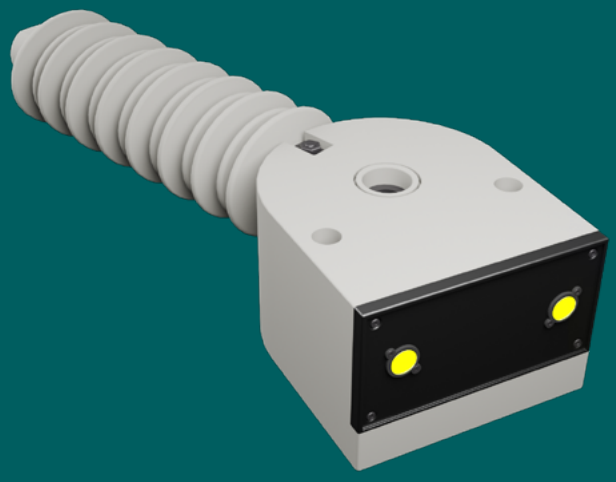
# CapMD™

## Capacitor Health Monitoring Solution



GE VERNOVA

## Why Capacitor Monitoring

High-voltage (HV) and medium-voltage (MV) capacitors are key elements to improving the efficiency and reliability of the grid by delivering reactive power. If not maintained or monitored, failures of capacitors within a bank could result in grid stability issues, unplanned system outages, safety hazards, and higher costs. When maintaining capacitor banks and substation equipment, capacitor asset managers are often challenged by:

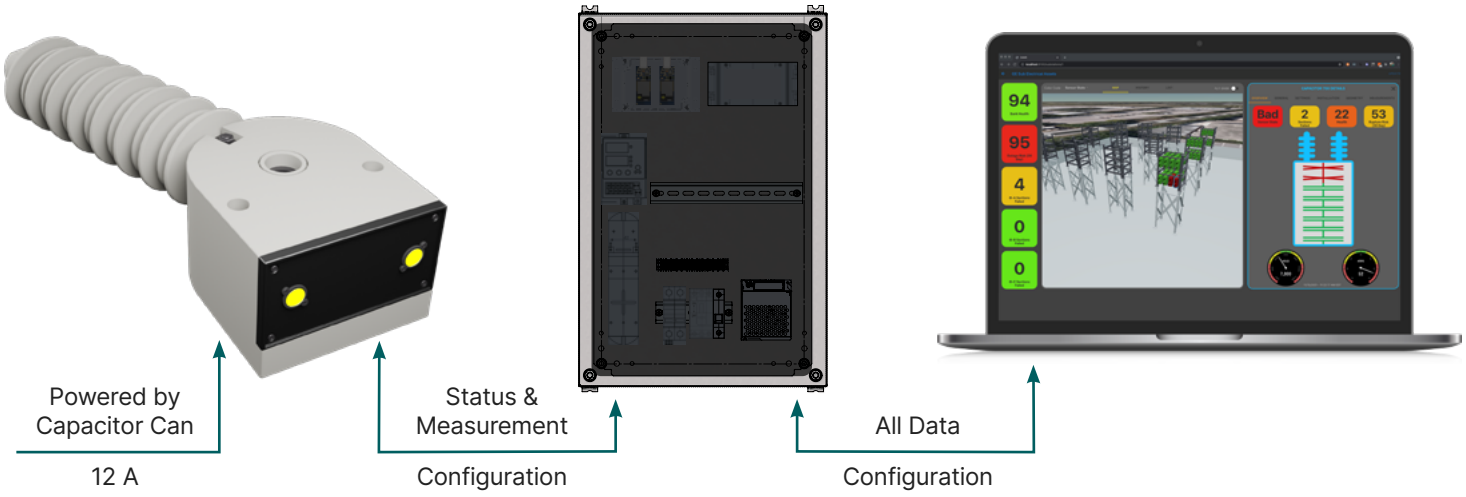
- **Capacitor failure** due to transient voltage and sharp temperature variations
- Access to **remote capacitor bank locations** or during **harsh weather** conditions
- **Loss of asset historical knowledge** as company technical experts retire
- **Regulatory pressure** and possible financial penalties for reduced reactive power
- **Ageing infrastructure**
- **Crew safety** and **liability**

# Introducing Grid Solutions at GE Vernova's CapMD

## Capacitor Health Monitoring Sensor Technology

Grid Solutions' CapMD allows electric utilities to easily identify failed capacitors and monitor the health status of individual capacitors in a capacitor bank.

