ENEIDA.IO

eneida DeepGrid®

Fault Applications

ROAD TO ZEN®

Neighbourhood Grid Intelligence for ZERO EMISSION NEIGHBOURHOODS

eneida DeepGrid® Fault Applications - Comprehensive Solutions for Reliable LV Network Management

In the dynamic landscape of Low Voltage (LV) networks, smooth operation is essential for Distribution System Operators (DSOs). Maintaining these networks effectively and responding swiftly to faults are imperative. Our company recognizes this challenge and has developed a suite of applications tailored to address a wide range of faults. This proactive approach streamlines network management and empowers DSOs to address faults precisely and efficiently.

Through collaborative efforts with clients, we've meticulously crafted and refined applications to optimize Low Voltage (LV) network management. Our applications have undergone rigorous real-world testing to ensure reliability and efficiency.

Developed with and for DSOs

Our expertise lies in crafting solutions that not only monitor LV network functionality but also promptly address disruptions. In our portfolio, we proudly offer the following applications:

- High Voltage Line Down (HVLD);
- Real-Time Alarms;
- Waveform Capture;
- Fault Classification, Impedance and Distance to Fault.

Each application seamlessly integrates into LV networks management, providing DSOs a comprehensive toolkit to maintain and enhance network stability and performance. Explore how Eneida's solutions can revolutionize LV network management and safeguard uninterrupted service for communities and businesses.

Key benefits:

- **Real-Time Event Notifications:** Receive instant event notifications to speed up service restoration.
- **Targeted Notifications:** Direct notifications to maintenance personnel according to operational zones, geographic regions, or specific asset.
- **Efficient Asset Management:** Prioritize critical situations, intervene promptly, and implement preventive actions for more efficient network asset management.

eneida DeepGrid® High Voltage Line Down (HVLD)

When a High Voltage (HV) line breaks, it can come into contact with the ground both on the supply or the load side. When the contact is on the supply side, this will likely generate a short-circuit fault, which will trigger conventional HV protections, which in turn will trip and clear the fault by disconnecting that part of the circuit. We define this situation as **an HV Open Circuit** (please see Figure 1).

On the other hand, if the line comes into contact with the ground on the load side, HV protections are unlikely to be triggered due to the extremely low current drawn by the fault. However, the line will remain energized due to the backfeed from downstream distribution transformers.

This situation, which we define as HV Line Down (please see Figure 2), **poses a very serious safety issue** that has become a pressing concern for DSOs, due to multiple reasons:

- **Serious safety hazard to the public**, as contact with an energized line can cause serious injury or death;
- **Extreme risk of wildfires**, when the line falls on trees, branches, bushes or other dry vegetation;
- **Risk to the safety of livestock and wildlife**, either by direct contact or step voltage.

At Eneida, we take these issues very seriously, and therefore developed, **the eneida DeepGrid® HV Line Down application (HVLD), to detect and locate these faults, triggering alarms in real-time and classifying them as an HV Open Circuit or an HV Line Down.**

