



# **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



# Plasma Ignitor Installation

## PacifiCorp Hunter Unit No. 3

Market and market drivers for technology

Steam plant operators experiencing changing market:

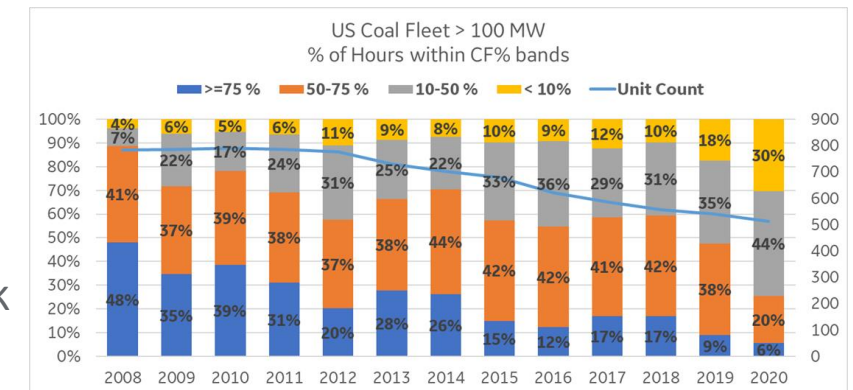
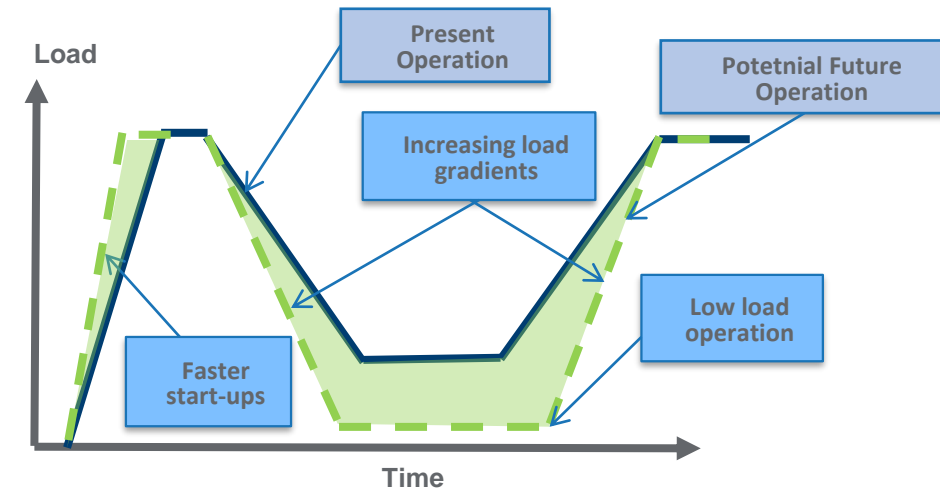
- Increased competition with lower cost generation
- Renewables: increased penetration & intermittent generation
- Regulatory pressures
- High cost of auxiliary fuels

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%.



