



Case Study Booklet



Presenting you more great GreenShield Ceramic coating projects

Since 1985, Furnace Mineral Products has been protecting power generation boilers from erosion, corrosion and slag build up. The GreenShield series of ceramic coatings developed by Furnace Mineral Products are non-toxic water based coatings that are spray applied to form a dense, impermeous protective barrier resistant to the aggressive conditions inside a boiler's firebox. This booklet provides a brief introduction to a few of the projects we've completed.

DID YOU KNOW?

Furnace Mineral Products has protected over 1 million square feet of boiler tube with GreenShield Ceramic coating.



For more than 25 years, the name FMP has stood for innovation and quality. Our employees take great pride in providing the best products and services to the power generation industry and today the FMP name continues to be identified with the finest surface protection coatings and services available worldwide.

No boiler protection is too small or too complex. We listen carefully to our customers and provide surface protection solutions to address their needs within their critical time constraints and budget. Our years of experience has taught us to do more in boilers including protecting areas in the backpass which were previously impossible to reach. Through innovation we are continuously finding ways to add value to aging boiler components through advanced coatings and application methods.

Our service offering doesn't stop in the boiler, our facility in Greenville, PA offers shop applied coatings and light manufacturing for your replacement boiler components such as tube shields and air insert tubes.

Our goal is to continue to exceed our customers' expectations. Our advanced organic polymer and inorganic liquid coatings make us uniquely different and well positioned to meet all the liquid applied surface protection needs of our customers. We can truly provide turn-key projects with a one-stop shop approach. Speak to your FMP representative to find out how we can add value by extending the life of your critical boiler components through advanced surface protection.

— Antonio Liberatore, President

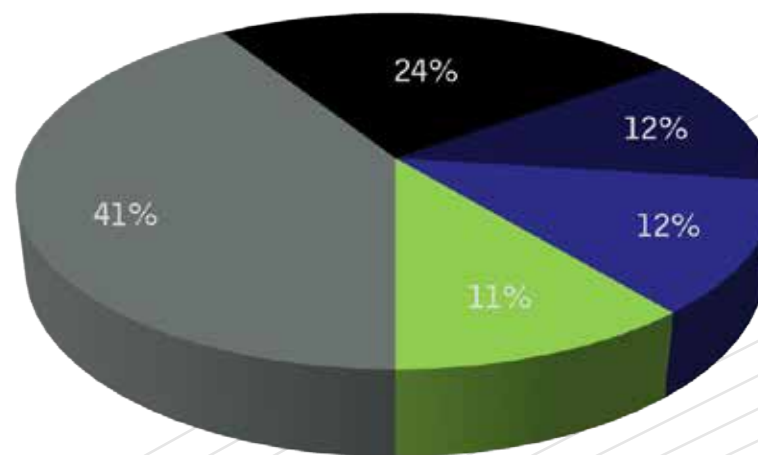
When maintenance budgets and outage schedules are reduced, ceramic coating technology offers an economical and fast turn around tube protection solution to keep your critical boiler components up and running.

Number of Applications by Area and Boiler Type

■ Waterwall CFB ■ Waterwall PC ■ Superheats PC ■ Superheats CFB ■ Economizer CFB

BOILER AREA SUMMARY

Waterwall - 65 %
 Superheats- 24 %
 Economizer - 11 %



BOILER TYPE SUMMARY

CFB - 64 %
 PC - 36 %

The Economics ?

| Production Rates (per applicator) | |
|-----------------------------------|---------------------------------|
| Weld Overlay | 1.0 to 2.0 square feet per hour |
| Thermal Spray | 4.0 to 6.0 square feet per hour |
| Ceramic Coating | 200 to 250 square feet per hour |

| Application Costs per square foot | |
|-----------------------------------|--|
| Weld Overlay/CRO | \$500 to \$700 *Highly dependant on material |
| Thermal Spray | \$150 to \$350 |
| Ceramic Coating | \$20 to \$30 |

Boardman is a city in Morrow County, Oregon, United States on the Columbia River and Interstate 84. The Port of Morrow, Oregon's second-largest port, is adjacent to the city and located on the Columbia Riverfront. The port property also includes Portland General Electric (PGE) coal fired power plant, the Boardman plant. PGE also has two Portland gas-fired power plants in the Boardman area.

