CONSEIL INTERNATIONAL DES GRANDS RÈSEAUX ELECTRIQUES
INTERNATIONAL COUNCIL ON LARGE ELECTRIC SYSTEMS

COMITE D'ETUDES A1 STUDY COMMITTEE	Machines Tournantes Rotating Machines

STRATEGIC PLAN

OF

STUDY COMMITTEE A1

ROTATING ELECTRICAL MACHINES

2009 - 2019

FINAL VERSION

TABLE OF CONTENTS :

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2009 – 2019

1. INTRODUCTION

1.1. Purpose of the document

The purpose of this strategic plan is to describe the long term objectives and ambitions of CIGRE Study Committee A1. It is a necessary tool in evaluating the present situation and for planning and organisation of future activities including the build-up and conservation of competence. It also provides guidance for the assessment and development of working group activities.

This strategic plan spans a ten year period and is updated every third year in order to allow for adaptation to developments and trends. The plan is completed with a Study Committee Action Plan covering a three-year period.

1.2. Mission and present field of activities

According to the Statutes, the objective of CIGRE is facilitation and promotion of the interchange of technical knowledge and information among all countries in the general field of electricity generation and transmission at high voltage. The mission of CIGRE Study Committee A1 is derived from these overall objectives as follows:

MISSION STATEMENT
To facilitate and promote the progress of engineering and the international exchange of information and knowledge in the field of rotating machines. To add value to this information and knowledge by means of synthesizing state-of-the-art practices and developing recommendations.

The field of activities of study committee A1 covers **research, development, design, manufacturing, operation**, **and de-commissioning of large rotating electrical machines**. This includes **the assessment of the condition of rotating machine components and elements, the maintenance, refurbishment, power upgrade, environmental aspects, asset management and long term health assessment.**

The output of the deliberations and actions would enable **quality, reliability, capability, availability, maintainability, productivity and the ability to raise capital and insurance to be realised.**

2. ORGANISATION AND COMPETENCIES

2.1. Organisation and competence

SC A1 organisation consists of the following:

Chairman (also member of the Technical Committee of CIGRE). Appointed by the Administrative Council. Term of office is 4 years; it can be extended to six years upon decision of the Administrative Council.

- 24 regular members as a maximum, each belonging to a different country. Appointments of regular members are proceeded to by the Central Office every two years. Members are appointed by the Steering Committee of CIGRE, based on proposals from the National Committees and recommendations of SC A1 Chairman. Term of office is 2 years, to be renewed no more than twice. In the case of exceptionally active members a further two-year extension may be granted once only. This Term limitation also applies when a member has changed status: the total membership term (regular and observer) within a SC can not be in excess of 8 years. Priority will be given to expertise and efficient contribution to the work of the SC. Therefore, Terms of office can be curtailed at the request of the SC Chairman.

If a member misses two consecutive meetings the Chairman will consider recommending that his Term of office be not renewed.

- 12 observer members as a maximum, one per National Committee not already represented by a regular member. National Committees may propose names to act as observer members, at the same time as candidacies are put forward for regular membership. Requirement and appointment procedures are the same for observer and regular members, as well as the Term of office.

When the membership is fully subscribed, National Committees candidates can be accorded observer status and the membership should be reviewed periodically.

- Secretary, chosen by SC A1 Chairman, assists the Chairman in the preparation of the SC meetings, Colloquia, Symposia and in writing the Annual report. He draws up the agenda and the Minutes of the meetings of the SC. At CIGRE Sessions he draws up the daily summary of discussions following the group discussing meeting. Term of office not fixed.

SC A1 sets up Working Groups (WGs) and Task Forces (TFs) to perform technical work in specific fields. Fields which require sustained involvement are dealt with by Advisory Groups (AGs) which are semi-permanent. Temporary WGs and TFs are appointed for finite timescale work under the responsibility of a convener, appointed by the SC. Every year, at the meeting of the SC, advisories and conveners of working bodies present their progress report.

SC A1 meets every year, in even years at the time of the Paris conference. In addition, SC A1 can organise Colloquium on specific subjects, in general jointly with National Committees in different countries, usually in odd years. The SC endeavours to visit all member countries, by invitation, and to make the meeting relevant to the country.

