



Coordination of the European transmission network research activities

RELIANCE Coordination Action

Towards a *European Centre for Electrical Networks*

FAQ

A short description of the
recommendations through
the most frequently asked questions

The RELIANCE Consortium is made of SUEZ-TRACTEBEL, ELIA, ENERGINET.dk, TERNA, RED ELECTRICA, STATNETT, TENNET, ELES, EDF, FGH, FEEM Servizi, ISET, SINTEF, TECHNOFI, UoM, KUL and CEPS

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Towards a *European Centre for Electrical Networks*

A short description of the proposal

The European interconnected Electricity Transmission Network (ETN) is the backbone of the Internal Electricity Market (IEM). This network should be openly accessible to all market participants and should provide enough **reliable transmission capacity** to give consumers access to a mix of primary energy sources with **sustainable energy sources**.

Since the Directive of 1996, the progressive energy market liberalisation in Europe has **increased energy exchanges** between the EU Member States and beyond. The massive integration of wind generation will amplify such cross-border trading.

New knowledge and solutions are therefore required to cope with these major changes, avoid major continental power disruptions and secure the ETN reliability, robustness and flexibility **at an acceptable cost**.

The Coordination Action RELIANCE is part of the Sixth Research and Technological Development Framework Programme of the European Commission. It results of an initiative of Suez-Tractebel which organised a group of eight European Transmission System Operators, one Distribution System Operator and several Research Centres and Universities. This group shares a common understanding of the needs to resume joint RTD tasks on power system issues.

Since late 2005, the RELIANCE consortium has designed a R&D roadmap to meet these **new knowledge challenges**. It has **also** shown that the current level of research and development (R&D) in Europe is **insufficient to address the issues described above properly**. Each national electricity transmission system was optimized separately. **The current, rather loose interconnection of such systems is no longer optimal at a European level**. Similarly, integrated Europe-wide R&D investments are required to handle the increasingly trans-national issues caused by the intensifying cross-border trading and interdependencies.

A substantial industry commitment to a long-term R&D programme is therefore required. This commitment should take the form of a **European Organisation** dedicated to transmission system issues. This initiative should be launched as early as 2008 and should be based on the following goals and principles:

- ✓ *A coherent R&D programme must be implemented collaboratively: this programme must address the concerns of all the stakeholders beyond the limited scope of each national transmission system. This R&D programme appraisal should not be limited to the local level but extended to the European level to consider all positive and negative externalities.*
- ✓ *Major changes are required in the way R&D on European power transmission is funded: the first estimates to complete the R&D programme reach 1.5 billion Euros for the next 10 to 20 years. Such a large amount cannot be funded using the existing national or European R&D instruments.*
- ✓ *Transmission System Operators (TSO's) are the focal points of the process of innovation in the electricity transmission system: TSO's will be the main users of the results of this R&D programme. They must therefore be at the heart of its management and of its funding mechanism.*

- ✓ ***R&D priorities for the Europe-wide transmission network might differ from those set by national regulators:*** A separate funding stream is needed to help them deal with these issues.
- ✓ ***The research to be undertaken under this umbrella must be to the benefit of the consumers.*** They must therefore ultimately pay for the costs of this European R&D initiative. This European R&D cost must be recognized as eligible by the national Regulatory Authority of each participating TSO.
- ✓ ***These European R&D activities should be monitored by the European Authorities on behalf of the European citizens:*** this will ensure that market integration of the R&D results works to the benefit of all the stakeholders (electricity consumers, but also generators, distribution, and retail companies, as well as manufacturers of electric equipment).
- ✓ ***Dedicated R&D management to package the R&D results into operational solutions for the transmission system stakeholders:*** such management is needed to deliver the research results expected by the TSOs and the other stakeholders
- ✓ ***Management of Intellectual Property Rights designed to facilitate a fast implementation of innovative ideas by the market players:*** an open access policy must be adopted because the research is produced with the financial support of the European consumers.

The preliminary conclusions of the RELIANCE consortium will be presented to all stakeholders through a series of workshops that will take place from January to April 2007. The goal of these workshops is to refine the R&D roadmap and to develop a first 5-year R&D programme for the proposed European research Organisation. A conference, to be held in September 2007 in Ljubljana, will deliver the final conclusions: a detailed R&D agenda, a viable funding mechanism, and a flexible and transparent structure to manage this research programme.

The following sections describe the proposed *European Centre for Electrical Networks* through answers to a set of Frequently Asked Questions. These questions were raised and answered during the first year of the RELIANCE project by the project Partners and other stakeholders.

1. What are the objectives of RELIANCE?

The objectives of the RELIANCE Consortium¹ are threefold: (i) design a vision for a European Transmission Network by 2030, (ii) pinpoint the knowledge gaps and R&D needs that must be addressed to make this vision a reality and (iii) propose a structure and a funding mechanism for a European Centre for Electrical Networks that will lead this effort.

