

SIRFN MICROGRID TESTING TASK

REVIEW OF MICROGRID BENCHMARK NETWORKS & STANDARDS

Terence O'Donnell¹, Jun Hashimoto², Hiroshi Kikusato², Wolfram Heckmann³, Siddhi Shrikant Kulkarni³, Luigi Pellegrino⁴, Maurizio Verga⁴, Thomas I. Strasser⁵, Changhee Cho⁶, Joseba Jimeno Huarte⁷, Artjoms Obusevs⁸

¹University College Dublin, Ireland ²National Institute of Advanced Industrial Science and Technology, Japan ³Fraunhofer IEE, Germany, ⁴RSE, Italy

⁵Austrian Institute of Technology, Austria ⁶Korean Electrotechnology Institute, South Korea ⁷Tecnalia, Spain, ⁸Zürich University of Applied Sciences, Switzerland

Introduction

- The Microgrid Testing task is a technical project of the IEA TCP ISGAN – SIRFN. The overall aim of SIRFN is to facilitate and accelerate the roll-out of renewables and the digital transformation of the power system to a cyber-physical system.
- The specific focus of SIRFN is on the advancement of testing methods and procedures.
- Microgrids have traditionally been of interest for the provision of power in remote locations, or the provision of a secure supply for critical entities in the case of grid failure.
- Recent interests in microgrids include: the organization of the power system as a multi-microgrid systems in order to improve resilience and flexibility: hybrid AC and DC microgrids, and all renewable microgrids.
- The establishment of platforms and procedures for the laboratory testing of such systems are required to better understand, validate, tune and compare system and controller performance.



Figure 1. Institutions and countries participating in this international collaboration.

SIRFN Microgrid Task

- The focus is on laboratory testing and validation of components and systems related to microgrids.
- Network of test laboratories and researchers who share best practices and devise common testing methods.

