



WORKING GROUP FORM

Study Committee: B4

WG number: WG B4.61

Name of Convener: Jingxuan (Joanne) Hu, CA

Title: General Guidelines for HVDC Electrode Design

Terms of Reference

Background:

Various types of ground electrodes have been designed and installed for HVDC transmission systems to provide a low resistance, return current path during monopolar and bipolar operation, using the earth and/or sea as the conductive medium.

A practical and successful electrode station design requires careful consideration of the parameters of the electrical system, the surrounding earth and bodies of water, and the potential impact the electrode installation could have on infrastructure (pipelines, railways, power lines, transformers and telecommunication) and on the environment. Knowledge in diverse disciplines including electrical, civil/structure, geology, geophysics, corrosion, marine biology, and chemistry is needed for engineering analysis and detailing of an electrode installation.

The available literature on HVDC electrode analysis and design are STRI report S90-003 – “HVDC Ground Electrodes” (1990), EPRI report EL2020 – “HVDC Ground Electrode Design” (1981), Kimbark’s Chapter 9 – “Ground Return” (1970), CIGRE WG 14.21 TF1 – “Summary of Existing Ground Electrode Designs” (1998), CIGRE WG 14.21 TF2 – “General Guidelines for the Design of Ground Electrodes for HVDC Links” (1998), and IEC pre-standard PAS 62344 – “General Guidelines for the Design of Ground Electrodes for HVDC Links” (2007).

The above body of knowledge covers the analysis of electrodes in simplified geological units, site selection methodologies, impacts of electrodes on infrastructure, and information on the existing electrode installations. However, topics such as electrical field studies, electrode element material selection, instrumentation and auxiliaries required for an electrode station, application of electrodes for a VSC HVDC scheme, electrode testing and commissioning, and pond electrode analysis and design are not covered in detail.

Also, with the development of new geophysical and geological investigation techniques, computer simulation tools for electrical field studies and infrastructure modelling, more practical and reliable designs of ground electrodes can be achieved, and the impacts of the electrode operation on the structure can be quantified accurately. Therefore, an update of existing electrode design procedures and technologies is considered beneficial for the future of electrode station analysis, design and construction.

Scope

The objective of this WG will be to complement the earlier work carried out under CIGRE WG 14.21 and the activities would include:

1. Review of HVDC schemes, electrode configurations, and modes of electrode operation.
2. Review of electrode types, selection of type of electrode for a scheme.
3. Update survey conducted by B4-44 (2006-2007) on operational experience of installed electrode stations and designs of auxiliaries and monitoring systems.
4. Develop electrode design criteria including electrode duty, safety, polarity, electrical

interference, corrosion impacts, and electrolysis emissions.

5. Review of site selection criteria and process.
6. Update on the technology of electrode station study and design
 - Geological modelling scenarios, including earth and water resistivity measurement technologies; field programs to collect the resistivities, and definition of extents of geological units to be modelled
 - Electrical field simulations, including modelling the electrode in the earth and/or sea model and interpretation of results
 - Land, shore/pond and sea electrode design processes and design examples including data required for environmental impact assessment.
 - Electrical interference, corrosion impact and simplified electrolysis emission analysis.
7. Electrode line termination and integration into electrode installations.
8. Auxiliary systems for electrode stations.
9. Testing and commissioning practices.
10. Operation and maintenance including possible instrumentation monitoring
11. Other considerations such as impact of electrode design on the reliability of HVDC schemes.

Deliverables and time schedule:

Deliverables: Technical brochure with summary in Electra

Time Schedule: Start May 2011; Final Report 2013

Other SCs/ Target Groups concerned by the work:

Consultants, utilities and regulatory bodies

Approval by Technical Committee Chairman: Klaus Fröhlich

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