APQRC
AUSTRALIAN POWER QUALITY AND RELIABILITY CENTRE

UNIVERSITY
OF WOLLONGONG
AUSTRALIA

Management of Voltages in LV Networks

Quarterly Progress Report

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1 Executive Summary

This report details the progress of the project (for the first quarter of 2019) titled 'Management of Voltages in LV Networks' funded by the ENA/API and undertaken by the University of Wollongong (UOW) in conjunction with a consortium of Australian Distribution Network Service Providers (DNSPs). The original project scope called for modelling of a finite number of 'typical' low voltage (LV) distribution networks. However, shortly after project commencement, it became clear that the application of such models would be limited as the wide variation in LV network topologies across DNSPs precluded effective identification of 'typical' networks. Consequently, a change of scope was requested of the industry partners (i.e., the consortium of DNSPs) such that the project develop a highly flexible modelling tool that could be applied to a wide range of LV network topologies. This change of scope, being directly beneficial to the industry partners, was endorsed by the DNSPs directly involved in the project and was also approved by the ENA asset management committee.

An effective project team has been established incorporating both UOW and DNSP staff. The project team meets regularly to discuss the progress and roadblocks, if any. Also, knowledge sharing systems have been established, especially for team members to share relevant project related information. Significant progress has been made on the design and implementation of the network modelling tool that has become the main project outcome.

At this stage, the project is on schedule and within budget. This report also includes risks associated with the project and highlights the risk management strategies in place. Finally, the project plan from this point up until the proposed project completion date is outlined.

Table of Contents

2 Introduction

This report details the progress of the project (till date) titled 'Management of Voltages in LV Networks' funded by the ENA/API and undertaken by the University of Wollongong in conjunction with a consortium of Australian Distribution Network Service Providers (DNSPs).

2.1 Change of Project Scope

The original project scope called for modelling of a finite number of 'typical' low voltage (LV) distribution networks. Shortly after project commencement, it became clear that the application of such models would be limited as the wide variation in LV network topologies across DNSPs precluded effective identification of 'typical' networks. Consequently, a change of scope was requested of the industry partners such that the project develop a highly flexible modelling tool that could be applied to a wide range of LV network topologies. This change of scope, being directly beneficial to the industry partners, was endorsed by the DNSPs directly involved in the project and was also approved by the ENA asset management committee.

3 Industry and University Partners

The current project team is shown in Table 3.1.

Table 3.1: Current Project Team

Name	Industry/University
Peter Wong (Industry project lead) and team	Jemena
Adrian Lloyd and team	Energy Queensland
Cathryn McDonald and team	SA Power Networks
Anil Khushalani and team	United Energy
Ashish Agalgaonkar (UOW project lead) and team	University of Wollongong

4 Project Progress

Overall, the project has been progressing well. OpenDSS has been selected as a software platform for modelling and tool development purposes. A Microsoft Excel graphical user interface (GUI) has been developed to communicate with the OpenDSS program in order to allow user input and provide graphical output of the simulation results.

A beta version of the flexible modelling tool was released to the industry team members on the 7th February 2019. During the face to face meeting between the university and industry members on 26th February 2019, an update was provided to all the participating DNSP members on the flexible modelling tool and feedback was sought.

As of the end of the first quarter of 2019, the modelling tool has the following capabilities:

- It can construct networks consisting of three-phase and single-phase lines including the neutral conductor (3-phase 4-wire and 1-phase 2-wire lines).
- It allows users to select from a number of different overhead conductor and underground cable types.
- It allows users to enter the customised data for conductors and tower geometry

- It allows users to include multiple loads, solar PV systems and energy storage systems at any bus in the network.
- It allows users to modify the neutral grounding impedance at the distribution substation and load connections.
- It can draw (i.e., provide a graphical representation) the schematic diagram of a network that the user is building.
- It allows users to run either snapshot or time-series simulations with time varying loads and generation and varying stiff voltage at the distribution transformer.
- It can export simulation results and the network plot with minimal user input.
- It gives the option for voltage management using PV inverters and on-load tap changer at the distribution substation during time-series simulation

The documentation (manual) for the modelling tool is currently being updated to include the latest capabilities of the tool with more detailed explanation of each network component.

