



Prague, 8-11 June 2009

EPRI Tutorial

CIGRE C6.11: Development and operation of active distribution networks

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Membership: 27 members, experts and observers

Convenor: Christian D'Adamo, ENEL

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Presentation Overview

- Background
 - CIGRE International
 - C6 Study Committee
- C6.11 achievements
- C6.11 future activities
- Summary

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Background

- CIGRE
 - 16 Study committees
 - Number of working groups on various topics related to SC objectives
 - Purposes – documentation and dissemination of knowledge
- CIGRE C6 study committee – dispersed generation and distribution networks
- C6.11 WG – Active distribution networks

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International Council on Large Electric Systems

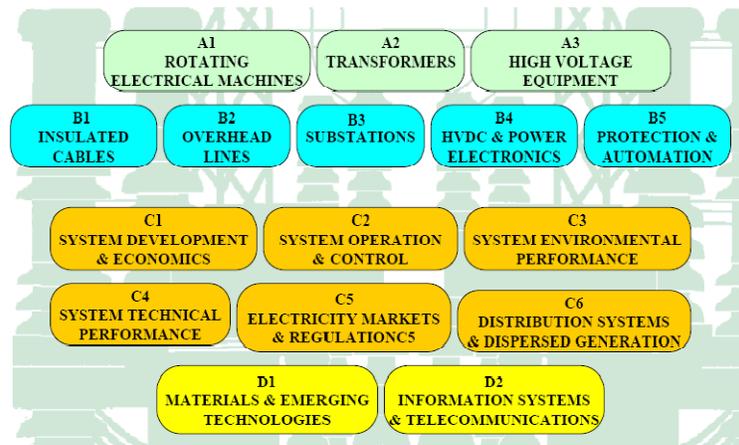


- **International Organization on Electric Power Systems, covering their technical, economic, environmental, organizational and regulatory aspects (based in France, founded in 1921).**
- **Study Committee structure**
- **Disseminate of knowledge and define the state-of-the-art**

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CIGRÉ study committees (SC)



C6 Objectives

- Develop new (for CIGRE) knowledge in the field of Distribution System and Dispersed Generation
- Identify the needs of SC Target Groups
- Develop technical analysis on the impact of DG to support National Bodies in developing policies
- Identify new SC members
- Promote the name of the SC in non-traditional (for CIGRE) areas, e.g. distribution
- Establish links with other bodies active in the field of the SC



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C6.11 Scope

- Provide a shared definition of active networks;
- Assess the actual status of implementation of active networks worldwide;
- Assess the network and generators requirements for the integration of DER (islanding criteria, black start capability and ancillary services);
- Identify the enabling technologies;
- Identify limits/barriers (infrastructure requirements, DG control, technology, economic, contractual / regulatory)

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C6.11 Achievements

- Preparation of a survey on active distribution networks
 - Define *Active distribution network* concept and main features
 - Review actual status of implementation and barriers
 - Review actual operational rules for DG
- Definition of 5 sub-WG and review of questionnaire responses
- Presentation of results from 5 WGs at Aug. 2008 meeting
- Published survey result in Electra and at CIRED

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Active Distribution Network Definition

Revised Definition

Active networks are distribution networks with the possibility of **controlling** a combination of **Distributed Energy Resources** (generators, loads, and storage). The DSO has the possibility to manage electricity flows using a **flexible network topology**. DERs take some degree of responsibility for system support, which will depend on a **suitable regulatory environment and connection agreements**.

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Strengths / Weaknesses / Opportunities / Threats

- Strengths:
 - Economic alternative to network reinforcement
 - Increased operational reliability, including power delivery
 - Electrical loss reduction
 - Automation and control leading to improved network access for DG / load customers

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Strengths / Weaknesses / Opportunities / Threats

- Weaknesses:
 - Maintenance issues
 - Present lack of experience
 - Distribution System Operators are not incentivised to take risks
 - Existing communications infrastructure
 - When islanded, weak grid complicates operation of system

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Strengths / Weaknesses / Opportunities / Threats

- Opportunities:
 - Ageing assets could be replaced with active management capable equipment
 - Development and implementation of smart metering technologies
 - Development of communications infrastructure
 - Movement towards a low-carbon economy through the accommodation of distributed renewable energy sources

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Strengths / Weaknesses / Opportunities / Threats