Unlike existing methodologies, CapMD can detect a degraded individual capacitor in real-time, without the need to manually test each capacitor within the bank. Employing CapMD, utilities can drastically reduce capacitor bank troubleshooting, outage times, as well as O&M spending all while improving system reliability and crew safety.




### CapMD Sensor

- Mounted onto a capacitor bushing terminal
- Measures electrical characteristics of individual capacitors
- Settings configured to detect failure and predictive maintenance

### CapMD Receiver Cabinet

- Ground receiver located locally at substation
- Communicates with sensors: Modbus and DNP3 are enabled for remote monitoring
- Can connect to multiple sensors within 300 ft line of sight

*Image shown for illustration purposes only. Actual product may vary.*

### Application Program Interface

- Connect locally via any PC or tablet to view data
- Aids in predictive and condition-based maintainence
- Displays health status location, and trends of individual capacitors

# Key Benefits

### Operational

- Capacitor bank restoration time improved by up to 75%*
- Reduced unplanned outages
- Aids in predictive and condition-based maintenance

### Financial

- Capex investment and reduced O&M costs
- Reduce tangible and intangible costs
- Reduce the need to spend on buying additional power due to forced outage up to $40/MWHr**

### Digitization

- Extract asset performance information
- Ability to analyze historical trends
- Access asset data remotely

### Safety

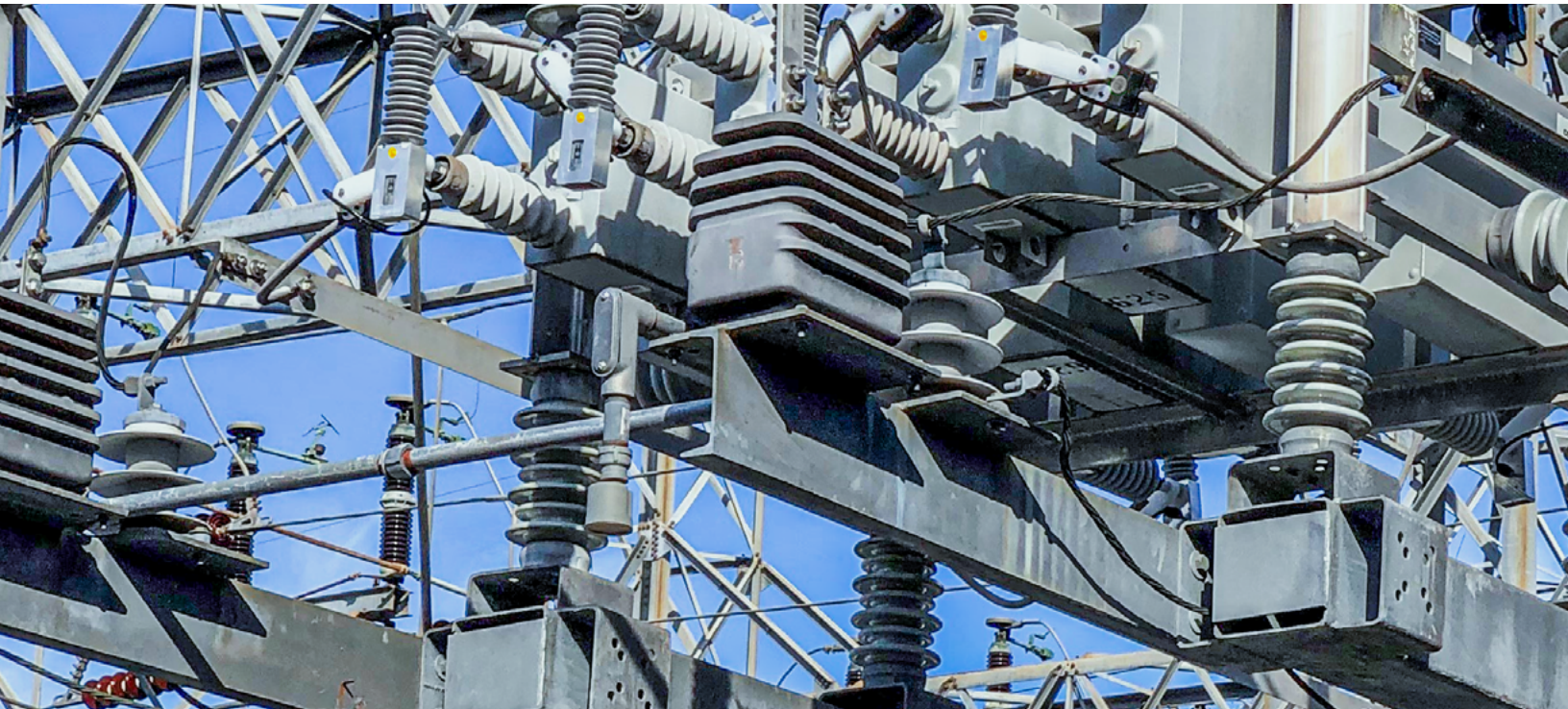
- Reduced time spent by crew onsite
- Helps avoid catastrophic capacitor failures
- Easy access to health status of capacitors in remote areas or during harsh weather conditions

