by a ACME 400 HP natural gas RICE. Old S/N = 5432, new S/N 2288.

Horsepower @ RPM	400	HP @	1800	RPM
Type of Overhaul	Engine replacement			Choose from Menu

Cost Calculation: Existing versus New

$$\frac{\text{Engine Overhaul Cost}}{\text{Comparable Entirely New Facility}}$$

Where:

Numerator = engine repair, trucking, crane & startup labor costs included.

Denominator = New Engine + Ancillary + Site Installation & Startup

Actual Cost Calculation: Overhaul versus New	$58,975	/	$140,200	=	42.1%

Result: Engine is below reconstruction criteria

Numerator = Engine Overhaul Costs	**Cost**
Engine Repair parts & labor	$55,100
Trucking & Lifting Services	$675
Commissioning & Startup Labor	$3,200
Other	$0
Total Numerator	$58,975

Denominator = Comparable New Facility

Notes:

Component		Method Used	Cost
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1: Generic Factors -->	$46,800		
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Installation, start-up and commissioning (use either method 1 or 2)		Generic Factors	$8,400
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PPI Adjustment on Ancillary and Installation adders			100%
Ancillary and Installation adders after PPI adjustment			$55,200
Total Denominator (Engine cost plus PPI adjusted Ancillary/Install)			**$140,200**

GCA Engine Reconstruction Analysis

Unit # or Project # 1234

Current Date 1/25/2010
Date of Overhaul 1/23/2009

Engine & Package Information: 3 Stage reciprocating compressor package driven by a ACME 400 HP natural gas RICE. Old S/N = 5432, new S/N 2288.

Horsepower @ RPM 400 HP @ 1800 RPM
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$$\frac{\text{Engine Overhaul Cost}}{\text{Comparable Entirely New Facility}}$$

Where:

Numerator = engine repair, trucking, crane & startup labor costs included.
Denominator = New Engine + Ancillary + Site Installation & Startup

Actual Cost Calculation: Overhaul versus New

$58,975	/	$140,200	=	42.1%

Result: Engine is below reconstruction criteria

Numerator = Engine Overhaul Costs	Cost
Engine Repair parts & labor	$55,100
Trucking & Lifting Services	$675
Commissioning & Startup Labor	$3,200
Other	$0
Total Numerator	$58,975

Facility is Reconstructed if…

$$\frac{\text{Cost of New Components (overhaul \$'s)}}{\text{Cost of Comparable Entirely New Facility}} > 50\%$$

And new date of manufacture if…

$$\frac{\text{Cost of New Components (overhaul \$'s)}}{\text{Cost of Comparable Entirely New Facility}} > 75\%$$

