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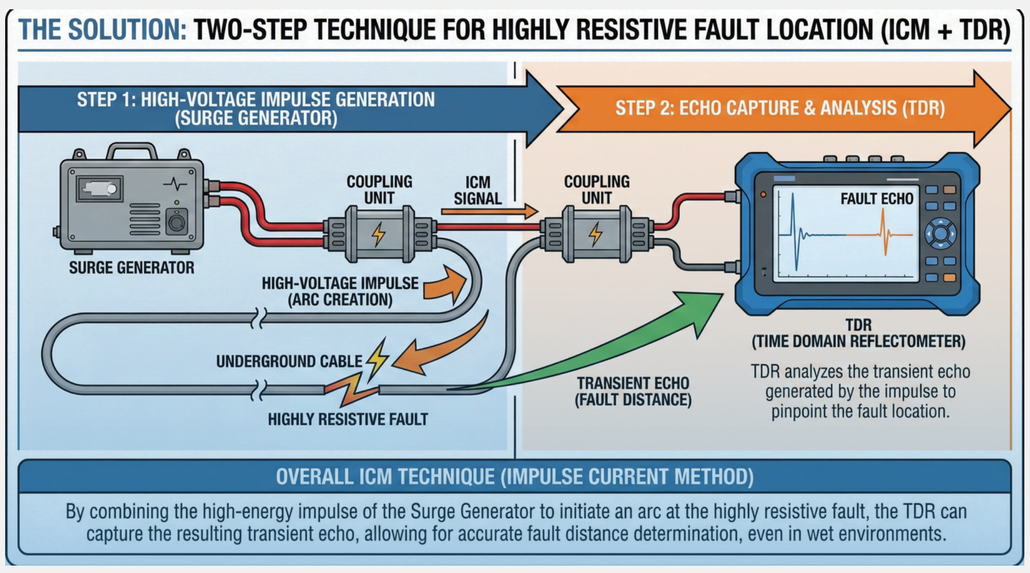
WESTCO Electrical & Equipment Corp. Case Study

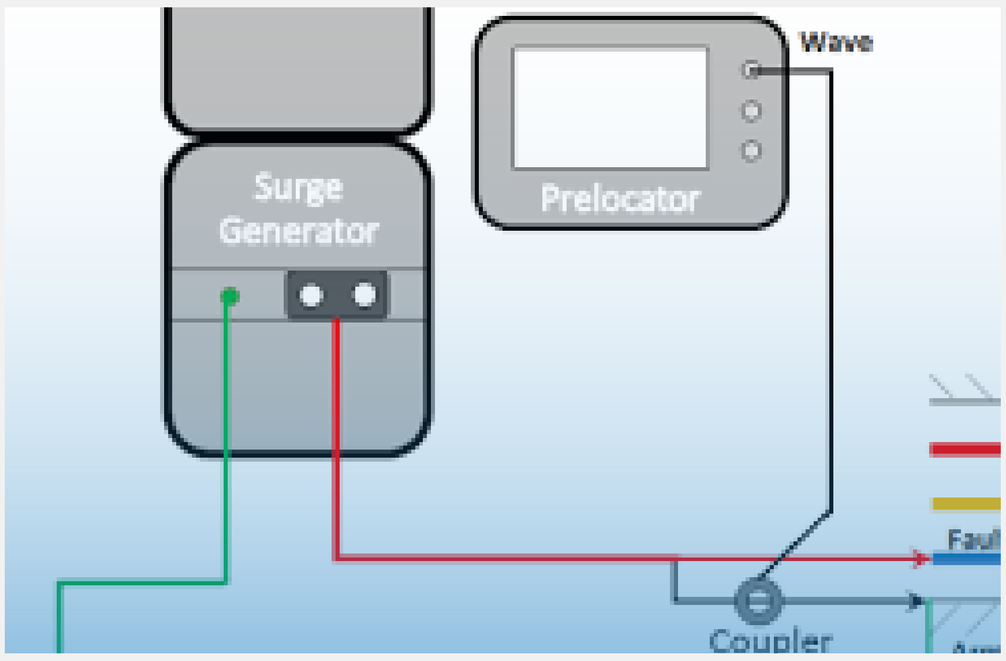
Submarine Cable Fault: ICM-TDR Locates Highly Resistive Failure on Roma-Alabat Link

In December 2023, just before the Christmas holidays, an island community was plunged into a blackout. The cause was identified as faults on Phases A and B of the submarine cable connecting Roma, Quezon, to Alabat Island.

The Solution

To overcome the challenge of the highly resistive fault, the maintenance team employed a specialized two-step technique: the Impulse Current Method (ICM), combining a Surge Generator with a TDR.





