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International Energy Agency

Implementing Agreement

on

ELECTRICITY NETWORKS ANALYSIS, RESEARCH AND DEVELOPMENT (ENARD)

PROGRAMME OF WORK

August 2011 – February 2012

prepared
by

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1. Introduction

The present document describes the Programme-of-Work (PoW) for the final seven months of the initial Term of the IEA Implementing Agreement on Electricity Networks Analysis, Research and Development (ENARD), covering the period 25th July 2011 to 29th February 2012[1]. The PoW describes the specific activities that will be undertaken within ENARD during this seven month period, their anticipated outcomes and deliverables. The PoW also provides an indication of the work in relation to request a Renewal-of-Term from the CERT (Committee on Energy Research and Technology), together with that associated with the development of a dialogue with ISGAN, the International Smart Grids Action Network Implementing Agreement. The PoW should be read in conjunction with the ENARD's Strategic Plan[2], which describes the vision and mission of the Implementing Agreement, its aim and objectives, operating structure, results and information protection and benefits, over the present Term, 2006 to 2011, and as now extended to February 2012. The PoW contained herein was formally adopted by the 10th ENARD Executive Committee (ExCo) Meeting, held Phoenix, AZ, 24th-25th March 2011.

2. Aim and Objectives

ENARD's aim is to develop as an authoritative, comprehensive and unbiased international source of information, data and advice, such as to inform Governmental officials, policymakers and key industry stakeholders of the pertinent issues relating to current and anticipated developments in electricity Transmission and Distribution (T&D) networks. The development of ENARD will also contribute to fulfilment of the objectives of the IEA's G8 Gleneagles Programme.

The objectives for the present PoW will be coincidental with those stated in the Strategic Plan, viz:-

- the collation, exchange and promulgation of information and data in relation to current and anticipated electricity T&D developments within the participating countries and associated programme activities;

- the in-depth review and analysis of the associated key research and development (R&D), design, operational and management issues in relation to electricity transmission networks;

- the complementary in-depth review and analysis of a range of key issues relating to the R&D, design, operation and management of electricity distribution networks; and

- the in-depth review and analysis of prevalent and anticipated regulatory frameworks and their associated impact on the economic evaluation and optimisation of network asset portfolios.

Particular features of the activities in the period covered by the present PoW will include the definition of the basis for a possible Annex V on "Knowledge Exchange of International Demonstration Projects", the ongoing development of the basis for a

[1] A seven month extension of ENARD's initial 5 year Term, from July 2011 to February 2012, was approved by the CERT, November 2010.
[2] IEA Implementing Agreement on Electricity Networks Analysis, Research and Development (ENARD). Strategic Plan, October 2006 to September 2011 and as extended to February 2012. Issue 2, April 2011.

proposed follow-on (5 year) Term, as to be submitted to the CERT and the development of a complementary dialogue with the International Smart Grids Action Network Implementing Agreement (ISGAN).

3. Organisational and Management Structure

ENARD will be executed and delivered as an Implementing Agreement within the IEA's Energy Technology and R&D framework. In particular, it will be enacted by an organisational and management structure comprising:-

- An Executive Committee (ExCo), comprising Delegates from all the participating countries ("the participants"). The ExCo will be responsible for the ongoing development of an operational roadmap for ENARD, the identification, prioritisation and selection of particular work areas for analysis and review, the periodic review of the operational Annexes and the associated upward reporting to the End Use Working Party (EUWP) and the Committee on Energy Research and Technology (CERT). The ExCo Delegates will reflect and service the overall core objectives of ENARD.

- The ENARD Secretariat will support and facilitate the ExCo in the discharge of its duties.

- A series of specific operational Annexes, each with its own Operating Agent, to discharge the PoW in particular areas. Various sub-sets of the ENARD participant base will participate in one or more of the operational Annexes.

Figure 3.1 illustrates ENARD's organisational and management structure. Activities within the period covered by this PoW will principally relate to the ongoing delivery of the Annex I (Information Collation and Dissemination) work programme, the dissemination of the outputs from Annex II (DG System Integration) on a series of national bases, the ongoing development of Annex III (Infrastructure Asset Management), the dissemination of the outputs from Annex IV, on Transmission Systems, and the development of the basis for Annex V, on Knowledge Exchange on International Demonstration Projects. The Annex I work programme will also include the requisite activities in relation to the development of the formal request to the CERT, for ENARD's proposed follow-on (5 year) Term and/or those necessary actions, as required to formalise any developing relationship with ISGAN.

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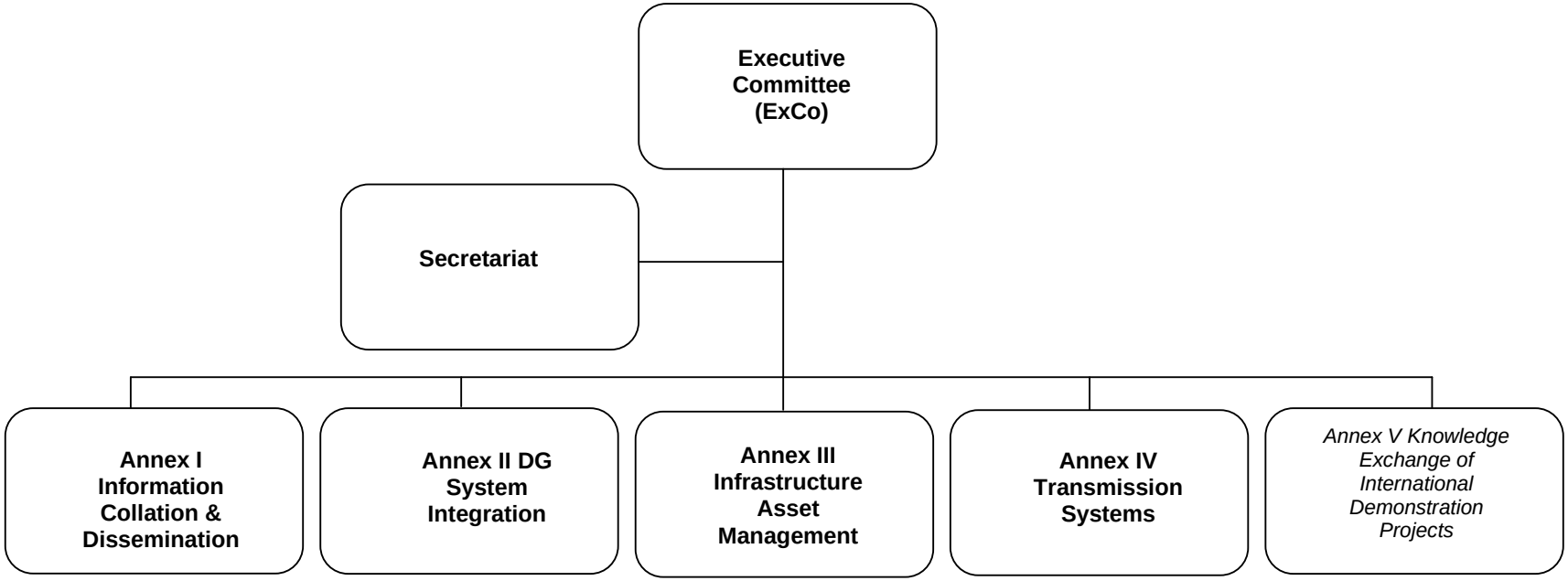

Figure 3.1:- Organisational and Management Structure

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4. Programme of Work

The present PoW will address the ongoing delivery of the Annex I (Information Collation and Dissemination) work programme, the dissemination of the outputs from Annex II (DG System Integration) on a series of national bases, the ongoing development of Annex III (Infrastructure Asset Management), the dissemination of the outputs from Annex IV, on Transmission Systems, and the development of the basis for Annex V, on Knowledge Exchange on International Demonstration Projects. The Annex I work programme will also include the requisite activities in relation to the development of the formal request to the CERT, for ENARD's proposed follow-on (5 year) Term and/or those necessary actions, as required to formalise any developing relationship with ISGAN.

The anticipated scheduling of these activities is as shown in the Gantt chart below, figure 4.1.

	Year		
	2011		2012
ExCo meeting		*	
Annex I			
Annex II			
Annex III			
Annex IV			
Annex V			

Figure 4.1:- Programme of Work, August 2011 to February 2012

All countries participating in ENARD will participate in Annex I, with sub-sets of the overall ENARD participant base having the option to participate in Annexes II, III, IV and any further Annexes, as may be developed.

4.1 Annex I: Information Collation and Dissemination

Scope

The central focus of Annex I in the seven months covered by the present PoW will relate to:-

- The organisation and delivery of a definition Workshop for the proposed Annex V "Knowledge Exchange of International Demonstration Projects", working in collaboration with Agentschap NL, the Netherlands proposer of Annex V;
- The documentation of the above;
- Working in collaboration with Agentschap NL, the development of a refined text for Annex V, suitable for consideration by the ExCo;
- Supporting the ENARD Chair, 2 x vice-Chairs and the full ExCo, in the development of the dialogue with ISGAN;
- Supporting the ENARD Renewal-of-Term process;
- the facilitation and promotion of the Implementing Agreement as a whole; and
- the ongoing maintenance and development of the ENARD web-site.

Annex V Definition Workshop, October/November 2011

The Annex I OA will work with Agentschap NL, in the organisation and delivery of a definition Workshop for Annex V. It is anticipated that this will be held immediately prior to the 11th ExCo Meeting, October/November 2011, either in the Netherlands or another European venue.

Development of Dialogue with ISGAN

Annex I will work such as to support the ENARD Chair, 2 x vice-Chairs and the full ExCo in the development of dialogue with ISGAN, the new International Smart Grids Action Network Implementing Agreement. It is the intent that such dialogue will support the ENARD ExCo's preferred medium/longer term alignment of ENARD with ISGAN, over a defined timescale, such as to allow for the assimilation of ENARD's work programme into ISGAN and the continuation of ISGAN, as a single Implementing Agreement, thereafter. Provision is made here for a range of activities and measures, including:-

- Facilitation of the work of the series of ENARD Working Groups (WGs), as established at the 10th ENARD ExCo Meeting, in support of ENARD's proposed alignment with ISGAN;

- preparation of appropriate material and information packs, for presentation to ISGAN Secretariat;

- support for and/or direct participation in ENARD specific element associated with ISGAN's inaugural ExCo Meeting;

- full engagement and involvement of ISGAN Secretariat, in ENARD Annex V Definition Workshop

- engagement with ISGAN Secretariat such as to address:
    - presentation of ENARD key highlights and achievements, in the 5 years to date;
    - presentation of ENARD current developments, including planning in relation to Renewal-of-Term and for Annex V;
    - development of future working relationships, in support of the ENARD ExCo's preferred alignment with ISGAN, as its preferred medium/longer term objective;
    - receipt of detailed briefings and information from the ISGAN Secretariat;
    - exploration of possibilities for further joint meeting(s) and/or Workshop(s);

- response, as appropriate to specific requests for further information from ISGAN Secretariat;

- facilitation of mutual understanding in relation to ENARD and ISGAN;

- facilitation of conference call and email dialogue between ENARD and ISGAN;

- preparation and despatch of such more formal correspondence, as may be required between ENARD and ISGAN; and

- receipt and onward communication of appropriate communications from ISGAN.

