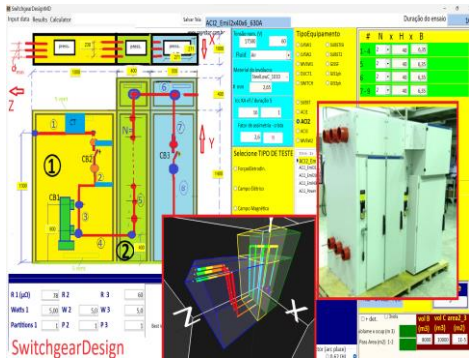
The lack of a medium / high-power testing laboratory is pushing the Brazilian Electric Industry back 35 years. We had great labs 20 years ago

it is a really good opportunity for international testing labs.

Author: Sergio Feitoza Costa



The author of this article helped, for 25 years, to design, build, operate and manage the former 14 CEPEL's test laboratories, including high power, high voltage, EMC, Ex, He also worked on the discontinued Itajubá lab project for 8 years.

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

ABSTRACT: Brazil was the 7th largest economy in the world between 2010 and 2014. In 2022, it fell to 11th. It is expected to return to 8th place very soon. If the economy grows, the electric power industry grows and needs to do more testing. Lack of planning, focus and leadership in the Brazilian electrical sector, which were strong points decades ago, are common points to the lack of testing laboratories that made the electrical industry grow. Brazilian manufacturers need again to go abroad. Gone back 35 years by letting its once efficient testing infrastructure to deteriorate. Manufacturers of equipment for substations and lines have already returned to sending equipment for testing abroad, as before 1981, when there were no high-power and high-voltage laboratories of CEPEL, of international level such as Kema and Cesi. Testing abroad increases the cost of equipment production that make electricity bills higher. It is sad to see that the team of 250 people in 14 laboratories, with 80% occupancy, which I coordinated, arrived, after retirements incentive plans and accommodation, with about 30 people, several laboratories closed and the main one under repairs until mid-2025. The only serious initiative to change this was the project of the 2500MVA high-power laboratory in Itajubá – MG (ISI CEDIIEE) in which I participated from 2010 to 2019. However, in the final phase of implementation, with the 138kV substation already energized, it was paralyzed in early 2019 without explanations.

This article presents an idea to reverse this process. I will explain it in a free lecture (September/2024) seeking to motivate potential investors to build a private laboratory that is economically sustainable. I am accepting invitations to host the lecture place, who knows, from Brazilian electrical industry associations or even international laboratories. I have a question that I have not yet had an answer to: Who could a serious investor approach to try to buy the 1,340MVA CEPEL laboratories in Adrianopolis or the assets of the discontinued 2,500 MVA laboratory in Itajubá? Is the absence of mentions about this possibility caused by vanity in not exposing the wrong decisions that led to this?

1. AVAILABILITY OF TESTING LABORATORIES HAS REGRESSED TO 1981 LEVELS. THE COMPETITIVENESS OF THE ELECTRICAL INDUSTRY, OBTAINED WITH 4 DECADES OF EFFORTS, WILL FALL FAST. WHAT AND HOW TO DO IT?

This article is a translation of the original text in Portuguese written by me. Brazil was the 7th largest economy in the world between 2010 and 2014. In 2022, it fell to 11th. It is expected to return to 8th place very soon. If the economy grows, the electric power industry grows and needs to do more testing.

Several Brazilian clients have asked me for the names of testing laboratories abroad to carry out internal arc tests on medium voltage panels, interruption tests on distribution expulsion fuse & switches and even short circuit and temperature rise tests on low voltage panels. It is sad to note that after having excellent laboratory capacity at the

end of the 90s, especially at CEPEL, a large part of those facilities have been deactivated or now have problems with lack of staff to operate. The well-trained team of around 250 people that I managed today have around 30.