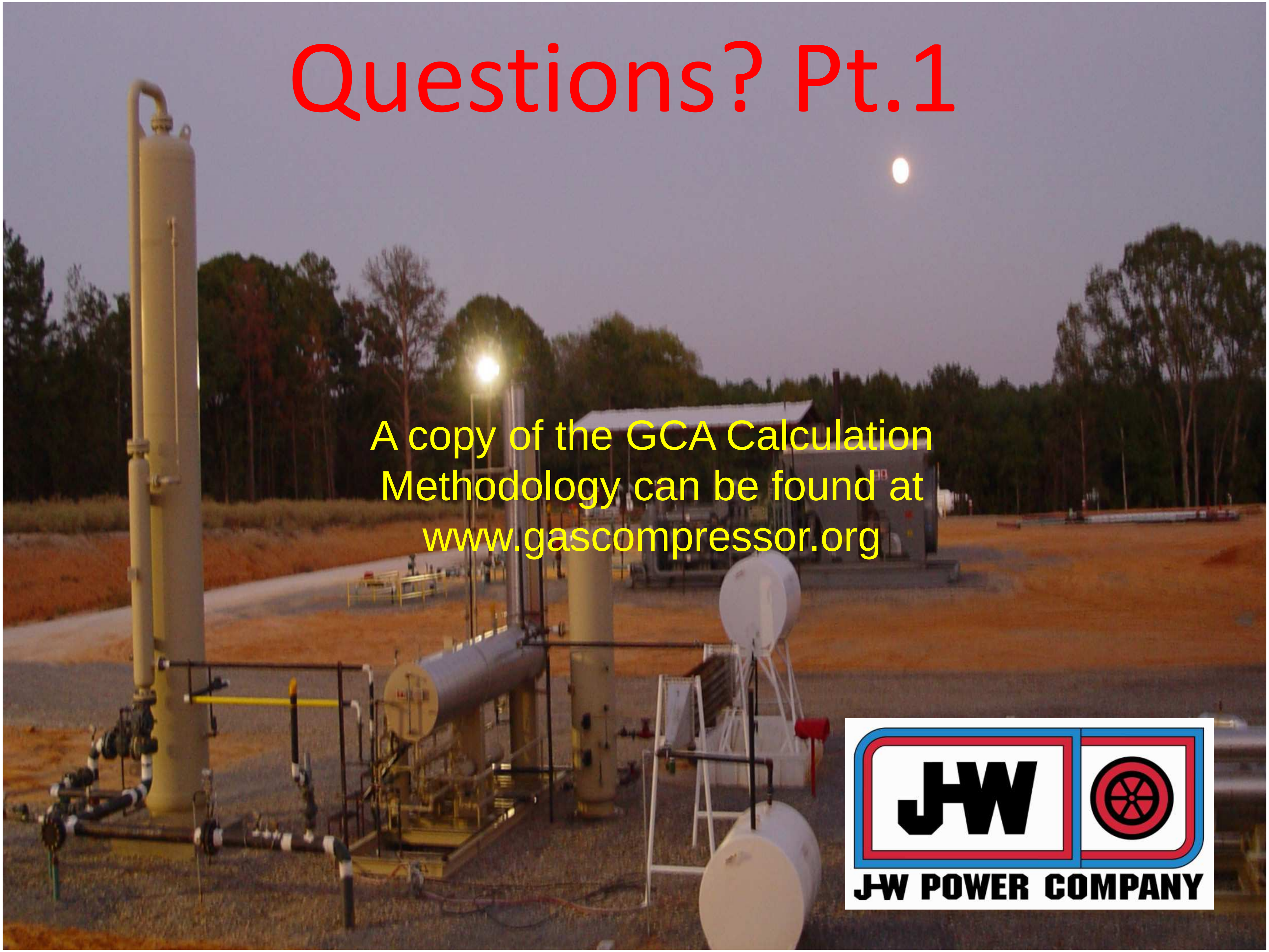
Reconstruction Guidance Summary

- Facility is more than just the engine
- Ancillary items and installation should be accounted for in the cost of the facility
- The Gas Compressors Association (GCA) has developed guidelines to assist in estimating the facility.
- 2011 Regulation requires a new date of manufacture if cost ratio exceeds 75%
- Web based tool available soon!

References

- US EPA Applicability Determination Index
  - http://cfpub.epa.gov/adi/
  - Control # NB28 dated 11/25/86
  - Control # 0200048 dated 9/3/99
  - Control # 9800085 dated 5/11/98
  - Control # 9900057 dated 04/23/98
  - Control # 0800031 dated 2/28/08