Joint WGs or TFs with other CIGRE SCs may be formed by mutual agreement. The convener reports to the appointed lead SC, keeping the other informed. In addition, Joint Sessions of the Paris conference may be organised with SCs working on related subjects.

The competence of the SC resides in the highly qualified technical membership drawn from all sides of the Power Generation Industry from the member countries. Working Groups reflect particular activities in the field of activity with in-depth technical expertise.

SC members are encouraged to be members of an Advisory Group, Working Group or Task Force to encourage contribution and awareness and to avoid a strict hierarchical relationship between WG and SC.

The SC, AGs, WGs and TFs are supported by the Central Office staff based on their long CIGRE experience of all facets of organisation and administration.

The results of A1 work are reported at the Paris conference, in Electra Publications as WGs/TFs reports/technical brochures and Colloquium/Symposium general reports, on the CIGRE website and as Tutorials.

2.2. Fields of activity

SC A1 is responsible for the field of Rotating Electrical Machines and includes in its scope all such machines for power generation and large motors for power stations. It also includes superconducting machines and a brief to cover materials technology relevant to machines.

There are four semi-permanent advisory groups. Each of these is concerned with exchanging practice and experience on design, construction, test and behaviour of turbine generators; hydro generators; new technologies and large motors.

There are links with international and national standards making and professional institutions through the national members of the SCs and WGs who have joint memberships, e.g. IEC, IEEE.

Study committee A1 consists of advisory members, working group conveners, special reporters, regular and observer members. The table below shows the segments that comprised the SC in 2005 and 2009:

Segment	2005 (%)	2009 (%)
From universities, research institutes	34	16
From asset owners and operators	29	57
From manufacturers/industries	29	20
From consultants	08	07

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2.3. Working Groups and Task Forces

The present Working Groups comprise the followings:

2.3.1. Working Group: Turbine Generators

Number	**Title**	**Scope of work**
A1.01	GUIDE ON OVERFLUXING GENERATORS	GUIDELINE
A1.03	GUIDE ON GENERATOR / POWER SYSTEM INTERRELATIONSHIP ISSUES	GUIDELINE
A1.05	ECONOMIC EVALUATION OF GENERATOR REFURBISHMENT/ REPLACEMENT	GUIDELINE
A1.07	GENERATOR MAINTENANCE, INSPECTION AND TEST PROGRAMS	MAINTENANCE
A1.09	GUIDE FOR MINIMIZING THE DAMAGE FROM STATOR WINDING GROUNDS ON TURBOGENERATORS	GUIDELINE
A1.11	GUIDE FOR ON – LINE MONITORING OF ELECTRICAL GENERATORS	CONDITION ASSESSMENT
A1.15	GUIDE ON STATOR WATER CHEMISTRY MANAGEMENT	GUIDELINE

A1.16	GUIDE ON GENERATOR COIL RETAINING RING - A SYSTEM SURVEY AND GENERAL GUIDELINE	GUIDELINE

2.3.2. Working Group: Hydro Generators

Number	**Title**	**Scope of work**
A1.02	GENERATOR STATOR WINDING STRESS GRADING COATING PROBLEM	EXPERIENCE, UPDATE
A1.04	GENERATOR FIRE PROTECTION	EXPERIENCE, UPDATE
A1.06	INTERMITTENT OPERATION – EXPERIENCE WITH HYDRO GENERATORS	FIELD EXPERIENCE
A1.10	SURVEY OF HYDRO GENERATOR FAILURES	FIELD EXPERIENCE
A1.12	STATE OF THE ART OF THE EFFICIENCY IN HYDRO GENERATORS COMMISSIONED IN THE LAST 10 YEARS	FIELD EXPERIENCE
A1.13	FEASIBILITY OF UPDATING FROM CLASS F TO CLASS H THE INSULATION SYSTEMS IN ELECTRICAL ROTATING MACHINES	EXPERIENCE, TRENDS
A1.14	GUIDE FOR MINIMIZING THE DAMAGE FROM STATOR WINDING GROUND FAULTS IN HYDRO GENERATORS	GUIDELINE, UPDATE A1.09 WORK WITH SPECIFIC MATTER

