ENARD:- INTERNATIONAL COLLABORATION IN ELECTRICITY NETWORKS R&D

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ABSTRACT

The paper describes the activities of ENARD, the IEA Implementing Agreement on Electricity Networks Analysis, Research and Development. The establishment of ENARD as an authoritative source of information and advice on electricity network issues is noted. ENARD's essential role in providing expert input and advice to the IEA Secretariat is described, in relation to the latter's policy considerations concerning electricity T&D networks

INTRODUCTION

The International Energy Agency (IEA) acts as energy policy advisor to its twenty seven OECD and associated member countries in Australasia, Europe and North America. Energy technology collaboration is pursued via a framework of more than forty "Implementing Agreements", which enable experts from different countries to optimise R&D investment by working jointly on RD&D and information collation and dissemination [1].

The crucial role of electricity transmission and distribution (T&D) networks in the delivery of energy policy objectives was recognized via the establishment of ENARD, as the IEA Implementing Agreement on Electricity Networks Analysis, Research & Development, July 2006. A CIRED 2007 paper reported on ENARD's initial programme-of-work [2]; the present paper describes the significant further development of ENARD in the period to date.

ENARD

ENARD's vision is to facilitate the uptake of new operating procedures, architectures, methodologies and technologies in electricity T&D networks, such as to enhance their overall performance in relation to the developing challenges of network renewal, renewables integration and network resilience. As such, ENARD provides a major international forum for information exchange, research, analysis and collaborative research and development across a range of electricity transmission and distribution system issues.

A key objective of the Implementing Agreement is to create an intensified level of awareness amongst policy makers and decision makers of the importance of electricity networks in meeting energy policy objectives, the challenges to be addressed and the work in-hand, on a truly international basis, to address these.

Organisational and Management Structure

Overall management responsibility for the Implementing Agreement is vested in an Executive Committee (ExCo), comprising representatives from each of the participating countries. The ExCo is responsible for overseeing the work within individual operational Annexes and for the ongoing strategic development of the Implementing Agreement. The ExCo works within the terms of a 5 year Strategic Plan and is also responsible for approving a Programme-of-Work, on a rolling annual basis [3,4]. A dedicated Secretariat supports the ExCo in the discharge of its duties. The ExCo reports upwards within the IEA's management structure, via the End Use Working Party (EUWP), to the Committee on Energy Research and Technology (CERT). The latter two bodies helping to co-ordinate the activities of individual Implementing Agreements and, ultimately, via the IEA Secretariat, provide high level policy advice to OECD member countries and to the G8 [5].

ENARD was developed from the outset with the organizational and operational structure of a multiple Annex Implementing Agreement, figure 1.

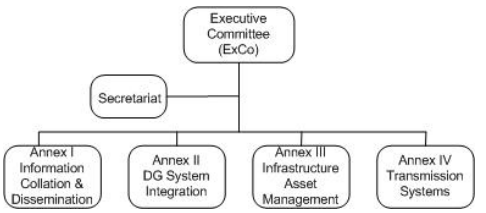

Figure 1: Organisational & Management Structure

To date, ENARD has succeeded in establishing the bases for a further three Annexes, over and above Annex I, which represents the original and ongoing Annex on Information Collation and Dissemination. The three further Annexes are:-

Annex II: "DG System Integration"
Annex III : "Infrastructure Asset Management"
Annex IV : "Transmission Systems"

Membership and Participation

Membership of the Implementing Agreement is on a national basis. Each participating country is represented on the ExCo by a Delegate and/or Alternate, and with one voting right per participating country. As at January 2009, thirteen countries are members of ENARD, namely Austria, Belgium, Denmark, Finland, Italy, Netherlands, Norway, Spain, Sweden,

Switzerland, UK and USA, and with France having just joined the Agreement at time of writing.

All ENARD participating countries participate in Annex I and also support the ENARD Secretariat. Thereafter, participation in the subsequent Annexes is entirely at the discretion of the participating countries, with the various operational Annexes having their own discrete make-up of participants. Individual countries designate specific entities, or "National Experts" to participate in the individual operational Annexes.

ANNEX I (INFORMATION COLLATION AND DISSEMINATION)

Annex I serves as the central information exchange forum and with all member countries participating. It also crucially serves as the definition Annex for the development of the associated series of follow-on R&D Annexes.

