Convert Gas Pneumatic Controls to Instrument Air

Lessons Learned

from Natural Gas STAR Partners

EPA's Natural Gas STAR Program,

Pioneer Natural Resources USA, Inc., and

The Gas Processors Association

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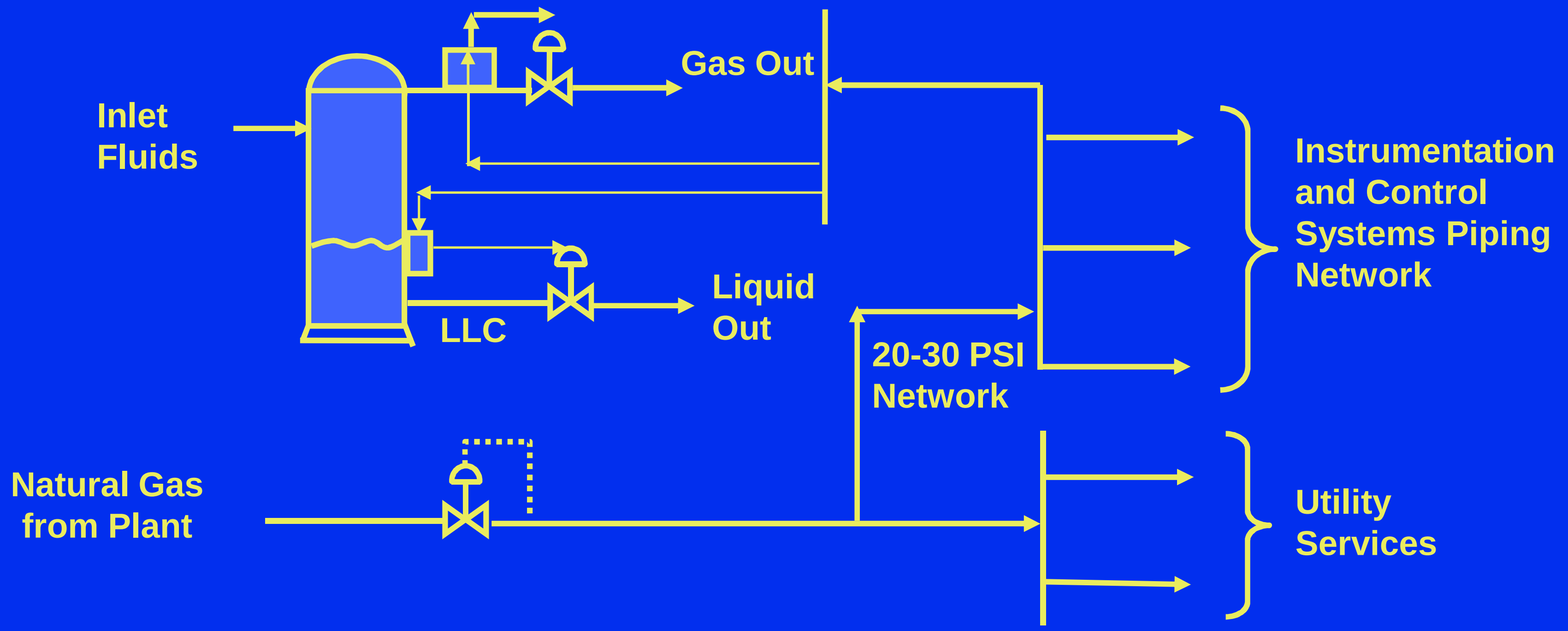
Air Pneumatic Devices

- Methane Losses
- Methane Recovery
- Is Recovery Profitable?
- Spreadsheet-based Analytical Tools
- Industry Experience
- Discussion Questions

Natural Gas Pneumatic System



LLC: Liquid Level Controller

Sources of Methane Losses

- As part of normal operations, pneumatic devices release natural gas into the atmosphere
- High-bleed devices bleed in excess of 6 scf per hour
  - Equates to >50 Mcf/ year
  - Typical high-bleed pneumatic devices bleed an average of 140 Mcf/year