In line with the objectives of the EC Green Paper “A European Strategy for Sustainable, Competitive and Secure Energy”, COM(2006)105 8.3.2006, the RELIANCE Consortium focuses on the ability of the electricity transmission system to meet objectives of crucial importance for the European economic and social development: sustainability, competitiveness and security of supply. Key success factors to such goals are the creation of knowledge and innovative solutions to face electricity transmission challenges and setting up of a regulatory environment that supports retention of experts and R&D.

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

- **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;
- **Quantify the research efforts** that have a demonstrable European-wide impact;
- **Propose an appropriate framework** leading to an independent permanent European research organisation for transmission systems together with related funding mechanisms;
- **Disseminate the project outputs** through a European conference to be held in September 2007 towards TSOs, public authorities, users of the electrical system, manufacturers and other RTD providers.

2. What electricity transmission system does Europe need?

The European transmission system is the largest and most complex power transmission system in the world. It must provide:

- *A reliable supply of electricity to all European consumers,*
- *Open access to an integrated and liberalised electricity market,*
- *Access to an efficient and secure mix of primary energy sources.*

Achieving these objectives requires a tighter integration of the national transmission networks.

The energy market liberalisation in Europe has given rise to increased cross-border energy exchanges. The advent of wind energy will further increase such cross-border interactions. The ETN operators must therefore be in a position to provide answers to new questions such as:

- ✓ *What are the appropriate transmission investments to support an efficient energy mix?*
- ✓ *What integration needs and methodologies are required to avoid major power disruption (control, monitoring, planning, training of operators, security...)?*
- ✓ *Etc...*

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Coping with the future intricacies of these cross-border issues will require new knowledge to further secure the ETN reliability, robustness and flexibility, within acceptable costs.

3. Why is investment in research required to achieve this transmission system?

The existing interconnections between national transmission systems were not designed to handle intensive cross-border transactions, nor the massive penetration of wind generation, nor the expansion of dispersed energy sources. All of these changes increase operational problems. Network failures have become more common since the mid 90's in Europe. New cost effective solutions are therefore needed to avoid major power disruptions while supporting the integration of the electricity markets and the integration of renewable energy sources. They will transform the actual networks into an effective ETN.

4. Why is the current R&D approach insufficient?

Although the optimization of the European system in terms of security, robustness and cost efficiency is in the interest of the European citizens and industry, there is no actor responsible to deliver this common good. Furthermore, there is currently no adequate mechanism to identify, prioritize, set up, fund and manage R&D projects on European-wide transmission system issues. Without such a mechanism, these issues will not be addressed in a timely fashion.

Since the liberalization of energy markets, the commitments of the main stakeholders (regulatory bodies, TSO's and research organisations) towards R&D on issues dealing with the European transmission system has decreased. Why?

- ✓ **Regulatory bodies:** are focused on cost reductions to improve the economic efficiency of regulated TSO's at national levels. Hence, national R&D priorities are addressed with increased scrutiny about their short term impacts on the TSO efficiency. For the European issues mentioned above, there is still regulatory vacancy to define:
 - *What are the welfare benefits that such European R&D projects would bring?*
 - *What are the adequate R&D budgets to reach the expected welfare levels?*
 - *How should these resources be collected?*
- ✓ **TSO's:** Cost constraints narrow the national R&D endeavours of TSO's. Hence, TSO's loose progressively some of the management and technical talents required to perform long term R&D tasks, which, in turn, restrain, drastically their capacity at innovating at a European level.
- ✓ **Research organisations:** since under severe cost constraints, several TSO's in Europe have reduced their internal R&D activities, reduced their R&D management activities or outsourced research programs to R&D organisations (public and private). Hence, long term research is no longer executed by TSO's alone, requiring far more coordination with R&D providers. Moreover, research on power systems (and more generally engineering) looses attractiveness for skilled students, which might become detrimental for the preparation of future generations of European R&D managers, (when compared to efforts made for instance in USA, China and India). At the same time, needs for world class skills increase in Europe to address transmission system complexity.

In recognition of some of those shortcomings, the 2007 energy package highlighted the need for Regulators to take increased account of the Community interest and for the TSOs to increase the network security through a new formalised Community mechanism of cooperation.

5. What needs to be changed in our approach to R&D on transmission systems?

We must change:

- the way R&D priorities are identified,
- the way R&D programmes are managed,
- the way R&D is funded for project of a European nature.