Renewal-of-Term

Annex I will work to service the requirements of the ExCo in relation to the preparation, facilitation, communication and presentation of the requisite documentation, such as to progress the formal request to the CERT for a renewal of ENARD's present Term. It is anticipated that this will involve the following specific activities:-

- The refinement of the draft End-of-Term report and Strategic Plan for a proposed follow-on Term of the Implementing Agreement;
- The completion and refinement of the appropriate CERT Self Evaluation Proforma for Implementing Agreements;
- Liaison with the IEA Secretariat, the End Use Working Party (EUWP) and the Committee on Energy Research and Technology (CERT), with the objective of facilitating the progress of a formal request for the Renewal-of-Term, via the EUWP and CERT.

The ongoing completion and discharge of these activities is anticipated to provide the necessary basis for the continuation of ENARD via a second Term.

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Web Site and Dissemination Activities

Annex I will be continue to be responsible for the development and maintenance of the fully functional ENARD web-site (www.iea-enard.org). This will continue to service the requirements of the Implementing Agreement as a whole and will serve as the principal dissemination mechanism for ENARD, both within the participant base and Annex structure and on a wider open access basis. The former is and will continue to be satisfied via a series of restricted access arrangements, catering for the requirements of the ExCo, Secretariat, Annexes I, II and III and IV and any other operational Annexes, as appropriate[3]. The public access area of the web site will continue to provide overview descriptions of ENARD, its activities and Annexes, topical briefing sheets and workshop profiles, links to publicly available reports and will generally serve as a marketing tool for the Implementing Agreement.

Dissemination activities will be essentially two fold, viz:

- the exchange of confidential information and data, within Annex I and other operational Annexes, limited to the individual Annex participants themselves;

and

- the provision of top level overview reports and outputs, not containing any sensitive information or data and suitable for publication in the public domain.

The subject of information exchange and confidentiality is discussed in more detail in section 5.

Operating Agent's Responsibilities

The Annex I Operating Agent will continue to be responsible for the overall management and delivery of its work programme and will work closely with the individual National Co-ordinators, such as to ensure the effective and expedient delivery of its objectives. It will continue to discharge its duties via the organisation and delivery of any further Meetings, as may be decided by the ExCo and via the specific further activities, as described below. The Operating Agent will submit its regular Annual report to the ExCo, ahead of the 11th ExCo Meeting, to be held October/November 2011. The Operating Agent will implement the decisions of the ExCo.

The Operating Agent will source and collate appropriate information and data, as may be required by the ExCo for the preparation of any further specific special purpose reports and/or fact sheets. The Annex I Operating Agent will liaise with and accommodate the complementary activities of other international T&D programme activities and initiatives, including those of IEA, CIRED, CIGRE the European Commission, Eurelectric and IEEE. Appendix 1 provides a summary of complementary developments and initiatives, which are likely to be of particular interest in the present context; the participants in the Annex are also invited to propose linkages with further complementary initiatives, as appropriate. The Operating Agent will facilitate introductions and exchanges of information with these complementary initiatives on behalf of the other operational Annexes, as appropriate.

[3] Noting that such other operational Annexes will be responsible for funding their respective area(s) of the web-site

The Operating Agent will be responsible for liaising with the ExCo and the IEA Secretariat and providing the necessary input and support, such as to develop the dialogue with ISGAN, in support of the ENARD ExCo's preferred alignment of ENARD with ISGAN.

The Operating Agent will be responsible for liaising with the ExCo and the IEA Secretariat and providing the necessary input and support, such as to facilitate and expedite the Renewal-of-Term documentation and its subsequent submission to the CERT, via the IEA Secretariat.

The Operating Agent will be responsible for the ongoing maintenance of the ENARD web-site and will work closely with the ExCo, the Secretariat and Operating Agents of the other ENARD Annexes, in order to accommodate their requirements.

Annex I National Co-ordinators' Responsibilities

The Annex I National Co-ordinators will be responsible for the collation of relevant national T&D related information and data and for the submission of this to the Operating Agent, as may be required for the Operating Agent to fulfil its obligations to the ExCo. The National Co-ordinators (or their nominees) will attend and participate in the October/November 2011 Annex V Definition Workshop. The National Co-ordinators will also take the lead responsibility in relation to the dissemination of the Annex outputs on a national basis and in the engagement of relevant stakeholders in their respective countries.

Deliverables

Specific deliverables from the programme-of-work, August 2011 to February 2012, are expected to comprise one or more of the following:-

- the preparation of the documented proceedings for the Annex V Definition Workshop;
- the development and publication of a complementary profile for the above;
- the development of specific material, as may be required to support the ENARD ExCo dialogue with ISGAN;
- the ongoing development of the requisite documentation sets, to support the Renewal-of-Term process;
- the production of any further special purpose report(s) and/or factual briefing sheet(s), as may be agreed with the ExCo;
- the ongoing maintenance of the fully functional ENARD web-site, www.iea-enard.org; and
- the production of the requisite Annual Report, for consideration by the ExCo, October 2011.

4.2 Annex II: DG System Integration

Details of the Annex II programme-of-work, associated activities, deliverables, funding and resource commitments are provided in Appendix 2. Annex II was formally adopted by the ENARD Executive Committee, at its September 2007 meeting and commenced work via its inaugural Experts' Meeting, held Vienna, Austria, 13th-14th May 2008. Annex II has now effectively concluded the major part of its work programme, although with ongoing dissemination continuing at the national and international levels.

The principal Annex II related activities which are expected to be addressed in the period August 2011 to February 2012 will therefore principally comprise the ongoing dissemination of its outputs, both via the Annex II Operating Agent and the Annex II National Co-ordinators.

4.3 Annex III: Infrastructure Asset Management

Annex III was formally adopted by the ENARD Executive Committee, at its September 2007 meeting and commenced work via its inaugural Experts' Meeting, held in Chester, United Kingdom, 22nd-23rd April 2008. The Phase 1 work programme was satisfactorily completed, November 2009, with the top level, executive overview report published in the public domain, March 2010. The Annex III Operating Agent discussed the draft findings, conclusions, policy messages and case for a proposed Phase 2 work programme, at the final Annex III Experts' Meeting, held 6th – 7th October 2009. The outcome from these discussions was subsequently reported to the 7th ExCo Meeting, held Fredericia, Denmark, October 2009. The Annex III Operating Agent was then invited to develop the basis for a follow-on Phase 2 work programme, which was subsequently adopted via Written Procedure, February 2010. Details of the Annex III Phase 2 programme-of-work, its proposed activities, deliverables, funding and resource commitments are as provided in Appendix 3.

Following discussion at the 8th ExCo Meeting, held Paris, April 2010, the Annex III Operating Agent proposed that the development of Phase 2 should be pursued, for the immediate future, via its Task 2 only, in relation to the "Options for Managing Medium Voltage Overhead Lines".

Subject to the development of a quorum of support for Annex III Phase 2 Task 2, the option remains to commence work on this activity, from mid-2011 on.

More generally, the case for the ongoing development of Annex III is to be reviewed, in the specific context of the ENARD ExCo's preferred medium/longer term alignment of ENARD with ISGAN.

4.4 Annex IV: Transmission System Issues

Details of the Annex IV programme-of-work, associated activities, deliverables, funding and resource commitments are as provided in Appendix 4. Annex IV was formally adopted by the ENARD Executive Committee, at its September 2008 meeting and commenced work via its inaugural Experts' Meeting, held Milan, Italy, 28th-29th April 2009. It is anticipated that it will conclude its present activities, by May 2011.

The principal Annex IV related activities which are expected to be addressed in the period August 2011 to February 2012 will therefore principally comprise the ongoing dissemination of its outputs, both via the Annex IV Operating Agent and the Annex IV National Co-ordinators.

4.5 Other Anticipated Activities

The activities as described above will comprise the principal focus of the remaining seven months of ENARD's present Term. Further anticipated activities may be progressed, as appropriate, including:

- the development of the overall membership and participation base;
- the provision of underlying support to the IEA Secretariat's Electricity Networks Roadmap activities;
- the provision of underlying support to the IEA Secretariat's Grid Integration of Variable Renewables initiative;
- selective engagement with the IEA Office's NEET[4] initiative, including specific liaison with selected "plus five" countries;
- engagement and development of working relationships with other IEA Implementing Agreements; and
- the consideration of the basis for the development of further new Annexes, as appropriate.

5. Results and Information Protection

The principal results and outputs from the activities, as described, will comprise reports, databases, analyses and methodologies, developed within the framework of the operational Annexes and their associated activities.

In general terms, such results and outputs will remain confidential to the individual Annex participants for a period of not less than two years after the completion of the respective Annexes, unless all the relevant participants agree to an earlier release of information.

Each of the operational Annex (es) will also be required to produce an executive overview report of its activities, not containing any sensitive information or data, and which is suitable for publication in the public domain.

6. Budgetary Provisions

ENARD will be executed consistent with the organisational and management structure shown in Figure 3.1.

A funded Secretariat will be retained, for the essential discharge of this role, principally in support of the ExCo and its activities.

The ExCo will approve the appointment of an Operating Agent for each operational Annex, who will be responsible to the ExCo for the discharge and delivery of its Annex specific work programme.

The actual and anticipated budgetary provisions for the discharge of the Secretariat role and the Annex I, II III and IV Operating Agency roles, are as summarised in table 6.1 below.

[4] Networks of Excellence in Energy Technology

All countries participating in ENARD will participate in Annex I. Sub-sets of the overall ENARD participant base will have the option to participate (or not to participate) in Annexes II, II, IV and any further Annexes, as the Implementing Agreement develops.

Table 6.1:- ENARD Budgetary Provisions, August 2011 to February 2012 (currencies as stated)

Role/activity	Budget (currencies as stated)
Annex I Operating Agency & ENARD Secretariat (GB£)	£82,040[5]
Annex II Operating Agency	-
Annex III Operating Agency (GB£)	-
Annex IV Operating Agency (€)	-

7. Contracting Party Financial and Manpower Provisions

The individual Contracting Party financial and manpower provisions will be dependent on the number of operational Annexes in which each Contracting Party chooses to participate.

All Contracting Parties will participate in Annex I and will be responsible for funding the Secretariat and Annex I Operating Agency on an equal cost share basis and will also be responsible for self-funding their own country specific activities.

Participation in any further Annex or Annexes is entirely at the discretion of the individual Contracting Parties.

Table 7.1 provides a summary overview of the provisions that need to be made for participation in Annex I, Annex II, Annex III and Annex IV.

[5] of which, £33,780 will be funded from the existing surplus on the Annex I Operating Agency/Secretariat Common Fund

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Table 7.1: Contracting Party Financial and Manpower Provisions, August 2011 to February 2012. (per Contracting Party)

Role/Activity	Financial/manpower commitment
Annex I Operating Agency & ENARD Secretariat (£)	£3,713
Annex I National Co-ordination Role	As appropriate, to service the requirements of Annex I
Annex II Operating Agency	-
Annex II National Co-ordination Role	-
Annex III Operating Agency (£)	-
Annex III National Co-ordinator Role	-
Annex IV Operating Agency (€)	-
Annex IV National Co-ordinator Role	-

The financial provisions for any further Annexes will be defined, as their work programmes may be developed.