Questions? Pt.1



A copy of the GCA Calculation Methodology can be found at www.gascompressor.org

J-W POWER COMPANY

Compressor Blowdown Model

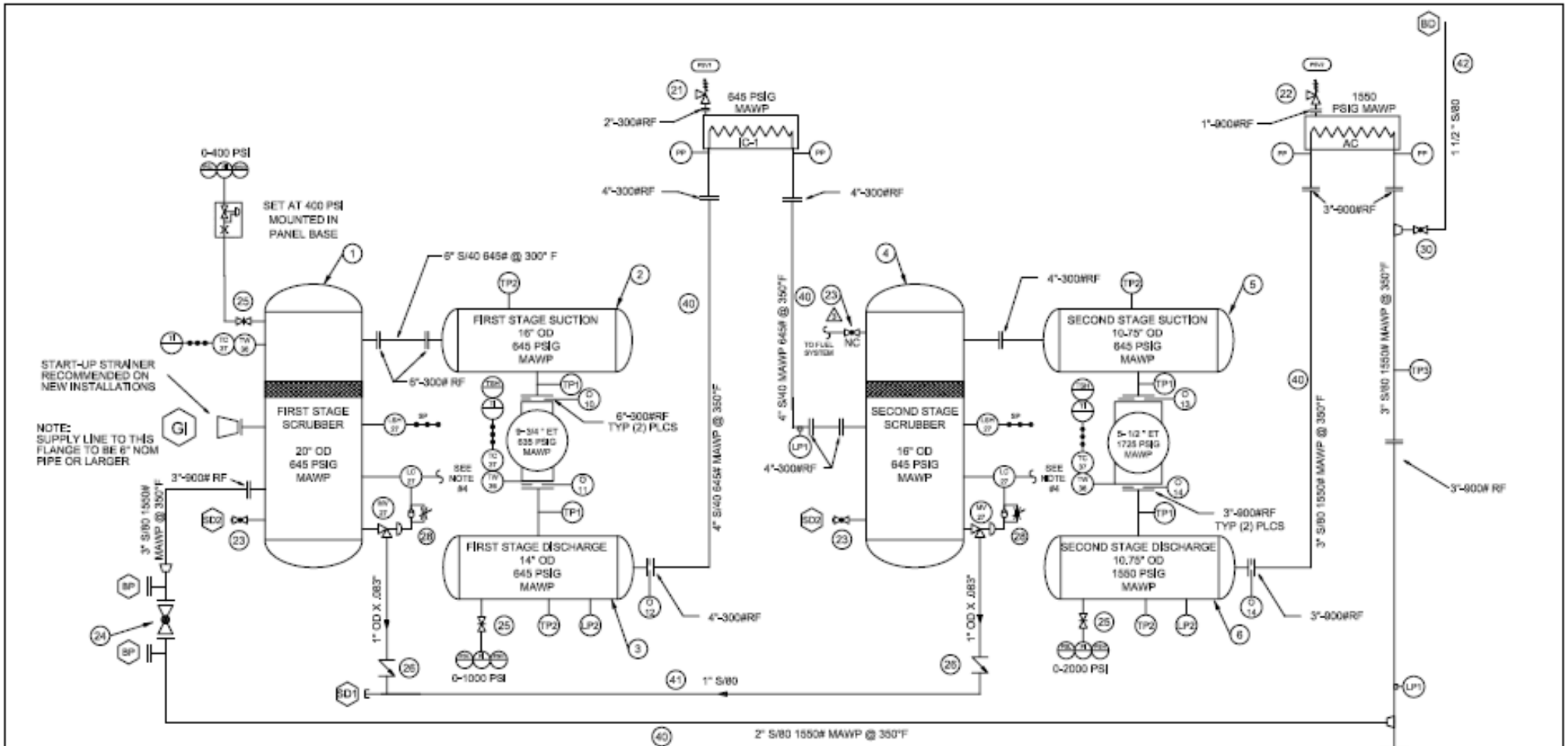
- Why do we have blowdowns
  - Maintenance
  - Starting
- Subpart W and TCEQ MSS
  - Greenhouse gas
  - Methane has CO2e of 21

Compressor Blowdown Model

- Comparison to TCEQ model
  - Regulatory Issues
  - Why it is important to be accurate
- Benefits of using the model
- ACF and SCF
- Calculation methodology and assumptions

TCEQ Venting Emission Calculation

- Uses overall pressure and temperature to determine gas volume
  - Due to the lack of instruction for the temp input, there could be variability in the model
  - Requires user to provide Actual Cubic Foot (ACF) volume
- Treats the unit as a single volume
  - Does not account for the majority of actual volume being at lower pressure
- Results in 2+ times greater predicted standard volume than detailed engineering calculations