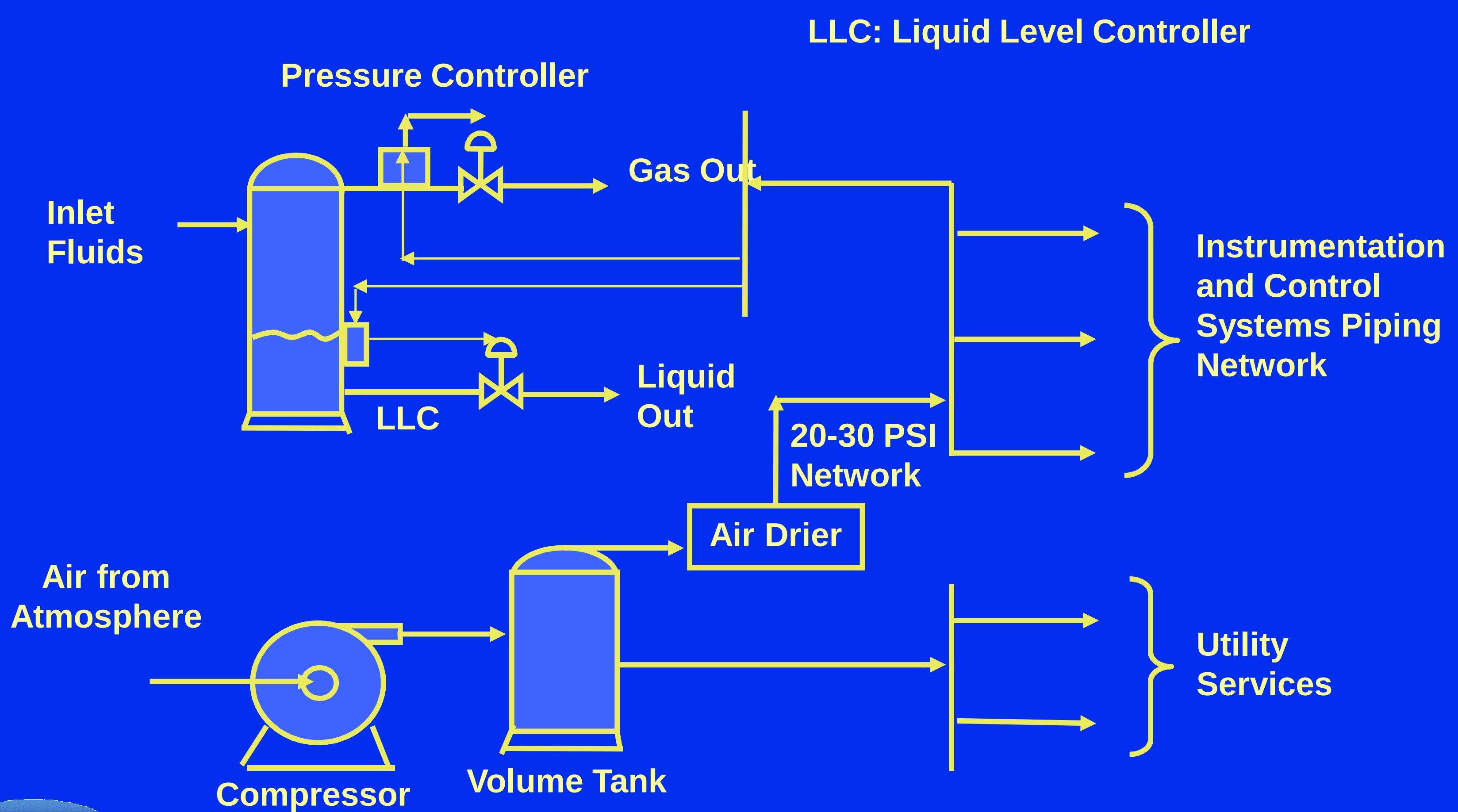
Magnitude of Methane Losses

- Major source of methane losses from the natural gas industry
- Pneumatic devices are used throughout the natural gas industry
  - Over 13,000 in the processing sector
  - Estimated methane loss of 16 Bcf/year = $48 million!

Convert to Instrument Air devices

- Most applicable to:
  - Large facility with high bleed pneumatic devices and has access to electricity
- Major components of instrument air system
  - Compressor
  - Power Source
  - Air Drier
  - Volume Tank

Compressed Instrument Air System



Instrument Air Decision Process

- Identify possible locations for system installations
- Determine optimal system capacity
- Estimate project costs
- Estimate gas savings
- Evaluate economics
- Develop an implementation plan

Determine Optimal System Capacity

- Instrument Air Requirements
  - Volume of the compressed air
    - Meter pneumatic gas supply
    - Rule of Thumb: 1 cfm air/control loop
  - Adjust for air losses
    - 17% of air input is bypassed in drier
- Utility Air Requirements
  - Rule of Thumb for pneumatic air systems:
    - 1/3 for instrument air
    - 2/3 for utility air

Calculate Gas Savings

- Determine the Gas Value Saved
  - Value of Gas = $(IA_u + UA_u)$ * M * P/1000
    - IA_u= Instrument Air Use: e.g. 35 control loops
    - UA_u= Utility Air Use: e.g. assume 10 cfm utility gas
    - M = Minutes in a year (525,600)
    - P = Price of Gas: assume $3.00/Mcf
  - Value of Gas = (35*1 + 10) * 525,600 * 3.00 / 1,000
    - Value of Gas Saved = $ 71,000/year

