

Natural Gas STAR Program Total Emission Reduction by Optimization of Compressor Utilization

Jim Haught, Director – Environment ONEOK Partners May 23, 2013





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- Existing models provided sufficient analysis for steady state commercial project assessment, however, did not contain performance data needed to assess costs of compression and optimal compressor sequence of operation
- The optimization team spent several months per pipeline reviewing data and meeting with operators at every compressor station to create models usable for this new purpose





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- This investment has yielded returns and benefits across the user groups and stakeholders
 - Customers, Environmental, Operations, Commercial, Gas Control, Safety, etc.



Model Output Manual Setup and Analysis by Engineering



-99.052 mmscfd 550.00 psig

Main Screen

Quick picture of horsepower efficiency and fuel burn

	r Das	shboard													
^D ipeline:				•	- Optimiza	tion Objective:	FUEL	-							
	Station	Operatin Status	g	Optimized Suction PSIG	Optimized Discharge PSIG	Optimized Fuel MMSCFD	Actual Suction PSIG	Actual Discharge PSIG	Actual Fuel	Actual Fuel KW	Ambient Temperature Deg F	Horsepower Utilized	Horsepower Available	Actual Horsepower	Set Pressure PSIG
HL	JMBOL										50.00	0.00	6200.00		870.00
	Unit 1	IDLE	-	0.00	0.00	0.000	0.000	0.100	0.0000	N/A				0.00	
	Unit 2	IDLE	-	0.00	0.00	0.000	0.100	0.000	0.0000	N/A				0.00	
	Unit 3	IDLE	-	0.00	0.00	0.000	0.000	0.000	0.0000	N/A				0.00	
	Unit 4	IDLE	-	0.00	0.00	0.000	0.200	0.000	0.0000	N/A				0.00	
4	NGUS										50.00	0.00	11100.00		870.00
	Unit 1	IDLE	-	0.00	0.00	0.000	0.000	0.100	0.0000	N/A				0.00	
	Unit 2	IDLE	-	0.00	0.00	0.000	0.600	1.000	0.0000	N/A				0.00	
	Unit 3	IDLE	-	0.00	0.00	0.000	0.200	0.300	0.0000	N/A				•	
	Unit 4	IDLE	-	0.00	0.00	0.000	0.000	0.000	0.0117	N/A			-uel S	avinds	
	ADA										50.00				
	Unit 1	IDLE	-	0.00	0.00	0.000	0.000	0.000	0.0000	N/A			Pos	sihle	
	Unit 2	IDLE	-	0.00	0.00	0.000	0.100	0.100	0.0000	N/A			1 000		
	Unit 3	IDLE	-	0.00	0.00	0.000	0.000	0.000	0.0000	N/A				0.00	
	Unit 4	IDLE	-1	0.00	0.00	0.000	0.000	0.000	0.0094	N/A				0.00	-
ompres	sor Station	ns Receip	pts/D	eliveries				Total Fuel (M	NSCFD) - Syi	nerGEE: 0.2	959	_	Total Fue	I - Actual: 0.5	5953
							Total Ho	orsepower -	Actual vs. (Optimal					
	5000-	1 1												Actua	инр
	4000-	+		_										Uptim	alhp
	3000-												<u> </u>		
	2000-	++		- +									<u> </u>		
	1000-	+		~											
	0 -	9:00 AM	1 1	0:00 AM 1	1:00 AM 12:	00 PM 1:00	PM 2:00	PM 3:00 PM	4 4:00 PM	5:00 PM	6:00 PM	7:00 PM 8	:00 PM	F	Print Chart
HP Tren	nding Ou	itput Log													
									C to	t/Reauma	Pausa	1 Ouerride	1 Court		Optimize
									<u></u> ta	wriesume	<u>r</u> ause			Moderrobb	

Auxiliary Screen

Performance vs Pipeline Capacity

Dashboard												
Pipeline	:	•	Optimization Objec	tive: FLIEL	•							
	Meter Name	Meter Number	Receipt or Delivery Meter	Volume MMCF	Actual Pressure (PSIG)							
•	Emerson	17003	R	280.984	828.272							
	St. Vincent	17016	R	0.000	878.828							
	Hallock	27003	D	-0.433	82 .554							
	Stephen	27004	D	-0.270	800970							
	Argyle	27005		-0.212 -0.756 -3.163	785. 183		1					
	Warren	27006			766.023	Volumes can be						
	Thief River Falls	27051			754.086	changed here to						
	East Grand Forks	27007	l I	-3.463	691.285							
	North American F	27083	C	0.000	684.132	calculate additional						
	Grand Forks	27008	D	-26.010	688 945	averhead expense						
	Crookston	27009	D	-5.873	725,929	overneau expense						
	Ada	27010	D	-0.678	672.153							
	Hawley	27014	D	-1.217	\$33.933							
	Moorhead	27011	D	-11.794	610.666							
	Fergo	27012	D	-35 561	610.066							
Compre	Compressor Stations Receipts/Deliveries Total Fuel (MMSCFD) - SynerGEE: 0.000 Total Fuel - Actual: 0.6055											

Actual vs. Optimal

	Station	Operatin Status	9	Optimized Suction PSIG	Optimized Discharge PSIG	Optimized Fuel MMSCFD	Actual Suction PSIG	Actual Discharge PSIG	Actual Fuel MMSCFD	Ambient Temperature Deg F	Horsepower Utilized	Horsepower Available	Set Pressur PSIG
	M118									59.00	3537.74	9739.61	855.31
	Unit 1	RUN	~	613.65	858.31	0.349	642.397	789.855	0.232				
	Unit 2	RUN	~	613.65	858.31	0.349	-0.415	0.411	0.000				
	Unit 3	IDLE	~	0.00	0.00	0.000	642.312	789.007	0.230				
	Unit 4	IDLE	~	0.00	0.00	0.000	0.708	-0.458	0.000				
	M115						727.000	728.000		60.00	0.00	3661.39	818.28
	Unit 1	OFFLINE	~	0.00	0.00	0.000			0.000				
	Unit 2	OFFLINE	~	0.00	0.00	0.000			0.000				
	Unit 3	IDLE	~	0.00	0.00	0.000			0.00				
	M113									60.00	0.00	10239.87	753.00
	Unit 1	IDLE	~	0.00	0.00		Graat	iohl	00				
	M110						Oreat	JOD:		60.00	0.00	11828.39	849.32
	Unit 1	IDLE	~	0.00	0.00				00				
	Unit 2	IDLE	~	0.00	0.00	0.000		6.933	0.000				
		IOL F	1000	0.00	0.00	0.000	-		0.000				
ressor	Stations R	eceipts/Deliv	ries				-	oral Fi	uel - SynerGEE:	0.622	Total	Fuel - Actual:	0.698
						Total Hor	sepower - A	ctual vs. Op	timal				
8	3000		-									Ao	tual HP
6	5000											Op	undinr
	4000				_				+				
2	2000												
	₀⊥↓												
	3:00	AM 4:007	AIM	5:00 AM 6	:00 AM 7:00	AM 8:00 AN	1 9:00 AM	10:00 AM 11:	00 AM 12:00	PM 1:00 PM	2:00 PM		

Output Analysis Management Tool





• Commercial optimization for daily capacity



- Commercial optimization for daily capacity
- Optimum fuel usage



- Commercial optimization for daily capacity
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- Reduced compressor start up/blow downs



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- Reduced emissions



Questions?