SCHEDULE OF CONNECTIONS

MARK	SIZE	DESCRIPTION
GI	6"-300#RF	PROCESS GAS INLET
GO	3"-900#RF	PROCESS GAS OUTLET
BP	2"-900#RF	BYPASS OPTION - BLIND FLANGE (2)
BD	1 1/2" NPT	BLOWDOWN LINE
SD1	1" NPT	AUTOMATIC SCRUBBER DRAIN HEADER
SD2	1" NPT	MANUAL SCRUBBER DRAIN (2)
PP	3/4" NPT	PRESSURE POINT PLUGGED (4)
LP1	3/4" NPT	LOW POINT DRAIN- PLUGGED (2)
LP2	1/2" NPT	LOW POINT DRAIN- PLUGGED (2)
TP1	1/2" NPT	TEST POINT (PLUGGED)
TP2	3/4" NPT	TEST POINT (PLUGGED)
TP3	1" NPT	TEST POINT (PLUGGED)

PRESSURE RELIEF VALVE IDENTIFICATION

ITEM	J-W PART NO	DESCRIPTION	SET PRESSURE
PSV1	635-01705	MERCER 81-43251T21G21	635 PSIG
PSV2	635-01706	MERCER 81-17181T17G21	1550 PSIG

LEGEND

- CUSTOMER CONNECTION
- INSTRUMENT CALLOUT IN PANEL
- INSTRUMENT CALLOUT ON UNIT
- SP CONNECTION TO SAFETY PANEL

NOTES

1. ALL ANSI FLANGES OF 600# RATING OR GREATER WILL USE FLEXITALLIC TYPE 'CG' GASKETS.
2. ALL NPT CUSTOMER CONNECTIONS ARE TO BE PLUGGED.
3. BLOWDOWN VALVE VENT TO BE PIPED ABOVE THE TOP OF COOLER.
4. FILTERED SUPPLY FOR SCRUBBER LEVEL CONTROLS FROM FUEL SYSTEM.
5. ALL PROCESS PIPE TO BE SA106-B SEAMLESS.
6. ALL GAS SERVICE TUBING TO BE 304SST. EXCEPT AS NOTED GAS SERVICE TUBING WILL BE ½" X .035" WALL.

