

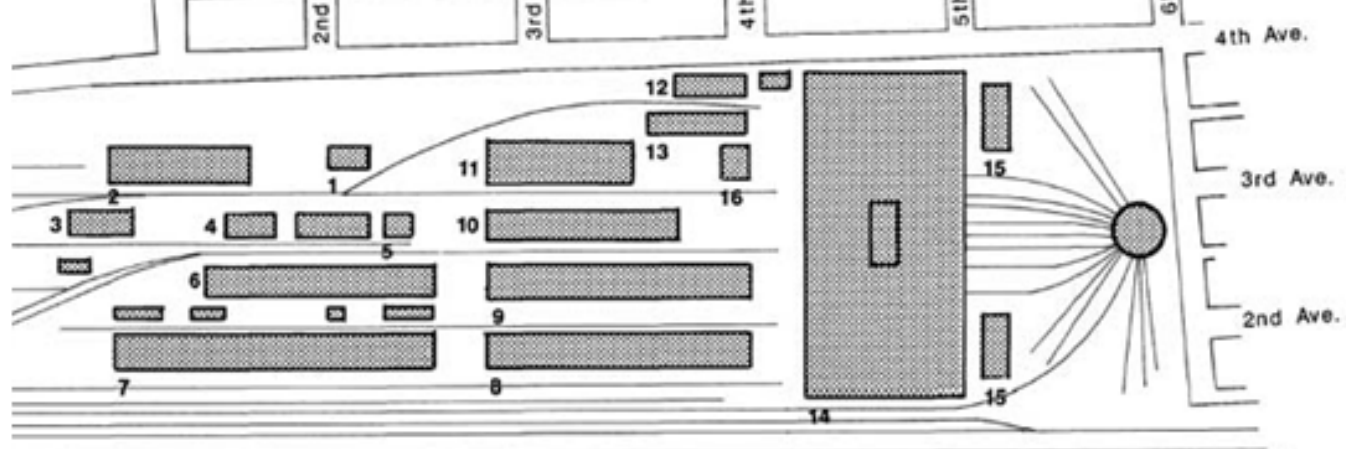
Railroad Sustainability Symposium

Combined Heat/Power Energy Improvement Project

Bill Hodan – Amec Foster Wheeler Environment & Infrastructure
Russ McDaniel & Esi Waters – Norfolk Southern

*The Rail Transportation and Engineering Center (RailTEC)
University of Illinois at Urbana-Champaign*
November 2, 2016

History



 JUNIATA SHOPS (CA 1931)

- | | |
|-------------------------------------|----------------------------------|
| 1. OFFICE OF GENERAL SHOP INSPECTOR | 10. STOREHOUSE & OFFICE BUILDING |
| 2. BLACKSMITH SHOP #2 | 11. MACHINE SHOP #2 |
| 3. SCALE SHOP | 12. FLUE SHOP |
| 4. POWER PLANT | 13. AIR BRAKE SHOP |
| 5. BOILER HOUSES 1 & 2 | 14. ERECTING & MACHINE SHOP |
| 6. BLACKSMITH SHOP #1 | 15. WELFARE BUILDINGS |
| 7. BOILER SHOP | 16. WELDING BUILDING |
| 8. X-29 SHOP | |
| 9. MACHINE SHOP #1 | |

