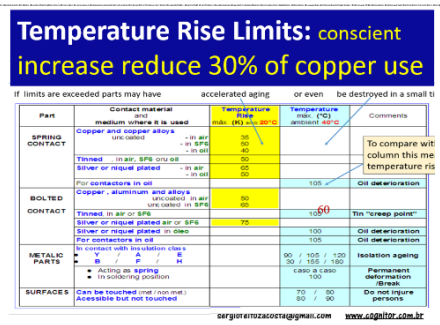
Demo Project 2: Substations & Lines innovative products. small R&D Centres + Testing Laboratory

By Sergio Feitoza Costa



1. THE DEMO PROJECT #2 of 7 (R&D Centre + Testing Lab implementation).

The "kG /MVA: Research Centre on Environmental Efficiency of Electric Products" is a concept explained in Reference [1]. The initial goal is to carry out 7 short-duration demonstration projects to show to the world that designing higher efficiency equipment using less materials is not a difficult task and depend more on serious attitudes than of significant investments. This project #2 intends to design and implement a financially sustainable center to provide R&D support and laboratory testing for the development of Substations & Lines Innovative Products and Patents. Innovation in this context refers to materials-saving goods or procedures. We provide samples below. Areas such as South America, Africa, and parts of Asia like Malaysia, Singapore, or Thailand may benefit greatly from this kind of center.

Table 1 – The scope of 7 demonstration projects

Demonstration project (Details in the links)	Name	Scope and monitoring of results
#1 http://www.cognitor.com.br/demo1certificate.pdf	Environmental efficiency certificate of electrical products (kG/MVA): technical standard & demo projects management	To disseminate the idea, to monitor the level of interest through the number of Linkedin followers, to create the guidelines for the implementation and to act within major technical standards organizations to discuss and prepare the standard.
#2 http://www.cognitor.com.br/demo2Lab.pdf	High Power (small size): Testing Laboratory with R&D services focused on lower kG/MVA products	Design and implementation of 3 units in) in three regions like South America (possibly Brazil), Africa and Asia (possibly in Malaysia ou Singapore or Thailand).
#3 http://www.cognitor.com.br/demo3SwitchgearEfficiency.pdf	Examples of more efficient switchgear (30% less kg/MVA) using thinner bars, small ventilation, and different materials Cu / Al profiles and coatings	Design, testing results & comparisons of kg/MVA between traditional techniques and (a) using several thin bars, per phase, (b) small (auto) ventilation resources , (c) different coatings of the busbar connections and (d) parts of components using metal foam
#4 http://www.cognitor.com.br/demo4HighRiseBuildings.pdf	Designing triaxial busways for high rise buildings (lower kg/MVA & impedance for IEC62271 – IEC 61439)	Design and testing comparing the traditional busways with a triaxial busway with higher rated and short circuit current ratings (lower kg/MVA) using proved concepts used in coaxial cables
#5 http://www.cognitor.com.br/demo5SuperEnclosures.pdf	A Super Enclosure for high current switchgear and controlgear (IEC62271 – IEC 61439)	To be disclosed soon
#6 http://www.cognitor.com.br/demo6EconoCosts.pdf	Decidix for kg/MVA – a tool to assess the efficiency of high electric power products	A tool for technical-economic evaluations easy to use by equipment developers with little knowledge of cost calculations. Allows you to compare the attractiveness of projects of different natures
#7 http://www.cognitor.com.br/demo7MHD.pdf	MHD for a water transportation vessel based on electrodynamic forces	To be disclosed soon. Check this article. http://www.cognitor.com.br/ElectrodynamicForces.pdf

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2. WHY THE TEST LAB OF THIS PROJECT DIFFERS FROM EXISTING TRADITIONAL TESTING LABS.