The only serious initiative to improve this situation was the high-power laboratory project in Itajubá – MG. ISI-CEDIIEE would be a complete G7 level laboratory but, although it was in the final stage of implementation, with the purchase of main equipment and even with the substation energized, it was suddenly discontinued at the beginning of 2019. Brazilian industry associations do not realize that need to come together to solve the problem. They seem more interested in secondary disputes among them than in acting before escalation of the problem. The end of the Itajubá project began exactly like this.

Try doing an internal arc test on a medium voltage panel in Brazil today. It will not be possible until May 2025 due to defective equipment being repaired. Brazilian industry associations, due to their inertia, are doing something of the same nature as what was done with the water gates that did not work in the Porto Alegre flood.

> The following text will be explained in a 3-hour lecture to be held in September to motivate potential investors to get involved and run the project presented below. We are accepting invitations from to host the lecture venue. Who knows initially at FIEP or FIESC or FIERS or FINDES? Or an international laboratory looking at South America. For me, it is not relevant whether the new laboratory will be a Brazilian initiative or one from foreign companies. The important thing is to create the availability of high-power testing laboratories.
> The testing market is very good as there is a great demand and now almost no competitors.

2. UNDERSTAND THE IMPACT OF THE LACK OF TESTING LABORATORIES OVER THE LECTRIC INDUSTRY IN SOUTH AMERICA.

A growing electrical industry, in developing countries like Brazil, produces positive results in development, employment and income. In Annex 1 I show some indexes. Keeping the industry growing depends much more on creativity and solid knowledge than on significant investments. At a time when the global focus is on seeking greater efficiency and drastically reducing environmental impacts, there are many opportunities for innovations, patents and cost reduction in equipment for substations and lines. Contrary to what happened in the 70s and 80s, there is a lack of institutions that organize the search for solutions and planning. In those times, Eletrobras did this with rare competence, but after the start of privatizations no one else occupied this role. The possible and realistic solution, in this case of testing laboratories, is through the private sector.

I participated intensely in the entire process of strengthening the electrical industry in Brazil, in the 80s to 90s. The results were very good, visible and easily verifiable via the web. Just compare the size and profile of the electrical industry in the early 70s and now. There were remarkable results, from the technological improvement of products for substations to the good electrification program for areas without access to electricity.

The incipient electrical industry of the 1970s grew to become solid and competitive, generating employment and development. Regarding using the electrical industry to boost development, we must remember that in most countries in the world the catalyst was testing laboratories. In the case of Brazil, the catalyst was the creation of CEPEL testing laboratories, which I helped create and coordinated the labs for more than 20 years.

> To do something immediate, we must think about smaller-scale, financially self-sustainable laboratories, using less investment, but with more innovative ideas such as mixing real tests with supporting manufacturers in product development through test simulations.

The path of the stones is to create a “small” electrical testing laboratory, which, in addition to testing, provides services to help manufacturers develop innovative products. The company would include, in addition to the testing team, a team focused on R&D to develop innovations in substation equipment (60% testing team + 40% R&D services team).

The focus would be on supporting manufacturers in the electrical industry to design and develop more efficient equipment with lower Kg/MVA (read Ref. [3] below). This course of action would become an economically sustainable business in 3 to 5 years. As said, there are no competitors in South America and countries are growing.

The world's main research centers and testing laboratories were built in the 50s to 80s with the vision of encouraging regional development. Some have stopped in the last 2 decades because, from the private investors' point of view, they are not the best investment for amounts like 20 to 100 million dollars. Others were closed because they fulfilled their original mission. Others are disappearing because they have not learned how to operate as a financially sustainable company. I think that in the Brazilian case they got used to the comfort zone of the state environment. They did not want to learn to walk on their own two feet.

THE NEW LABORATORY OPERATION STRATEGY: The concept is to combine a group of experienced specialists (20%) with a group of professionals with average experience (50%) and a group of recent graduates or future university graduates (30%). Initially the "experienced" would carry out R&D tasks. The "intermediate" group would be responsible for regular testing activities. Depending on the skills they demonstrated, members of the younger group would work in the testing or R&D groups. The laboratories I managed in Brazil until the end of the 90s worked like this, with recognized success.