Responsibility for the delivery of the Annex I work programme is vested in the Annex I Operating Agent (EA Technology, UK), who works in close collaboration with the series of Annex I National Co-ordinators, as designated by the participating countries. The principal Annex I activities to date have comprised the collation and dissemination of T&D related information and data, the organization and delivery of a series of topical workshops, the provision of support to the definition and development of the small series of follow-on Annexes and a general programme of representation and outreach activities

Information Collation and Dissemination

Information collation and dissemination represents one of the core activities of Annex I. A major activity over the first two years of the Implementing Agreement has involved the compilation of an authoritative digest of T&D developments, for the benefit of Annex I and the ExCo, and the complementary publication of a series of topical briefing sheets and workshop profiles.

Annex I Workshops and Annex Development

The organization and delivery of a series of topical workshops represents a second integral component of Annex I. Six such workshops have been organized and delivered to date, namely:-

- Distribution systems and end-user issues;
- Distributed Generation (DG) system integration;
- Management of ageing infrastructures (jointly with CIRED 2007);
- Economic and regulatory issues;
- Transmission System issues; and
- Intelligent distribution networks, micro-grids and active network management.

The outcomes from these workshops have represented a key consideration in guiding the development of the series of follow-on Annexes initiated to date.

Representation and Outreach

Representation and outreach activities have represented and continue to represent a further important and integral component of the Annex I workplan, consistent with ENARD's strategic objective to engage with and provide authoritative, comprehensive and unbiased international information, data and advice to its four key stakeholder communities, namely:-

- Governments;
- Policy makers
- Electricity T&D companies;and
- Power engineering equipment suppliers.

Annex I has effectively represented ENARD at various IEA, governmental and industry forums. It has also maintained responsibility for the ENARD web-site, at www.iea-enard.org , which serves as the principal public domain dissemination medium for the Implementing Agreement.

ANNEX II (DG SYSTEM INTEGRATION)

The development of Annex II followed on from the previously referenced Annex I workshop on the same subject. A major consideration in its formulation was to address the challenges associated with accommodating a very significant penetration of Distributed Energy Resources (DER) as Distributed Generation and, in particular, in facilitating the transition from today's passive distribution networks into the active distribution networks of tomorrow, figure 2.

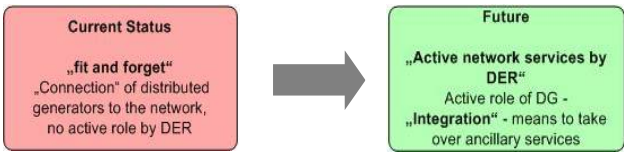

Figure 2: Underlying Rationale for Annex II

Aim and Objectives

The scope of Annex II is to address DG system integration into low and medium voltage networks including technical, economical, organizational and regulatory aspects. Annex II aims to:-

- Build up and exchange knowledge on DG system integration and existing approaches to active network management;
- Promote the possibilities for the implementation of active distribution networks; and
- Develop an authoritative set of guidelines to facilitate the transition from today's passive distribution networks to the active distribution networks that will be increasingly required in the future.

Organisation & Timescales

Arsenal Research, Austria, is the Operating Agent (OA) for Annex II and is responsible for the overall technical and administrative management of the work programme. The work programme itself is structured on three levels: the Annex, Tasks and Activities. The OA works in conjunction with a network of Task Leaders and Activity Leaders, in order to discharge the work programme.

Annex II commenced work May 2008 with a detailed task planning and coordination workshop. The Analysis/Evaluation Phase itself will take 24 months. Following the successful completion of the analysis/evaluation phase, an Annex review will take place, with a view to the development of a further (optional) extension phase.

Work Programme

In Annex II three DER system integration tasks have been launched:

- Task 1: Aspects for Activation of Distribution Networks
- Task 2: Operation and Control of Active Distribution Networks
- Task 3: Cross Cutting Issues, Interrelation and Dissemination

The aim of Task 1 is to review national active network related definitions as well as to review, analyse and document existing architectures and planning methodology of active distribution networks in the participating countries including barriers and models.

Task 2 reviews, analyses and documents technical and economical operation and control approaches of existing active networks and defines technical and economical operation and control requirements and recommendations. DG related regulatory issues and organisational barriers are also in focus of Task 2.

Finally Task 3 deals with interrelation and dissemination. Workshops, conferences, online support tools for information exchange and dissemination are to be arranged.

ANNEX III (INFRASTRUCTURE ASSET MANAGEMENT)

Aim and Objectives

Annex III addresses the challenges associated with the management of increasingly ageing T&D asset bases within the participating countries and beyond, via the exchange of information and data in relation to the ageing, degradation, failure and end-of-life characteristics of the asset base and the complementary development of new asset management techniques and methodologies.

