Plasma Ignition and Combustion Stabilization Technology to Improve Flexible Operation, Reliability and Economics of an Existing Coal-Fired Boiler

2021 Spring Review Meeting

DOE/NETL – GE Steam Cooperative Agreement No. DE-FE0031766

May 12, 2021

Plasma Ignitor Installation
PacifiCorp Hunter Unit No. 3

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Plasma Ignitor Installation
PacifiCorp Hunter Unit No. 3

Agenda

- Market and market drivers for Plasma Ignitor technology
- Technology overview
- PacifiCorp Hunter No. 3 installation
- Testing plan for Hunter
- Expected results
- Project status
- Summary

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Market and market drivers for technology

Steam plant operators experiencing changing market:

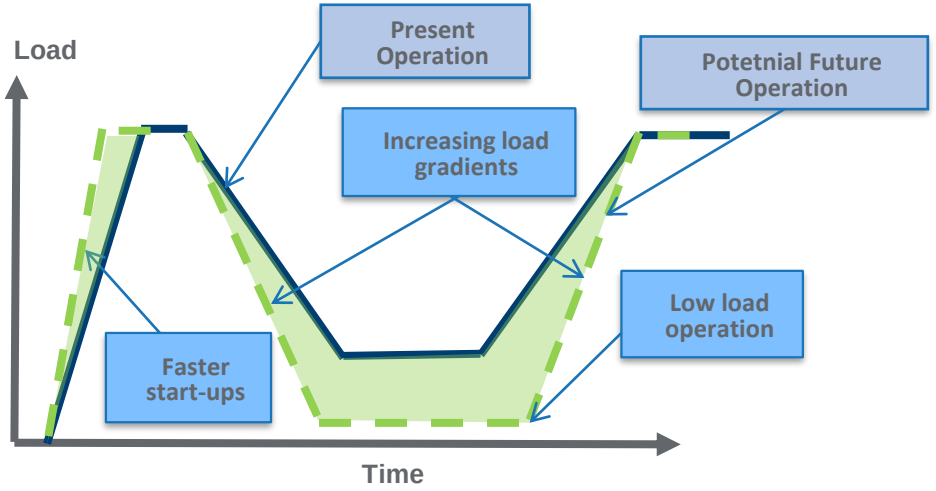
- Increased competition with lower cost generation
- Renewables: increased penetration & intermittent generation
- Regulatory pressures
- High cost of auxiliary fuels

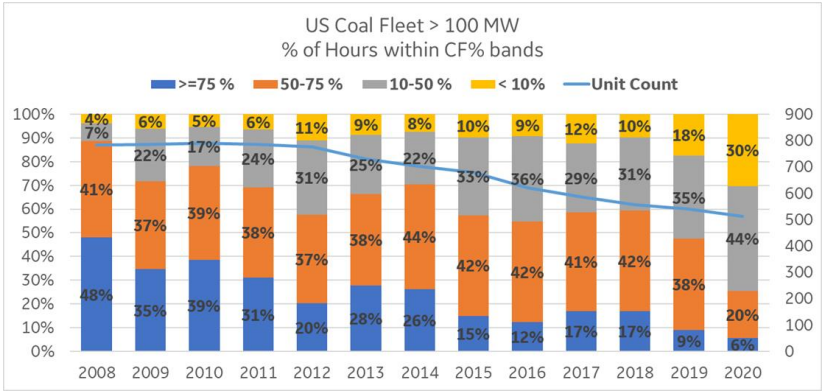
Steam plant operators experiencing changing operation:

- Load following
- Cycling operation
- Single or double shifting
- Seasonal variation

Cyclic operation leads to:

- Higher O&M cost with increased off-design
- Increased stresses -> reduced life; increased availability/reliability risk





12 years ago the US Coal-Fired Generating Fleet spent ~ 50% of the time operating above 75% CF. Today, that number has dropped to about 6%.