* Estimation only, varies for each utility

** Estimation only, depends on applications

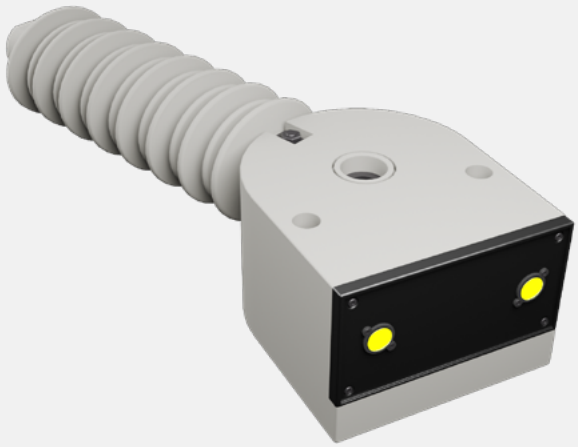
# Applications

- HV and MV transmission and distribution capacitor banks with capacitor ratings of 2.4 kV-25 kV / 280 kVAR-2925 kVAR
- Applicable to shunt banks and harmonic filters for industrial and renewable (wind, solar) applications



# CapMD Sensor

Designed to monitor and detect failure of HV and MV capacitors. The capacitor sensor performs the majority of the “heavy lifting” by continuously sampling the electrical characteristics of a capacitor and has the ability to detect failure as well as monitor the health status of individual capacitors.



## Sensor Specifications

| | |
|---|---|
| Capacitor Can Type | Internally Fused, Fuseless |
| Turn-on Current | 12 A |
| Capacitor Max. Rating | 25 kV and 175 A |
| Operating Temperature | -50 °C to 65 °C |
| RF Module | 2.4 GHZ Transceiver / 255 Ch |
| Measurements | Electrical characteristics of capacitors |

# Key Features

- **Configurable Sensor:** configured for failure detection and predictive maintenance.
- **Self-powered Sensor:** draws minimal wattage <.5 W out of the individual capacitor.
- **Reusable Sensor:** can be taken off a failed capacitor and installed on the replacement capacitor.
- **Self-Contained:** can be used as a standalone device for failure detection. An LED indicator and flip dot provides visual indication of failure.
- **Flexible Sensor:** can be used on GE Vernova or non-GE Vernova capacitors. Retrofitted for new or existing capacitors.
- **Firmware upgrades and configuration:** can be done via RF communication without need for maintenance outage.
- **Outdoor Rated:** IP67 rated and UV resistant.

# CapMD Receiver

Installed locally in the substation, the CapMD receiver is a crucial part of the solution that allows for remote monitoring. The receiver communicates to individual sensors requesting the status of the capacitor. The data received can be transmitted to any systems via TCP/IP for remote monitoring purposes.