The way R&D tasks are addressed to solve European transmission issues must be changed:

- **Collaborative identification of the R&D priorities** is a must, involving all the concerned stakeholders beyond the limited scope of each national TSO. A first qualitative appraisal of the expected economic impacts onto the European economy of each R&D project has been made. They are shown to bring significant European added value, beyond and above what is brought today by the existing R&D activities.
- **Dedicated R&D management must be designed:** this is needed to network all the involved research providers and participating TSO's, in view of producing knowledge according to a common and coherent R&D roadmap. This in turn will deliver knowledge outputs valuable for TSO's but also other stakeholders and European manufacturers who face a world wide competition.
- **TSO's must manage this innovation process:** TSO's are instrumental in using the results of this R&D programme. They must therefore be at the heart of the management of these R&D activities and their funding mechanism. As the ETN R&D priorities might differ from the ones recognized by the national regulators ones, TSOs cannot be accountable for the future R&D risks related to EU transmission system issues. Indeed, they already face increasing difficulties to channel some of their national R&D funding to solve European integration problems.
- **R&D activities must be monitored jointly by the national Regulating Authorities and the EC on behalf of the European citizens:** this will ensure that step to market of the R&D results is facilitated for all the market players (electricity consumers, but also generation, distribution, and retail companies, as well as manufacturers).
- **European R&D funding needs must be addressed:** the first estimates to complete the RELIANCE R&D programme reach (see question 12 below: 1.5 billion Euros for the next 10 to 20 years). The existing R&D Community instruments are inadequate to address such daunting needs. A dedicated funding mechanism must be set up.

6. What type of R&D is needed to deliver a suitable European transmission system?

Nine main R&D themes have been defined:

- **Integrate the European electricity markets:** common R&D at European level addressing market design efficiency and market coupling mechanisms to optimise the use of transmission capacities and send the correct economic signals to ensure generation capacity. The larger the problems, the larger the R&D challenges where new knowledge is urgently needed to improve the market design i.e. network externalities, reliability as a public good and convergence between balancing, simultaneous spot energy and transmission market.

- **Improve the use of the existing grid:** implement new technologies to enhance the control of power flows
- **Increase network robustness:** develop a common European methodology for assessing network security and design defence plans to stabilise the system following multiple contingencies
- **Integrate the national transmission systems:** develop new methods for system planning and design
- **Facilitate a massive penetration of renewables** through the development of strategies to handle their intermittency and increase their contribution to adequacy
- **Support the implementation of active distribution systems:** these active systems represent not only a challenge but also an opportunity at the TSO/DSO interfaces
- **Develop solutions** that increase the observability and controllability of the whole European transmission system in real time
- **Develop fast and robust simulation and analysis tools** that can handle the models of the entire European transmission system
- **Support grid expansion and sustainability** through a better management of its environmental impact.

A more detailed description of the R&D specified roadmap is given in Annex 1.

7. Why do we need to do it at the European level?

The problems and challenges are shared and cannot be solved separately in each country. For example, we must develop a common approach to the pan European observability and controllability of the transmission system that is challenged by the intermittency of wind generation. Similarly, the implemented algorithm, methods and related exchanged information tools need to be updated to cope with very large size problems. A joint effort increases the chance of success while reducing the risk and the cost of this R&D effort. Also a number of problems are local but solutions could be developed on a common basis as a result of a European common effort with an economy of scale as main benefit.

8. Why is an European R&D Organisation needed?

A dedicated European organisation is the best approach:

- to define a coherent R&D programme focussed on trans-European transmission issues,
 - to give all stakeholders a voice in the definition of the R&D programme,
 - to manage this R&D programme effectively and efficiently.
- A new organisation is required because R&D is not within the scope of the existing organisations (ETSO, UCTE, NORDEL...). Moreover, these organisations do not have the governance rules that are appropriate for the conduct of R&D intended to benefit all the parties that have a stake in the transmission system.

9. Why now?

An R&D organisation of this type should have been implemented along with the EU directives on the liberalisation of the electricity market. Recent failures in the transmission system demonstrate that the need is becoming urgent.

10. What is the scope of this European R&D Organisation?

The scope of this new Organisation is to design, select, fund and manage joint R&D and innovation projects dealing with the electricity transmission activities that have a European dimension.

11. How much is this R&D going to cost?

The initial estimate of the cost of completing the R&D programme reaches 1.5 billion Euros over the next 10 to 20 years. This corresponds to an average increase of 0.026€ per MWh consumed. This can be compared with the average prices of the residential and industrial sectors, respectively 100.2€/MWh and 62.3€/MWh (EUROSTAT 2004 figures).

This figure was obtained by adding up estimates for a set of high priority R&D projects over the next twenty years (see Annex 1). This is 0.5 % of the ETSO² estimated yearly turnover if spread over 20 years, which comes on top of an estimated upper value of average declared R&D expenses well below 1% by the same ETSO members today.

12. Who will pay the cost of this R&D?

Because all European electricity consumers will benefit from the R&D results supplied by the Organisation, they should all contribute to the R&D costs through a transmission tariff pass-through mechanism approved by the national regulatory authorities.

The research program deals with transmission system issues at European level. As a consequence, TSO's must be central in the funding mechanism, since they will be the first to use the research outputs. However, TSO's cannot be accountable for the R&D risks taken at EU level, nor asked to channel some of their scarce national R&D funding to solve European integration issues. A change of perception on the regulatory side is also required to recognize the eligibility of R&D priorities of European dimension that may not be strictly aligned with the national ones, if too narrowly understood.

