

GROUP D1

MATERIALS AND EMERGING TECHNOLOGY

28th august 2008

Chairman : **E. Gockenbach**

Secretary : **J. Holboell**

S U M M A R Y

The session was attended by about 200 delegates. 24 papers were accepted under Study Committee D1. The discussion included 32 prepared contributions and 28 spontaneous contributions, thus reflecting the wide interest of topics within materials and emerging technologies.

Introductory, the SC chairman gave a short overview of the scope and the present activities of the SC.

The new name of the study committee now is: "Materials and Emerging Test Techniques". The SC has 24 regular members and 9 observers.

The mission of SCD1 is to facilitate and promote the progress of engineering and the international exchange of information and know-ledge in the field of materials and emerging test and diagnosis techniques. Also D1 contributes to improve the information and knowledge by synthesizing state-of-the-art practices and developing recommendations in general and to relevant study committees for activity regarding new or novel materials and emerging test and diagnosis techniques.

The new scope of the study committee is to identify, investigate, monitor and report upon:

- new and existing materials for electrotechnology
- emerging test and diagnosis techniques
- support of other study committees in their analysis of recently introduced and developing materials and emerging test and diagnosis techniques

The work of the Study Committee is principally scientific in nature and has as its main aim the provision of timely information on new developments and trends to other CIGRE Study Committees. Through its work the Study Committee strives to keep CIGRE fully aware of the evolution of materials and technologies relevant to its activities.

The chairman pointed out the roll of D1 as a Study Committee working in cooperation with other committees and standardisation organisations.

The activities are carried out by 14 working groups plus 5 advisory groups including a customer and strategic advisory group.

In 2007 a joint colloquium was held together with SC A2 (Transformers) in Bruges, Belgium and a joint colloquium with SC A1 (Rotating Electrical Machines) in Korea.

Three special reporters were appointed for the 3 preferential subjects:

Preferential Subject 1, *Emerging technologies for power systems* (6 papers): J. Densley

Preferential Subject 2, *Development and practical experiences with the diagnostic of material properties in power equipment*(15 papers): M. Muhr

Preferential Subject 3, *Vision on future power systems with challenges for materials operating under special environments* (3 papers): D.Windmar

The following report covers the submitted papers and reflects the contributions given at the D1 main session.

PS1, Emerging technologies for power systems: J. Densley

Six papers were submitted on three different topics.

The first topic, Power generation from landfill sites, showed a model to predict the accuracy of methane generation which is about 10%, depending on moisture present and organic content of landfill. Different levels of gas pre-treatment are available and engine operating conditions can be optimized to minimize NOx gases.

The second topic was EDLC voltage sag compensators. Field experience is limited in terms of number of units and time and about 3 years. Experiences are good so far, but they are most cost competitive when total life costs are considered. The maximum voltage is limited by high speed switch voltage rating.

High temperature super conductors (HTS) were the third topic, in particular covering device operational experience and reliability. HTS fault current limiters are new installations on power systems so there is little operating experience at present. The reliability of cryogenic cooling systems remains a concern. Utilities need reassurance that the life-time of HTS electrical insulation systems will exceed 40 years

PS 2, Development and practical experiences with the diagnostic of material properties in power equipment: M. Muhr

The 15 papers on this subject have been divided into 4 sub-topics with 15 questions.

The first sub-topic has been “practical experiences and methods for monitoring and diagnostics”. The presentations and contributions have shown advantages with diagnostic systems but there is more work required to confirm the results of some

methods. Also there is a need of standardization but most methods are in full use and give good practical results.

The second sub-topic is “diagnostics of HV power cables”. The discussion between a relation of measured values in pC and measured values of new PD measuring methods continues, though a correlation is not possible, but in IEC standards the PD levels for equipment are given in pC. It should also be mentioned that by nonconventional PD methods there will be a check and not a calibration. Important is also to develop reliable models to compare measurements with calculations. In the subject there has also been discussed possible estimations of the residual life-time of cables, but there is coming out that beside diagnostic values other parameters are also very important.