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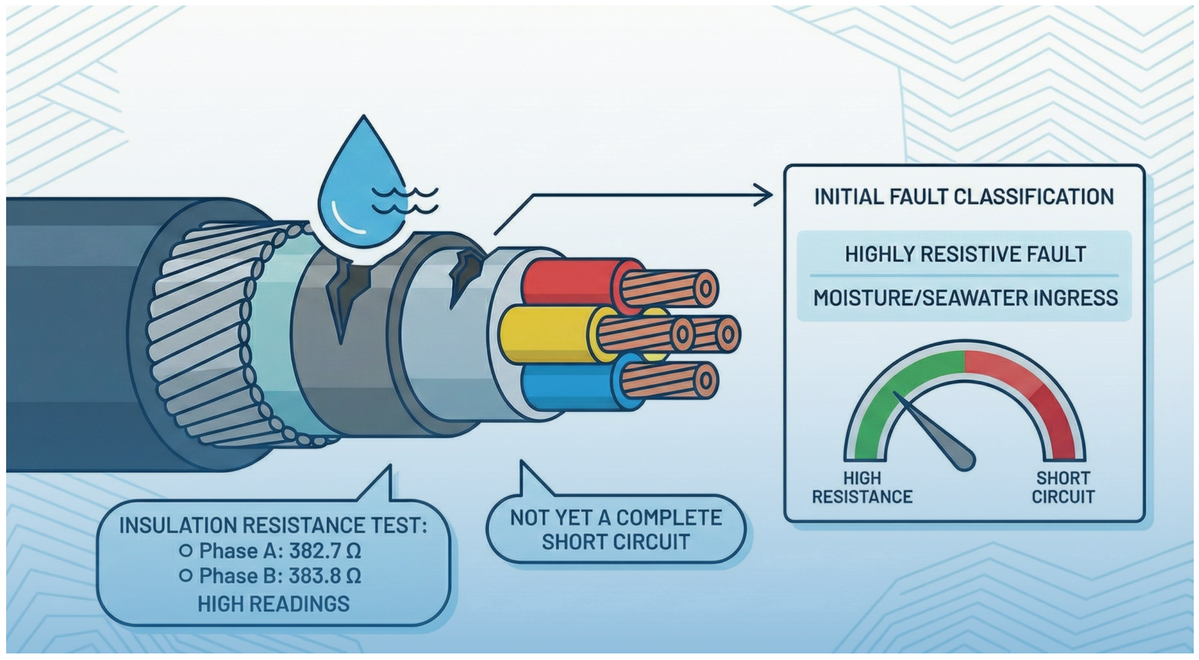
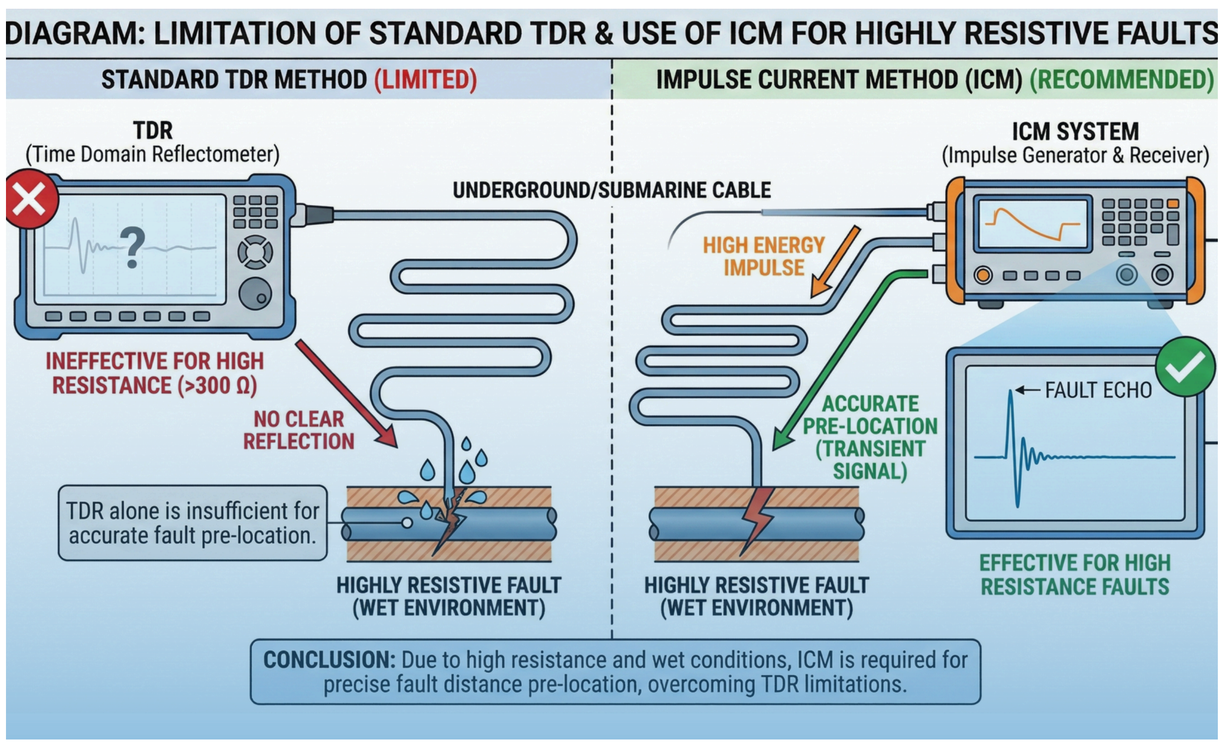
The Challenge / Assessment After Testing

- **Initial Fault Classification:** An Insulation Resistance Test showed high resistance readings, classifying the faults as highly resistive due to moisture or seawater ingress that had not yet caused a complete short circuit.