Case Study

Boardman Plant/

The Boardman Coal Plant is a coal-fired power plant located in Boardman, Oregon. The facility has a nameplate capacity of 550 megawatts (MWs) and is operated by Portland General Electric. The plant is the only remaining coal powered plant in Oregon.

Project Outline

During a scheduled maintenance outage in May 2010, Furnace Mineral Products (FMP) was contracted by PGE to install GreenShield Ceramic coating to approximately 25,000 square feet of division walls and finishing superheat tubes. Greenshield was selected by PGE as an anti fouling coating to reduce the initial sintering of slag on the boiler tube.

BOILER DETAILS

- Boiler Manufacturer - Foster Wheeler
- Boiler Firing Type - Opposed Firing
- In service since 1980
- Nameplate rating - 550 MW
- Dry bottom ash handling
- Primary fuel - Subbituminous
- Coal Origin - Wyoming
- Fuel Consumed (1000 tons) - 2,313

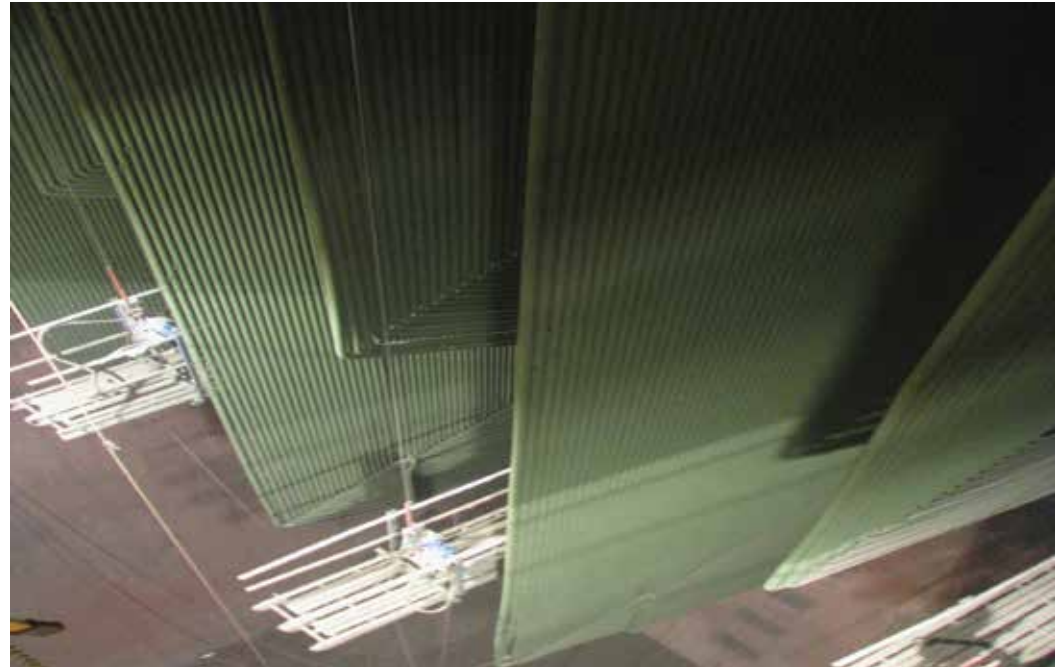
Based on the success of the GreenShield coating, FMP returned to the Boardman plant in 2012 to perform additional abrasive blasting and ceramic coating work. Approximately 12,000 square feet of ceramic coating was applied to the primary vertical superheat tubes. The GreenShield coating was applied to a coating thickness of 8 mils. An additional 18,000 square feet of horizontal primary superheater tubes were abrasive blasted and a thin layer of the GreenShield coating was applied to protect the tubes from oxidation.



