



Combined Power Plant Air Pollutant Control Mega Symposium

SEI/ELEX Rigid Discharge Electrodes on Narrow Plate Spacing

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The Problem

The Solution

3 Beta Sites

SEI/ELEX Rigid Discharge Electrode Description

Inter-Electrode Geometry

Beta Site Descriptions

Performance Results

Conclusions

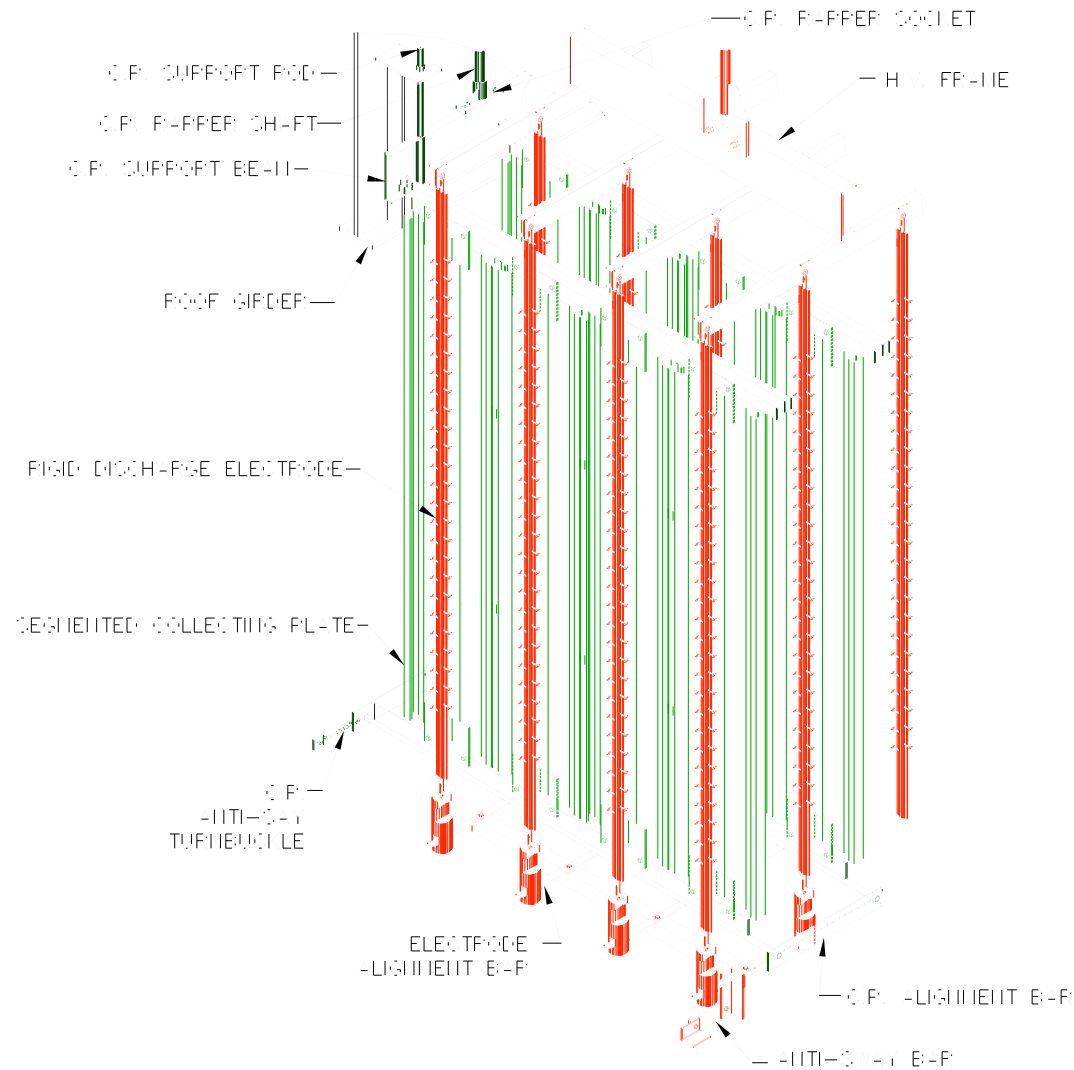
The Problem

- You Want Increased Reliability by Eliminating Wire Breakage
- But You Need Cost Savings by Re-Using Existing Equipment
- And You Want to Maintain or Improve ESP Performance

The Solution - SEI/ELEX RDE

- Weighted RDE
 - Individual Thermal Expansion
 - Reduced Potential for Bowing
- Slender Profile
 - Minimized Electrical Clearance Issues
- Increased Reliability
 - Eliminates Wire Breakage
- These Facts make the SEI/ELEX RDE Ideally Suited for Narrow Plate Spacing Application