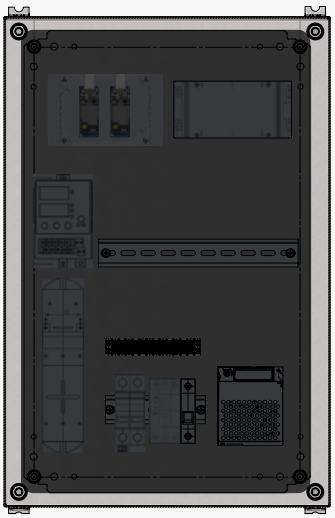


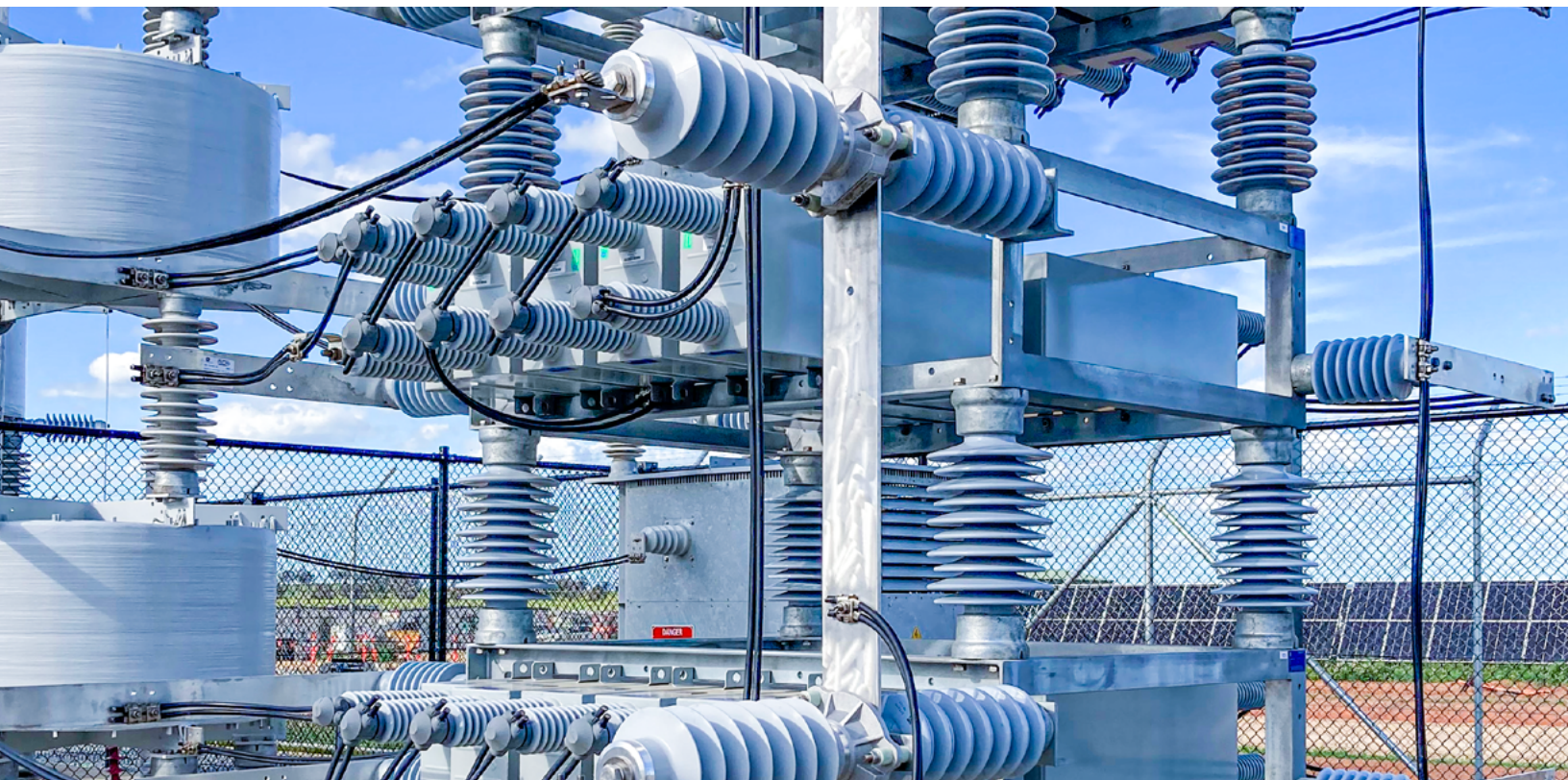
*Image shown for illustration purposes only. Actual product may vary.*