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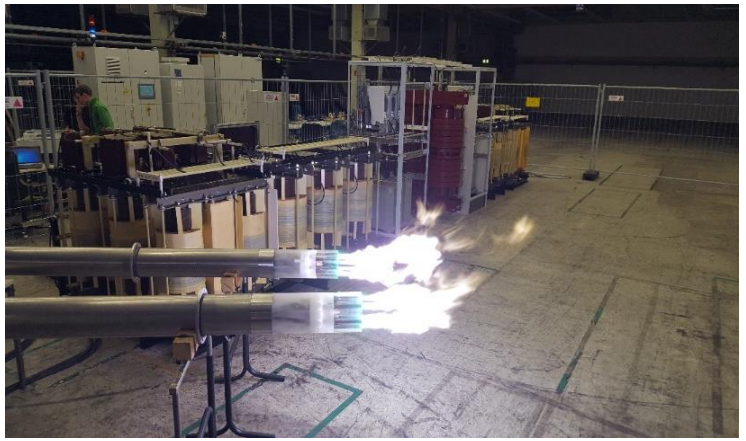
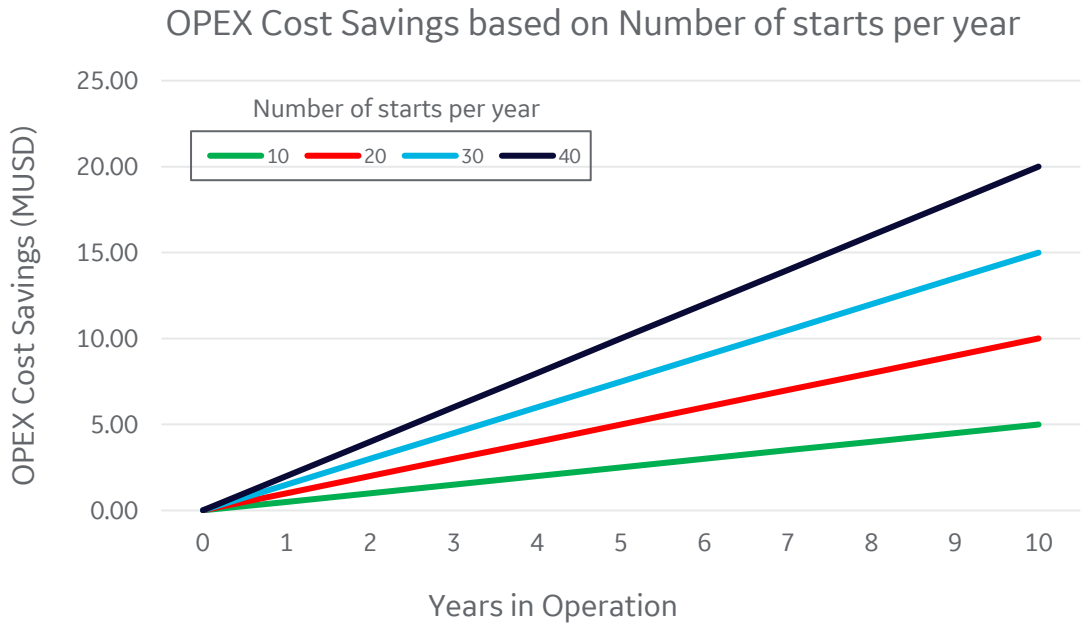
Market drivers for technology



Typical Return on Investment

- Low load flame stabilization fuel savings
- Cold start fuel savings



Customer Justification
ROI Elements for customer

- Cost for oil support, 8 hours/day = 2.33 MUSD/Yr
- Costs for coal, 20% MCR vs 35% MCR = 5.10 MUSD/Yr
- Total saving = 7.43 MUSD/Yr

Operating costs

- Cost to operate Plasma Ignitors = 0.162 MUSD/Yr

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Technology Overview

- The system produces a high energy plasma, ~5000°C (Ionized gas, air, which is highly electrically conductive) which supports the volatile release and the subsequent volatile ignition. The released volatiles ignite and produces further heat to further fuel de-volatilization. Full flame formation at the burner mouth in the furnace.

- Reducing fuel oil or natural gas consumption for low load and cycling stabilization on coal fired steam generators is a global issue. As renewable energy sources become a larger driving force in the energy market, coal fired units which were previously base loaded are being forced to cycle and operate at reduced loads more frequently.

- The economic benefit for installing a Plasma Combustion Stabilization system can be measured by the reduction in:
    1. Coal consumption
    2. Fuel oil or natural gas consumption