SEI/ELEX Rigid Discharge Electrode Design



SEI/ELEX RDE Adapter

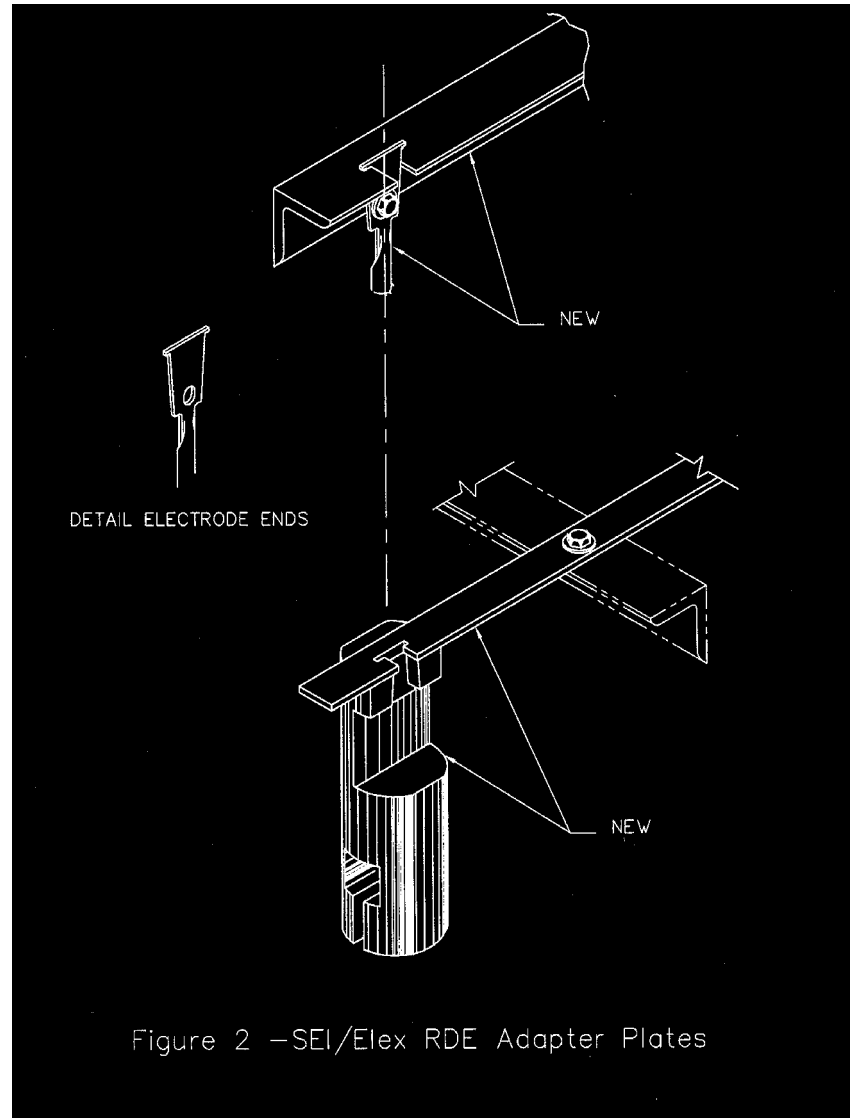


Figure 2 –SEI/Elex RDE Adapter Plates

SEI/ELEX Lower Weight Guide Arrangement



Different Lower Guide Design



The Solution

- Cost Effective Project
 - Save Approximately 75% of Project Budget
 - Re-Use Collecting Plates
 - Re-Use T/R Sets
 - Re-Use Collecting Plate Rapper Systems
 - Re-Use Upper High Voltage Frames
 - Usually Accomplished within the Length of a Typical Annual Outage

Beta Sites

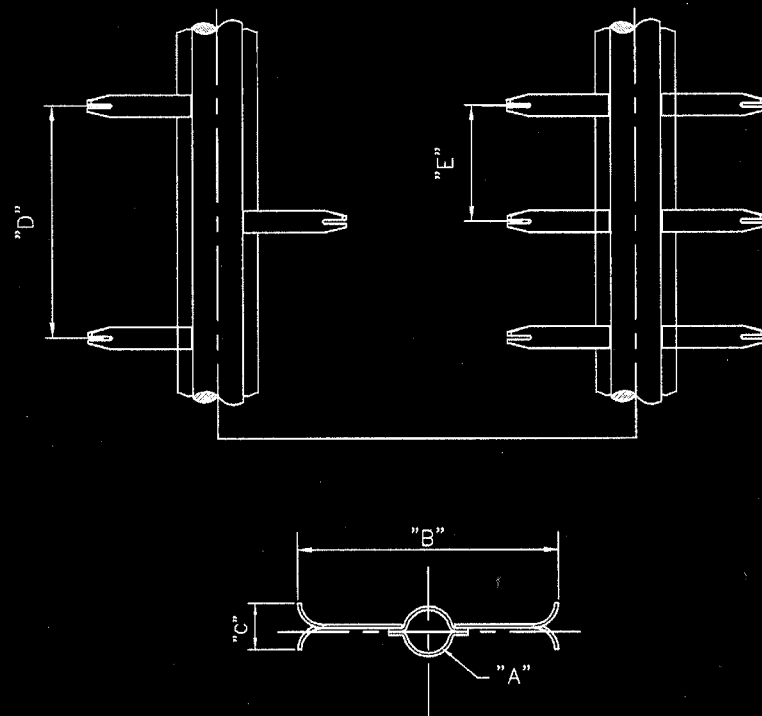
- Variety of Coals
 - PRB
 - Moderate Resistivity Eastern Bituminous
 - High Resistivity Eastern Bituminous
- Variety of Operating Conditions
 - High Collecting Plate Rapping Density
 - SO₃ Flue Gas Conditioning
 - 325° F to 405° F
- Enhanced Performance

SEI/ELEX RDE Description

- History
 - Experience: Over 30 Years of Installed Base in Utility Applications
 - Purpose of Customized Electrode Design
 - Uniform Current Distribution
 - Low Corona Onset Voltage