## Data Concentrator Specifications

| | |
|---|---|
| Power | 110-240 AC or DC (can be customized) |
| Operating Temperature | -50 °C to 65 °C |
| RF Module Primary | 2.4 GHZ Transceiver w/255 Ch |
| RF Module Emergency | 2.4 GHZ Receiver w/255 Ch |
| SCADA Protocols | Modbus, DNP3 |
| Enclosure | Stainless Steel 24×16×8, NEMA 4X |
| Included Accessories | Heater, Terminal blocks, DIN Rail |

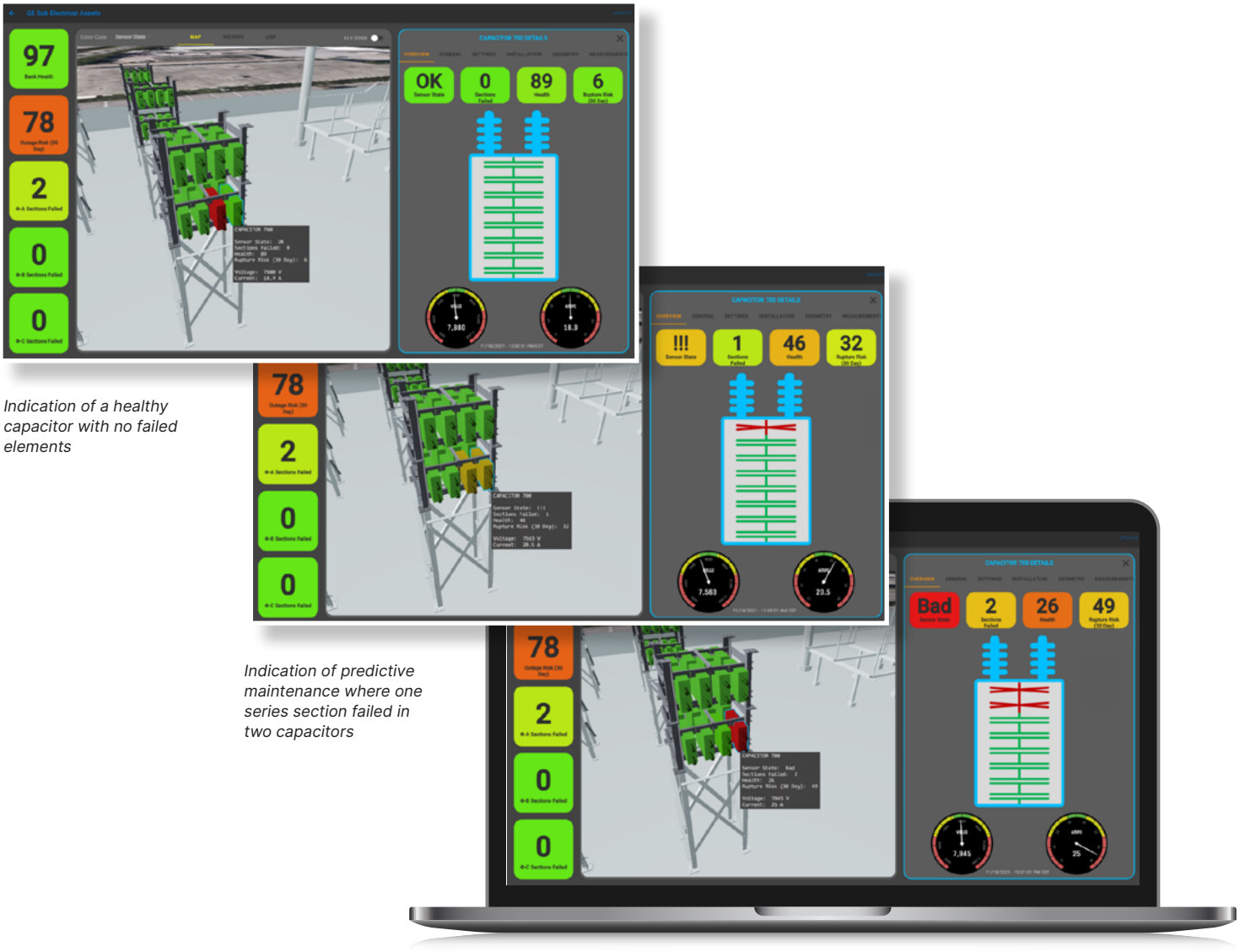
# Key Features

- **Communication:** Connects to any number of sensors within a ~300 ft radius
- **Storage capacity:** Customizable data storage capacity of up to 256 GB
- **Customizable and expandable:** Power level and storage capacity are configurable