Appendix 1:-

Related Activities and Information Networks

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Appendix 1: Related Activities and Information Networks

It is expected that the proposed new Implementing Agreement will pursue and maintain a pro-active communications and information exchange programme with various complementary initiatives, including the following:

A1.1 International Energy Agency

Working Parties and IEA Office Initiatives:

End Use Working Party
Fossil Fuels Working Party
Renewable Energy Working Party
Electricity Co-ordination Group
Energy Technology Perspectives 2010

Implementing Agreements:

Advanced Fuel Cells
Demand Side Management
Energy Conservation through Energy Storage
Energy Technology Data Exchange
Greenhouse Gas R&D Programme
Heat Pumping Technologies
High Temperature Superconductivity on the Electric Power Sector
Hydropower Technologies and Programmes
ISGAN (International Smart Grids Action Network)
Ocean Energy Systems
Production and Utilisation of Hydrogen
Photovoltaic Power Systems
Wind Turbine Systems

A1.2 CIRED

Principally via themes:

Alpha 3: Operation, Control & Protection of Supply System
Alpha 4: Distributed Generation – Management & Utilisation of Electricity
Alpha 5: Power Distribution System Development

A1.3 CIGRE

Study Committees and their Working Groups including:

C1: System Development & Economics
C2: Power System Operation & Control
C3: System Environmental Performance
C4: System Technical Performance
C5: Electricity Markets and Regulation
C6: Distribution Systems & Dispersed Generation

A1.4 European Commission

SmartGrids: Technology Platform for Electricity Networks of the Future

A1.5 Eurelectric

Principally via:

Environmental & Sustainable Development Committee
Management Committee
Networks Committee
Working Group for Renewable Energy Sources

Appendix 2:-

Annex II “DG System Integration”

Draft Work Program Version 15; 25.07.2008

IEA Implementing Agreement on Electricity Networks Analysis, Research and Development (ENARD)

Annex II

„DG System Integration in Distribution Networks”

Author: Arsenal Research & IRM

IEA Implementing Agreement on Electricity Networks Analysis, Research and Development (ENARD)

Work Programme for Annex II

Annex II of IEA Implementing Agreement on Electricity Networks Analysis, Research and Development (ENARD)

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i. ENARD Vision

"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"

ii. What does ENARD do for YOU?

- ENARD membership permits active participation enabling direct exchange of countries / companies / peoples experiences.
- ENARD membership active contribution to positioning countries views, intentions & problems and/or solutions.
- ENARD membership brings together various stakeholders to exchange concerns and requirements
- ENARD's participants have a better chance to have their interests taken up in the formulation of the compendium.
- The more active participants, the more versatile the ideas, the more input and therefore a more well rounded output.

1. Motivation

Due to current energy related framework conditions and technical developments the penetration of Distributed Energy Resources (DER) and especially Distributed Generation (DG) in distribution networks increases continuously and it can be expected that this increase will even grow in the future.

These results in a growing density of electricity resources within distribution networks, where technical issues related to the bidirectional power flow, reliability aspects (power quality and continuity of electricity supply), stability aspects, network capacity, network-, energy- and load management are becoming increasingly important. The common strategy to view electricity production as a negative load and the therefore resulting „fit & forget“ philosophy is not a sustainable and applicable solution for the future. Under such conditions, a significant rise of the share of DG would only be possible with a very cost intensive extension of network capacity. In addition, modelling, ICT, market and regulatory aspects play an important role when dealing with the growing share of DG in distribution networks.

Research on active integration of DER in distribution networks has been progressing over the past, but has not managed to progress from a theoretical concept to practical real life experience with active networks. There is virtually no global collaboration at the scientific level.

2. Objectives

- to build up and exchange knowledge on DER system integration aspects and existing active network approaches amongst the global players in distribution networks,
- to develop guideline(s) for network operators and political decision makers on how to manage and implement the transition from a passive to an active distribution network,
- to promote implementation possibilities for active distribution networks as an overall goal of this Annex II.

3. Values for participating countries:

1. Participation in the global process of decentralization and regionalisation of the energy structure taking account of the leading role of IEA in global energy strategies.
2. Delivering direct input, moulding and shaping the transitional process towards active distribution networks.

3. Being integrated into an international network of outstanding experts which brings together the various stakeholders.
4. Based on early discussions for recommendations, participants have the opportunity of parallel shaping the national strategy process in related fields.
5. Identifying market opportunities at an infant stage.

4. Approach

- Identifying countries and areas with DER integration and existing active networks as well as benchmark knowledge and experience in these areas to compile international comparable information about the various integration methods of distributed generation, energy storages and flexible demand in distribution networks, thus increasing the value added of distributed generation and demand response. This will help to manage problems caused by intermittent distributed generation (mainly based on Renewable Energy Resources - RES) in the physical distribution systems and in the electricity market.
- to define concepts for active network approaches taking into account local factors and to provide recommendations on individual designs (mix of technologies, architecture, size…),
- to compile and disseminate best practice examples and guideline(s) on implementing the transition from a passive to an active distribution network,
- survey of existing models and define requirements for improved modelling and the development of new concepts,
- complement other initiatives (EU and other international RTD-Projects, work of CIGRE, …)

5. Scope

The scope of Annex II is DER system integration into low and medium voltage networks including technical, economical, organisational and regulatory aspects and related active distribution network operations. A detailed definition of the used terms within this Annex II can be found in Chapter 13.

The work programme is organised into three tasks:

- **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**

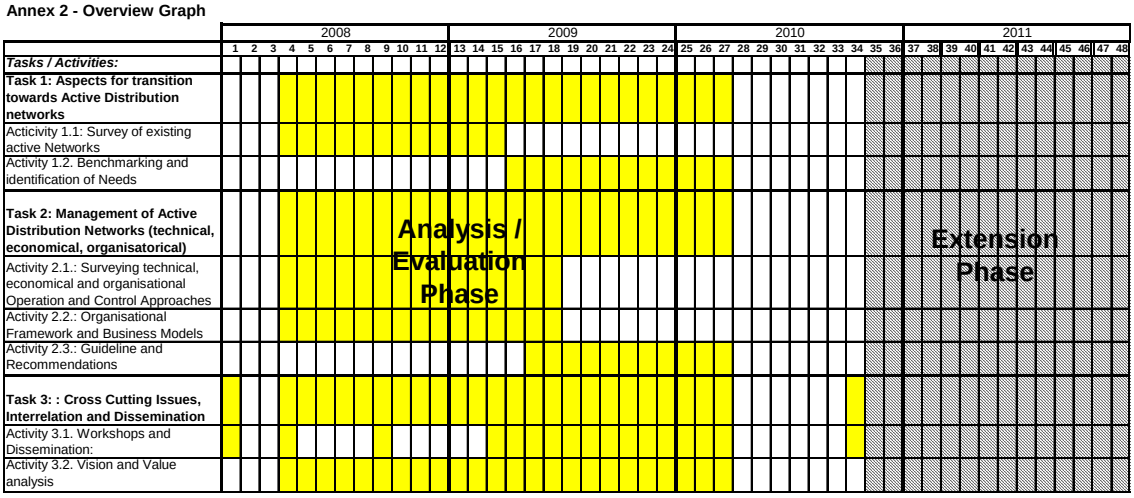
Activities within the tasks will be carried out on a task sharing basis, as practised in

other IEA programmes as well.

6. Annex II Time Table

The first activities of the proposed Annex II will start in January 2008 with a start work shop for detailed Activity / Task planning and coordination. The Analysis/Evaluation Phase itself will last for a work period of 24 months, which will start in April 2008. So far commitment is only being sought initially for the Analysis/Evaluation Phase, running for 27 months from January 2008 to March 2010. 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. These results of the Analysis/Evaluation phase and addressed needs for the Extension Phase will be presented on an international conference in Vienna in Oct. 2010.

Annex 2 - Overview Graph



7. Responsibilities

The Operating Agent (OA) is responsible for the overall technical and administrative management of work performed within Annex II and for implementing the decisions of the IEA ENARD Executive Committee. The work is structured on three levels: Annex, Tasks and Activities. The OA, the task leaders and the activity leaders are responsible for the work undertaken at these levels as follows:

Operating Agent:

- Coordination, scheduling and communication between Tasks.
- Assisting task and activity leaders.
- Preparing, leading and summarizing Annex meetings (twice annually).
- Reporting to IEA ENARD Executive Committee (status & annual reports).
- Coordinate/ensure publications of technical reports and other materials.

Task Leader:

- Coordination, scheduling and communication between activities
- Assisting activity leaders within the Tasks.
- Reporting and coordinating at task level to OA

Activity Leader:

- Prepare activity plan and scheduling.
- Coordinate activity work and communicate with other participants.
- Produce and submit deliverables to task leader and OA.

8. Task 1: Aspects for transition towards Active Distribution networks

Task Leader: Austria

Participating Countries: Austria, Belgium, Italy, United Kingdom, Finland, Denmark, Sweden (t.b.a.), Switzerland (t.b.a.), Norway (t.b.a.)

Level of effort: 3 person months per country
Duration: 24 months
Start date: month no. 4 after start

Context: Due to the very diverse and plentiful technologies, which have to be integrated and simultaneously managed in active distribution networks, the entire system gets extremely complex. The high degree of reliability expected from this system as a whole requires very high standards on the single technologies and the components interactions. As the share of distributed generation in distribution networks is rising, an optimal planning and activation of the network and integration of DER can produce advantages for the system itself.

Scope: The Task deals with state of art of active distribution networks. Among other aspects the architecture and planning methodology will be analysed. The transition process from passive to active networks will be considered with special attention.

Objectives: The objectives are to find common definitions (a common language), to provide engineering references and recommendations on system architecture, planning tools, best practices and lessons learnt. Architectural and planning methodology barriers will be identified; best practice examples and recommendations will be developed.

Method/Approach: To review national smart grids related definition and to review, analyse and document existing architectures and planning methodology of active

distribution networks including barriers and models.

Deliverables: Reports will be formulated on the following topics: State of the art, trends, barriers and recommendations for active distribution networks architectures and planning methodology

Target Audience: DNO, TSO, political decision makers, system operators and researchers

Milestones: D1 - Report on State of the art, trends, barriers and recommendations for active distribution networks architectures and planning methodology

Description of Work for Activity:

Activity 1.0: IEA ENARD Annex II Definitions

Activity leader: **Austria**

Participating countries: all Countries

Level of effort: 0.1 PM per participating country

Duration: 6 months

Start date: month no. 4 after start

There are a couple of national definitions in the area of smart grids. To find a common language within IEA ENARD Annex II it is necessary to analyse national and international existing definitions and to find common definitions for the following terms (finding IEA definitions):

- Distribution network
- Smart grid
- Active network
- Distributed generation (DG)
- Distributed Energy Resources (DER)
- Demand Response (DR)…

The common definitions ensure that all participants in Annex II and the target groups of the publications and guidelines are going to speak about the same things. First suggestions can be found in chapter 13.

Activity 1.1: Survey of Existing Active Networks

Activity leader: **United Kingdom**

Participating countries: United Kingdom, Austria, Italy, Finland, Denmark, Sweden (t.b.a.), Switzerland (t.b.a.), Norway (t.b.a.)

