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SPECIAL REPORT FOR SC B1
(Insulated Cables)

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Special Reporter

1. General

Study committee (SC) B1 is responsible for all aspects regarding land and submarine insulated cable systems. The scope of work of SC B1 is theory, design, applications, manufacture, installation, testing, operation, maintenance and diagnostic techniques for AC and DC cable systems.

The four strategic directions given by the Cigre Technical Committee serve as a basis for the performed work. These are preparation of the electrical power system of the future, to make the best use of existing systems, focus on environment and sustainability and communication on power system issues for decision makers.

For the 2014 Discussion Session, three preferential subjects were proposed to stimulate discussion in the light of the strategic directions. The total number of published papers is 33.

2. Preferential Subject No. 1

The title for PS1 is **Feedback from newly installed or upgraded underground and submarine AC and DC cable systems**. The subject covers all four strategic directions and involves the following sub-items:

- Design, installation techniques, operation
- Environmental issues
- Lessons learnt from planning to consent and to execution

This preferential subject attracted 14 contributions.

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2.1 Papers for Preferential Subject No. 1

B1-101: The paper describes the use of T-joints at both 132 kV and 220 kV in confined spaces when a new line is to be added in a substation. T-joints will require less space but also there is a possibility to provide switching capability between underground cables and overhead lines. Another possibility is to un-plug the connectors from the T-joint onto GIS and to use them also as transitions between XLPE and OF cables. Disadvantages mentioned are longer unavailability during connection and disconnection and more civil works due to the curvature needed to enter straight into the T-joint.

B1-102: The first major 330 kV cable installation in Australia made the operator evaluate if the testing requirements in IEC 62067 were enough for the application. Four additional tests were undertaken: heat cycling voltage testing at 105°C, pressure test of the pre-moulded joint in the XLPE – EPR interface during cycling, friction between the cable core and the sheath during operation and finally short circuit bonding test between the cable metallic sheath and the joint metallic sleeve. The tests gave valuable information on the potential impact of operation at high temperature and also implied a number of modifications and simplifications during installation which resulted in cost savings.

B1-103: The paper discusses the application of an extended type test program when the electrical field stress is increased in a 150 kV cable system. The extended type test including a 100 heat-cycle program with higher temperatures and other additional tests have resulted in a higher assurance of the performance in the Belgian HV cable systems. The same test philosophy was decided to be incorporated on the EHV levels.
The paper also presents the background for the IEC 60840/62067 standards starting with the outcome from the Cigre WGs and how changes since then have been introduced.

B1-104: This contribution presents the development of HV underground cables in Brazil. In a national WG, information and experiences were collected from the Brazilian utilities regarding underground cables in order to make recommendations for future undergrounding and to report potential difficulties such as approvals from environmental point of view. The authors elaborate on the permits and licenses that are needed, construction characteristics and the cost factors in different regions and cities in Brazil.

B1-105: The fast development of off-shore wind farms in the North Sea due to the German turnaround of energy generation has led to several submarine cable connections where most of them use the extruded DC cable technology. The authors discuss the experience and the challenges of these cable systems and bring up proposals for improvements and additional tests. Both new areas of research but also routine and after installation tests are discussed and proposed.

B1-106: The challenges in execution of laying underground cables in congested cities in developing countries are presented in this paper. The authors deliver experiences from difficulties encountered in the megacities Delhi and Mumbai in India. Difficulties are to install cables in narrow and heavily congested roads and presence of other cables, gas lines, sanitation etc. This results in that many different utilities are involved and a strong coordination is needed. The authors give example of mitigation of these challenges, e.g. duct bank installations, for a future hybrid transmission network. Finally a new technique for connecting cable terminations with OH lines with less required space is presented.

B1-107: This paper describes the permitting process for an AC underground cable connection and gives lesson learnt from this process. The example given is a 150 kV transmission line on Sardinia, Italy. The authors present the different issues that needed to be handled during the project. These are approval of different agencies, environmental issues and electromagnetic interference with other utilities. The conclusion is that the project describes the "NIMBY" issue ("Not In My BackYard") and that going underground from OH lines does not necessarily mean shorter overall project time.

B1-108: The current rating of wind farm export cables is discussed in this paper in order to optimise the overall power transfer capacity and the cost. The authors discusses the use of the IEC 60287 standard and the conservatism that it may result in due to two main assumptions (constant load and constant burial depth). Also the standard does not include the use of J-tubes and there are questions about the calculation of the loss factor for the sheath and armour losses are correct. Experiments and modelling of induced losses, landfall and J-tube show that an increased rating of 10-12% is possible. The same topic is also discussed in paper B1-306.

