SUCCESS CASE 62.2025

reCONNECT

E-REDES SOLUTION FOR REAL-TIME OVERVOLTAGE MONITORING IN LV GRID

THE CHALLENGE

E-REDES has been implementing initiatives to **proactively identify anomalies in the low-voltage (LV) network**, seeking more efficient asset management, to reduce supply interruptions, customer compensations, and to improve the customer experience.

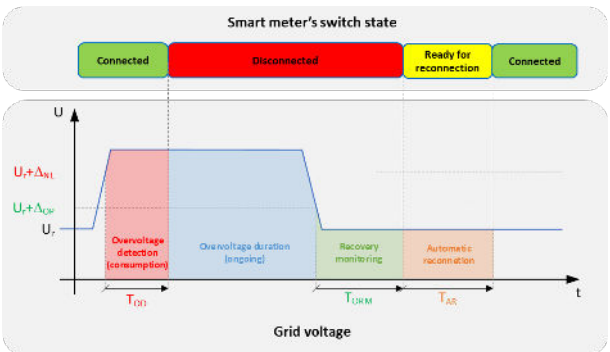
Considering that approximately **75% of customers' premises damage in Portugal is caused by grid-neutral losses**, the need to detect neutral ruptures in advance and mitigate their effects was raised.

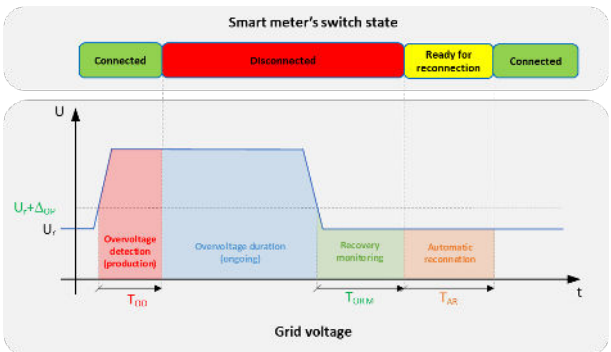
THE SOLUTION

A new functionality was specified for the LV smart meters to **detect situations of effective neutral rupture and simultaneously disconnect customers' installations** to avoid potential damage to their electrical appliances, in two different uses cases.

The neutral loss detection feature is based on **real-time voltage monitoring**. When an overvoltage is detected the **consumer's installation is disconnected from the grid through the opening of the smart meter circuit breaker**, and, as long as the overvoltage remains, **manual reconnection by the customer is not allowed** and a specific message is presented on the smart meter display informing there is a disturbance on the grid.

This feature can also interrupt installations in **overvoltages scenarios** not associated with neutral loss, namely as **overgeneration**. Considering the high increase of distributed generation, **different voltage limits are used** for injection (lower) or consumption (a bit higher). This distinction of voltage thresholds is crucial to achieve **selectivity** depending on the **overvoltage root cause**, avoiding network disturbances propagation and increasing grid resilience.





By default: Δ_{NL}=20% Δ_{OP}=15% T_{OD}=5s. T_{ORM}=60s. T_{AR}= 1s.

For more information about the project, please contact:
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THE SOLUTION (CONTINUATION)

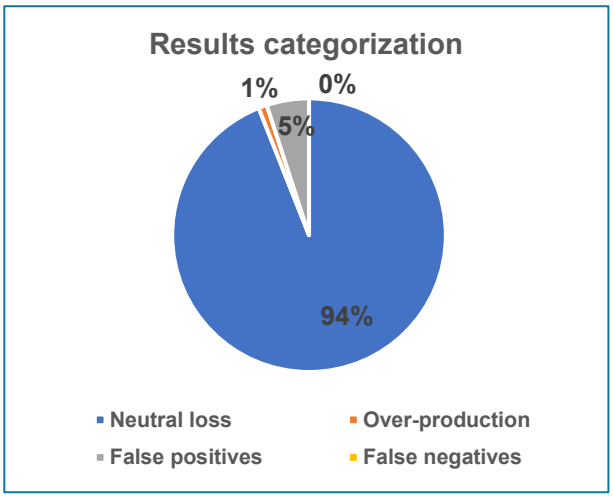
In both use cases, only when the **voltage returns to the established limits** during a predefined monitoring period does the **smart meter's circuit breaker become available for manual reconnection** and, in that case, the previous display message is replaced by another informing the customer that reconnection is now possible.