* for clarity not all railroad tracks are depicted on this map



Weld Shop



Power Plant in 2014

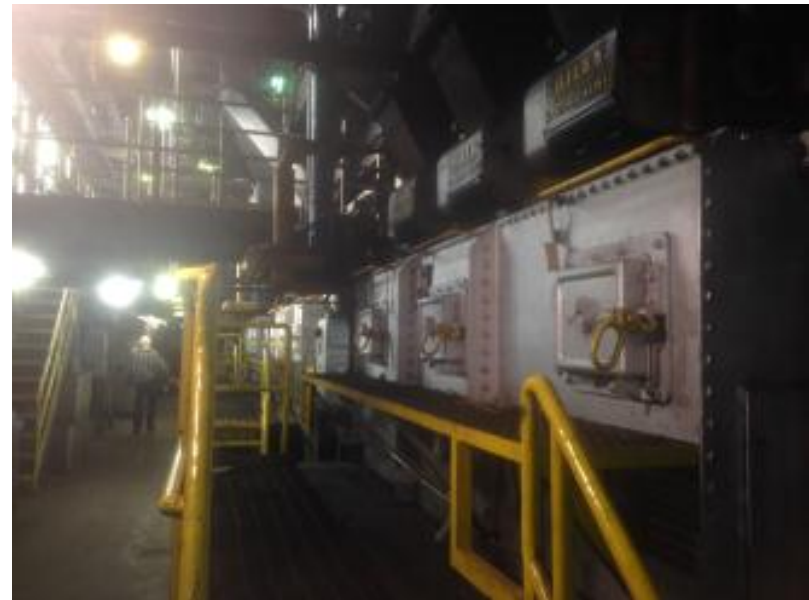


Power Plant in 2014



Coal Boilers

- East River coal
- Used up to 1.25 car loads per day
- Used steam to thaw coal to dump into Riley Coal Boiler
- Riley Stoker Corporation
- Contract No. B-2190
- Serial Nos. 3085, 3086, 3087



Gas Boilers

- Cleaver-Brooks boilers (three)
- Model – 4W1-200-600-200
- Date – 2005
- Input 25 MMBtu/hr Natural Gas