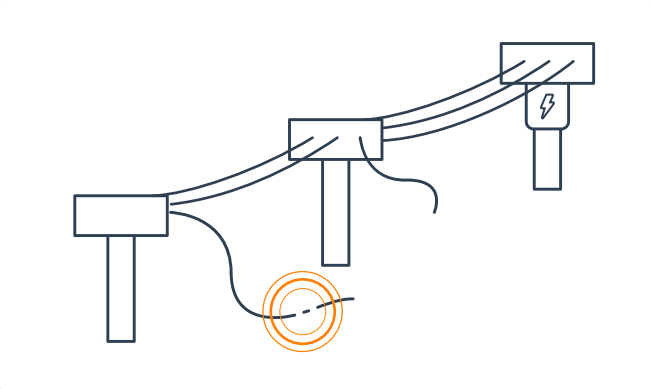

Figure 1: HV Open Circuit fault diagram

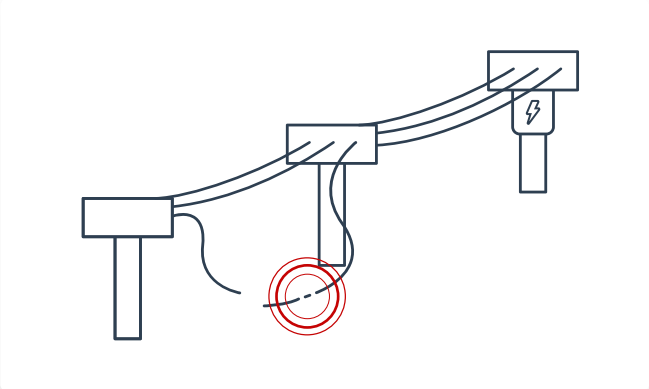

Figure 2: HV Line Down fault diagram

eneida DeepGrid® Real-Time Alarms

The incident management process in the distribution grid is traditionally triggered by customers' complaints. Upon communicating an incident to the call center, it is investigated by the DSOs operation center, which combines the reported data with other information available (e.g.: data from sensors), and requests action to field teams, if the incident is caused by some issue in the distribution network.

This implies that the DSOs is dependent on electricity customers to receive notification of grid events and outages, rather than having an automatic event report system.Therefore, the trigger to the resolution process is an action taken by a person (customer), which is typically slow and generates a significant operational delay from the moment an event occurs to the moment the DSOs is able to take action.