Level of effort: 1,5 PM per participating country

Duration: 12 months

Start date: month no. 4 after start

This activity will survey national experiences in the field of active distribution networks in terms of:

- grid layout (structure, design, characteristics)
- types of existing components:
    - DER (Distributed Generation, Distributed Storage, Demand Response)
    - Storage Technologies
    - DSM or DR used
- type and share of renewable energy sources
- choice of communication
- protection issues
- unintentional islanding
- interconnection aspects
- planning tools, software simulation programmes
- type of services provided (network parallel operation or islanding mode)
- Information collation from other IEA Activities, European Technology Platform Smart Grids, EU Projects

Activity 1.2. Benchmarking and Identification of Needs

Activity leader: **Norway (t.b.a.)**

Participating countries: Norway (t.b.a.), Austria, Belgium, Italy, United Kingdom, Finland, Denmark, Sweden (t.b.a.), Switzerland (t.b.a.)

Level of effort: 1,5 PM per participant country

Duration: 12 months

Start date: month 16 after start

Activity 1.2 and 2.3 will be performed in close contact and common discussions.

Contents:

- Methods to compare and identify strengths and weaknesses (“Benchmarking”)
- Identification of barriers
- Possibilities to overcome the barriers
- Trends on further development
- Requirements
- Development of guidelines for the transition towards active distribution network planning
- Identification of fields of technology development for improvement of active network operation

9. Task 2: Management of Active Distribution Networks (technical, economical, organisational)

Task Leader: Switzerland (t.b.a.)

Participating Countries: Switzerland (t.b.a.), Austria, Belgium, Italy, United Kingdom, Finland, Denmark, Sweden (t.b.a.), Norway (t.b.a.)

Level of effort: 5 PM per country

Duration: 24 months

Start date: month 4 after start

Context: Active distribution networks require coordinated operation and control mechanisms. The control can be divided into two levels:

1. reliability, security and quality of supply,
2. technical and economic optimisation and the contribution of all DER components.

Scope: This Task will focus on investigation of control and operational strategies to facilitate stable and optimal operation of active distribution networks, in either parallel operation and/or islanding operation. Attention will be paid to incorporate predictive and/or forecasting strategies and models to deal with the variability of the renewable and/or fluctuating energy input and load and the optimisation.

Objectives: To foster the development of control and operational strategies that can be utilised to improve the reliability, operation and performance of active distribution grids.

Method/Approach: To review, analyse and document technical and economical operation and control of existing active network approaches, definition of technical and economical operation and control requirements and recommendations developed; identification of organisational barriers.

Deliverables: Report: SoA, trends, barriers and recommendations for control and operation of active distribution networks. Current state of the art, trends, barriers and recommendations for control and operation of active distribution networks.

Target Audience: DNO, TSO, political decision makers, system operators and researchers

Milestones: D2 - Report on: SoA, trends, barriers and recommendations for control and operation of active distribution networks. Current state of the art, trends, barriers and recommendations for control and operation of active distribution networks.

Description of Work:

Activity 2.1.: Surveying Technical, Economical and Organisational Operation and Control Approaches

Activity leader: **Finland**

Participating Countries: Finland, Austria, Italy, United Kingdom, Denmark, Sweden (t.b.a.), Switzerland (t.b.c.), Norway (t.b.c.)

Level of effort: 2 PM per participant country

Duration: 15 months

Start date: month 4

This activity will survey national experiences in the field of active distribution networks in terms of:

- type of services provided (network parallel operation or islanding mode possible)
- active network operation and control concepts and tools
- distribution automation (ie. fault location & isolation, switching planning, load management, voltage regulation, reactive power compensation etc)
- Metering aspects
- System balancing
- Power quality
- Black start availability
- Disconnection and connection to main grid
- Ancillary services (Win / Win / Win)
- Trends on further development

Activity 2.2.: Commercial Market Regulatory

Activity leader: **Denmark**

Participating Countries: Denmark, Austria, Belgium, Italy, United Kingdom, Finland, Denmark, Sweden (t.b.a.), Switzerland (t.b.a.), Norway (t.b.a.)

Level of effort: 2 PM per participant country

Duration: 15 months

Start date: month 4

Because there are so few examples of commercial activities concerning active network management, for developing this activity some scoping research to identify the barriers/drivers to commercial arrangements for active networks will be necessary. This would require an analysis of the existing relationships between e.g. DNOs and generators/loads and maybe suppliers and customers (including generators through

existing power purchase agreements/bilateral contracts) and electricity markets in general..
Conclusions could be made on how interactions would need to develop to allow the incorporation of more elaborate contracts and development of commercial arrangements for active management services.

Some initial work has already been done in EU projects on analysis of contracts between parties to identify the conditions necessary for development of new business models for DG integration. These methods could be extrapolated across annex participants to survey national conditions and used as a basis for the development of new commercial approaches for active network management.

Topics:

- Electricity markets
- Organisational framework
- Business model of active distribution networks

Activity 2.3.: Guideline and Recommendations

Activity leader: Austria.
Participating Countries: Austria, Belgium, Italy, Finland, Denmark, Sweden (t.b.a.), Switzerland (t.b.a.), Norway (t.b.a.)
Level of effort: 1 PM per participant country
Duration: 11 months
Start date: month 17
Activity 1.2 and 2.3 will be performed in close contact and common discussions.

Based on the analysis of national experience, guidelines and recommendations for the organisational framework, business models and the operation and control of active networks with a high penetration of distributed renewable energies will be developed.

10. Task 3: Cross Cutting Issues, Interrelation and Dissemination

Task Leader: Austria
Participating Countries: Austria, Belgium
Level of effort (PM): 2
Duration: 34 months
Start date: month 1

Context: Vision and value of active network integration, interrelation with existing

activities, dealing with aspects of active distribution networks is relevant for avoiding duplication of work and exchanging of knowledge. Dissemination will play a relevant role for supporting a wide implementation.

Scope: The Task will focus on strengthening interrelation and perform dissemination of relevant information about active distribution networks.

Objectives: To develop a clear vision of active distribution networks and to evaluate the micro- and macroeconomic benefit; to perform dissemination activities for active distribution networks, to strengthen interrelation with relevant actors and to avoid duplication of work.

Method/Approach: Workshops, conferences, online support tools for information exchange and dissemination, development of value reports and guidelines for stakeholders to assist DNO´s to progress from passive to active approach.

Deliverables: Reports on interrelation and dissemination activities, guidelines for stakeholders to assist DNO´s to progress from passive to active approach, vision and value report.

Target Audience: DNO´s, Public, Governments, other IEA Tasks

Milestones: D3 - Reports on interrelation and dissemination activities, guidelines for stakeholders to assist DNO´s to progress from passive to active approach, vision and value report.

Activity 3.1. Workshops and Dissemination:

Activity leader: Austria.

Participating Countries: Austria, Belgium

Level of effort (PM): 1

Duration: 34 months

Start date: month 1

Contents:

- performing joint topical workshops for information exchange between Tasks 1, 2 and 3
- performing joint topical workshops with IEA
    - IEA Wind – Annex 25: Design and Operation of Power Systems with Large Amounts of **Wind** Power
    - IEA PVPS – Task 10 (Urban Scale PV) and Task 11: PV Hybrid Mini Grids as well as the concluded Task 5 (Grid interconnection of building integrated and other dispersed photovoltaic systems)
    - IEA DSM: Task XVII Renewables and Distributed Generation
    - …

- Workshops with utilities in conjunction with Annex II expert meeting
- Workshops with national stakeholders in conjunction with Annex II experts meeting – these regional workshops should be organised to link the IEA activity with the national stakeholders in the hosting country
- Cooperation with G8 project grid integration of RE – (Gleneagles plan of action)
- Cooperation with NEET activities
- Discussion and dissemination of guidelines for stakeholders to assist DNO´s to progress from passive to active approach (Based on experiences of Tasks I and II)
- Presentation at Conferences
- IEA Publications

Activity 3.2. Vision and Value Analysis

Activity leader: Austria.
Participating Countries: Austria
Level of effort (PM): 1
Duration: 24 months
Start date: month 4

Topics:

- Discussions & vision workshops
- preparation of value reports (what is the value of DG integration – PVPS T-10 value report as model)
    - Climatic value
    - Economic value, value of using local resources
    - Employment
    - Increase in security
    - Other values

11. Annex II Deliverables

- Detailed in-country surveys of current state of the Art, lessons learnt, limitations, future developments etc…
- Complementary fore sighting activities and abstraction, visions goals for the future (e.g. growth), future fully integrated active networks
- International overview report drawing out key messages
- Formulation of guidelines for stakeholders to assist DNO´s to progress from passive to active approach

- Report on interrelation and dissemination activities
- Requirements / needs for further actions and work (focus on IEA activities)

12. Estimated Resources needed

For country participation within Annex II it is suggested to be obligatory to participate/support/finance at least 1 Activity in each Task!

Operating Agent:	**Suggested: 2 PM per year**
	Austria
Task leaders:	**Suggested: 1,5 PM per year**
Task 1:	Austria
Task 2:	Suggested: Switzerland
Task 3:	Austria

Activity leaders:	**Suggested: 1 PM per year**
Activity 1.0:	Austria
Activity 1.1:	United Kingdom
Activity 1.2:	Suggested: Norway
Activity 2.1:	Finland
Activity 2.2:	Denmark
Activity 2.3:	Austria
Activity 3.1:	Austria
Activity 3.2:	Austria

13. Definition of Terms

Active Networks: the term within Annex II will be used for distribution networks, able to deal with the integration of a high share of Distributed Generation (DG).

Distributed Generation (DG): generators connected to the medium or low voltage distribution networks.

Distributed Energy Resources (DER): DG, Storage and DR connected to the medium or low voltage distribution networks.

Demand Response (DR): measures at the consumer's side to adapt the load shape to the generation characteristics with respect to the timing and level. There are various types of demand response methods as listed below:

- Type1: Initiatives that are based on sending price signals to customers. There is a wide range of initiatives of this type, but the basic characteristic of all of them is that the electricity price is different at different times of the day. Both prices and time periods can be fixed and pre-established, or can be completely

variable.

- Type2: Indirect load control initiatives which force or encourage customers to reduce their consumption during certain periods. The main characteristic of this type of initiative is that the actual reduction must be executed by the customer itself.
- Type3: Direct load control programs where utilities, TSOs or program operators directly disconnect part of the customer's load. These initiatives require the existence of a direct communication system between the initiative promoter and the participating customers.
- Type 4: Initiatives or market structures that allow the participation of the customers offering load reduction. Under these initiatives a customer can present bids offering to reduce part of its load at a given price. If the bid is accepted, the customer will execute the demand reduction itself

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Appendix 3:-

Infrastructure Asset Management

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International Energy Agency

Implementing Agreement

on

ELECTRICITY NETWORKS ANALYSIS, RESEARCH AND DEVELOPMENT (ENARD)

Annex III:- "Infrastructure Asset Management"

Proposal for

Phase 2:- "Distribution Asset-specific Related Aspects"

prepared
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1 Introduction

Background

ENARD, the IEA Implementing Agreement on Electricity Networks Analysis, Research and Development, was established as a new Implementing Agreement in July 2006 with a view to facilitating 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 (the "3Rs" of electrical power systems).