SEI/ELEX RDE Description

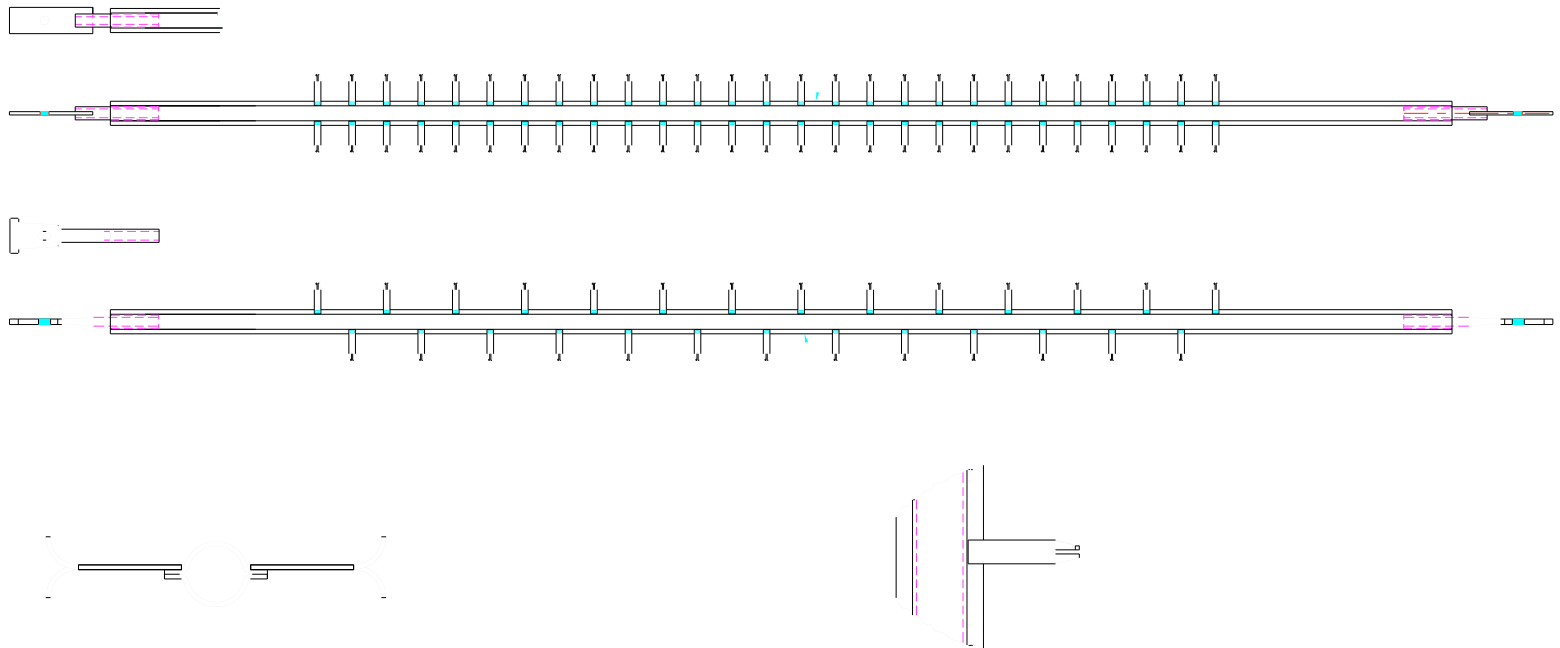
- Physical Description
 - Slender (3/4”), Roll Formed Body
 - 16 Gauge
 - ASTM A-620 Aluminum Killed Mild Steel
 - Spot Welded Emitter Tabs
 - Various Configurations for Customized Application