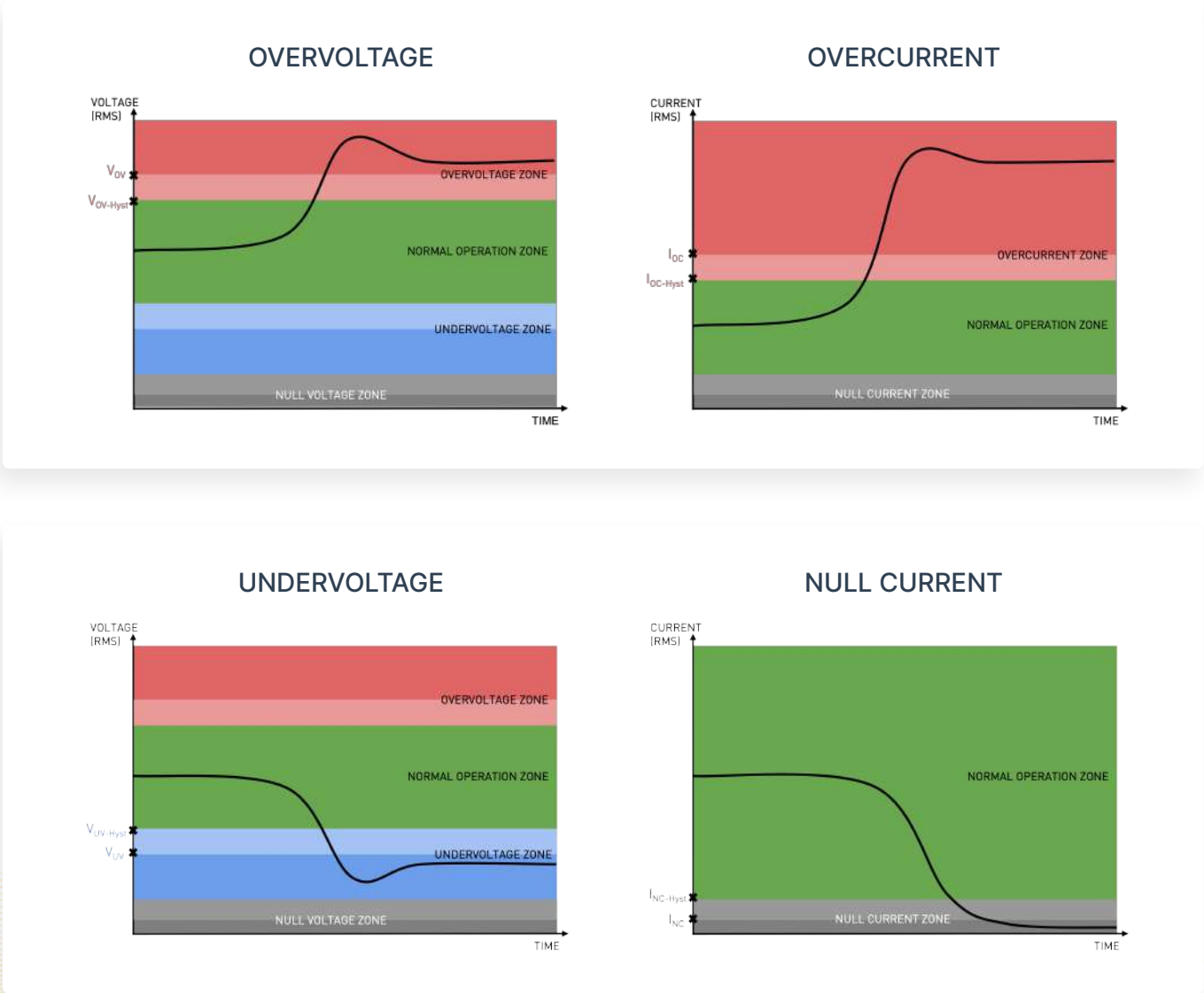

Figure 3 (a): eneida DeepGrid® Real-Time Alarms logic diagrams

Eneida's mission is to arm DSOs and their operational teams with tools that optimize this process, enabling proactiveness and enhancing the decision-making stage. The eneida DeepGrid® Real-Time Alarms (RTA) application provides notifications in real-time for key events that occur in the network. By promptly alerting operational teams (or maintenance personnel directly), these alarms enable swift intervention and preventive measures, helping to reduce downtime and the risk of future damage to equipment. Ultimately, the eneida DeepGrid® RTA aims to help improve system reliability and improve Key Performance Indicators (KPI's) such as Customer Minutes Lost.

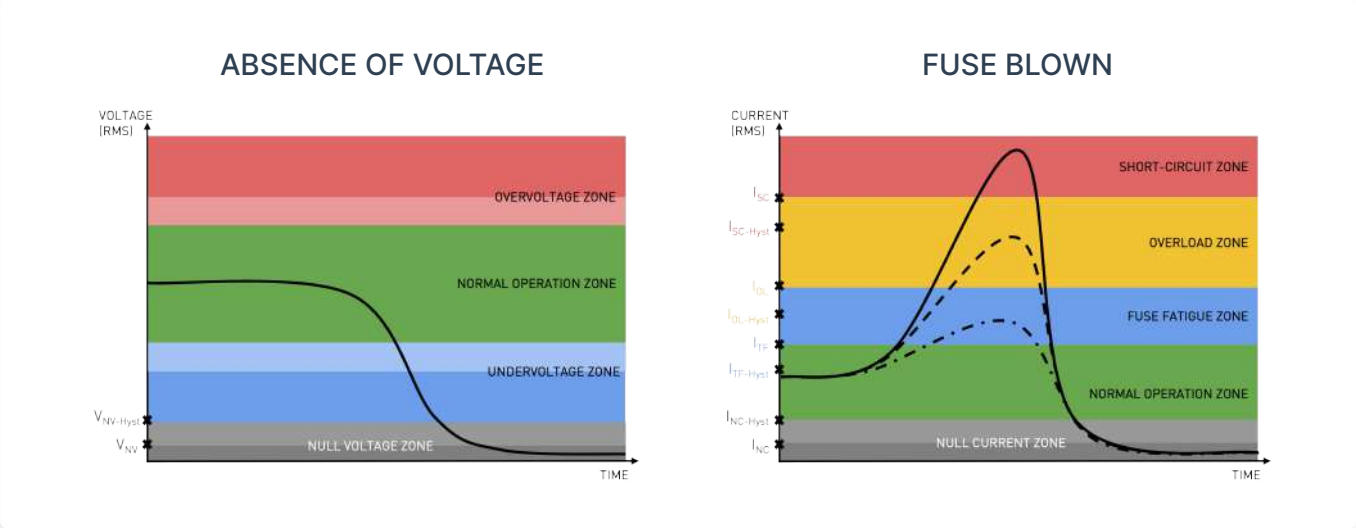

Figure 3 (b): eneida DeepGrid® Real-Time Alarms logic diagrams

eneida DeepGrid® Waveform Capture

The eneida DeepGrid® Waveform Capture application (WFC), built on top of the eneida DeepGrid® Real-Time Alarms, allows users to choose to receive a snapshot of the voltage and current waveforms around the time an event was detected. This feature can be enabled or disabled for each real-time alarm independently.

