Position paper by the RELIANCE Consortium on the Green Paper

"A European Strategy for Sustainable, Competitive and Secure Energy"

Catalyzing the Research in Electrical Transmission System Activities

RELIANCE Consortium

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Table of Content

1. Introduction

The following paper is the position of the RELIANCE Consortium[1], in response to the publication of the "Green Paper: A European Strategy for Sustainable, Competitive and Secure Energy", COM(2006)105 8.3.2006.

The Green Paper addresses objectives of crucial importance for the future European economic and social development: sustainability, competitiveness and security of supply.

The RELIANCE Consortium focuses on the future ability of the **electricity transmission system** to meet the above objectives. It argues that the key success factors to reach such goals are:

(i) a critical number of experts in the electricity sector,

(ii) the generation of knowledge and new innovative solutions to solve electricity transmission challenges

(iii) a regulatory environment that supports retention of experts and knowledge generation.

This paper describes how the on-going work of the RELIANCE Consortium supports and complements the objectives of the Green Paper and hence contributes to the discussion on how to attain these goals.

2. Background

The liberalization of power markets and the ongoing implementation of the European Electricity Market have led to power flows that could not have been foreseen in magnitude and direction at the time of the design of any of the European Transmission networks and their links.

The large scale capture of wind energy, as already implemented in several Member States, and its further development, may expose interconnected transmission systems to major risks: power imbalances and unpredicted flows for which these systems have not been designed.

The expected growth of distributed generation[2] and the expansion of the Internal Electricity Market, will further affect the effectiveness of European Transmission

[1] in charge of an EC funded Coordination Action on transmission network research activities

[2] especially the deployment of the renewable energy sources in line with the Kyoto protocol orientations

Networks as well as the technical and economic performance of the whole electricity system.

Recent blackouts have painfully demonstrated the strong interactions between the various national transmission systems and the need to approach the transmission activities as an integrated European Transmission Network rather than a set of interconnected national transmission networks. The necessary coordination and information exchange between the network operators extend beyond the operational level into the research and development work on transmission system design, operation and control.

Several side effects of the liberalization of the energy sector currently hamper the effectiveness and critical mass of the transmission system related research and development: the unbundling of the incumbent monopolies has disbanded most of the in-house research teams into commercial or non-transmission system related work - the urgent priority of the transmission system operators today is to restructure their business models. At the same time, regulatory authorities are increasing their pressure for short term cost reductions and accountability.

Coordination at the European level has already taken place at the regulatory level through CEER/ERGEG and within ETSO[3] at the TSO level.

A similar structure should be created to expand and coordinate Research and Technological Development (RTD) efforts on transmission activities in Europe. This effort of all stakeholders coordinated by the TSOs is urgently needed and will result in the creation of new knowledge, implementation of new methods and development of new facilities, hardware and software. Coordination of research efforts will also help to reach progressively the right critical size of expert groups to address the issues that are relevant both at Member States and EU levels.

It is the direction followed by the RELIANCE Consortium[4], which proposes several relevant orientations in support of a European Transmission Network:

- **optimize the reliability to support electricity supply as a vital, cost-efficient energy system**;
- **increase the integration of the electricity market**;
- **support the massive penetration of RES and DER**;
- **improve the system robustness and resilience**;
- **achieve a sustainable grid development**.

The Consortium members have set the following objectives over the two year duration of the Commission contract ending in October 2007:

[3] and affiliated technical bodies (UCTE, NORDEL, UKTSOA, ATSOI)

[4] a group of eight European Transmission System Operators, one Power Producer, one Distribution System Operator, one Consultant and several Research Centres and Universities (see Appendix).

- **Identify the challenges** faced by the European transmission system up to 2030;
- **Identify and prioritize the research needs** that require collaboration between European TSOs and other stakeholders;
- **Evaluate the potential impacts** of the innovative solutions on all the electricity system stakeholders;
- **Design collectively a research roadmap** and assess its implementation risks;
- **Quantify the research efforts** that have a demonstrable European impact;
- **Propose an appropriate framework** leading to an independent permanent European research organization for transmission networks;
- **Design funding schemes** based on private-public partnerships;
- **Disseminate the project outputs** through a European conference to be held around mid 2007;
- **Keep including other stakeholders** in this process (TSOs, public authorities, users of the electrical system, manufacturers and other RTD providers).

