Power Quality Disturbance Analysis Report

Event Metadata

Parameter	Value
Location	BUS 11
Sampling Frequency	10 kHz (Assumed)
Nominal Voltage	230 V (Assumed for report structure)
Event Type	Voltage Sag
Event Time	2025-12-15 01:18:10
Event Duration	99 ms
Amplitude Drop	230 V → 135 V (Estimated 41.3% drop)
Recovery Time	120 ms (Estimated)

Summary

At 01:18:10 on December 15, 2025, a voltage sag was detected at BUS 11 in the Simulink*14Bus*System. The voltage is estimated to have dropped from 230 V to 135 V, lasting for 99 milliseconds, and recovering within an estimated 120 milliseconds.

Technical Analysis

- **Sag Severity**: Moderate and transient
- **Voltage Deviation**: Approximately 41.3% drop (estimated)
- **Likely Causes**:
  - A short circuit on an adjacent line (e.g., LINE10*11 or LINE11*12) or at a connected bus (BUS10 or BUS12).
  - A fault or sudden, large inrush current demand from the `rectifier` connected to BUS 11.
  - Startup of a large inductive load at BUS10 (LOAD10) or BUS12 (LOAD12), causing a momentary high current draw and voltage drop.
- **System Impact**:
  - Potential malfunction, tripping, or reset of the `rectifier` system connected to BUS 11.
  - Interruption or poor performance of the `DC_LOAD` fed by the `rectifier`.
  - Possible impact on other loads connected to BUS 11 or adjacent buses (BUS10, BUS12) if they are sensitive to voltage sags.
- **Standards Compliance**:
  - The event duration of 99ms is within typical IEEE Std 1159 recommended limits for sag duration, but the impact depends on the sensitivity of connected equipment.

Recommendations

Immediate Actions

- Monitor voltage (VM11) and current (IM11) at BUS 11 for recurrence using the available measurement points.
- Investigate the `rectifier` system connected to BUS 11 for any fault conditions, abnormal operation, or sudden load changes (e.g., DC_LOAD behavior).
- Inspect the physical integrity and protection settings of transmission lines `LINE10_11` and `LINE11_12` for any signs of short circuits or insulation breakdown.
- Review operational logs for `LOAD10` (at BUS10) and `LOAD12` (at BUS12) to identify any recent switching events or motor starts that coincided with the sag.

Preventive Measures

- **For BUS 11 and the Rectifier**:
  - Conduct a detailed power quality audit specifically at BUS 11, focusing on the `rectifier` and its `DC_LOAD` to determine their exact sag immunity levels.
  - Consider installing a dedicated voltage sag compensator (e.g., a Dynamic Voltage Restorer or a voltage stabilizer) at BUS 11 to protect the critical `rectifier` system.
  - Evaluate the ride-through capability of the `rectifier` during voltage sags. Enhance the `DC_LINK_CAP` or integrate an energy storage system (e.g., battery bank) on the DC side if critical `DC_LOAD` operation is paramount.
- **System-Wide Consideration**:
  - Review the protection coordination schemes for `LINE10_11` and `LINE11_12` to ensure rapid fault clearing and minimize sag duration for downstream components.
  - Assess `LOAD10` and `LOAD12` for the presence of large, frequently starting inductive loads. If identified, consider implementing soft starters or other inrush current limiting devices.

AI Remarks

The disturbance at BUS 11 was moderate in severity and relatively transient. While the duration of 99ms is short, the estimated 41.3% voltage drop can still impact sensitive equipment, particularly the connected `rectifier` and its `DC_LOAD`. Continued monitoring of BUS 11 and its immediate vicinity (LINE10*11, LINE11*12, BUS10, BUS12, and the rectifier system) is crucial to identify underlying causes and ensure power system stability and reliability. Specific attention should be paid to the rectifier's performance and any downstream critical DC loads.