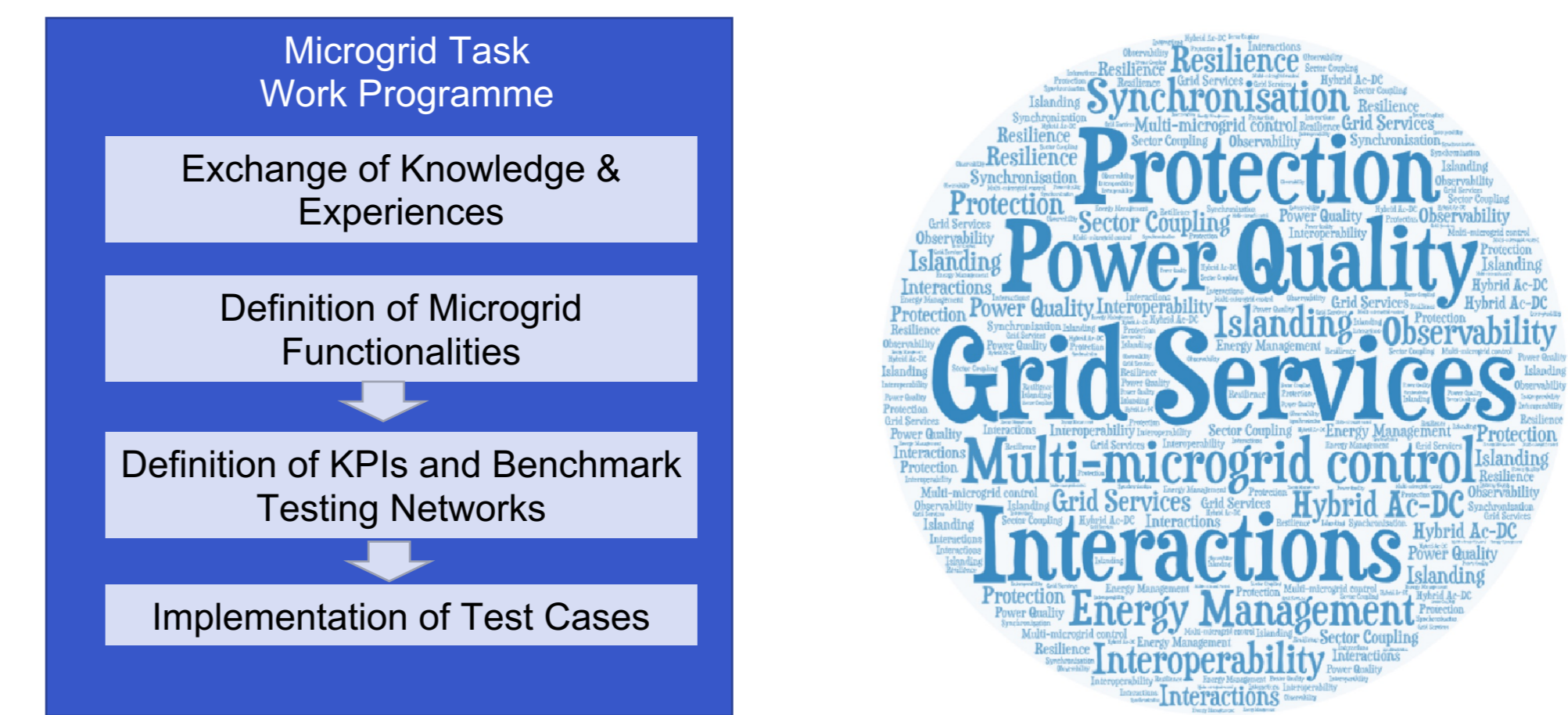


Figure 2. Overview of Microgrid Task Activities and interests

Microgrid Benchmark Networks

- Microgrids are diverse in terms of their compositions, topologies and purpose.
- No one benchmark which can cover all applications and purposes.

Ideally what constitutes a benchmark system?

- Representation of a realistic system with traceable, publicly available data which facilitates the complete reproduction of its operational performance
- Defined performance criteria and metrics for operational scenarios to facilitate comparison and assessment of results from different control approaches at device or system level.
- Different studies may require different depth levels of modeling of the various subsystems and components and such information should be available.
- Applicable to a wide variety of different types of studies, for example from longer term energy management studies to shorter term dynamic studies.

Microgrid Standards

- Microgrids operation are governed by various standards.
- No well summarized document that provides a bird's eye view of the various standards related to microgrids.
- Aim to provide a reference document for development of standards compliant testing procedure.

	Voltage & Power		Type of Studies							Other Criteria			
	Voltage	Power	Planning	Energy Management	Monitoring & Control	Dynamics	Protection	Reliability	Resilience	Cyber Physical	Performance Metrics	Open Access Data	Associated Test Bed
CIGRE LV Benchmark [1]	LV	kVA	✓	✓	✓	✓	✓	✓	✓				
Multi-Microgrids [2]	MV	MVA	✓	✓	✓	✓	✓	✓	✓		✓		
EriGrid 2.0 Electrical Network [3]	LV	kVA	✓	✓	✓	✓	✓	✓	✓		✓	✓	
Banshee Distribution Network [4]	MV & LV	MVA	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Distribution System with Residential Microgrids [5]	MV & LV	MVA	✓	✓	✓	✓	✓	✓	✓		✓		
Hybrid AC/DC [6]	MV & LV	MVA	✓	✓	✓	✓	✓	✓	✓		✓		
Cape Verde Island [7]	MV	MVA	✓	✓	✓	✓	✓	✓	✓		✓	✓	

Figure 3: Summary of Microgrid Benchmark Systems and their characteristics.

Test procedure	IEEE 1547.1	IEEE 2030.8	AC Microgrid	DC Microgrid
Requirement/ Specification	IEEE 1547	IEEE 2030.7 Microgrid Controller	IEC TS 62898-1 IEC TS 62898-3 Series	IEC SyCLVDC/125/NP
Use case	interconnection	IEEE 2030.9 Microgrid	IEC TS 62898-4	
Guide/ Guideline	IEEE 1547.2, 3, 4, 5, 6, 7, 9		IEC TS 62898-2	
Design				IEEE 2030.10

Figure 4: Bird's eye view of standards related to microgrid.

Listed of standards relevant to microgrid

- The IEEE 2030 Series deals with various aspects of Smart Grid Interoperability.
- The IEEE 1547 Series provide standards for DER interconnection.
- The IEC TC 62898 Series provide standards for Microgrid.
- The IEC SyCLVDC/125/NP will provide standard for DC microgrid.

Conclusion and future work

- Benchmarks and international standards were summarized as reference information for those involved in microgrid testing.
- These draft reports "Microgrid Benchmark Networks" and "Microgrid Standards," will be published from ISGAN/SIRFN web page.
- We welcome institutions who want to join this activity.

This review has been performed by a group of researchers, members of the IEA TCP ISGAN - SIRFN, as part of their efforts to enhance the close collaboration among international test facilities and identifies potential activities for future application and standardization of Smart Grid. In this context, the contributions from the members are acknowledged.