3. Comments on the Green Paper priority areas

The Green Paper identifies six key priority areas where action is necessary to address a European energy strategy. Proposals are made to meet the three strategic objectives of Europe's energy policy: **sustainability, competitiveness and security of energy supply**.

It is shown below how each of these key priority areas can be served by the creation of an independent permanent European Power System Research Organization:

3.1. Competitiveness and the internal energy market

The completion of the internal electrical market means new RTD needs for the independent transmission system operators:

- **Further harmonization of the security standards to allow even more massive power exchanges while maintaining the reliability of the transmission system at an adequate level**: as pointed out in the Green Paper, further RTD work is required on grid codes and grid access levels with impacts on data sharing between network operators, but also easier access to network data for market actors to enable effective risk assessments for investors in generation assets across Europe, both for investment decisions and during operation of generation assets.

- **Harmonization of the congestion management techniques and better understanding of interactions between power market and reliability and between electricity market and other energy markets**: significant progress must be made to better support the retail markets and market based demand side participation.

- **RTD work on the interdependencies between market design, market coupling and transmission system information exchanges to consolidate the disparities in retail, ancillary services and transmission capacity markets**: this research will improve the competitiveness of European generators, encourage market entry as well as enhance market efficiency and subsequent investments incentives.

- **New planning and design methods for new transmission investments to meet market needs. New business models for transmission operation and assets maintenance are also needed by transmission system operators acting as market facilitators**: work in this area will improve, for instance, effectiveness and efficiency of heavy interconnection investments justified by cross-borders transits or interconnection with electrical systems beyond UCTE, UKTSO and NORDEL.

- **A coordinated research agenda on the European transmission system and the internal electricity market acting as a precursor to other integrated systems**: Europe represents only 1/10 of the world market when a number of European manufacturers and engineering service providers are global players in the transmission systems business. Competitiveness of the European industry will be boosted with positive impacts on the exports of equipment, technology and service suppliers.

The RELIANCE Consortium proposes changes that support economic competitiveness at two levels. The effective full functioning of integrated energy market have a positive effect on end-user prices, which increases the competitiveness of European industry and commerce in general compared to other markets. With respect to European equipment manufacturers and relevant service providers, the independent power system research provides the TSOs with new innovative system solutions for which the manufacturers and providers can provide new or improved components, systems and services. While working together with the European TSOs as demanding and well informed buyers, the equipment manufacturers and service providers will have to increase their own expertise to match the demand, which, in turn, will increase their competitiveness on a world market that is ten times bigger in size than the local European. It is the opinion of the RELIANCE Consortium that the new knowledge generated will provide lasting improvements in competitiveness for all the market stakeholders and operators and users of the electricity system. **This should be one of the primary objectives of the European Centre for Energy Networks proposed in the Green Paper.**

3.2. Diversification of the energy mix

A diversification of the energy mix is aimed at in the near future: massive penetration of renewable energy sources, wind power generation, heavy reinvestments in nuclear generation or displacements of the main generation centers

towards borders of Europe to reflect fuel price differences (import of coal and biomass).

It crucially depends on the ability and readiness of the electricity transmission system to react to changes in the above generation patterns.

New solutions must be found to provide the electric transmission system operators with the flexibility needed to accommodate for the forthcoming diversification of the energy mix. One can mention:

- **New network architectures, control/command structures and related standards and grid code adjustments**: they are necessary to cope with new generation technologies constraints and opportunities, such as the prerequisites for the involvement of DER and RES in ancillary service provision;

- **Proactive analysis and development of market mechanisms and products such as dedicated balancing techniques, reflecting the intrinsic intermittent nature of the RES**: this is necessary to promote the effective and cost efficient use of RES;

- **Development of new knowledge oriented towards the management of environmental constraints, forecasting of RES generation and reserve management**: these are critical tools for the reliability of the transmission system at the planning stage, but also at the operational stage such as the upgrade of the emergency management strategies;

- **New generation of robust and reliable modeling tools**: they will then be used by the various stakeholders at the planning and operational stages in order to improve cost efficiency, time performance and to reduce operational uncertainty.

