



## Study Committee B3 "Substations"

### WORKING GROUP FORM

**WG: B3.36**

**Name of Convener: Peter Sandeberg**

**Title of the Group: "Special Considerations for AC Collector Systems and Substations associated with HVDC connected Wind Power Plants"**

#### **Background**

Since 2009 Working Group B3.26 has been working on developing "Guidelines for the Design and Construction of AC Offshore Substations for Wind Farms" This WG intentionally limited its scope to AC connected wind farms. Naturally, the majority of the work of this working group will also be applicable for AC substations to be used as collector substations for HVDC connected wind farms but there are a number of factors to be considered which are quite different. While SC B4 (WG B4.55) is working on the HVDC connections, WG B3.36 will deal with the AC collector systems.

Some of the issues that will be considered will be:-

- What frequency should the offshore network operate at? As the HVDC link provides a distinct separation from the onshore network, serious consideration should be given to advantages of determining and using an optimum frequency.
- What voltage should the collector AC network operate at? Again it does not need to be related to the onshore voltage.
- How is fault ride through of the Wind Turbine Generators (WTGs) achieved compared to an AC connected system? As the HVDC system basically decouples the AC offshore from the AC onshore they cannot inject maximum reactive current but they must return to at least 90% of the active power available before the fault is within 500ms of the fault being cleared.
- How many collector substations should be used? What is the optimal ratio of AC stations to HVDC offshore substations?
- What are the reactive compensation requirements on an offshore AC network i) considering different Grid Codes (GC) and ii) requirements only from a system point of view, i.e. disregarding the different GC requirements.
- How will the reactive power requirements be met?
- For the AC transformers on the AC offshore substations how to optimise the impedance required? For AC connection the impedance choice was heavily dominated by controlling the fault level as the major fault infeed came from the AC system onshore. With an HVDC link high fault current is not a problem but low fault current may be.
- The protection on AC connected wind farms has been heavily focussed on current operated protection systems and grading. With a fault infeed from the HVDC converters of about 1.2 pu load current the protection philosophy of the substation will need to be totally reconsidered. Particularly for the protection of the array cables.
- How will the communications systems work?
- What interconnection will be needed using AC either between collector substations or between HVDC hubs?

#### **Scope and aim**

The scope of the Working Group will be limited to the AC collector system associated with offshore wind power plants connected to shore by HVDC connections. The HVDC platform and its equipment is outside of the scope of this Working Group. Both WG B4.55 and B3.36 will work in close consideration of their respective works.

The aim of the activity is to:-

- (i) Identify the key differences between AC collector systems associated with HVDC connection to shore as compared to AC connection to shore and to provide guidance on how to optimise the design of these collector systems and substations.
- (ii) Some of the findings may be applicable also for substations connecting large onshore wind power

plants to the grid by means of HVDC. However, it is not the intention of this WG to investigate all the different aspects in relation to onshore substations.

### **Deliverables / time schedule**

**Deliverable:** A guideline document providing constructive advice to enable designers, developers and constructors to optimise the design of AC collector systems and substations associated with HVDC connected wind power plants

**Form:** A technical brochure with a summary published in Electra.

**Time Schedule:** Start of the activity: Autumn 2011 with final brochure by end 2012.

**Note:** It is expected that many of the WG members of B3.26 will work on this WG as a very quick delivery time is required and it is hoped that this will avoid the learning time required to become familiar with offshore work.

**Approved by TC Chairman: Klaus Fröhlich 27/10/2011**