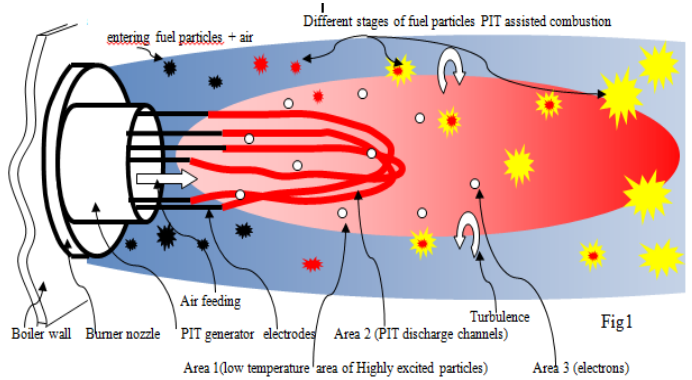
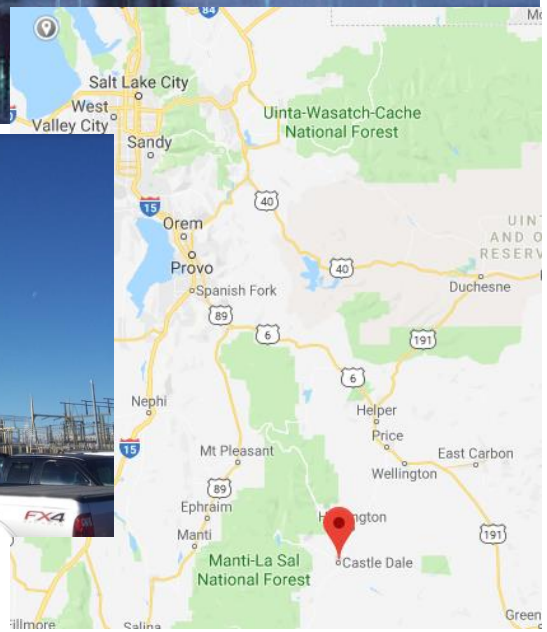


Fig1

Plasma Ignitor Installation PacifiCorp Hunter Unit No. 3

Installation at PacifiCorp Hunter No. 3

ROCKY MOUNTAIN POWER
A DIVISION OF PACIFICORP



- Located 160 miles southeast of Salt Lake City, Utah
- Rocky Mountain Power HQ located at Salt Lake City, Utah

Unit 3

- 496 MWe (nameplate) coal fired EGU
- B&W opposed wall fired boiler
- requires oil ignition for lightoff through mill stabilization (40%)
- Experiences frequent load fluctuations from renewables

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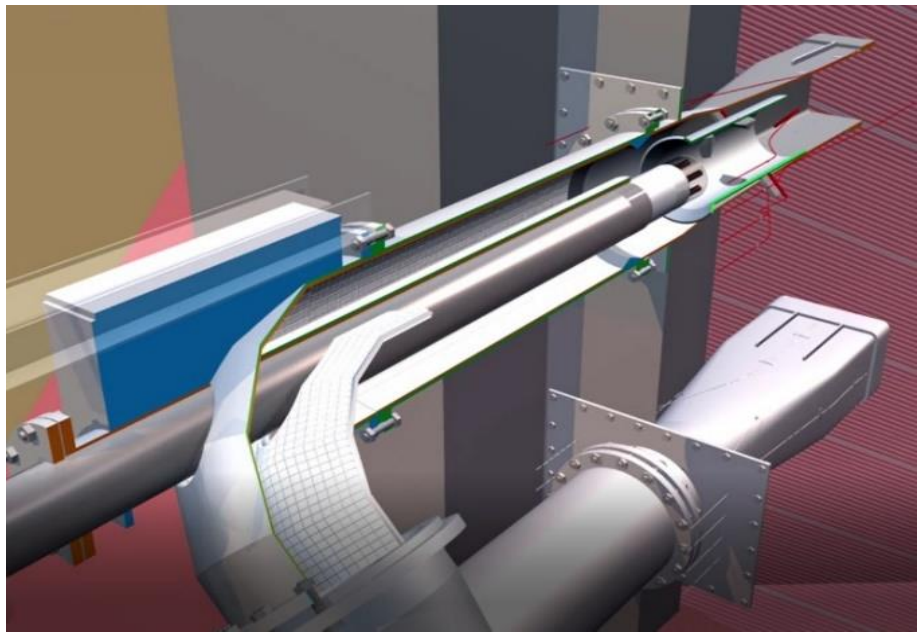
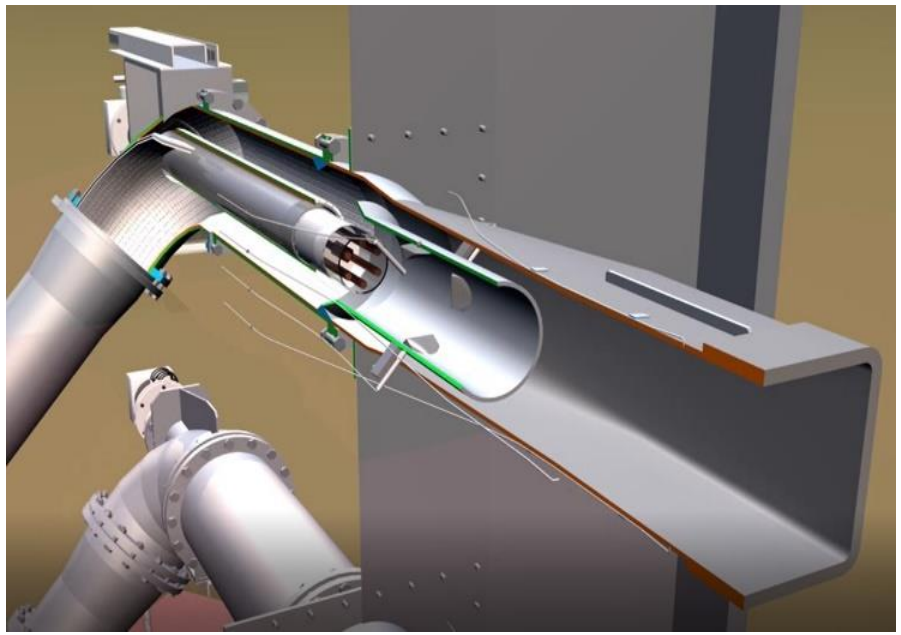
Technology Overview





