Compressor Optimization Study

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Problem Statement

- A company region has ~50 rental compressors. The compressors are configured to operate at a given design point and have some operating flexibility around this design point. After a few years of operation, the required production flow and pressures of the compressors can change dramatically. In some cases, the compressor performance envelope is no longer optimally suited for the current flow and pressure conditions.

- It's possible that the compressor begins to operate inefficiently, resulting in lost production due to increased fuel consumption of the compressor driver. Compression inefficiency will also result in higher than necessary exhaust emissions of CO & CO2, both greenhouse gases.

- It's also possible that the compressor horsepower is oversized resulting in higher than necessary monthly rental payments to the compressor supplier.

- This project evaluates the potential to mitigate the above-mentioned problems by "Optimizing" the compressor fleet within a specific region.

Agenda

- Defining Optimization
- Summary of Work
  - Data gathering
    - Fuel, emissions, and rental rates
    - Logistics, switching, and permit costs
  - Data analysis
    - Supplier advised
    - Zero based approach
- Conclusions

What is Optimization?

- **Phase 1**
  - What it is: Right sizing individual compressors without any changes to the system hydraulics.

Location	Total Monthly Rate	HP Required at Current Conditions	Rated HP of Existing Unit	% Load
A	$ __.___	259	505	51.3%
B	$ __,___	389	505	77.0%
C	$ __.___	154	421	36.6%
D	$ __,___	78	301	25.9%
E	$ __.___	444	1,147	38.7%
F	$ __,___	790	1,550	51.0%
G	$ __.___	350	811	43.2%
H	$ __,___	180	332	54.2%
I	$ __,___	1,046	1,533	68.2%
Totals	**$ xxx,xxx**			**51.9%**

- **Phase 2**
  - What it is: Review of system hydraulics to determine if we have compression in the right places.

Project Deals with Phase 1. Phase 2 would be an Engineering led project, not Global Procurement led project

Data Gathering- Logistics & Switching Costs

- Objective- Identify cost components for switching out compressors
  - Cost Elements Identified
    - Freight
    - Crane Rental
    - Materials
    - Labor
    - Permits
    - Fuel
    - Deferred Production

Data Gathering- Logistics & Switching Costs

Unit or Horsepower→	AJAX	0-120	120-200	200-500
Removal Costs				
Installation Costs				

Unit or Horsepower→	500-1,000	1,000-1,600 (L)	1,000-1,600 (G)
Removal Costs			
Installation Costs			

Compressor Switch Out Costs Identified by Model / Size

Data Gathering- Fuel, Emissions & Rental Rates

- Two Main Strategies to Optimize Rental Fleet

1. Supplier advised: Ask the supplier to give their “right sizing” recommendations on all compressors based on alternative units that they currently have in inventory

2. Zero based approach: Ask the supplier to give their “right sizing” recommendations on all compressors based on alternative units, regardless of the unit inventory status.

Recommendation: Use a power margin during “Right Sizing” efforts

Data Analysis- Supplier Advised

Values without change-out production loss

	Lease Name	Operating Load, HP	Annual Value of Production Delta ($)	Annual Rental Rate Delta ($)	Annual Total of Production and Rental Rate Deltas ($)	3-Year Total of Production and Rental Rate Deltas ($)	Change-out Costs	1- Year Sub-Total, Benefit / (Cost)	3- Year Sub-Total Benefit / (Cost)
1	J	811	($20,236)	$__,___	$17,684	$53,053	($45,000)	($27,316)	$8,053
2	B	389	$30,289	$__,___	$41,473	$124,419	($35,000)	$6,473	$89,419
3	G	350	$24,087	$__,___	$71,943	$215,828	($35,000)	$36,943	$180,828
4	C	154	$6,501	$__,___	$70,437	$211,312	($24,200)	$46,237	$187,112
5	A	259	$20,131	$__,___	$31,315	$93,946	($35,000)	($3,685)	$58,946
6	D	78	$3,450	$__,___	$30,534	$91,603	($22,200)	$8,334	$69,403
	Totals		**$64,223**	**$199,164**	**$263,387**	**$790,162**	**($196,400)**	**$66,987**	**$593,761**