The main barrier to the development of more eco-friendly products that consume less materials and resources on Earth is the requirement for costly testing in high power testing laboratories. A facility like a medium size high power test laboratory (HPL) cost from 20 to 50 million euros to build. Although there is a healthy market for testing, there are greater return on investment opportunities for investors to consider. There are not so many laboratories in the world, and the cost of a single testing day can range from 2,000 to 15,000 euros, depending on the test.

IEC, IEEE and most national standards are only focused on type testing and , unfortunately, do not even mention greater efficiency and material savings as a benefit. Manufacturers, at least in the end of a product's development, need to go to a third part testing lab to obtain a test report to be used for commercialization. They go to the laboratory with the concern that, if the equipment does not pass test, they will have more expenses with test repetitions. For this reason, they design the prototypes with safety margins higher than necessary. This is the opposite of the concept of higher efficiency and lower costs.

By this reason, rather of attempting to create more efficient projects, any manufacturers prefer to copy old, already tested projects, developed in the past by the large international manufacturers. It was not even contemplated at the time to use less materials and be more efficient in order to preserve Earth's resources. It would be easy for big international manufacturers to develop more efficient versions of their old designs. They will not, however, venture outside of what they have been doing well for more than 50 years, particularly because the majority of buyers, governments, and organizations in the electrical sector do not clearly perceive the macro notions of "high efficiency".

I state this consciously. At 69, I've spent 25 years designing, building, operating, and managing the largest testing labs in South America. After that, for the past 23 years I've developed knowledge and used simulation software to review the design before manufacturers go to the lab for actual testing. I review and correct their projects with almost 100% success. Most designs I touched had possibilities of efficiency improvements.

A point to notice is that developing a growing medium-size electrical industry - higher efficiency based is not difficult and produces impacting results in development, employment & income. I had a rare opportunity to witness and participate in an entire process of enlarging Brazilian electric industry in the 80's to 90's. Nowadays, could be done better and faster. The results in Brazil were very good, visible, and easily verifiable via web, just comparing the size and profile of the electric industry in the 70's and now. The, before, incipient electric industry growed and became solid and competitive generating employment and development.

The world changed and to do something with similar effect today we should think about a smaller scale testing lab, using less investment but adding more innovative ideas like to mix this with the approach of testing simulations. By doing this, a sustainable business would be created, which would not be achievable with just funding conventional testing lab operations.

> The path of the stones is to create a small R&D centre with a small electrical testing laboratory including a team focused on R&D to develop innovations in substation equipment (60% testing team + 40% R&D team). The focus would be to get more efficient equipment with lower Kg/MVA. The strategy would also involve systematic action in technical standardization bodies like IEC and IEEE to disseminate the knowledge acquired. Following this line of action, in some 7 years the results will appear. To spread these kinds of efficiency concepts, CIGRÆ, the most reputable voice of the electric industry, can be very useful.

2. WHO ARE THE PRIMARY SPONSORS / INVESTORS OF THIS KIND OF R&D CENTER PLUS TESTING LAB?

Around the world, the majority of current research facilities and testing labs were constructed between the 1950s and 1980s. Numerous investments were made by state-owned enterprises with the aim of stimulating regional growth. In the past 20 years, a number of large-medium centres and labs have closed and not replaced because private investors believe they are not the best investments for sums higher than 20 million euros. Others were shut down because they had already completed their initial goal or failed to see how the world was changing.

The project vision is of a private investment having as background the creation of a market for "higher efficiency saving resources equipment" supported by a CERTIFICATE. Read in Ref. [1] the draft of an international technical standard. This "Certificate" is an action to signalize that higher efficiency via a lower kg/MVA is good for the environment. The plan calls for putting a marketing strategy into action to enhance the company's environmental image and persuade the general public that manufacturing products with fewer kG/MVA and $/MVA is good for the Planet.

Big buyers that need to take care of the environmental image, will prefer to buy products with lower kg/MVA values. The first ones which obtain the Certificate can strategically do campaigns to disclose who buys and who does not buy more efficient products. Declarations about the relevancy of kg/MVA in product standards of entities really committed to the environmental issue, would accelerate the process. IEC and IEEE could do a great contribution on this.

