Technology/Knowledge Transfer Plan

GLOW, EPC-17-043,
HiPAS GridLAB-D: High-performance Agent Based Simulation using GridLAB-D (EPC-17-046),
OpenFIDO: Open-source Framework for Integrated Data Operations (EPC-17-047)

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1. Executive Summary

GridLAB-D is a powerful program meant to help improve access to electric distribution system modeling. Developed more than a decade ago between the Department of Energy and the Pacific Northwest National Laboratory, GridLAB-D continues to be an excellent tool for evaluating the interconnection, scalability, and use of distributed energy resources into power grids. However GridLAB-D has suffered from limited uptake due, in part, to the primary interface being based on command line style. To overcome this barrier, the California Energy Commission issued EPIC grants in 2018, aiming to empower GridLAB-D in a variety of fundamental ways.

Led by the SLAC National Accelerator Lab (SLAC), Hitachi, Gridworks, National Grid, and the Pacific Northwest National Laboratory (PNNL) GridLAB-D will see several major updates by the conclusion of the program.These updates are focused around creating a new graphical user interface (GLOW), developing a powerful multithreading capability to increase simulation speed (HiPAS), and creating an open source data interchange that allows for the data governing existing grid systems to be freely shared among participants (OpenFIDO). These upgrades are meant to bring GridLAB-D to the forefront of the power flow and distribution level modeling toolkit. With California working to lead the way on renewable integration, tools like GridLAB-D will play a core role in ensuring that the modernization of the grid happens in a safe, secure, and effective manner.

2. Introduction

a. GridLAB-D Program Overview

GridLAB-D presents an opportunity to continue to develop an effective open source tool that is meant to provide greater insight to interested parties in the area of distribution system modeling. Led by SLAC, Hitachi, Gridworks, National Grid, and the PNNL three separate EPIC funded projects support ongoing development of GridLAB-D into a future-proofed tool to provide data access and modeling capabilities California's energy agencies, utilities, community choice aggregators, distributed energy resource providers, and interested stakeholders.

i. GridLAB-D Open Workspace (GLOW) Overview

GridLAB-D Open Workspace (GLOW) is an EPIC funded initiative focused on improving the basic accessibility of GridLAB-D by developing a high-end graphical user interface (GUI) that will be more intuitive and user friendly for all stakeholders, including non-expert users. The

development of this GUI is meant to provide an opportunity for the novice user to work within the program while still maintaining the depth and power that experienced distribution modelling teams have come to expect through their own usage and development. Facilitating this work is Hitachi and Gridworks in a human-centered design process emphasizing the needed capabilities of the modeling program.

ii. Hi-Performance Agent Based Simulation using GridLAB-D (HiPAS) Overview

Hi-Performance Agent Based Simulation using GridLAB-D (HiPAS) is a powerful open-source upgrade to GridLAB-D that improves the analysis performance and computational efficiency of the tool. By using intelligent and adaptive multithreading to deploy a highly granular parallelization in agent based simulations the HiPAS upgrade will be able to greatly improve the overall efficiency of GridLAB-D for large modeling projects.

iii. Open Framework for Integrated Data Operations (OpenFIDO) Overview

The Open Framework for Integrated Data Operations (OpenFIDO) initiative is developing a data interchange, synthesis, and analysis platform that will be open source. This is meant to improve the exchange of data between different power flow systems by evaluating the existing frameworks for this data, what gaps exist, how these gaps can be filled, and improve the reliability of data systemwide. With the goal to develop a gold standard data platform that can be adaptive and comprehensive the OpenFIDO initiative will ensure that interested parties are able to efficiently find the information they need.

b. Project Goals

These GridLAB-D initiatives will continue to improve a powerful existing tool and improve its accessibility. Through a human-centered design process the development of these initiatives is meant to be as user friendly and forward looking as possible. The human centered design process focuses on speaking with current users and modelers in this area and understanding the difficulties they face in their projects. Human centered design understands the functional needs of the program and attempts to incorporate the workflow of modeling from current experts. Working to reduce the extraneous clicking, scrolling, and navigating to find the results and information the user is looking for improves the overall experience and can reduce ergonomic strain.

