



## Smart Grid Technology for Predictive Analytics of Grid Resistor Life

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### White Paper Summary:

Dayton-Phoenix Group introduces Smart Grid Technology, a solution designed to monitor and predict the lifespan of braking grid resistors in locomotive and mining applications. By leveraging advanced temperature monitoring and predictive analytics, this system enables users to make informed decisions on braking grid resistor replacement, optimizing safety, efficiency, and cost savings. This paper outlines the capabilities, benefits, and value of Smart Grid Technology for customers and Dayton-Phoenix Group.

### Introduction

Braking grid resistors are critical components in heavy-duty applications such as locomotives and mining trucks, playing a key role in energy dissipation during braking. Over time, resistors experience wear due to high temperatures and environmental factors, leading to potential insulation failures. However, with Dayton-Phoenix Group's Smart Grid Technology, customers now have access to predictive analytics that can forewarn them of resistor end-of-life, allowing for preventative maintenance and reducing the risk of sudden failures.

### Customer Improvement Objectives

Smart Grid Technology is designed to provide substantial benefits to customers in the rail and mining industries. The system delivers predictive insights that offer key advantages:

1. **Prevent insulation failures:** Early detection of temperature-related stress helps avoid catastrophic insulation failures.
2. **Preventative maintenance:** Customers can schedule resistor replacements based on data, reducing unexpected failures and downtime.
3. **Intelligent decision making:** Data-driven insights allow for smarter asset management and maintenance decisions.
4. **Scheduling:** Maintenance can be scheduled during planned downtimes, avoiding unscheduled interruptions.
5. **Alerts:** The system sends alerts when a resistor is nearing the end of its life cycle, preventing breakdowns.
6. **Reduce maintenance costs:** Predictive analytics optimize maintenance intervals, preventing premature or delayed servicing.
7. **Increased safety:** Early detection of resistor wear minimizes the risk of failure during operation, increasing the safety of equipment and personnel.
8. **Reduce downtime:** With timely replacements, customers experience reduced equipment downtime, improving overall operational efficiency.
9. **Supplier trust:** A more proactive maintenance approach strengthens the relationship between suppliers and customers.
10. **Abnormal activity alerts:** The system flags abnormal wear patterns, enabling immediate action to address potential issues.



## DPG Improvement Objectives

Smart Grid Technology also drives several benefits for Dayton-Phoenix Group, positioning the company as a leader in the market:

1. **Increase market share:** Offering predictive maintenance solutions makes DPG products more attractive to customers, helping capture a larger market.
2. **More desirable product:** The technology differentiates DPG resistors from competitors by offering enhanced value.
3. **Product expertise:** Gaining deeper knowledge of product performance over time improves future innovations.
4. **Solidify as market experts:** Demonstrating leadership in predictive analytics establishes DPG as a trusted expert in resistor technology.
5. **Business growth:** Offering cutting-edge solutions drives business growth, creating new jobs and expanding DPG's market footprint.
6. **New challenges:** Developing predictive analytics fosters innovation within DPG.
7. **Strengthen customer relationships:** Providing intelligent maintenance solutions strengthens customer loyalty and trust.

## Data Collection

Smart Grid Technology can collect and process critical data points that inform predictive analytics, enabling precise resistor life estimation:

1. **Insulator temperatures** (*key for analyzing resistor life*)
2. **Time** (*key for analyzing resistor life*)
3. **Locomotive #/ID**
4. **Voltage/current (power)**
5. **Inlet/outlet temperatures (air density)**
6. **Element temperatures**
7. **Airflow characteristics (V&A -> velocities)**
8. **Geographic location**
9. **Location in the stack**

By focusing on the most impactful variables, such as insulator temperatures and time, the system generates reliable insights on resistor lifespan.

## Data Transfer Capabilities

Smart Grid Technology is flexible in how it processes and transmits data, offering multiple options to suit customer needs:

1. **Onboard processing:** Real-time data analysis directly on the equipment.
2. **Constant data streaming:** Continuous data flow for detailed monitoring.
3. **On-demand data download:** Customers can retrieve data as needed.
4. **Scheduled streaming:** Data can be transmitted at preset intervals to reduce bandwidth usage.
5. **Communication options:** AM/FM, GSM, satellite, WiFi.



6. **Offboard processing:** Data can be processed remotely for deeper analysis.
7. **Alerts:** Customers receive e-mail, text, or onboard alerts when action is needed.

### Algorithmic Capabilities

The system employs advanced algorithms to interpret collected data, providing valuable insights and actionable alerts:

1. **Temperature and time calculations:** The system computes real-time life expectancy of resistors.
2. **Insulation temperature alerts:** Alerts are triggered when insulation temperatures reach unsafe levels.
3. **Abnormal wear detection:** The system identifies abnormal wear rates, alerting users to potential issues.
4. **Hardware issues:** Thermocouple or hardware issues are flagged, and faulty data is discarded to ensure accuracy.
5. **Data conditioning:** Transmitters process and condition data before transmission to eliminate noise.

### Benefits for Rail and Mining Industries

Smart Grid Technology is well-suited for the rail and mining industries, where operational efficiency and safety are paramount. By offering precise predictions on resistor wear, customers in these industries benefit from:

1. **Reduced downtime and improved efficiency**
2. **Enhanced safety for operators and equipment**
3. **Optimized maintenance scheduling, avoiding disruptions to operations**
4. **Improved relationship with Dayton-Phoenix Group through better product performance and service**

### Conclusion

Dayton-Phoenix Group's Smart Grid Technology is a game-changing solution that brings predictive analytics to the maintenance of braking grid resistors. By offering early warnings of resistor wear, users can take proactive steps to replace components before failure occurs, reducing downtime, maintenance costs, and enhancing safety. For Dayton-Phoenix Group, this technology opens new market opportunities, strengthens customer relationships, and sets the company apart as an industry leader in innovative resistor solutions.