13. How will the funds be collected?

The participating TSO's each pay a share of the cost of the Organisation. They recover this cost through their respective transmission tariffs with the approval of their regulatory authorities. The sharing rule mechanism should reflect the various countries impact on the European Electricity system.

Each TSO will therefore be allowed to charge its contribution to the European R&D costs through a cost eligibility mechanism approved by the participating national Regulators. Once implemented, the Regulators of the participating TSOs will have the prerogative, through a representation in the Organisation Executive Board, to

ensure that **the sum of all funds** collected nationally over an activity period do **match the R&D costs** of the resulting European R&D program.

This funding mechanism remains indifferent to the R&D financing model adopted within each national regulatory regime. It is therefore flexible, transparent but also offers the longevity needed to address the long term R&D activities.

The proposed sharing rule is based on two parameters the nominal value of GDP and the total gross electricity generation where both parameters have an equal weight³. The two parameters have been chosen to reflect the size of the economy and the size of the electricity market for each country.

14. How will the R&D results be exploited?

Two broad categories of projects are defined on the basis of their funding scheme and related R&D results exploitation. The Intellectual Property Rights and access conditions for exploitation are based on an open access policy when the projects are funded with the cost eligibility mechanism. They are negotiated when the projects are funded with extra financial resources.

Two broad categories of projects are defined on the basis of their funding scheme and related R&D results exploitation (see Annex 3).

Pan European RTD projects are the projects funded by the electricity consumers of the participating TSO countries using the cost eligibility mechanism described above. The Organisation implements an Open Access policy for the Pan European Project outputs. Results are generally published and the Intellectual Property belongs to the R&D Organisation. This allows the R&D Organisation to patent some solutions and control the access to the results by giving a competitive advantage to the European stakeholders requesting exploitation rights. The participating TSO members are granted an irrevocable non-exclusive license at no cost. Access rules for the exploitation of the patented knowledge by any other player are set by the Executive Board. This approach favours the fastest implementation of innovative ideas by the market players.

In the second category called External projects⁴, which can be financed by all the stakeholders interacting with the Transmission Network the intellectual property belongs to the entities that have funded the R&D tasks. **Exploitation rights** are negotiated on a case by case basis between the Organisation and the entities funding the external projects, before the R&D tasks are launched.

15. What are the benefits for the various stakeholders?

This framework ensures that transmission system issues that have a European dimension are resolved through R&D. Resolving these issues will:

- **Help TSOs and DSOs maintain the security of their systems under increasingly challenging conditions;**
- **Help Power Producers reach more consumers in the European electricity market by enhancing the transmission capacity of the transmission system;**
- **Maintain or enhance the reliability of the supply of electricity to the consumers;**
- **Reduce the cost of electrical energy by fostering a more efficient operation of the electricity market;**
- **RTD providers benefit from being able to participate in a coherent, long term, properly financed R&D programme managed on an open, transparent and competitive basis;**

³ This rule is not binding. Still, results obtained with reasonable alternative methods would not be radically different, given the sums involved.

⁴ See Question 26

- **EC and regulatory authorities benefit from having R&D issues that have a European dimension being addressed using a coherent, transparent and competitive approach where funding is directed at projects that create welfare for all European citizens.**

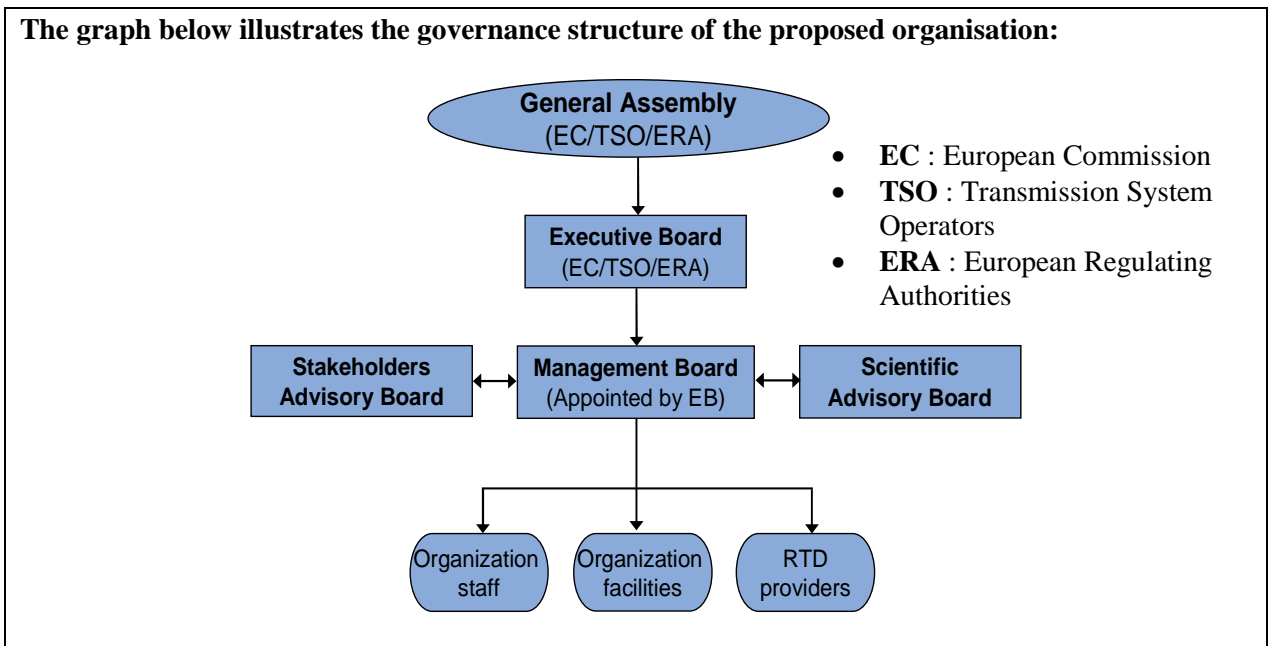
A more detailed description of the stakeholder’s perspective is presented in Annex 2.