ENARD's present Annex I (Information Collation and Dissemination) work programme is responsible for the systematic collation and dissemination of T&D network related information and data and also for the organisation and delivery of a series of topical experts' meetings and workshops. The latter are regarded as a key enabling mechanism in the identification of priority areas, to be addressed in detail, in potential new Annexes.

ENARD's inaugural Annex I Experts' Meeting, held 28th September 2006, addressed the subject of "Distribution Systems and End User Aspects[6]". The meeting succeeded in identifying two principal priority areas in relation to distribution systems, firstly those in relation to today's "here and now networks" and, secondly, those in relation to tomorrow's "new" networks. Whilst it was recognised that significant programme efforts at both national and international levels were increasingly directed towards the latter, the issues associated with the management of an increasingly ageing electrical infrastructure were receiving far less attention on a co-ordinated international basis, notwithstanding that they will remain at the centre of T&D operations, for at least the next 20 to 30 years. A further specific workshop on the subject of "Managing an Ageing Infra-structure", was therefore organised and delivered in conjunction with the CIRED 19th International Conference and Exhibition on Electricity Distribution, held Vienna, 21st-24th May 2007[7].

Annex III

This joint ENARD/CIRED Workshop confirmed the considerable benefits to be obtained from the sharing of knowledge and experience in relation to the ageing and degradation of the distribution asset base and associated issues, in order to assist with the development and implementation of effective strategies for managing ageing networks.

The case for a dedicated new Annex, aimed at addressing such issues was therefore developed over the summer of 2007 and subsequently presented to the third ENARD Executive Committee (ExCo) Meeting, held Trondheim, September

[6] Proceedings of Experts' Meeting on ENARD Annex I Experts' Meeting on "Distribution Systems and End User Aspects", held Milan, September 2006. EA Technology report no.6055, November 2006.

[7] Proceedings of Joint ENARD/CIRED Workshop on "Managing an Ageing Infrastructure", held Reed Messe, Vienna, 21st May 2007. EA Technology report no.6117, June 2007.

2007. This third ExCo meeting formally adopted Annex III, to run through to July 2011, although with only the first Phase of this ("Phase 1") defined in detail.

Annex III Phase 1. April 2008 to November 2009

The Phase 1 work programme examined the asset management practices of the six participating countries[8], primarily focussing on assets in the voltage range 6kV to 45kV. The project considered five principal asset groups: Transformers, Cables, Overhead Lines, Switchgear and Protection & Control. In addition the project looked at some case studies that reviewed different asset management practices employed around the world.

The essence of the Phase 1 findings were presented at the seventh ExCo Meeting, held Frederica 21st – 22nd October 2009, including the basis for a possible Phase 2 Work Programme. The ExCo therefore agreed that the latter should be captured in a formal draft text for a proposed Annex III Phase 2, for formal consideration by the ExCo, via Written Procedure, and with a view to enabling any start of work on Phase 2, ahead of the eighth ExCo Meeting, end April 2010.

The primary output of Phase 1 was a comprehensive report that documented the work carried out under this project, drawing commentary and conclusions from all of the inputs received from the six participating countries and from the case studies identified by the Operating Agent. The key level conclusions and all of the recommendations from the 'detailed report' were published in a 'high level' report that was presented to the ENARD Executive Committee (ExCo) in November 2009[9]. Four of the recommendations were as follows:

i. *Environmental pressure and restrictions on the use of SF_6 present a number of questions that DNOs need to have answered:*

   - *What is the future for SF_6?*
   - *Should DNOs continue to install SF_6 at MV?*
   - *What are the options / prospects for an alternative insulating / arc quenching medium at HV?*
   - *How should DNOs manage their ageing assets that contain SF_6?*

ii. *Options for managing MV OHLs – a detailed review of current practices in order to identify the conditions / situations where each of the following approaches might be considered to be optimal:*

   - *Minimal intervention – fix on failure*
   - *Refurbishment – major replacement of ageing components*
   - *Renewal – rebuild on existing route*
   - *Replace with underground cable*

[8] ENARD Annex III, Phase 1 participating countries: Finland, France, Italy, Norway, Sweden and the UK.
[9] ENARD Annex III: Infrastructure Asset Management Final Report for ENARD ExCo. November 2009

iii. *What will be the effects of climate change on asset management? In particular what will this mean for the ratings of transformers and OHLs as ambient temperatures are predicted to increase; also what will be the effect of change environmental conditions on all asset groups; and what will be the effect of increasing environmental pressure on electricity network operators?*

iv. *It would be useful to look at the asset management implications for SmartGrids in order to confirm that the conclusions of this report still remain valid where the consequences of failure might be more pronounced than for existing distribution networks.*

The Phase 2 programme-of-work, as proposed herein, will specifically address these emerging issues from Phase 1 in relation to the distribution asset base, with the option of any further phase(s) to the Annex extending this work to cover the transmission asset base and further issues, as may be identified.

2 Aim and Objectives

Annex III aims to address 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 T&D asset base and the complementary development of new asset management techniques and methodologies.

The objectives of the Phase 2 programme-of-work, which specifically addresses a series of asset specific aspects, are to:-

- Provide guidance on how to identify the most cost effective options for network operators to manage their existing fleet of SF_6 switchgear; and the alternatives to SF_6 switchgear, both now and in the future.

- Document the various practices employed around the developed world for the management of MV overhead lines. The intention is that this work will provide guidance on how to deliver the most cost effective management of MV overhead lines.

- Identify the potential impact of climate change between 2010 and 2050 on the rating and operation of MV network assets; in particular the work will look at the possible effects on transformers and overhead lines.

- Document the key features of a number of SmartGrid trials that have or are taking place around the world, using these examples to identify the challenges for asset management within SmartGrids and to propose suggested solutions for addressing these challenges.

The output of Annex III Phase 2 will be a vital reference and provide significant benchmarks for asset managers attempting to build and use condition or risk based processes to define the need and justify future investment programmes that enable economic renewal and continuation of satisfactory performance of

distribution networks. Such objectives are noted to be entirely consistent with ENARD's core objectives. The four Annex III Phase 2 items outlined above are listed in what may be the likely order of priority amongst participating countries. They are separated as four distinct Tasks, each with its own set of subtasks.

3 Activities

Annex III Phase 2 will address the above objectives via the performance of a structured programme-of-work, co-ordinated by the Operating Agent and involving the full and active participation of the Annex Participants. The programme-of-work for each of the four Tasks identified is further described in the following pages.

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Task 1: Identifying the options for managing assets that contain SF_6 and identify potential alternatives to SF_6.

Programme of Work. Task 1 of Annex III Phase 2 will be addressed via the performance of a structured Work Programme comprising the following subtasks.

Task 1.1: Confirm the legal requirements concerning the use of SF_6 in switchgear within the participating countries and beyond. This Task will also include an assessment of future legislation / regulation in this area.

Task 1.2: Identify what other work is currently taking place around the world on the subject of how to manage MV switchgear that contains SF_6.

Task 1.3: Collect and collate information on the volumes of MV switchgear containing SF_6 within each participating countries, and canvass input from at least 15 other major economies – exact listing to be agreed with the Task 1 Participants. This request for information will also ask for information on current and proposed practices for managing this switchgear[10].

Task 1.4: Identify the possible alternatives to SF_6 as an insulating / interrupting medium within MV switchgear, available both now and in the predicted future. Determine the costs and benefits of these alternatives.

Task 1.5: Using the information gained under Tasks 1.1, 1.3 and 1.4, identify the necessary considerations for determining the most cost effective asset management practice for MV switchgear that contains SF_6; and also identify the most appropriate choice of MV switchgear for future installations.

Task 1.6: Produce a final report that collates all work undertaken in Tasks 1.1, 1.2, 1.3, 1.4 and 1.5.

[10] A certain amount of information on the management of MV assets containing SF_6 was gathered under ENARD Annex III, Phase 1. This information will only be supplied to the Phase 2 Task 1 project with the express permission of the relevant participating country of the Phase 1 project.

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Task 2: Options for Managing MV Overhead Lines.

Programme of Work. Task 2 of Annex III Phase 2 will be addressed via the performance of a structured Work Programme comprising the following subtasks.

Task 2.1: Collect and collate information on the asset management practices, for MV Overhead Lines, employed by the participating countries, and canvass input from at least 15 other major economies – exact listing to be agreed with the Task 2 Participants. In addition to the four bullets considered under the Recommendation from the Phase 1 project, this Task will also be looking to indentify the construction of overhead lines, the protection systems employed and the use of downstream disconnection / reconnection devices.

Task 2.2: Analyse input to Task 2.1 with the intention of identifying why each practice is employed (i.e. what are the benefits that it delivers) and why alternatives are not used.

Task 2.3: Consider the costs and benefits of the various asset management practices for a range of different situations and environments – exact listing to be agreed with the Task 2 Participants; it is expected that the list will include a range of climatic conditions and different regulatory regimes.

Task 2.4: Using the information gained under Tasks 2.1, 2.2 and 2.3, identify the necessary considerations for determining the most cost effective asset management practice for MV overhead lines for a range of situations and environmental conditions – exact listing to be agreed with the Task 2 Participants.

Task 2.5: Produce a final report that collates all work undertaken in Tasks 2.1, 2.2, 2.3 and 2.4.

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Task3: Identifying the effects of Climate Change on Electricity Network Assets.

Programme of Work. Task 3 of Annex III Phase 2 will be addressed via the performance of a structured Work Programme comprising the following subtasks.

Task 3.1: Identify the range of climate change scenarios across each of the participating countries. This data gathering exercise will primarily use public source information; non-public source information will only be used where it can be provided by the participating country – i.e. the Operating Agent will not undertake a separate study project to determine a climate change forecast.

Task 3.2: Consider the impact of each climate change scenario on the five principal groups of MV network assets[11]: Transformers, Cables, Overhead Lines, Switchgear and Protection & Control. Identify any de-rating posed, or other deleterious effects, posed by climate change on each of the asset groups.

Task 3.3: Produce a final report that collates all work undertaken in Tasks 3.1 and 3.2. The report will draw conclusions about the potential effects of climate change and, if appropriate, make recommendations on possible mitigating actions that could be taken to reduce these effects.

[11] These "five principal asset groups" were determined under project ENARD Annex III, Phase 1.

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Task 4: SmartGrids Asset Management.

Programme of Work. Task 4 of Annex III Phase 2 will be addressed via the performance of a structured Work Programme comprising the following subtasks.

Task 4.1: Collate information on at least five (maximum 10) SmartGrid trials that have been or are being conducted around the world.

Task 4.2: Identify the challenges for Asset Management within SmartGrids. Looking at the requirements for: operation, inspection, maintenance, assessment, refurbishment, replacement.

Task 4.3: Draw conclusions on the key differences between asset management for SmartGrids as compared to conventional networks.

Task 4.4: Assess the options of managing assets within SmartGrids and make recommendations on how these options can be cost effectively applied.

Task 4.5: Produce a final report that collates all work undertaken in Tasks 4.1, 4.2, 4.3 and 4.4.

4 Deliverables

The principal deliverables associated with the Annex III Phase 2 programme of work are anticipated to include:-

Task 1: Identifying the options for managing assets that contain SF_6 and identify potential alternatives to SF_6.