# Plasma Ignitor Installation PacifiCorp Hunter Unit No. 3

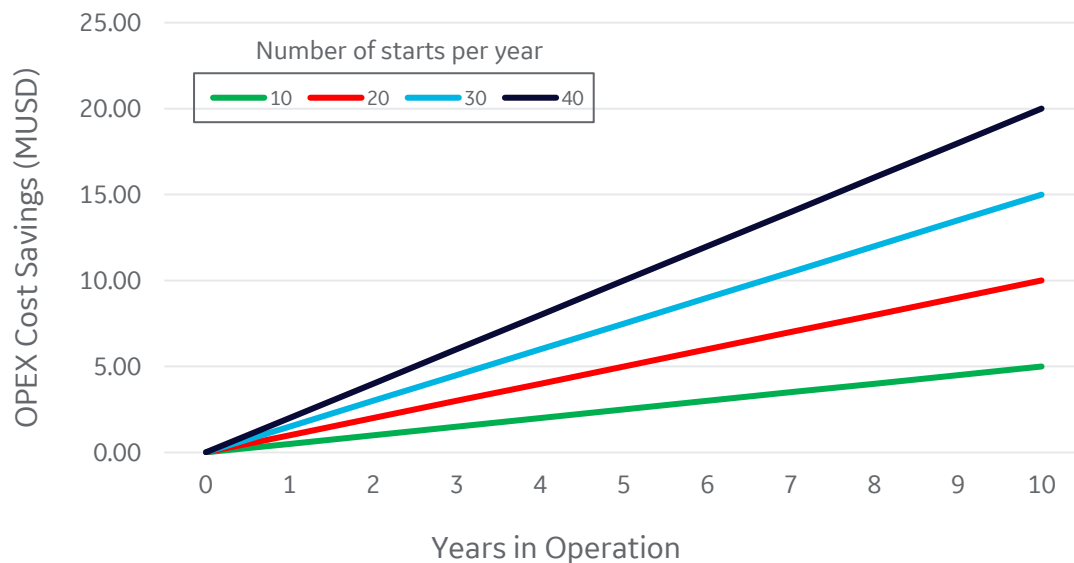
Market drivers for technology

## Typical Return on Investment

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



OPEX Cost Savings based on Number of starts per year



## 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

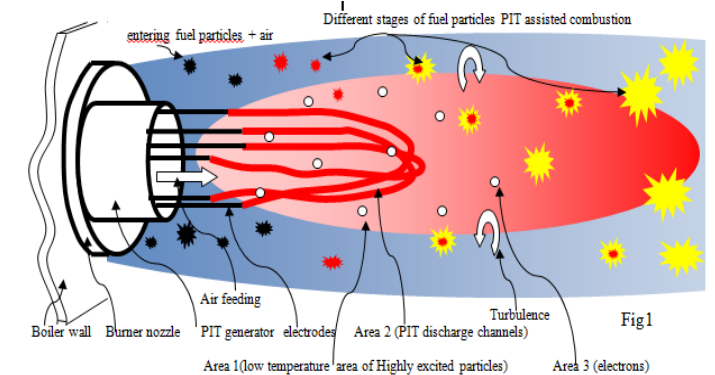
- Cost to operate Plasma Ignitors = 0.162 MUSD/Yr



# Plasma Ignitor Installation PacifiCorp Hunter Unit No. 3

## Technology Overview

- The system produces a high energy plasma,  $\sim 5000^{\circ}\text{C}$  (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





