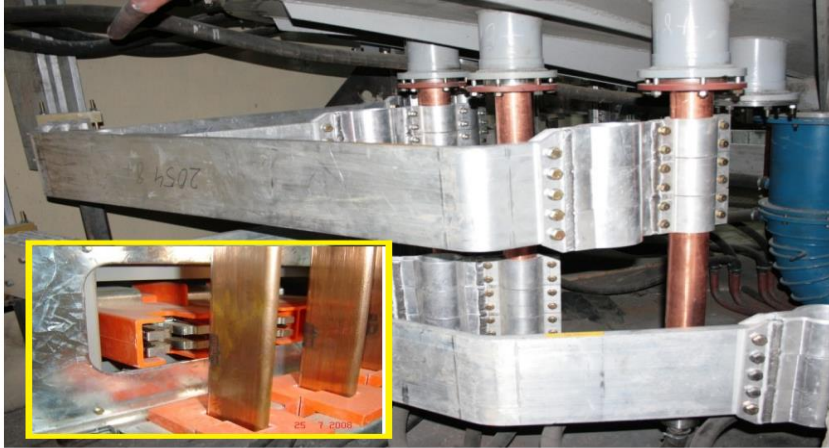


# ALUMINUM INSTEAD OF COPPER:

## Steps to convert panels / switchgear design

Authors name: Sergio Feitoza Costa - COGNITOR – Consultancy, Research and Training Ltd.



**Check the high reduction in weight (50%) and the lower estimated cost (80%), for the aluminum alternative.**

For more details about this matter read the article in this link, with special attention to Table 3.

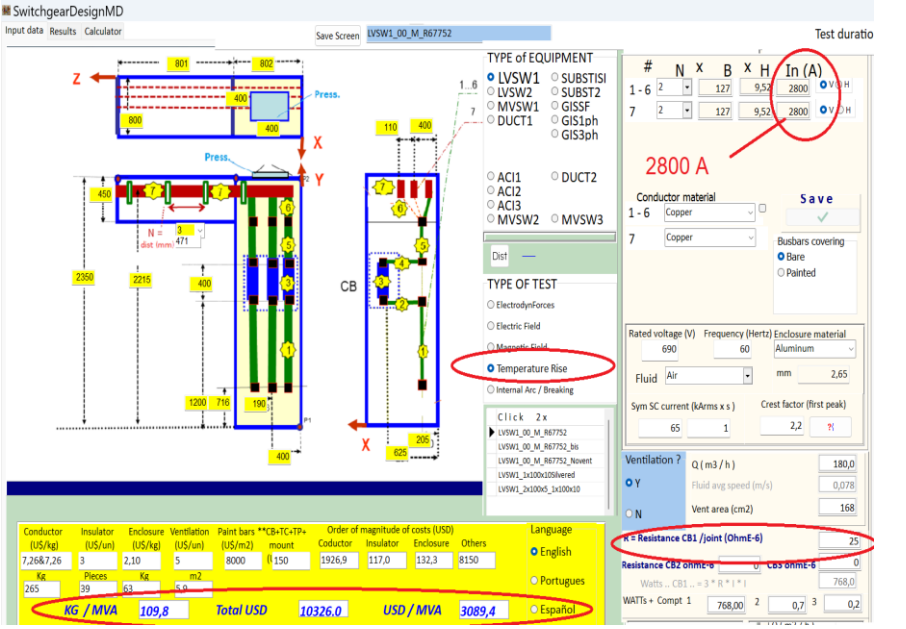
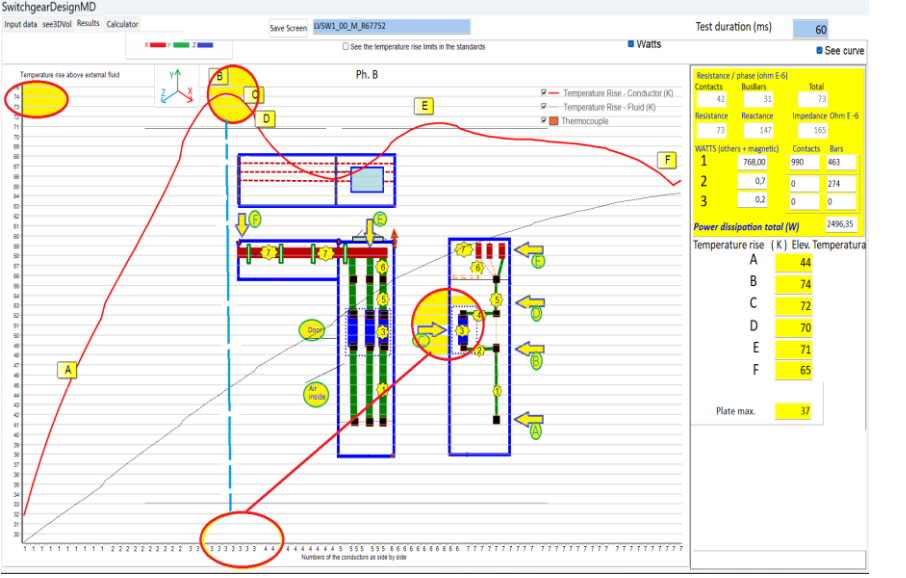
[https://www.cognitor.com.br/DesignOptimizationCuxAl\\_2019.pdf](https://www.cognitor.com.br/DesignOptimizationCuxAl_2019.pdf)