It is the opinion of the RELIANCE Consortium that, changing generation patterns and massive penetration of RES and DER, will require major changes in the electricity transmission systems. These changes call for the coordinated development of new knowledge through a significant increase in European RTD efforts. Again these changes can serve as important asset for international competitiveness in systems and services.

3.3. Solidarity

The Green Paper acknowledges that network security is an integral part of the European security of supply and as such should be addressed at the European level.

Regarding the transmission activities, the following main challenges are identified and deserve dedicated RTD efforts:

- What are the **reliability and security requirements** of the transmission system users? How to translate those new requirements into design criteria, operational codes, cross-border restoration procedures and training of operators?

- How can **new technologies** such as the massive deployment of Phasor Measurement Units (PMU) and Wide-Area Measurement System (WAMS) or the European Galileo system improve real time knowledge of the state of the European transmission system and emergency controls acting as the last line of defense to **avoid widespread blackouts**?

- How does the design of the system need to be adapted to include threats that could affect its **physical and cyber security**?

- What are the **interactions** between the electrical, natural gas, carbon emission and renewable **energy markets**?

- How to better package, disseminate and implement new solutions at European level especially in regions of Europe for which the critical mass is not fulfilled to address efficiently the above challenges?

A European Organization dealing with the RTD challenges of the European Transmission System will contribute per se to reinforce the solidarity between Member states in term of security of supply. It will support the proposed European Energy Supply Observatory and the European Centre of Energy Networks with regards to the electrical system. It will serve the network security by the injection of new knowledge and innovative technological solutions.

The RELIANCE Consortium strongly believes that coordinated efforts to better serve the common needs of the electric transmission systems and the integrated energy market can foster solidarity among member states, where even the smallest player may have an important role in the integrated energy system. An independent permanent European research organization will help foster the equitable and efficient development of the European energy system, with a capacity to address intertwined natural gas, emission, various certificates and electricity network issues.

3.4. Sustainable development

The Green Paper underlines the need to tackle security and competitiveness of energy supplies through the sustainability, efficiency and energy mix diversity. According to the RELIANCE Consortium, this requires a sustainable transmission system development which is compatible with the long-term environmental, social, technical and economic requirements of a sustainable energy policy. In particular, the need to reconcile contradictory demands for cost-efficient network capacity expansions and the resistance of local communities to these installations calls for an in depth revisit of the decision processes and technologies involved.

The future will be increasingly characterized by a more efficient use of the existing transmission corridors, i.e. to do more with the existing infrastructures by using new technologies, by more correctly estimating in real time the transmission reliability margins through better observability but also through real time prediction of the physical limits and very fast corrective measures. Efforts should be devoted to more effective siting and permitting procedures, together with RTD efforts to improve social acceptance of transmission equipments.

This implies a better understanding of the benefits for society of the transmission system but also a technological effort in the directions of environmental impacts and equipment decommissioning. For example, replacing overhead transmission lines by underground cables presents massive technical and economic problems that can be minimized only through increased RTD efforts.

The RELIANCE Consortium believes that the transmission system development can support sustainability through the massive integration of renewable energy resources, the use of new generation locations and the increased use of new technologies and processes to site, design, construct, maintain and operate transmission systems. Since this common challenge surpasses the scope of any single transmission system, only an orchestrated initiative like the European research organization is capable of addressing the above issues effectively and efficiently.

3.5. Innovation and technology

According to the International Energy Agency, the energy infrastructure investments are estimated at 16 trillion dollars in the next thirty (30) years from which 2/3 will be dedicated to electricity investments and 10% dedicated to European electrical infrastructures[5]. If one accepts that only 10% of this amount is dedicated to electrical transmission activities and only 3% is allocated to RTD, this represents an annual spending of 106 M$ in RTD over 30 years devoted only to asset replacement.