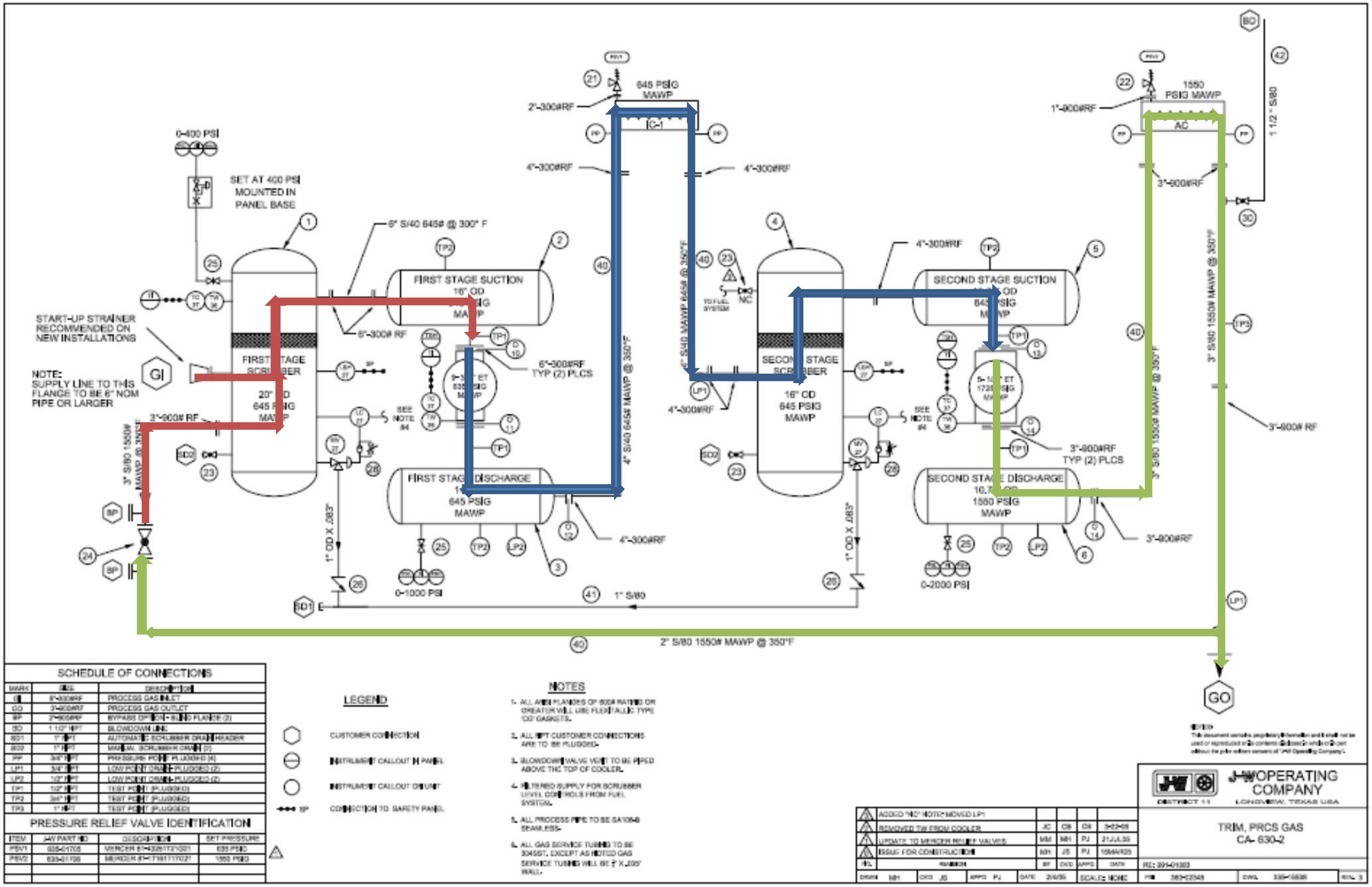
J-W OPERATING COMPANY
DISTRICT 11
LONGVIEW, TEXAS USA

TRIM, PRCS GAS
CA- 630-2

NO.	REVISION	BY	CKD	APPD	DATE
3	ADDED "NC" NOTE; MOVED LP1				
2	REMOVED TW FROM COOLER	JC	CB	CB	3-22-06
1	UPDATE TO MERCER RELIEF VALVES	MM	MH	PJ	21JUL05
0	ISSUE FOR CONSTRUCTION	MH	JS	PJ	15MAR05