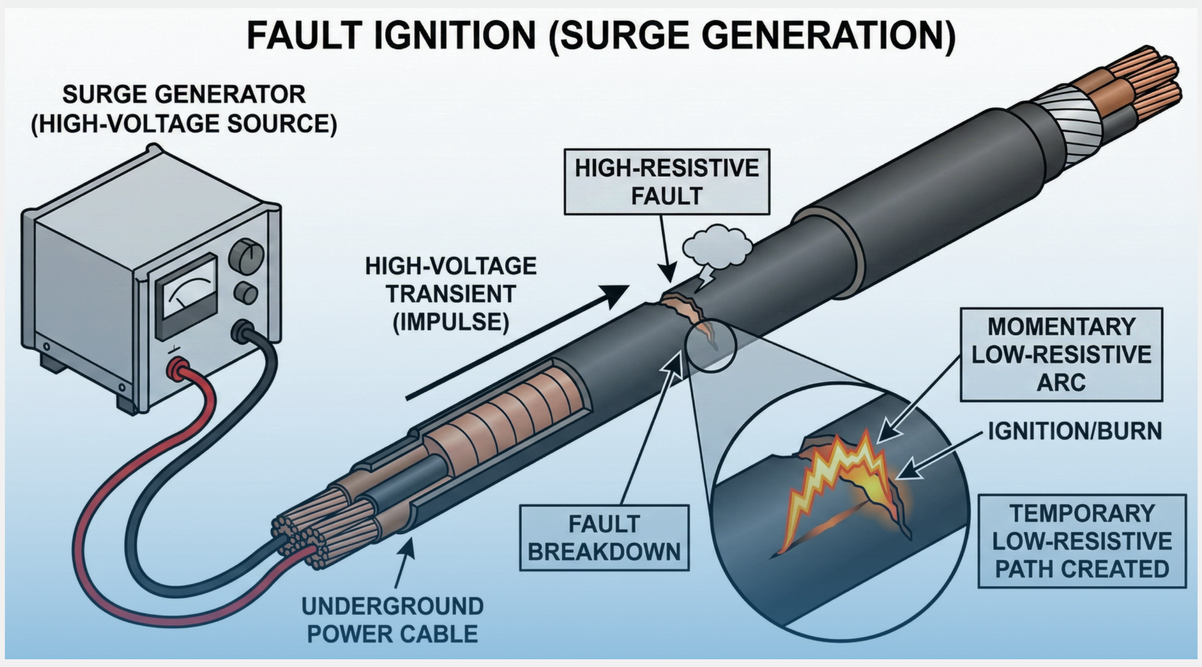
  ◯ Phase A: 382.7 Ω
  ◯ Phase B: 383.8 Ω



- **Limitation of Standard Tools:** The highly resistive fault concluded that the standard Time Domain Reflectometer (TDR) alone cannot be utilized as a Fault Localization method. TDR is typically effective only for low-resistive faults (e.g., <300 Ω) and is insufficient for accurate fault pre-location. Since the fault is highly resistive and the condition involves a wet environment, the Impulse Current Method (ICM) was used to pre-locate the fault distance.



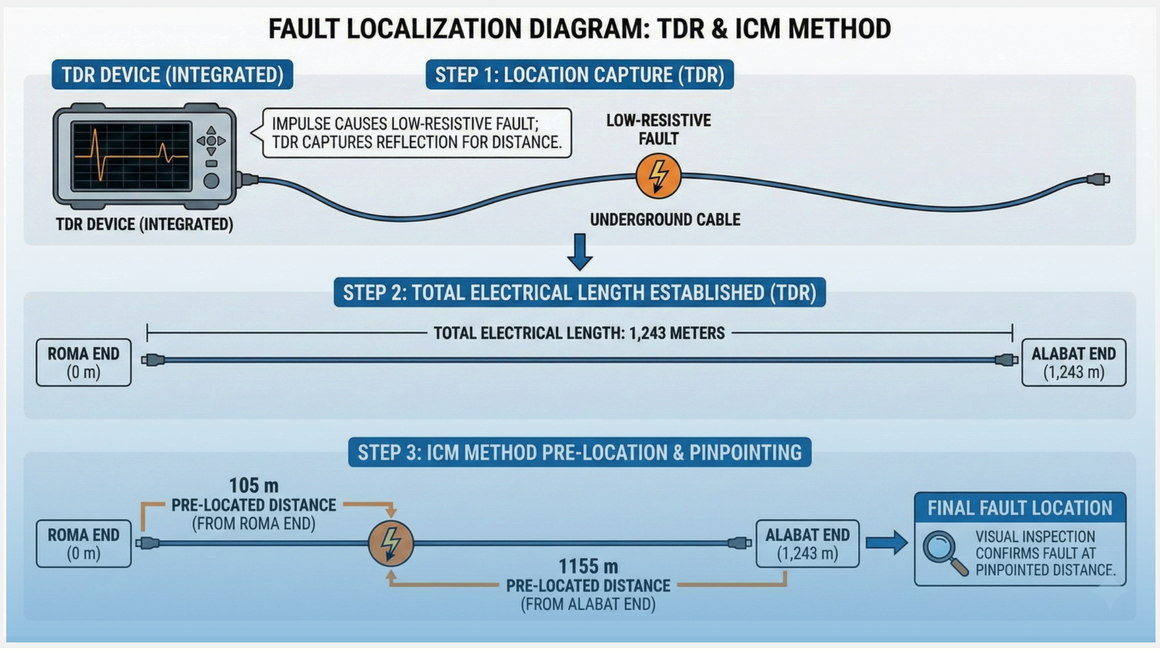
- **Fault Ignition (Surge Generation):** A Surge Generator was used to provide a high-voltage transient (impulse) to the faulty phases. The primary goal was to "ignite" or "burn" the high-resistive fault, causing it to momentarily break down and become a low-resistive fault (an arc).



- **Location Capture (TDR):** Immediately after the impulse caused the fault to become low-resistive, the integrated **TDR** captured the electrical reflection, providing a precise distance reading to the fault location.

  ◯ The TDR first established the total electrical length of the cable: **1,243 meters.**

  ◯ ICE method indicates pre-located distance of 105 m from Roma end and 1155 m from Alabat end. Pinpointing at these pre-located distances through actual visual inspection was conducted and the fault was finally located.