16. Are the funding needs in line with the expected benefits?

While there is no guarantee that an R&D investment will always deliver benefits, two simple calculations demonstrate its potential impact:- A Europe-wide blackout lasting one day would cost very roughly 1/365 of the EU-25 GDP. Using 2005 numbers, this is about 400 times the estimated annual cost of this research organisation.
- Cutting the cost of electricity transmission by one percent would save 150 millions Euros per year, as compared to the 75 million Euros of annual cost of this research organisation.

17. What is the proposed governance structure of the Organisation?

The graph below illustrates the governance structure of the proposed organisation:



- *The General Assembly made of representatives of the European Commission (EC), the TSO’s and the European Regulating Authority (ERA). The General Assembly elects and appoints the TSO representatives in the Executive Board. Only TSO members have voting rights in the General Assembly.*
- *The Executive Board made of five members: three representatives of Transmission System Operators elected by the General Assembly, one representative of the European Commission, and one representative of the European Regulating Authority. The Executive Board is headed by the President chosen among three TSO representatives and one or two Vice-Presidents. The president and vice-presidents are elected by the members of the General Assembly for a five year term. The Executive Board meets at least four times per year and is responsible for:*

appointing the Management Board;

- *choosing the activity plan based on the proposal of the Management Board;*
- *monitoring all activities of the Management Board.*
- **Management Board:** The members of the Management Board are appointed by the Executive Board for a five year period. They should be experts in the fields covered by the Organisation. Members of the Management Board are appointed to provide day-to-day management of the R&D programmes. The Management Board will report to the Executive Board and will be responsible for monitoring and organising all activities of the Organisation. The functions of the Management Board include:
 - collecting stakeholders R&D project proposals;
 - managing the project selection process;
 - managing internal staff including researchers;
 - selecting RTD providers.
- **Scientific Advisory Board:** gives medium- and long-term advice to the Management and Executive Boards and ranks the proposed projects from the scientific perspective.
- **Stakeholder Advisory Board:** gives short- and medium-term advice to the Management and Executive Boards and ranks the proposed projects from the stakeholders' perspective.
- **Organisation staff:** is divided in two parts: administration staff and internal researchers. Both groups are under the control of the Management Board. The administration staffs assist the Management Board in the everyday operation. Internal researchers may be hired through contracts issued directly by the Management Board. Internal researchers belong to the Organisation for a limited period of time and are chosen as functions of the selected projects.

18. Who will manage the Organisation?

The Executive Board appoints a mix of TSO's and professional R&D managers to perform the management duties. They compose the Management Board. The responsibilities of the Management Board are:

- **Planning and specifying the RTD projects;**
- **Periodic revision of the Research roadmap;**
- **Awarding of RTD contracts;**
- **Monitoring of progress on RTD contracts;**
- **Packaging of the research results.**

19. Where will the R&D Organisation be located?

The management and administrative staff of the organisation can be located anywhere in Europe. The main consideration when choosing a location will be to minimize the operational costs.

Most of the R&D activities will be distributed among qualified research providers located in all the participating Member States. New central R&D facilities may be developed if no existing one can be used.

20. Who will do the R&D work?

Two modes of R&D work are foreseen:

- 1) It is expected that most of the R&D projects will be outsourced. The Management Board selects either single or consortia of RTD providers based on proposals submitted in response to call for tenders for specific projects.
- 2) R&D internalised through internal researchers working together on specific projects for a limited time with a group of experts seconded from various companies.

21. Who can belong to the R&D Organisation?

The membership of the Organisation is limited to the European TSOs who contribute to the funding of the Organisation.

The TSO's that are not members of the Organisation can finance R&D tasks as External projects (see question 25). The EC and representatives from regulatory authorities are *de jure* members of the Executive Board with representatives of the TSO's.