# Plasma Ignitor Installation PacifiCorp Hunter Unit No. 3

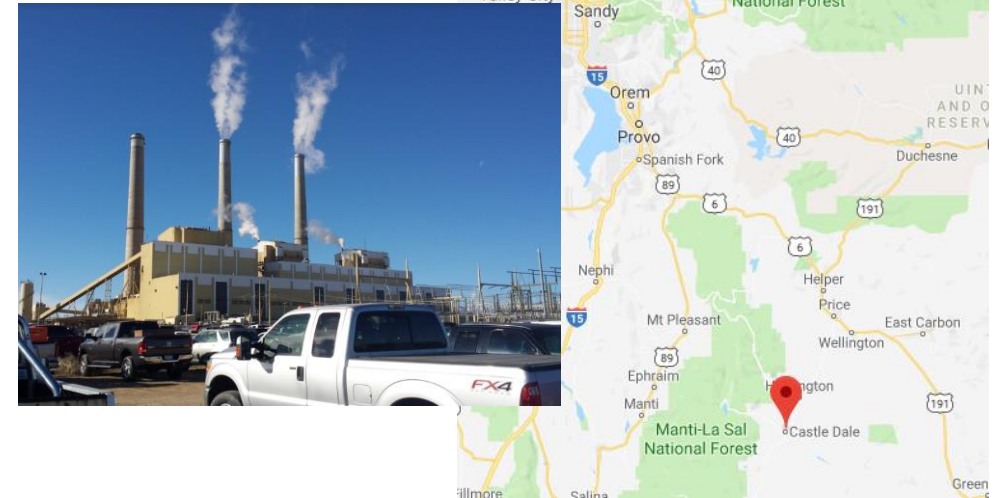
Installation at PacifiCorp Hunter No. 3



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

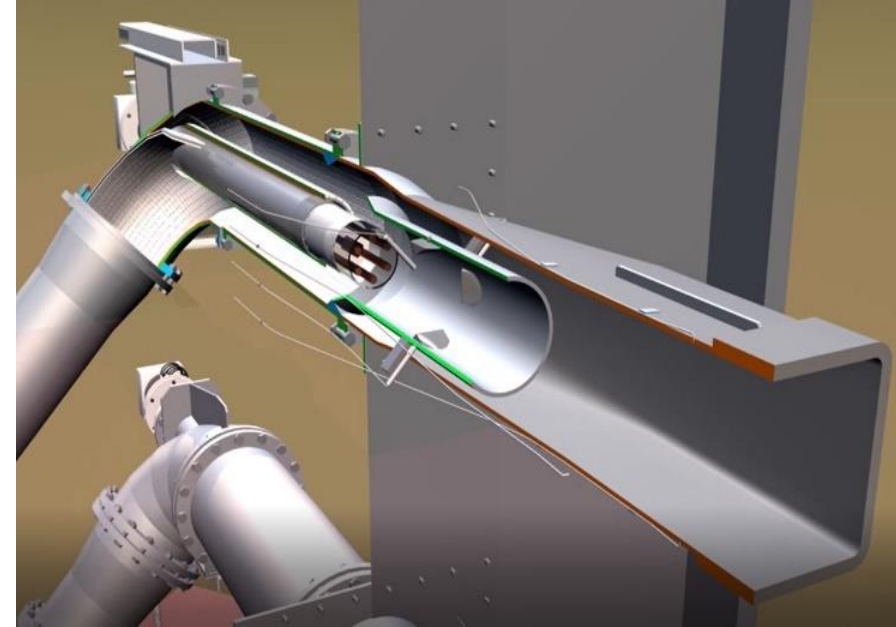
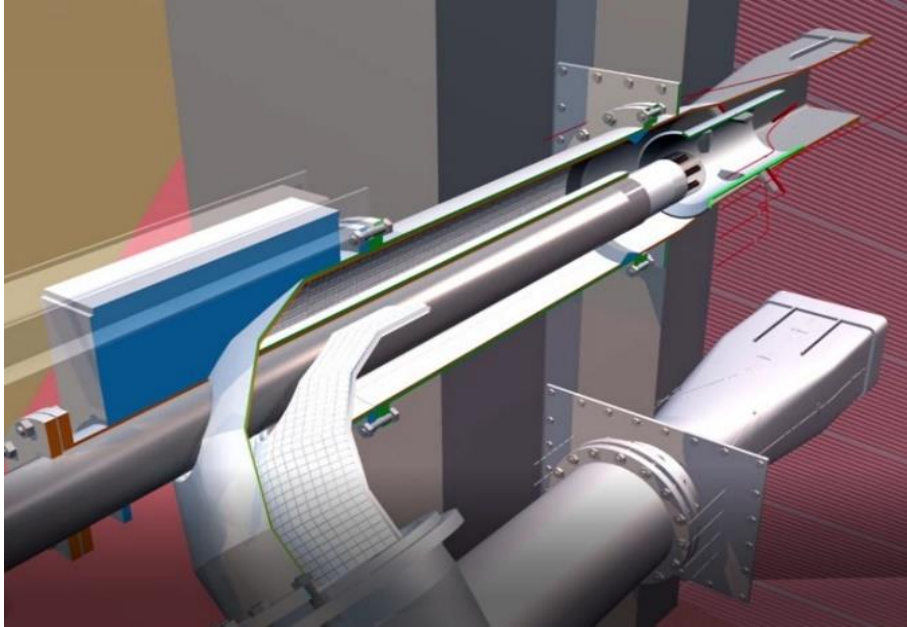
## Unit 3