Creating an open and easily accessible platform for modeling the grid will expand the conversation around the value of grid services, and working to provide independent validation of the planning and grid development process.

c. Value of Knowledge Transfer

Knowledge transfer refers to the process by which information gained is documented and communicated to identified key audiences. This update of GridLAB-D is an opportunity to develop a more comprehensive outreach program surrounding this powerful open-source tool. Improving transparency and shared analytics are important goals correlated with the knowledge transfer process. The combination of transparency, data access, and the new graphical user

interface will help introduce GridLAB-D to a new generation of users for whom it can be the powerful and default choice for their modeling needs.
The value of knowledge transfer for the GLOW program are broadly across these areas:

- Providing insight to California's distribution grid to a broad range of public and private sector users that did not have this access previously.
- Improving access to a tool which can independently assess the ability of any modeled grid to integrate more distributed energy resources and reflect the value of doing so.
- Ensure that anticipated future use cases are integrated into the platform to provide added utility as the need develops.

d. Statement of Purpose

This knowledge transfer plan aims to provide a platform for lessons learned and knowledge gained over the course of the GridLAB-D initiatives. The target audiences include the staff at the California Energy Commission, the California Public Utilities Commission, Community Choice Aggregator staff, DER vendors, public interest organizations, research institutions, and other interested parties. To support the overall goal, this plan outlines actors, partners, and channels to communicate about the results of these projects.

3. Knowledge Transfer Plan Implementers and Partners

Implementers:

- SLAC
- Hitachi
- Gridworks

Partners:

- National Grid
- Pacific Northwest National Laboratory
- Technical Advisory Committee members:
    - Kristen Brown (ComEd)
    - Jameson Thornton (PG&E)
    - Aram Shumavon (Kevala)
    - Eric Lightner (DOE)
    - Merrian Borgeson (NRDC)
    - Justin Regnier (CPUC)
    - Pedram Jahangiri (National Grid)
    - Jamie Patterson (CEC)
    - Audrey Lee (SunRun)
    - Raul Perez-Guerrero (SCE)
    - Rachel Huang (SMUD)
    - Davianna Olert (EDF)
    - Jim Baak (STEM)
    - Andy Bilich (EDF)
    - Laura Fedoruk (SunRun)

4. Target Audiences

Audience	Suggested Communication Content
CPUC Staff	
CEC Staff	• Downloads packaged with step-by-step validation examples, calculations, and alternative energy scenarios.

Other Interested Parties	● Download packages showing expected growth and development throughout CA ● Tracking data on DER deployment and impact
Associated Service Providers (e.g. Sunrun, Calpine Energy Services)	● Outreach emphasizing data sharing platform ● Newsletters about use-case development in progress
Utilities (IOUs, CCAs, Municipals)	● Promotion of data sharing ● Utility of higher quality data and increased availability ● Demonstrations of other regional adoptions and impacts

5. Knowledge Transfer Process

a. Key Messages

The key messages for the GridLAB-D process include:.

- This program will lower the barrier to entry for GridLAB-D and help to improve the power of the platform by integrating new features to improve data access and simulation speed.
- GridLAB-D is intended to continue to drive the conversation about data, accessibility, and the democratization of modeling using California as a preview for a larger rollout at national and potentially international scale.
- GridLAB-D will provide another avenue to validate grid development plans and the associated integrated resource planning processes.
- These projects are intended to future-proof the GridLAB-D platform by evaluating the current needs and anticipate the future use cases of users and deploying features that ensure GridLAB-D will continue to be the best tool for the job.

To deliver these messages, the program's knowledge transfer process will:

- Ensure that newly developed features are announced and easily visible through websites, newsletters, and introductory features in GridLAB-D
- Update invested stakeholders on key milestones through announcements through major channels (website updates, newsletters, etc)
- Ensure intuitive updates and access to news within the GridLAB-D environment

b. Knowledge Transfer Products

The following products will be developed by the various project teams to support the transfer of knowledge. All products prepared for public dissemination will include the CEC's Legal Notice Requirement

- Draft and Final Initial Project Fact Sheets - *Complete*
- Draft Final Project Fact Sheet - *Complete*
- Final Project Fact Sheet - *Complete*

- Draft Presentation Materials
- Final Presentation Materials
- Draft Knowledge Transfer Plan - *Complete*
- Final Knowledge Transfer Plan
- Draft Knowledge Transfer Report
- Final Knowledge Transfer Report

c. Activities

Knowledge transfer activities will occur from Q4 2018 to Q1 2023, with reporting on activities from Q2 2019 to Q4 2023. The following chart maps out an approximate timeline for knowledge transfer initiatives:

Activity	Q3 2018	Q4 2018	Q1 2019	Q2 2019	Q3 2019	Q4 2019	Q1 2020	Q2 2020	Q3 2020	Q4 2020	Q1 2021
Product Publication											
Communication Outreach											
Direct Engagement											
Reporting											
Activity	**Q2 2021**	**Q3 2021**	**Q4 2021**	**Q1 2022**	**Q2 2022**	**Q3 2022**	**Q4 2022**	**Q1 2023**	**Q2 2023**	**Q3 2023**	**Q4 2023**
Product Publication											
Communication Outreach											
Direct Engagement											
Reporting											

Product Development and Publication, Audiences, Implementers		
Product Publication	**Audience(s)**	**Implementer/Partner**
Technical Advisory	TAC members, general public	Gridworks

Committee Notes/Updates		
GridLAB-D	General public, technically interested parties	SLAC, Hitachi
Press Release(s)	All, especially public	All
Presentation Materials	State and local regulators, other	SLAC, Hitachi, assistance from Gridworks
Reporting Documentation	CEC, CPUC	SLAC, Hitachi, Gridworks

6. Policy Development

Currently GridLAB-D has three major projects that focus on use case development with significant potential policy implications. A brief outline of these projects, use cases, and potential policy implications is included.

The Visual Analytics for Distributed Energy Resources (VADER) project is an excellent example of the work being done in this space with funding provided by the DOE's ARPA-E program to focus on the issue of DER integration into a grid system that was not initially designed for this level of flexibility and two-way power flow. GridLAB-D and VADER are able to accomplish this by integrating a real-time data flow that includes an array of non-SCADA sources.

PowerNET and PowerNET with Markets are similar projects funded at the national (DOE) and state (California Energy Commission) level with the goal to provide a simulated estimate of control systems impact on the grid. This project has the potential to add improvements in the implementation of demand response, DER performance impacts, and impacts on cost/revenue.

The Grid Resilience Intelligence Project (GRIP) is another project emphasizing mitigation and evaluation on grid issues by providing real-time(?) feedback on absorption capabilities within the existing grid. With ongoing environmental degradation the risk to existing infrastructure continues to grow. Resilience, redundancy, and absorption are key aspects of ensuring the provision of safe and affordable service.

At this point in time the GridLAB-D team is not aware of any citations of these initiatives in government policy publications. After greater progress has been made in developing GridLAB-D, we expect that GridLAB-D will develop as a more widely utilized solution for tackling policy questions on a broader scale. The utility of independent confirmation and analysis will be a powerful benefit for a variety of actors.

In the future we expect that GridLAB-D will help to inform policy decisions through the CEC and CPUC by providing an additional avenue to substantiate the analysis done by IOUs concerning concerning IRP processes and other areas. Providing in-house analysis on claims

made by the IOUs, the CEC will be in a position to better serve the people of California. This will likely be one of the most immediate and direct impacts at the conclusion of the GridLAB-D project. With the CEC leading by example we would also expect GridLAB-D to gain traction with other organizations focusing on understanding local grid conditions and providing a greater level of adaptation.

Informal usage of the GridLAB-D platform by other interested parties may serve to provide novel insights into the development of the grid or encourage the adoption of more localized solutions in the support and deployment of DER. Providing a platform where everyone has access to the same information about local, regional, and larger conditions is an opportunity to drive larger conversations about the role of energy and development within communities.

7. Reporting

Once the Knowledge Transfer Plan has been implemented the corresponding activities will be reported in the Knowledge Transfer Report. Implementers and partners will track metrics that provide a framework to measure the success of the plan and the overall uptake or interest in the initiatives and GridLAB-D program. Metrics may include: downloads, newsletter sign ups, inquiries received, the number of Technical Advisory Committee members, the number of participants in the Technical Advisory Committee, and the number of people receiving newsletters.

Deploying training sessions, available in-person or online, provides another opportunity to evaluate interest and uptake. In-person courses or webinars allow for following up with participants on their needs and why they are seeking out GridLAB-D as a solution.

The metrics outlined above provide insight into the accessibility and direct outreach on the behalf of GridLAB-D. Beyond the hard metrics outlining downloads and visibility, there are other ways that the GridLAB-D project will be considered a success. Seeing greater engagement in public meetings, working groups, and other areas where IOUs are often the only source of future modeling on grid conditions provides an opportunity to push back against the ingrained assumptions in these models. On a longer time horizon, GridLAB-D may provide a way for a form of distribution leapfrog - with other states, regions, or even countries learning lessons from early adopters like California and being able to avoid repeating the missteps along the way to a resilient grid.

These numbers will be updated and available through avenues including ongoing status reports, web publications, and informational newsletters. Many of these avenues also provide an opportunity to highlight additional usage of GridLAB-D in other regions and novel use cases.