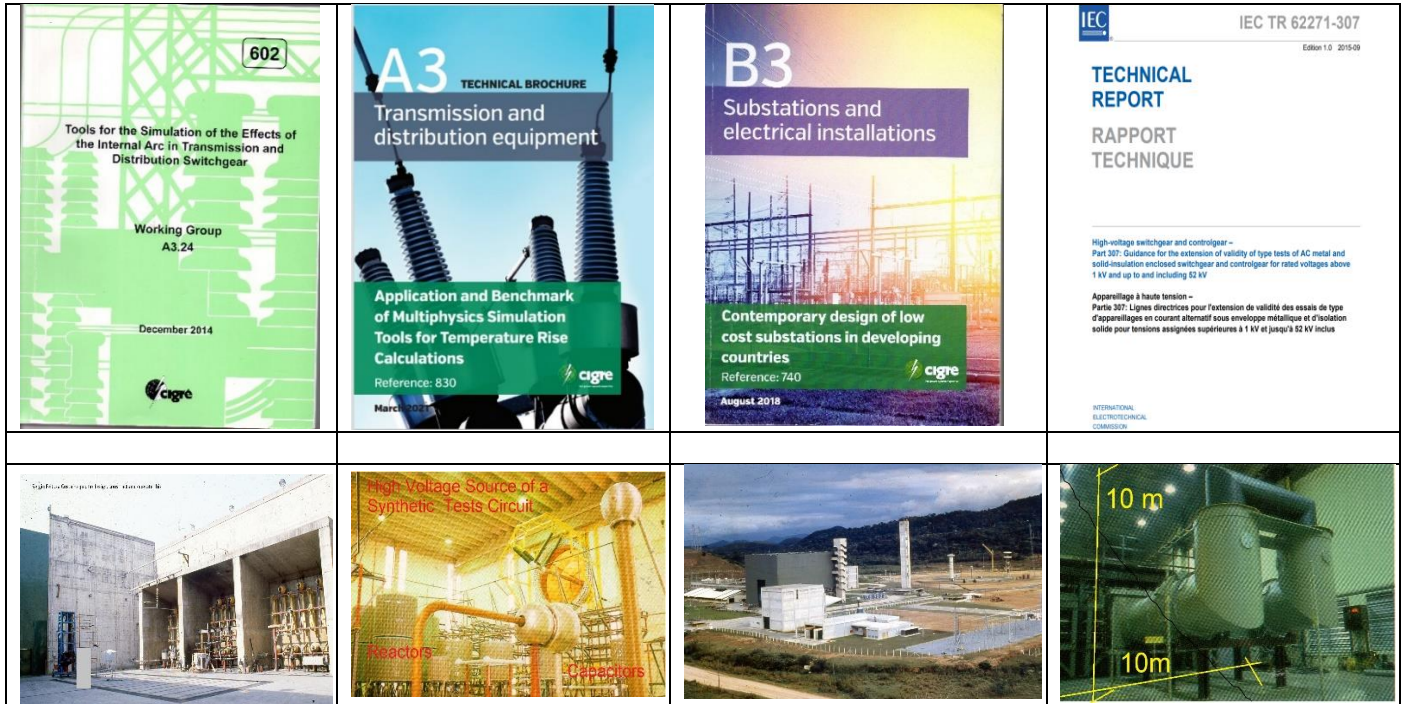


# Why are the world's big manufacturers working hard on testing simulations, but small / medium do not even know what this is?

With a complete bibliography

<https://www.cognitor.com.br/testingsimulations.pdf> Author: Sergio Feitoza Costa (Cognitor – Consultancy, R&D, Training)

keywords: #iecstandards, #cigre #busbar #testinglaboratory #internalarc #overpressure #temperature #electrodynamics #stresses #shorttimecurrent #emc #magneticfields #electricalfield #certification #qualitysystem #newtechnologies #design #costreduction #validation #calculation #busway #sergiofeitozacosta #switchgeardesign #highpower #R&D #simulation #highpower #testing #shortcircuit #cprl #jstc #peha #sts #stha #zku #intertek #igs #bureauveritas #switchgear #switchboards #basefa #paines #barras #seaf #tablero #consultant #iec62271 #veiki #iec61439 #substation #flowcost #kema #keri #bactec #ces #stl #koppel #powertech #igs #sergiofeitozacosta #aelja #chpl #komet #fg #abnbnf.



## 1. About these UNIQUE PUBLICATIONS and WHO PREPARED THEM

I am 68 years old and possibly, I am one of the very few persons in the World having 25 years of real experience in high power and high voltage testing labs and more 23 years of experience in the use and development of high-power testing simulations. The photos above show some of the testing laboratories that I helped to design, to construct, to operate as testing engineer and to manage. So, take it seriously when I describe the role of testing simulations and compare them with laboratory services. They are two sides of the same coin

I am honored to be coauthor of the above 3 Cigrè brochures and IEC document. These documents are the only complete references in our today's world. I invested a lot of time and my own money to help to write them. It was not an easy task to go from Brazil to other far countries for participating in the working group's (WGs) meetings.