- 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



# Plasma Ignitor Installation PacifiCorp Hunter Unit No. 3

## Technology Overview

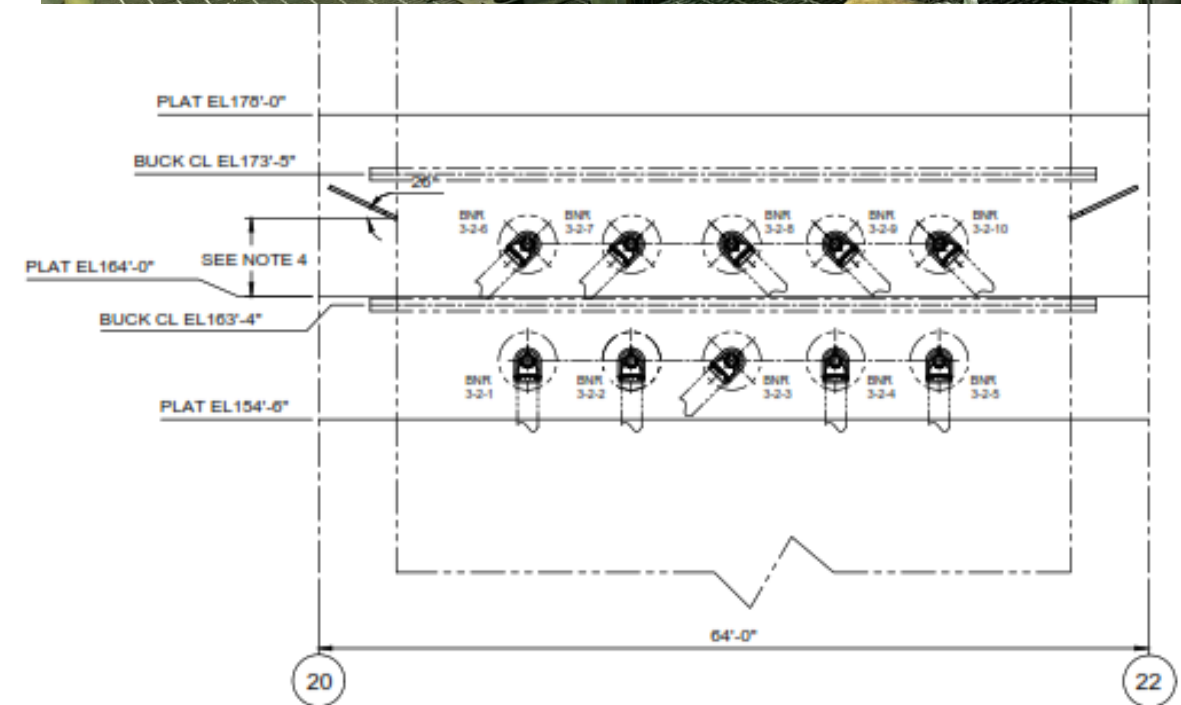
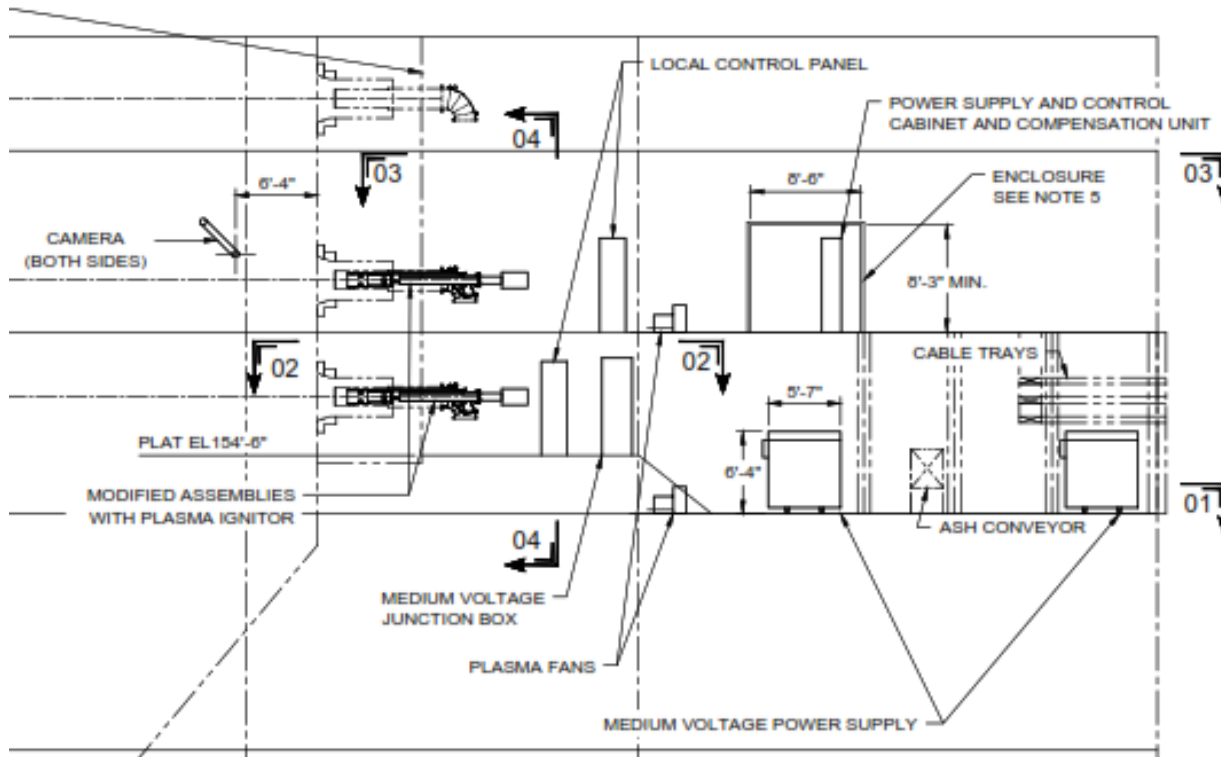


