Benefits of the Big Bend Power Station Project

Power Plant Improvement Initiative

Big Bend Power Station Neural Network Sootblower Optimization

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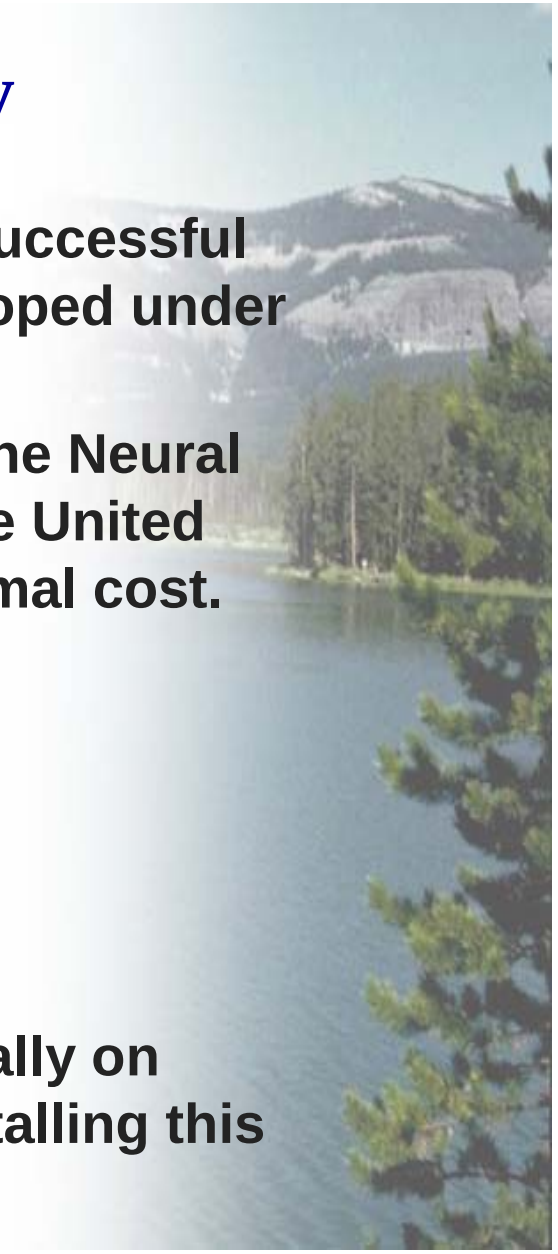
Executive Summary



- **Demonstration projects are critical to successful commercialization of technology developed under DOE's Fossil Energy R&D program.**
- **Successful commercial application of the Neural Network-Sootblower Optimization in the United States would reduce emissions at minimal cost.**
  - Installed cost is about $5/kW
  - 196,320 tons per year of NO_x
  - 30,120 tons per year of SO_2
  - 6,114,000 tons per year of CO_2
  - 1,490 tons per year of particulate matter
- **Up to $67 million would be saved annually on reduced fuel costs by power plants installing this technology.**

Outline

- **Description of the Neural Network-Sootblower Optimization Process.**
- **Quantitative estimates of the benefits of the Tampa Electric Company project.**
  - Benefits to the Nation
  - Benefits to Tampa Electric's Big Bend Power Station Unit Number 2
- **Approach used to calculate benefits.**

Tampa Electric Project

- A 445 MW_e demonstration of the Neural Network-Sootblower Optimization Process.

