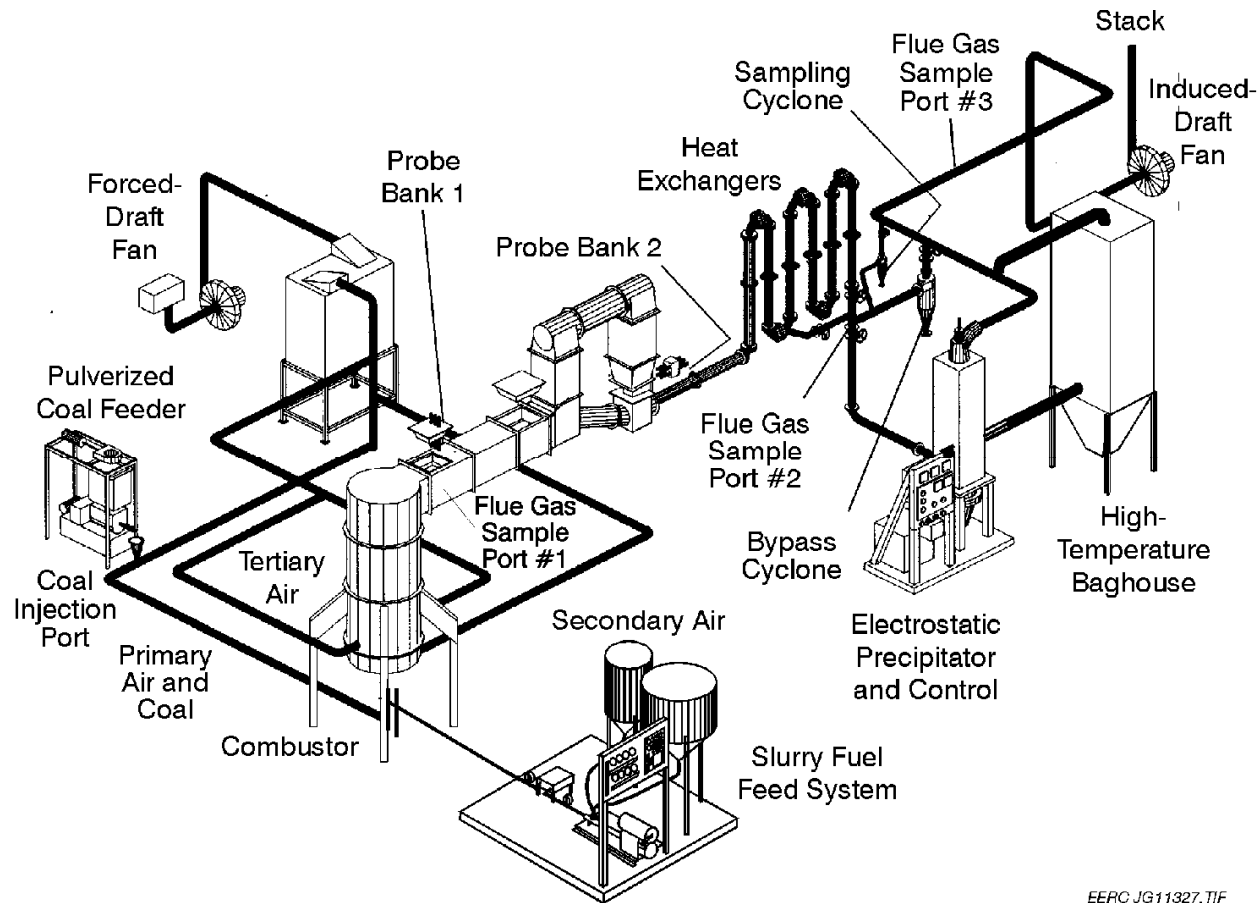


# Cofiring Undervalued Agricultural Biomass for Power Generation

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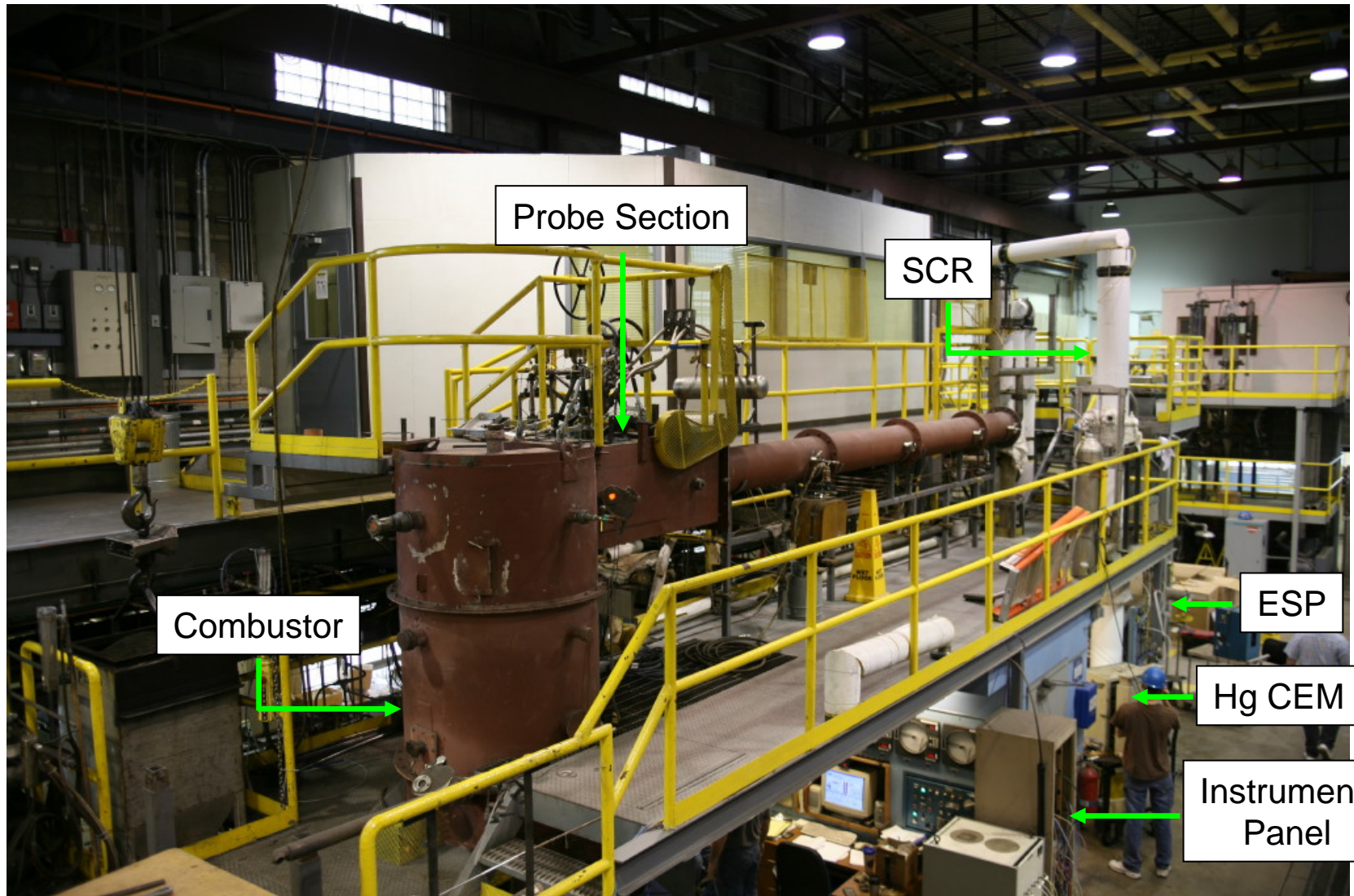
# Schematic of CTF Facility



EERC JG11327.TIF

- Slurry feed system and baghouse not used for these tests.
- An SCR was installed at the outlet of the first heat exchanger.