I did this to have the opportunity to interact with the main international experts and because I anticipated that test simulations will play an increasingly fundamental role in the development and qualification of equipment for substations. They will never replace final 3rd party lab tests to get a commercially useful test report. However, at 5% of the cost, they will occupy almost all the space to develop projects until they arrive at a well-defined product that can go to the laboratory with almost 100% probability of passing the final type tests.

As a longtime advocate of the need to save the Planet's resources, I am sure that the lower cost of testing simulations will enable to demonstrate the concept of "lower kg/MVA equipment to save Earth resources". Nowadays companies and institutions talk about efficiency but, for example, IEC and IEEE standards do not reward or encourage greater efficiency and less use of materials. There's a lot of marketing but nothing effective as a "certificate of environmental efficiency of electrical products" (article below)

---

The experts participating in the mentioned working groups are mostly top developers working in the big world-wide companies. They invest in “testing simulations” by technological and industrial interests. There are also well-known universities in the electrical engineering field. In these documents’ preparation participated, among others, experts from (alphabetical order) ABB, Alstom, Areva, Cognitor EDF, Eaton, Eskom, G&W, GE, Hyosung, Hyundai KEMA, KERI, Meidensha Mitsubishi, Ormazabal, RWTH\_Aachen, Sintef, Schneider Siemens, TUDelft\_Univ, Telemark\_Univ and Toshiba.

A point to be noted is that several of these world companies, have their own test laboratories. Meanwhile, small, and medium-sized companies, which would have more to gain, pay little attention to the matter. I am a permanent user and developer of software to do testing simulations. I needed to create a tool to provide consultancy to manufacturers and certifiers, in the development of products. When you work a long-time doing tests you think you are the king of knowledge. This is a false thinking. To do serious consultancy, it is not enough to say that you think it will work. You must calculate and predict if it will work. Nowadays, after 22 years of simulations experience summed to my lab experience, I learned how to do this.

Knowledge of tests and technical standards are useful, but not sufficient to design new equipment. For this, it is necessary to know how to make complex calculations and simulate tests to predict what will happen and if the equipment will be approved. If the simulations indicate that it would not pass the tests, you adjust the design and simulate again. It is easy and fast.

So, I have spent many years developing and validating the SwitchgearDesign software that simulates internal arc tests, temperature rise, short circuit thermal and dynamic forces and stresses, electromagnetic fields, etc. If I had these tools at the time, I helped to design Cepel’s high power laboratories life would have been easier. It was not so hard because my chief, master and friend Dr. George Zabłudowski was much ahead our time in engineering calculations.

## **2. WHY TESTING SIMULATIONS ARE MORE USEFUL THAN REAL TESTS IN THE DEVELOPMENT PHASE, BEFORE THE FINAL TYPE TESTS?**

In the 25 years working in the main Latin America laboratories (CEPEL), I saw the difficulties of the manufacturers in paying the high price of using the labs to achieve a test report informing that the equipment was approved according to a technical standard. Tests are expensive because high power testing laboratories are special installations which may cost something like 10 to 100 million USD.

From the point of view of an investor, large testing labs are not an attractive R.O.I business. However, they are extremely useful to create development in a region or country. That’s why most of the existing ones were created in the past. The countries where they were implemented became the top of the world electric power industry.

From the point of view of investors, a small high-power testing laboratory associated to R&D services based on testing simulations can be a sustainable enterprise. Read the article in the Reference [15] below.

In my 2 decades experience doing testing simulations to develop products for dozens of manufacturers, I can say that in more than some 98% of the cases the equipment was approved in the first real lab test.

This will never be 100% because you may have from small errors in mountings to undue interpretations of the test results, made by the lab. I learned also that it is essential that test reports contain a statement passed / not passed .

## **3. CAN WE ASSURE THAT TESTING SIMULATIONS GIVE THE SAME RESULTS OF REAL TESTS ? WHY IEC62271-307 AND THE CIGRE BROCHURES ABOVE ARE USEFUL TO CONFIRM ?**

Yes. It can be demonstrated in several documents how close the testing simulations results are from real laboratory tests. Check next section bibliography.

## **4. GOOD BIBLIOGRAPHY ABOUT OR MENTIONING TESTING SIMULATIONS (Sergio Feitoza Costa is author or coauthor of these documents)**

---

These documents are the best available world-wide

[1] BROCHURE CIGRE 602(2014): TOOLS FOR SIMULATION OF EFFECTS OF THE INTERNAL ARC IN T&D SWITCHGEAR.

