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Question 1.2 : What design and operation considerations should be included to optimize the selection of transformer for photovoltaic plant applications ?

Collector power transformers, applied in solar photovoltaics power plants, can optimize their rate when some additional inputs are informed during the procurement process. The two significant contributors to this optimization process are knowledge of the historical environment temperature and solar irradiation in the site of installating. Although experienced engineers have very deep knowledge about technical issues, sometimes financial aspects are neglected during the procurement process, even more, when the power transformer is going to be installed on an intermittent power resource. Thence, financial data input is encouraged in order to have an accurate total ownership cost of the equipment during its entire life.

It is possible to observe the importance of acquiring reliable data on the loading and the ambient temperature of the installation site of the equipment, as well as the concepts of the weighted average cost of capital of the investor/buyer of the transformer, reliable estimates on the growth of the electricity values and the concept of capitalization of losses over the useful life of the equipment. Besides that, a high safety factor does not have a direct relationship with the high quality of the overall system or higher prices, therefore the goal of the proposed contribution is an optimization process for dimensioning a GSU power transformer for photovoltaic power plants considering not only the conventional real loading curve and the ambient temperature which the transformer will operate throughout its lifecycle, but also show the main considerations needs.

Some additional points must be taken into account when the transformer has been applied as collector equipment in a photovoltaic application. This transformer has to be designed to withstand a huge loading variation and overload during the peak of production of the solar power plant. Bushing and tap changers have to be dimensioned accordingly because the maximum rate of this transformer should not be a bottleneck for bushing and tap changers furthermore, internal lead connections and crimping also must be dimensioned to the maximum rated and, high temperatures materials can be used to fulfill the material class temperature without occurring non-controlled gas generation. Other accessories and gaskets ought to be designed to attend to higher temperatures and it has to be presented, analyzed, and discussed during the design review meeting.

Although in recent years, some investors have reduced attention to the topic of losses capitalization, just focusing on the initial price of the transformer, or not distinguishing the difference between the capitalization of no-load losses and the capitalization of load losses and, ergo, to avoid a reduction in the revenue of electricity production, a deep analysis must be done on the importance to take into account the loading profile and the huge difference between capitalization of no-load and load losses amplified, even more, when the solar profile is applicable.

Moreover, engineering numerical software such as electromagnetic could help the manufacturers to prove, during the design stage, whether the temperature of the tank and metallic parts are below the standard limit values. The Computational Fluid Dynamic, CFD, analysis is used to verify the hotspot in the winding during normal operation and transient situations as well. Heat run tests and thermoscan cameras under normal and overload are also encouraged for a prototype unit to confirm the calculated temperatures. Besides, daily overloadability will increase the necessity to collect more parameters of the transformer operation like gases and loading, so the control and digitalization became more important items to be specified in this kind of equipment and application. Monitoring costs can be not significant when compared with the total asset cost to be monitored.