

Colorado School of Mines Heating Plant

Andrew Mudd, Colorado School of Mines

Campus Steam

- Under Capacity
- Reliant on 3rd Party
- Rising Expenses
- Supply Line imminent failure

Heating Plant

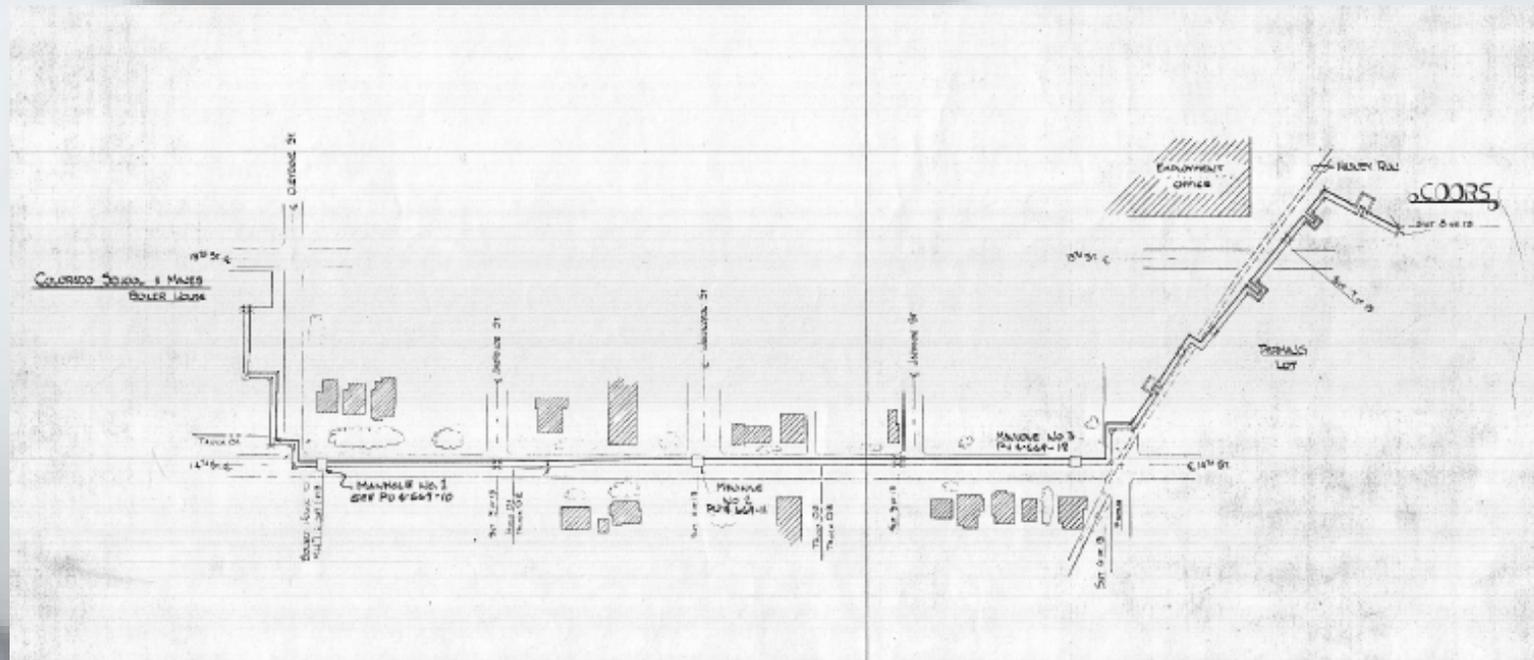
- Old and Failed Equipment with asbestos
- State mandated building audit score less than 60%

1971 Remodel

- 1971 campus was over capacity with zero redundancy. Every new building was being built with a self-serving boiler
- 1971 first remodel; estimated cost \$226,000
- Replaced old Babcock and Wilcox boilers with two 40,000 lb./hr Riley water tube boilers
- Installed new deaerating feed tank
- Decommissioned use of coal and use natural gas
- Operated continuously for 11 years before purchasing steam from Coors Brewery