# EERC Combustion Test Facility (CTF)



# Straw

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Initial Product



Final Product



# Corn Cobs

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Initial Product



Final Product



# Test Fuels

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Test	Coal		Biomass	
	PRB %	East. Bit. %	Straw %	Corn Cobs %
1	85.0	15.0	0.0	0.0
2	72.3	12.8	15.0	0.0
3	59.5	10.5	30.0	0.0
4	72.3	12.8	0.0	15.0
5	59.5	10.5	0.0	30.0

# Fuel Analyses

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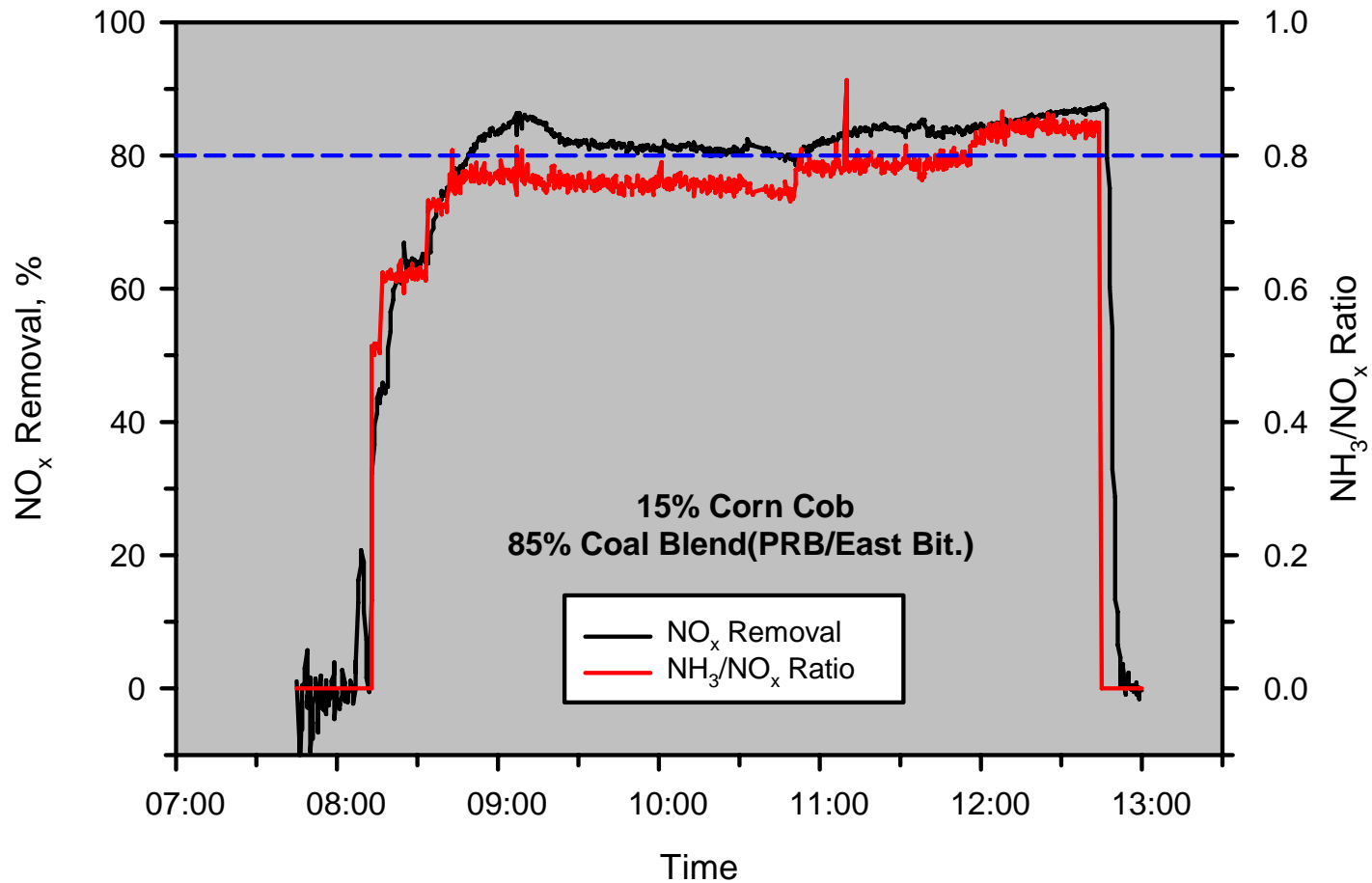
	Coal Blend (85% PRB and 15% East. Bit.)	Straw	Corn Cob
Mercury, ppm (dry)	0.075	0.005	0.029
Chlorine, ppm (dry)	253	1990	1920
Proximate Analysis			
Ash, wt%	6.53	4.25	1.90
Moisture, wt%	15.30	8.00	8.50
Sulfur, wt%	0.38	0.01	0.01
Heating Value, Btu/lb	10,220	7,048	7,182