FINANCING THE INITIAL STAGES: the idea is to bring together 5 to 10 companies (including manufacturers, certifiers, universities, 1 to 3 electrical industry federations) to create a third-party company and start the project. If well planned and sized, as we were doing in the case of the Itajubá laboratory it would be attractive from an economic point of view. I could see this very clearly in the phase of market study.

The few laboratories that survive today get most of their money from providing testing services. Most of them need to have many employees because they are large facilities. Here is the error. We are not proposing things like that. We are talking about around 10 to 20 people, trained to be very well qualified. We are talking about investments of around 8 to 15 million US dollars. We are not talking about investments like the 100 million US dollar Itajubá laboratory in which the substation was ready, civil works and the purchase of main equipment would begin. I participated in this entire project and carried out the initial feasibility study

In short, the central idea is to implement the construction of a small to medium-sized 3rd party laboratory. In addition to conventional testing services, an R&D team will support substation and line equipment manufacturers and equipment certifiers. A well-sized laboratory managed from the perspective of private companies will immediately get a large market because
(a) in South America there is little or no availability of other significative laboratories
(b) the focus is to create conditions for the growth of the electrical industry
(c) growth of the renewable energy market
(d) large buyers such as oil, gas and mining companies, needing to take care of their environmental image, will prefer to buy products with lower kg/MVA. This is a very interesting market opening if mixed with carbon credits concept.

3. HOW TO START UP THE PROJECT

To repeat, implementing a third-party laboratory that goes beyond conventional testing services by additionally providing support to manufacturers in the development of energy products is a real innovation. If the team and facilities are well sized, and the laboratory is managed along the lines of a private business, it will be a self-sustainable enterprise with the sale of testing services and R&D services.

Most laboratories around the world still have a conservative view that "everything should be tested" and, furthermore, that a third-party laboratory should not help manufacturers develop products because it would conflict with the interest of "doing neutral tests". They still think like they did 40 years ago and forget that more than 95% of their customers go to the laboratory just to have a test report in hand. There is no conflict in supporting manufacturers throughout developments. It is good for the pocket and for local industry.

For those who have limited financial resources for testing, there are useful new tools. The best of these is the use of low-cost test simulations to develop products. I see in the working groups I participate in at Cigrè and IEC that the world's main manufacturers use these tools intensively. In the References below there are CIGRE publications demonstrating applications and validations such as CIGRE 602 (Internal Arc), 740 (Low-Cost Substations) and 830

(Temperature Elevation). At IEC, openings for test simulations were finally created as in IEC TR 62271-307. I am co-author of all these Cigrè / IEC documents. I participated in the working groups that produced them, most of which were formed by large international manufacturers.

4. IMPLEMENTATION OF THE SERVICES

Details of the following aspects will be detailed in the lecture with numbers and evidence.

The focus is to implement the project with an acceptable return on investment for investors.
In the feasibility study, it must be considered that the return on investment involves revenues from the sale of tests and development support services, patents and other consequences of R&D such as improving the system's quality indexes.

The business plan will have two lines of action:
• A small/medium sized laboratory to perform the high-power tests described below and,
• Parallel activity of "Support for the development of equipment for substations" with worldwide operations, including lower-cost solutions to expand the use of renewable energy. This market is not commonly explored by testing laboratories and can bring even greater revenues than testing and high-level diagnostics sales.

The business's direct revenue will come from
(a) carrying out conventional tests and high-level diagnostics as in the following list,
(b) provide manufacturers with technical support for developing more efficient products,
(c) use simulations and training to reduce development costs and
(d) neutral lectures, on behalf of manufacturers, about products that help improve energy efficiency.
(e) 3rd part failure analysis and forensic reports (impacting events only)

Testing Laboratory scope: the main tests to be carried out will be: .