The envisaged step to follow is to implement the Demo Project 2 (Small lab) and monitoring the results for a certain period of time. The idea is to implement the construction of a small - medium-sized 3rd part centre with a testing laboratory. In addition to the conventional testing services the R&D team will provide support to manufacturers of equipment for substations and lines. The idea is to help them in the development of more efficient products. It is expected that a well-dimensioned centre + laboratory, managed from the perspective of private companies, will immediately get a big market. The reasons are: (a) it creates conditions for a new attractive market and growth of the electric industry (b) big buyers needing to take care of the environmental image, will prefer to buy products with lower kg/MVA (c) the growth of the renewable energy market (d) low availability of cheaper small-sized testing labs .

3. WHAT and HOW TO DO IT?

The construction of this 3rd part laboratory goes far beyond test services because it provides support to manufacturers for development of innovative products. The team and installations will be dimensioned to be a self-sustaining enterprise with the sale of testing services and R&D services. The key for the success is to help the power industry to develop or improve products. This does not conflict with doing third-party testing.

Most of the existing labs I know, all over the world, still have an extremely conservative view that "everything should be tested" and furthermore, that a third-party lab should not act to help manufacturers to develop products because would be conflicting with the interest of "doing neutral tests". The world has changed and doesn't care about this.

The important new is the use of low-cost testing simulations to develop products. The big world-wide manufacturers use them intensively. However, the others, which would be the big beneficiaries – rarely know they exist. There are recent CIGRE brochures demonstrating applications and validations like CIGRE 602 (Internal Arc), 740 (Low-Cost Substations) and 830 (Temperature Rise). In IEC the openings for testing simulations were finally created as in IEC TR 62271-307. I am co-author of these Cigrè and IEC documents and participated of the WGs. The main big manufacturers were there participating actively in the working groups.

Nowadays, almost always, manufacturers go to testing labs with the main objective of having a test report in hand to show to product buyers. What matters is having the lowest expenses and passing in the tests. The concept with our idea is to make the developments cheaper using design experience and test simulations. The idea is to go to the labs only in the final stage of development, to carry out the type tests and get the test report. The focus is also to develop higher efficiency + less materials products and to use this as a marketing strategy.

4. "TESTING LABORATORY + R&D SERVICES" IMPLEMENTATION

The idea is implementing a commercial venture with an acceptable return on investment for investors. In the feasibility study we consider that the return on investment involve revenues from the sale of tests, patents, and other R&D consequences as well as the improvement of system quality indexes. The enterprise will have two lines of action:

- *A small - medium sized laboratory to carry out the high - power tests and,*
- *A parallel activity of "Support in the development of equipment for substations & lines systems" with worldwide operations, including lower-cost solutions to amplify the use of renewable energy. The market of this R&D activity is not still explored and may bring incomes even higher than the tests sales. Depends mostly on the creativity of experienced specialists.*

Direct business revenue will come from

- conducting conventional tests like in the list to follow,
- to provide, to manufacturers, technical support for the development of more efficient products,
- testing simulations and training to reduce development costs and
- neutral lectures, on behalf of manufacturers, on products and technical standards that - clearly - help to improve energy efficiency.

The "Testing Laboratory" will allow remote viewing (as F.A.T.). The main tests to be performed will be:

- Tests of medium voltage, low voltage equipment and even some up to class 550 kV.
- Tests of short time current withstand and crest (short-circuit) up to 200 kArms - 1s
- Temperature rises to 20,000 A permanent.
- Low voltage internal arc (and some for MV)
- Dielectric tests up to medium voltage equipment.