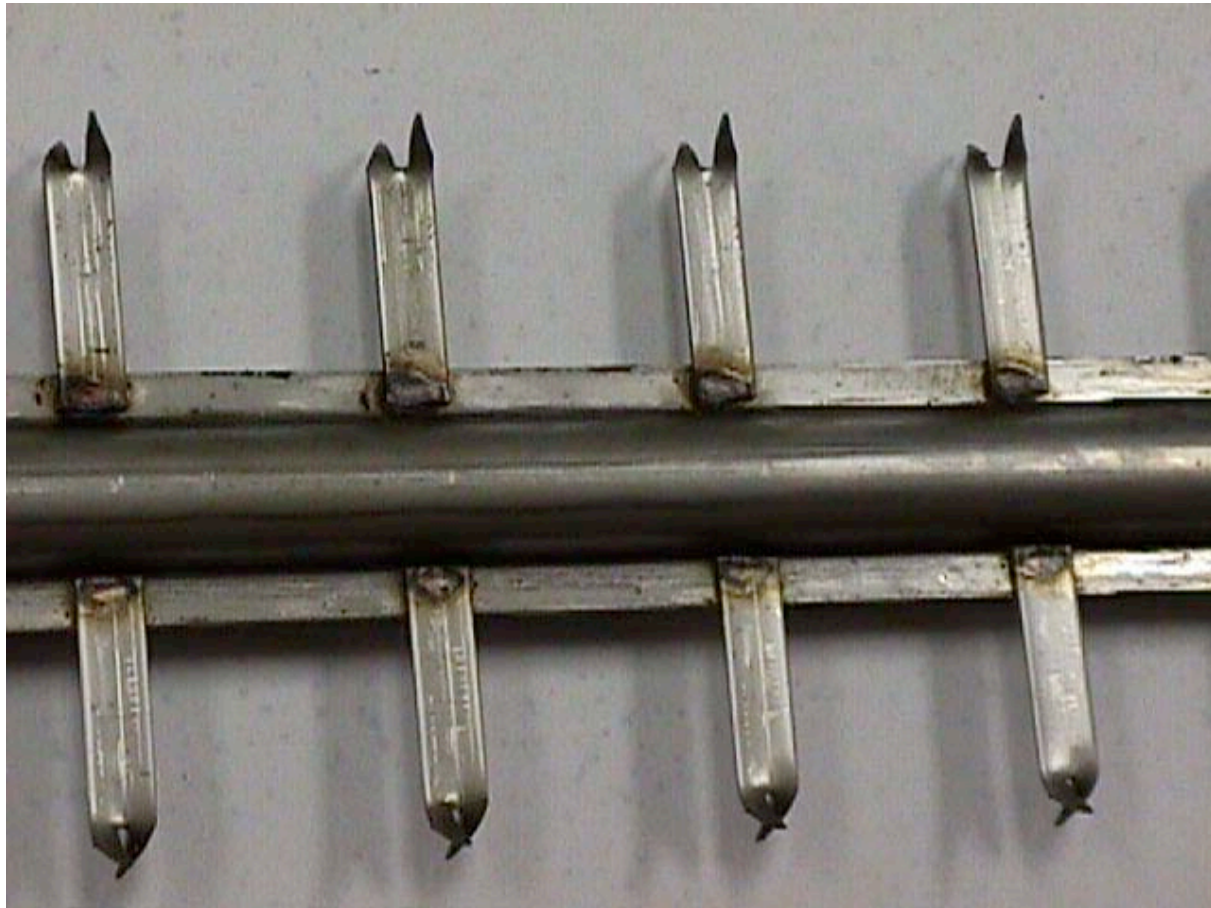
ELEX RDE	(inches)				
	A	B	C	D	E
11/16" stag	0.750	4.500	0.688	3.938	-
11/16" opp	0.750	4.500	0.688	-	1.969
0" stag	0.750	4.927	0	3.938	-