• Tests on distribution transformers up to 1000 kVA and distribution expulsion fuses and switches up to 10 kArms.
• Type tests on low and medium voltage panels / switchgear , busways and busbar systems in general.
• Tests for short-time currents and peak withstand currents (short circuit) up to 80 kAef - 1s
• Temperature rise up to 10,000 A permanently in MV/LV.
• Low voltage internal arc (some)
• Interruption tests at low voltage and electrical and mechanical life (including some at medium voltage)
• Dielectric tests on low and medium voltage equipment.
• Remote viewing of tests such as F.A.T.

5. FINAL COMMENTS

It is easy to notice that without testing laboratories the situation in the Brazilian electrical industry will quickly worsen. We need to act quickly to be able to do tests again in Brazil instead of sending equipment to test abroad, as before 1981, when there was no way to test here.

Industry associations need to get out of their comfort zone and organize themselves to make a project like this to move forward. We cannot repeat omissions and attitudes like those that led to the failure of the floodgates to prevent flooding in Porto Alegre.

As will be detailed in the September lecture, the idea presented here is feasible, economically viable and quick to implement. I can say this because I have done this successfully more than once.

We are accepting invitations to host the lecture venue. Maybe initially at FIEP (Paraná) or FIESC (Santa Catarina) or FIERS (Rio Grande do Sul) or FINDES (Espírito Santo)

The lecture will allow interested companies to understand:

- Economic technical feasibility study and business plan
- Detailed market study
- Estimated implementation costs and future revenues
- Team size
- I have more than 45 years of international experience in the subject.

- CV of the lecturer and author: https://www.cognitor.com.br/Curriculum.html
- Things I helped to do along my professional life: https://www.cognitor.com.br/HelpedToDo.pdf

---------- END OF THE ARTICLE ----------

1. INDICATORS OF THE QUALITY OF ELECTRICITY DISTRIBUTION SERVICES (from Reference 4)

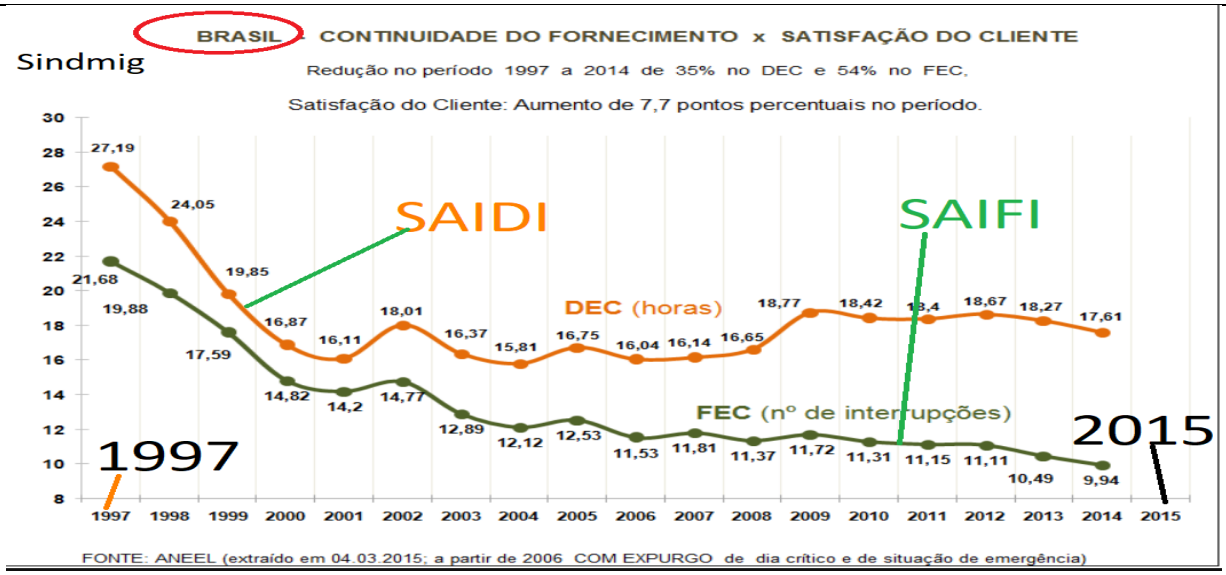
Here are some indicators of the quality of electricity distribution services from the late 80's to recent years. I got this data in the web, just to present orders of magnitude. In the case of Brazil, they give an idea of how the distribution systems improved after the program Proquip and NBR7282. I used as indicators:

- SAIDI (System Average Interruption Duration Index) ,= total duration of interruptions / Number of customers
- SAIFI (System Average Interruption Frequency Index) = total amount of interruptions/ Number of customers
- Electricity price (USD/KWh or USD / MWh)
- Electricity price divided by the country minimum wage, to understand the difficulty to pay the electricity bill

Table 1 - ELECTRICITY QUALITY & COSTS indicators: ORDER of MAGNITUDE

Country	SAIDI (minutes)		SAIFI		Quality of electricity supply Index (World Bank GovData360)	Price (*) of residential consumer bill (USD / MWh)	(USD / MWh) divided by minimum month wage in the country
USA/Canada	> 92 (2019) IEA		1,25 (2016) IEA		**6,2 -6,6**	140 - 170	**0,12**
France	48,0 (2002) 70,0 (2016) CEER methodology		0,11 (2002) 0,22 (2002) CEER methodology		**6,7**	267	**0,13**
Netherlands	31,5 (2012) 27,3 (2016) CEER methodology		0,33 (2012) 0,32 (2016) CEER methodology		**6,8**	259 - 316	**0,14**
Australia					**5,7**	176	**0,14**
Turkey					**4,4**	77	**0,23**
Philippines					**4,2**	150	**0,50**
South Africa					**3,9**	208-230	**0,70**
B R A Z I L	**26 (1996) 16 (2016)** DEC - GESEL		**22 (1996) 8 (2016)** FEC - GESEL		**4,5**	280-314 (*)	**0,85**

(*) Order of magnitude of values. In Rio de Janeiro - Brazil I paid the electricity bill in April 2022 (apartment for 3 people) ~ USD 206.00 for 654 kWh (USD 314.00/MWh). Taxes are 33% of the total bill.
(**) CEER -Table 9 - Electricity: planned and unplanned SAIDI, including exceptional events (minutes per customer)
(***) CEER - Table 17 – Electricity: planned and unplanned SAIFI, including exceptional events (interruptions per customer



SINDIMIG: http://www.sindimig.com.br/wp-content/uploads/2016/04/dec-e-fec-aneel.bmp

SOME INTERESTING SOURCES OF INFORMATION:

Minimum Wage by Country 2022 (worldpopulationreview.com)	https://worldpopulationreview.com/country-rankings/minimum-wage-by-country OECD https://stats.oecd.org/Index.aspx?DataSetCode=RMW
Quality of electricity supply - GovData360 (worldbank.org)	https://govdata360.worldbank.org/indicators/heb130a3c?country=BRA&indicator=547&viz=line_chart&years=2007,2017
IEA - Statistics report - Key World Energy - Statistics 2021 - September 202 + EIA	https://iea.blob.core.windows.net/assets/52f66a88-0b63-4ad2-94a5-29d36e864b82/KeyWorldEnergyStatistics2021.pdf EIA methodology USA https://www.eia.gov/todayinenergy/detail.php?id=45796
MAIFI , SAID, SAIFI (Wikipedia)	https://en.wikipedia.org/wiki/MAIFI#:~:text=The%20Momentary%20Average%20Interruption%20Frequency,period%20(typically%20a%20year).
International electricity prices: How does Australia compare? (energycouncil.com.au)	https://www.energycouncil.com.au/analysis/international-electricity-prices-how-does-australia-compare/#:~:text=The%20average%20annual%20cost%20of,costs%20(down%20by%20%2467)
Energy Quality of Supply Work Stream (EQS WS) - **CEER** Benchmarking Report 6.1 on the Continuity of Electricity and Gas Supply - Data update 2015/2016	https://www.ceer.eu/documents/104400/-/-/963153e6-2f42-78eb-22a4-06f1552dd34c
ERIA Research project report 2017 Nr.12 Comparative Power Prices in the Philippines and selected Asian Countries	https://www.eria.org/research/comparative-analysis-of-power-prices-in-the-philippines-and-selected-asean-countries/
ANEEL – Indicadores coletivos de continuidade	https://www.eia.gov/todayinenergy/detail.php?id=45796
Dados Energéticos – São Paulo	https://dadosenergeticos.energia.sp.gov.br/portalcev2/intranet/Eletricidade/index.html
SINDMIG (chart above 1997 – 2015)	http://www.sindimig.com.br/wp-content/uploads/2016/04/dec-e-fec-aneel.bmp