Isometric Showing Installation in Coal Nozzle

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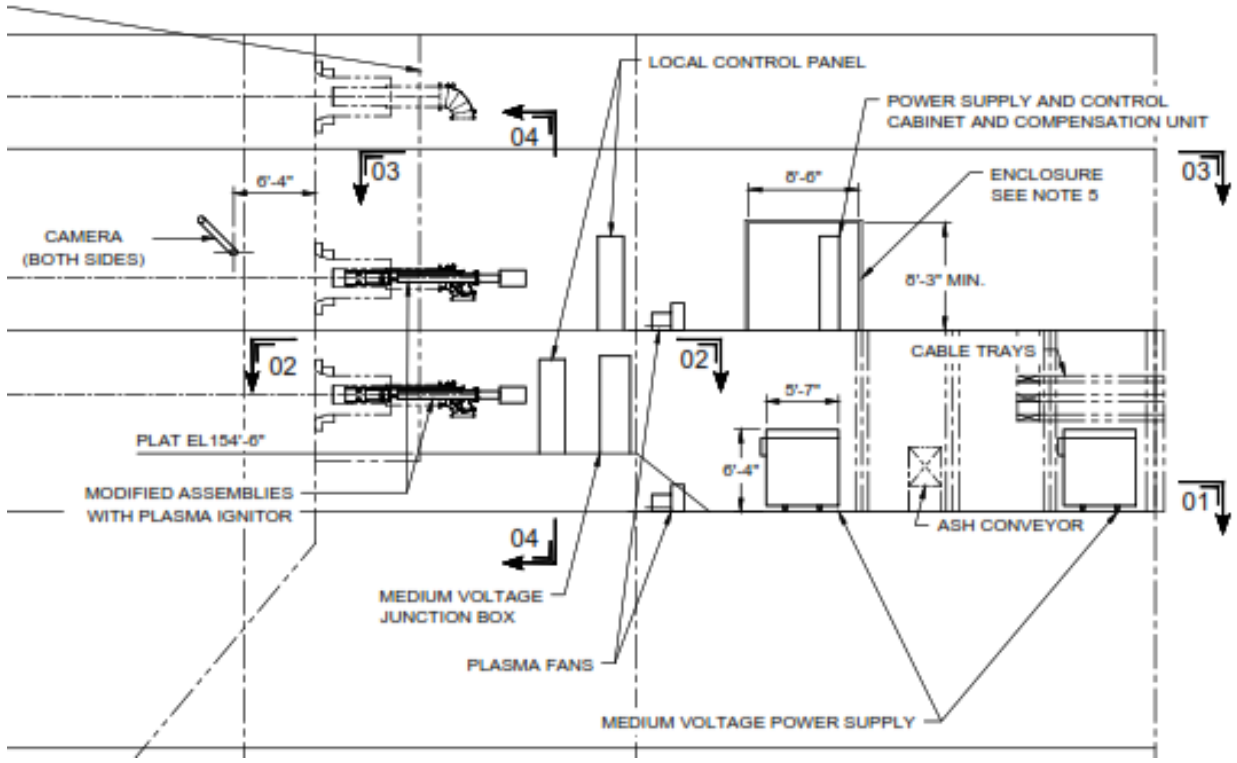
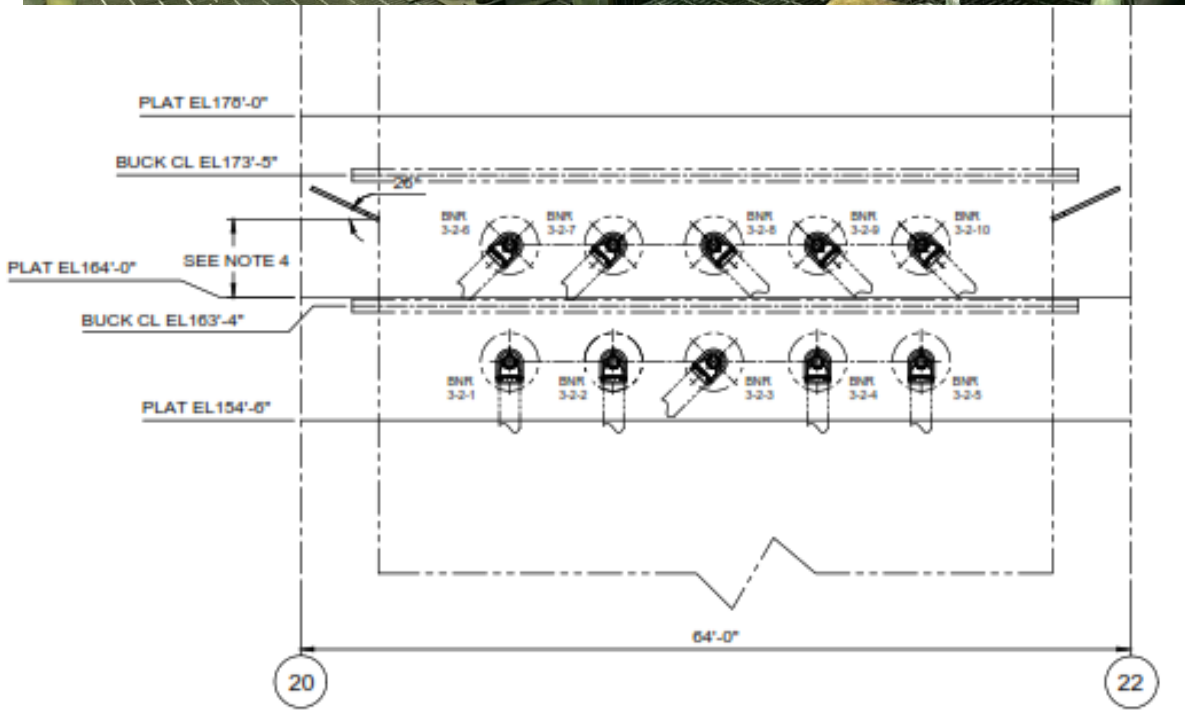
Installation at PacifiCorp Hunter No. 3





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Installation at PacifiCorp Hunter No. 3

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Testing Plan for Hunter

	Boiler Load			
	>60% MCR 3 to 4 Mills in Operation	> Min. Permitted w/o Oil Firing 2 Mills in Operation	Boiler Start-up with & w/o Oil Firing 2 Mills in Operation (Hot / Warm / Cold)	One mill operation w/o Oil Firing Mill Nr. 4 in Operation
Bench-marking coal burnout rate w/o Plasma support (Baseline testing)			XX	XX
Plasma ignitor position in the burner		XX		
PC particule fineness, Mill classifier position		XX		
Mill startup with Plasma ignitors (Function check)		XX		
Ignition performance over the mill & boiler load	XX		XX	XX
Influence of plasma supported combustion on NOx & CO emission	XX	XX		

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Expected results from Hunter Testing

Low load operation:

- Stable ignition of coal down to 25% feeder speed on single mill operation

Cold start capabilities:

- Demonstrate the ability to bring a mill on-line (cold start) without support fuel (oil)

Reduction in fuel oil consumption:

- 80% to 85% reduction in oil consumption
  - Coal start condition
  - Mill transition conditions
  - Low load operation