FIGURE 3 - SEI/ ELEX RDE CONFIGURATIONS

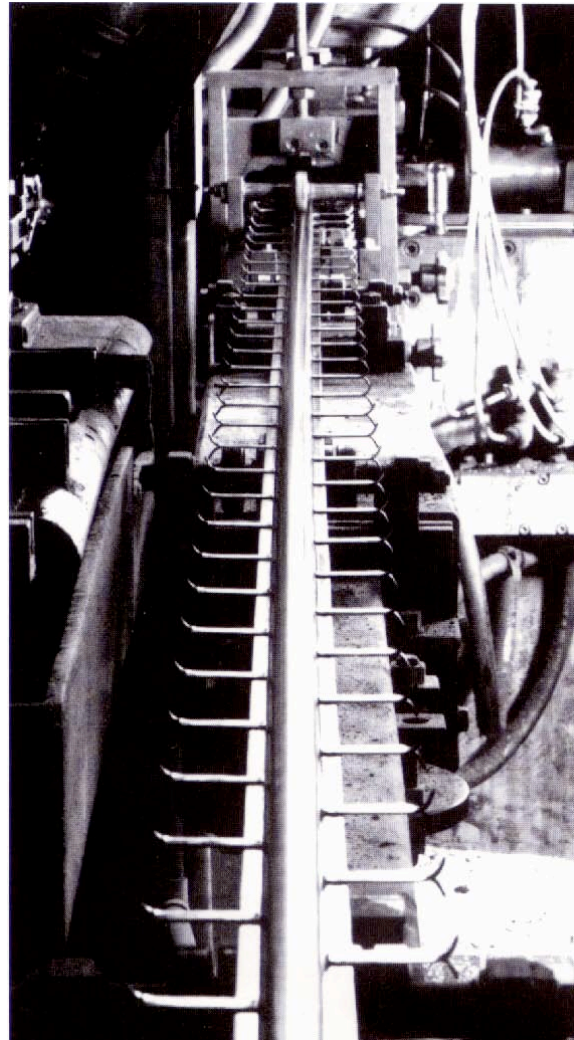
Add Photo of RDE



Aggressive SEI/ELEX RDE



SEI/ELEX RDE Machine



SEI/ELEX RDEs During Manufacturing



Protective Packaging



SEI/ELEX RDE Hanger Bracket



QA/QC Destruction Testing

Customer Name: <u>Duke</u>		Purchase Order No.: <u>5-10-26</u>		
Crate No. <u>23</u>	Date <u>10-25</u>	Inspected By <u>TY</u>	Body Welds Size: <input checked="" type="checkbox"/> 80% <input checked="" type="checkbox"/>	Hanger Welds Top: 1 <input checked="" type="checkbox"/> 2 <input checked="" type="checkbox"/> 3 <input checked="" type="checkbox"/> 4 <input checked="" type="checkbox"/> 5 <input checked="" type="checkbox"/> 6 <input checked="" type="checkbox"/> Bottom: 1 <input checked="" type="checkbox"/> 2 <input checked="" type="checkbox"/> 3 <input checked="" type="checkbox"/> 4 <input checked="" type="checkbox"/> 5 <input checked="" type="checkbox"/> 6 <input checked="" type="checkbox"/>
Crate No. <u>23</u>	Date <u>10-26</u>	Inspected By <u>Henry</u>	Body Welds Size: <input checked="" type="checkbox"/> 80% <input checked="" type="checkbox"/>	Hanger Welds Top: 1 <input checked="" type="checkbox"/> 2 <input checked="" type="checkbox"/> 3 <input checked="" type="checkbox"/> 4 <input checked="" type="checkbox"/> 5 <input checked="" type="checkbox"/> 6 <input checked="" type="checkbox"/> Bottom: 1 <input checked="" type="checkbox"/> 2 <input checked="" type="checkbox"/> 3 <input checked="" type="checkbox"/> 4 <input checked="" type="checkbox"/> 5 <input checked="" type="checkbox"/> 6 <input checked="" type="checkbox"/>
Crate No. <u>24</u>	Date <u>11-26</u>	Inspected By <u>TY</u>	Body Welds Size: <input checked="" type="checkbox"/> 80% <input checked="" type="checkbox"/>	Hanger Welds Top: 1 <input checked="" type="checkbox"/> 2 <input checked="" type="checkbox"/> 3 <input checked="" type="checkbox"/> 4 <input checked="" type="checkbox"/> 5 <input checked="" type="checkbox"/> 6 <input checked="" type="checkbox"/> Bottom: 1 <input checked="" type="checkbox"/> 2 <input checked="" type="checkbox"/> 3 <input checked="" type="checkbox"/> 4 <input checked="" type="checkbox"/> 5 <input checked="" type="checkbox"/> 6 <input checked="" type="checkbox"/>
Crate No. <u>27</u>	Date <u>02-27</u>	Inspected By <u>TY</u>	Body Welds Size: <input checked="" type="checkbox"/> 80% <input checked="" type="checkbox"/>	Hanger Welds Top: 1 <input checked="" type="checkbox"/> 2 <input checked="" type="checkbox"/> 3 <input checked="" type="checkbox"/> 4 <input checked="" type="checkbox"/> 5 <input checked="" type="checkbox"/> 6 <input checked="" type="checkbox"/> Bottom: 1 <input checked="" type="checkbox"/> 2 <input checked="" type="checkbox"/> 3 <input checked="" type="checkbox"/> 4 <input checked="" type="checkbox"/> 5 <input checked="" type="checkbox"/> 6 <input checked="" type="checkbox"/>
Crate No. <u>25</u>	Date <u>10-29</u>	Inspected By <u>Henry</u>	Body Welds Size: <input checked="" type="checkbox"/> 80% <input checked="" type="checkbox"/>	Hanger Welds Top: 1 <input checked="" type="checkbox"/> 2 <input checked="" type="checkbox"/> 3 <input checked="" type="checkbox"/> 4 <input checked="" type="checkbox"/> 5 <input checked="" type="checkbox"/> 6 <input checked="" type="checkbox"/> Bottom: 1 <input checked="" type="checkbox"/> 2 <input checked="" type="checkbox"/> 3 <input checked="" type="checkbox"/> 4 <input checked="" type="checkbox"/> 5 <input checked="" type="checkbox"/> 6 <input checked="" type="checkbox"/>
Crate No. _____	Date _____	Inspected By _____	Body Welds Size: _____ 80% _____	Hanger Welds Top: 1 _____ 2 _____ 3 _____ 4 _____ 5 _____ 6 _____ Bottom: 1 _____ 2 _____ 3 _____ 4 _____ 5 _____ 6 _____

SEI/ELEX RDE Description

- Electrical Description
 - High Corona Current Producer
 - Uniform Current Distributor
 - At 9” Gas Passage the SEI/ELEX Resembles a Pipe & Spike RDE at 12”



RDE Airload V-I Curves (Field Data)