FMP performed abrasive blasting and coating application from mobile swing-stages. ▲

GreenShield Ceramic coating was applied to 5 large division panels and 6 smaller division panels. ▶▶

Ash slag accumulation on the primary superheats prior to the application of the GreenShield Ceramic coating. ▼



▼ Application of GreenShield Ceramic coating to the primary superheater tubes.



Case Study

Nucla Station/



▲ Nucla Station is located near Nucla, Colorado. Nucla is a Statutory Town in Montrose County. Its name comes from the town's founders intent that it serve as a "nucleus" for the surrounding farms and mines, although it has since come to be associated with the growth of uranium mining in the region.

DID YOU KNOW?

Tri-State's Nucla Station in southwest Colorado shows the lowest mercury emissions of any coal-fired power plant in the United States according to EPA data.

Nucla Station is a baseload resource owned and operated by the Tri-State Generation and Transmission Association. Tri-State is a wholesale power supply cooperative serving 44 consumer-owned utilities in Colorado, Nebraska, New Mexico and Wyoming.

Nucla Station produces 100 megawatts of generating capacity and is the world's first utility-scale power plant to utilize atmospheric CFB combustion.

Project Outline

For more than 10 years, FMP has been an outage contractor at the Nucla Station. GreenShield Ceramic coating has been a technology of choice to protect the boilers' waterwall from tube erosion.

The green color of the GreenShield coating is also a notable feature as it provides a visible wear indicator for plant personnel. GreenShield makes it easy to visually identify wear patterns and areas of erosive concern in the boiler unit.

The entire waterwall in the Nucla Station's CFB unit is protected by ceramic coating with only a few localized pad weld repairs. There is no additional need for other coating technologies to protect the tubes.

The test of time has proven the long term performance benefits of the GreenShield Ceramic coating at the Nucla Station. Nucla is committed to a maintenance regime with the use of ceramic coating as a tube protection solution.

In 2012, FMP completed approximately 6,000 square of coating application at the Nucla Station, 4,500 square feet of spot repairs on the boiler waterwalls, 1,300 square feet in the air heater inlet duct and 128 square in the convection pass.

BOILER DETAILS

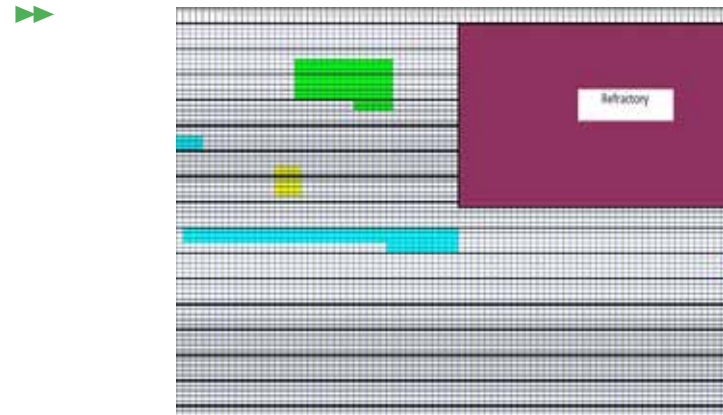
Boiler Manufacturer - Pyro Power
Boiler Firing Type - Fluidized bed
In service since 1991 (as ACFB)
Nameplate rating - 100 MW
Dry bottom ash handling
Primary fuel - Bituminous
Coal Origin - Colorado (New Horizon Mine)
Fuel Consumed (daily tons) - 1,600

Furnace Mineral Products and their team possess a strong work ethic with an un-failing attention to detail. They take pride in precise workmanship that consistently results in a quality product.
— Howard Kettle, Plant Manager

Areas where aggressive erosion conditions have depleted the GreenShield coating are easily identified by visual inspection.



Boiler maps, generated by FMP, are a useful tool to identify areas of high erosion wear. GreenShield can be reapplied to itself, after subsequent inspections, by roughening the base layer and reapplying additional coating thickness.



GreenShield applied to the corner of two waterwalls at the refractory interface.