The key deliverable from this Task will be a final report that provides guidance on how to identify the most cost effective options for network operators to manage their existing fleet of SF_6 switchgear; and the alternatives to SF_6 switchgear, both now and in the future.

Task 2: Options for Managing MV Overhead Lines.

The key deliverable from this Task will be a report that documents the various practices employed around the developed world for the management of MV overhead lines. The report will aim to identify the factors that should be considered when looking to optimise the management of MV overhead lines for a range of different situations and environmental conditions. The intention is that this report will provide guidance on how to deliver the most cost effective management of MV overhead lines. It is assessed that the Task will require a minimum of five participating countries in order to make it effective.

Task 3: Identifying the effects of Climate Change on Electricity Network Assets.

The key deliverable from this Task will be a final report that identifies the potential impact on climate change between 2010 and 2050 on the rating and operation of MV network assets; in particular the report will look at the possible effects on transformers and overhead lines.

Task 4: SmartGrids Asset Management.

The key deliverable from this Task will be a report that documents the key features of a number of SmartGrid trials that have or are taking place around the world, using these examples to identify the challenges for asset management within SmartGrids and to propose suggested solutions for addressing these challenges.

5 Timescales

Annex III Phase 2 will initially be implemented over an 18 month period through to the end of ENARD's present 5 year Term, July 2011. Activities beyond July 2011 will be contingent upon a renewal of ENARD's present five year term.

Benefits

Task 1: Options for Managing Assets Containing SF_6

Improvements in the processes for managing fleets of assets containing SF_6 will be identified.

These will be set out in a final report that provides guidance on how to identify the most cost effective options for network operators to manage their existing SF_6 switchgear; and the alternatives to SF_6 switchgear, both now and in the future.

Participants will benefit either through endorsement of their current practices and intended future policies, or enlightenment as to possible alternatives, which may have been considered elsewhere and which may or may not have been adopted.

Task 2: Options for Managing MV Overhead Lines

Optimum solutions will be identified for the operation of MV overhead lines in different environments (physical, regulatory, topographical).

These will be presented in a report that documents various practices employed around the developed world for the management of MV overhead lines. It will aim to identify the factors to consider when looking to optimise the management of MV overhead lines for different situations and environmental conditions.

Task Participants will benefit from expanded appreciation of the management of MV overhead lines based on the collective historic experience of the group and its contemplations and aspirations for future developments. The full range of environments considered will be broad, and offer insight into unfamiliar areas.

Task 3: Impact of Climate Change on Electrical Assets Operating at MV and above.

The potential impacts of climate change on network assets will be identified, in order that network operators can take cost effective preventative / mitigating measures to optimise the performance of their networks.

These will be set out in a final report that identifies the potential impact on climate change between 2010 and 2050 on the rating and operation of MV network assets; in particular the report will look at the possible effects on transformers and overhead lines.

Current concerns that climatic variations may broaden, with more pronounced extremes than experienced in recent years, may lead to opportunities for practices and polices in use in other parts of the world becoming more pertinent

in others where previously no such need has yet been foreseen. The report will advise and enlighten on the impacts and mitigation factors considered.

Task 4: Asset Management for SmartGrids

The potential challenges of managing assets within a SmartGrid will be identified and assessed, in order that suitable measures can be designed in at lower overall cost than having to retrofit such measures.

These will be presented in a report that documents the key features of a number of SmartGrid trials that have or are taking place around the world, using these examples to identify the challenges for asset management within SmartGrids and to propose suggested solutions for addressing these challenges.

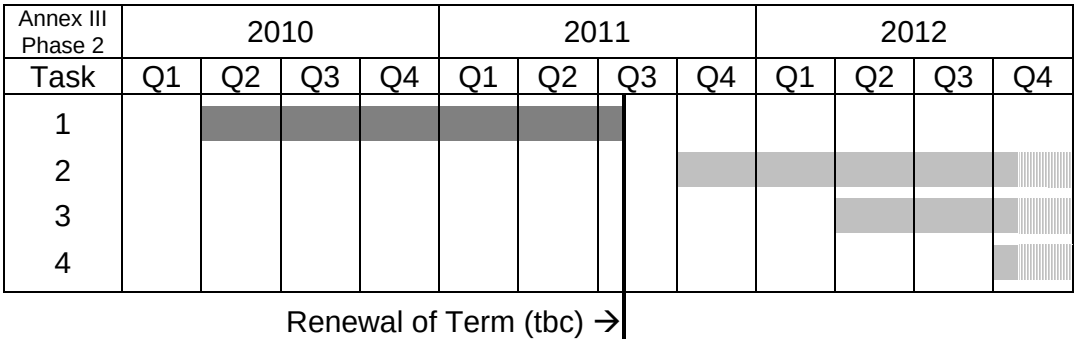
Participants will gain from an expanded awareness of the SmartGrid trials that are in progress, and the key elements and objectives of those trials. This will enable greater appreciation of the network physical requirements and the benefits that may accrue if transposed and applied to other distribution networks.

Timing of Tasks

All of the four proposed Phase 2 Tasks are suggested with activity expected to begin with the first Task in 2010-2011 and subsequent Tasks to run approximately sequentially from 2012-2013. However, each Task will only proceed subject to sufficient support being provided for it from the members. It is proposed that the four Tasks are progressed sequentially, starting with Task 1. Continuation of activities beyond July 2011 is contingent on a renewal of Term.

The programmes-of-work, subtasks and other activities within the Annex shall be performed in accordance with the Gantt chart shown below in Figure 5.1. (Activities beyond ENARD's present Term are illustrated solely for example).

At present, this is shown with Task 1 being conducted within the Term, and Tasks 2, 3, and 4 to follow at times to be discussed, if ENARD is extended. (This would be suitably revised if Task 2, 3, or 4 received more interest than Task 1).



Task 1: Options for Managing Assets Containing SF_6
Task 2: Options for Managing MV Overhead Lines
Task 3: Impact of Climate Change on Electrical Assets Operating at MV and above
Task 4: Asset Management for SmartGrids

Figure 5.1: Annex III Phase 2 Timescales

The programmes-of-work, broken down into sub-tasks within the Annex, shall be performed in accordance with the Gantt charts for each Task shown on the four pages that follow.

These programmes-of-work are all presented as possible alternatives within the Term, for comparison on a common basis. Each ENARD participating country may elect to participate in any one, or more, of the Tasks, as proposed.

The Task(s) receiving the greatest support would proceed through to formal start of work soonest, subject only to this / these achieving the minimum level of support, as required to execute the Task(s).

At time of writing and based upon the feedback from Phase 1, it is anticipated that Task 1, in relation to the management of assets containing SF_6, is most likely to be the initial starter Task within Annex III Phase 2. However, this will be

reviewed and amended as necessary, in the light of the Expressions of Interest received.

ENARD Annex III, Phase 2, Task 1: Identifying the options for managing assets that contain SF_6 and identify potential alternatives to SF_6.

Timetable. It is assessed that this Task will take no longer than 18 months to complete, with 3 (possibly 4) meetings of the project group, consisting of a kick-off meeting, one or two review meetings and a final meeting to review the draft final report. It is assumed that the Task will start in Q1 or Q2 2010. An outline timetable is shown below.

Annex III Phase 2	2010				2011			
Task	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
1.1								
1.2								
1.3								
1.4								
1.5								
1.6								

Figure 5.1: Annex III Phase 2 Task 1 Timescales

Operating Agent

It is proposed that EA Technology, UK will be the Operating Agent for this project.

Fee

The Fee for this project will be £16,000 per participating country, this is based a minimum of five participating countries.

Declaration of Intent

ENARD ExCo members will be asked to register their interest in participating in Task 1 of Annex III Phase 2.

ENARD Annex III, Phase 2, Task 2: Options for Managing MV Overhead Lines.

Timetable. It is assessed that this Task will take no longer than 18 months to complete, with 4 meetings of the project group, consisting of a kick-off meeting, two review meetings and a final meeting to review the draft final report. An outline timetable is shown below.

Annex III Phase 2	Year 1				Year 2			
Task	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
2.1								
2.2								
2.3								
2.4								
2.5								

Figure 5.2: Annex III Phase 2 Task 2 Timescales

Operating Agent

It is proposed that EA Technology, UK will be the Operating Agent for this project.

Fee

The Fee for this project will be £20,000 per participating country, this is based a minimum of five participating countries.

Declaration of Intent

ENARD ExCo members will be asked to register their interest in participating in Task 2 of Annex III Phase 2.

ENARD Annex III, Phase 2, Task 3: Identifying the effects of Climate Change on Electricity Network Assets.

Timetable. It is assessed that this Task will take no longer than 12 months to complete, with 3 meetings of the project group, consisting of a kick-off meeting, one or review meeting and a final meeting to review the draft final report. An outline timetable is shown below.

Annex III Phase 2	Year 1				Year 2			
Task	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
3.1								
3.2								
3.3								

Figure 5.3: Annex III Phase 2 Task 3 Timescales

Operating Agent

It is proposed that EA Technology, UK will be the Operating Agent for this project.

Fee

The Fee for this project will be £14,000 per participating country, this is based a minimum of five participating countries.

Declaration of Intent

ENARD ExCo members will be asked to register their interest in participating in Task 3 of Annex III Phase 2.

ENARD Annex III, Phase 2, Task 4: SmartGrids Asset Management.

Timetable. It is assessed that this Task will take no longer than 18 months to complete, with 3 (possibly 4) meetings of the project group, consisting of a kick-off meeting, one or two review meetings and a final meeting to review the draft final report. An outline timetable is shown below.

Annex III Phase 2	Year 1				Year 2			
Task	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
4.1								
4.2								
4.3								
4.4								
4.5								

Figure 5.4: Annex III Phase 2 Task 4 Timescales

Operating Agent

It is proposed that EA Technology, UK will be the Operating Agent for this project.

Fee

The Fee for this project will be £12,000 per participating country, this is based a minimum of five participating countries.

Declaration of Intent

ENARD ExCo members will be asked to register their interest in participating in Task 4 of Annex III Phase 2.

6 Rights and Obligations

6.1 Rights

The principal results and outputs from the Annex III programme-of-work will remain confidential to the Annex III Participants in each Phase 2 Task for a period of not less than two years after the completion of the Annex, unless all the Participants in the Phase 2 Task agree to an earlier release of information.

The Annex will also be required to produce an executive overview report of its activities, not containing any sensitive information or data, and which is suitable for publication in the public domain.

Although the Phase 2 programme-of-work, as proposed herein, is not anticipated to lead to the development of any new Intellectual Property (IP), the ownership and commercial exploitation of any IP which may be produced shall be established by the unanimous vote of the ENARD Executive Committee, consistent with Article 8 of the ENARD Implementing Agreement.

6.2 Obligations on the Operating Agent

The Annex III Operating Agent will be responsible for the overall management and delivery of the Annex III work programme and will work closely with the individual Participants, such as to ensure the effective and expedient delivery of its objectives. It will discharge its duties via the organisation and delivery of a programme of six-monthly Experts' meetings and via specific further activities, as may be required. The Operating Agent will submit regular six monthly reports to the ExCo and will implement the decisions of the ExCo.