# CTF Operation Data

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Test	Fuel lb/hr	Flow scfm	Probe Temp. °F	Furnace			ESP Outlet			NH <sub>3</sub> /NO <sub>x</sub> Ratio	NO <sub>x</sub> Removal %
				O <sub>2</sub> %	SO <sub>2</sub> ppm	NO <sub>x</sub> ppm	O <sub>2</sub> %	SO <sub>2</sub> ppm	NO <sub>x</sub> ppm		
1	66.4	123.3	2258	3.28	332	364	3.88	332	28	0.84	92.2
2	65.8	120.0	2253	3.48	281	305	3.98	285	70	0.77	76.4
3	65.2	106.0	2222	4.10	259	220	4.52	237	36	0.84	83.0
4	69.3	122.7	2254	3.42	308	359	3.91	284	60	0.78	82.7
5	70.9	118.2	2250	3.51	240	327	4.06	225	40	0.82	87.5

# Typical SCR Results



# Mercury Emissions

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Test	Biomass	Flue gas measured at ESP Outlet			Hg* Removal, %
		Avg. Total Hg, $\mu\text{g}/\text{m}^3$	Hg <sup>2+</sup> , %	Hg <sup>0</sup> , %	
1	None	4.58	70.3	29.7	55.9
2	15% Straw	5.56	59.7	40.3	39.0
3	30% Straw	2.47	53.8	46.2	71.1
4	15% Corn Cob	4.57	53.6	46.4	54.0
5	30% Corn Cob	3.74	61.8	38.2	61.0

\*Based on average Hg in fuel

# ESP Performance

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Test	Voltage, KV	Current, ma	Collection Efficiency, %
1	50	0.20	98.73
2	45	0.15	97.68
3	46	0.14	94.86
4	48	0.17	95.43
5	50	0.18	98.11

# Probe Assembly at End of Test



# Probe Deposit

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Baseline Condition



# Probe Deposits

15% Straw



30% Straw



15% Corn Cobs



30% Corn Cobs



# Slag Buildup in CTF Combustor Following Test with 30% Straw

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# SCR Catalyst – End of Run

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Baseline



30% Straw



30% Corn Cobs



# Preliminary Conclusions

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- The biomass was relatively easy to handle. The straw was sliced, and the ground corn cob material was finished using a hammer mill.
- During the baseline test (85%–15% PRB and eastern bituminous coal blend) a small deposit formed on the probe over the 5.25-hr test but was highly friable.
- When 15% straw was added to the coal, a deposit similar in shape and size to the baseline test formed but the deposit was somewhat less friable – no deposition problems expected at 15%.
- When the straw was added, there was a slight increase in sparking in the ESP. This resulted in a slight decrease in operating voltage. It became worse at 30% addition of the straw.

# Preliminary Conclusions

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- When 30% straw was added, a substantial amount of slag formed and the deposit was very glassy, indicating substantial melting. In fact, the test had to be shortened because of plugging.
- The fuel feed could be maintained at 15%. At 30% it became a bit more difficult to maintain compared to the baseline test, resulting in less stability.
- When corn cob biomass was added to the fuel at 15% the results were similar to the straw but the ash was more friable – good operation. At 30%, slag deposit was formed but less glassy than the straw in appearance – less melting.
- For all the tests, the SCR operated and performed well, and there was little buildup at the end of each test.