Users have the flexibility to set up waveform sampling and capture window settings.

These settings include the sampling frequency (1, 2, 4, or 8 kHz) and the number of cycles to capture before and after the alarm triggers.

For a single WFC-enabled alarm, this capture window can extend up to 4.8 seconds. The same capture window applies for multiple WFC-enabled alarms triggered simultaneously. If the accumulated capture window exceeds the allowed period, the alarms will be sent without waveform capture.

Examples of Waveform Capture in eneida DeepGrid® Discovery for different events: figures 4 to 8.

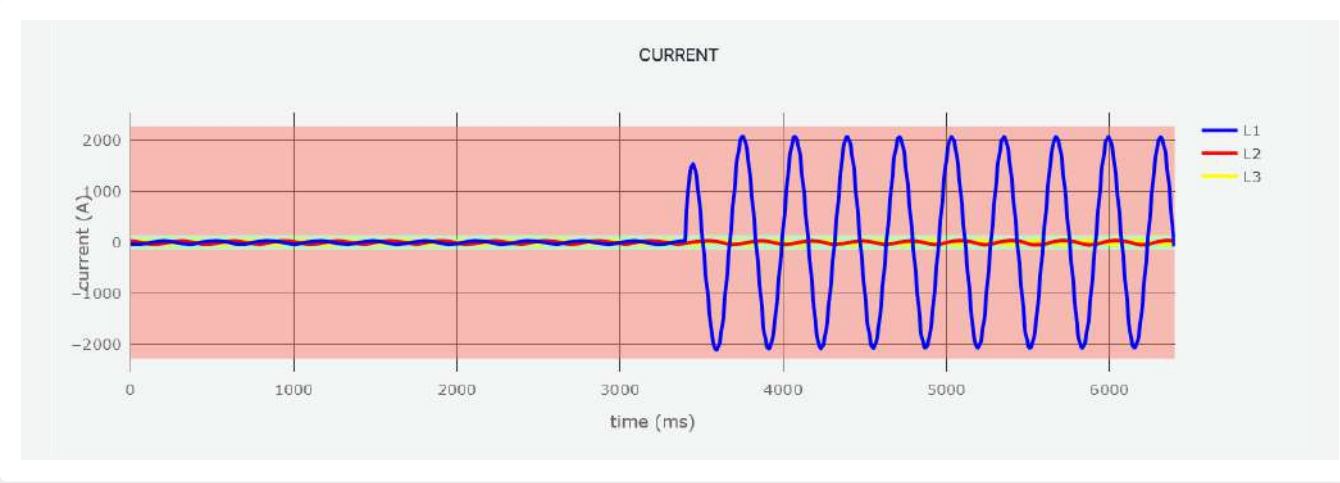

Figure 4: Overcurrent - Ignition of a line-to-ground short-circuit fault, detected by an overcurrent alarm.