The Operating Agent will be specifically responsible for:-

- the establishment of a co-ordinated framework for the collation of the desired information and data, the specification of their desired formats and for the compilation and appropriate cross-referencing of all the information received, such as to produce an authoritative, substantive and robust international information base in relation to the ageing, degradation, failure and EoL characteristics of the principal distribution asset categories;

- actively engaging with the network of National Experts, by means of one or more of the Experts' Meetings and via supplementary one to one dialogue, in order to elicit the necessary information in relation to the application, meaning and understanding of risk based definitions and methodologies in the participating countries;

- actively engaging with the network of National Experts, by means of one of more of the Experts' Meetings and via supplementary one to one dialogue, in order to elicit the necessary case study information on the application of asset management methodologies within the power distribution networks of the participating countries; and

- the production of the Annex deliverables, as described in section 4 above and for the commissioning of a dedicated Annex III restricted access area, within the structure of the existing ENARD web-site. This latter provision will provide an on-line information resource, for the use of the Operating Agent and the Annex Participants.

6.3 Obligations on the Participating Countries

Each participating country within Annex III shall be required to nominate one or more National Co-ordinators (otherwise known as a "National Expert" or "Expert"), as appropriate to each Task or Tasks. The National Experts will be expected to have a good working knowledge of distribution asset management terminology and methodologies. Each National Expert will be required to:-

- Provide the Operating Agent with a National Participation Letter, indicating their commitment to the Annex. The collective set of National Participation Letters represent the National Participation Plan;

- Attend and participate in the programme of Experts' meetings, to be organised by the Operating Agent in the discharge of its obligations;

- Support the Operating Agent in the discharge of its obligations via the timely and appropriate provision of information, data and other material, as may reasonably be required to service the requirements of the programme-of-work, as described in section 3 above;

- Take the lead responsibility on an individual national basis in relation to the sourcing and collation of any information inputs that may reasonably be required to service the requirements of the Annex;

- Take the lead responsibility on an individual national basis for the dissemination of the outputs from the Annex.

7 Budgets

The performance of Annex III Phase 2 will require a combination of financial and in-kind contributions, as shown below for each of the four Tasks described above.

Task 1: Options for Managing Assets Containing SF_6
Task 2: Options for Managing MV Overhead Lines
Task 3: Impact of Climate Change on Electrical Assets Operating at MV and above
Task 4: Asset Management for SmartGrids

7.1 Operating Agent

The Operating Agent role will be funded on a cost-share basis, between the participating countries. A financial contribution per participating country is required for the discharge of the Operating Agent's duties, subject to a minimum of five countries participating in any Task or Tasks of Phase 2, as outlined below.

Task 1: £16,000 per participating country

The corresponding financial contributions for alternative or sequential tasks, should ENARD be extended beyond July 2011, are shown below:

Task 2: £20,000 per participating country
Task 3: £14,000 per participating country
Task 4: £12,000 per participating country

Contributions from participating countries will be associated only with one Task at a time. A different mix of Participants for each Task is acceptable.

7.2 Annex Participants

The Annex Participants will be expected to support National Expert participation at a minimum level of person-weeks per participating country, over Annex III Phase 2 as indicated below.

Task 1: 10.8 person-weeks

The corresponding participation requirements for alternative or sequential tasks, should Phase 2 be extended beyond July 2011, are shown below:

Task 2: 13.4 person-weeks
Task 3: 9.6 person-weeks
Task 4: 8.4 person-weeks

Multiple Experts may be assigned, as appropriate, e.g. from the power distribution sector, industry R&D centres etc. The same person may also be assigned as Expert to more than one Task.

All participating countries will be required to provide National Expert representation and contribution to the relevant, Task specific, Experts' meetings, to be held throughout the discharge of Annex III Phase 2. Travel and accommodation costs for these meetings shall be the responsibility of the Annex Participants.

Active participation is expected outside of the programme of Experts' Meetings, including, but not limited to, ongoing dialogue and information exchange via e:mail, the Annex III portion of the ENARD web-site, occasional conference calls and related.

Late Participants

During the execution of Annex III Phase 1, a new Participant joined the Annex. For Annex III Phase 2, a minimum of five Participants is required for each Task that is undertaken. Should a sixth or subsequent member join a Task that is in progress, it is proposed that if they join between the first and second meetings that 50% of their fee be refunded to the existing Participants. Should they join between the second and third meeting, 20% of their fee would be refunded to the

other Participants. Thereafter, their full financial contribution shall be retained, in order to fully service the requirement of the Task(s).

7.3 Budgetary Overview

Table 6.1 below provides a budgetary overview of the contributions required from the Annex Participants, for the delivery of Annex III Phase 2.

Table 6.1:- Contributions required from Annex Participants for Annex III Phase 2

Annex III, Phase 2 Project, Role / Activity	**Financial / manpower provision**	
Proposed Task		
Task 1: Options for Managing Assets Containing SF_6	Apr. to Dec. 2010	Jan. to July 2011
Annex III Operating Agency[12]	£8,000	£8,000
Annex III National Co-ordination / National Expert Role	5.4 person weeks	5.4 person weeks
Alternative or Sequential Tasks		
Task 2: Options for Managing MV Overhead Lines	Year 1	Year 2
Annex III Operating Agency[13]	£10,000	£10,000
Annex III National Co-ordination / National Expert Role	6.7 person weeks	6.7 person weeks
Task 3: Impact of Climate Change on Electrical Assets Operating at MV and above	Year 1	Year 2
Annex III Operating Agency[14]	£7,000	£7,000
Annex III National Co-ordination / National Expert Role	4.8 person weeks	4.8 person weeks
Task 4: Asset Management for SmartGrids	Year 1	Year 2
Annex III Operating Agency[15]	£6,000	£6,000
Annex III National Co-ordination / National Expert Role	4.2 person weeks	4.2 person weeks

[12] Task 1. Subject to a minimum of five countries participating in the Annex
[13] Task 2. Subject to a minimum of five countries participating in the Annex
[14] Task 3. Subject to a minimum of five countries participating in the Annex
[15] Task 4. Subject to a minimum of five countries participating in the Annex

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8 Further Work

It is recognised at the outset that Annex III Phase 2 may well generate new ideas for the application of practical asset management techniques and/or identify the requirement for further targeted R&D. The Annex Participants shall therefore review the basis for any such further work, towards the end of Phase 2, or as may be requested by the ExCo. Subject to the conclusions of such review, the basis for the extension of the Annex, via future follow-on Phases shall be determined, for submission to the ExCo. There shall however be no obligation on any Participant in Annex III Phase 2 to participate in any future Phase(s) of the Annex, as may be decided.

Appendix 4:-

Annex IV “Transmission Systems”

International Energy Agency

Implementing Agreement

on

ELECTRICITY NETWORKS ANALYSIS, RESEARCH AND DEVELOPMENT (ENARD)

Annex IV
"Transmission systems"

Prepared
by

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1. Introduction

1.1. Background and Motivation

ENARD, the IEA Implementing Agreement on Electricity Networks Analysis, Research and Development, was established as a new Implementing Agreement in July 2006 with a view to facilitating 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 electricity markets, renewables integration, network renewal and network resilience.

ENARD's Annex I (Information Collation and Dissemination) work programme is responsible for the systematic collation and dissemination of T&D network related information and data and also for the organisation and delivery of a series of topical experts' meetings and workshops. The latter are regarded as a key enabling mechanism in the identification of priority areas, to be addressed in detail, in potential new Annexes.

One of the priority areas is power transmission. Transmission systems will continue to play a key role in the power systems of the future and are expected to become increasingly important for a number of reasons:

- The present emphasis on climate change and CO_2 mitigation is likely to result in an increased share of electricity as a primary energy carrier, with consequentially increased pressures to maintain high quality and secure electricity supplies.

- Present targets for development and deployment of renewable energy sources in general, and wind energy in particular, are a main driver for transmission system developments. Offshore wind, representing a vast and largely untapped potential, is a special challenge in this respect.

- A key challenge to be addressed in the context of any such massive development of variable generation such as wind relates to its regulation and balancing. This will require flexible transmission solutions, improved operational tools and enlarged balancing markets.

- The development of a fully integrated, liberalised market is a key element for the future and sets new challenges for the grids of the future. The user will become a key player in the electricity system.

- Transmission grids can be made more flexible and controllable as new technologies based on advanced power electronics become available.

- Permits for new installations of overhead transmission lines are difficult to obtain due to pressure of the general public. New challenges, both technical and economical, arise from the increasing trend to force the use of cables in transmission networks to avoid overhead lines.

ENARD's contribution to this process is to act as an authoritative, comprehensive and unbiased source of information, data and advice to Governments, policymakers and key industry stakeholders, whilst also supporting the IEA's G8 Gleneagles Programme-of-Work.

1.2. The ENARD Annex I Transmission Systems Workshop, September 2007

The ENARD Annex I transmission systems workshop[16] was convened to help develop the structure and content of a dedicated new ENARD work programme activity (Annex) in this area. The workshop drew the support of 24 participants from 12 countries and comprised a series of expert presentations, dedicated working groups and open discussion and dialogue.

Consensus was reached in relation to the development of a dedicated ENARD transmission systems Annex (Annex IV), with the objective of addressing various technological, operational and planning issues, such as to provide authoritative guidance to the IEA, G8 and CEC, whilst also being of real value and use to its essential TSO stakeholders. The workshop concluded by reaching agreement on the anticipated scope of the new Annex and for its forward development, with a view to its formal presentation to the April 2008 ENARD Executive Committee meeting.

1.3. Scope of Annex IV

The aim of the new Annex IV is to establish a long term vision for developments in transmission systems beyond 2020. The scope of the work includes addressing the main barriers towards a necessary development of transmission capacity and to identify the most promising solutions and challenges in terms of expansion planning and market analysis, secure operation of the transmission networks and the need for new transmission technology.

The Annex should be of real relevance to TSOs and other key stakeholders by addressing the most relevant issues, such as risk management, risk based planning, technology to enhance capacity and utilisation, lower maintenance and increased reliability by introducing new technologies.

Other key considerations in the development of the new Annex are:

- It should provide an added value extra-European dimension by helping facilitate high level political objectives and providing guidance to the IEA, G8 and CEC.
- It should address incentives to enhance transmission capacity (both via better use of existing systems and via planning and implementation of system expansions).
- It should similarly address the provision of adequate levels of system security.
- It should provide a valuable information exchange forum.
- It should provide insight on how market integration can be enhanced.
- It should give indication on how the integration of variable energy sources is enhanced by more flexible grids.
- It should identify and highlight examples of “best practice”.

It is emphasised that the new Annex must 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. Furthermore, it should demonstrate an appreciation and understanding of different TSO and political objectives (eg, via the “building of bridges” between political objectives and the tasks and responsibilities of the TSOs).

[16] Proceedings of the ENARD Annex I Transmission Systems Workshop, held in Trondheim, Norway, September 2007. EA Technology report no.6179, October 2007

2. Objectives

The main objective of the Annex is to establish a long term vision for developments in transmission systems with the aim to serve as an essential information exchange forum and service ENARD's 3Rs of power systems development, namely network Renewal, Renewables integration and network Resilience.