DRAWN MH | CKD JS | APPD PJ | DATE 2/4/05 | SCALE: NONE

RE: 391-01303 | PN 380-02348 | DWG. 335-15536 | REV. 3

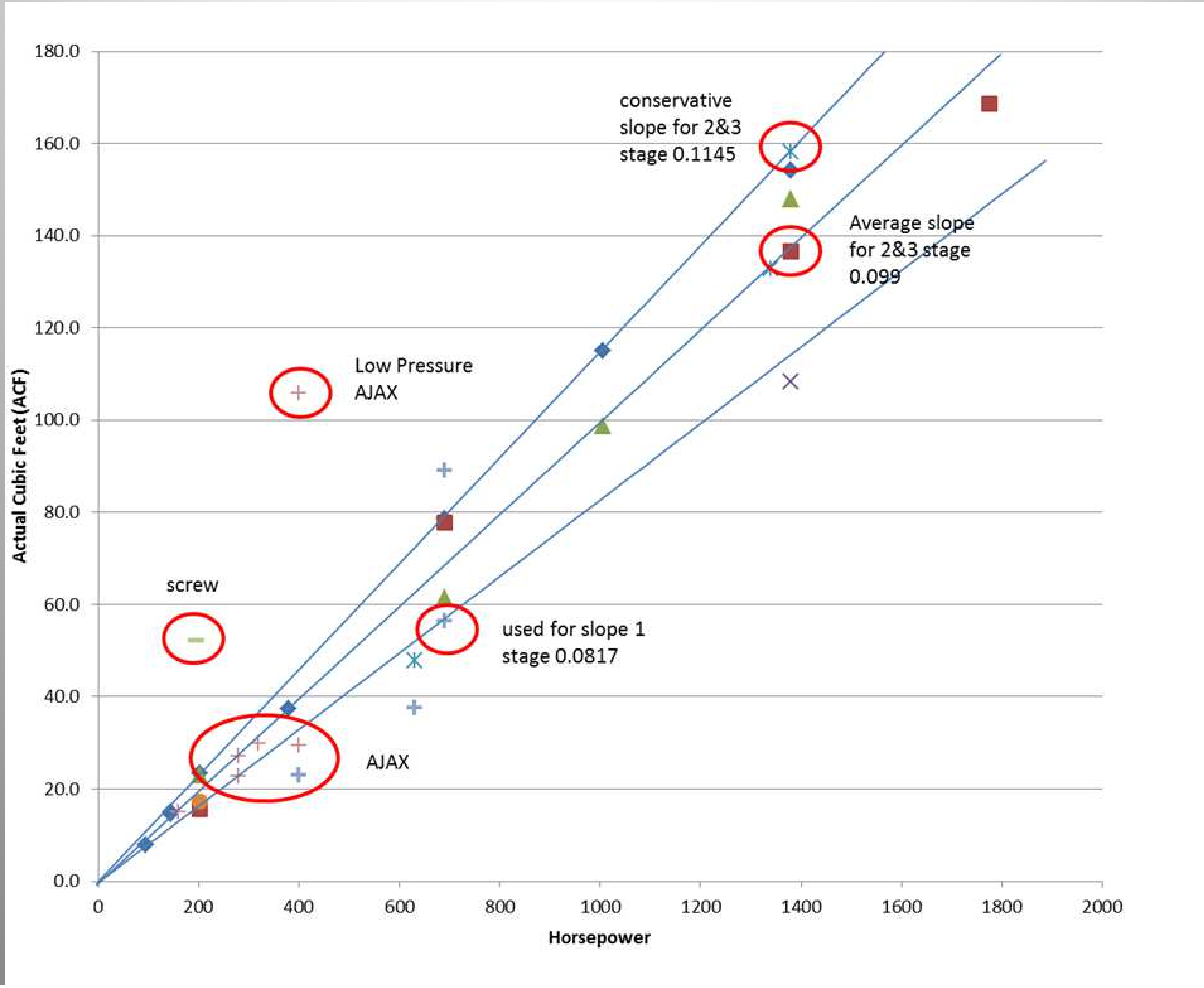


FIRST STAGE SUCTION
FIRST STAGE DISCHARGE
645 PSIG MAWP
SECOND STAGE SUCTION
SECOND STAGE DISCHARGE
1550 PSIG MAWP
16" OD
645 PSIG MAWP
SECOND STAGE SCRUBBER
1550 PSIG MAWP
AC
C-1
SET AT 400 PSI MOUNTED IN PANEL BASE
0-400 PSI
0-1000 PSI
0-2000 PSI
START-UP STRAINER RECOMMENDED ON NEW INSTALLATIONS
NOTE: SUPPLY LINE TO THIS FLANGE TO BE 6" NOM PIPE OR LARGER
6" S/40 645# @ 300° F
4" S/40 645# MAWP @ 350°F
3" S/80 1550# MAWP @ 350°F
2" S/80 1550# MAWP @ 350°F
1" S/80
1 1/2" S/80
1" OD X .083"
6"-300#RF
6"-900#RF TYP (2) PLCS
4"-300#RF
3"-900#RF
3"-900#RF TYP (2) PLCS
2"-300#RF
1"-900#RF
TO FUEL SYSTEM
NC
SEE NOTE #4
SCHEDULE OF CONNECTIONS
PRESSURE RELIEF VALVE IDENTIFICATION
LEGEND
CUSTOMER CONNECTION
INSTRUMENT CALLOUT IN PANEL
INSTRUMENT CALLOUT ON UNIT
CONNECTION TO SAFETY PANEL
NOTES
OPERATING COMPANY
LONGVIEW, TEXAS USA
TRIM, PRCS GAS
CA- 630-2

GCA Blowdown Calculation

- Larger horsepower=larger Actual Cubic Feet (ACF)
- Model uses horsepower and number of stages input by the user and a volume per horsepower ratio to conservatively determine ACF volume
- Surveyed packagers to get a typical representation of the fleet
- Data was gathered with ACF divided into streams
- The ACF number is worth its weight in gold due the vast differences from package to package