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[3] **CIGRÈ BROCHURE 740 (2018)** Contemporary design of **low-cost** substations in developing countries. (Sergio Feitoza Costa is co-author)

[4a] **IEC62271-307 (2015) -** High-voltage switchgear and controlgear - Part 307: 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. (Sergio Feitoza Costa is co-author)

[4b] **ARTICLE "EXPLAINING IEC 62271-307** – EXTENSION OF THE VALIDITY OF TYPE TESTS TO AVOID TESTS REPETITIONS" . https://www.cognitor.com.br/IEC62271307ENG.pdf

[5] **Article "TEMPERATURE RISE LIMITS OF IEC 61439-1** : unclear values distort the LV switchgear market. (May,12, 2023) - http://www.cognitor.com.br/IEC614391Table6.pdf

[6] **IEC TR 60943:1998** - Guidance concerning the permissible temperature rise for parts of electrical equipment, in particular for terminals. (Issued 1st time by IEC Technical Committee TC 32 when Sergio was the chair of IEC TC32)

[7] **Free book by Sergio "SWITCHGEAR, BUSWAYS & ISOLATORS & SUBSTATIONS & LINES EQUIPMENT"**
https://www.cognitor.com.br/Book_SE_SW_2013_ENG.pdf

[8] **Free book by Sergio "180 POSTS FOR THE ELECTRIC POWER INDUSTRY.**
https://www.cognitor.com.br/180posts.pdf

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http://www.cognitor.com.br/switchgearmetalfoam.pdf

[10] **GUIDELINES FOR THE USE OF SIMULATIONS AND CALCULATIONS TO REPLACE SOME TESTS SPECIFIED IN INTERNATIONAL STANDARDS ".** This document authored by Sergio Feitoza Costa in 2010, is referred in the Cigrè Brochure 602 (above) http://www.cognitor.com.br/GUIDE_Simulations_v0_October2010.pdf

[11] **TR 71 - TESTING SIMULATIONS REPORT FOR THE VALIDATION OF SWITCHGEARDESIGN**
https://www.cognitor.com.br/TR_071_ENG_ValidationSwitchgear.pdf

[12] **TR74 - VALIDATION OF MAGNETIC & ELECTRIC FIELDS MAPPING & TEMPERATURE RISE TESTS** SIMULATIONS.
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http://www.cognitor.com.br/EnvironmentalEfficiencyCertificate.pdf

[16] **IMPROVEMENT OF QUALITY OF ELECTRIC SYSTEM INDEXES:**
https://www.cognitor.com.br/IEC602822sugestionstosc32afrombrazil.pdf

[17] **Free book by Sergio "RENEWABLE ENERGY + ENVIRONMENTAL EDUCATION TO TRY TO SAVE THE PLANET"** https://www.cognitor.com.br/educationfortheplanet.pdf

[18] **Free book by Sergio" PROJECT SAVE RIO IN 10 YEARS:**
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[19] **Other reference articles** https://www.cognitor.com.br/Downloads1.html

[20] **HIGH-POWER (SMALL) TESTING LABORATORY + R&D SWITCHGEAR DEVELOPMENT SERVICES A SUSTAINABLE ENTERPRISE FOR DEVELOPING COUNTRIES.** https://www.cognitor.com.br/hplENG.pdf