This figure does correlate with about 150 M€ worth of European RTD efforts (1% of the total turnover of the organizations composing ETSO[6]). The amplitude of such efforts and the need to converge towards a harmonized European transmission system, strongly favor the integration and the coordination between EU and Member States research and innovation programs.

It is the RELIANCE Consortium's opinion that the magnitude of RTD efforts goes well beyond the DG-Research Framework Programs (FP7 and beyond) capabilities that can be allocated to transmission system research. The requested RTD

[5] A 40%, 10% and 50% allocation key is assumed between the generation, transmission and distribution sectors, European infrastructures representing 10% of world total infrastructure needs.

[6] The transmission activities portion of the ETSO organizations annual turnover is cautiously estimated at 15 billion Euros.

organization should act as a key partner to strengthen the European research efforts to meet the commonly agreed EU levels goals and to prevent overlaps in national technology and RTD programs. It should have critical mass and represent all the transmission system operators, users and stakeholders including the EC and National authorities to impact the equipment standards that are more and more defined worldwide and accounting for other markets needs (Asia or North America).

As identified in the Green Paper, another important and potentially critical issue is the insufficient human resource mobilization at public, private and academic levels leading to suboptimal development of the system due to insufficient high skilled human resources (especially engineering but also economic and regulatory).

The RELIANCE Consortium is convinced that the transmission system is a vital component of the single market: it raises scientific, technological and economic challenges to be addressed by conscious and systematic RTD efforts. Given its strategic integrated role in the energy sector, innovation and technology in transmission system design, operation and control will create cascading benefits for lower voltage networks, generation, energy utilization, hardware manufacturers and information technology providers all over Europe. The establishment of an independent permanent research organization will guarantee the retention and recruitment of human and financial resources not only to generate incremental improvements in existing technologies, but also the capability to launch breakthrough innovation projects based on the appropriate stages of research, development and field testing.

3.6. External policy

The need for a coherent external energy policy is clearly established in the Green Paper. It translates into a set of recommendations and related policy tools such as the need for a strategic EU energy review and a set of new initiatives towards the pan-European Energy Community.

The RELIANCE Consortium has identified several cross benefits of having an integrated RTD organization dealing with the transmission activities:

- Several large electrical interconnections are ongoing and this process should continue. Such an RTD Organization could **support organizations such as UCTE** in charge of the extension eastward and southward of the European electrical system extending the Internal Electricity Market “from Lisbon to Vladivostok”.

- Similarly to ITER and other wide scale European initiatives, the Green Paper recommended a **single reference point** providing an appropriate format for external partnerships: this is fully relevant for RTD projects. It will enable, in parallel with manufacturer global player corporate RTD efforts , to reach the critical mass of coordinated RTD actions and a stronger

position of the pan-European energy community in RTD partnerships with countries like Japan, US, China or India. Today those partnerships are mainly decided at the National level while those single reference points already exist in the other areas of the world (CRIEPI in Japan, EPRI in the US play this very peculiar role with respect to transmission activities in these countries).

- Additionally, a world class single reference point would **encourage mobility and cross fertilization** of European experts but also attract world wide top skilled RTD players.

The RELIANCE Consortium pinpoints that the building of a clear external policy requires a shared, sound and fact-based internal knowledge about current and future functioning and development of the European transmission system. An independent research organization will become a recognized partner to assist in the design of such a policy, to develop the contacts with international centers of excellence and to help focus attention on the European model through a critical mass of solid research in the area.

4. Scope of the permanent and autonomous European Power System research organization

One of the main missions of the European Commission is to maximize welfare of Europe. RTD and innovation processes coordinated at European level are not an increase of costs for end-consumers, but rather an instrument to increase current and future welfare. However, there might be possible discrepancies in the definition of welfare at Community and National levels. For instance, RTD promoting European welfare through addressing RTD subjects with cross border impacts may fall between the concerned Member State interests: they will not be recognized as eligible at Member State level, whereas the only possible implementation mode is through European cooperation.

