CIGRE Study Committee B3

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

WG N° B3.47	**Name of Convenor: Jianbin FAN** **E-mail address**: jianbin-fan@sgcc.com.cn
Technical Issues # [2]: 8, 10	**Strategic Directions # [3]: 2, 3**
The WG applies to distribution networks [4]: Yes	
Title of the Group: Application of Robotics in Substations	

Scope, deliverables and proposed time schedule of the Group:

Background:

Traditional substation patrol, inspection and manual operations in substations require significant manpower and have issues with efficiency, consistency and quality. There are also potential safety problems in severe climatic conditions, such as rain, snow, fog, storm, heat and cold. With increasing demands for more intelligence in substations and unattended operation, it is necessary to develop new technologies for inspection and operation in substations.

The rapid development of robotics technology has made it possible to be applied in the electric power industry. The robot may also replace or assist human workers to complete equipment inspection, analysis and diagnosis, remote control, supplementary maintenance and live-line working, etc., and effectively reduce inspection cost, labor intensity and safety risk of the operation and maintenance.

In the 1980s, many countries including Japan, Canada and China began research into the application of the robotics in substations and since that time there have been significant developments in robotic technology. The International Conference on Applied Robotics for the Power Industry (CARPI) has been successfully held four sessions since 2010 and during these conferences more than ten countries have demonstrated their research results and prototypes. Robots for substation inspection have become commercialized and currently more than 900 substations in China using robots to replace or assist human inspection.

Due to the current global business environment and awareness of risks, robots used in substations must meet many requirements, such as functionality, environmental adaption, reliability, safety etc. Additionally, up to now, IEC and ISO have not yet carried out standards development in relevant fields associated with robotics.

Scope:

To investigate and research worldwide needs for the application of robotic technology in substations, define main application scenarios, identify key technical requirements and challenges, prepare case studies describing best practices, identify standardization needs and provide suggestions for the follow-up work.

1. Collect relevant background information, user needs and experience regarding the application of robotic technology in substations worldwide, including substation operation and maintenance (O&M) schemes, application of robots, issues solved by robots, advantages and problems, and identify the substation O&M requirements regarding the present and future functionality, performance and operation of robots.
2. Study the current robotic applications in substations worldwide, including system composition, inspection schemes, application scenarios, measuring techniques, decision-making strategies and human-machine interaction. Identify the main

advantages and challenges of using robots in substations.

3. Study the operational security and safety aspects as well as maintenance and inspection of the robotic application itself.
4. Identify the needs and opportunities for semi-autonomy and artificial intelligence for robotic applications.
5. Showcase and document best practice robotic applications in substations based on the working group investigation results.
6. Analyze the demands for technical guidelines, define technical requirements, develop testing methods, and propose a standards development plan.
7. Identify future trends and user needs for robotic application in substations and provide suggestions for the next steps in this work.

This work will be coordinated with WG B3.44, which focuses on smart sensing, communication and general data management for asset management. Also the Working group will coordinate with WG B2.52 for synergies with the work on robotics for overhead lines referring to any published brochures.

Deliverables: Technical brochure, summary in Electra, Tutorials, conference presentations

Time Schedule: start: late 2016 **Final report**: 2019

Approval by Technical Committee Chairman:

Date : 01/11/2016

(1) or Joint Working Group (JWG) - (2) See attached table 1 – (3) See attached table 2
(4) Delete as appropriate

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 within distribution level and to the upstream network.
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 (cf. 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