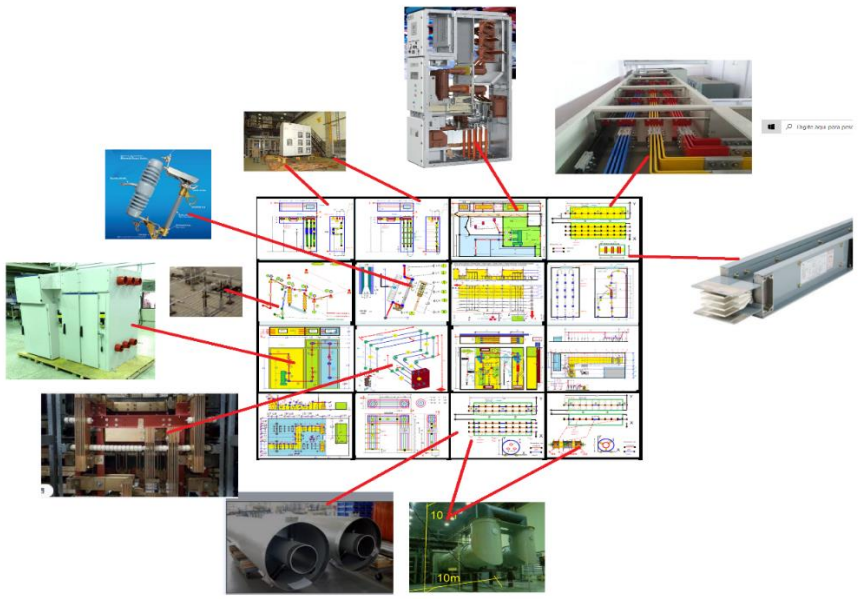
CV Sergio Feitoza Costa https://www.cognitor.com.br/Curriculum.html

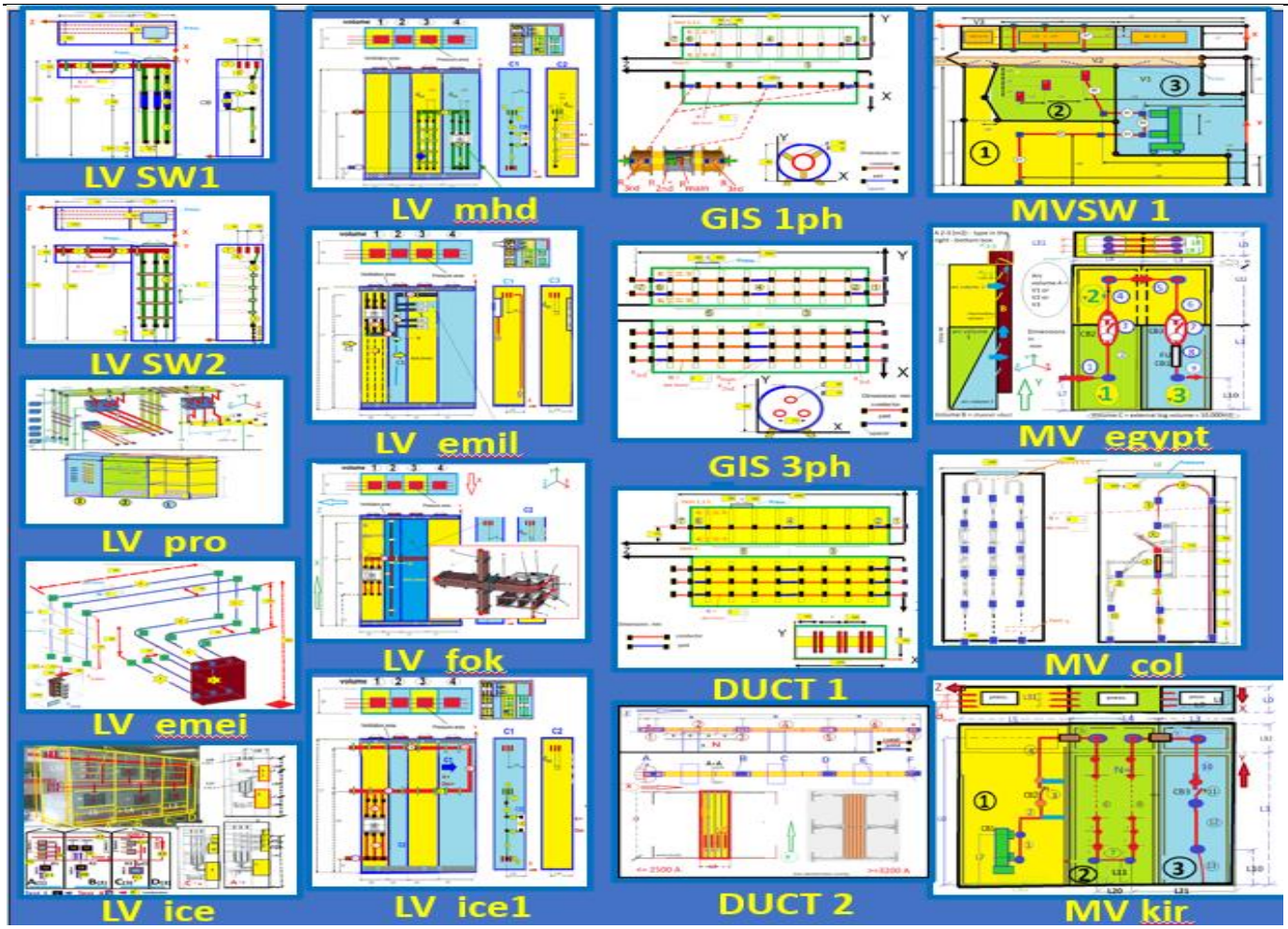
Things Sergio helped to do http://www.cognitor.com.br/HelpedToDo.pdf

