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Final technical report for LBNL CRADA (FP00009949) with the American Public Power Association: - Electricity Reliability Metrics, Analysis, and Planning

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Peer reviewed

Cooperative Research and Development Agreement (CRADA) Final Report

Report Date: December 20, 2022

In accordance with Requirements set forth in the terms of the CRADA, this document is the CRADA Final Report, including a list of Subject Inventions. It is to be forwarded to the DOE Office of Scientific and Technical Information upon completion or termination of the CRADA, as part of the commitment to the public to demonstrate results of federally funded research.

Parties to the Agreement: The American Public Power Association and Lawrence Berkeley National Laboratory

CRADA number: FP00009949

CRADA Title: Electricity Reliability Metrics, Analysis, and Planning

Responsible Technical Contact at Berkeley Lab: Joseph Eto

Name and Email Address of POC at Partner Company(ies): Ji Yoon Lee <jlee@publicpower.org>

Sponsoring DOE Program Office(s): Office of Electricity

LBL Report Number: LBNL-2001499

OSTI Number:
[SPO to complete]

Joint Work Statement Funding Table showing DOE funding commitment:

DOE Funding to LBNL	\$50,000
Participant Funding to LBNL	-
Participant In-Kind Contribution Value	\$54,068
Total of all Contributions	\$104,068

Provide a list of publications, conference papers, or other public releases of results, developed under this CRADA:
(Publications must include journal name, volume, issue, Digital Object Identifier)

Ling Jin, Joseph H. Eto, Ji Yoon Lee, Alex Hoffman. "Distribution Feeder Characteristics and Their Resiliency to Natural Hazards." Submitted to *IEEE Transactions on Power Systems*.

Provide a detailed list of all subject inventions, to include patent applications, copyrights, and trademarks:

(Patents and patent applications are to include the title and inventor(s) names. When copyright is asserted, the Government license should be included on the cover page of the Final Report)

No inventions were developed through this CRADA.

Executive Summary of CRADA Work:

LBNL and APPA (the team) jointly examined the extent to which differences in distribution feeder characteristics are correlated with differences in their reliability performance when exposed to three different types of natural hazards (wildlife, weather, and vegetation). The team employed data-driven approaches to quantify the relationships between various measures of feeder reliability and a suite of feeder characteristics individually and jointly via a statistically-based clustering method.

The team developed suggestions on how comparisons across groupings of feeders and review of the relative contributions of the constituents of SAIFI and SAIDI could be used to help prioritize utility actions to improve reliability. However, they also caution that their suggestions require further evaluation because they are based on only one year of information from a modest number of small utilities.

Summary of Research Results:

The American Public Power Association (APPA) provided LBNL with data from 8 public power utilities. LBNL and APPA (the team) jointly examined the extent to which differences in distribution feeder characteristics are correlated with differences in their reliability performance when exposed to three different types of natural hazards (wildlife, weather, and vegetation).

The team found that individual feeder characteristics are highly correlated with different measures of reliability and that these correlations vary depending on the type of natural hazard that caused the power interruption. The team further illustrated the usefulness of un-packing the aggregated measures of reliability, such as System Average Interruption Frequency Index (SAIFI) and System Average Interruption Duration Index (SAIDI), to examine their underlying constituents (number of interruptions, number of customers interrupted, and total customer minutes of interruption) when making these assessments. Finally, because many individual feeder

characteristics are correlated with one another, further insights into the reliability impacts of natural hazards were gained by examining entire populations of feeders that have been grouped into like types that are defined by ensembles of feeder characteristics.

APPENDIX A (Reference Only)

*This appendix has been developed by DOE to assist DOE Labs in drafting the **Executive Summary** and **Summary of Research Results** sections of the CRADA Final Report.*

Executive Summary of CRADA Work:

Include a discussion of 1) how the research adds to the understanding of the area investigated; 2) the technical -effectiveness of the materials, methods or techniques investigated or demonstrated, and their economic feasibility, if known; and 3) how the project is otherwise of benefit to the public. The discussion should be a minimum of one paragraph and written in terms understandable by an educated layman.

Summary of Research Results:

- *INCLUDE, IF APPLICABLE: "This product contains Protected CRADA Information, which was produced on [DATE] under CRADA No. [##-####] and is not to be further disclosed for a period of [up to and not to exceed] five (5) years from the date it was produced except as expressly provided for in the CRADA."*
- *Summarize project activities for the entire period of performance, including original hypotheses, approaches used, problems encountered, any departure from planned methodology, and an assessment of their impact on the project results. Incorporate technical data, e.g. facts, figures, analyses, and assumptions used during the life of the project to support the technical conclusions of the work. It is acceptable to incorporate the technical data by reference to other publicly available sources, such as a publications or other reports, but not websites. Provide a comparison of the actual accomplishments with the goals and objectives of the project. Where possible, the summary should cover each task listed in the Statement of Work (SOW) and should note any deviations from the project plan, or lack of technical data.*
- *Identify products, potential applications, and technology transfer activities developed under the CRADA, including those completed and anticipated at the time of the report. These include, but are not limited to: 1) networks or collaborations fostered; 2) technologies/techniques/methodologies; 3) other products that reflect the results of the project, such as commercial products, internet sites, data or databases, physical collections, audio or video, software, models, educational aid or curricula, and instruments or equipment.*

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