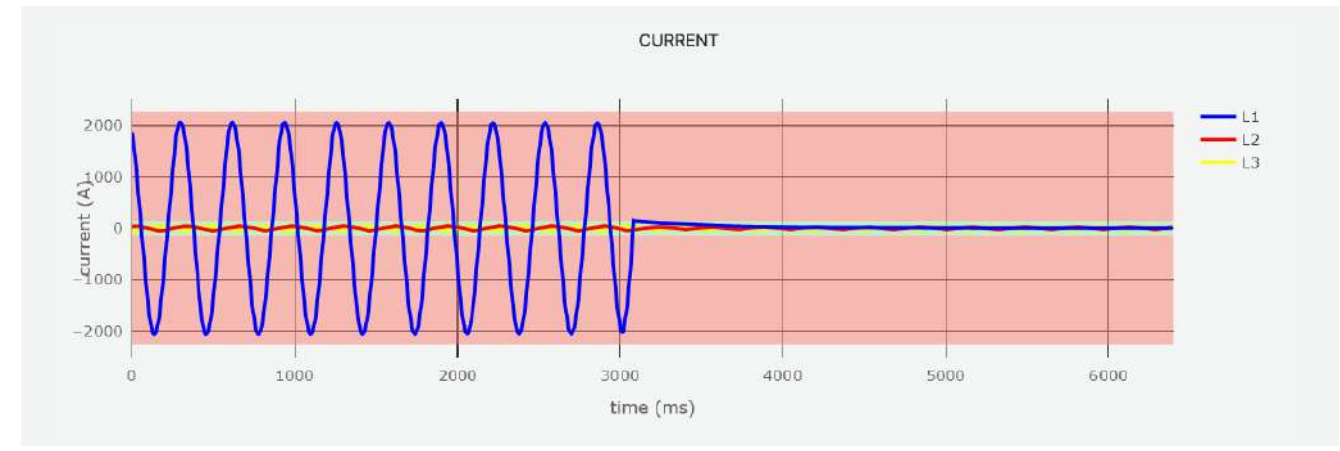

Figure 5: Fuse Blown - Current waveform associated with a fuse blowing and clearing a line-to-gound short-circuit fault.

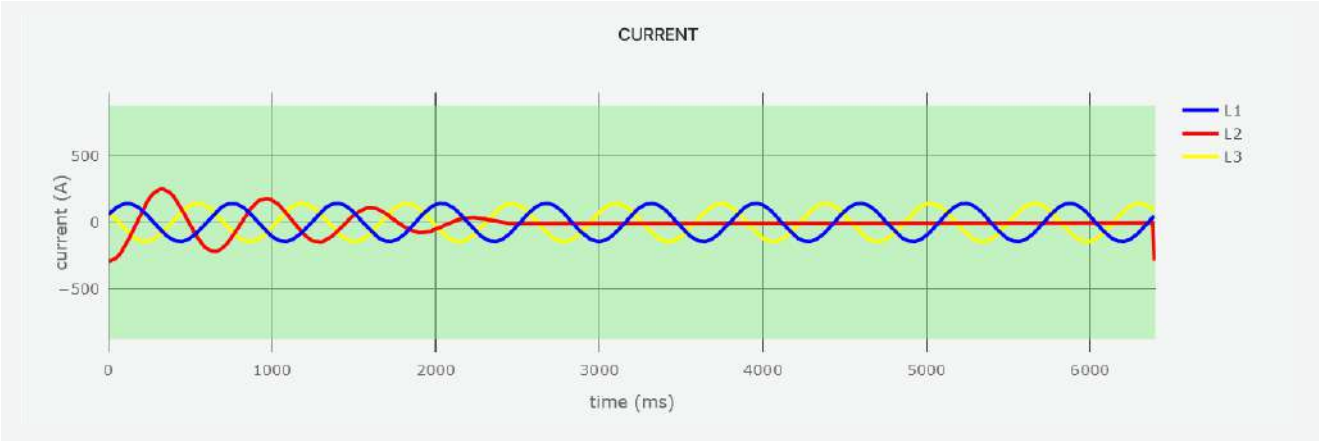

Figure 6: Null Current - Disconnection of the existing load, resulting in a null current in line L1