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The Impact

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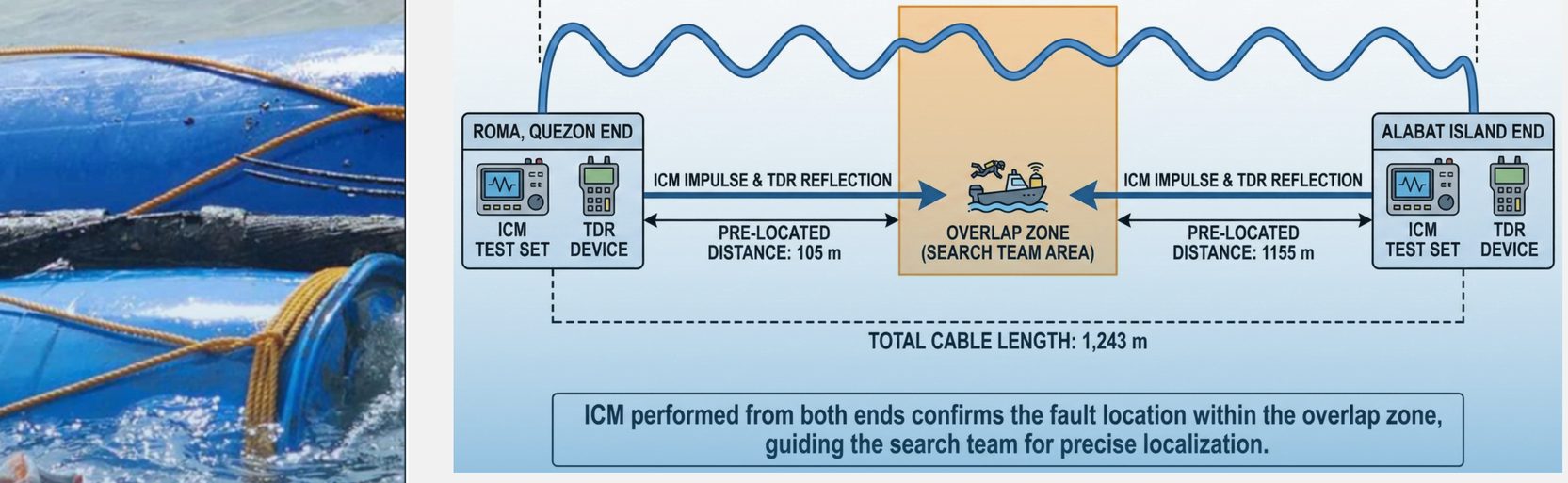
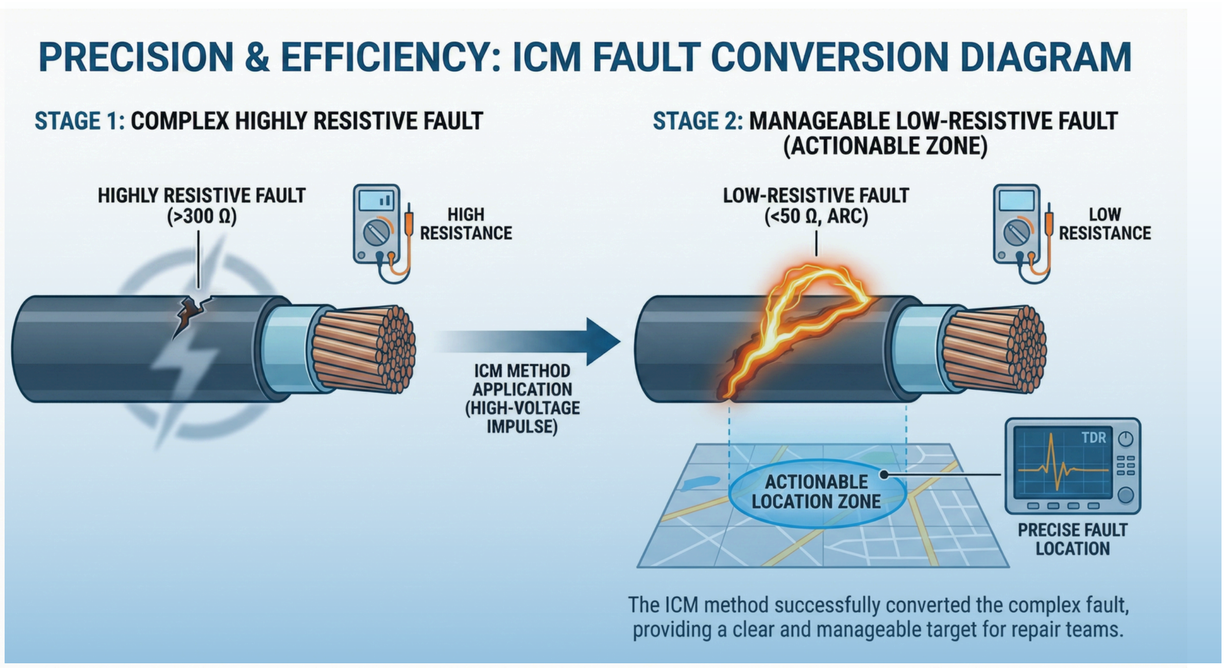