The Golden Nugget



User Input

Horsepower	1380	(minimum 50, maximum 2,400)			
# Stages	2	(must be 1, 2 or 3)			
Suction Pressure	75	psig			
Suction Temperature	60	F			
Discharge Pressure	1000	psig			
Ambient Temp	100	F			
Elevation	500	feet. Used to calculate Avg Atmoshperhic Pressure of:			
Molecular Weight	21.17				
Scrubber Dimensions (optional)		1st	2nd	3rd	
Suction Scrubber Diameter		28	18		inches
Suction Scrubber Length s/s		83	70		inches
Number of Scrubbers per stage		0	0	0	
Actual Cubic Feet		0	0	0	

Standard Conditions

Standard Pressure	14.7	
Standard Temp	60	F

Theory

- The total volume is distributed to the various streams based on number of stages
- Scrubber sizes may be entered in order to produce a more accurate result, otherwise the volume will be distributed to the streams according to a percentage breakdown
- The interstage pressures and temperatures are then calculated using theoretical formulas and a slight weighting is given to early stages as is typical in practice
- Ambient temperatures provided by the user are used to calculate temperature after cooling using a 20 degree approach
- The SCF is calculated stream by stream and then summed
- This method assumes complete blowdown of the package to atmospheric pressure
- The SCF is converted to pounds and then to weight percent of VOC, Benzene and H2S to find pounds per event of each contaminant

Assumptions and Methodology

- Head volumes are added on scrubbers
- Packages less than 250 HP do not often include pulsation bottles and distribute volume differently
- Standard conditions come from Subpart W 14A calculations
- Packagers use standard engineering to design which allows for usable results

Calculations

Total Ratios	11.34	
Ratios per stage	3.37	
Ratio 1st stage	3.70	110% Shifts ratios towards 1st stage
Ratio 2nd stage	3.06	110% shifts ratios towards 2nd stage
Ratio 3rd stage	n/a	

P&T Trails	3 Stage				
	Pressure, Psig	Temp, F	Actual cubic feet	Large 2 stage	SCF
Suction Scrubber	75	60	41.90	31%	255
Suction Other	75	60	14.50	11%	88
Discharge 1	317	221	20.13	15%	346
Suction 2 Scrubber	317	120	19.71	14%	398
Suction 2 Other	317	120	16.69	12%	337
Discharge 2	1000	271	14.72	11%	723
Suction 3 Scrubber	n/a	n/a	0.00	0%	n/a
Suction 3 Other	n/a	n/a	0.00	0%	n/a
Discharge 3	n/a	n/a	0.00	0%	n/a
Final Discharge	1000	120	8.96	7%	554
Total			136.62	100%	2702
Pounds per Event	150.803				

		Version #	14
Result:	**137**	**Total ACF**	
	2702	**Total SCF**	
	weight %	Tons per event	
VOC	25.8%	38.968	pounds per event
Benzene	7.4%	11.128	pounds per event
H2S	0.0%	0.000	pounds per event
14.45			

GCA model ACF prediction

- TCEQ requires ACF volume to be known, where the GCA model predicts ACF based on HP and number of stages saving time and money $$
- GCA predicts ACF volumes between 9% and 24% above engineering calculated ACF volume
- GCA model is less cumbersome to use
- Removes some potential for human error
- Provides a standard to compare against

SCF prediction GCA vs TCEQ

- GCA predicts SCF volume between 4% and 33% above engineering calculated volume
- TCEQ predicts SCF volume between 96% and 161% above engineering calculated volume
- The GCA model provides more accuracy while still being conservative
- State database may be used in future regulatory efforts and accuracy will increase rulemaking effectiveness.

