CRITICAL ELEMENTS FOR CORRECT CLIMATE CONTROL DESIGN FOR ELECTRICAL PANELS

Calculation of the thermal dissipations of the electrical cabinet

In the previous WHITE PAPERS, all the concepts necessary for the calculation of the thermal dissipations through the walls of the electrical cabinet have been provided. It is now possible to proceed with the determination of the thermal power through the walls, which must be defined both to design the heating and cooling system of the electrical cabinet and which can be calculated with the following relation:

$$\mathbf{Q_{diss}=U*A*\Delta T\ [W]} \qquad \mathbf{1}$$

-$\mathbf{U[\frac{W}{m2K}]}$ is the thermal transmittance of the walls of the electrical cabinet, which can be determined as described in the WHITE PAPERS **"Thermal balance of the electrical cabinet"** and **"Adduction coefficient calculation"**;

-**A[m²]** is the total heat exchange area, calculated taking into account the surface coefficients mentioned in the WHITE PAPER **"Thermal exchange surfaces"**;

- **ΔT[K]** is the temperature difference between the cabinet exterior and interior ($T_{environment}$-$T_{cabinet}$). This term must be determined in the following way:

• Replacing the maximum possible temperature in the installation environment and the maximum acceptable inside the electrical cabinet (recommended at 35° C) for the calculation of dissipations **Qdiss**, to be used to dimension the cooling system;

• Replacing the minimum verifiable temperature in the installation environment and the minimum acceptable in the electrical cabinet for the calculation of dissipations **Qdiss**, to be used to dimension the heating system.

According to the sign convention used, all the thermal powers entering the electrical cabinet are considered positive, while the outgoing ones are negative.

Replacing the numerical values of the individual terms in formula **1**, the thermal power passing through the walls of the electrical cabinet is determined, separately for designing the heating and cooling systems.

To dimension the heating system to be installed, it is possible to refer to the mathematical formulas discussed in the WHITE PAPER **"Thermal balance of the electrical cabinet"**, in particular:

1. Heating: **Qdiss+Qrisc=0 [W]**

where, replacing the numeric value of **Qdiss, Qrisc,** the only unknown, can be easily found.

Dimensioning the cooling system instead requires a more complex analysis, because, as shown in the following formula, it requires the calculation of further terms in addition to the thermal dissipations and not treated in this series of WHITE PAPERS:

2. Cooling: **Qdiss + QJoule + Qsolar + Qraff = 0 [W]**

Conclusions

The dimensioning of the heating and cooling systems of the electrical panels is essential for correct operation and to avoid failure phenomena due to overheating or condensation.

Through the basic notions described in this "White paper", it is possible to understand which factors are related to the thermal balance of the electrical cabinet:

- Desired environmental conditions inside the electrical cabinet and the most hostile possible in the installation environment;

-Electrical cabinet construction material and wall thickness;

- Convection of air flows inside and outside the electrical cabinet;

- Layout of the cabinet in space.

Lastly, the $\mathbf{Q_{diss}=U*A*\Delta T}$ **[W]** formula determines the thermal power passing through the cabinet walls for both heating and cooling. It is important to remember that this power is **not** the only one necessary for the resolution of thermal balance formulas **1** and **2** in paragraph "**Thermal balance of the electrical cabinet"** therefore, it is sufficient to determine the heating power to be installed on an electrical cabinet, not to determine the cooling one.

Davide Rocca
Alberto Tonietti