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Revision [1.1]

Project co-funded by the European Commission within the Sixth Framework Programme (2002-2006)		
Dissemination level		
PU	Public	X
PP	Restricted to other programme participants (including the Commission Services)	
RE	Restricted to a group specified by the consortium (including the Commission Services)	
CO	Confidential, only for members of the consortium (including the Commission Services)	

TABLE OF CONTENTS:

1. INTRODUCTION

This is the third newsletter of ADINE-project. The project team will publish these brief summaries in six months periods to keep interest groups updated about the proceeding. The first newsletter was published in the end of March 2008.

ADINE comes from words Active Distribution Network, which summarises the idea of the whole project. Components in electricity distribution networks should be intelligent enough to interact with each other. The network should be active and alive as an intelligent machine which has no problems in plugging in any kind of distributed generators or loads.

This third newsletter explains the steps, which has been done in the Project until the end of March 2009.

The names of the Partners in the Project are:

- Technology Centre Hermia Ltd, Finland
- Tampere University of Technology, Department of Electrical Energy Engineering, Finland
- ABB Oy Distribution Automation, Finland
- Lund University, Department of Electrical Measurements and Industrial Electrical Engineering and Automation, Sweden
- Compower AB, Sweden
- AREVA T&D Ltd, Finland
- AREVA Energietechnik GmbH, Germany

2. PROJECT GOALS AND STRUCTURE

The problem - need for the project is still the same
Considerable amount of renewable energy in Europe represents distributed generation (DG). However, the distribution networks have been designed without considering interconnection of DG. One of the main barriers to the penetration of DG at the distribution network level is the complexity of the interconnection process of DG into the network. Each planned interconnection requires accurate modelling, simulation and analysis to tackle potential problems concerning stability, protection and voltage control in the network. The main cause of complexity is the present methods for managing distribution networks as well as the features of the different DG components themselves which are not designed to enable an easy interconnection. Also customers´ expectations for extreme reliability and quality of power are increasing simultaneously with an increasing diversity of power generation methods. Therefore significant investments will be needed in the coming decades. It is now time to reconsider traditional network solutions in order to secure the efficiency, security and reliability of networks in the long run.

The solution developed in the project
ADINE develops demonstrates and validates a new method for the active management of a distribution network and the enabling solutions to support it. The solutions operate as active components in managing the network to enable an easy interconnection of different DG units. The solutions cover the protection of the network, planning and information systems, and voltage and reactive power control.

The extraordinary feature of this project is to develop and demonstrate the active network management method and the enabling solutions simultaneously. Either one alone would not solve the problem described above. When interacting with each other according to the active network management method,

the overall system operates better than it would by letting individual solutions interact randomly – which is the common practice today.

As the result ANM is increasing the security of distribution grids, improving the stability of the grid in fault situations and enhancing the optimal management of network. This adds value at European level by increasing the potential for renewable energy and by enabling more efficient management of distribution network assets for network owners.

The work flows from basic planning to demonstrations and monitoring so that best knowledge of the partners is involved in each stage. The results from the demonstrations of solutions are combined together in SP5 into one integrated simulation environment in order to demonstrate and validate ANM method.

Sub projects
SP1-Project management and dissemination
SP2-Protection of distribution network including distributed generation
SP3-Voltage control of distribution network including distributed generation
SP4-Flexible STATCOM for distribution network
SP5-Development of Active Network Management method

3. MANAGEMENT AND DISSEMINATION (SP1)

In addition to the earlier Public project review we have done issues which are explained in following sentences.

Third set of deliverables has been sent to Commission until end of September 2008.

Fourth set of deliverables has been sent to Commission until end of December 2008. One deliverable was sent later, within 45 days from the end of the December 2008.

The third face-to-face meeting has been arranged in Tampere in February 2009. In this meeting we have important conversation of essential issues, the situation in each Sub Project, Steering Committee and Implementation Committee meetings and visit to Tampere University of Technology RTDS laboratory.

After AREVA has acquired Nokian Capacitors Ltd, we have done a lot of work to get the administrative issues done concerning AREVA Energietechnik GmbH.

In every month coordinator is organizing teleconference meetings to Implementation Committee. Agendas and memos are made of these meetings. They are in ADINE portal Implementation Committee Work Room Material Folder in certain category for each teleconference meeting.

Coordinator is offering the ADINE website infrastructure for use to everyone in the Project. Mainly coordinator and every Sub Project leader are updating the content of the intranet continuously. Also other members of the Project, to whom Sub Project leaders has given the rights to the intranet and coordinator has made username and login with certain rights, they can add files and update content in the intranet pages and material folder.