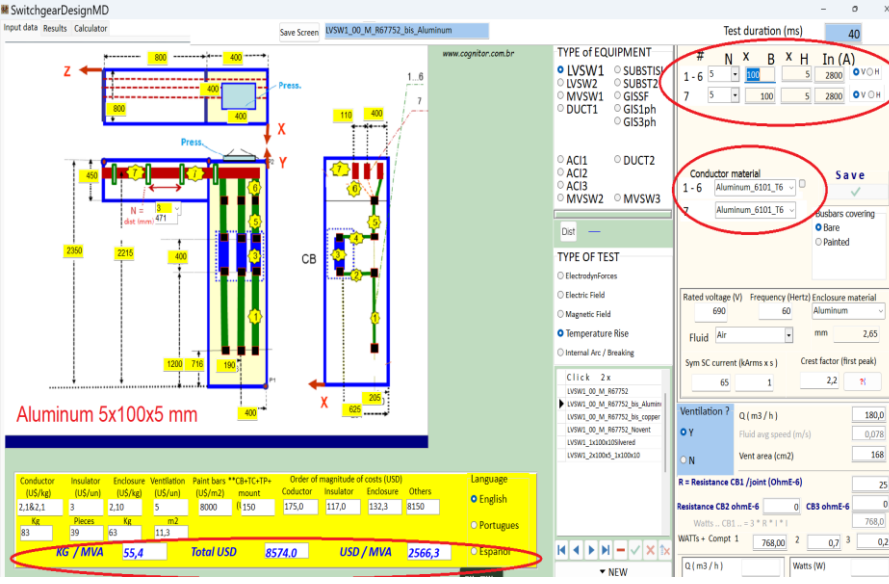
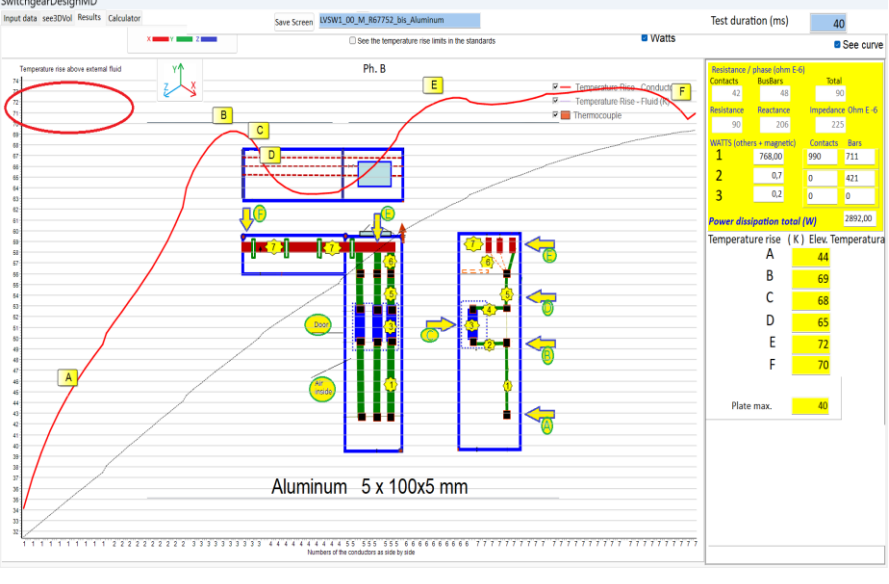
This is a short text to explain the approach to convert an existing COPPER DESIGN to another made of ALUMINUM.

Both are 2800 A rated current (temperature rise test)

The maximum permitted temperature rise in the connections to the circuit breaker is 75K. The same is applicable to the connections between bars

Although written to help the participants of my trainings on design, testing and specification of switchgear, busbar systems and substations, using SwitchgearDesign software, these concepts are applicable in general.