Phase 1 of the project focuses on the distribution asset base. The objectives of Phase 1 are to:

- Develop an authoritative, substantive and robust international information base in relation to the ageing, degradation, failure and end of life characteristics of the principal asset categories within the distribution asset base;
- Develop a detailed understanding of risk based definitions and methodologies;
- Source, collate and systematically analyse relevant case study information, providing practical examples of the use of asset information in condition or risk based asset management decision making;
- Cross reference this information and data with that available in relation to the transmission system asset base and to elicit similarities and differences; and
- Distil the above into a comprehensive information base and digest, for use and application within the participating countries.

Organisation and Timescales

EA Technology is the Operating Agent for Annex III. At the time of writing there are five countries participating in Annex III (Finland, Italy, Norway, Sweden and United Kingdom), although a further country is expected to join the Annex shortly.

The work of Annex III is conducted in accordance with the five Tasks agreed by the ExCo, viz:

- Task 1: Definition and Categorization of Principal Distribution Asset Groups.
- Task 2: Collation of Distribution Network Operator Experience.
- Task 3: Review of Existing and Proposed Methods of Quantifying Asset Related Risk.
- Task 4: Assessment of Distribution Asset Management Case Study Material.
- Task 5: Consolidation of Information from Tasks 2, 3 and 4.

Annex III Phase 1 commenced work in April 2008 and the work is due to conclude by 31 December 2009.

Work Programme

To address Task 1, the participants of Annex III agreed that the project should focus on distribution assets in the voltage range 6kV-45kV, on the basis that there has been little work done to date on assets in this range in terms of comparing the asset management practices of different countries. The participants identified five Asset Groups that should be reported on, viz:

- Transformers
- Cables
- Overhead Lines (including aerial bundled conductor, ABC)
- Switchgear
- Protection and Control

To address Tasks 2 and 3, the Operating Agent is gathering information from each participant on each of the Asset Groups in their own country. From this information the

Operating Agent produces an overarching report with commentary on the areas of commonality and differences, drawing attention to the various influencing factors and the direction of best practice.
To address Task 4, the Operating Agent is gathering information from participants and from experiences worldwide.

ANNEX IV (TRANSMISSION SYSTEMS)

Annex IV was formally adopted by the ENARD ExCo, September 2008, with the aim to establish a long term vision for developments in transmission systems beyond 2020. Annex IV will address the main barriers towards the necessary development of transmission capacity and will identify the most promising solutions related to the various operational, planning, technological, and market aspects, including the need for development and application of new methods and tools. Finally the Annex is expected to address the specific R&D activities needed as a result of the vision.

Work Programme

The Annex will take an overall system view, considering transmission in the overall system context and as a key enabler in allowing operation of generation in a well functioning power market. The work will be organised in two main activities, viz:-

- Expansion Planning and Market analysis
- System Operation Management and Security

The main goal of the first activity is to assess available methods and tools for transmission expansion planning, and to identify the need for new tools that integrate market modelling, network analysis and security assessment, also including the possible contribution of promising transmission technologies.

The aim of the second activity is to assess available methods and tools for operational monitoring and control, and in particular to identify the need for new tools and methods to manage future challenges in balancing control also accounting for the potential of transmission technologies.

The responsibility for the Annex IV Operating Agency will be shared equally between SINTEF Energy Research and CESI RICERCA, with the Annex itself to be implemented over a two-year period, starting early 2009.

CURRENT STATUS AND FUTURE ACTIVITIES

At time of writing, ENARD is some 2½ years into its present 5 year Term. In this time, it has developed considerably, with the membership base increasing from 8 to 13 participating countries and with it initiating three follow-on (R&D) Annexes, each addressing highly topical and relevant subject areas. The Implementing Agreement has also become recognised as an authoritative source of information and advice on electricity T&D network issues and, as such, is an active participant in associated IEA and other activities in this area.

Over the next 2½ years, ENARD will continue to develop its activities and work programmes, including the ongoing delivery of the individual Annex work programmes, the organisation and delivery of selected further topical Annex I workshops and, significantly, in contributing expert input and advice to the IEA Secretariat, in relation to the latter's policy considerations concerning electricity T&D networks.

ACKNOWLEDGEMENT

The support of the ENARD ExCo is acknowledged in the preparation of this paper. ENARD functions within a framework created by the International Energy Agency. The views, findings and publications of ENARD do not necessarily represent the views or policies of the IEA Secretariat or of all its individual member countries.

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