After end of September 2008 representatives of consortium have taken part in

- EPRI Active Distribution Network Workshop in Nice, France, 9. December 2008
- IRED Conference in Nice, France, 10.-12. December 2008.

4. PROTECTION OF DISTRIBUTION NETWORK INCLUDING DG (SP2)

ABB Distribution Automation in Finland is leading subproject 2, which consists of four work packages related to new protection systems of the electric distribution network. The development and demonstration work is based on products or prototypes from ABB.

In Work Package 2.1 research on DG effects on network protection and protection coordination has been conducted. Deliverables 5 and 7 has been prepared and delivered to Commission

In Work Package 2.2 New protection relay applications and in Work Package 5.2 Simulation environment there has been following activities:

- Using DSpace integrated to RTDS in real-time simulations has been analyzed and it seems to be a too challenging way for relay algorithm simulation
- Real protection terminals usage in RTDS simulation has been planned. In addition to real-time simulations RTDS recorded signal can be used in playback simulations.
- Several ABB's internal meetings and meetings with TUT have been arranged
- Deliverables 6 and 15 has been prepared and delivered to Commission

In Work Package 2.3 New fault location solutions in distribution network there has been following activities:

- Field tests with real faults have been done (in Pori Wind park)
- Research on DG effects on relay operation
- Real time simulations in TUT RTDS laboratory for testing existing impedance based fault location algorithm
- Deliverable 14 and 21 has been prepared

In Work Package 2.4 New protection planning methods there has been following main activities:

- Specification work have been done mainly by TUT as planned
- The implementation environment at TUT has been prepared
- Deliverables 7 and 9 have been prepared

For more information contact Mr Matti Kärenlampi, first.last@fi.abb.com

5. VOLTAGE CONTROL OF DISTRIBUTION NETWORKS INCLUDING DG (SP3)

University of Lund in Sweden is leading subproject 3 dealing with new voltage control solutions.

In Work Package 3.1 Voltage control of the DG unit, the following activities have taken place:

- The microturbine prototype has been installed at the field test site in Kristianstad.
- Deliverable 16 on information on microturbine simulation model has been submitted
- The simulation model of microturbine with voltage control and the MV/LV networks is ready
- Matlab simulations of microturbine with voltage control have started
- Hardware of the laboratory prototype of network interface with voltage control is almost ready
- Programming of the laboratory prototype has started

Work Packages 3.2 Defining coordinated voltage control is finished after the following activities:

- The simulation network based on the test site has been defined (Deliverable 12)
- The co-ordinated voltage control algorithm has been specified (Deliverable 17)

In Work Package 3.3 Demonstrating coordinated voltage control a number of actions have been taken:

- The field test network has been selected
- Voltage control in the network at present has been analyzed (Deliverable 10)
- The co-ordinated voltage control simulation model has been developed (Deliverable 22)
- Co-ordinated voltage control has been simulated in PSCAD [1], [2] and in RTDS

For more information on these issues contact Ass. Prof. Olof Samuelsson, first.last@iea.lth.se.

6. FLEXIBLE STATCOM FOR DISTRIBUTION NETWORK (SP4)

AREVA Energietechnik GmbH in Germany is leading subproject 4 with the focus on studying and demonstrating the intelligent solutions required for compatibility of new generation STATCOM converter with ANM method.

In Work Package 4.1 Development of new features of STATCOM have been done following main issues:

- A new space vector based PWM control method for three-level voltage source converter has been developed and tested in the laboratory. With this new method the dynamic power losses of the semiconductor valves (IGBT) could be reduced significantly. In the same time the quality of the output current and the dynamic response of the system could be improved.

- The internal (STATCOM) and external (load, network, DG) measurements were defined

- Macro-models for non-real-time and real-time simulations were developed.

- Non-real time simulations were performed. The deliverable Deliverable 13 has been prepared.

- The hardware and basic software for a prototype of a STATCOM control system was developed. The control system consists of a so called STATCOM Control Unit and a Master Control Unit. (Refer to deliverable Deliverable 25)
  After considerably testing in the laboratory, some minor issues could be identified. Within a second design step, the STATCOM control system is to be optimized.

- An initial real-time simulation of the STATCOM control system in combination with a PSCAD model was performed on a RTDS system. The general functionality of both STATCOM controller and real-time simulation model could be verified. The test results are described in Deliverable 23.