Coors Builds Steam Line Through Golden

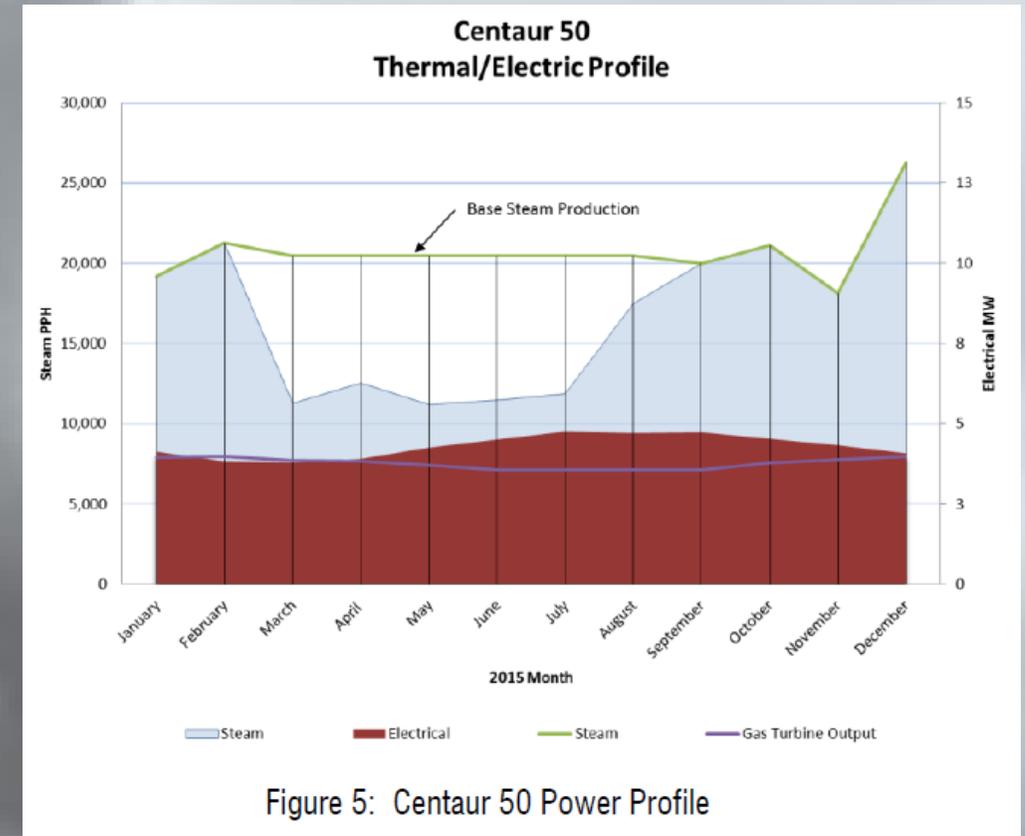
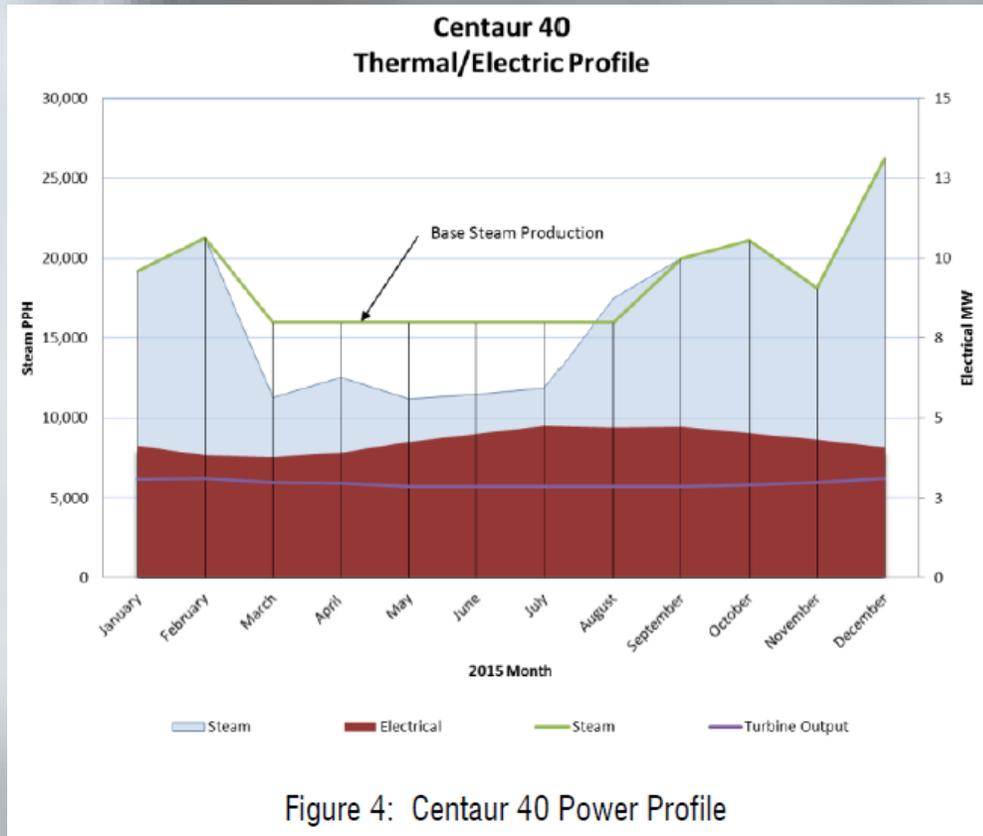
- 1982 Coors was operating a COGEN (CHP) Plant. Their discharged process steam was piped approximately 1/4 mile through downtown Golden



