Pauwels supplies Phase Shifter to Elia substation in Monceau

The decision to separate the generation and transmission of power, recently taken by European policy makers, has created additional challenges. Progress in the liberalisation of energy markets is evolving at different speeds in different countries and progress is very often not made without difficulty. For example, due to liberalisation, electrical energy markets are now undergoing major restructuring and one major effect of this is the increase of power flow variations in networks. As a result, there has been a growing interest in tools that allow for better control and more efficient use of the power network.

A Phase Shifting Transformer (PST or Phase Shifter) serves that purpose as it helps to control the active power flow in a complex distribution network in a very efficient manner. In the recent past, Pauwels Trafo Belgium has contributed to power flow management by the construction of an Autotransformer Phase Shifter for ELIA, the transmission system operator of the Belgian power network. The importance of such a project in a context of liberalisation, the degree of complexity of the transformer and the proof of expertise linked with the successful realisation of this project, are excellent reasons to highlight this challenging topic.

What is a Phase Shifter?

A Phase Shifting Transformer differs from a conventional transformer in that it creates a phase shift between its primary (source) and secondary (load) terminals. This is achieved by introducing a boost voltage with a phase angle perpendicular to the line voltage (thereby creating a 'phase shift'). This boost voltage influences the real power flow, which would in normal circumstances only be subject to Kirchhoff's Law.

Installing a PST allows for the reduction of load on transmission lines that would otherwise incur risks of overload and provides the opportunity for power flow to be controllable. Consequently, operational flexibility, network security and transmission capacity are increased, while losses in regional networks are reduced. In modern electricity networks the management of power flow and the use of Phase Shifters are becoming a matter of routine.

The ELIA Monceau Phase Shifter manufactured by Pauwels Trafo Belgium

In the context of power exchange in the border region of Belgium and France, ELIA has decided to install a Phase Shifting Autotransformer in the 150kV substation of Monceau (B). Indeed, the 220kV line between Chooz (F, RTE) and Monceau (B, ELIA) threatened to go into serious overload condition in case of failure, outages or maintenance. Given the significance of this power line to provide power to the industrial Charleroi (B) region, ELIA ordered a 220/150kV 400MVA Autotransformer (with OLTC for voltage regulation) able to create phase displacement between the 220kV and 155kV windings. The main purpose of this unit was to divert potential overload current in order to safeguard the operability of the transmission line in all conditions.

Several features make this phase shifting transformer a project of which Pauwels Trafo Belgium is really proud:
Apart from being a phase shifter, this unit is also a so-called autotransformer. Like a normal transformer, an autotransformer changes the voltage level between its incoming and outgoing circuits. The difference however lies in the fact than an autotransformer uses a single winding for both its high voltage and low voltage sections. This results in a smaller overall size of the transformer by comparison with a transformer that has separate primary and secondary windings and provides advantages in both weight and dimensions.
Despite this reduction in size, the Monceau Phase Shifter is still one of the largest units ever built in the Pauwels factory. With a total mass of 383 tons and dimensions of 11.5 x 12.2 x 8.3m,

> Phase Shifter heralds a new era in transformer design