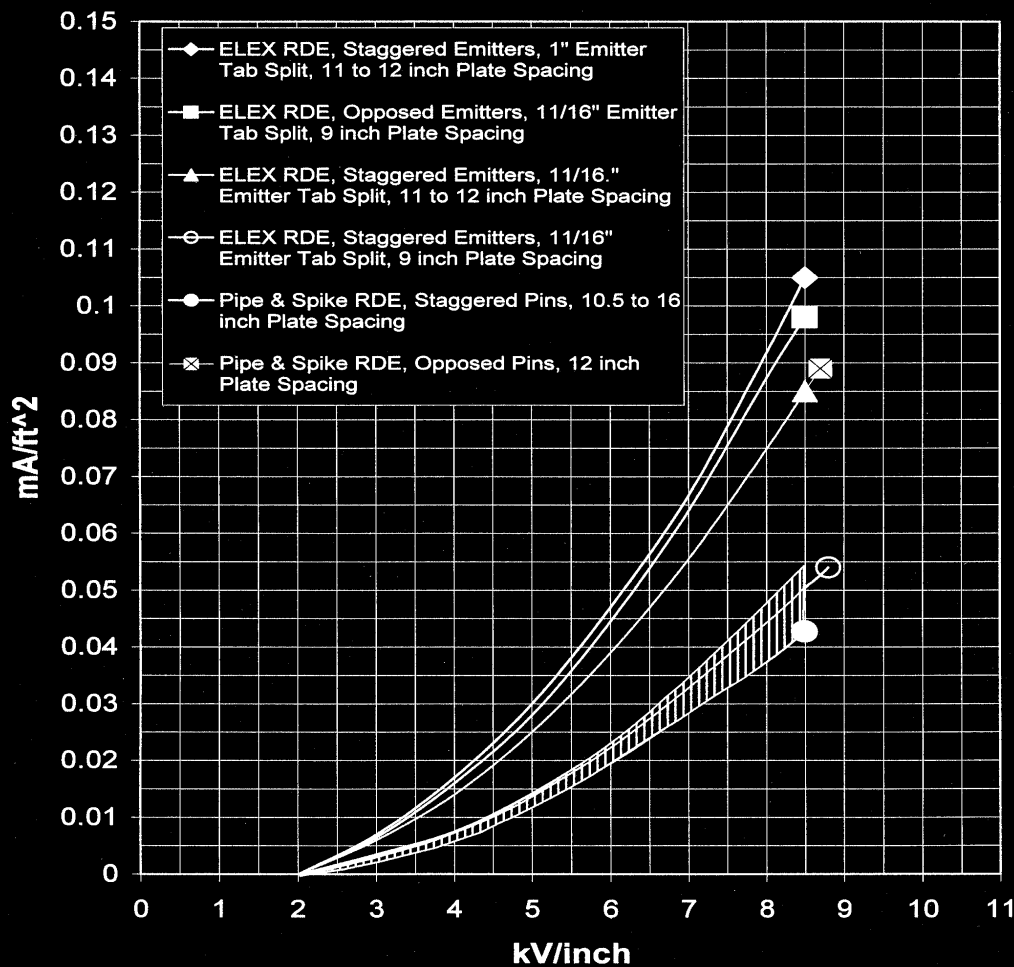
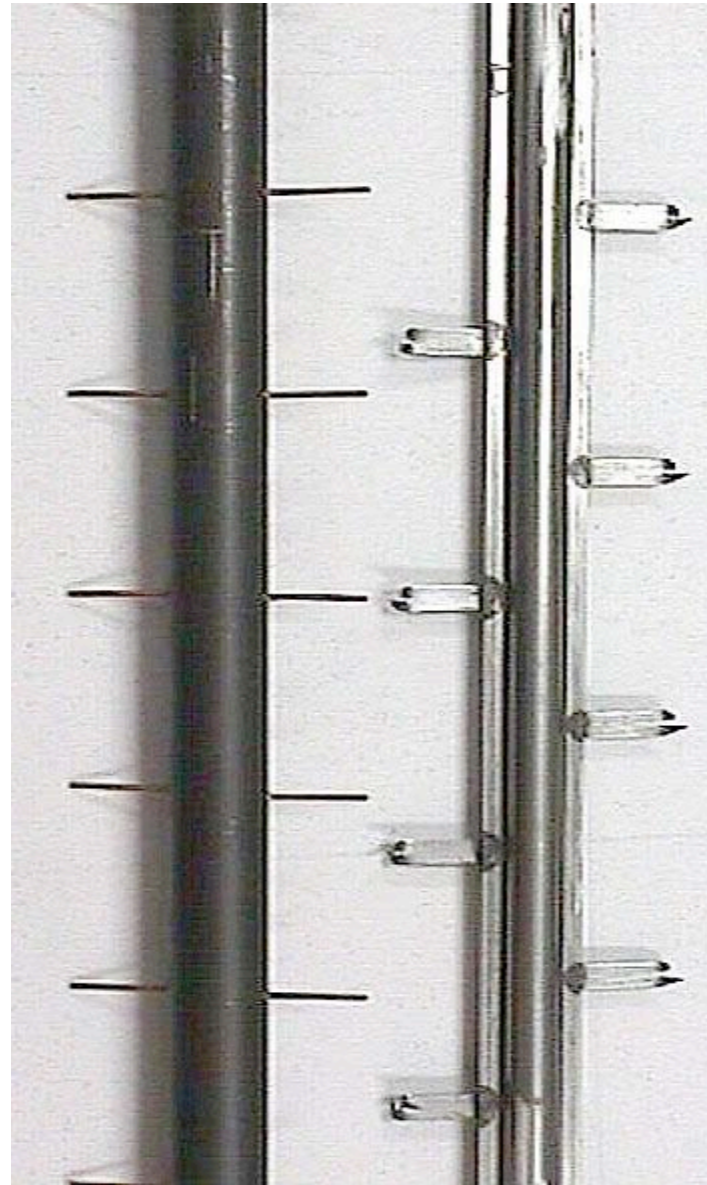


Figure 4

Inter-Electrode Geometry

- Comparison of RDE Types
 - SEI-ELEX vs Pipe & Spike RDEs
 - 3/4” Mast SEI/ELEX RDE
 - 1.5” & 2” Pipe and Spike RDEs
- Electrical Clearances
 - RDE-to-Collecting Plate
 - RDE-to-Collecting Plate Upper & Lower Support Systems



Inter-Electrode Geometry

- Comparison of Electrical Clearances
 - RDE-to-Collecting Plate
 - Reduction of Cross Sectional Area:
 - SEI/ELEX : 9.7%
 - 1.5” Pipe & Spike: 16.7%
 - 2” Pipe & Spike: 22.2%
 - Resulting in Gas Velocity Increase
 - Increases Plate Scouring in Higher Velocity Areas