The work will address the main barriers towards a necessary development of transmission capacity and identify the most important challenges in terms of expansion planning and market analysis, secure operation of the transmission networks and the need for new transmission technology. In addition to the integration of renewables the focus has to include all new low carbon generation, including clean fossil fuels and new nuclear energy, as these are all essential in terms of long term network developments.

The long term vision will identify and describe the most promising solutions related to the various technological, operational and planning aspects, including the need for development and application of new methods and tools. Finally the Annex should address the specific R&D activities needed as a result of the vision.

The Annex will be organised in two main activities focusing on the different areas of responsibility for transmission system operators:

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

A close coordination is necessary between the work carried out in the two activities in order to avoid overlaps and realising that for example the tools developed for operational purposes could also be of interest for planning studies. There is also a significant potential in integration of the various tools that are used for more efficient data management.

3. Activities

Task 1: Expansion Planning and Market Analysis

Context: Unbundling of the electric power industry creates new challenges for transmission expansion planning, in terms of environmental concerns (difficulties in getting construction permits especially for overhead lines), cost of transmission projects and the uncertainties concerning the benefit and profitability of transmission projects in a changing environment. The time horizon from planning and consenting processes to actual construction and commissioning of transmission projects are often longer than the corresponding process to construct new power plants. This represents a huge challenge towards the development of cost optimised and efficient transmission networks.

Objective: The aim of this activity is therefore 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.

Scope: Support tools are expected to be of increasing importance and value for various tasks related to transmission planning. The main challenges and possible activities of interest to this task include:

- Transmission system planning in context of market rules.
- Analyses related to societal levels of risk and cost.
- Policy towards undergrounding.
- Risk based planning.
- Regulatory issues and consenting processes:
    - Investment incentives for cross border capacity.
    - Financing of transmission system infrastructure.
- Analyses related to grid solutions and integration of large scale wind power (onshore and offshore grids) and of other variable energy sources (photovoltaics, tidal).
- Analyses of congestion management and efficiency of the power markets.
- Selective introduction of competition for system expansions.
- Most promising (existing and emerging) technologies.

Deliverables: D1 - Report on availability and application of planning tools, market and network models and on the identification of need for new tools

Target audience: Transmission system operators, regulating authorities, political decision makers, researchers

Activity 1.1: Assessment of available methods and tools for transmission expansion planning

Activity 1.2: Potential of transmission technologies in enhancing power system exploitation

Activity 1.3: Identification of requirements for tools addressing new transmission planning needs

Task 2: System Operation Management and Security

Context: The development of electric power systems with a larger mix of generation technologies and an increased penetration of renewable energy sources is expected to lead to larger and more frequent changes in generation and load behaviour in the future. Generation will also be located further away from demand. This emphasises the need for new methods and tools for monitoring and control of power systems, including the activation of the loads (demand side participation).

Objective: The aim of this activity is therefore 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. This also includes market design and management of balancing services, as well as methods for adequate provision and distribution of operational reserves and other ancillary services. The development of real time markets is an essential element.

Scope: A key issue to be addressed is the operational challenges related to massive development of offshore wind power. One example to illustrate this problem area is the visions of a North Sea "supergrid" to harness the potential of deep water offshore wind and tidal energy. Development of the necessary transmission capacity to tap into this potential and its control is a huge task. This requires new thinking about the management and exchange of balancing services, and the possibilities and impacts of enlarged control areas (across borders and interconnections) need to be thoroughly analysed.

Another area of interest is Wide Area Monitoring Systems (WAMS) based on synchronised phasor measurements. Together with developments in ICT this technology provides for a number of new applications and functions within control centres related to state estimation and situational awareness. The contribution of this Annex would be to identify and describe the most promising applications from a system operation point of view.

Important challenges and possible activities of interest to this task include:

- Development of balancing and real time markets.
- Probabilistic (risk) based operation planning methodologies.
- Development of flexibility (e.g. frequency response capability) of low carbon generation plant including renewables to ensure adequate balancing cover under rapidly varying generation mix.
- Load (demand) as a resource with reference to the IEA's Implementing Agreement on Demand Side Participation (DSP).
- Application of WAMS for improved situational awareness.
- Application of power flow control in the grid (phase shifting transformers, FACTS and HVDC).
- Crisis management/security of supply.

Deliverables: D2 - Report on availability and application of advanced operational tools and on needs for new operational monitoring and control tools

Target audience: Transmission system operators, regulating authorities, political decision makers, researchers

Activity 2.1: Assessment of available methods and tools for operational monitoring and control

Activity 2.2: Role of transmission technologies to enhance power system control

Activity 2.3: Identification of needs for new methods and tools to manage balancing control

4. Deliverables

The main deliverables will be workshops and reports, including an executive summary report

- Workshops, tentatively in collaboration with other relevant organisations, such as CIGRE.

- Reports:
    - D1 - Report on availability and application of planning tools, market and network models and on the identification of need for new tools
    - D2 - Report on availability and application of advanced operational tools and on needs for new operational monitoring and control tools

- Executive summary describing a long term vision for developments in transmission systems, the need for further R&D and recommendations regarding policy developments.

5. Timescales

Annex IV will be implemented over a 2 year period, commencing at such time as five countries are able to commit to the Annex. For initial planning purposes, a 1st January 2009 commencement is assumed, but the start-up workshop may be in late 2008 if possible.

The programme-of-work, tasks and other activities within the Annex shall be performed in accordance with the Gantt chart shown in the figure below.

Activity	**Year/quarter**							
	2009				**2010**			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Annex work planning								
Task 1								
Activity 1.1								
Activity 1.2								
Activity 1.3								
Task 2								
Activity 2.1								
Activity 2.2								
Activity 2.3								
Final reporting								
Expert meetings (XM) Workshops (WS)	WS Startup		XM		XM			XM (final)

6. Rights and Obligations

6.1. Rights

The principal results and outputs from the Annex IV programme-of-work will remain confidential to the Annex IV Participants for a period of not less than two years after the completion of the Annex, unless all the Participants agree to an earlier release of information.

The Annex will also be required to produce an executive overview report of its activities, not containing any sensitive information or data, and which is suitable for publication in the public domain.

Although the programme-of-work, as described herein, is not anticipated to lead to the development of any new Intellectual Property (IP), the ownership and commercial exploitation of any IP which may be produced shall be established by the unanimous vote of the ENARD Executive Committee, consistent with Article 8 of the ENARD Implementing Agreement.

6.2. Obligations of the Operating Agent

The Operating Agent (OA) is responsible for the overall technical and administrative management of work performed within Annex IV and for implementing the decisions of the IEA ENARD Executive Committee. The work is structured on two levels: Annex and Activities. The OA and the Activity leaders are responsible for the work undertaken at these levels as follows:

Operating Agent:

- Coordination, scheduling and communication between Activities.
- Assisting Activity leaders.
- Preparing, leading and summarizing Annex meetings (twice annually).
- Reporting to IEA ENARD Executive Committee (status & annual reports).
- Coordinate/ensure publications of technical reports and other materials.

The responsibility as Operating Agent will be shared equally between CESI RICERCA and SINTEF energy Research.

6.3. Obligations of the Participating countries

Each participating country within Annex IV shall be required to nominate a National Co-ordinator (otherwise known as a “National Expert” or “Expert”). The National Experts will be expected to have a good working knowledge of transmission system operation and planning terminology and methodologies. Each National Expert will be required to:

- Provide the Operating Agent with a National Participation Letter, indicating their commitment to the Annex. The collective set of National Participation Letters represent the National Participation Plan;
- Attend and participate in the programme of two Experts’ meetings per year, to be organised by the Operating Agent in the discharge of its obligations;
- Support the Operating Agent in the discharge of its obligations via the timely and appropriate provision of information, data and other material, as may reasonably be required to service the

requirements of the programme-of-work, as described in section 3 above;

- Take the lead responsibility on an individual national basis in relation to the sourcing and collation of any information inputs that may reasonably be required to service the requirements of the Annex;
- Take the lead responsibility on an individual national basis for the dissemination of the outputs from the Annex.

The work is further structured on two levels: Tasks and Activities. The Task Leaders and the Activity Leaders are responsible for the work undertaken at these levels as follows:

Task Leader:

- Prepare task plan and scheduling.
- Coordination, scheduling and communication between activities
- Produce and submit deliverables at Task level to OA

Activity Leader:

- Prepare activity plan and scheduling.
- Coordinate activity work and communicate with other participants.
- Reporting on activity work to Task Leader.

7. Budgets

The performance of Annex IV will require a combination of financial and in-kind contributions, as described below.

7.1 Operating Agent

The Operating Agent role will be funded on a cost-share basis, between the participating countries. A financial contribution of EUR 23,000 per participating country is required (payable over the 24 months of Annex IV) for the discharge of the Operating Agent's duties, subject to a minimum of five countries participating in the Annex.

7.2 Annex Participants

The Annex Participants will be expected to support National Expert participation at a minimum level of 4 person-months per participating country, over the 24 months of Annex IV. Multiple Experts may be assigned, as appropriate, e.g. from the power transmission sector (especially TSOs), industry R&D centres etc.

All participating countries will be required to provide National Expert representation and contribution to the four Experts' meetings, to be held throughout the discharge of Annex IV. Travel and accommodation costs for these meetings shall be the responsibility of the Annex Participants.

Active participation is expected outside of the programme of Experts' Meetings, including, but not limited to, ongoing dialogue and information exchange via email, the Annex IV portion of the ENARD web-site, occasional conference calls and related.

7.3 Budgetary Overview

Table 7.1 below provides a budgetary overview of the contributions required from the Annex Participants, for the delivery of Annex IV, based upon the assumption of a 1st January 2009 commencement.

Table 7.1:- Contributions required from Annex Participants for Annex III

Role/Activity	**Financial/manpower provision**	
	2009	**2010**
Annex IV Operating Agency	EUR 12.000,-	EUR 11.000,-
Annex IV National Coordination/ National Expert role	2 Person Months	2 Person Months

8 Related working groups and activities

Task 1

IEA Wind Energy Systems – Annex 25: Design and Operation of Power Systems with Large Amounts of Wind Power
IEA Demand-Side Management – Annex 17: Integration of Demand Side Management, Energy Efficiency, Distributed Generation and Renewable Energy Sources
CIGRE Study Committees
- C1: System Development and Economics
- C5: Electricity Markets and Regulation

IEEE Power & Energy Society: Technical Committee Power System Planning and Implementation

Task 2

IEA Wind Energy Systems – Annex 21. Dynamic models of Wind Farms Power System studies
IEA Demand-Side Management - Annex 18 Demand Side Management and Climate Change
VLPGO: Very Large Power Grid Operators
CIGRE Study Committee
- C2: System Operation and Control
- C4: System Technical Performance

IEEE Power & Energy Society Technical Committee Power System Operations
IEEE Power & Energy Society Technical Committee Power System Analysis, Computing and Economics

9 Further Work

It is recognised at the outset that Annex IV may well generate new ideas for the application of practical transmission system techniques and/or identify the requirement for further targeted R&D. The Annex Participants shall therefore review the basis for any such further work, towards the completion of the Annex, or as may be requested by the ExCo. Subject to the conclusions of such review, the basis for the extension of the Annex, via future follow-on Annexes shall be determined, for submission to the ExCo. There shall however be no obligation on any Participant in Annex IV to participate in any future Annexes, as may be decided.