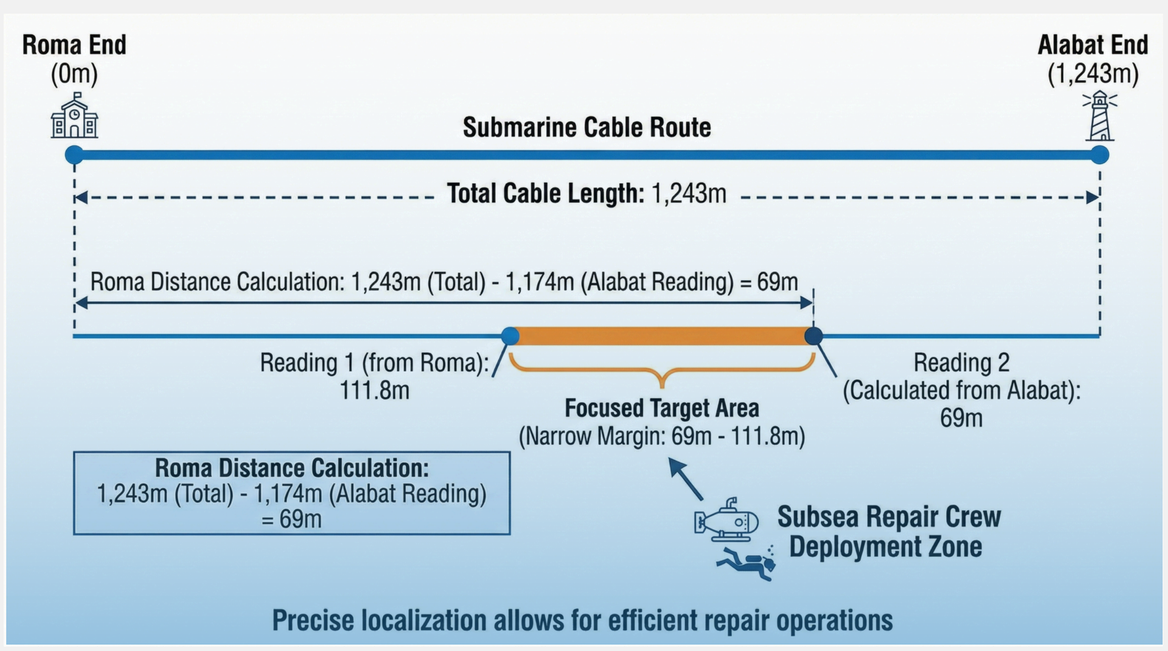
- **Bilateral Pre-location:** The ICM method was successfully performed from both ends of the cable (Roma, Quezon, and Alabat Island) to maximize accuracy and create an overlap zone for the search team.

The team calculated the distance from the Roma end using the Alabat reading: 1,243m -1,174m = 69m. The narrow margin between the two readings (69m and 111.8m) established a focused target area for the subsea repair crew.

Technical Result:

- **Precision and Efficiency:** The use of the ICE method successfully converted a complex highly resistive fault into a manageable low-resistive one, providing an actionable location zone.





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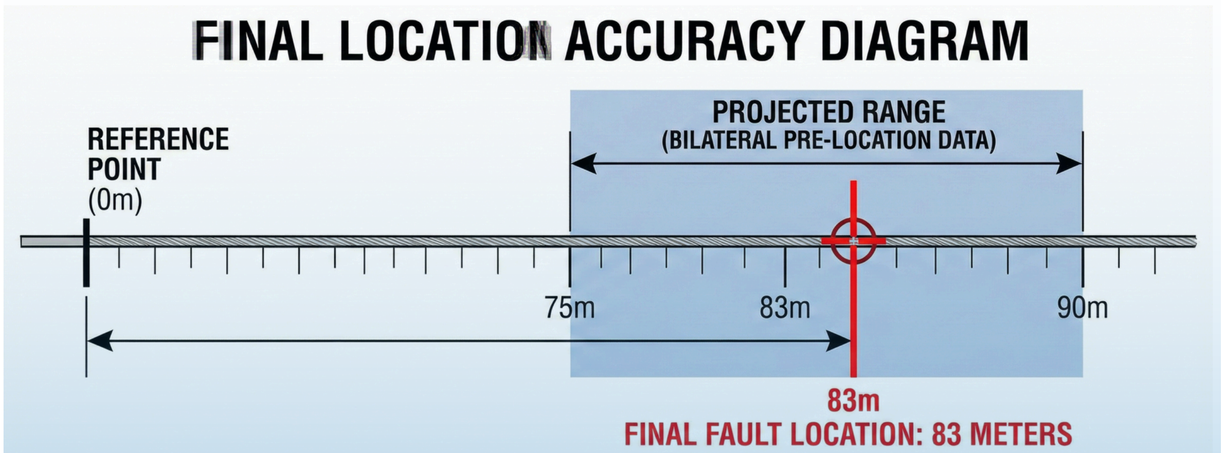
Final Location Accuracy: The final fault location was found at 83 meters from the reference point, a distance falling precisely within the projected range established by the bilateral pre-location data.