Inter-Electrode Geometries

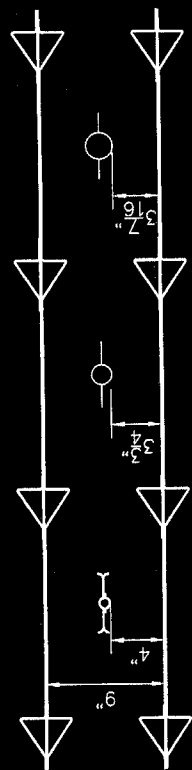


FIGURE 5A

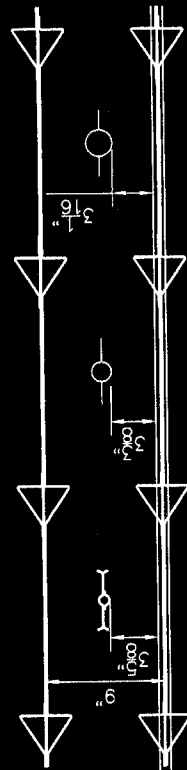


FIGURE 5B

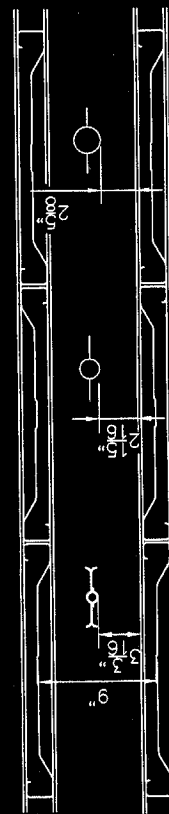


FIGURE 5C

Inter-Electrode Geometries

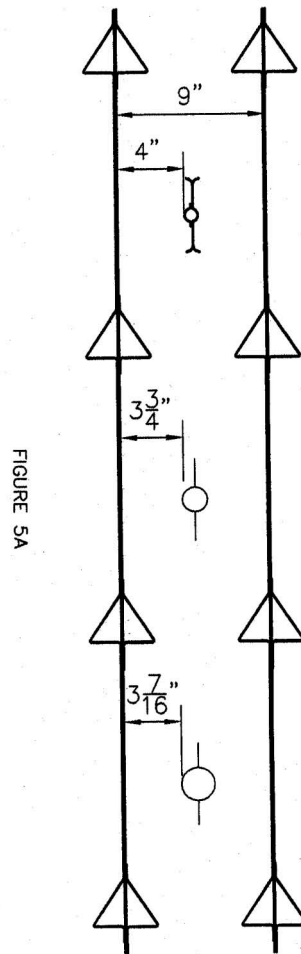


FIGURE 5A

Inter-Electrode Geometry

- Comparison of Electrical Clearances
 - RDE-to-Collecting Plate Support
 - Solid Curtain Upper & Lower Horizontal Stiffeners
 - SEI/ELEX: 7% more than 1.5” Pipe & Spike RDE
 - SEI/ELEX: 16% more than 2” Pipe & Spike RDE
 - Segmented Plate Design with 2” Wide Support or Rapping Mechanism
 - SEI/ELEX: 8% more than 1.5” Pipe & Spike RDE
 - SEI/ELEX: 18% more than 2” Pipe & Spike RDE