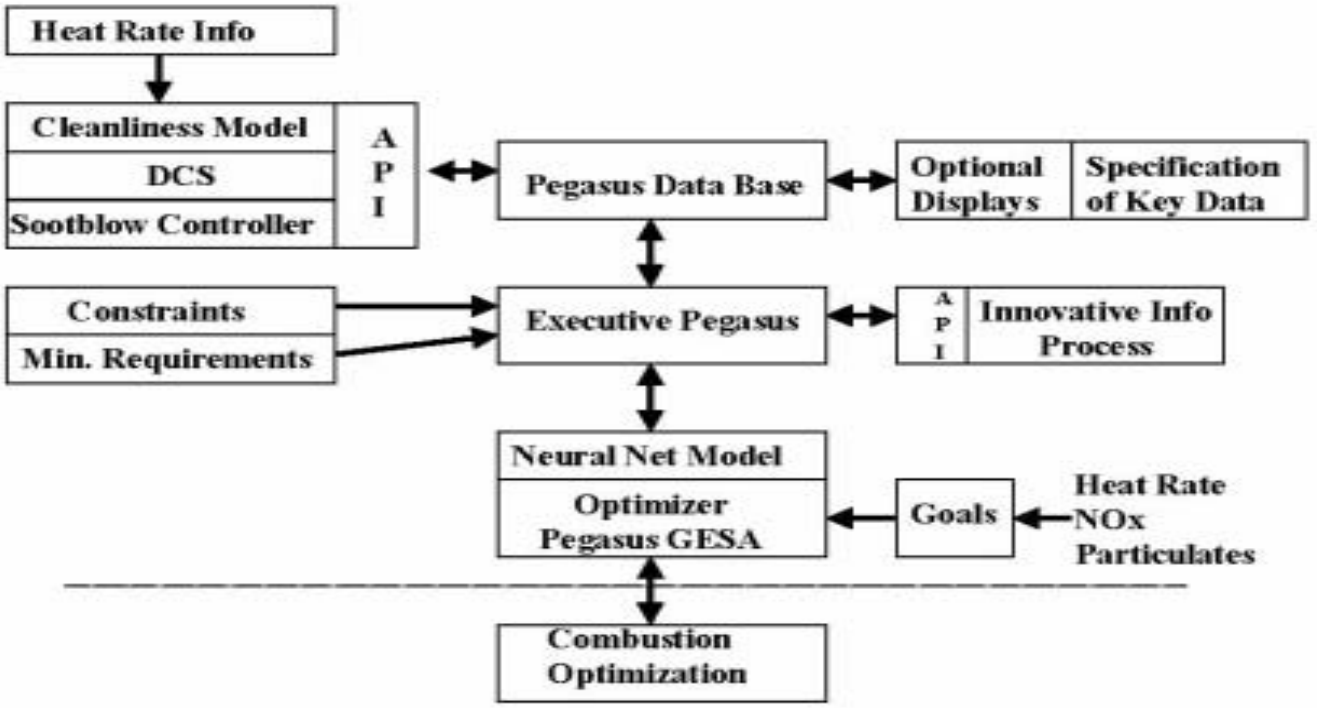
- Installed on a Riley wet bottom turbo-fired boiler at Tampa Electric's Big Bend Power Station Unit #2.

- Total Project Cost: $2,381,614[1]
  DOE Share: $905,013 (38%)

Tampa Electric Big Bend Power Station

[1] Including unshared project costs, total cost is near $3 million.

Neural Network-Sootblower Optimization Process Schematic

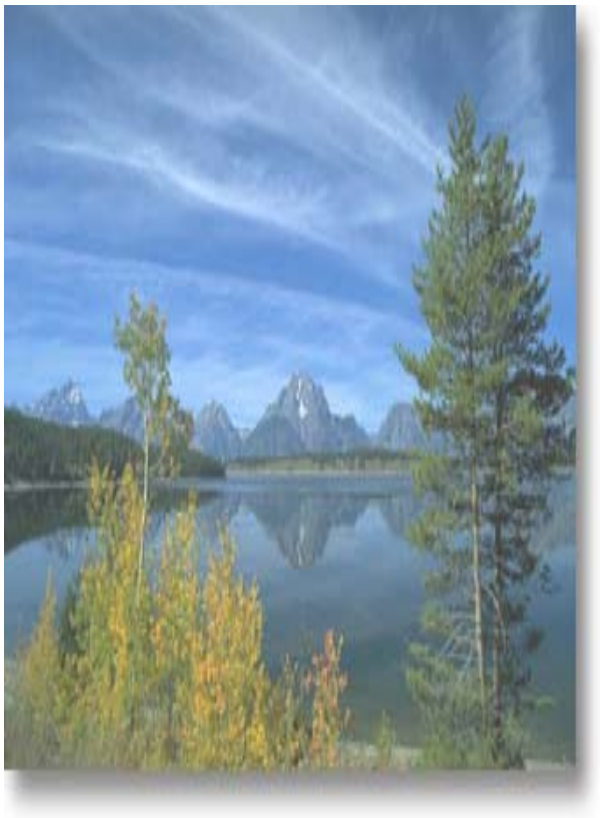


The neural network system automatically determines the need for sootblowing in specific sections of the boiler and activates a blower or sequence of blowers for removing soot.

Neural Network Driven Intelligent Sootblowing

- Proactive approach to sootblowing in response to real-time events or conditions within the boiler.
- Potential to reduce NO_x emissions by up to 30%, improve heat rate by up to 2% (with concurrent 2% reduction in SO_2 and CO_2 emissions), and reduce opacity by up to 5%.
- Forecast to be installed on 47 GW_e of existing coal-fired capacity.

Advantages of Neural Network Sootblowing



- Capital cost investment is small (about $5/kW).
- Heat rate improvement directly translates into SO_2 and CO_2 emission reductions as well as reduced operating cost (less coal consumption).
- NO_x reductions of up to 30%.
- Opacity reductions of up to 5%.
- Reduced tube erosion and Equivalent Forced Outage Rate by reducing overblowing of soot.
- Reduced auxiliary power consumption.

Competing Technology Options

- Other neural network or smart systems applied to sootblowing operations.
- Traditional time based systems
- Rule based systems

Estimated Reductions in National Pollution Emissions from Neural Network-Sootblower Optimization Commercialization

	Neural Network Sootblower Emission Reductions, tons/year	All Boiler Emissions, tons/year
NO_x	**196,320[1]**	**4,611,900[3]**
CO_2	**6,114,000[2]**	**2.13 billion[3]**
SO_2	**30,120[2]**	**10,770,000[3]**
Particulate Emissions	**1,490[2]**	**522,400[3]**

[1] Basis: Technology market penetration of 47 GW_e and 30% NO_x reduction.