Calculate Compressor Size

- Determine Air Compressor Capacity
  - Air Compressor Capacity = $IA_S + UA_S$
    - IA_S = Instrument Air Supply
      = IA_U / (100% - % air bypassed in drier)
    - UA_S = Utility Air Supply
      = IA_U * (fraction of utility air use) / (fraction of instrument air use)
  - Air Compressor Capacity
    = [(35 /(100% - 17%)) +((35*(2/3))/(1/3))] = 112 cfm

Determine Compressor Costs

Service Size	Air Volume (cfm)	Compressor Type	Horsepower	Equipment Costs ($)	Annual Service ($/yr)	Service Life (yrs)
Small	30	Reciprocating	10	2,500 [1]	300	1
Medium	125	Screw	30	12,500	600	5-6 [2]
Large	350	Screw	75	22,000	600	5-6 [2]

[1] Cost included package compressor w ith a volume tank.

[2] Rebuilt compressor costs $3,000 plus $500 labor minus $500 core exchange credit.

Determine Cost of Tank

Service Size	Air Volume (gallons)	Equipment Cost ($)
Small	80	500
Medium	400	1,500
Large	1,000	3,000
Small reciprocating air compressors, 10 horsepow er and less, are commonly supplied w ith a volume tank.		

Determine Cost of Drier

Service Size	Air Volume (cfm)	Drier Type	Equipment Cost ($)	Annual Service ($/yr)
Small	30	membrane	1,500	500
Medium	60 [1]	membrane	4,500	2,000
Large	350	alumina	10,000	3,000
1 Largest membrane size; use multiple units larger volumes.				

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Calculate Capital and Operating Costs

- Determine Capital Cost
  - Equipment Cost =
    Compressors Cost (2)+Tank Cost (2)+Dryer Cost
    = 2*$12,500 + 2*$500 + 1*$4,500
  - Equipment Cost * Installation Cost Factor
    Total Capital Cost = $30,500*1.5 = $45,750
- Determine Operating Cost
  - Electrical Power = $13,140
    Engine Power * Operating Factor * Electricity Cost

Economics of Replacement

	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5
Installation Cost ($)	(45,750)					
O&M Cost ($)	0	(13,140)[1] (3,200)[2]	(13,140) (3,200)	(13,140) (3,200)	(13,140) (3,200)	(13,140) (3,200)
Overhaul Cost ($)	0	0	0	0	0	(4,800) [3]
Total Cost ($)	(45,750)	(16,340)	(16,340)	(16,340)	(16,340)	(21,140)
Gas Savings ($)	0	71,000 [4]	71,000	71,000	71,000	71,000
Annual Cash Flow ($)	(45,750)	54,660	54,660	54,660	54,660	49,860
Cumulative Cash Flow ($)	(45,750)	8,910	63,570	118,230	172,890	222,750
Payback Period (months)						**10**
IRR						**117 %**
NPV [5]						**$158,454**

[1] Electrical Power at 7.5 cents/ kWh.
[2] Maintenance costs include $1,200 compressor service and $2,000 air drier membrane replacement
[3] Compressor overhaul cost of $3,000, inflated at 10% per year
[4] Value of gas = $3.00/Mcf
[5] Net Present Value (NPV) based on 10% discount rate for 5 years

Partner Experience: Spirit Energy '76

- Installed air compression system in its Fresh Water Bayou facility
- Project Cost = $60,000
- Emissions Reductions = 69,350 Mcf/year
- Savings = $208,050 /year
- Payback Period < 4 months

Partner Experience : Texaco

- Installed compressed air system to drive pneumatic devices in 10 South Louisiana facilities
- Project Cost = $40,000
- Emissions Reductions = 23,000 Mcf/year
- Savings = $69,000 / year
- Payback Period ~ 7 months

Lessons Learned

- Instrument air system has potential to increase revenue and cut methane emissions
- It may extend the life of system equipment
- Installing low-bleed devices in conjunction with switch to instrument air is economical
- Existing infrastructure can be used
- Rotary air compressors lubricated with oil must be filtered ahead of membrane dryer

Other Technologies

- Liquid nitrogen system
  - Expensive and potential safety hazard
- Mechanical controls and instrumentation system
  - No power source needed
  - Limited application, frequent calibration required
- Electric and electro-pneumatic devices

Discussion Questions

- To what extent are you implementing this BMP?
- How can this Lessons Learned study be improved upon or altered for use in your operation(s)?
- What are the barriers (technological, economic, lack of information, etc.) that are preventing you from implementing this technology?