B1-109: A 138 kV transition joint between high pressure fluid filled (HPFF) cables and XLPE cables has been developed, tested and installed in the network in the city of New York, USA. The joint enables transition from three cables in one common steel pipe on the oil side to three separate XLPE cables which are installed in a fiber glass reinforced epoxy conduit (conventional duct bank). The joint has passed the IEEE 404 qualification test and presently fourteen transition joints of the type are installed.

B1-110: This paper describes the first Japanese installation of a commercial extruded HVDC cable. The installation is a 600 MW 250 kV cable connecting Hokkaido with Honshu. The submarine cable length is 42 km and the land cable 1.3 km. The operation started in December 2012. The insulation material contains an inorganic filler in order to improve the DC characteristics and results are presented from space charge measurements, DC voltage-time data on sheet specimens as well as type test and PQ test on the full scale cable according to the LCC scheme (i.e. including polarity reversals) in the Cigre Technical Brochures (TB 219[1] and 496[2]). Since the link also includes an overhead line, the cable system was also tested for superimposed lightning impulse tests.

B1-111: This paper brings up the question on lightning impulse (LI) test levels for extruded HVDC cable systems. When a HVDC transmission system consists of both overhead lines and cables the lightning strikes can propagate into the cables. The authors discusses that a general statement on the expected overvoltage levels cannot be given for a specific HVDC cable system and proposes that the LI test levels should be determined on a case-by-case basis based on simulations. It is also mentioned that it could be appropriate to test superimposed LI of both opposite and same polarity. It is also evident that strikes close to the cable terminations will result in higher overvoltage in the cable as well as the cable portion closest to the overhead line will be exposed to the highest LI. This fact may be taken into account when designing the system.

B1-112: In order to stress the reliability of a large 380 kV cable system in the Netherlands, a quality assurance and control scheme was developed. The quality assurance program includes first the built-in quality assessed in prequalification, type and sample tests, secondly factory

[1] TB 219 : Testing DC extruded cable systems for power transmission up to 250 kV
[2] TB 496 : Recommendations for Testing DC Extruded Cable Systems for Power Transmission at a Rated Voltage up to 500 kV

and site acceptance tests, thirdly maintaining of the quality and finally measures to restore quality. Included in the program was also lessons learned from earlier projects. Due to failures during sample testing of the accessories, activities were initiated to improve the quality and to define a special test to confirm the improvements. Statistical methods were used to evaluate the data from impulse testing in order to confirm the quality and the probability for a future failure. A successful site acceptance test concludes that the increased focus on quality assurance and control was beneficial.

B1-113: The paper describes the cable installation of the fourth submarine cable between Denmark and Norway. The 500 kV HVDC Mass Impregnated cable has considerable land sections and the installation challenge was to use long cable sections 1400-1600 m long. A special vehicle was used for transportation of the large drums. The issues during the installation of the 1500 m long HDD is also described as well as a pulling distance up to 5.5 km in the rocky terrain on the Norwegian side. The submarine part uses a route where the largest depth is 523 m. In the shallow water close to Denmark ploughing was performed before the cable installation at a depth of 2 m. This makes the cable perfectly protected from e.g. fishing gears.

B1-114: The challenge to transmit large powers in EHV cables laid in tunnels in the urban area of Dubai is the topic of this paper. In order to design a cooling system a calculation model was developed to take into account different constraints and also to include both natural and forced ventilation. Forced ventilation may only be needed during the warmest period in the summer and is performed with large fans. Design assumptions and environmental data serve as input to the model and outputs are position, size and number of the shafts and to specify the ventilation equipment such as fan and filters. First indication shows that the design is working.

2.2 Discussion of Preferential Subject No. 1

The papers submitted in this subject show the wide development that is going on in new cable installations around the world in order to (i) increase the power transmission capability, (ii) improve the reliability and (iii) introduce new designs and installation methods to e.g. mitigate the environmental impact or enable installation in confined spaces.
Several papers present and discuss the introduction and use of extruded DC cable systems. The technology has now been used commercially for up to 15 years and the voltage is increasing and service experience is collected. During this development e.g. additional tests or other concerns are addressed such as experience from wind farm connections or lightning impulse levels. The further growth of this area is also discussed in Preferential Subject No. 3. The introduction of large scale wind farm connections gives rise to questions if the calculations from existing standards need to be improved. This is dealt with in the running Cigre WGs B1.35[3] and B1.40[4].
Additional testing in order to increase the confidence of the HV cable systems are addressed by several papers. Reasons are sometimes different, but overall different utilities specify extra testing in order to get more confidence in their installed circuits. This is an important subject to discuss in the Cigre SC B1 as a basis for future standardization work. In the TB 303[5] this is as well discussed.