***Excludes* Lost Production During Change-out**

~$600,000 Savings before production loss

Data Analysis- Supplier Advised

Values with change-out production loss

	Lease Name	Operating Load, HP	1- Year Sub-Total Benefit / (Cost)	3- Year Sub-Total Benefit / (Cost)	Value of Lost Production During Change-out	1- Year Net Benefit / (Cost)	3- Year Net Benefit / (Cost)
1	J	811	($27,316)	$8,053	$192,500	($219,816)	($184,477)
2	B	389	$6,473	$89,419	$74,800	($68,327)	$14,619
3	G	350	$36,943	$180,828	$82,500	($45,557)	$98,328
4	C	154	$46,237	$187,112	$35,200	$11,037	$151,912
5	A	259	($3,685)	$58,946	$88,000	($91,685)	($29,054)
6	D	78	$8,334	$69,403	$48,400	($40,066)	$21,003
	Totals		**$66,987**	**$593,761**	**$521,400**	**($454,414)**	**$72,361**

~$600,000 shrinks to <$100,000 savings with production loss

Data Analysis- Zero Based Approach

A Word about Emissions

Data Analysis- Zero Based Approach

Values without change-out production loss

	Lease Name	Operating Load, HP	Annual Value of Production Delta ($)	Annual Rental Rate Delta ($)	Annual Total of Production and Rental Rate Deltas ($)	3-Year Total of Production and Rental Rate Deltas ($)	Change-out Costs	1- Year Sub-Total, Benefit / (Cost)	3- Year Sub-Total Benefit / (Cost)
1	D	78	$1,256	$__,___	$33,464	$100,393	($35,167)	($1,702)	$65,227
2	G	350	$34,231	$__,___	$80,587	$241,763	($49,967)	$30,620	$191,796
3	B	389	$11,271	$__,___	$35,859	$107,579	($37,663)	($1,804)	$69,916
4	E	443	$5,516	$__,___	$150,200	$450,601	($37,000)	$113,201	$413,602
5	J	810	$(7,921)	$__,___	$56,398	$169,195	($45,355)	$11,043	$123,840
6	K	823	$(8,047)	$__,___	$56,272	$168,816	($45,107)	$11,165	$123,709
7	L	1,046	$49,228	$__,___	$145,804	$437,412	($49,967)	$95,837	$387,445
	Totals		**$85,536**	**$473,052**	**$558,588**	**$1,675,764**	**($300,228)**	**$258,360**	**$1,375,536**

***Excludes* Lost Production During Change-out**

~$1.4MM Savings before production loss

Data Analysis- Zero Based Approach

Values with change-out production loss

	Lease Name	Operating Load, HP	1- Year Sub-Total Benefit / (Cost)	3- Year Sub-Total Benefit / (Cost)	Value of Lost Production During Change-out	1- Year Net Benefit / (Cost)	3- Year Net Benefit / (Cost)
1	D	78	($1,702)	$65,227	48,400	($50,102)	$16,827
2	G	350	$30,620	$191,796	82,500	($51,880)	$109,296
3	B	389	($1,804)	$69,916	74,800	($76,604)	($4,884)
4	E	443	$113,201	$413,602	114,400	($1,199)	$299,202
5	J	810	$11,043	$123,840	192,500	($181,457)	($68,660)
6	K	823	$11,165	$123,709	192,500	($181,335)	($68,791)
7	L	1,046	$95,837	$387,445	247,500	($151,663)	$139,945
	Totals		$258,360	$1,375,536	952,600	($694,240)	$422,935

~$1.4MM shrinks to <$500,000 savings with production loss

Conclusions

1. A significant savings opportunity exists when production loss is minimized (in this case ~$1.4MM over 7 units)
2. Production loss is minimized when change out occurs during normal maintenance periods
3. Significant savings can be achieved from rental rate reduction
4. Site specific permitting issues need to be considered
5. Care must be taken to not decrease system reliability
6. Good business practice → Supplier's cooperation should result in an upside for the supplier such as committed future business, etc..