The third sub-topic is “measurement and diagnostics of transformers”. The first contribution has given an example to improve gas-in-oil analysis without great additional work. Then there was a good great discussion about furan analysis and a correlation to the degree of polymerization (DP). Because there are a lot of open questions, additional activities are necessary but a CIGRE Brochure on this question will be available in the next few months. UHF-PD measurement coming from application at GIS will also be used on transformers. A contribution has shown the possibility to perform the reliability and the sensitivity of PD sensors and where you should locate these sensors.

The fourth sub-topic is “monitoring and diagnostics of power equipment”. The first part of the presentations and discussions dealt with UHF-PD measurement in GIS. This technique is a very good and practical method for PD measuring and it has shown that a relationship between measured values of PC and mV may be possible. The diagnostic methods depend on defects and failures and therefore different sensors should be used. Secondly, there has been a discussion of polarization/depolarization measurements for giving results of the condition of insulation systems, but the question has also been discussed from the physical viewpoint for very low frequencies. Is there a DC or an AC behavior and their relationship? The last point has been test procedures for silicon rubber (SR) insulation. One presentation has shown the FTIR analysis for SR insulation, but further investigations are needed to establish a suitable test method for the acid immersion of SR insulation. The second presentation has given an example of a multi-stress test of SR insulators for polluted areas, which has given good results.

PS 3, Vision on future power systems with challenges for materials operating under special environments: *D.Windmar*

This topic was addressed by three papers. The first one reported on improved properties of LDPE with the addition of nano-fillers, and the following 2 papers cover challenges that material for composite insulators in tropical and costal environments are subjected to.

We have heard that cable systems with nano-composites with associated accessories have been tested and that the performance is good. However, to fully utilise the properties of nano-composites the electrical properties of combined

systems of nano-composites and other materials under DC voltage application need to be verified.

We have also seen how the properties such as volume resistivity and DC breakdown strength are varying with temperature and with the content of MgO.

It was shown that based on today's technology for production of XLPE cables, nano-filler can be sufficiently dispersed in production by optimised mixing conditions.

The health aspects of nano-materials are of concern and it was concluded that all measure need to be taken in order to avoid dispersal of nano-particles in air. However, more information on how to minimise the effect of nano-particles on health is needed.

Storage of insulators is of importance. If stored correctly (e.g. in plastic tubes or sealed containers) there is no effect of storage. However, if not stored correctly (in particular under polluted and tropical conditions) there is a shelf life of the insulators. A test method has been proposed on how to assess the status of the stored insulators before installation.

The growth of fungus and algae on insulators has been shown not only in tropical environments but also in temperate climates. It was shown that the microbiological growth does not damage the insulator material nor does it decrease the wet flashover values to critical levels. Even though the fungus tends to grow more on composite insulators, the FOV is still higher than for porcelain. We have also seen that surface resistance decreases when the surface is covered by algae. Different counter measures have been suggested, one is to clean the insulators and another is to add biocides to the material.

Closing of the session

The chairman of SC D1 thanked the special reporters, the secretary and all contributors and attendants for valuable contributions and their interest in the session.

JOINT GROUP C5 – D2

ELECTRICITY MARKETS AND REGULATION INFORMATION SYSTEMS AND TELECOMMUNICATION

Tuesday, the 26th of August 2008

The Discussion Meeting started with a Joint SC C5/D2 Meeting chaired by Mr. Ken Laughlin, SC C5 Chairman, Mr. Georges de Montravel, SC D2 Chairman, Mr. Alain Taccoen (FR), Preferential Subject N°1 Special Reporter and Mr. Maurizio Monti (FR), SC D2 Secretary, as meeting secretary.

The Chairmen opened the Joint Meeting with a brief presentation of:

- ✓ Study Committee C5, “Electricity Markets and Regulation”;
- ✓ Study Committee D2 “Information Systems and Telecommunication”.