Inter-Electrode Geometries

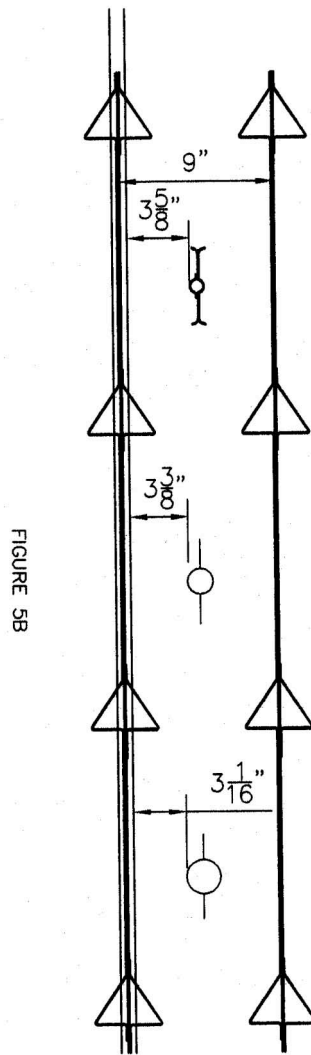


FIGURE 5B

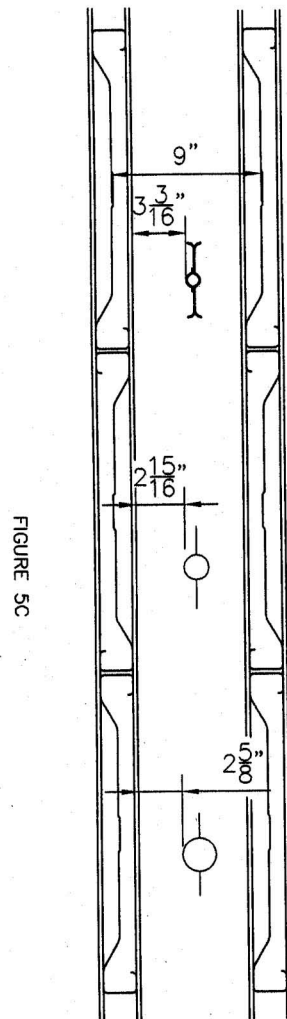
SEI/ELEX RDE-to-CE Support



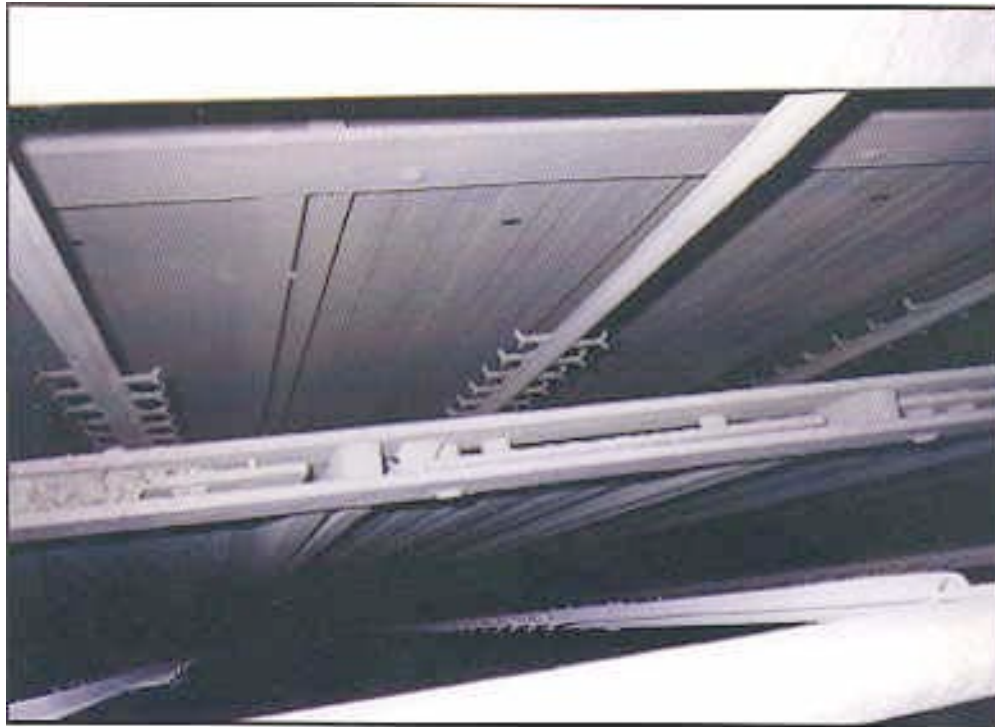
Inter-Electrode Geometry

- Comparison of Electrical Clearances
 - RDE-to-Collecting Plate Support
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 - SEI/ELEX: 7% more than 1.5” Pipe & Spike RDE
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 - SEI/ELEX: 18% more than 2” Pipe & Spike RDE

Inter-Electrode Geometries



SEI/ELEX RDE-to-CE Support



Beta Site A

- CE Tangentially Fired Boiler
- PRB Coal, Sulfur Content: 0.24%, Ash Content: 5%
- Flue Gas Temperature: 325°F-350°F
- 6.1 feet per second Gas Velocity
- 4 Mechanical Fields with Gas Flow
- 8 Electrical Bus Sections with Gas Flow
- 9" Gas Passage Width
- Customized SEI/ELEX RDE in all Fields

Project Results - Beta Site A

- Saved an Estimated \$ 3,500,000
 - Re-Used Collecting Plates and Support System
 - Re-Used T/Rs and Controls
 - Re-Used Rappers and Controls
- Inlet Loading: Approx. 3.0 lb/mmbtu
- Outlet Emissions: Approx. 0.03 lb/mmbtu
- ESP Efficiency: Approx 99%
- A Range of ESP Power Density: 0.6 Watts/ft² at the Inlet to 1.5 Watts/ft² at the Outlet

Beta Site B

- CE Tangentially Fired Boiler
- 1.8% Sulfur - Eastern Bituminous Coal
- Flue Gas Temperature: 390°F-405°F
- 5.65 feet per second Gas Velocity
- 4 Mechanical Fields with Gas Flow
- 4 Electrical Bus Sections with Gas Flow
- 9" Gas Passage Width
- SEI/ELEX RDE in First 2 Fields

Beta Site C

- 180,000 lb/hr PC Fired Boiler
- High Resistivity, Low Sulfur (1%), High Ash Content (20%) Eastern Bituminous Coal
- Flue Gas Temperature: 365°F
- 5 Mechanical Fields with Gas Flow
- 5 Electrical Bus Sections with Gas Flow
- 8" Gas Passage Width
- SEI/ELEX Electrodes in all Fields

Beta Site C



Project Results - Beta Site C

- Inlet Loading: 4.55 lb/mmbtu
- Outlet Emissions: 0.019 lb/mmbtu
- ESP Efficiency: 99.6%
- ESP Avg Power Density: 0.43
Watts/ft²

Electrical Performance

- Moderate Resistivity Fly Ash Power Densities: 1.3 - 1.7 Watts/ft²
- Moderate Resistivity Fly Ash Field Strength: 7.7 - 9.3 kV per inch
- High Resistivity Fly Ash Power Densities: 0.5 Watts/ft²
- High Resistivity Fly Ash Field Strength: 7.7 - 9.3 kV per inch
- 4 - 8% Higher Voltages than Projected from Wide Gas Passage Data

Conclusions

- SEI/ELEX in Narrow (8"-10") Gas Passages is Commercially Proven
- Performance has been Enhanced
- Reliability has been Improved
- Cost Savings have been Demonstrated
- Outage Commitments were Met
- This is a Viable Alternative to Re-Wiring a Weighted Wire ESP

Conclusion

- These Facts Show that Installing SEI/ELEX Rigid Discharge Electrodes is a Cost Effective and Performance Enhancing Alternative to Re-Installing Weighted Wires “In-Kind” in a Narrow Gas Passage ESP