- Threats:
 - Regulatory issues impede the development of active distribution networks
 - DG continues to grow in size and is connected to the transmission network
 - Security of information on the communication infrastructure
 - Active networks are not compatible with existing distribution system infrastructure

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Main features of ADN

Infrastructure Needs / Specifications	Applications	Driver/Benefit
<ul style="list-style-type: none">• Protection• Communication• Integration into existing systems• Flexible network topology	<ul style="list-style-type: none">• Power flow congestion management• Data collection and management• Voltage management• DG and load control• Fast reconfiguration	<ul style="list-style-type: none">• Improved reliability• Increased asset utilization• Improved access for DG• Alternative to network reinforcement• Network stability

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Communication Means

Method	Wireless	Hard wired
<ul style="list-style-type: none">• Voice only (telephone to local operator)• Remote control• Connection to SCADA systems	<ul style="list-style-type: none">• Microwave• Radio, UHF radio, radio links• Satellite	<ul style="list-style-type: none">• Copper pilot table• Optical fibre• Power line carrier (PLC)• GSM• GPRS



Current Operating Practices

- Parallel to the network
- Protection and fault clearing
- Remote control
- Voltage control
- Intentional islanding



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Future Activities

- Summarize results from EPRI events:
 - IRED conference, CIRED tutorial
- Document innovative pilot projects using standard template
- Classify active distribution network applications
 - Distribution system operator benefits
 - Enabling technologies
 - Barriers or research needs
- Final technical report (August 2010)

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Sources of Information

- International events – EPRI Workshops, conferences
- EU projects - More Microgrids, ADDRESS, ADINE
- Smart Grid Demos
- Other National Programs
 - Australia, Canada, Korea, Japan

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Classifying ADN projects

General Application	Specific Application	Benefit/Driver	Demo Project Relevance		
			P1	P2	P3
Planning	Distribution upgrade deferral	Alternative to network reinforcement			■
	DG siting	Facilitate integration of DER			■
Operations	Peak Shaving	Utilization factor, deferment			■
	Voltage regulation	Losses, Integration of DER			■
	Balancing Intermittent Generation	Facilitate integration of DER			▨
Advanced Protection	Planned islanding / Microgrids	Reliability	■		
	Fast Reconfiguration	Reliability		■	
	Fault Locating Technology	Cost, Reliability	■		
	Fuse Savings	Cost			

*Note: P1 – Project 1, P2 – Project 2, P3 – Project 3

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ADN Applications and Enabling Technologies

General Application	Specific Application	DER Relevance			Enabling Technologies
		DG	DR	DS	
Planning	Distribution upgrade deferral	■	■	■	OpenDSS
	DG siting	■	■	■	
Operations	Peak Shaving	■	■	■	Monitoring, information and control, DMS, AMI
	Voltage regulation	■	■	■	Controllable VR, Cap banks
	Balancing Intermittent Generation	■	■	■	DMS, AMI
Advanced Protection	Planned islanding / Microgrids	■	■	■	DMS
	Fast Reconfiguration	■	■	■	IntelliTEAM
	Fault Locating Technology	■	■	■	AMI
	Fuse Savings	■	■	■	

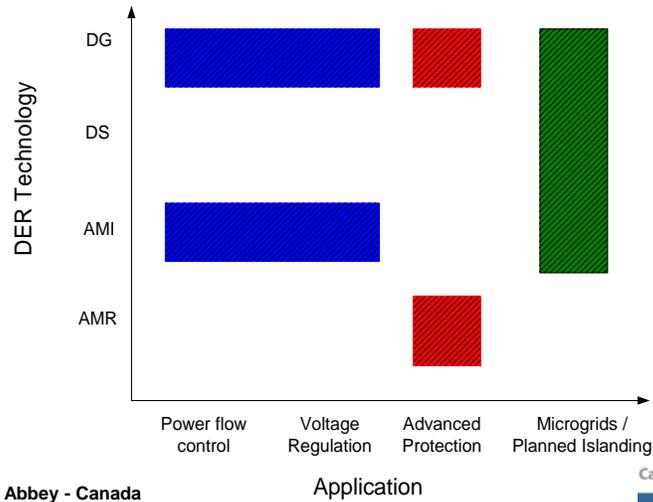
*Note: DG – Distributed Generation, DR – Demand Response, DS – Distributed Storage

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Applications Matrix Summary



Summary

- CIGRE structure and C6 SG
- C6.11 scope
- Survey results
- Future activities - map demos, categorize, identify enabling technologies
- Technical report - August 2010