[2] Basis: Technology market penetration of 47 GWe and 2% emissions reduction.

[3] Basis: All coal-fired power plants in the U.S. using data in the NETL Coal Power Plant Database 2000.

Additional National Benefits from Intelligent Sootblowing Commercialization

- Improved heat rate from implementation of the Neural Network Sootblowing Optimization would save $67 million annually in fuel costs.
- Reduced tube erosion due to reduced overblowing of soot.
- Reduced auxiliary power consumption.

Benefits of Intelligent Sootblowing for Big Bend Power Station Unit #2

	NO_x, tons/yr	CO_2, tons/yr	SO_2, tons/yr	PM, tons/yr
Before Retrofit	11,000 (EPA 2000 data)	2.92 million (EPA 2000 data)	16,660 (EPA 2000 data)	640 (calculated value)
After Retrofit	7,700	2.86 million	16,320	630
Emissions Avoided	3,300	58,400	340	10

Additional benefits:

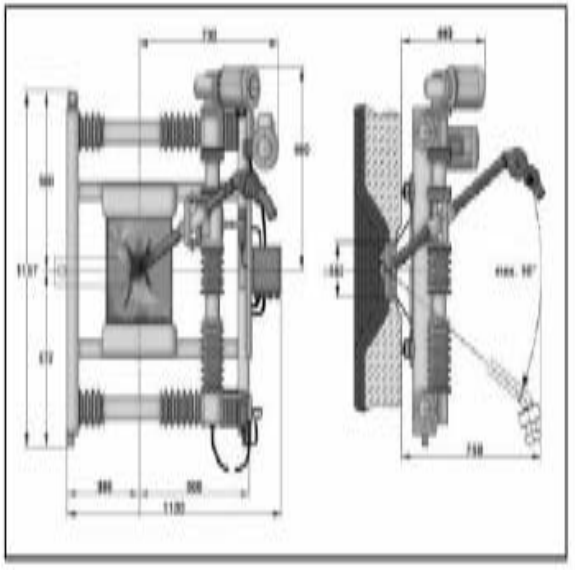
- **The plant will realize an operating cost savings of $908,000 annually based on reduced coal utilization (improved heat rate).**
- **Knowledge gained from this demonstration could be transferred to other Big Bend units.**

Approach to Estimating Benefits

- **Forecast market penetration.**
- **Quantify differences between performance of current arrangement and the anticipated performance of the Neural Network-Sootblowing Optimization being demonstrated.**
  - Pollutant emissions, tons per year
  - Operating cost, constant dollars

Assumed Market Penetration

- **All boilers over 100 MW_e capacity were assumed candidates for the technology.**
  - The technology is a low cost (~$5/kW) retrofit that has emissions and cost savings benefits.
  - The technology will work equally well on small-, medium- and large-size boilers
- **A market penetration of 15% was assumed giving a total market of 47 GW_e.**



Typical water cannon mechanism

Differences in Performance
- Emissions Reduction -

- Emissions from all coal-fired boilers and from target market boilers taken from the NETL Coal Power Data Base.
- Coal consumption for target market plants and Big Bend Power Station Unit 2 taken from the NETL Coal Power Data Base and then used to calculate operating cost savings.
- Average national coal cost from EIA and Big Bend coal cost from the Tampa Electric technical proposal.

Differences in Performance

- SO_2 and CO_2 emissions reduced by the heat rate improvement (2%).
- NO_x emissions reduced by up to 30% due to improved temperature uniformity across the boiler.
- Opacity reduction of up to 5% was assumed to occur primarily due to the ash loading reduction resulting from the improved heat rate. Thus a 2% reduction in ash emissions was assumed. There will be additional ash reduction benefits from reduced ESP loading during sootblowing operations.

Differences in Operating Cost

- **The improved heat rate reduces coal consumption to generate an equivalent amount of electricity.**

- **The average cost of coal nationwide in the year 2000 was $24.28/ton (EIA), and the cost of coal to Tampa Big Bend was $40/ton (Tampa Electric Technical Proposal).**
  - Benefits to Tampa Electric based on Big Bend coal prices.
  - Nationwide benefits based on average coal price per EIA.

- **Elimination of overblowing of soot will reduce tube erosion and hence maintenance costs. This cost benefit was not quantified.**

Conclusions

- **There are significant benefits to the nation that will be realized by the commercialization of technologies being demonstrated in the Power Plant Improvement and Clean Coal Power Initiatives.**

Visit the NETL web site for information on all Power Plant Improvement Initiative and Clean Coal Power Initiative projects.

www.netl.doe.gov/coalpower/ccpi