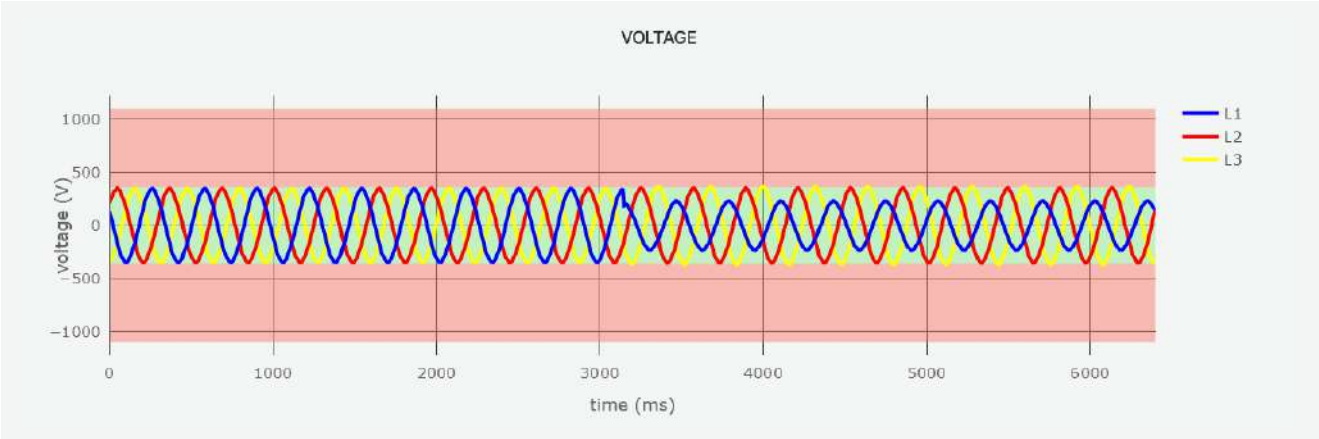

Figure 7: Overvoltage (L3) / Undervoltage (L2) - Undervoltage on line L2 caused by a line-to-ground short-circuit fault. Simultaneously, the voltage slightly rises on line L3, surpassing the regulatory threshold.(L3) / Undervoltage (L1)

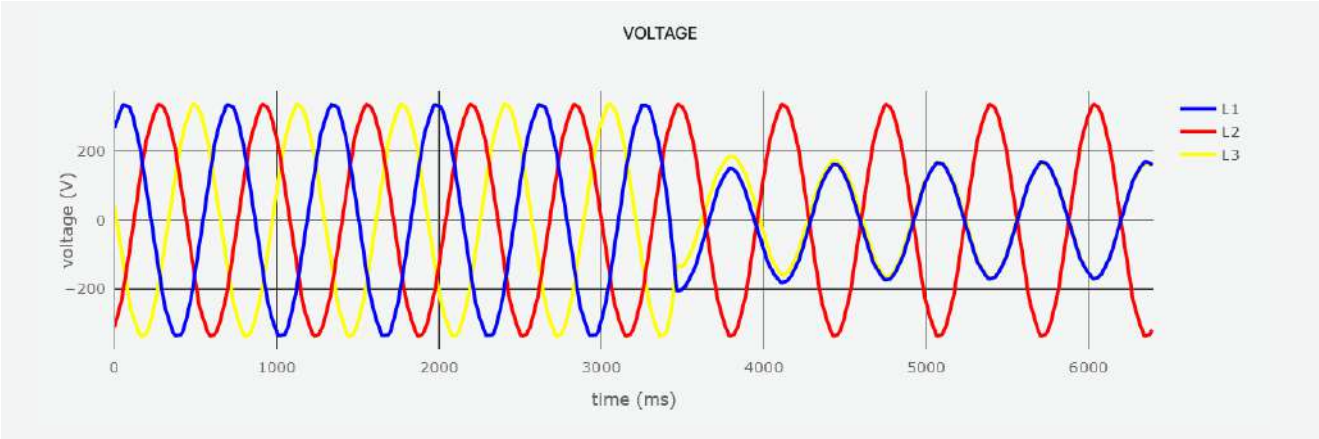

Figure 8: HV Line Down - Moment when an HV overhead line breaks, interrupting the voltage supply on one phase of the HV network and impacting the voltages on the LV side.

eneida DeepGrid® Fault Classification, Impedance and Distance to Fault

When a fault occurs in the LV network, it typically leads to a power outage. In this situation, it is paramount that operational teams are able to act as quickly as possible to fix the issue and restore service to customers.