# CapMD Application

Displays key capacitor KPIs with the click of a button. Connect locally at the ground receiver via any PC or tablet to display data or access remotely via secure DNP3 communications. The data allows for easy identification of failed capacitors, predictive maintenance, and historical trends.




*Indication of a healthy capacitor with no failed elements*

*Indication of predictive maintenance where one series section failed in two capacitors*

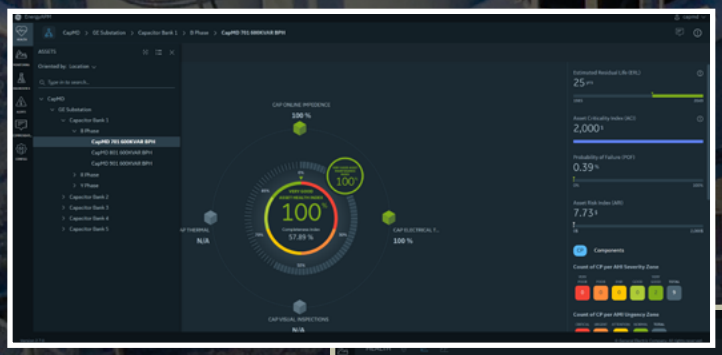
*Indication of failure where two series sections failed in a capacitor*

# Key Features

- **Capacitor Details:** Capacitor name plate details or ID for easy identification
- **Settings:** Customized sensor parameters
- **Measurements:** Individual capacitor electrical characteristics
- **Bank Health:** Bank health indication and outage risk configured based on historical data
- **Location:** Failed capacitor location for crew
- **Trends:** Plots measured values for historical trends

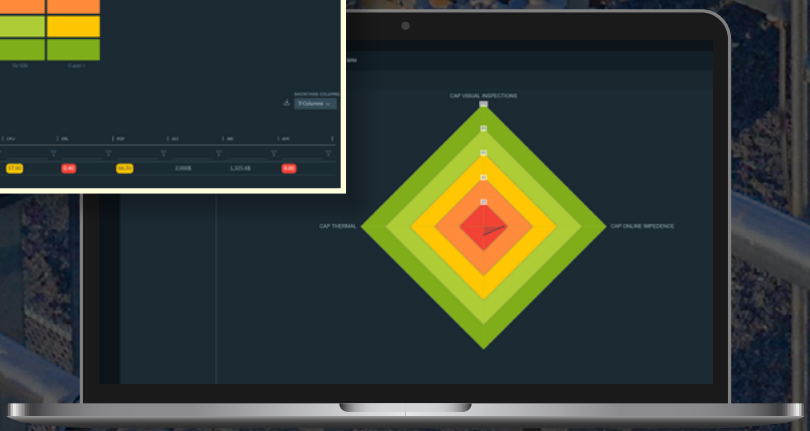
# CapMD Remote Monitoring

- Grid Solutions' CapMD can be integrated into any remote monitoring platforms to access capacitor health data.
- CapMD is DNP3-enabled which allows for easy integration into asset monitoring software.
- Grid Solutions offers CapMD integrated into EnergyAPM as a full system solution.
- EnergyAPM is Grid Solutions' data analytics software platform that is designed for power transmission and distribution assets.
- EnergyAPM allows for management of capacitor banks located at various sites/substations from one remote location and can provide multiple health representations for easy analytics
- Allows for single, fleet, zonal, and network asset health management.
- Detect impending failures, provide warnings, and conduct reliability analysis.
- Predict end-of-life and manage maintenanc and planning schedules.
- Optimize project cost and risks and protect health of employees and the environment.



*Individual capacitor health data*

*Health and risk matrix*



*Health spider*

For more information, visit:
**gevernova.com/grid-solutions**



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