[3] WG B1.35 : Guide for rating calculations of HV cables
[4] WG B1.40 : Off shore generation cable connections
[5] TB 303 : Revision of qualification procedures for high voltage and extra high voltage AC extruded underground cable systems

In order to mitigate environmental impact and/or reduce costs during installation of cable systems the use of longer cables is one way to go. The example from the new interconnection between Denmark and Norway is showing this as well as a long horizontal drilling in a rocky terrain. Another example from Sardinia shows that the permitting process can be quite time-consuming also for an underground installation.
Installation of cables in urban areas addresses several challenges and is presented in several papers. New designs of joints and terminations are required for example to cope with installation in confined spaces or to enable new connections or transitions. Other issues that are presented are underground installations in developing countries where sometimes additional concerns need to be handled, such as installation in congested roads in the city with many other services involved and in the lack of detailed information such as drawings during the excavation process.

2.3 Questions from Preferential Subject No. 1

The review of the papers and the discussion implied the following questions for Preferential Subject No. 1 (Feedback from newly installed or upgraded underground and submarine AC and DC cable systems):

Question PS1 Q1: Will we need more case-by-case specific test requirements in the future? What is the driving force for adding extra requirements besides the standards and Cigre recommendations? When do we need to make additional project or contract testing for a particular cable system?

Question PS1 Q2: How do we meet the significant introduction of wind farm connections to the grid via cable systems? What is critical regarding design, operation, system features etc and how are they handled?

Question PS1 Q3: The permitting process of underground cable installations is generally considered easier than overhead lines, but still it may be a quite long process. How are these issues handled and how can this process be improved? How can environmental concerns for underground cables be further mitigated?

Question PS1 Q4: Several papers describe new installation methods of cable systems due to different challenges to be handled. Which challenges remain and how are they solved in e.g. urban areas?

Question PS1 Q5: Joints are critical components in HV cable systems. How do we secure the quality and reliability for existing as well as new designs and features of these?

3. Preferential Subject No. 2

The title for PS2 is **Best use of existing cable systems**. The subject addresses the second strategic direction. The subject covers:

- Condition assessment and diagnostic testing of cable systems
- Trends in monitoring cables and accessories
- Upgrading methodologies and related experiences
- Trends in maintenance strategies

This preferential subject attracted 11 contributions.

3.1 Papers for Preferential Subject No. 2

B1-201: This paper describes a detailed overview of the challenges encountered during fault location on long submarine cables. These challenges are different from land cables such as finding the location, critical repair time and access to specialized ships. A flow chart is shown where fault pre-location methods are described followed by methods for the final route tracing/pin pointing. Examples on the Time Domain Reflectometry (TDR) method are given on two cables in the Mediterranean Sea. How to handle fault location with higher resistance are then described and finally safety issues due to the high amount of electrical energy long submarine cables may store.

B1-202: The collaboration between utilities in Australia and a university has produced techniques for partial discharge (PD) on-line monitoring on cable systems. The main obstacle is to obtain signals which are not in interference with other on-site signals. By developing digital signal processing algorithms a solution is obtained. As an additional outcome these partial discharge monitors (PDM) were also tested on other equipment in the system. These PDM use clip-on and field-coupled PD sensors that can easily be connected and disconnected. The field experience is described in the paper.

B1-203: The experience from Belgium on PD and temperature monitoring techniques is described in this paper in order to establish the condition of the cable system. It is also envisaged that in the future cable systems can be at a higher loading which may need new on-line techniques to be introduced. Further, the Belgian experience on PD monitoring is given as well as examples on temperature monitoring with DTS using optical fibre. The future introduction of DTS monitoring systems for real time follow-up and the use of optical fibre in directional drillings are also mentioned in order to get the maximal possible load of the cable system.

B1-204: This paper describes a new way of performing voltage withstand tests followed by PD tests in order to evaluate the status of power cables in the field. To replace the damped AC (DAC) generated by DC voltage, a new method is proposed where the PD test under DAC voltage automatically follows the AC voltage withstand test by cutting off the inverter power supply. Gains are reduced work amount and less investment cost for the testing. The measurement apparatus is now under trial on a 10 kV cable in Beijing, China.

