

Eff/ncy Benchmark / Double-Circuit OHL

Thales M. Papazoglou

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Introduction - remarks

- **The usual problem: having enough transmission capacity when the grid is used up to its limits**
- **Transmission losses are adding to CO₂ releases and cost today even more!**
- **The power transmission efficiency of an OHL depends on its load**
- **The transmission efficiency increases when the transmitted power gets closer to a *specified load***



What the matter really is

- **Are there periods when we can choose the load of a circuit of an OHL?**
- **For off-peak periods, e.g.: when for a Double-Circuit OHL, suppose we have the choices: of equal loading for both circuits, or to concentrate the load to just the one Circuit**
- **In which case transmission losses become less?**



Some Calculations

- The maximum transmission efficiency of an OHL having characteristic constants: A, B, C is computed as: $\eta = \frac{|A|^2 + \text{Re}(BC^*) - \sqrt{(4\text{Re}(AC^*)\text{Re}(BA^*) - \text{Im}^2(BC^*))}}{|A|^2 + \text{Re}(BC^*)}$
- The load of the OHL that corresponds to the maximum transmission efficiency, given by the above formula, is: $P = V^2(|A|^2 + \text{Re}(BC^*) - \eta) / \text{Re}(BA^*)$
- This load we can see as a *yardstick* or as a *benchmark*
- *Let's see an example:*



An example of actual load transmission

- For a D-C OHL: 220 kV, 250 km we have computed:
 $\eta=97,13\%$ with corresponding load $P\approx 83$ MW
- If the actual load is 200 MW/.85 lag for just one circuit gives: $\eta=91.24\%$, while for two circuits gives:
 $\eta=95.21\%$
- On the contrary for actual load 50 MW/0.85 lag the load should better be transmitted on just one circuit with efficiency 96.9% (instead of: $\eta=96.7\%$ for sharing this load on both circuits)



Remarks for the OHL Design

- **The reduction of ohmic resistance of an OHL increases the transmission efficiency as well as the load corresponding to the maximum transmission efficiency of the OHL, therefore, results in achieving maximum OHL efficiency for higher transmitted loads**
- **The ohmic resistance is chosen during the OHL-design stage**



Conclusions I

- For the optimization of operational efficiency of an OHL we can compute a *benchmark load** which indicates when, at off-peak operation, we should equally divide the load to both circuits, or transmit the total load on just one circuit
- *corresponding to the maximum efficiency of power transmission



Conclusions II

- **The benchmark-load depends on the OHL parameters, which can be varied either at the design stage, or during the OHL operation via OHL-compensation measures**
- **OHL design, and compensation strategies can result in the optimization of the OHL transmission efficiency**



Conclusions III

- For every Double-Circuit OHL having computed the benchmark-load means that we know from which load-demand downwards we should transmit power from just one circuit
- In the design stage, if we want to place the *yardstick higher* (i.e.: at higher loads) this will result in a higher investment cost, and we have to compute in advance whether this can be written-off in a reasonable time period



Conclusions IV

- **The compensation equipment that have been installed on an OHL to augment stability of operation can also be used during off-peak periods to optimize the operational transmission efficiency of a Double-Circuit OHL**



Thank you!

For your attention!

