

UNIVERSITY  
OF WOLLONGONG  
AUSTRALIA

# Management of Voltages in LV Networks

Milestone 1 Report

APQRC, University of Wollongong  
11 February 2018

## 1 Executive Summary

This report details the progress of the project 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). Specifically, this report details project progress with respect to the deliverables defined for the Milestone 1. 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 topology 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 was endorsed by the DNSPs directly involved in the project and was also approved by the ENA asset management committee.

The deliverables for Milestone 1 which were agreed at the project kick-off meeting are as follows:

1. Finalise the DNSP partners who will participate in the project team;
2. Agree to an approach for collection of network data;
3. Collect network data for modelling purposes; and
4. Establish information sharing framework for all relevant trials from partner organisations

The above deliverables for Milestone 1 have been achieved and exceeded. 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 set up, especially for team members to share relevant project related information. In addition to the above deliverables, significant progress has been made on the design and implementation of the network modelling tool that has become the main project outcome.

The project is also under budget mainly due to a delay in recruiting the research associate who is undertaking the project work. This report also includes risks associated with the project and the risk management strategies in place. Finally, the project plan from this point up until the proposed project completion date is outlined.

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## 2 Introduction

This report details the progress of the project 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). Specifically, this report details project progress with respect to the deliverables defined for Milestone 1.

### 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 topology 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 was endorsed by the DNSPs directly involved in the project and was also approved by the ENA asset management committee.

### 3 Project Progress

Overall, the project has been progressing well and progress is ahead of schedule. The deliverables for Milestone 1 which were agreed at the project kick-off meeting are as follows:

1. Finalise the DNSP partners who will participate in the project team;
2. Agree to an approach for collection of network data;
3. Collect network data for modelling purposes; and
4. Establish information sharing framework for all relevant trials from partner organisations

Each of the above milestones has been met within the specified timeframe. In addition, progress beyond Milestone 1 has been achieved. As such, the project is ahead of schedule. Specific details for each of the above deliverables are discussed below.

#### 3.1 Finalisation of industry partners

The DNSPs that are making a direct contribution to the project have been finalised as:

- Energy Queensland
- Jemena
- SA Power Networks and
- United Energy.

The current representative from each organisation is as follows:

- Energy Queensland - Adrian Lloyd
- Jemena - Peter Wong and Yogendra Vashishtha
- SA Power Networks - Brendon Hampton, Bryn Williams, Cathryn McDonald, James Brown and Siyuan Wei
- United Energy - Anil Khushalani and Hedy Dalvand

To date, cooperation between the project team members has been very effective. The research team from UOW and the industry participants are communicating well and relevant updates are shared between the members. Monthly teleconference meetings have been held to discuss the project progress and next steps.

#### 3.2 Approach to collection of network data

Microsoft SharePoint has been selected as the most effective tool for collection of data from project participants the most. To that end, the UOW team has established a Microsoft SharePoint sites for the project where all the industry members can upload relevant information for the project. The UOW team listed the required data as well as the preferred format on the SharePoint webpage and all members responded by sharing their versions of the required data. Also, the relevant progress reports were made available to the industry partners using the SharePoint webpage.

#### 3.3 Collection of network data for modelling

Continuous knowledge sharing is undertaken in parallel with the stage of the modelling tool development. The UOW team has collected different overhead conductors, underground cables and distribution transformers details for network modelling. A default overhead conductor tower configuration, PV system and neutral grounding details have been assumed and agreed by all the project team members.

### 3.4 Information sharing framework for all relevant trials by partner organisations

The UOW team has also collected different voltage issues in LV networks encountered by the industry members. Dated and current voltage management strategies have also been shared by the industry members and will be used in the next stage of the project. Ongoing knowledge sharing for other relevant trials will continue with the project.