B1-205: This paper from Egypt discusses and compares the measurements of PD during type tests and after installation (on-site) tests with respect to magnitude calibration of the PD pulses. Successful measurements give a fingerprint of the cable system which in turn can be used for further diagnostics during service. Two methods are described, a conventional method using a PD detector with a HV series resonant system at 50 Hz and an unconventional method using a PD detector with high frequency current transformer (HFCT) sensors. The authors propose that PD measurements should be introduced for after installation tests in the IEC standards 60840 and 62067.

B1-206: This contribution is focusing on maintenance PD measurements after a cable system is energized. Both on-line and off-line PD measurements are compared and the merits of each one are discussed through experiences from Spanish utilities. Outcome from these experiences show that the PD amplitude is not the only parameter. Advantages with on-line/continuous monitoring PD techniques are reduced costs and no interruption of the power transmission, but they demand a higher technical level from measurement instruments and signal treatment tools.

B1-207: Monitoring of screen currents in underground cable circuits as one way to define a maintenance strategy is presented in this contribution from the Spanish TSO. Since 2008 a systematic program has been carried out on specific circuits by sensors that have continuously been delivering measurement data during operation of the circuit. If there is a deviation, maintenance staff are alerted which can prevent future failures. This experience can be considered as a first step for the development of models that make it possible to predict the existence of defects and their possible location.

B1-208: A pilot project for determining the optimal current carrying capacity during operation and to find thermal bottlenecks in time is presented in this paper. The means are to lay optic fibre cables along the cable route in order to measure the cable sheath temperature. The measured results were compared with simulated results by a FEM based software module. These results show good correlation and the conclusion is that the cable temperature monitoring can be a valuable tool for future grid planning.

B1-209: Dissolved gas analysis (DGA) of oil-filled terminations in order to assess their status is reported in this contribution. The DGA method is quite well established for oil-paper cable terminations, but here it is shown that this technique can also be used on oil-filled terminations for extruded cables. The paper discusses the differences between DGA for the two types of terminations from analysis results on aged terminations in the US. The conclusion is that this method very well also can be used on extruded cable terminations.

B1-210: This contribution reports on a fault location method which can be used for underground cross-bonded cables. The paper discusses the complexity of the electromagnetic wave propagation for cross-bonded cable systems. A fault locator system has been developed and tested on artificially created faults on a real 245 kV cross-bonded cable system. The results show that fault location can be found quite accurately with this method. This system will be used to monitor the Danish cross-bonded cable systems in the future.

B1-211: This paper describes a PD testing method developed in Korea since 2012 to be applied during after installation tests of underground cables. A compact type on-line PD monitoring system has been developed which is in use during the initial voltage withstand test. Several advantages are mentioned compared to the conventional method where PD testing is performed after the voltage withstand test at nominal voltage. A test scheme for a 345 kV link where this new test set-up is used is discussed in the paper.

3.2 Discussion of Preferential Subject No. 2

The papers that sort under this Preferential Subject illustrate quite well the topics that are under development regarding “Best use of existing cable systems”.
The two first sub-topics regarding monitoring and diagnostics of cable systems seem to attract a lot of attention. In order to better use and predict the life time of the cable system new techniques are under testing and implementation. Here, several papers present measurements

and monitoring of partial discharge (PD) activity as an important feature to assess the status. New strategies are proposed in several contributions. WG B1.28[6] has covered this topic.
A method for establishing the status for oil-filled terminations is also described in one paper (mentioned in WG B1.37[7]).
Monitoring of temperatures and screen currents are also presented as tools for better use of existing cable systems. This will help decisions for future cable grid planning and to consider upgrading as an alternative. A new WG B1.45[8] is dealing with this matter.
Fault location of cable systems are discussed in two papers. This will link to the fourth sub-topic regarding maintenance strategies. Both for submarine and underground cable systems fast fault location and repair preparedness is of outmost importance in order to restore the link back to normal operation. A new task force is started on this topic (TF B1.52[9]).

3.3 Questions from Preferential Subject No. 2

The review of the papers and the discussion implied the following questions for Preferential Subject No. 2 (Best use of existing cable systems):

Question PS2 Q1: Fault location of underground as well as submarine cable systems is discussed in some papers. Which new developments can we expect to be introduced? What are the main challenges and how can we find solutions to these?