SC C5 Chairman stated that, although created in 2002, SC C5 has since accomplished a lot of work. In particular he highlighted the next Cigré Symposium, “Operation and Development of power Systems in the New Context”, to be held in Guilin City, China, from the 28th to the 30th of October 2009 in co-operation with SC C1, C2 and C5.

SC D2 Chairman pointed out that the SC D2 is a horizontal Study Committee dealing with the core business of Electric Utilities, i.e., SCADA, EMS, MMS (market management System), Metering and Billing, Protection and System Control as well as Telecommunication.

To highlight the contribution of IT to the evolution of electricity markets, the SC D2 Chairman presented a short film, “Information Systems – The invisible hand”.

The Preferential Subject was “Information and Communication Systems in the deregulation of the electric sector” (PS1):

- ✓ Impact on the information and communication systems of the unbundling of vertically integrated companies;
- ✓ Implementation of the new market oriented services;
- ✓ Integration of the new information and communication system.

About 200 persons attended the meeting. There were 11 prepared contributions and 5 spontaneous ones.

As concerns PS1, the Special Reporter proposed to discuss the following areas based on the review of the papers received:

- ✓ ***From old single integrated company to multi-zones competitive markets;***
 - Japan presented two contributions. The first contribution described the step by step approach to open the electricity market and the roles of the JEPX (Power Exchange) and the respective Generation/Transmission/Distribution integrated utilities. The second one described the two different exchange systems used for electronic data interchange, the “business protocol” for the exchange with TSOs and the JEPX protocol for market transactions. APIs have been developed to enable the market participants to interface their own systems with the JEPX.
 - European Transmission System Operators (ETSO) organisation presented the work carried out in the Task Force “Electronic Data Interchange” and especially the

harmonisation work of different business processes (scheduling, settlement, capacity allocation and nomination, etc.) made with the European Federation of Energy Traders (EFET) and eBIX. This work enables to shorten the implementation delays and accordingly the investment cost. By the end of the year, co-operation with IEC TC 57 will result in the publication of the European Profile for CIM market Extension.

- The issue of Transmission Rights was addressed. It was stressed that traders expect to have detailed information on the mechanism used to allocate the cross-border capacity. As concern “market integration”, day-ahead market is the most suitable one to start the market integration but it does not provide long term signals. It was stated also that the traders worldwide are looking for multi-year capacity rights and not only to yearly ones.
- Three spontaneous contributions came from the attendance. The first one was about the retail market and stressed the need for harmonisation of the business processes especially for the Customer Switching and the Metering. The second one was about the capacity mechanism and the need to distinguish the specific ancillary services requirements. The third one was a general statement on who should be the driving force on harmonisation of business processes – and it was proposed that organisation such as Cigré or ETSO should initiate such kind of work.

✓ ***Energy Management Systems;***

- WGD2.24 presented the main concepts developed in their approach to the new SCADA/EMS architecture, i.e., high level of standardisation (common set of requirements), reusable architecture, common “business processes”, etc. The objective is to provide the software supplier with a long-term road map in order to reduce the Total Cost of Ownership.
- PJM (US) presented their Advanced Control Centre architecture. From different products for SCADA, EMS, MMS, e-Suite and Settlement, a single Corporate System based on an Enterprise Service Bus was developed. Among the advantages of the new architecture, the new system facilitate the management of security rules – previously, every week there was an update of security rules and this update has to be implemented on each individual system.
- AREVA T&D presented the software provider point of view. Standardisation enables not only to reduce IT cost and delays but also to have a greater automation of business processes and thus fully auditable processes. Software providers are nowadays integrating system with components from different providers – MMS modules from different sources.
- ABB stressed the need for increasing data exchange between the existing SCADA/EMS system and the MMS (Market Management System), in particular to assess the reserve (more reliable calculation of system reserve) and to maximize the usage of the power grid beyond the conventional limits (Voltage Control and Transient Stability Analysis).