Case Study Woodland Biomass



Woodland Biomass Power in Woodland, CA produces up to 25MW for their customers. The plant utilizes 260,000 tons of woody biomass fuel annually. The renewable energy generated at Woodland Biomass Power is sold to Pacific Gas & Electric under a long term contract. The plant's fuel comes from a variety of sources. These include: wood chips, urban wood waste, logs from forest thinning, tree/orchard trimmings, and agricultural waste such as nut shells and fruit pits. Woodland Biomass Power has been owned and operated since 2005 by DTE Energy Services (DTEES) of Ann Arbor, MI.

Woodland Biomass Power, LTD is an alternative energy company located in nearby Woodland, California. Woodland (formerly Yolo City) is located approximately 15 miles northwest of Sacramento.



BOILER DETAILS

Boiler Manufacturer - Gotaverhen
Boiler Firing Type - Fluidized bed
In service since 1989
Nameplate rating - 28 MW
Primary fuel - Wood, agricultural waste
Fuel Consumed (tons/year) - 200,000

Project Outline

Since early 2000, FMP has been a supplier and installer of GreenShield ceramic coating to protect the critical boiler components at Woodland Biomass. In 2010, FMP coated the air heater tubes to protect against corrosion.

In 2012, FMP returned to complete more than 5,000 square feet of finned economizer tubes. The challenge with this application was the depth of the economizer bank. With a depth of 24 tubes, FMP developed specialized blast nozzles, spray application nozzles and lances in order to reach deep into the economizer bundle.



The economizer tubes were abrasive blasted to a white metal finish (SSPC SP 5). Abrasive blasting is an important step in the application of GreenShield coating.



GreenShield Ceramic coating was applied to the economizer bank. GreenShield was selected to offer erosion and corrosion protection to the aging economizer unit.



The Dickerson Generating Station is located in Montgomery County, Maryland. It is located on Maryland Route 28, between Sugarloaf Mountain and the Potomac River.



Case Study

Dickerson Generating/

The Dickerson Generating Station is a 853 MW electric generating plant owned by GenOn (formerly Mirant Services LLC). The facility consists of three 182 MW coal-fired steam generating plants, two 147 MW gas and oil-fired simple cycle combustion turbines, and one 13 MW black start and peaking turbine. The three coal-fired units are base-loaded and went into operation in 1959, 1960, and 1962 respectively.