- A general structure for the communication between the STATCOM control unit and the Human-to Machine Interface (HMI) has been designed. This work package is not yet finished.

- The definition of the communication and remote surveillance which are compatible to ANM is not yet done.

In Work Package 4.2 Demonstrating the operation of new features of STATCOM has been done following main issues:

- The internal (STATCOM) and external (load, network, DG) measurements which were defined in WP4.1 have been verified and validated.

- The test procedure for the STATCOM control unit was specified and verified within laboratory tests. The report Deliverable 24 describes the test procedure in detail.

- Real-time RTDS/dSPACE performance testing simulations with control system has not yet started.

- Negotiations with potential subcontractors for the converter detail design and manufacturing are ongoing.

- Testing of HMI is not yet started.

- Designing the mechanical construction of the real-life-demonstration device is not yet started.

- Evaluating the potential test sites and defining the test site is in progress.

- Planning and execution of the factory tests is not yet started.

- Comparing factory test results with simulation results is not yet started.

- Supervision of the manufacturing the real-life demonstration device is not yet started.

- Planning, engineering, site assembling and running the real-life demonstration is not yet started.

- Study the performance of the real-life demonstration and analyzing the results is not yet started.

For more information contact Mr Ralf Jessler, first.last@areva-td.com.

7. DEVELOPMENT OF ACTIVE NETWORK MANAGEMENT METHOD (SP5)

Tampere University of Technology, Department of Electrical Energy Engineering is leading the subproject 5, where Active Network Management method is developed and demonstrated.