Entry and exit conditions for new members will be defined in the Organisation Charter as per the decision of the founding members.

The Organisation's mission will allow cooperation agreements with non-European R&D entities.

22. What is the role of the other stakeholders?

The other stakeholders (generation companies, DSOs, large electricity consumers, manufacturers, consumer organisations,...) can interact with the R&D process at four levels:

- They can participate in the Stakeholders Advisory Board to suggest and rank R&D projects;
- They are indirectly represented in the definition of the R&D programme through the Regulatory Authorities and the EC who select R&D projects that maximize the European economic welfare and competitiveness;
- They can propose and participate to RTD projects;
- They have access to the results of the R&D programmes through its open access policy.

23. What is the appropriate legal form for the R&D Organisation?

Various existing legal forms have been considered. The International Non-Profit Association (INPA), and European Economic Interest Grouping (EEIG) models have been identified as the most appropriate approaches, considering the legal liability and Intellectual Property Rights (IPR) issues.

A more detailed analysis of the possible legal forms is detailed in Annex 4.

24. How many people work within the R&D Organisation?

We expect that this Organisation will need:

- 10-15 people for management, contracts, finance and support services;
- 10-20 people working as project managers of the Pan European and external projects in charge of managing the technical and financial issues associated to these project risks.

Internal researchers will be contracted according to programme selection criteria that indicate the needs for performing core research jointly within the same site. It is anticipated that not more than 20% of the funds will be devoted to fund internal researchers.

25. Why is some R&D done internally?

While it is expected that a large majority of the research work will be outsourced, there will be situations where the Executive Board may decide that some projects should be carried out internally. This will be the case when:

- *Experts from different companies need to work on the same site to solve a particular R&D issue;*
- *A controlled environment is required to protect confidentiality;*
- *It is deemed that the success of a particular R&D project requires this approach.*

26. How will the RTD work be decided, contracted and performed?

R&D projects (“Pan European” and “External”) are proposed by the Management Board and approved by the Executive Board. Except for those that are carried out internally, projects are awarded to public or private R&D providers through a tendering process.

A more detailed description of the “Pan European” and “External” project is presented in Annex 3.

Activities and number of internal researchers are decided by the Executive Board, based on a full budget and management proposal prepared by the Management Board for a semi-annual period (five year).

For all the projects that are not performed by internal researchers, the administrative body of the R&D Organisation set tenders towards the accredited R&D providers to perform the R&D tasks. Tenders are examined according to selection criteria accepted by the tendering consortia and based on highest quality research. The selection might include other considerations such as impact on industrial policies for European manufacturers.

27. Who can participate to the tenders for R&D work?

Public or private organisations are allowed to bid for any R&D project, provided that they belong to accredited bodies, in accordance to EU procurement regulations. Organisation accreditation is approved by the Executive Board.

The accreditation list of RTD providers is published by the Executive Board on a yearly basis, each candidate being accredited by at least one TSO member of the Organisation.

Annex 1: A summary of the R&D roadmap

The RELIANCE consortium has developed a R&D roadmap with 9 main items:

1. **Improve the use of the existing grid**, namely to “do more” with today’s infrastructures, by using new technologies for an increased coordination of flow control. As the number of installed devices increases, so does the need for coordination. Besides, an efficient use of the grid depends also on an efficient life-cycle management and maintenance of the transmission system components based on accurate life cycle models of the involved pieces of equipment. Active maintenance and equipment online monitoring will support timely and adequate investment decisions. Also, vegetation management must be improved through dedicated R&D and new common approaches to the problem.
2. **Integration of European electricity markets**: because such an integration has never been achieved anywhere before, it is impossible to build on past or existing experience. New knowledge is needed to:
 - *Further consolidate the **security standards** which will allow even more massive power exchanges while maintaining the reliability of the transmission system at an adequate level. Harmonization as a political issue raises knowledge needs, and therefore R&D efforts;*
 - *Further consolidate the **congestion management** techniques and better understand interactions between power market and reliability, and between electricity market and other energy markets;*
 - *Better understand the **interdependencies between market design, market coupling and transmission system information exchanges** to consolidate the disparities in retail, ancillary services and transmission capacity markets; it involves a mix of technical, economical and management issues that must be addressed simultaneously;*
 - *Meet market needs **through dedicated planning and design methods for new transmission investments**. It is shown that coordinated planning and funding of investment would solve the issue of conflicts between the national horizons of each TSO and the multinational impacts of transmission investments. Moreover, new business models for transmission operation and assets management might emerge to help transmission system operators’ work more efficiently as market facilitators.*
3. **Increase network robustness** to cope with severe events without jeopardizing the system integrity. This implies to share, compare and improve the emergency crisis management procedures at a European level. New cyber and physical vulnerabilities and threats including those resulting from the climate change need to be included in the robustness requirements. A common European methodology for assessing the robustness of the grid is needed together with defence actions able to bring back automatically the system to a secured state following multiple contingencies. As the risks of load interruptions and local blackouts cannot be totally eliminated, their consequences should be minimized through fast restoration schemes based also on cross-border training of operators.
4. **Increased cooperation and integration** between TSO’s, to the extent that they can be considered as a single body with a shared strategy and objectives for system R&D and development. Currently the European grid is a cluster of interconnected national control zones, each one having its own network management rules and investment policy. This might result in conflicting business strategies, causing inefficiencies that need to be addressed at a European level. Significant R&D efforts are needed to support the planning and design of the future architecture of the system.