Isometric Showing Installation in Coal Nozzle



# Plasma Ignitor Installation PacifiCorp Hunter Unit No. 3

Installation at PacifiCorp Hunter No. 3





# Plasma Ignitor Installation PacifiCorp Hunter Unit No. 3

Installation at PacifiCorp Hunter No. 3



# Plasma Ignitor Installation

## PacifiCorp Hunter Unit No. 3

### Testing Plan for Hunter

|                                                                       | Boiler Load               |                                 |                                          |                                   |
|-----------------------------------------------------------------------|---------------------------|---------------------------------|------------------------------------------|-----------------------------------|
|                                                                       | >60% MCR                  | > Min. Permitted w/o Oil Firing | Boiler Start-up with & w/o Oil Firing    | One mill operation w/o Oil Firing |
|                                                                       | 3 to 4 Mills in Operation | 2 Mills in Operation            | 2 Mills in Operation (Hot / Warm / Cold) | 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                              |                                          |                                   |



# Plasma Ignitor Installation

## PacifiCorp Hunter Unit No. 3

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

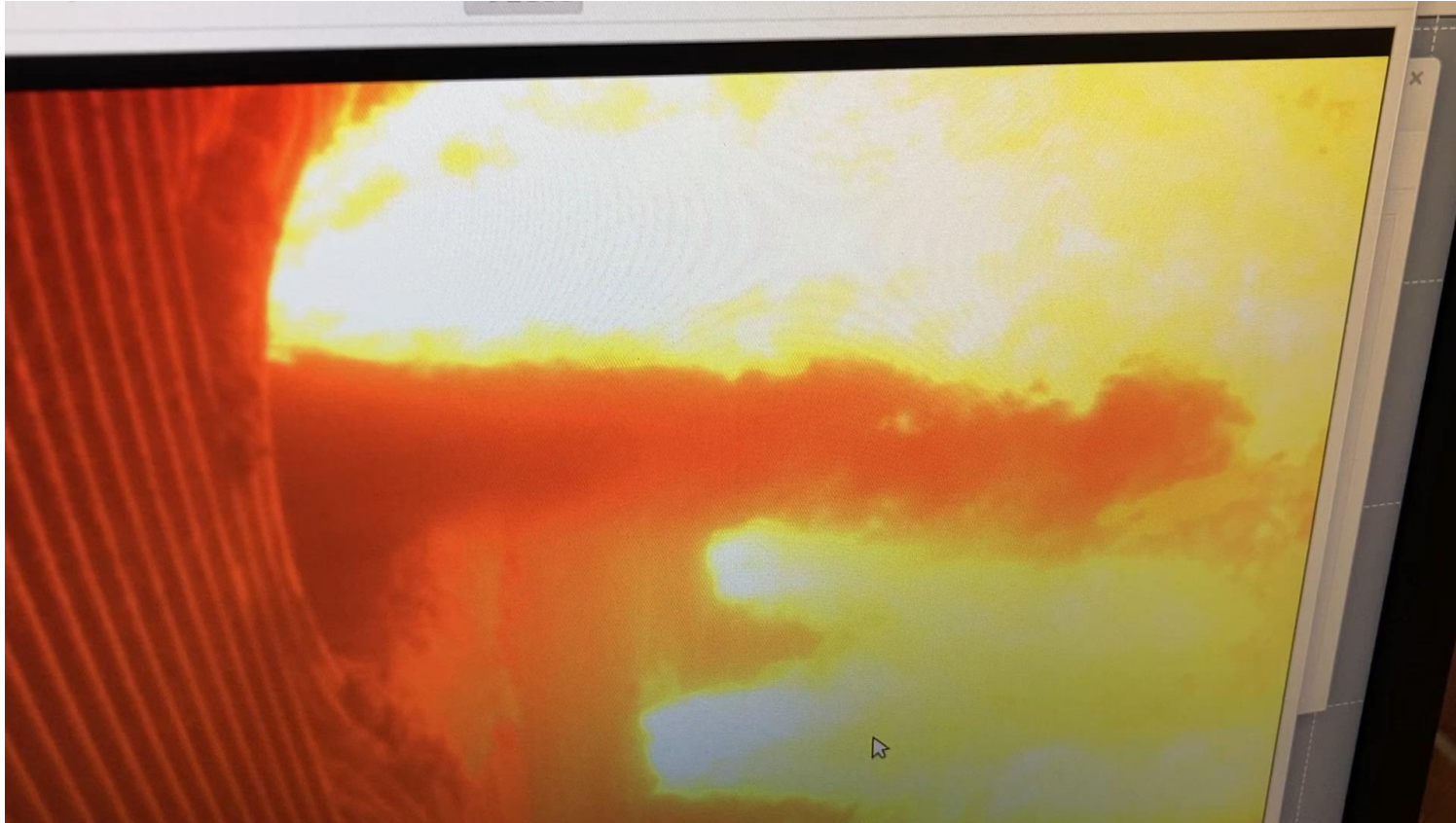




# Plasma Ignitor Installation

## PacifiCorp Hunter Unit No. 3

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

## PacifiCorp Hunter Unit No. 3

### Summary

Project schedule on track 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