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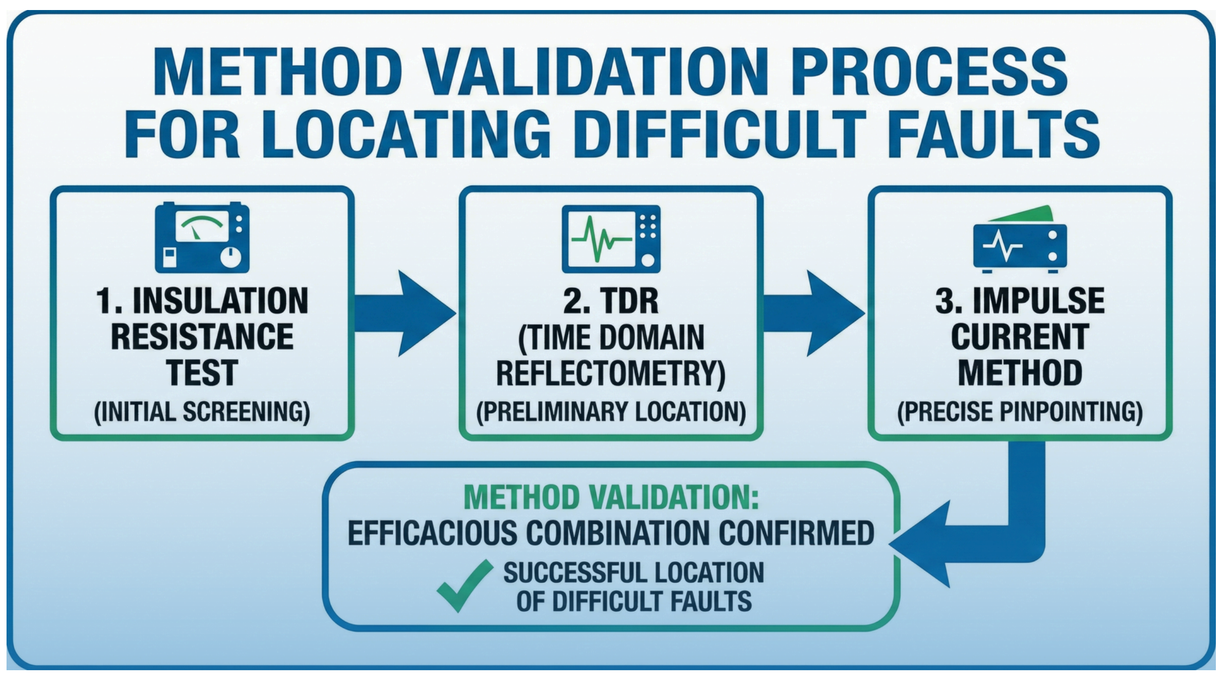
Method Validation: The entire process validated the efficacy of using a combination of Insulation Resistance Test, TDR, and the Impulse Current Method for locating difficult faults.



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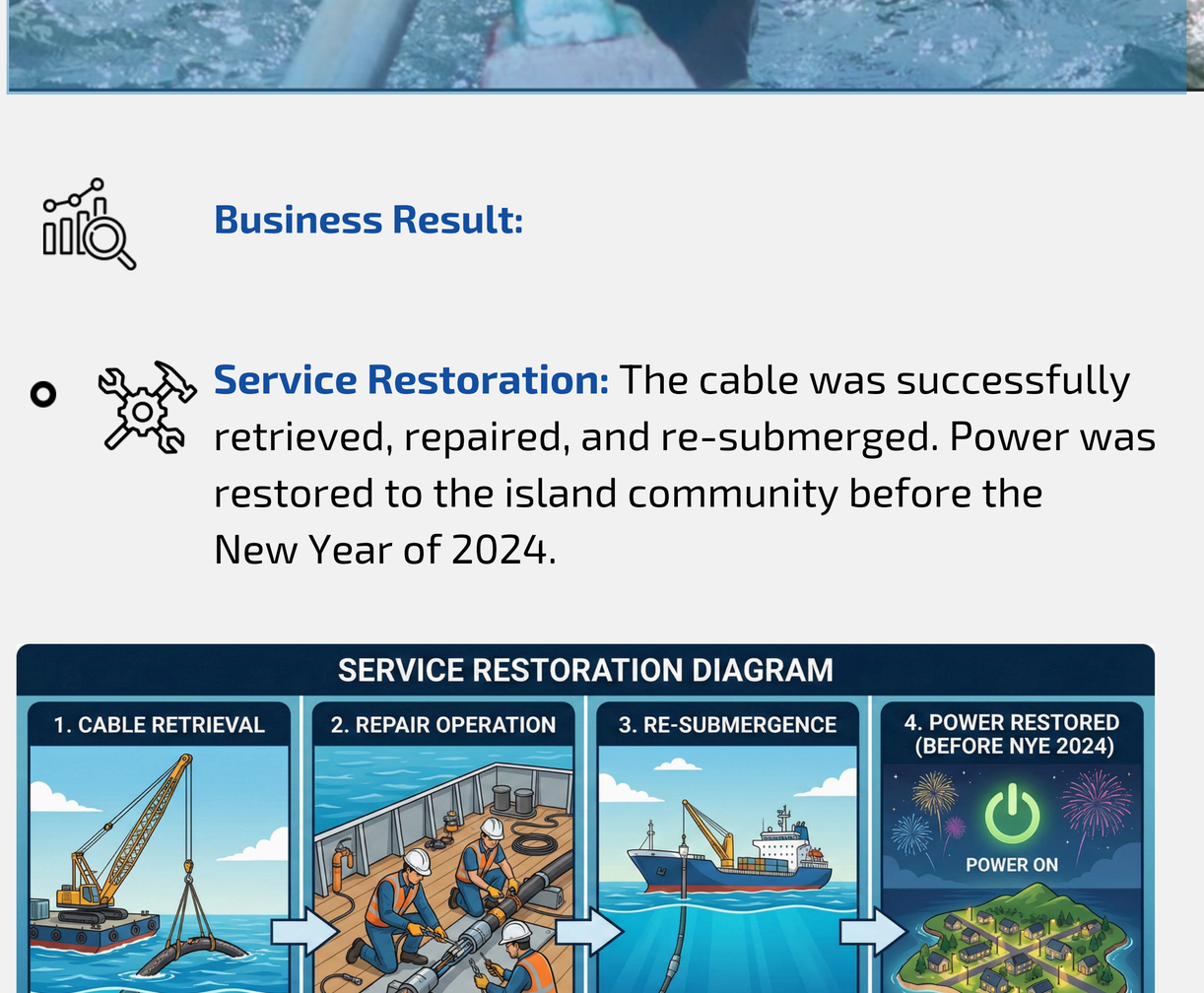
The Impact



Business Result:

- **Service Restoration:** The cable was successfully retrieved, repaired, and re-submerged. Power was restored to the island community before the New Year of 2024.