Step	Action	Example of geometry																												
<p><b>1</b></p> <p>Take your existing <b>COPPER DESIGN</b> as defined by the materials, permanent current and geometric dimensions. Only the data in the right side is necessary.</p> <p>Check each value carefully because all of them are important in the results of the temperature rise test</p> <p>This test is the one which define the main design using copper. Other aspects of tests lie short circuit forces, internal arc and dielectric distances are easy to accommodate</p>		 <p>SwitchgearDesignMD</p> <p>TYPE OF EQUIPMENT</p> <ul style="list-style-type: none"> <li><input checked="" type="radio"/> LVSW1</li> <li><input type="radio"/> SUBSTSI</li> <li><input type="radio"/> LVSW2</li> <li><input type="radio"/> SUBST2</li> <li><input type="radio"/> MVSW1</li> <li><input type="radio"/> GIS5F</li> <li><input type="radio"/> DUCT1</li> <li><input type="radio"/> GIS1ph</li> <li><input type="radio"/> GIS3ph</li> </ul> <p>TYPE OF TEST</p> <ul style="list-style-type: none"> <li><input type="radio"/> ElectrodyForces</li> <li><input type="radio"/> Electric Field</li> <li><input type="radio"/> Magnetic Field</li> <li><input checked="" type="radio"/> Temperature Rise</li> <li><input type="radio"/> Internal Arc / Breaking</li> </ul> <p>Conductor material: Copper</p> <p>Rated voltage (V): 690</p> <p>Frequency (Hertz): 60</p> <p>Enclosure material: Aluminum</p> <p>Fluid: Air</p> <p>Sym SC current (kArms x s): 65</p> <p>Crest factor (first peak): 2,2</p> <p>Resistance CB1 / joint (Ohm-6): 25</p> <p>Resistance CB2 Ohm-6: 0</p> <p>WATTS + Compt 1: 768,00</p> <table border="1"> <thead> <tr> <th>Conductor (US/kg)</th> <th>Insulator (US/un)</th> <th>Enclosure (US/kg)</th> <th>Ventilation (US/m2)</th> <th>Paint bars **CB+TC+TP+ mount (US/m2)</th> <th>Order of magnitude of costs (USD)</th> <th>Language</th> </tr> </thead> <tbody> <tr> <td>7,2687,26</td> <td>3</td> <td>2,10</td> <td>5</td> <td>8000</td> <td>1150</td> <td>English</td> </tr> <tr> <td>Kg</td> <td>Pieces</td> <td>Kg</td> <td>m2</td> <td></td> <td></td> <td>Portugues</td> </tr> <tr> <td>265</td> <td>39</td> <td>63</td> <td>5,9</td> <td></td> <td></td> <td>Español</td> </tr> </tbody> </table> <p>KG / MVA 109,8 Total USD 10326,0 USD / MVA 3089,4</p>	Conductor (US/kg)	Insulator (US/un)	Enclosure (US/kg)	Ventilation (US/m2)	Paint bars **CB+TC+TP+ mount (US/m2)	Order of magnitude of costs (USD)	Language	7,2687,26	3	2,10	5	8000	1150	English	Kg	Pieces	Kg	m2			Portugues	265	39	63	5,9			Español
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<p><b>2</b></p> <p>Do trials changing the value of the test current up to the value that produce, in the terminals of the circuit breaker, a temperature rise 75K (standard limit for a silver plated connection)</p> <p>In this example the value for the <b>COPPER DESIGN</b> was 2800A</p>		 <p>SwitchgearDesignMD</p> <p>Temperature rise above external fluid</p> <p>Ph. B</p> <p>Resistance / phase (Ohm-E-6)</p> <table border="1"> <thead> <tr> <th>Contacts</th> <th>Busbars</th> <th>Total</th> </tr> </thead> <tbody> <tr> <td>41</td> <td>31</td> <td>73</td> </tr> </tbody> </table> <p>WATTS (ohms + magnetic)</p> <table border="1"> <thead> <tr> <th>Contacts</th> <th>Bars</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>768,00</td> </tr> <tr> <td>2</td> <td>990</td> </tr> <tr> <td>3</td> <td>463</td> </tr> </tbody> </table> <p>Power dissipation total (W): 2496,35</p> <p>Temperature rise (K) Elev. Temperatura</p> <table border="1"> <thead> <tr> <th>Point</th> <th>Temperature Rise (K)</th> </tr> </thead> <tbody> <tr> <td>A</td> <td>44</td> </tr> <tr> <td>B</td> <td>74</td> </tr> <tr> <td>C</td> <td>72</td> </tr> <tr> <td>D</td> <td>70</td> </tr> <tr> <td>E</td> <td>71</td> </tr> <tr> <td>F</td> <td>65</td> </tr> </tbody> </table> <p>Plate max.: 37</p>	Contacts	Busbars	Total	41	31	73	Contacts	Bars	1	768,00	2	990	3	463	Point	Temperature Rise (K)	A	44	B	74	C	72	D	70	E	71	F	65
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The author of this paper is Mr. Sergio Feitoza Costa.

Sergio is an electrical engineer, M. Sc in Power Systems, and director of COGNITOR. He develops designs for switchgear and has a long experience in management, operation, and design big to small high power testing laboratories

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