5 Next Steps

Following the project plan, the next steps for this project involve:

- Inclusion of LV voltage regulators
- Inclusion of energy storage (battery) control
- Verification of the proposed tool using a realistic network
- Developing an option to make more user-friendly simulation output
- Second beta release of the proposed tool (to be made available to the industrial partners)

6 Conclusion

This document reports the progress of the project titled 'Management of Voltages in LV Networks' undertaken by University of Wollongong in conjunction with a consortium of Australian DNSPs (industry partners). The report highlights the latest project updates and lists the current industry and university partners involved in this project. The risk matrix, project plan, financial statement and endorsement by the industry partners are included in the appendix.

7 Appendix

7.1 Risk Matrix

Table 7.1 shows the risk matrix which has been developed for the project.

Table 7.1: Project Risk Matrix

No	Risk	Likelihood	Severity	Management/Mitigation
1	Difficulties in sharing network data and test data from partnering organisations	3	7	- Use of other available data
2	Delays in reaching agreement to a small number of low voltage circuit types to be studied in the project	4	7	- Agreement on network selection well before testing
3	Delays in obtaining the results and findings of recent and current industry trials on low voltage networks	5	7	- Reliance on simulation and laboratory testing
4	Difficulties in obtaining industry input in areas of economic evaluations and optimisation where UOW has limited practical skills and knowledge	4	9	- Intervention from Project Manager - Reliance on literature review
5	Scope "blowout" noting the limited time, resources and funds available for the project vs the broad and diverse industry needs	4	10	- Establishment of realistic project tasks and timeline
6	Project desertion by the research associate	3	7	- Ensuring that all members are aware of the project progress - Ensuring that the project progress is well documented

7.2 Project Plan

Table shows the agreed project plan for the remainder of the project.

Table 7.2: Project Plan

Timeframe	Activities/Tasks	Responsibilities
Jan 2019 – Apr 2019	Modelling tool development: - Release of beta version of the modelling tool - Inclusion of underground system - Ability to conduct time-series simulation	UOW
Feb 2019	Face-to-face meeting - Modelling tool testing and feedback - Development of detailed plan for the final stage of the project	All
Mar 2019 – June 2019	Simulation studies: - Testing of different voltage management strategies - Identify technically feasible solutions - Inverter testing in the laboratory - Case studies report collection from the industry partners - Validation studies completed	All
June 2019 – Jan 2020	Cost-benefit analysis - Identification of optimal economic solutions Preparation of final report and knowledge sharing material	All

7.3 Financial Statement

Table shows the project expenditure from project commencement (2nd July 2018) through to 30th April 2019. Total funding for the project from the ENA is $215,000. Based on the data shown in Table 2, 31.8% of the project budget has been exhausted. Given that the project timeframe is 19 months, and that the figures above are for 10 months (i.e. 53% of total project timeframe), the project is under budget. It should also be noted that $25,000 is allocated in the budget for travel and knowledge sharing and to date no funding related to that allocation has been accessed.

Table 7.3: Project Expenditure

Item	Amount ($)
Research Associate Salary	67,991.65
Catering for Meeting	384.81
Total	68,376.46

7.4 Endorsement by Participating Members

1. Energy Queensland

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2. Jemena

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3. SA Power Networks

Name: Cathryn McDonald
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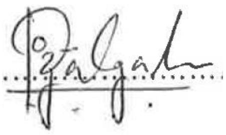
4. United Energy

Name: Anil Khushalani
Date: 01/05/2019
Email: anil.khushalani@ue.com.au

5. University of Wollongong



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