



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

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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

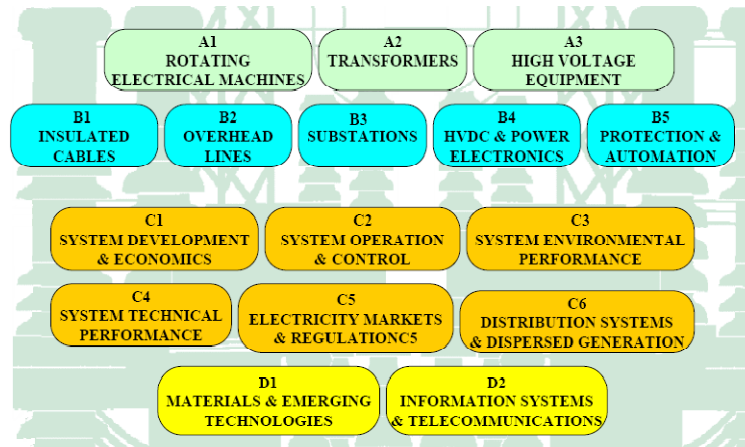


- **International Organization on Electric Power Systems, covering their technical, economic, environmental, organizational and regulatory aspects (based in France, founded in 1921).**
- **Study Committee structure**
- **Disseminate of knowledge and define the state-of-the-art**

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## CIGRÉ study committees (SC)



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## 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)

## 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

## Main features of ADN

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

## Communication Means

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

## 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

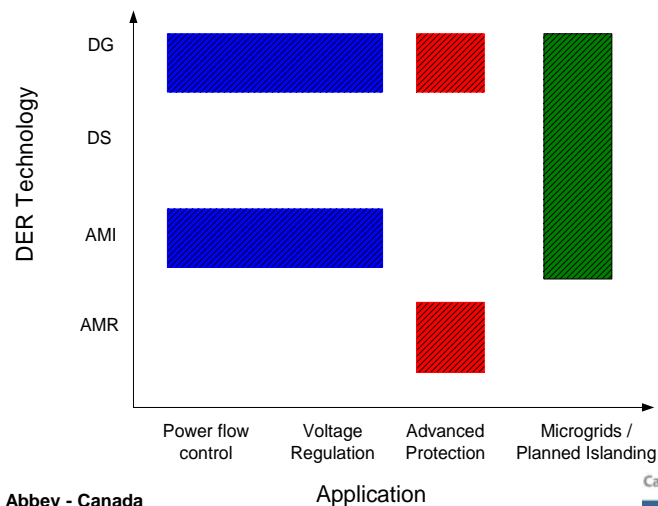
General Application	Specific Application	DER Relevance			Enabling Technologies
		DG	DR	DS	
Planning	Distribution upgrade deferral				OpenDSS
	DG siting				
Operations	Peak Shaving				Monitoring, information and control, DMS, AMI
	Voltage regulation				Controllable VR, Cap banks
	Balancing Intermittent 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