Investigating Options

- Consulting Engineering Firms in 2012
- Steam Distribution Study and CHP Study conducted
- CHP not economically feasible (too expensive)
- Personnel
- Real Estate
- Matching existing steam load with existing electric load (absorption chillers installed throughout campus)

CHP (Combined Heat and Power) Analysis



Construction

- Commenced in 2016
- Operational equipment without a roof through winter
- Operating on Coors Steam through start up and commissioning
- Installing temporary DA shed in the parking lot
- Contractor feuds cause multiple delays in the project

Removal of Old DA Tank for Temporary Install



No Roof for 2016/2017 Winter



Concrete Insulating Blankets



Installed to keep operational steam piping safe during cold weather.

Keeping Coors Steam Supply Line Warm

The Coors supply line was kept on a slow bleed to keep from going cold during commissioning



Being Respectful Neighbors



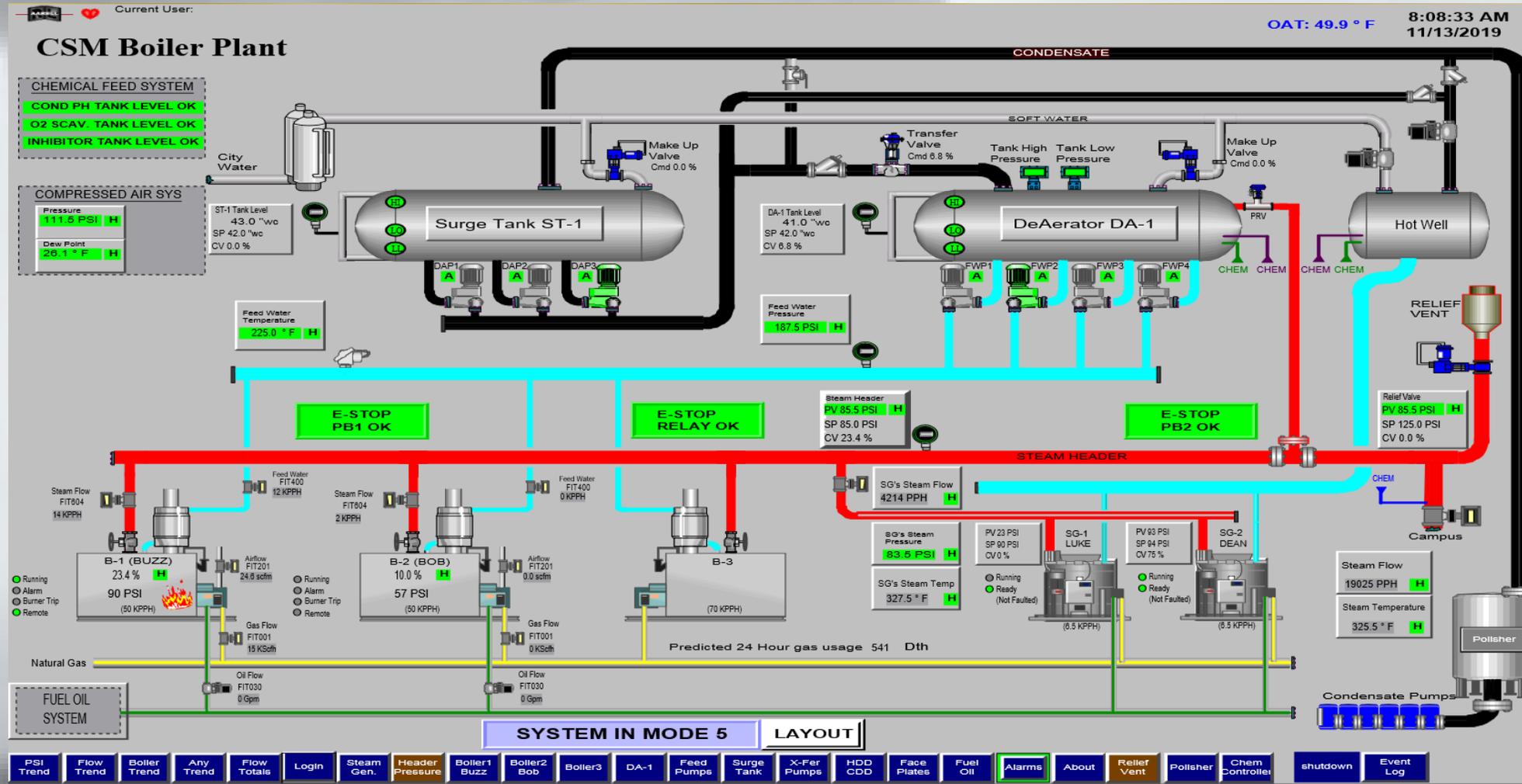
Construction Complete



Using Technology

- Plant operates automatically; starting/stopping equipment based on load/demand
- Individual equipment controls integrated with Master Plant control
- Phone alarm dialers in plant and in strategic points in the steam distribution system
- PLC controls allow remote view and operation of the plant
- Extra safety measures utilized in order to mitigate risks from operating unmanned

PLC Controls



Cost Savings Analysis

- Coors Steam \$13.11 per 1000 lbs. steam
- Heating Plant Steam \$6.14 per 1000 lbs. steam
- 1st year savings over \$0.5 million including staff salaries and benefits

Daily Predicted and Average Readings												
Avg Steam Production since midnight	28973	Lbs/ Hour	<table border="1"> <tr> <td>Predicted Boiler Dth by gas usage</td> <td>852</td> </tr> <tr> <td>Predicted STG Dth by steam</td> <td>8</td> </tr> <tr> <td>Predicted Total Dth</td> <td>860</td> </tr> </table>	Predicted Boiler Dth by gas usage	852	Predicted STG Dth by steam	8	Predicted Total Dth	860			
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Predicted Total Dth	860											
Predicted 24 Hour gas usage	916	Dth										