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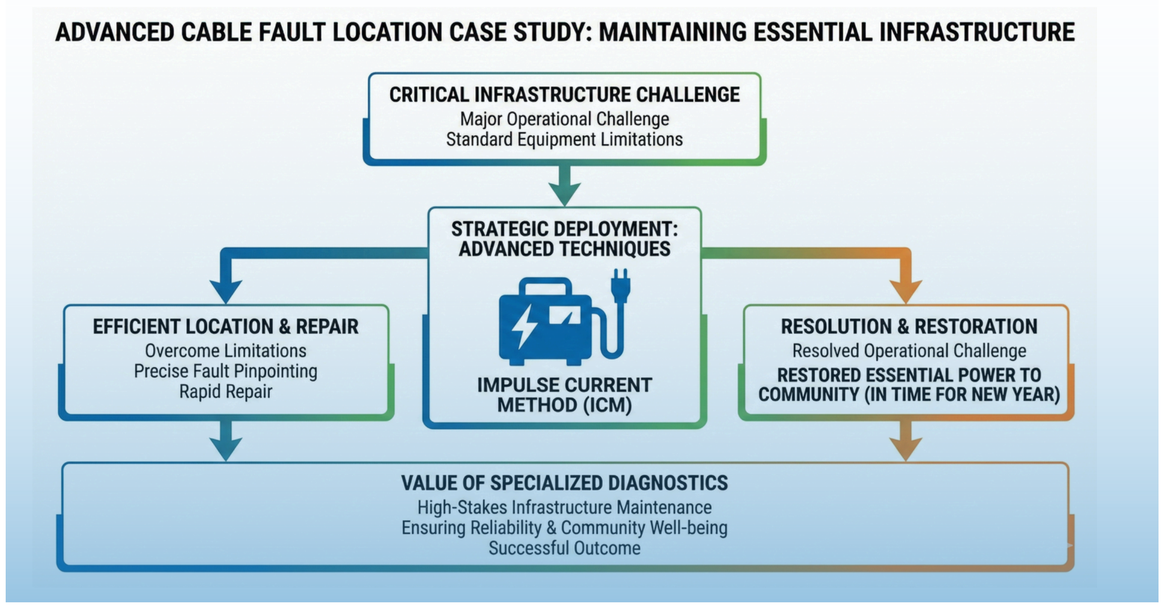
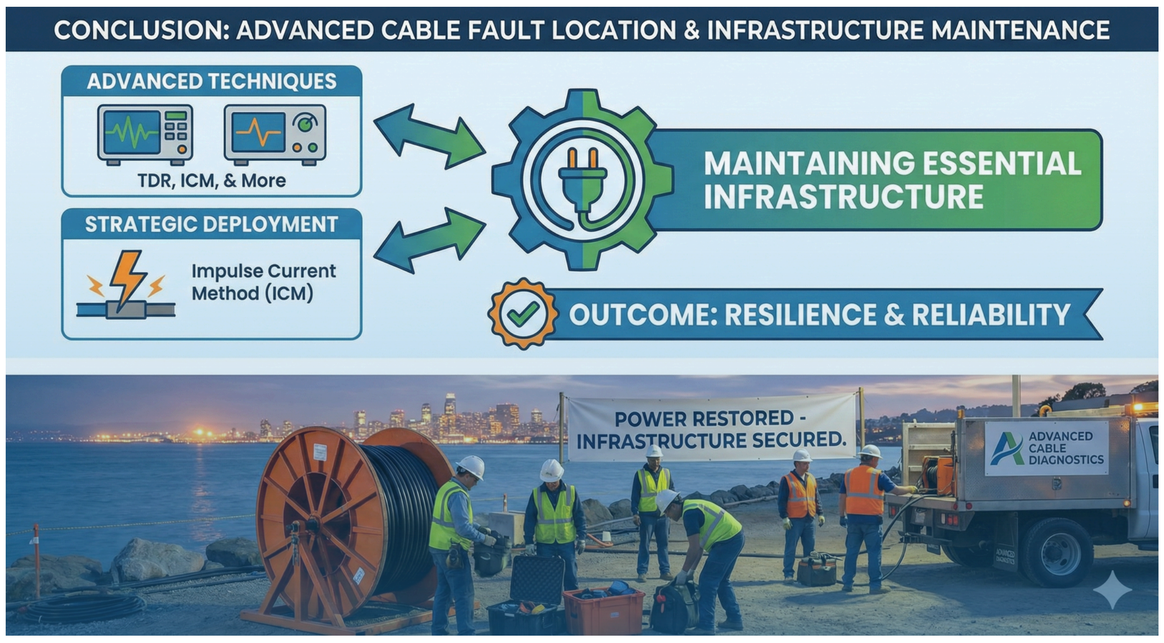
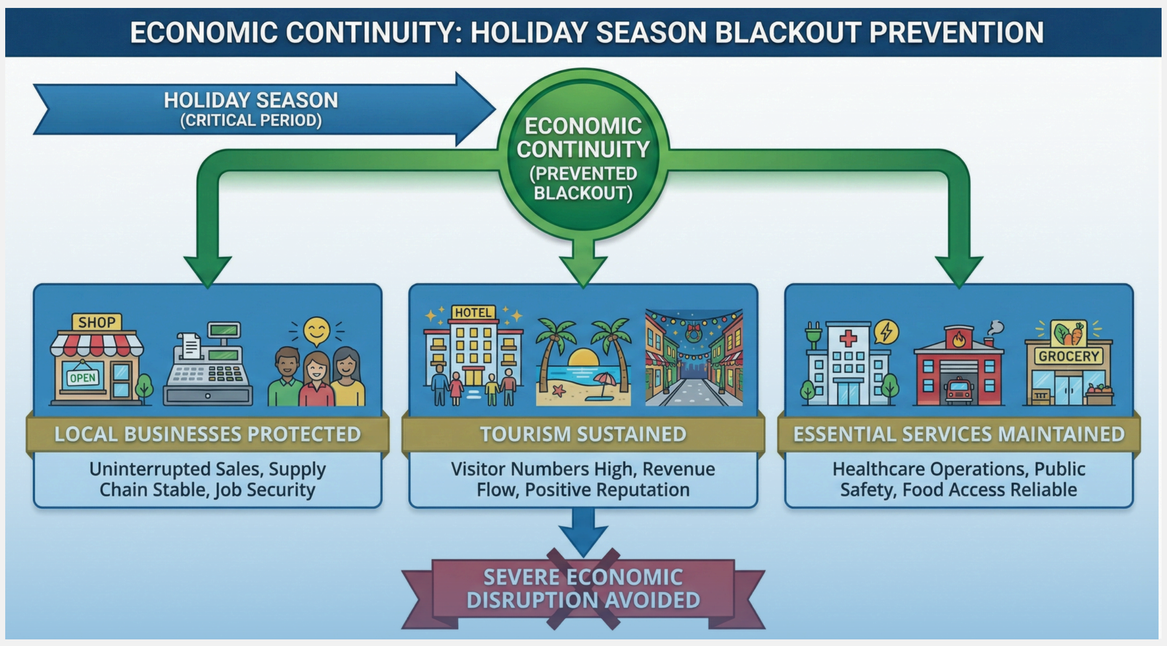
Conclusion