Summary

- Both TCEQ and GCA models are conservative
- GCA model results in greater accuracy
- Mean Percent Error (MPE) for GCA model prediction of SCF is 14.37%
- MPE for TCEQ model prediction of SCF is 119.70%
- This could create permitting issues for operators by grossly over-predicting emissions
- Committee is meeting Wednesday to finalize model

GCA Emissions Guidance Document

Gas Compressor Association

Summaries of Emissions Requirements

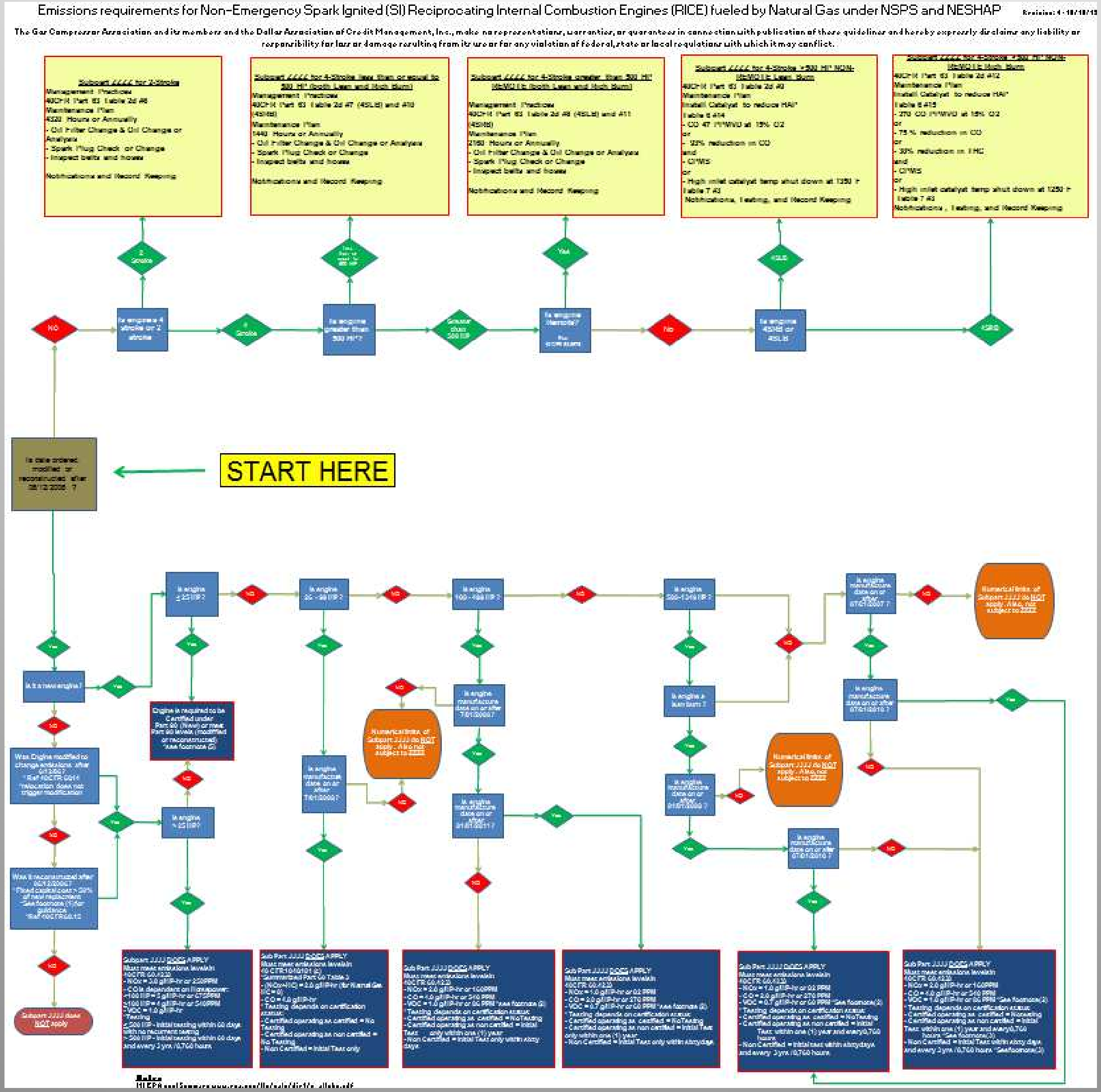
For

Natural Gas Fired Reciprocating Engines

Revision: 6
August 19, 2011

Index:

EPA Applicability Flow Chart



Thank You For Attending