Project Outline

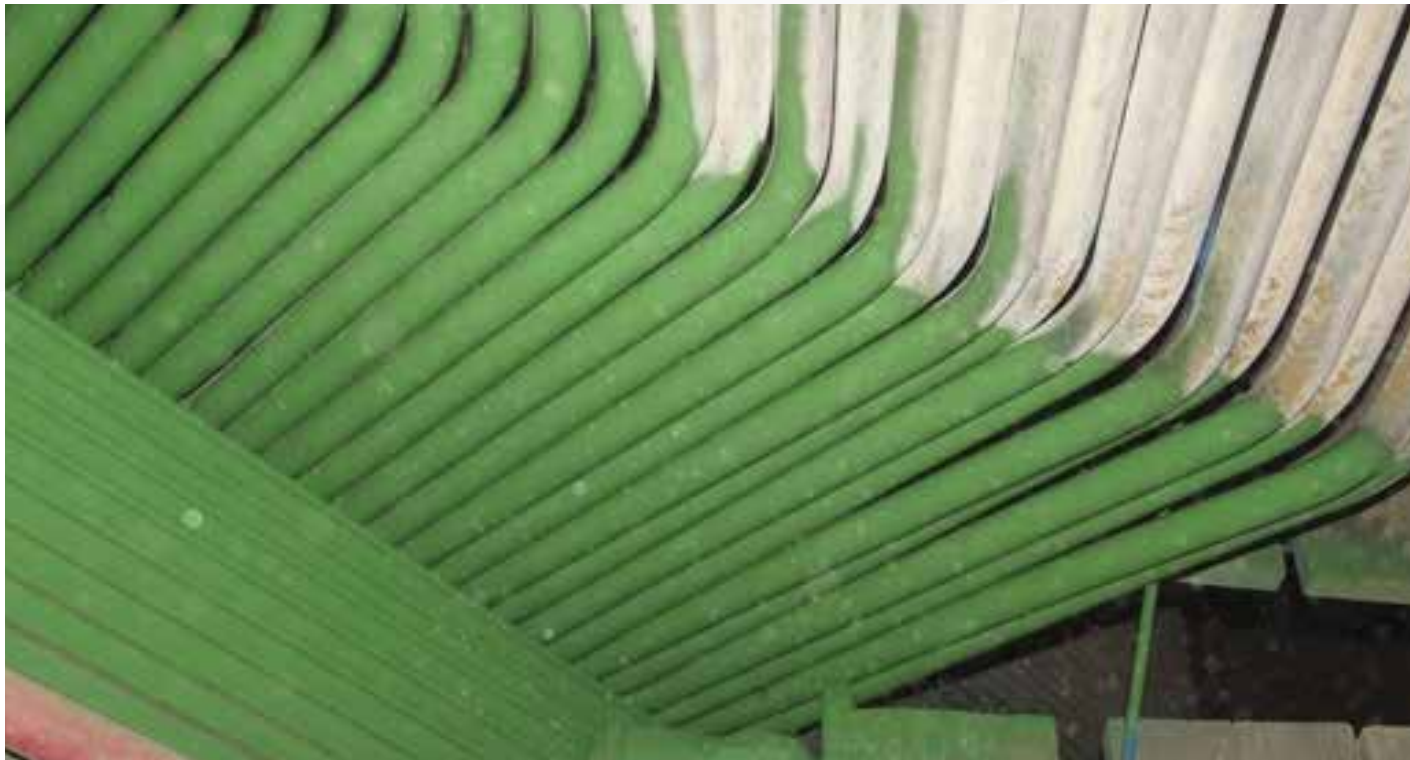
FMP was approached in 2010 by Dickerson Generating to provide a coating technology to protect an isolated corrosion area in two of their boilers. The corrosion was isolated at the slope and waterwall interface. Based on the success of FMPs' application in 2010, FMP returned in 2011 and 2012 to apply additional coating to areas of corrosion concern.

BOILER DETAILS

Boiler Manufacturer - Combustion Engineering
Boiler Firing Type - Tangential firing
In service since 1960
Nameplate rating - 182 MW
Primary fuel - Bituminous
Fuel Origin - West Virginia

DID YOU KNOW?

The outpour of water from the power plant became the Dickerson Whitewater Course in 1991, a training course for kayakers and canoeists for the 1992 Olympic Games.



GreenShield Ceramic coating was applied to 8 mils of the boiler slope and adjacent waterwall.



Case Study

Seminole Generating Station/



Seminole Generating Station is located on 2,000 acres in Putnam County, just north of Palatka and about 60 miles south of Jacksonville, FL.

Project Outline

FMP began working with Seminole Generating Station in 2007, following the installation of low NOx burners in both units 1 and 2. The modifications to the combustor increased the corrosion rates in both units.

Seminole Electric selected the GreenShield coating technology based on its application speed and installed price. The production rates for the GreenShield coating was approximately 90 hours to complete 20,000 square feet of abrasive blasting and coating.

To date, FMP has completed over 90,000 square feet of boiler tube surface at Seminole Electric, including boiler waterwalls and super-heat tubes.

Seminole Generating Station is the first cooperative-owned generating plant in the state of Florida. Consisting of two 650 megawatt (MW) coal fired generating units, Seminole began operation in 1984. Since its inception Seminole has spent more than \$233 million, about a quarter of its original construction cost to upgrade for environmental protection. Environmentally beneficial upgrades included; installation on new low nitrogen oxide (NOx) burners and selective catalytic reduction (SCR) systems.