2.3.3. Working Group: New Technologies

Number	**Title**	**Scope of work**
TF A1.20	ESTABLISH THE BACKGROUND AND SCOPE FOR NEW WORKING GROUPS ON WIND POWER GENERATION	SET UP OF NEW WORKING GROUPS

2.3.4. Working Group: Large Motors

Number	**Title**	**Scope of work**
A1.08	POWER STATION LARGE MOTORS REQUIREMENTS IN THE FIELD OF STANDARDS	RECOMMEDATIONS FOR STANDARDS
A1.17	METHODS OF DETERMINING THE CONDITION OF STATOR WINDING INSULATION AND	EXPERIENCE, TRENDS

	THEIR EFFECTIVENESS	
A1,18	EXTENDING LIFE OF LARGE MOTORS IN NUCLEAR POWER PLANTS	EXPERIENCE
A1.19	MOTOR FAILURE SURVEY	EXPERIENCE

3. CHANGES RELATING TO THE OVERALL ENVIRONMENT

This section identifies development and trends in the power supply sector and assesses the possible effects on Generation plants in general and the activities of SCA1 in particular.

3.1. Changes of the operational environment

Utilities and generation plant owners are operating in a changing environment of competition and cost reductions. This places a demand on a reduction in maintenance, operating cost, forced outages, and major failures. Plant owners are continually seeking more reliable, operating flexibility, cost effective and reduced maintenance plant. Focus is placed in appropriate asset management and overall life cycle cost of a plant. Owners are also driven to run the plant at increasing load factors. The demand on optimising the peak load demands plants are run more on load flowing and daily shift (start / stop) operations.

3.2. Environmental changes

Due to the continual increase on environmental pressure, utilities are facing challenges to address the impact their plants have on the greenhouse effect: wildlife, air pollution, location siting of the plant and noise emissions.

Focus is placed on conservation, cleaner fuels, efficient generation, and renewable energies.

3.3. Changing business environment

Rising labour costs, competition with other energy industries and funding competition in the market are some of the financial constrains some utilities experience.

Privatisation of utilities, regulation / de-regulation, independent power producers, dispersed generation, spot market selling, free market culture are some of the issues utilities are facing.

On the suppliers' side, a reduction in orders for new plants and the mergers and acquisitions as a way to meet fiercer competition are some of the contributors of the crisis suppliers are facing today. Users have less technology or suppliers to select from as large merged organizations rationalize their designs into one for all factories with centres of excellence. This places a risk that any defects can have devastating impact as the number of units in service with the same design is very high and design defects could impact a utility widely and financially ruin large suppliers. "Too many eggs in one basket".

Both suppliers and owners are reducing technical expert skills, and no longer focusing on long term career paths and training programmes. Research programmes are reduced.

3.4. New technological possibilities

The swing to renewable energies has resulted in large quantities of new small machines being injected into the industry. One such type is the wind energy whose participation in the generation mix of several countries is having a fast growing. Others renewable possibilities in the field of electrical machines, besides the medium-large hydraulic generators, are: the bulb, tide, wave and small hydroelectric plants.

The competition between suppliers presently is to supply the largest simple and reliable generator. Most perceive this to be the air cooled generator and the challenge is to manufacture every increasing size generators to match the gas turbine industry trends. Similar applies for indirectly hydrogen-cooled generators for combined cycle single-shaft applications.

The recent move back towards nuclear plants again requires larger units to be produced and a similar size increase may be seen on fossil-fired 2-pole units. Hydro generation, however, has not experienced similar changes in machine sizes. Due to developments in the area of design, materials, cooling, insulation and bearings technology it is foreseen for the next years turbo generators with a capacity of more than 2000 MW.

Superconducting synchronous compensators are already a reality, but in very small sizes, to reduce flicker caused by arc-furnaces. Studies have shown that they can improve substantially the low voltage ride through (LVRT) capability of wind farms during depressed voltage events, avoiding disconnection of the generators from the grid due to a fast reacting transient capability.