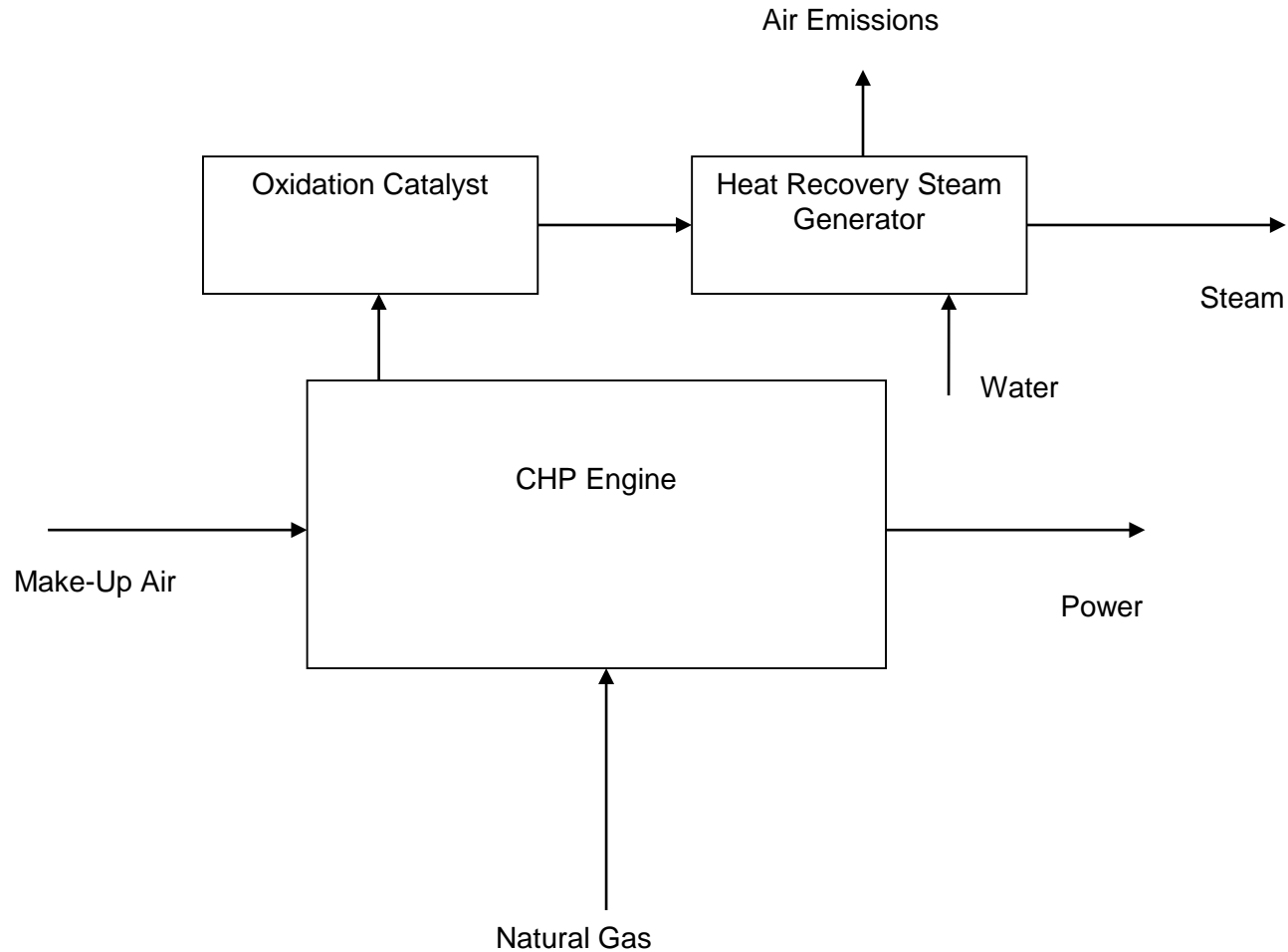
Power Plant in 2016



Power Plant in 2016



Combined Heat and Power Unit Process Flow Diagram



Emissions Reductions from Heat/Power Energy Improvement Project

Pollutant	New CHP Engine Potential Emissions (tpy)	New Heaters Potential Emissions (tpy)	Total Project Potential Emissions (tpy)	Coal Boiler Baseline Actual Emissions (tpy)	Net Project Emission Change (tpy)
Criteria Pollutants					
NO _x	10.62	20.49	31.11	74.05	-42.94
CO	3.40	28.92	32.32	22.00	10.32
VOC	1.49	1.90	3.39	0.47	2.92
SO ₂	0.03	0.21	0.24	347.05	-346.81
PM	0.59	2.63	3.21	25.02	-21.81
PM ₁₀	0.59	2.63	3.21	21.77	-18.55
PM _{2.5}	0.59	2.63	3.21	9.42	-6.21
Lead	0	1.73E-04	1.73E-04	2.83E-03	-2.66E-03
Fluorides	0	0	0	1.01	-1.01
CO ₂	6,872	41,157	48,029	36,083	11,946
Methane	0.13	0.78	0.91	4.25	-3.34
N ₂ O	0.01	0.08	0.09	0.62	-0.53
CO ₂ e ⁽²⁾	6,879	41,199	48,078	36,374	11,705

Implications of the Energy Improvement Project on Sustainability

- Increased energy efficiency
 - CHP unit produces electricity and uses waste heat to produce base-load steam
 - CHP unit uses new technology to maximize operating efficiency
 - Electricity from CHP unit is more cost effective than grid power
 - Steam provided where needed for process heat
 - Natural gas-fired heaters provide comfort heat only where and when needed – reduces steam requirement in remote locations where steam delivery was most inefficient

Implications of the Energy Improvement Project on Sustainability

- Other improvements
 - Significant reduction in air emissions and corresponding annual emission costs
 - Elimination of the need for caustic chemicals to treat coal boiler exhaust gas
 - Elimination of fuel requirement for coal boilers along with ash handling
 - Reduced water consumption resulting from reduction in steam demand and elimination of exhaust gas scrubbers
 - Reduction in process water treatment requirement
 - Increased energy efficiency reduces the facility carbon footprint

Power Plant in 2016

Questions?



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