[2] GUIDE" FOR THE USE OF CALCULATIONS AND SIMULATION OF LABORATORY TESTS (referred in the brochure Cigrè 602/2014)" [http://www.cognitor.com.br/GUIDE\\_Simulations\\_v0\\_October2010.pdf](http://www.cognitor.com.br/GUIDE_Simulations_v0_October2010.pdf)

To understand the context read also: [http://www.cognitor.com.br/Article\\_Competitivity\\_Eng\\_04102011.pdf](http://www.cognitor.com.br/Article_Competitivity_Eng_04102011.pdf)

[3] BROCHURE CIGRÈ 740 (2018) - CONTEMPORARY SOLUTIONS FOR LOW-COST SUBSTATIONS. (Check Cigrè site)

[4] BROCHURE CIGRÈ 830 (2021) - SIMULATIONS FOR TEMPERATURE RISE CALCULATION. (Check Cigrè site)

[5] IEC TR 62271-307 (2015) - GUIDANCE FOR THE EXTENSION OF VALIDITY OF TYPE TESTS of AC metal and solid-insulation enclosed switchgear and controlgear for rated voltages above 1 kV and up to and including 52 kV ( IEC site)

[6] "SIMULATIONS AND CALCULATIONS AS VERIFICATION TOOLS FOR DESIGN AND PERFORMANCE OF HIGHVOLTAGE EQUIPMENT" –

Co-authors: M. Kriegel, X. Zhu, M. Glinkowski, A. Grund, H.K. Kim, P. Robin-Jouan, L. Van der Sluis, R.P.P. Smeets, T. Uchii, H. Digard, D. Yoshida, S. Feitoza Costa CIGRE WG A3-20 publication A3-210 (2008) - Presented at Congress Cigrè - Paris 2008 [http://www.cognitor.com.br/Cigre\\_Paris\\_A3\\_210\\_2008.pdf](http://www.cognitor.com.br/Cigre_Paris_A3_210_2008.pdf)

[7 ] SIGNIFICANT PARAMETERS IN INTERNAL ARC SIMULATION AND TESTING, CIGRE WG A3.24, CIGRE A3 SESSION, 2009 –

Co-authors: M. Kriegel, R. Smeets, N. Uzelac, R. Pater, M. Glinkowski, P. Vinson, S. Feitoza Costa, G. Pietsch, E. Dullni, Th. Reiher, L. van der Sluis, D. Yoshida, H.K. Kim, K. Y. Kweon, E. Fjeld,

[8] VALIDATION OF SIMULATIONS OF HIGH-POWER TESTS (TEMPERATURE RISE, SHORT TIME AND CREST CURRENT TESTS – ELECTRO DYNAMICAL FORCES / STRESSES AND OVERPRESSURES FROM INTERNAL ARC) - REPORT 071/2014: [http://www.cognitor.com.br/TR\\_071\\_ENG\\_ValidationSwitchgear.pdf](http://www.cognitor.com.br/TR_071_ENG_ValidationSwitchgear.pdf)

[9] VALIDATION OF MAGNETIC & ELECTRIC FIELDS MAPPING & TEMPERATURE RISE TESTS SIMULATIONS - TEST - REPORT 074/2015 <http://www.cognitor.com.br/TR074ENGValidationTempRise.pdf>

[10] Book "SWITCHGEAR, BUSWAYS & ISOLATORS and SUBSTATIONS / LINES EQUIPMENT [https://www.cognitor.com.br/Book\\_SE\\_SW\\_2013\\_ENG.pdf](https://www.cognitor.com.br/Book_SE_SW_2013_ENG.pdf)

[11] Book "180+ POSTS FOR THE ELECTRIC POWER INDUSTRY " <http://www.cognitor.com.br/180posts.pdf>

[12] EXPLOSION AND FIRE PREVENTION SYSTEMS FOR POWER TRANSFORMERS , to avoid overpressures resulting from internal electric arcs - A proposal for a new IEC standard based on the Brazilian Standard NBR 8222 (2005):

<http://www.cognitor.com.br/suggestionnewiecstandardtransformersfiresandexplosions.pdf>

To better understand the context read this article <https://www.cognitor.com.br/transformersfiresexplosions.pdf>

[13] "SUGGESTIONS TO SC32A FOR NEXT REVISION OF IEC 60282-2 - High-voltage fuses - Part 2: Expulsion Fuses (Cover aging of fuse links, concepts of IEC62271-307 and identification of what was tested)

<http://www.cognitor.com.br/suggestionnewiecstandardtransformersfiresandexplosions.pdf>

[14] Article: LET'S ACT SERIOUSLY ON ENERGY EFFICIENCY ? ENVIRONMENTAL EFFICIENCY CERTIFICATE of electrical products (kg/MVA) - Draft of a global technical standard

<http://www.cognitor.com.br/EnvironmentalEfficiencyCertificate.pdf>

[15] Article: High-power testing laboratory + R&D services A sustainable enterprise

<https://www.cognitor.com.br/hplENG.pdf>