The next two R&D areas help TSO’s future flexibility through new growth options for the European integrated electricity market.

5. **Integrate massive penetration of renewables** through the development of strategies to handle their intermittency and increase their contribution to adequacy. Improvement of weather forecasting, reduction of the market gate closure intervals, novel large scale energy storage systems, demand side activation and regional clustering of RES and DG among others will contribute to the integration of RES and especially deal with wind intermittency.

6. **Interact with active distribution grids** and related technological developments such as the widespread use of DER will force a different relation between transmission and distribution grids. Active distribution grids and demand side management offer a set of new possibilities from the transmission system level such as the provision of ancillary services. Before their effective deployment, the impact of the new concepts such as micro-grids, self-tuning and self-healing networks should be anticipated from the transmission system perspective

Two R&D areas deal with the joint development of methods and techniques suited to face the challenges of large scale power system integration.

7. **Increase the network observability, the understanding and predictability of the power system behaviour**, which will help provide an encompassing picture of the Pan-European transmission system in real time, predict its evolution, identify the threats and weak points and consequently coordinate the most efficient remedial actions. Indeed, thanks new tools, methods and increased TSO interactions, monitoring, forecasting and control of the system should be implemented at a European level. Similar developments are expected at the boundaries between DSOs and TSO's, which is a prerequisite for an effective use of the new possibilities offered by active distribution grids.
8. **Advanced simulation and analysis tools and methods** are a prerequisite for all developments in the field of power systems. The next generation of simulation methods and tools will be characterized by their ability to cope with large power systems such as the European interconnected system or the detailed representation of a regional transmission system including the underlying active distribution grids. Related challenges are the provision of fast solution methods for large problems and the management of the huge amount of data required to support and validate these models.

This overall network optimization is performed under expansion constraints, leading to specific R&D tasks.

9. **Support grid expansion** in a sustainable fashion, which implies compatibility 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 review of the decision processes and technologies involved. Efforts should be devoted to more effective sitting and permitting procedures, together with R&D efforts to improve social acceptance of transmission equipments. This implies a better understanding of the benefits for society of the transmission system but also technological efforts towards the better management of environmental impacts.

Annex 2: Benefits of collaborative R&D for the various stakeholders

For the TSO's:

- They have agreed on a long term commitment to generate together the knowledge needed to address the challenges of the European transmission system;
- They benefit from economies of scale and coordinated synergies through pooling expertise and research outputs;
- The Organisation acts as an instrument able to propose development options to the transmission system operational and decisional bodies (UCTE, NORDEL etc.)
- The Organisation prepares real life applications through the injection of high quality R&D results: operational life will be made easier and more efficient.
- The Organisation becomes the single reference point for European R&D on transmission system activities, a world class expertise centre able to collaborate with other similar Organisations worldwide and a mean for stakeholder R&D personnel to gain expertise on challenging European issues.

For the European electricity consumer:

- An instrument to support the development of a reliable, robust and flexible power transmission network, at acceptable costs;
- A network that permits to achieve full benefits of the IEM directives and initiatives towards sustainable energy sources.

For the R&D providers on transmission system:

- They work on R&D subjects reflecting short, medium and long term transmission system stakeholders interests in close collaboration with TSO's experts;
- They can rely on long term funding to address major issues requiring multidisciplinary teams;
- Their close links to all transmission system stakeholders maintain the focus on relevant issues.

For the regulatory authorities:

- The Organisation is an instrument to cover R&D subjects with cross-border impacts that may fall between the members states interests and that are currently not recognised at the member state level;
- The Organisation is an effective way to run the R&D activities impacting the European transmission system;
- A transparent and fair approach to address challenges of a European dimension resulting from the liberalization of the energy markets in Europe;
- A selection and funding mechanism that maximizes the probability of increasing the welfare of European citizens, thanks to the implementation of the proposed solutions.

For the other transmission system stakeholders (generators, distributors, retailers etc.):

- A place to access R&D outputs that ease their operational cooperation with TSO's;
- A place to launch collaborative R&D tasks to the benefits of the end electricity consumers.

Annex 3: Implemented projects description

There are two types of R&D projects, classified according to their funding mechanism: Pan European and External projects.

“Pan European Projects” are those which must be performed **in a framework of full cooperation between TSO's**, in order to obtain reliable and useful knowledge.

The following general features can be identified:

- They have to be considered of the highest strategic priority for the Organization
- They require an in-depth knowledge of the network operations at European level
- They deal with issues, which are so far not fully addressed, due to the lack of a common institutional framework.