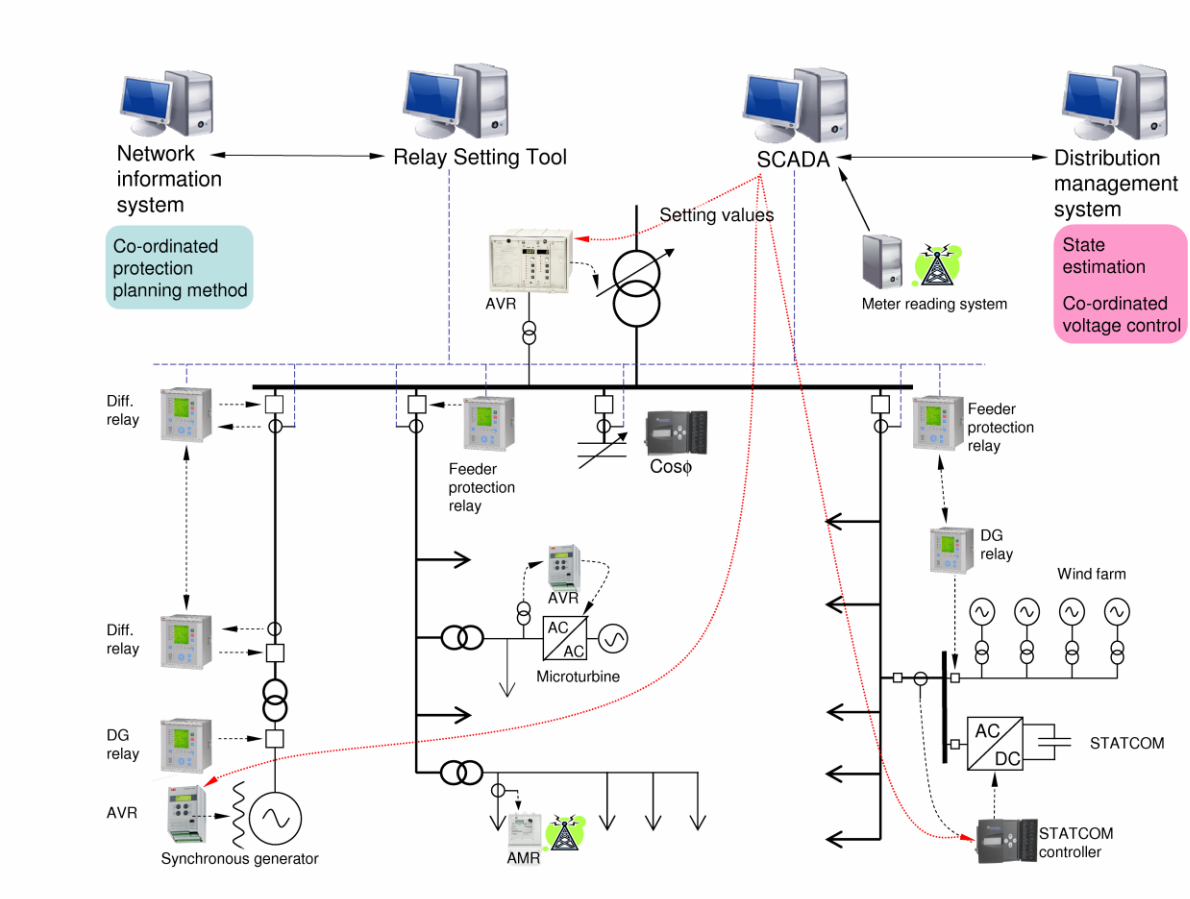

Figure 1. Overview of ANM method.

In the Work Package 5.1 Developing the integrated simulation environment have been done following main issues:

- The real-time digital simulators for power system (RTDS) and the real-time digital simulator for control systems (dSPACE) are integrated through analog interface [3].
- The real time simulation environment includes also
    - SCADA, DMS and relay setting software. These are integrated to real-time simulation environment via protection relay communication and OPC interface.
    - Protection relays:
        - Feeder protection relay (ABB REF 615)
        - Line differential relays (ABB RED 615)
        - Fault location application (ABB REF 543)
        - Loss-of-mains protection (ABB REF 543)
    - Protection relay communication:
        - SPA to REF 543
        - IEC 61850 over LAN to REF 615 and RED 615
        - Binary signal transfer over fiber optic between RED 615
- Modeled devices in dSPACE

  - General full converter wind turbine including the fault ride-through capability [3]
  - Three-level STATCOM [4]
  - Series compensator
- A model of distribution network of field test site Koillis-Satakunnan Sähkö has been implemented in RTDS.

In the Work Package 5.2 Developing and verifying of ANM method has been done following main issues:

- The initial definition of ANM method has been published.
- The interaction studies going to be simulated in real-time simulation environment in order to test ANM method and devices have been defined
  - Influence of DG on feeder protection schemes
  - Co-ordination of feeder and loss-of-mains protection
  - Protection impacts on fault ride through of DG unit
  - Interactions of voltage control
  - Voltage dip and flicker mitigation of STATCOM
- First interaction studies have been performed in RTDS simulation environment.

For more information contact Dr. Tech. Sami Repo, first.last@tut.fi, Dr. Tech. Kari Mäki, first.last@tut.fi or professor Pertti Järventausta, first.last@tut.fi.

8. DISSEMINATION OF THE RESULTS

ADINE wants to show that distribution networks could be managed in a more intelligent way than at present. Intention is to tell about the findings and results as early as possible to let other specialists in the field to contribute and refine ideas further. We try to gain attention in two arenas:

- Research groups working in the same field around Europe
- Distribution network owners and operators around Europe

At least following interfaces are arranged to allow easy information flow in and out of the project:

- www.adine.fi – project public web pages including all public materials at any time in any location
- Project mailing list, which anyone can join from www.adine.fi. We will send short alerts about public deliveries, workshops etc. to this list.
- Presentations in conferences and seminars
- Project workshops in Portugal, Spain and UK. First round of workshops for DSOs in these countries have been arranged between May and September 2008. The focus is in introducing the new ideas to real operators letting them to contribute and give feedback. Later on, when the demonstration results are in hands, we will gather same persons together to discuss how the results should be adopted to the market.

We encourage you all to contact ADINE team members to discuss about new ideas!

9. REFERENCES

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[2] A. Kulmala, S. Repo and P. Järventausta, Increasing penetration of distributed generation in existing distribution networks using coordinated voltage control, accepted for publication in International Journal of Distributed Energy Resources, 2009.
[3] A. Mäkinen and H. Tuusa, Wind Turbine and Grid Interaction Studies Using Integrated Real-Time Simulation Environment, Proceedings of Nordic Workshop on Power and Industrial Electronics (NORPIE) conference, Espoo, Finland, 9-11 June 2008.
[4] P. Lauttamus and H. Tuusa, Simulated electric arc furnace voltage flicker mitigation with 3-level current-controlled STATCOM, Proceedings of Twenty-Third Annual IEEE Applied Power Electronics Conference and Exposition, 2008.
[5] S. Repo, K. Mäki, P. Järventausta and O. Samuelsson, ADINE - EU demonstration project of active distribution network, Proceedings of Nordic Electricity Distribution and Asset Management Conference, Bergen, Norway, 8-9 September 2008.