ML-Powered Grid Operations Decision Support System

Siemens Energy AI Lab

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Press Release

FOR IMMEDIATE RELEASE

Utility Launches Feeder-Level Extreme-Weather Outage Risk Nowcasting

Real-time probabilistic forecasting enables smarter crew staging, wildfire/PSPS decisions, and restoration sequencing—reducing storm outage duration.

The Problem. Storm coordinators rely on coarse regional forecasts and experience to stage crews and trigger Public Safety Power Shutoffs. Without feeder-level precision, utilities over-deploy in low-risk areas while under-resourcing the hardest-hit corridors.

The Solution. The system fuses high-resolution weather inputs, asset condition scores, and vegetation-proximity data with SCADA/OMS/DMS telemetry to produce feeder-level calibrated outage probabilities refreshed every 15 minutes—degrading gracefully when telemetry is delayed. Supported events: hurricane, wildfire (including PSPS mode), and severe convective storms.

Table 1: Key Benefits and Expected Impact

Benefit	Expected Impact
Storm SAIDI reduction	10–20 % during major events
Crew pre-positioning	Staging aligned to top-risk feeders
Wildfire/PSPS precision	Narrower shutoff zones, fewer customers affected
Shift-handover quality	Objective risk snapshots replace verbal summaries

> "This gives operators a trusted decision-support layer—not a black box. They see calibrated probabilities, overlay judgment, and act earlier with confidence."
>
> —**Maria Sandoval, VP of Grid Operations**

> "The NERC CIP-compliant architecture and built-in feedback loops mean we improve every storm season while meeting regulatory expectations."
>
> —**James Okafor, Chief Resilience Officer**

Availability. MVP covers the primary service territory with phased expansion across remaining regions. *Technical details in the Technical Supplement.*

External FAQ — Operations & End-User Questions

Supplementary Materials. For engineering, compliance, and business details, see Appendix: Internal FAQ.

Table 2: External FAQ — Operations & End-User Questions

#	Question	Answer
1	What does it show during a hurricane or wildfire?	Ranked feeder-level risk heat maps with affected-customer counts and calibrated uncertainty bands.
2	How far ahead and how often?	Day-ahead forecasts refresh every 15 minutes; uncertainty bands widen with lead time.
3	Can I trust it in unprecedented storms?	Ensemble methods provide calibrated uncertainty, but tail-event limitations exist. Operators retain authority.
4	How does it integrate with OMS/DMS?	FastAPI dashboards embed alongside existing consoles; OMS/DMS widget roadmap planned.
5	Does it cover wildfire PSPS decisions?	Yes—fuel moisture, wind, and asset-condition scores feed the same feeder-level risk framework for PSPS go/no-go governance.
6	What data does it need?	OMS outage history, SCADA telemetry, GIS/asset registry, and weather feeds. New territories require a data-quality assessment.

Internal FAQ — Engineering, Compliance & Business Questions

1. **What is the ML approach?**
   Gradient-boosted ensemble produces feeder-level outage probabilities using weather, asset condition, vegetation, historical labels, and SCADA anomalies. Conformal prediction provides calibrated uncertainty bands. *See Technical Supplement.*

2. **How do we meet NERC CIP requirements?**
   OT data exits via unidirectional data diode into Azure. Inference runs in a CIP-011-compliant workspace with CIP-005 access controls. The system is **advisory-only** (no closed-loop control), limiting CIP scope.

3. **Timeline, team, and cost?**
   Six-month MVP: data integration (M1–2), model development (M3–4), deployment & ops testing (M5–6). Team of 5 engineers plus utility SME. Azure: \$15–25K / month.

4. **How do we meet <500 ms latency?**
   Pre-computed scores refresh every 15 min and are cached (<50 ms response). On-demand re-scoring for topology changes uses optimized AKS GPU inference within 500 ms.

5. **What happens during unseen extreme events?**
   Synthetic oversampling and loss weighting address class imbalance. Ensemble disagreement signals uncertainty; the system falls back to climatological baselines when confidence is low. Human-in-the-loop is mandatory.

6. **How do we validate with rare storm data?**
   Backtesting against 5–10 years of historical storms, synthetic stress tests, and live validation during storm season. Metrics: Brier skill score, reliability diagrams, precision/recall at actionable thresholds.

7. **Top risks and mitigations?**

Table 3: Key Risks and Mitigations

Risk	**Impact**	**Mitigation**
Data integration delays	MVP timeline slip	Early IT/OT engagement; parallel pipelines
Poor tail-event calibration	Missed high-impact outages	Conformal prediction; ensemble uncertainty; human override
CIP compliance friction	Deployment blockers	Architecture review in M1 with utility CIP team; advisory-only classification