4. CUSTOMERS OF STUDY COMMITTEE A1

The SC A1 is a part of CIGRE and as such has the responsibility to share information and promote interchange of technical knowledge between countries. In the past the countries who were members of CIGRE had large utilities that were generally vertically integrated. Members were from the utilities to a fairly large extent. At present the utilities are privatising and forming asset owners and operators. They are also downsizing and reducing technical staff. Support for overseas trips is also reduced.

Despite of that, most of the membership of SC A1 is, at present (2009), from asset owners and operators, followed by manufactures, universities/research institutes and consultants. It seemed that the asset owners and operators had recognized CIGRE as an organization in which the techniques, technical knowledge, informations and experiences are shared among their members who belong to different entities spread throughout the world.

In 2005, the situation was different in SC A1 where the most part of its membership was from the universities/research institutes, not far from and equally followed by asset owners/operators and manufactures (see item 2.2). Comparing the membership from universities/research institutes between 2009 (34%) and 2005 (16%) we notice a decrease of more than 50%. Probably the universities/research institutes are facing problems due to fewer resources available for international activities. This analysis covering a short three – year period can only shows a tendency, at most. It will be necessary, in case of SC A1, to compare the distribution of its membership in 2011, in order to support or not the present considerations.

Based on the facts mentioned the membership that is more active in SC A1 has changed from universities/research institutes to asset owners and operators in a three-year period. However, we can say that, besides the differences in the percentages of membership the real customers of SC A1 are all the segments of the electrical sector which have at their disposal all technical documents produced by the Committee, such as: technical papers, brochures and guidelines which may be used to provide input to standards.

5. OPPORTUNITIES AND THREATS

The changing working environment causes threats and opportunities to the work of SC A1. The most important threats are listed in the following:

- Work pressure on committee members not being able to attend to CIGRE work
- Retiring of “old” experts/specialists not compensated by new entries
- Increased cost pressure means that members have less resources available for international research activities and for international co-operation in general and that it is increasingly difficult to find experts which are able to devote sufficient time to working group and task force activities
- Increased competition makes asset owners and operators more aware of the value of “intellectual property“, resulting in tendencies to limit exchange of technical know-how
- Competition among different international organizations (CIGRE, CIRED, UNIPEDE, IEEE, IEC, CENELEC)
- Differences in the expectations on the CIGRE-work from industrialised and developing countries
- Large manufacturing corporations: smaller amount of variety in offered solutions; one manufacturing company might have several representatives in the same committee (from different countries)

On the other hand, the changes in the operational environment of the SCA1 also offer opportunities, for example:

- Possibility to meet new needs: production, & environment
- Adaptation of new technologies, share of teething problems
- Satisfying specific needs of the developing countries
- Increasing needs for refurbishment, upgrading, life extension enriches service business
- Mitigation of environmental impact
- Co-operation with other study committees, research and standardization organizations
- Unique CIGRE spirit of sharing information and experience

6. THE PRESENT SITUATION OF STUDY COMMITTEE A1

6.1. Strengths of SC A1

SC A1 has an active membership consisting of experts from suppliers, consultants, academics, researchers and users. This includes hydro, fossil, renewable, nuclear generating plant and motors experts. The expertise of the group ensures that it can identify and resolve any issue relating to lines. The focus on elaboration of best practices and guidelines benefits developing countries.

6.2. Weaknesses of SCA1

- Limited and infrequent committee and working group meetings (once per year)
- Difficulty to attract young members due to financial constraints

7. OBJECTIVES AND STRATEGY

7.1. Ambitions and objectives

Study committee A1 shall continue to play a pivotal role in the field of rotating machines. Besides expanding the interests into the superconducting and renewable energy machines, there appears to be no need to alter the field of activities of the study committee.

Within its field of activity study committee A1 shall:

⇒ Serve all its customers involved in the process of generating electrical energy by means of:

- Providing a forum where suppliers and users can share and exchange experiences and information
- Being aware of customers needs
- Monitoring and reporting on the international development
- Promoting trends beneficial for its customers
- Issuing guidelines and recommendations
- Updating former reports due to recent developments in design, materials, insulation, cooling and bearings technology and improvements in efficiency and maintenance.

