Press Release

XLPE DC cables rated higher than 500 kV – a key building block for the energy shift

Innovative high power-density product makes it possible to design the transmission grid of the future with overhead transmission lines and underground cable sections

Mannheim, January 28, 2015 – One of the challenges presented by the energy shift (Energiewende) is that the transmission grid will have to handle new tasks in the future. To ensure that it is capable of doing so as effectively as possible, it is planned to construct more than 2,000 kilometers (km) of High Voltage Direct Current (HVDC) transmission lines, which in many cases will cross sensitive environmental or residential areas. The 525 kV DC cable system with extruded insulation developed by ABB has such a high power density that for the first time a cable system can transmit approximately the same amount of power as an overhead transmission system.

The energy shift in Germany already began in 2000 with the enactment of the European Renewable Energy Directive (EEG); however, it only really started to take off after the German Federal Government, following the Fukushima disaster, decided to shut down all of Germany’s nuclear plants by 2022. Since then it has become clear that the massive shift in the generation base will have to be dealt with very quickly, especially in the industrial centers of southern Germany.

New fossil-fueled power plants could be built, but this does not appear very feasible given today’s market mechanisms. Strengthening the power transmission grid in order to be capable of balancing generation and consumption swings on a large scale is the alternative. Germany’s Federal Government in fact documented this in the Federal Requirement Plan. Three HVDC transmission corridors extending 400 to 800 km are planned to balance trans-regional fluctuations. Plans call for using mainly overhead transmission lines to interconnect the nodes of these HVDC corridors, but cables can also be used in some sections.

In many cases, the new HVDC systems planned for construction along corridors that will be over 2,000 km long will cross sensitive environmental zones or pass very close to residential areas. Where possible, the transmission line operators are planning alternative routes to bypass these areas to a great extent. Where this is not possible, or only possible at unjustifiably great expense, legislators have provided an opportunity to run sections of the corridors underground.

Until now, such underground cable sections would have been constructed using conventional oil-impregnated-paper-insulated cables (also called mass-impregnated or MI cables) because no modern extruded cables were available for the planned 400 to 500 kV DC transmission voltage ratings. In fact, the designs called for two cable systems per HVDC corridor to transmit 2 Gigawatt (GW) of power; that is, four single-conductor cables in total. This would have required a corridor width of thirty to forty meters, with commensurate excavation and back-filling costs. MI cables have lead sheaths and steel armor, which make them very heavy. Laying such cables would have required a carefully planned logistics concept for transporting heavy loads. Each cable reel can hold around 500 meters of cable. The joints needed for connecting individual cable sections have to be made on site. Jointing MI cables is very time consuming, while each joint takes about one week to complete.

In August 2014, ABB presented a cross-linked polyethylene (XPLE) insulated DC cable system with a voltage rating of up to 525 kV, which significantly reduces some disadvantages of underground cabling compared to overhead transmission lines. The highest voltage rating for existing commercial applications using this technology to date was 320 kV. ABB has thus boosted the rated voltage sixty-four percent. In Germany, XLPE cable systems rated 320 kV have become a de facto standard; for
example, for links between offshore wind farms and the onshore grid. ABB has installed 360 km of underground cable in northern Germany alone and 240 km of submarine cable in the North Sea. The transmission capacity at this voltage level can be as high as 1,200 Megawatts (MW).

Using the new 525 kV cabling system, transmission capacities up to 2,600 MW can be reached, more than double the previous rating. As an added bonus, the weight per megawatt of transmission capacity is also lower. The higher transmission voltage is thanks to the use of a new XLPE insulating material ABB developed jointly with a leading plastics manufacturer. The innovative HVDC cabling system has already been successfully tested. A completely tested cabling system that has already passed the endurance test specified by applicable standards is thus now available. The cable, cable joints and cable terminations were set up in a lab and thoroughly tested for over a year under the supervision of an independent auditor. The reliability of the cable and its accessories (joints, cable terminations) thus conforms to all relevant technical standards. This cable is available from ABB immediately and comes with the same guarantees offered as for previous cables.

This means that there is now an underground cable available for the German HVDC corridors that is capable of transmitting up to 2.6 GW per cabling system; that is, only one cabling system consisting of two single-conductor cables is required per 2 GW HVDC corridor. This cuts the width of the corridor in half. Since only half as many cables are required as compared to MI-cable based systems, excavation and backfill as well as logistics costs are also lower. Furthermore, since the cables weigh only half as much, the length of individual cable sections can be doubled (to around 1,200 m per cable reel), which in turn reduces the number of joints required by a factor of two. The joints for XLPE insulated cables can be prefabricated at the factory, which reduces the installation time per joint at site to around two days. In addition, the XLPE cables take less time to manufacture, which means that the same production unit can produce more cable per unit of time.

Until now HVDC corridors sections with partial cabling could have been planned and realized using 500 kV MI cables; however, ABB's new XLPE cable system now offers further advantages; namely, significant production and installation resource, cost and time savings compared to conventional MI cabling systems.

Photos can be found on the press area of our website www.abb.de.

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