Pan-European projects are divided into three categories:

- **Integration projects** directly addressing topics with cross-border impact and TSO integration in terms of the technical and economic functioning of the transmission system. Let us mention for the sake of clarity: observability of the pan-European system and related cross-border information exchange, cross-border investments, new methods for congestion management, etc.
- **Fundamental research projects** that have an impact at a European power system-wide level. This category should include issues addressing the long term vision of the European transmission system.

These two categories have common features: their benefits are prohibitively difficult to value per country or per stakeholder. Hence their impact on the European economy will be assessed ex-ante, in order to justify the adequate RTD investments at EU level.

- **Generic system projects**, which address common⁵ critical transmission system issues in operations, technology and management.

These projects if addressed jointly would greatly reduce costs and improve the quality of results through the use of multi country data sets.

Pan European projects are first ranked by the Stakeholders and Scientific Advisory Boards of the Organisation; then the Management Board, using the results of the ranking, proposes to the Executive Board for approval the so called “**Activity Plan**”. This is a well balanced portfolio of projects over a 5 years time span (with possible yearly revisions). It is foreseen that there could be several iterations between the Management and Executive Boards before the final approval.

The categories are explicitly taken into account in the ranking in order to clearly identify the priorities of the Organization.

In terms of funding the projects are financed with a membership fee paid directly by the TSOs (see description in the main text Question 3).

External Projects are projects funded through additional financial resources provided on a project by project basis by **any stakeholder (TSO, Generator, Regulator, Trader, Supplier, Manufacturer, etc.) or group of stakeholders interacting with the Transmission System.**

They must satisfy two main requirements:

- To be compatible with the mission statement of the Organization.
- To be compatible with the realization of the five year Activity Plan, as this has to be the main focus of the Organisation.

The aim is to offer a flexible scheme, which would allow direct interaction with stakeholders facilitating the access to the information and the knowledge on the Transmission System.

The Organization could also provide a reliable and transparent framework for stakeholders willing to develop joint research initiatives on the power transmission network in Europe.

The selection of topics is left to the financing parties⁶, knowing that all the relevant stakeholders can directly propose initiatives, within dedicated confidentiality agreement set forth by the financing bodies.

External projects should not be taken into consideration during at least the first three years of activity of the organization, in order not to interfere with the launch of the first Activity Plan and the set up of the basic structure of the Organisation.

Given this delay and the fact that their format will be fully dependent on the final decisions concerning the set up of the Pan European Projects, we consider unnecessary to develop a more detailed description of their functioning.

⁵ The difference with integration projects is that generic system projects have national impact and not cross-border. As a matter of fact it is possible to assess benefits on a country by country level.

⁶ Clearly the selection could be done with the advice of the Organisation, but final decisions have to be taken by those who supply the funding. The Organisation has only the right to refuse.

Annex 4: Optional legal forms for the Organisation

As the R&D Organisation is set for not profit purposes, following options for the legal form have been examined: the de facto Association, the International Not Profit Association (INPA), the European Economic Interest Grouping (EEIG), the Foundation and the Joint Undertaking.

The Joint Undertaking, based on Article 171 of the European Union Treaty, is not appropriate, since dedicated to set up very large projects or facilities initiated by institutional members and thus entailing complex and long negotiations for its set up.

The de facto Association model exhibits a major disadvantage: since it has no legal existence, it cannot legally act towards third parties. Therefore, the association can only be operational and bound by one of its members and/or directors acting on an individual basis, which may lead to intricate liability issues in practice.

The Non Profit Association ruled under National law is not eligible as it is normally used in a national context.

The foundation legal form is typical for non-profit organisation ruled under National law (often Dutch). This legal form is commonly used for research purposes. It highlights the non-profit character of the research work and allows for flexible governance structure with a board consisting of the financing parties. Management reports to the board and has full authority for the daily management tasks (entering into contracts, hiring and firing personnel, etc.). In some countries, it benefits from private procurement regulations and may have fiscal advantages for the participating members. Notwithstanding the successful example of the German-Dutch Wind Tunnels based on large facilities and founded by National laboratories, the benefits of this model for the present purposes are unclear.

The INPA, Foundation and EEIG models have been retained as the most appropriate approaches, considering the legal liability and Intellectual Property Rights (IPR) issues:

- **INPA** (or any related non profit association ruled under National law): it appears to be **the recommended organisational model** since the European R&D is set for not-for-profit purposes with an international utility. Under the INPA form, there is no nationality requirement as far as the members are concerned. The INPA may have its registered office in one country and its secretariat or administrative seat based in another country. The members and directors are in principle not personally liable for the Association's debt and liabilities. The member's liability is limited to their contribution.
- **EEIG**: Although specifically intended for companies willing to cooperate internationally, operating through an EEIG may show unresolved issues about the **joint and several liabilities of the members**. As a consequence, it requires specific measures from the participating members in joining this legal structure.