⇒ Promote innovative solutions and concepts considering all relevant factors (economical, technical, environmental and others)

⇒ Be aware of the needs of the developing countries, actively work in order to fulfil them and involve representatives of these countries in its work

⇒ Actively promote and support international co-operation and conferences

⇒ Promote Symposium/Colloquium during Study Committee Meetings in odd years

⇒ Participate in Regional Meetings with technical contributions

7.2. Strategic administrative directions

7.2.1. Organisation of work

Focus will be placed on more disciple working style of meeting and shorter turn-around time of existing projects and working groups. Initially the committee needs to complete existing tasks before taking on new tasks.
The organisation of the study committee and its way of working shall be adapted to the changing operating environment, aiming at increased flexibility and short response time.
The use of email system, the web and setting milestones between meetings will be used to speed up the work output.

7.2.2. Co-operation with others

Establish a more extensive co-operation within CIGRE, in particular with the system study committees. Improve co-operation with other international organisations in the field, particularly with the standardization organisations.

7.2.3. Use of internet

Encourage the use of internet applications.

7.2.4. Tutorials

Disseminate technical knowledge by means of Tutorials on specific subjects, in general jointly with local National Committees in different countries, usually in odd years. The SC endeavours to visit all member countries, by invitation, and to make the meeting relevant to the country.

7.2.5. Young experts

Promote the recruitment of young experts and their inclusion in the activities of the Committee.

7.3. Technical directions

7.3.1. Large generators

For many years, manufacturers have increased the size of the generators they produced in order to gain the benefits of economy-of-scale. This trend slowed down with the introduction of gas turbines, but the recent move back towards nuclear plants again requires larger units to be produced and a similar size increase may be seen on fossil-fired 2-pole units. Hydro generation, however, has not experienced similar changes in machine sizes. Due to developments in the area of design, materials, cooling, insulation and bearings technology it is foreseen that future turbo generators will have a capacity of more than 2000 MW.

7.3.2 Life management

The design life of a generator is normally about 30 years for turbo generators and over 50 years for hydro generators. Turbo generators built in the 70's and hydro generators built in the 40's and 50's have already reached the end of their useful life and nearly all show various technical problems caused by ageing. Due to the economic and financial difficulties, as well as environmental restrictions, faced by the power companies to build new power plants, analyses must be done to extend the life of existing generators. This involves in taking decisions which include alternatives such as: partial repairs, components replacement or even a complete replacement with due consideration to the time in which the machine is out-of-service without generating income to the owner.

Each alternative conceived may increase the generating capacity in different ways and will have different costs. According to the type of repairs the generating capacity may even stay the same as in the old existing units. With the new scenario involving deregulation and globalization of electric energy supply, there is a need to analyse economically the various alternatives proposed for modernization in order to choose the most attractive to power plant owners.

7.3.3. Machine monitoring and diagnosis

In this area, the process is one of continuous evolution and development. The long term goal is the most effective operation of machines to optimise performance, reliability and efficiency and to take maintenance decisions through understanding behaviour and signs of deterioration. This is called Condition Based Maintenance, that is maintenance is performed when it is really required. Short-term and long-term risks can be evaluated with a condition monitoring system, which performs on-line mechanical and electrical monitoring. The system is also designed to provide diagnosis of machine conditions allowing forecast problems, optimize operation efficiency and improve plant productivity. Some systems are based on expert systems and further development is anticipated.

Risk analysis techniques for evaluating the benefits and costs of implementation on-line monitoring and diagnostics systems for risk mitigation is a necessary tool for decision-making.

There is an important link between monitoring and diagnosis and the life management and life extension processes.

7.3.4. Renewable generation

Renewable energy technologies vary widely in their technical and economic maturity, but there are a range of sources which offer increasingly attractive options. These include wind, biomass, photovoltaic, solar thermal, geothermal, ocean and hydroelectric power. Their common feature is that they produce little or no greenhouse gases, and rely on virtually inexhaustible natural sources for their ‘fuel’. Some of these technologies, with the exception of hydroelectric power plants whose energy costs are inferior to that of a gas natural power plant, are expected to compete with fossil fuels, as their economics will further improve due to their technological developments and increase in production.