✓ ***Integration of demand response and balancing markets.***

- Different countries are carrying out experiments on demand management for balancing mechanism. Such experiments are reported from France, Norway and US.
- France presented two experiments being carried out to enhance the balancing mechanism through demand management (Industrial consumers or aggregation of domestic loads). Feed back of these experimentations will enable to state the technical feasibility of these solutions, but also the market incentives (sharing of benefits, etc.).
- PJM introduced the impact on IT system of demand response for ancillary service markets. From their experience, there is only a data volume increase for the wholesale market operator, but impacts are very different for the customer. The impact ranges from only more automated control for Industrials, to the installation of control systems on backup equipment and integration with the building control system for Hospitals, to implement new building control facility in Universities.
- Norway presented an experimentation carried out by the Norwegian retailer Trondheim Energy to contract power offered by residential customers. At the time being, the existing IT system is used. Stress was put on the fact that customers wanted to know the market price (today, through a web site, but tomorrow an in-house IT solution may provide the

way to display/control). Automatic meter reading will only be put in operation in 2013 with additional facilities.

The Chairmen closed the meeting by stating that:

- ✓ A safe and reliable electric system is the basic condition to have an electricity market. Thus, all investment made in IT systems help the development and proper operation of the electricity market.
- ✓ Currently, electricity markets are implemented on a step-by-step basis. It is agreed that this leads to integration difficulties in the IT systems.
- ✓ Tremendous increase of information exchanges between EMS system and MMS system, market participants, market operators, called for standardisation. WGD2.24, “EMS Architectures for the 21st Century”, is contributing to this task by defining standard EMS specifications. Numerous projects are currently underway both in Europe and Japan on this matter.
- ✓ A new challenge for IT system is the increasing role of “demand management” for the balancing mechanism, and in particular the implementation of IT solution on the customer side.

GROUP D2

INFORMATION SYSTEMS AND TELECOMMUNICATION

Date of meeting: 26/08/2008

S U M M A R Y

The Discussion Meeting started with a Joint SC C5/D2 Meeting chaired by Mr. Ken Laughlin, SC C5 Chairman, Mr. Georges de Montravel, SC D2 Chairman, Mr. Alain Taccoen (FR), Preferential Subject N°1 Special Reporter and Mr. Maurizio Monti (FR), SC D2 Secretary, as meeting secretary.

The Chairmen opened the Joint Meeting with a brief presentation of:

- ✓ Study Committee C5, “Electricity Markets and Regulation”;
- ✓ Study Committee D2 “Information Systems and Telecommunication”.

It was pointed out that SC D2 is a horizontal Study Committee dealing with the core business of Electric Utilities, i.e., SCADA, EMS, MMS (Market Management System), Metering and Billing, Protection and System Control as well as Telecommunication.

To highlight the contribution of IT to the evolution of electricity markets, the SC D2 Chairman displayed a short film, “Information Systems – The invisible hand”.

The first Preferential Subject was “Information and Communication Systems in the deregulation of the electric sector” (PS1):

- ✓ Impact on the information and communication systems of the unbundling of vertically integrated companies;
- ✓ Implementation of the new market oriented services;
- ✓ Integration of the new Information and communication system.

The synthesis related to this common discussion is to be found in the Discussion Meeting Report of SC C5/D2.

The SC D2 Discussion Meeting was then chaired by Mr. Georges de Montravel, SC D2 Chairman, Mr. Gustavo Arroyo (MX), Preferential Subject N°2 Special Reporter and Mr. Maurizio Monti (FR), SC D2 Secretary, as meeting secretary.

The second Preferential Subject chosen for this session was “Frameworks for the governance and the management of the information and communication systems in the Electric Power Utilities” (PS2):

- ✓ Description of best practices;
- ✓ Utilization of emerging standards (COBIT, ITIL, BS15000...);
- ✓ Organization of the utility.