The regulatory context is rapidly evolving in that frame through the increasing role of CEER/ERGEG in the monitoring of transmission system activities.

The main “raison d’être” of a permanent and autonomous European power system research organization is to guarantee effective and efficient RTD efforts addressing European transmission system issues (interconnected power systems challenges such as wind impact, reliability harmonization, grid code, data exchanges, market mechanism such as balancing etc…), having in mind benefits of all European transmission system users and stakeholders.

The **effectiveness** of the research organization is provided through:

- its **independence** that enables the unbiased selection of crucial projects of system-wide importance without resorting to local interest groups,

- its **focus on a precise technological and scientific area**, the transmission system operations, which provides focus for project selection, monitoring and evaluation,
- its **broader scope** to encompass all stages from innovation, research, technology development, field tests, pilot implementations to operators training, which warrants for the applicability of the results,
- its **close links to all transmission system stakeholders** through the initial project specifications down to field studies, maintaining a focus on relevant issues.

The **efficiency** of the research organization is provided by:

- its **lean structure** to encompass only a minimal set of experts to select, monitor, control and evaluate international research and technology providers retained for funding on the basis of objective and transparent criteria,
- its ability to address both **system-wide long-term** issues with a critical mass of researchers and system operators and **system-specific** issues with ad hoc groups of operators pursuing a particular interest,
- its **flexible financing model** that permits both the support of long-term projects and the occurrence of system-specific projects with adequate project selection criteria to qualify for both private and public funding,
- its **economies of scale** in the professional management of a large budget of related research projects in close cooperation with the stakeholders,
- its **coordination synergies** in the added quality and reduced lead time through pooling staff, data and information on all relevant phases of the RTD.

The RELIANCE Consortium concludes that the consolidation of RTD on transmission systems brings **numerous advantages** both at industrial, societal and environmental levels. Nevertheless, as any coordination action, it requires **awareness** and a **forward-looking perspective** among Member States, European regulatory authorities and funding agencies. This is a prerequisite to guarantee an adequate financing of the organization as well as an explicit recognition of the RTD resources and efforts provided by transmission system operators and other regulated entities within regulatory performance reviews. Only a **clear common policy from the regulatory authorities** will guarantee the long-term subsistence of the independent research organization.

Last but not least, the scope of work of the electricity networks can be enlarged to natural gas networks. The responsibility for the Integrated Energy Market is indeed shared among the electricity and gas sectors, among which the transmission system operators in both sectors are assigned key coordination tasks. It is the conviction of the RELIANCE Consortium that many of the system-wide issues addressed herein,

together with the RTD organizational model are independent of the energy vector under scrutiny. It is therefore foreseeable that a similar process for the gas sector could be envisaged, thus benefiting form the expertise gained in RELIANCE.

Appendix

The RELIANCE Consortium is composed of four types of Partners:

- A group of representatives of the TSOs:

  - CEPS, a.s. (Czech Republic),
  - ELES Elektro-Slovenia, d.o.o. (Slovenia),
  - ELIA SYSTEM OPERATOR (Belgium),
  - ENERGINET.DK (Denmark),
  - RED ELECTRICA DE ESPAÑA (Spain),
  - STATNETT (Norway),
  - TENNET bv (The Netherlands),
  - TERNA SpA (Italy).

- A representative of the DSOs

  - EDF (France).

- A representative of the power producers

  - SUEZ-TRACTEBEL (Belgium).

- A group of expert organizations, Universities and Research Centres, representatives of RTD performers on Power Transmission Networks:

  - FEEM SERVIZI SRL (Italy),
  - FGH - FORSCHUNGSGEMEINSCHAFT FÜR ELEKTRISCHE ANLAGEN UND STROMWIRTSCHAFT E.V. (Germany),
  - ISET- INSTITUT für SOLARE ENERGIEVERSORGUNGSTECHNIK (Germany),
  - KATHOLIEK UNIVERSITEIT LEUVEN (Belgium),
  - SINTEF (Norway),
  - TECHNOFI S.A. (France),
  - UNIVERSITY OF MANCHESTER (UK).