This case study demonstrates the critical role of **advanced cable fault location techniques** in maintaining essential infrastructure. By strategically deploying the Impulse Current Method, the technical team was able to overcome the inherent limitations of standard equipment. The efficient location and repair of the cable not only resolved a major operational challenge but also successfully achieved the crucial goal of **restoring essential power to the community in time for the New Year**, underscoring the value of specialized diagnostics in high-stakes infrastructure maintenance.

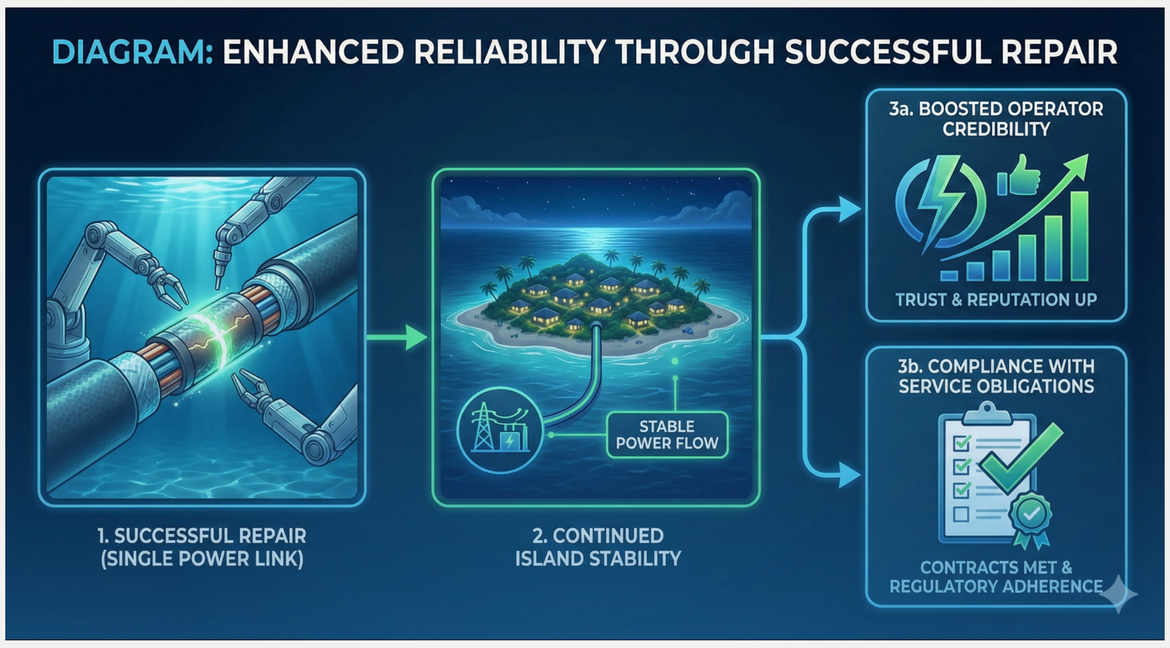




- **Economic Continuity:** Preventing a prolonged blackout during the critical holidaseason protected local businesses, tourism, and essential services from seveeconomic disruption.



- **Enhanced Reliability:** The successful repair ensured the continued stability of the island's single point of power delivery, boosting the operator's credibility and compliance with service obligations.



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