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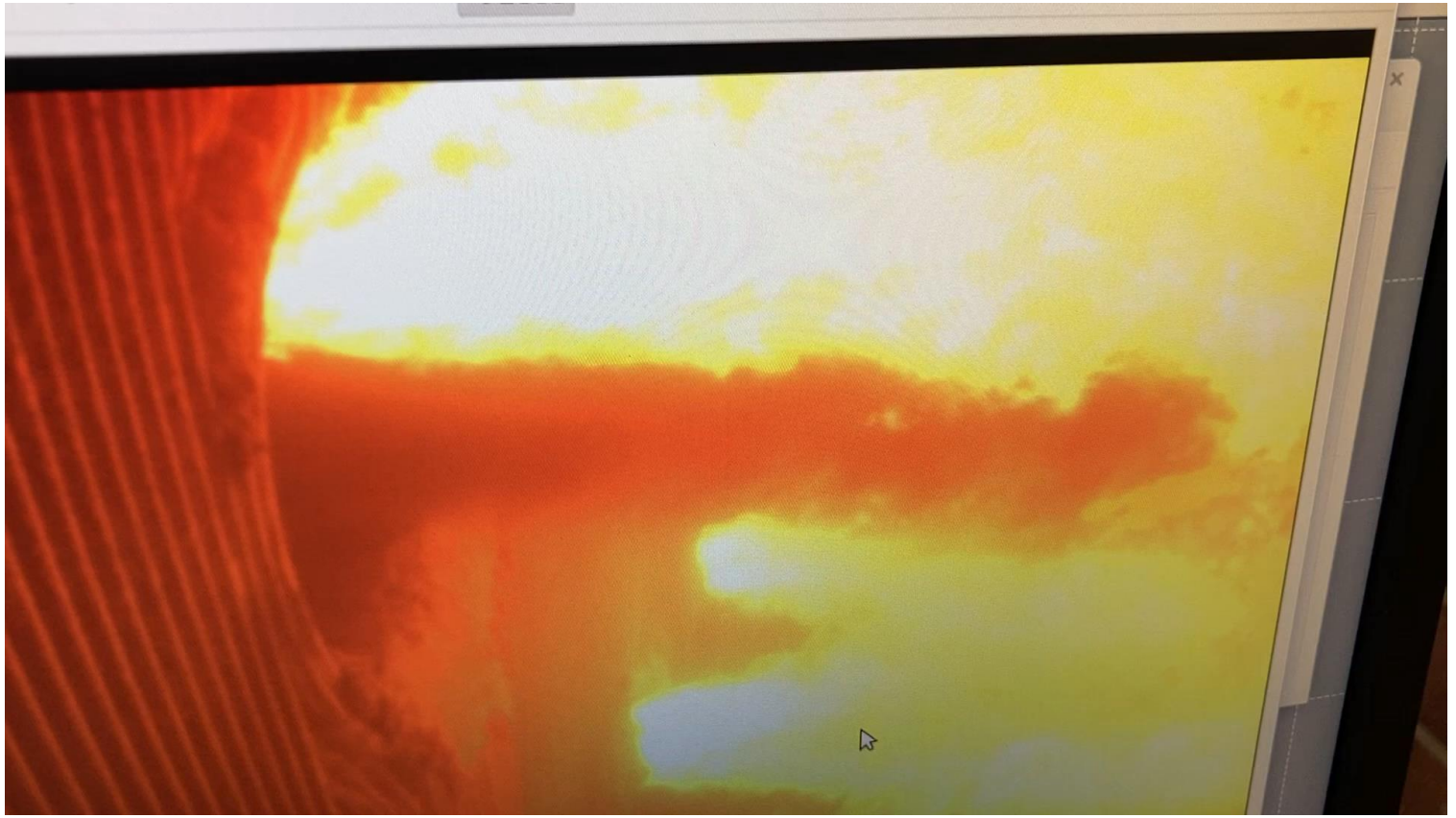
Expected results from Hunter Testing



Plasma Ignitor Installation PacifiCorp Hunter Unit No. 3

Project Status

Project schedule:

- Installation – completed
- Commissioning – underway, to be completed Q1 2021
- Host site field testing – to be completed Q1 2021
- Host site summary meeting – Q3 2021
- Project close out meeting – Q4 2021
- Final report – Q1 2022

Project delays due to:

- COVID
- Restricted plant access
- Travel restrictions, etc.

Plasma Ignitor Installation
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Summary

Project schedule on tract to be completed – 2/28/2022

Initial operation of Plasma Ignitor system has been successful

Expect testing to be successful:

- Recent test installation on unit firing EU lignite were successful