About 150 persons attended the meeting. There were 22 prepared contributions and 2 spontaneous ones.

The Special Reporter introduced the PS2. IT Governance allows to handle and to structure the IT and provides mechanisms that enable the development of integrated business and IT plants, allocation of responsibilities within the IT organization, and prioritization of IT initiatives. The final goal of IT governance is rather to provide the business with the support needed in order to conduct business in a good manner.

In the context of EPU, the IT Governance concept is fairly a new one. The application of governance can generate many benefits to the EPU, like having a good control of the existing infrastructure and this way to support the process of business of the EPU.

As concerns PS2, the discussion addressed the following areas:

- CFE (MX) presented the IT Governance policy that was implemented. It was highlighted that it is important to show where is the added value not only to the stakeholders but also to the end-users. A feed back on the implementation was provided and some recommendations were issued:
 - ✓ To be aware of the business needs and strategy of the company;
 - ✓ To decide the dimension, scale and depth of the effort needed;
 - ✓ To define an adequate organization and clear objectives before start to implement the strategy.

IT governance involves cultural changes and thus acceptance is highly dependent upon the management involvement and support.

- RTE (FR) provided a feedback on a four year IT governance policy experience. It was stressed that the greatest difficulty is to overcome the following dilemma:
 - ✓ To have a sufficient part of mutual component in IT system to reduce cost of development and maintenance,
 - ✓ To have more and more reactivity to realise specific new components or to correct existing applications at the same time as the need appears.

Today, after 4 years of such governance, RTE succeeded in global cost reduction (-17% since the 2 last years; mainly in operation cost of the IT systems and by a dedicated purchasing policy) with the same quality level and delivery successfully aligned with business needs. He highlighted the fact that the “Services Committees” have really contributed to this success, being the favourite places for business and IT interaction where the choices were discussed and solutions conceived.

RTE and IT business lines together are reviewing project governance policy and a new organisation to allow business managers to drive directly projects portfolio and maintenance of their respective domains is scrutinized.

Finally, it was pointed out that COBIT and ITIL were used as reference for the implementation of this IT governance policy, but only on some specific items.

- KEPCO (JP) stressed the fact that on one hand there is an increase of mission-critical IT system leading to an increasing complexity and more and more sophisticated operation and management tasks; on the other hand, competition requires efficiency improvements and cost reduction of system operation as well as management tasks.

They presented a successful experience in implementing ITIL for their fault/failure information management system and in particular the benefits brought by this approach. Fault/failure information was not shared between monitoring/management and maintenance stations, resulting in a dual information-management structure that created a major impediment to preventive measures against failures and speedy restoration. The new system will be put into operation at the beginning of 2009, and it is anticipated that this will be able to realize of high-quality failure restoration work.

Concerning the outsourcing policy for Network Supervision Tasks, to overcome the risk of losing technological skill, KEPCO decided to send “on loan” young employees to the outsourcing company.

KEPCO presented also the utilisation of speech recognition technology to ensure work efficiency (less transcription errors, less time to enter the date, etc.).

- TNB (MY) presented the implementation of the Telecommunication Management System and more precisely of the Customer Management System (CMS) to manage customer requests, complaints, service incidents etc. The CMS, based on ITIL best practice framework for service management, incorporates incident, problem, change, configuration, and release management components. Therefore, service incidents and problems are managed in an organized manner resulting in fast and effective services restoration.
- Japan introduced how NMS (Network Management System) functionality has been enhanced in order to mitigate IT governance issues resulting from the shift from legacy to IP networks in Japanese electric power companies.

- Finally, it was concluded that more work is required for the application of IT Governance. EPU needs to build its own Governance framework based on existing approaches, best practices and standards. Facing these challenges, the AGD2.02 should make research and studies about the state and directions about IT governance at Electric Power Utilities.