Site https://www.cognitor.com.br
Contact e-mail: write to sergiofeitozacosta@gmail.com
Linkedin profile (31K followers) : linkedin.com/in/sergiofeitozacosta

Design Review + Training + software : https://www.cognitor.com.br/proposal.pdf.

Typical SwitchgearDesign software models





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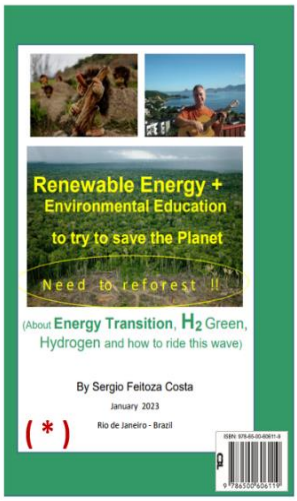

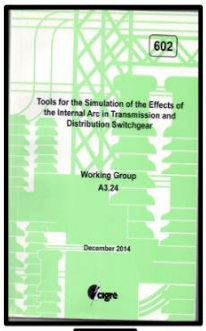

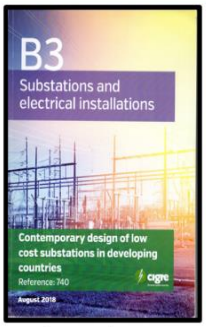

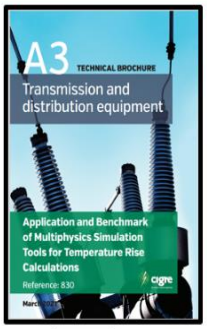

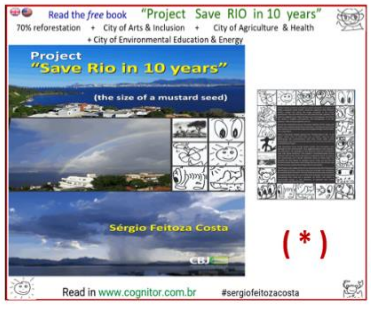

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