CIGRE Study Committee B2

PROPOSAL FOR THE CREATION OF A NEW WORKING GROUP[1]

WG N° B2.68	**Name of Convenor:** Cécile Rozé (France) **E-mail address**: cecile.roze@rte-france.com
Strategic Directions #[2]: 2, 3	**Technical Issues #[3]:** 8, 9
The WG applies to distribution networks[4]: Yes	
Potential Benefit of WG work #[6]: 1, 2, 3	
Title of the Group: Sustainability of OHL conductors and fittings – Conductor condition assessment and life extension	

Scope, deliverables and proposed time schedule of the Group:

Background:

Many OHL transmission lines throughout the world are nearing or have gone beyond their expected life. Since the conductors (including their installation) represent approximately 40% of the cost of the line, their condition is predominant in the decision to replace the line or extend its life after evaluating if they are degraded. The challenge is to prolong the residual life of the conductors without impacting the line reliability beyond what is acceptable to the Transmission System Operator. The interaction between conductors and fittings must also be considered since they are part of the same system.

Reading the CIGRE documents (see appendix and others not listed), it can be seen that there are knowledge gaps and the following actions are needed :

- An update on corrosion (latest publication in the 1990's)
- An update on fatigue curves including if possible the latest data
- Identify and discuss other degradation mechanisms (thermal, electrical…)
- An update on recently/newly developed diagnosis tools (robotics/drones, new sensors as in B2-206_2016, monitoring devices) and ageing tests
- A discussion on the link between technical and economical points of view for asset management (impact of ageing on losses and maintenance policy)

Scope:

Although lots of work has already been done on the subject, there is still a need to gather all the information available and use it to be able to reach the following points:

- Assess the degradation factors and their severity for fittings and conductors (from fittings…) :
  - Fatigue due to aeolian vibration, sub-span oscillations, galloping
  - Excessive loads due to ice and wind
  - Corrosion due to atmospheric and industrial pollution (NB : Corrosion is also covered in WG D1.71 and synergies between B2.68 and D1.71 will be sought).
- Provide tools to estimate the residual life of the conductor and fittings using the following information
  - Ductility of the aluminum wires of the conductor, grease…
  - Fatigue tests
  - Visual examination (field observations, …)
  - Monitoring devices
  - Diagnosis tools (measure the electrical resistance of the joints…)
  - Maintenance practices
  - Etc.
- What can be done to prolong the life of the conductor and fittings
- Propose a decision chart to address the following option

- Keep the conductor and fittings as they are and determine when another evaluation is required
- Upgrade or rehabilitate the conductor and/or fittings
- Replace the conductor and/or fittings

The knowledge to reach all those points may not be available yet but a questionnaire will be sent to utilities and a state of the art review will be done to gather the best practices and make recommendations whenever possible based on the questionnaire, lab testing and the WG members' expertise.
Since there is not much long term experience with HTLS, gap-type, and other conductors that were developed more recently or that are used only in a few parts of the world, the WG will cover only conventional ACSR, AAAC and AACSR conductors.
The WG will not cover the legal aspects that may be associated with conductor and fittings ageing and thus will not provide expected lifetime for conductors and fittings.

The following topics will be covered in the technical brochure:
0/ Bibliography
1/ Ageing phenomena description on conductors and fittings: corrosion, fatigue, thermal, electrical…
2/ Inspection and test methods of conductors and fittings to estimate its residual life
3/ Methods to prolong the life of the conductors and fittings
4/ Ongoing research and prospects
5/ Asset management of conductors and fittings (decisional chart on best practices to establish conductor condition, how to collect data from the field…)

Deliverables:

☒ Technical Brochure and Executive summary in Electra

☐ Electra report

☒ Tutorial[5]

Time Schedule: start: August 2017 **Final Report**: 2021

Approval by Technical Committee Chairman:

Date: 02/08/2017

Notes: [1] or Joint Working Group (JWG), [2] See attached Table 2, [3]See attached Table 1, [4] Delete as appropriate, [5] Presentation of the work done by the WG, [6] See attached table 3

Table 1: Technical Issues of the TC project "Network of the Future" (cf. Electra 256 June 2011)