Papers, not directly linked to the Preferential Subject n°2, have been submitted to SC D2 by the National Committees. SC D2 Chairman kindly accepted them for this year and thus the Special Reporter reviewed them.

The Special Reporter stressed that the power utilities' telecommunications and IT infrastructure have an increasing major and strategic role. There is a continuous search for novel technologies and solutions to overcome the difficulties related with the power network inherent complexity as well as operational one. In this situation, the increasing customers' demands on quality of service and the intense competitive environment play also a key role, influencing this search for new solutions.

The power utilities have been searching for years a way to standardize the communications and information systems architectures for substations. An architecture or model that would allow them to upgrade or modernize existing substations and to construct new ones, without losing connectivity or facing incomparability, regardless of using equipments or software from different manufacturers.

The papers are dealing with the following areas:

- ***Information and communication systems for EPU.***
 - ✓ Optical network technology: contributions from Thailand and Japan highlighted the importance of this subject. Different technologies were discussed such as DWDM (Dense Wavelength Division Multiplexing) and CWDM (Coarse Wavelength Division Multiplexing). Japan stated that CWDM brings cost reduction in the construction of the next-generation network for electric power system to accommodate multiple Ethernet and existing optical terminals (SDH: Synchronous Digital Hierarchy, PDH: Plesiochronous Digital Hierarchy).
 - ✓ Ethernet redundancy for IEC 61850 and redundant telecommunication links: a set of papers addressed different issues that are summarized hereafter:
 - Iberdrola (ES) presented a challenging approach for the redundancy telecommunication path by using GPRS (General Packet Radio Services) technology for the monitoring of an electrical network rather than GSM.
 - Proposals were made on Ethernet redundancy for IEC 61850 in particular on the handling of the "zero frame lost". Spain stated that to provide highly available automation networks parallel redundant networks are to be used; they are currently standardized in IEC 62349 and PRP (Parallel Redundancy Protocol) should be the one to use for a reliable process bus. It was however stressed that IEC TC 57 WG10 was dealing with the subject and defining bumpless communication in order to cover the process bus but also possibly fast automation using Goose.
 - ✓ Telecommunication Network management: a set of papers addressed different issues that are summarized hereafter:
 - REE (ES) introduced the evolution towards a unified technology communication network and the better bandwidth management provided.
 - TNB (MY) stated that asymmetrical delays of more than 2ms shall cause improper operation of current differential relays leading to line tripping when sub-network connection protection (SNCP) is used to for path protection.
 - EGAT (TH) presented the IP pilot project they implemented for control, operation and maintenance. Japan, too, experienced an increasing shift to IP networks from existing PDH (Presynchronous Digital Hierarchy) or SDH (Synchronous Digital Hierarchy) networks to handle increasing size in scale, efficient introduction and maintenance management of the networks for electric power systems.
 - ✓ Telemetry techniques: Australia presented operational results of a system used to gather data from transmission lines and other sources, analyse them and then every minute automatically adjust the transmission line rating. Korea presented another application of telemetry techniques for fault location.
- ***Information security and IT security and its applications for EPU.***
 - ✓ As concerns security WGD2.22 stated that presently there is no a rigorous and precise framework to be used, but only a skeleton on which EPIs have to build their own

security framework. Different practices are also used for Risk Assessment, and the subject is not mature today and is mainly experimental.

- ✓ It is agreed that electricity is a “critical infrastructure” but it appears that IT systems to support power grid infrastructure are not always considered as “critical infrastructure”. Experience in Australia, Sweden, Japan and US are reported. Solution to enhance this awareness is either through communication to the corporate management (Sweden and Japan) or through regulation issued by NERC (US) with financial penalties. Australia has published a report on the security recommendations at www.tisn.gov.au.

To conclude, the SC D2 Chairman thanked the attendance and stated that at the 2010 Paris Session:

- ✓ A joint session with SC B5 will be made dealing with IEC 61850;
- ✓ For the SC D2 session, a stronger paper selection will be made based on the Preferential Subject.