Avg Boiler Gas consumption since midnight	32	KSCF/ Hour										
Predicted 24 Hour V-Cone	695341	Lbs.	<table border="1"> <tr> <td>Yesterday's Dth</td> <td>757</td> </tr> <tr> <td>Predictions</td> <td>736</td> </tr> </table>	Yesterday's Dth	757	Predictions	736					
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Predictions	736											
Predicted 24 Hour Steam Gen	6383	Lbs.										
Predicted 24 hour lbs/Dth	759	Lbs/Dth										
<table border="1"> <tr> <td>Boiler 1 Efficiency</td> <td>81</td> <td>%</td> </tr> <tr> <td>Boiler 2 Efficiency</td> <td>89</td> <td>%</td> </tr> </table>				Boiler 1 Efficiency	81	%	Boiler 2 Efficiency	89	%			
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<table border="1"> <tr> <td>Boiler 1 Daily Efficiency</td> <td>85</td> <td>%</td> </tr> <tr> <td>Boiler 2 Daily Efficiency</td> <td>89</td> <td>%</td> </tr> </table>				Boiler 1 Daily Efficiency	85	%	Boiler 2 Daily Efficiency	89	%			
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<table border="1"> <tr> <td colspan="3">Yesterday's Boiler Efficiency</td> </tr> <tr> <td>Boiler 1 Daily Efficiency</td> <td>23</td> <td>%</td> </tr> <tr> <td>Boiler 2 Daily Efficiency</td> <td>89</td> <td>%</td> </tr> </table>				Yesterday's Boiler Efficiency			Boiler 1 Daily Efficiency	23	%	Boiler 2 Daily Efficiency	89	%
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<table border="1"> <tr> <td>Predicted Dth with 1 SG on Oil for 12 hours</td> <td>774</td> </tr> </table>			Predicted Dth with 1 SG on Oil for 12 hours	774								
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Efficiency is Our Mission

- Daily efficiency monitoring BTU in BTU out
- 98% condensate return
- Monthly trap maintenance
- Annual insulation refurbishment
- Peak shaving gas usage
- Make-up water savings by installing a Condensate Polisher

Preparing for the Future

- Increasing steam distribution capacity for new construction on campus
- Replacing 70,000 lb./hour boiler with new/updated controls to integrate into system
- Completing end of campus steam loops for steam supply redundancy
- Upgrades for easier maintenance and operation

Questions?

THANK YOU

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