With the exception of hydroelectric generation, the wind generation has presented the greatest growth among the sources of renewable generation. At the end of 2007 the wind capacity worldwide was around 94,000.00 MW. Roughly 20,000 MW was added in 2007, the highest volume achieved in a single year, and up from about 15,000 MW in 2006.

There are projects, in Europe, called “Upwind” funded under the EU's Sixth Framework Programme towards the design of very large wind turbines (8-10MW), both onshore and offshore and in USA between an American manufacturer and the U.S. Department of Energy to validate the economics of a 10 MW superconductor wind turbine which will weight around 120 tons instead of 300 tons for a conventional design. This next generation of wind turbines can be used by countries that have limited wind sites.

Due to the continuous increase of wind generation in the composition of the generation mix it is of utmost importance that SC A1 analysis the latest technological developments of this generation, taking into account aspects related to design, maintenance, efficiency, costs, performance and reliability.

Besides wind generation, bulb, tidal and wave power generation will also be investigated by SC A1.

7.3.5. Power electronics

There are many aspects of the current and conceived development having longer term implications.

For machines the important changes are one, that rotating speed is no longer directly bound to system frequency and two, that variable speed machines can replace other means of fluid flow regulation with benefits in efficiency and resultant environmental benefits.

Variable speed hydro power units are already in application. The renewable generation including wind, wave and tidal would benefit from power electronics and variable frequency generation.

The effects of harmonics in transmission systems, due to variable speed machines and variable frequency drives, on power quality are relevant transmission and distribution issues.

For CIGRE, apart from the activities on HV directly connected machines and the monitoring of drive development, the longer term issues are the possible changes to system stability concepts due to the growth of renewable energy generation spread throughout the system.

7.3.6. Superconducting Generators (SCG)

SCG will be the promising alternative for increasing generation efficiency beyond 99%, reducing size, weigh, increasing capacity of reactive power and improving power system stability in comparison with conventional generators. A SCG will have about 1/3 of the overall volume and losses reduced by as much 50% in comparison with an equivalent conventional generator. They may be used in existent or new power plants where expansion and space are a problem. In a SCG the field winding is made up of High Temperature Superconductor (HTS).

The rotor structure is multi-cylinder in order to maintain the field windings at low temperatures. Its construction requires special techniques for the supply of helium liquid and temperature control. The stator is water cooled, with a metal conductor and a structure of the air gap type (without slots) eliminating much of the magnetic steel of a conventional generator.

A HTS synchronous compensator of ± 8 MVAr, 13,8 kV has been operating in USA since 2005 to provide reactive support to an arc furnace. The machine output is independent of system voltage and the current output is several times its continuous rating avoiding any problem of voltage instability.

The theme of using superconductivity in synchronous machines has been and will be a focus of SC-A1. Unfortunately we have received very few contributions on this subject up to now. With the exception of one manufacturer in USA, the development of superconducting machines is also being carried out in Japan where 1 MW class synchronous motor which directly drives ships is under developing.

The main problem is that the superconducting wire material is too expensive today, however it is predicted in the next years a reduction to 1/4 of today's price. It will be necessary to invest on researches in order to develop HTS wires with higher critical temperatures. An interaction with D1 is envisaged.

7.3.7. Machine/System interaction

Increasing use of digital control with some examples of adaptive control points the way to medium term developments in that direction and the need for interaction with CIGRE System Control Study Committees.

The use of SMES for enhanced system control is a medium/long term possibility. The transmission capacity of some utility grids is limited not by steady state operation in normal and emergency conditions, but rather by their ability to handle transient conditions. Sudden changes in flow patterns can pose the risk of voltage instability, causing component failures and the threat of cascading outages. To avoid this risk the utilities have to make new investments in transmission facilities.