Eneida's mission is to arm DSOs and their operational teams with tools that optimize this process, enabling proactiveness and enhancing the decision-making stage. The insight provided by eneida DeepGrid® through Fault Classification and Impedance and Distance to Fault estimations allows operational teams to guide maintenance personnel directly to the most likely locations of the fault, largely reducing the area to be patrolled. This not only reduces the total cost of a short-circuit fault by optimizing the maintenance process, but also improves Key Performance Indicators (KPI's) such as Customer Minutes Lost.

Example of Waveform Capture, Fault Classification, Impedance and Distance to Fault in eneida DeepGrid® platform for a line to line short-circuit fault:

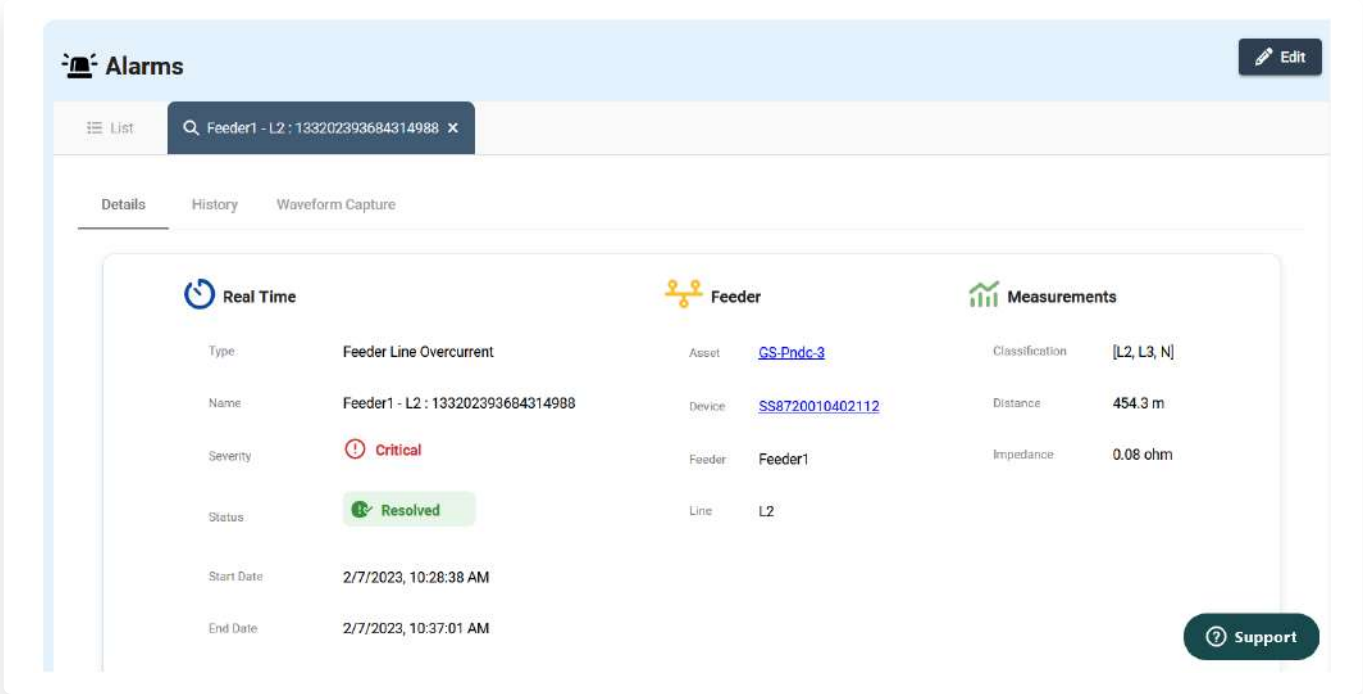

Figure 9: Short-circuit event Impedance and Distance to Fault in Alarm Details page