### 3.5 Progress beyond Milestone 1 deliverables

As noted, the project has progressed beyond the deliverables outlined to be achieved for Milestone 1 and as such, the project is ahead of schedule. Specifically, the following progress has been achieved beyond the deliverables of Milestone 1:

- A software modelling platform has been selected for the modelling tool. The selected platform is OpenDSS. A Microsoft Excel graphical user interface (GUI) has been developed to interface with the OpenDSS program in order to allow user input and to provide graphical output of simulation results.
- At this stage, the modelling tool has the following capabilities:
  - It can construct networks consisting of three-phase and single-phase lines including the neutral conductor.
  - It allows users to select from a number of different overhead conductor and underground cable types.
  - It allows users to include multiple loads, solar PV systems and energy storage systems at any bus in the network.
  - A time-series capability in which it allows users to simulate a study for a 24-hour period with variable time intervals.
  - It can export simulation results and the network plot with minimal user input.
- It is envisaged that the Beta release version of the modelling tool along with the associated documentation (manual) will be distributed to the industry partners on 8th February 2019.
- The face to face meeting involving all the project team members will be held on 26<sup>th</sup> February 2019 at UOW.

## 4 Risk Matrix

Table 4.1 shows the risk matrix which has been developed for the project.

*Table 4.1: Project Risk Matrix*

No	Risk	Likelihood	Severity	Management/Mitigation
1	Difficulties in sharing network data and test data from partnering organisations	3	7	- Usage 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

## 5 Financial Statement

Table 5.1 shows the project expenditure from project commencement (2<sup>nd</sup> July 2018) through to 31<sup>st</sup> December 2018. Total funding for the project from the ENA is \$215,000. Based on the data shown in Table 2, 17.5% of the project budget has been exhausted. Given that the project timeframe is 19 months, and that the figures above are for 6 months (i.e., 32% of total project timeframe), the project is under budget. The primary reason for this was the delay in recruiting the research associate. 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 5.1: Project Expenditure*

<b>Item</b>	<b>Amount (\$)</b>
Research Associate Salary	37356.72
Catering for Meeting	384.81
<b>Total</b>	<b>37,741.53</b>

## 6 Project Plan

Table 6.1 shows the agreed project plan for the remainder of the project. A second milestone report is due at the end of June and the project is scheduled to be completed by January 2020.

*Table 6.1: Project Plan*

Timeframe	Activities/Tasks	Responsibilities
Jan 2019 – Apr 2019	Modelling tool development: <ul style="list-style-type: none"> <li>- Release of beta version of the modelling tool</li> <li>- Inclusion of underground system</li> <li>- Ability to conduct time-series simulation</li> </ul>	UOW
Feb 2019	Face-to-face meeting <ul style="list-style-type: none"> <li>- Modelling tool testing and feedback</li> <li>- Development of detailed plan for the final stage of the project</li> </ul>	All
Mar 2019 – June 2019	Simulation studies: <ul style="list-style-type: none"> <li>- Testing of different voltage management strategies</li> <li>- Identify technically feasible solution</li> <li>- Inverter testing in the laboratory</li> <li>- Case studies report collection from the industry partners</li> <li>- Validation studies completed</li> </ul>	All
June 2019 – Jan 2020	Cost-benefit analysis <ul style="list-style-type: none"> <li>- Identify optimal economic solutions</li> </ul>	All

## 7 Conclusion

This document reports the outcomes of Milestone 1 for 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 describes the deliverables for the milestone and how they have been achieved. All deliverables for Milestone 1 have been achieved. In addition, progress beyond the deliverables of Milestone 1 has been made and as such the project is ahead of schedule. Also, the project is under budget mainly due to a delay in recruiting the research associate who is undertaking the project work.

This report includes risks associated with the project and the risk management strategies in place. Finally, the project plan from this point up until project completion is outlined.

## 8 Endorsement by Participating Members

1. Energy Queensland



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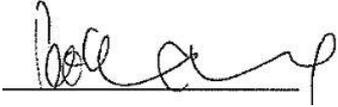
Name: Adrian Lloyd

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2. Jemena



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3. SA Power Networks



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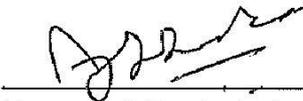
Name: Cathryn McDonald

Date: 08/02/2019

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4. United Energy



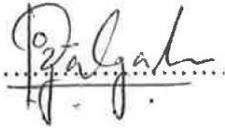
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5. University of Wollongong



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