New technologies, like SMES, are able to relieve these voltage stability limitations, by injecting large amounts of real and reactive power instantaneously, at its particular location, resulting in a quicker voltage recovery than a similar sized Static Var Compensator (SVC) or Static Synchronous Compensator (STATCOM) and increasing the available transfer capability on a given system. Torsional vibrations have been observed on large thermal units due to interaction among machines and the grid. Here again, cooperation with System Control Groups is indicated.

As far as can be foreseen, existing machine characteristics, if necessary, with high response excitation and stabilizing signals are capable, in general, of meeting envisaged system stability requirements. However, the long term evolution of system designs and future requirements need to be anticipated. The application of directly connected high voltage machines is one such case, as is the desynchronizing of machine speed from system frequency. A dialogue with System Groups needs to be established to foreshadow the system requirements and harmonise with machine capability.

7.3.8. High Efficient Electrical Machines

The improvement in the efficiency of electrical machines can have a great impact on the reduction of losses in power systems contributing to energy savings and optimizing the overall system performance. With the development of new materials, improving cooling and insulation in generators and motors a better efficiency can be reached. This is particularly important in case of renewable generators and also in electric motors due to its widespread use. It is expected that improving energy efficiency will result in saving costs compared to additional energy supply.

7.3.9. Other Issues

Improvements in electrical insulation systems and understanding their condition are part of continuous evolution. The latter is a long term item simply by nature of its complexity.

Electrical Machine evolution cannot be divorced from the choice of fuel, methods of energy conversion, the closely related mechanical behaviour of prime mover turbines, pumps, fans etc. and environmental issues.

The relationship between electrical machine issues and the mechanical behaviour of closely coupled prime movers, the implications of variable speed machines, and the overall representation of plants in system behaviour studies, e.g. the boiler, turbine, generator, excitation and prime-movers energy controls, are areas where modelling is fundamental to obtain accurate results from simulations.

The implementation, in most countries, of demand management with smart household and industrial controls which will reduce consumption at times of high system demand (and high market prices) must be an alternative to be contemplated in order to reduce the requirements for peaking power plants with sensible economic benefits.

The utilization of polymer nanocomposites is promising as near-future HV electrical insulation in rotating machines and in other applications. An interaction with D1 is envisaged.

8. CHANGES TO THE OPERATION OF THE STUDY COMMITTEE

In line with the new rules of Study Committees, the working groups are expected to carry out the work related to their ToRs within limited and pre-determined periods of time – usually three years or less (4 years at the most, in some special cases) – and to produce relevant documents for publication. The main reason for this is to improve the output of the working groups. As SC A1 has some groups that have a life of longer than 3 years, it was necessary to change the manner in which the WGs operate. The challenge was to ensure three main points:-

1. The productivity of the work is to improve with no disruption of present tasks
2. The networking benefit realised with present groups is not to be disrupted
3. The continuity of documents and information is to be maintained.

8.1. Working Groups (applicable to all Advisory Groups)

8.1.1. Terms of reference and structure changes

- That no structure of the working groups are altered at present in any way, however, no working group should have items that will not be completed within a maximum of 3 years (2012). If there are such items the need for the items need to be reviewed as well as checked whether the task cannot be divided into parts some of which could be completed within 3 years.
- That all working groups propose a revised term of reference indicating the work intended for the next three years.
- That in 2011, one year before the intended end to the existing groups, or before new working groups are formed with tasks that are focused for the next three years.

8.1.2. Maintenance of WG documents

A procedure is to be drawn up covering the method of keeping working group documents. This is to include a website which will contain the responsible, reference, title as well as location of the document.

8.1.3. Introduction of New topics

Expected drivers:

- Large generators
- Risk analysis techniques for evaluating the benefits and costs of implementation on-line monitoring and diagnostics systems for risk mitigation
- Air-cooled generators and indirect hydrogen-cooled generators uprating
- Revival in nuclear technology
- New Technologies: wind, bulb, tidal, wave and superconducting machines
- Utilization of polymer nanocomposites as near-future HV electrical insulation in rotating machines

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Prepared by: Erli F. Figueiredo
With contributions from: Enzo Tortello, David Wallis, Makoto Tari, Remi Tremblay, Yuri Vinitzky, Oscar Martinez, Robert Fenton, Sameh Salem and Trevor Stokes.