Question PS2 Q2: New techniques and new approaches for measuring partial discharges (PD) as a tool both to be used during after installation testing and as a monitoring tool during service are discussed in several papers. What is today's experience? How will these techniques develop and be used in the near future?

Question PS2 Q3: Temperature monitoring is currently widely used and new techniques and applications are also reported in several papers. Which new developments can we expect? How will these developments affect existing circuits (such as upgrading) and future planning of cable networks?

Question PS2 Q4: After Installation Testing seems to attract a lot of attention. Which new and additional techniques are used or under development and what are the additional benefits? What are the expectations from the customers such as utilities?

Question PS2 Q5: Maintenance, asset management and replacement of cable systems is a topic which is continuously under discussion. Which methods and policies are in use and what improvements are under way in the near future?

4. Preferential Subject No. 3

The title for PS3 is **Insulated cables in the network of the future**. The subject addresses the first strategic direction. The subject covers:

- Higher voltage level for AC and DC cables

[6] WG B1.28 : On site Partial Discharges Assessment
[7] WG B1.37 : Guide for the operation of fluid filled cable systems
[8] WG B1.45 : Thermal monitoring of cable circuits and grid operators' use of dynamic rating systems
[9] TF B1.53 : Fault location on land and submarine links

- New functionalities expected from cable systems
- Integration of cables in the network
- Innovative cable types

This preferential subject attracted 8 contributions.

4.1 Papers for Preferential Subject No. 3

B1-301: The requirement of increasing the network safety in south-eastern France has led to the use of several innovations within the HV power cable field. By using larger drums giving longer cable lengths, an increase of the pulling strength of cables in ducts and doubled withstand level of shield break joints and surge arresters reduced the number of joints by one-third. Also an optimized trench design resulted in a significant reduction in waste excavated materials, less use of filler materials and other benefits from environmental point of view. For the first time in France, a mobile polyethylene extrusion line was installed close to the cable route to produce continuous length of ducts. This resulted in less environmental impact due to less transportation needed.

B1-302: This paper is a report from a study performed by Medgrid to analyse the feasibility of an interconnection grid in the Mediterranean Sea. The prospective link is a 600 km, 1000 MW HVDC cable pair reaching a water depth of 2500 m. The challenges are divided into four areas: design and technology, installation, operation and maintenance and economical and contractual issues. Several areas are identified as critical such as submarine cable installation in deep waters, repair capability, access to vessels and manufacturing capability.

B1-303: The paper reports from a recent installation of a HTS (High Temperature Superconducting) cable system in Essen, Germany. The voltage is 10 kV, the circuit is 1 km long and this installation is the first where a fault current limiter is installed in a HTS cable system in a real grid. The cable design is concentric with all three phase having a common screen. A prototype cable system was type tested successfully before production started. The final commission test was conducted in December 2013.

B1-304: A new cable insulation material which does not need crosslinking is presented in this contribution. The material is polypropylene based and is denoted a high Performance Thermoplastic Elastomer (HPTE). Several advantages compared to cross-linked material are mentioned. The material has been used in commercial cables since 2009 in the MV range in Italy, Netherlands and Spain. The route to use the material also on HV cables started with prototypes on the 150 kV level where development and type test are finalized and prequalification test is ongoing. A field test is now installed.

B1-305: This paper describes a Japanese initiative to test the operational performance of HTS (High Temperature Superconducting) cable system in Yokohama. The voltage is 66 kV and the circuit is 0.24 km long. The insulation material is PPLP. The system has now served for more than a year with no issues. Factory and verification tests were conducted on the system in order to confirm the design including compliance with new recently published work by WG B1.31[10].

B1-306: This contribution presents new results within an area that has drawn attention recently and is also discussed in paper B1-108. The subject is the calculation of the armour losses in

[10] WG B1.31 : Testing of superconducting cable systems

three-core submarine XLPE cables. By making measurements on two different cable designs the conclusion further emphasizes that calculations from IEC 60287 give too high losses. The authors state that the armour losses are of limited importance to the rating of submarine three-core cables which in turn will result in smaller conductor sizes.