BOILER DETAILS

Boiler Manufacturer - Foster Wheeler

Boiler Firing Type - Opposed Fired

In service since 1984

Nameplate rating - Two (650) MW

Primary fuel - Bituminous

Fuel Origin - western Kentucky and southern Illinois coal/petcoke



Over 90,000 square feet of boiler tubes have been protected by GreenShield Ceramic coating at Seminole Generating Station.



Superheat inspection after 2 years in service. The GreenShield coating is fully intact with a light layer of visible slag.





Whitecourt is a town in central Alberta, Canada within Woodlands County. The town has branded itself as the snowmobile capital of Alberta.

Case Study

Whitecourt Power/

BOILER DETAILS

Boiler Manufacturer - Shanghai Boiler Works
Boiler Firing Type - Circulating Fluidized Bed
In service since 1994
Nameplate rating - 25 MW
Primary fuel - Waste wood

Biomass is an important part of Canada's energy mix, supplying about 6% of the country's energy supply, the second largest source of green energy after hydroelectricity. Whitecourt Power operates one of the largest biomass power plants in Alberta. Whitecourt operates as a base load facility, which reflects its advanced, reliable technology and strong availability.

Project Outline

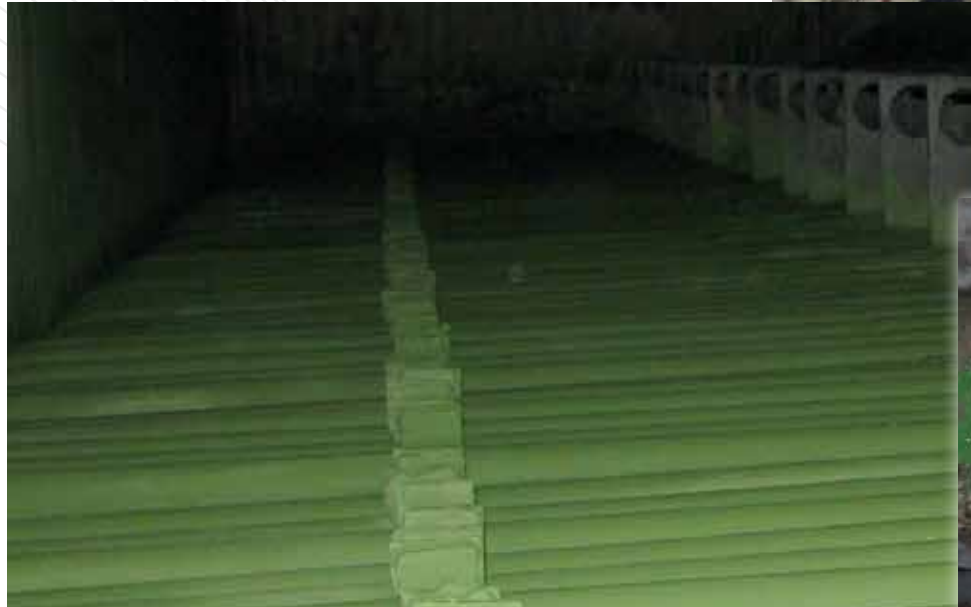
Since 2011, FMP has been an important service contractor to Whitecourt Power. FMP was contracted by Whitecourt Power to address erosion issues in the evaporator section of their boiler.

As part of our scope of work, FMP was responsible to abrasive blast clean the horizontal superheat tubes above the evaporator to remove slag accumulation. The slag accumulation was very dense and piled high in areas. This was the first time that the plant had abrasive blast cleaned this section of the boiler. Historically the water cleaning used could not provide the cleanliness required to inspect the tube surfaces.

Following the abrasive blast cleaning there was evidence of under deposit pitting corrosion on the superheater section. Whitecourt Power has since contracted FMP to apply our ceramic coating technology to the superheat section to reduce further pitting corrosion.

DID YOU KNOW?

Whitecourt's average annual nitrogen oxide (NOx) and carbon monoxide (CO) emissions are approximately 50% below the level of emissions that are permitted. *Canadian Bioenergy Association.



Greenshield inspection in the superheat section after 1 year in service.



Liked what you saw?

Learn more. www.fmpcoatings.com

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