CIGRE Study Committee A1

PROPOSAL FOR THE CREATION OF A NEW WORKING GROUP (1)

WG* N° A1.35	**Name of Convenor : Edgar Robles (Mexico)** **E-mail address**: **erp@iie.org.mx**
Technical Issues # (2): xxxxxxx	**Strategic Directions # (3): 2**
Title of the Group: Hydroelectric Generators Behaviour under Abnormal Operating Conditions	

Scope, deliverables and proposed time schedule of the Group :

Background :

Generators abnormal operating conditions accelerate ageing, or in extreme cases can cause severe failures. Particularly, hydroelectric generators require functioning under load cycling, from no load to full load in a short period of time; in some cases are used to supply peak loads, and therefore required to be connected daily. Consequently, the possibility of an out-of-step synchronization or a failure in the generator circuit breaker is greater in this type of generators.

One of the most critical conditions is the operation under short circuit that can occur within or outside the generator. As most of the generators neutrals are grounded with a high resistance, a phase to ground failure is limited to a few amperes and generally produces minor damages. Failures in the generator lubricating or cooling systems might contaminate the stator windings with oil or water and produce a phase to phase short circuit in the stator end windings that are more deleterious. Primary windings of the step up transformers are delta connected; then a failure occurring in the high voltage side of the transformer or in the substation equipment will give rise to phase to phase circulating currents in the generator. Phase to phase currents in the stator windings also affect the rotor windings and the excitation system, also they produce negative sequence currents that enhance mechanical stresses. Other type of abnormal operation and its effects on the hydro generators that will be considered are loss of field and load rejection.

In the other hand, hydroelectric generators can be synchronized to the network with a circuit breaker in the high voltage side of the transformer unit or at the generator output. Both schemes operate properly under steady state conditions; therefore the need of an extra breaker at the generator output seems to be redundant. Under fault conditions; both on the generator, on the transformer unit or in the substation. There might be instances where the generator cannot be isolated from the failure and severe damages can be produced. Special consideration should be taken into account according to the general arrangement of the power plant.

Scope :

Modern monitoring systems, transient recorders and digital relays provide important information to understand hydro electric generators behaviour under abnormal operating conditions. Some variables can be recorded under actual failure conditions, like generator and excitation current and voltages or stator windings neutral currents, for instance. Other variables can be recorded after the event, like stator winding partial discharges or vibration levels.

Abnormal operating conditions can produce catastrophic failures or accelerate the ageing process of a hydroelectric generator; information gathering and analysis under both circumstances are relevant to understand generator behaviour.

The Working Group will classify all possible operating scenarios on different types of hydroelectric generators to define the most convenient interconnection scheme. One of the scenarios that can be foreseen is the use of gas insulated substations in a peak hydroelectric power plant; continuous switching operations aged the circuit breaker and endanger the power plant primary equipment. Potential damages to the generator under transient conditions will be analysed with and without a circuit breaker at the generator output.

Deliverables : Report to be published in Electra or Technical Brochure with summary in Electra

Time Schedule :

- TOR submitted for approval on 14 December, 2011
- Draft questionnaire by 2 March , 2012
- Issue Questionnaire for responses: 30 April 2012
- Discussion at CIGRE session in Paris August 2012
- Responses due: 31 October 2012
- Draft report on questionnaire & recommendations – 15 Feb 2013
- Draft report / guide presented at Romania Meeting - Sept. 2013
- Comments by members and experts - 31 December 2013
- Approval of final document – SC-A1 meeting 2014
- Final document to be published– 30 November 2014

Comments from Chairmen of SCs concerned : None

Approval by Technical Committee Chairman : Klaus Fröhlich **Date** :08/01/2012

(1) Joint Working Group (JWG) - (2) See attached table 1 – (3) See attached table 2

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	Interactive communication with the public and with political decision maker