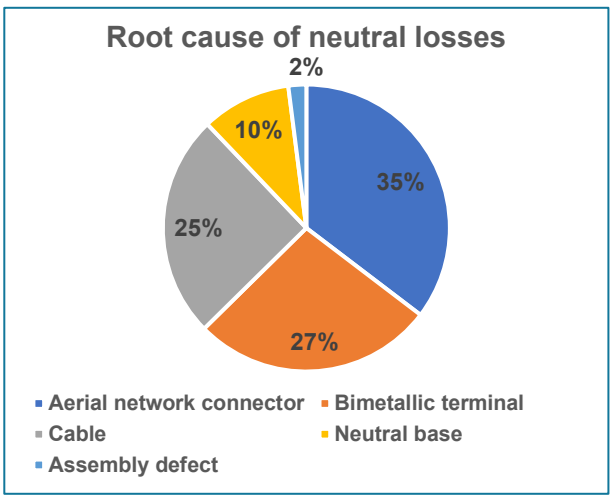
The **reconnection** after the overvoltage restoration **can also be automatic**, and if this feature is enabled the smart meter's circuit breaker is closed after a maximum period in which no local action for manual reconnection was taken by the customer.

MAIN ACHIEVEMENTS

A **two-stage pilot** was conducted to test the functionality in a **real environment**, with a relatively limited universe of about **105k LV customers** over around **9 months.**

The pilot's **first stage** consisted of the feature activation in an **exclusive events/alarms mode**, with the smart meter's circuit breaker not being triggered by the overvoltage feature. The main purpose of this stage was to **proactively identify anomalies already present** on the grid or in the smart grid infrastructure, to be corrected before turning on the circuit breaker trigger activation. In the **second stage** the overvoltage feature that **opens and closes the smart meter's circuit breaker** when an overvoltage scenario is detected was enabled.





Main results:

- Around **94% of occurrences** were confirmed as **neutral loss** and only **1%** due to **over-production**. 5% were detected as false positives (defects on the customer installation) and no false negatives (overvoltage not detected).
- **72% of the disconnections** were **less than one hour** (depends on the type of defect and the technical team effectiveness to find it).
- In **68% of overvoltage cases**, at least **one real-time alarm was received spontaneously via PLC PRIME**, enabling the LV Dispatch to handle the occurrence effectively.
- The **main causes** of **neutral loss** were damaged **aerial network connectors**, broken **bimetallic terminals** in cabinets and **defective cables**.
- In **361 installations** affected, only **6 customers requested compensation**:
  - 2 due to the interruption time;
  - 2 due to errors in defect correction;
  - **2 related effectively to neutral loss** (damaged electrical appliances).

Success rate avoiding damages **> 98%**

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KEY SUCCESS FACTORS

This feature is **natively included in the newer smart meters** delivered and installed according to the last version of the technical specification. However, it is also being added to the previously (older) **installed smart meters through a firmware update**.

Prior to the pilot, **integrated laboratory tests** were also conducted to understand how the dynamic behavior introduced by the active smart meter's circuit breaker disconnection in an overvoltage scenario impacts the grid operation and stability. Those tests allowed us to **adjust the parameters of the algorithm**, keeping in mind a **balance** between ensuring a **high overvoltage detection rate** and, at the same time, **minimizing power supply interruptions**.

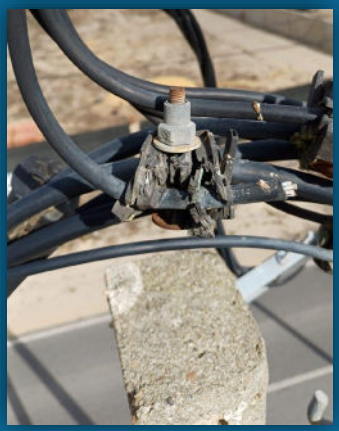
The **solution design** allows a **very flexible way** to manage its operation on the field. The possibility of using this feature only in a "simulation" mode, where events are merely recorded and the smart meter's circuit breaker does not operate, allows the identification of potential latent neutral faults in the network. This prevents a surge of occurrences right after the feature activation, which could compromise the technical field teams' response capacity.

WAY FORWARD

Following the very positive results of this pilot it was decided to **roll out of the solution for all installed smart meters**, which is **already ongoing** and estimated to be concluded by Q2/2026.

Similarly to what was done during the pilot, the **rollout plan foresees a period with the functionality active but without disconnections**, in order not to overload the technical teams in the initial phase and thus reduce the risk of deterioration in the quality of service provided.

NEUTRAL LOSSES EXAMPLES



Aerial network connector damaged

Bimetallic connector broken

Neutral base oxidized