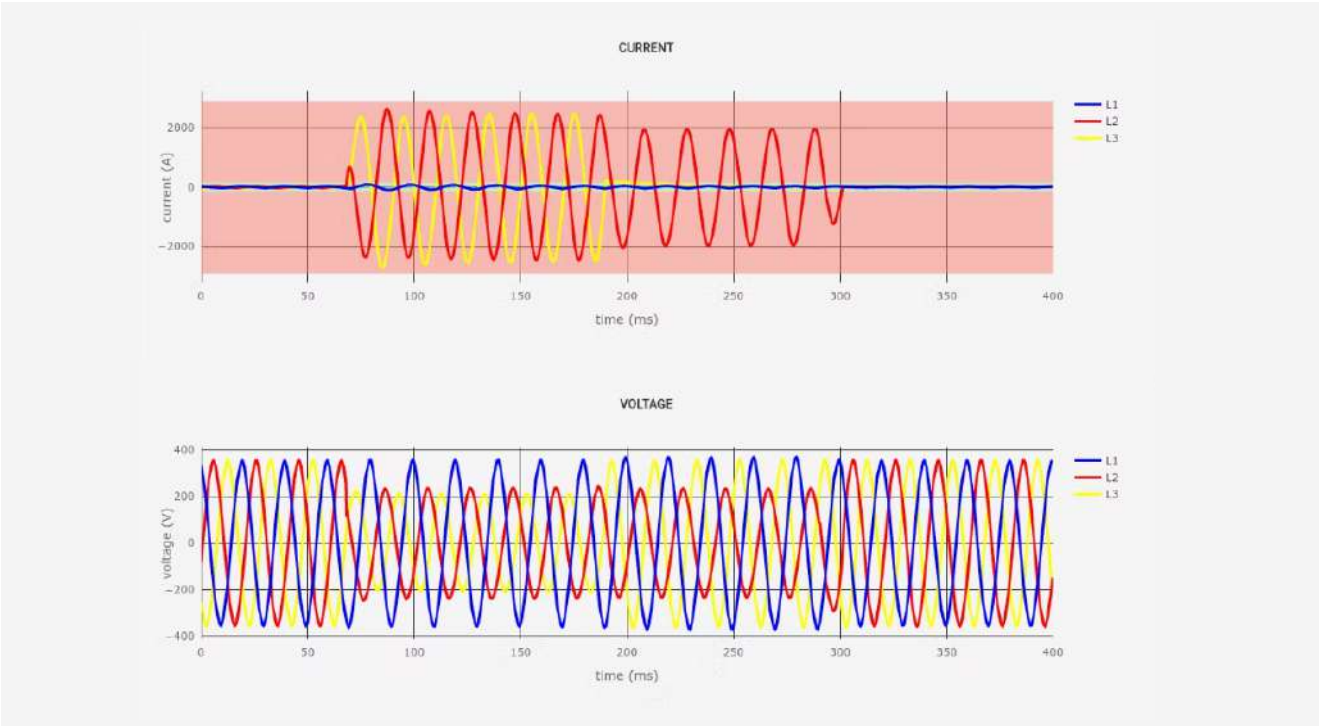

Figure 10: Short-circuit event Waveform Capture

The current paradigm of ever-increasing distributed energy resources, such as **photovoltaic (PV) production**, and non-linear loads like **Electric Vehicles (EV)** and **Heat Pumps (HP)**, creates a very demanding environment for DSOs. Not only may these technologies, however necessary, threaten the stability of the network, but they also **add complexity to already challenging issues**. Such is the case of fault detection and location, for example.

Therefore, it is increasingly necessary for DSOs to be armed with tools that enable them to deal with these issues by having access to comprehensive algorithms which:

- **Incorporate the influence of these technologies** in their decision-making process;
- **Enable DSOs to be proactive**, getting key information directly into the control room instead of depending on external sources, such as customer complaints;
- Instantly **access key metrics**, such as faults classification, impedance, and distance to fault, which can help optimize the fault response process.

Discover the power of our fault apps in boosting LV network reliability and performance, securing seamless service for both communities and businesses!

ENEIDA.IO

Carlos Pina Teixeira
CEO
E-mail: cpt@eneida.io

Guilherme Freire
Product Manager
E-mail: gfreire@eneida.io

Eneida Grid Intelligence SA
R. Alexandre Herculano 21B,
3000-019 Coimbra, Portugal

T. (+351) 239 111 180 | E. product@eneida.io