1	Active Distribution Networks resulting in bidirectional flows
2	The application of advanced metering and resulting massive need for exchange of information.
3	The growth in the application of HVDC and power electronics at all voltage levels and its impact on power quality, system control, and system security, and standardisation.
4	The need for the development and massive installation of energy storage systems, and the impact this can have on the power system development and operation.
5	New concepts for system operation and control to take account of active customer interactions and different generation types.
6	New concepts for protection to respond to the developing grid and different characteristics of generation.
7	New concepts in planning to take into account increasing environmental constraints, and new technology solutions for active and reactive power flow control.
8	New tools for system technical performance assessment, because of new Customer, Generator and Network characteristics.
9	Increase of right of way capacity and use of overhead, underground and subsea infrastructure, and its consequence on the technical performance and reliability of the network.
10	An increasing need for keeping Stakeholders aware of the technical and commercial consequences and keeping them engaged during the development of the network of the future.

Table 2: Strategic directions of the TC (ref. Electra 249 April 2010)

1	The electrical power system of the future
2	Making the best use of the existing system
3	Focus on the environment and sustainability
4	Preparation of material readable for non-technical audience

Table 3: Potential benefit of work

1	Commercial, business or economic benefit for industry or the community can be identified as a direct result of this work
2	Existing or future high interest in the work from a wide range of stakeholders
3	Work is likely to contribute to new or revised industry standards or with other long term interest for the Electric Power Industry
4	State-of-the-art or innovative solutions or new technical direction
5	Guide or survey related to existing techniques. Or an update on past work or previous Technical Brochures
6	Work likely to have a safety or environmental benefit

Appendix : Related work performed by CIGRE

Brochures :
TB to be published : WG B2.47 (Repair of conductor and conductor-fittings system),
TB653 -- Safe Design Tensions for Single Conductors Fitted With Elastomer Cushioned Suspension Units - 2016
TB477 -- Evaluation of aged fittings – 2011
TB471 -- Working Safely while Supported on Aged Overhead Conductors - 2011
TB429 -- Engineering guidelines relating to fatigue endurance capability of conductor/clamp systems – 2010
TB332 -- Fatigue Endurance Capability of Conductor/Clamp Systems - Update of Present Knowledge - 2007
TB277 -- State of the art survey on spacers and spacer dampers - 2005
TB251 -- The mechanical behaviour of conductors and fittings - 2004
TB273 -- Overhead conductor safe design tension with respect to Aeolian vibrations - 2005
TB216 -- Joints on transmission line conductors: field testing and replacement criteria - 2002

Papers :
B2-203_2016 – Innovation in Evaluating and Managing the Reliability of Aged Transmission Structures
B2-206_2016 -- Portable X-ray system for in situ detection of broken ACSR strands at suspension clamps: field results and equipping the LineScout robot
B2-212_2016 – Condition Assessment of Overhead Line Connectors by the Pulse Current Method
B2-303_2016 – Development of estimating method for conductor corrosion and high corrosion resistant conductor for OHL
B2-305_2016 – Temperature profile along an OHL conductor in and near the tension clamp
B2-306_2014 -- Creep and fatigue into copper micro alloys for overhead transmission lines
B2-208_2012 -- Overhead lines asset management in the Belgian network
B2-213_2012 -- Corrosion characteristics based on an investigation of Sampled OHTL conductors and a probabilistic lifetime estimation method
B2-302_2012 -- Example of refurbishment of overhead lines 400 kV at Western Cape after major pollution event in February 2006

B2-305_2010 -- Robotics applied to power line inspection and maintenance: Hydro-Quebec's experience and future applications
B2-303_2010 -- Impact of turbulence on vortex induced vibrations and fatigue of conductors: modelling and real span experimentation
B2-309_2010 -- Assessment of OHL availability and residual life-time by using nondestructive instrumental control for conductors, steel wires and guys
B2-214_2008 -- Aeolian vibrations on high voltage lines comparative self-damping as evaluated on the field
B2-210_2008 -- Pulse current measurements for condition assessment of conductor joints of overhead lines
B2-209_2008 -- Geographical information tools for overhead lines preventive maintenance
B2-207_2008 -- Development of estimation and diagnostic method of ACSR inner corrosion based on the corrosion mechanism study