B1-307: The question about water treeing and the influence of mechanical tension is presented in this paper. The focus is on dynamic subsea cables hanging from floating installations. Wet designs without water barrier are usually used for the lower voltage range. In the experiments 12 kV cables were subjected to both longitudinal and bending strains (up to 1%) and a dynamic load frequency of 0.1 Hz. The result is that the density and growth rate of water trees are affected where the tensile stress increases the water tree degradation whereas the compressive stress retards it. The overall conclusion is that there is no significant increase of the water tree ageing effect on the cables up to 1% dynamic strain which normally is well below during actual operation.

B1-308: This contribution describes the development status of extruded XLPE DC cable in Korea. After carrying out research for several years type tests are performed and underway. Three voltage levels are presented, first a 80 kV type test according to the former Cigre TB 219[11] on a cable with a nano-composite XLPE insulation compound. The same compound was then used in a type test on the 250 kV level according to the new TB 496[12]. Finally the authors mention that a type test on the 320 kV level using a commercial DC XLPE compound is under way and planned to be completed in the first half of 2014.

4.2 Discussion of Preferential Subject No. 3

The papers in this subject about the future cable networks cover a large area of the important topics within the HV cable development as of today. The main topics are higher ratings, improved mechanical properties, new materials, new designs, new installation features and improved modelling and calculations of cable systems.

For higher ratings the hottest topics are the introduction of HTS (High Temperature Superconducting) AC cables for higher current and increased voltage for HVDC cable systems. This is also reflected in recently published Technical Brochures by SC B1 (TB 496 and TB 538[13]).

Mechanical properties of submarine cable systems are also becoming more important mainly in order to cope with larger sea laying depths but also for new applications such as connection of floating platforms. Also for land cable systems improved mechanical properties and the prediction of these will enable new underground installation possibilities. There is now ongoing work in SC B1 regarding mechanical properties of cable systems.

New materials are also presented in order to challenge non-filled XLPE compounds for extruded cables and several advantages are promoted in different applications. How quickly significant material changes can be introduced on a commercial scale will be an interesting question in the near future.

The fast development of new requirements and new possibilities of the future cable HV systems will also require that the recommendations and standards follow in the same pace.

[11] TB 219 : Testing DC extruded cable systems for power transmission up to 250 kV

[12] TB 496 : Recommendations for Testing DC Extruded Cable Systems for Power Transmission at a Rated Voltage up to 500 kV

[13] TB 538 : Recommendations for testing of Superconducting cables

Overall the topics in the subject show that the HV cable area is developing fast and the needs of the future network put several challenges on the HV cable community to meet this need.

4.3 Questions from Preferential Subject No. 3

The review of the papers and the discussion implied the following questions for Preferential Subject No. 3 (Insulated cables in the network of the future):

Question PS3 Q1:
Extruded DC cable systems attract a lot of interest in the future grids and there is a driving force for higher voltages. What can we expect in the near future for these systems to be further developed regarding higher voltage?

Question PS3 Q2: HTS cable systems are now on selected sites in commercial operation. What is the driving force for the implementation of these systems? What is remaining and needed for these systems to be commercially viable in a larger scale?

Question PS3 Q3:
New materials (e.g. thermoplastic elastomers and nano-composites) are presented in several contributions for HV cable applications. What is needed and what is the time frame for these materials to take a considerable portion in the future from XLPE compounds? What are the concerns and the benefits?
Are the existing standards appropriate for these new materials when additional testing is already required by users of the well-established technologies?

Question PS3 Q4:
Besides higher ratings, improved mechanical properties of HV cable systems is a prerequisite for submarine cables in the network of the future in order to cope with higher laying depths. What is the status as of today and what are the main challenges regarding development and testing of cable systems for e.g. deeper sea, floating platforms and longer pulling lengths. Are there any alternative solutions?

Question PS3 Q5: The calculation of armour losses is one example where the interpretation and validity of existing standards are discussed recently. Are there other examples where standards and recommendations need to be updated? Will the networks of the future require a higher pace of these activities?

IMPORTANT NOTE: it is expected that above questions relevant to the three Preferential Subjects will attract a number of prepared contributions. The timing of the B1 session usually allows a maximum of 45 prepared contributions. Contributors are invited to comply with Cigre rules i.e. to send their contributions two weeks in advance to the Session and to be ready to discuss contents and allocated speaking time on Tuesday 26th of August, the day before the Group Meeting. Contributions shall be prepared on the basis of the templates that can be found on the Cigre website. These templates will be also posted on Cigre B1 website together with the latest information regarding SC B1.
The SC B1 session held on Wednesday August 27th will start at 8h45 in “Salle Bleue” and the lunch time will be from 12h30 to 14h00 (sharp).