For companies that show interest in the idea we can provide information and expertise like:

- Economic technical feasibility studies and business plan
- Detailed market study
- Estimated implementation costs and future revenues
- Team size (less than 25-30 people)

To know more about the author of this project idea read the CV of Sergio Feitoza Costa here https://www.cognitor.com.br/Curriculum.html . Check here some things that he helped to do along a successful engineering and R&D life https://www.cognitor.com.br/HelpedToDo.pdf

REFERENCES

[1] **IEC TR 60943:1998** - Guidance concerning the permissible temperature rise for parts of electrical equipment, in particular for terminals. Issued by IEC Technical Committee TC 32.

[2] **CIGRÈ BROCHURE 830 (2021)** – "SIMULATIONS FOR TEMPERATURE RISE CALCULATION". (Sergio Feitoza Costa is co-author)

[3] **Cigrè Brochure 740 (2018)** Contemporary design of **low-cost** substations in developing countries.

[4] **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

[5] **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.

OTHER USEFUL REFERENCES

[6] **Article "METAL FOAM in SWITCHGEAR, switchboards & bus ducts**
http://www.cognitor.com.br/switchgearmetalfoam.pdf

[7] **ENVIRONMENTAL EFFICIENCY CERTIFICATE OF ELECTRICAL PRODUCTS (KG/MVA): TECHNICAL STANDARD & DEMO PROJECTS MANAGEMENT)**
http://www.cognitor.com.br/demo1certificate.pdf

[8] **SUBSTATIONS & LINES INNOVATIVE PRODUCTS. SMALL R&D CENTRES + TESTING LABORATORY**
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[10] **CIGRÈ BROCHURE 602 (2014)** Tools for Simulation of The Effects of the Internal Arc in T&D Switchgear,

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https://www.cognitor.com.br/IEC602822sugestionstosc32afrombrazil.pdf

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

[13] **Free book by Sergio "SWITCHGEAR, BUSWAYS & ISOLATORS & SUBSTATIONS & LINES EQUIPMENT"**
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[14] **Free book by Sergio" PROJECT SAVE RIO IN 10 YEARS:**
https://www.cognitor.com.br/saverioENG.pdf

[15] Visiting researcher training: https://www.cognitor.com.br/trainingENG.pdf

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

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

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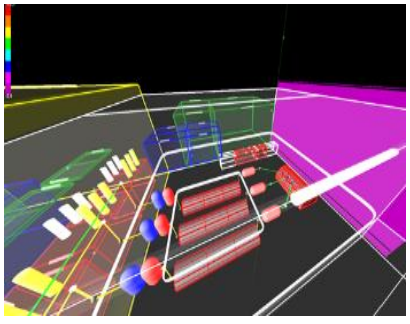
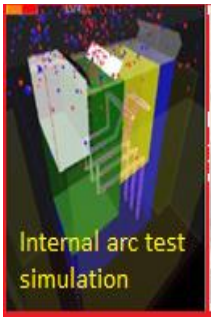
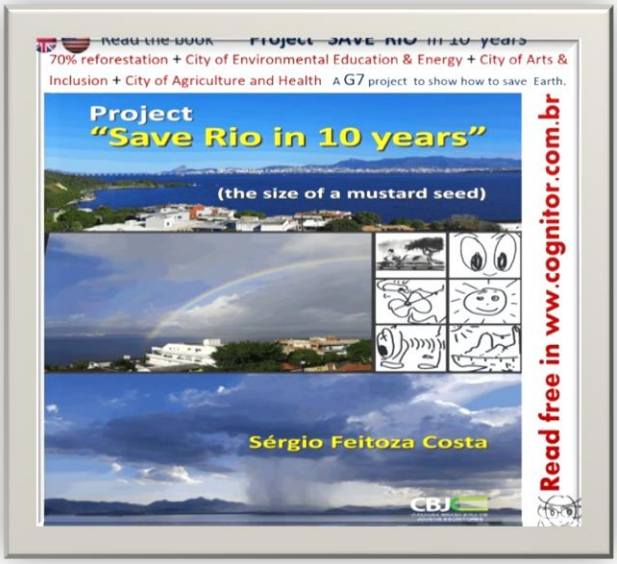
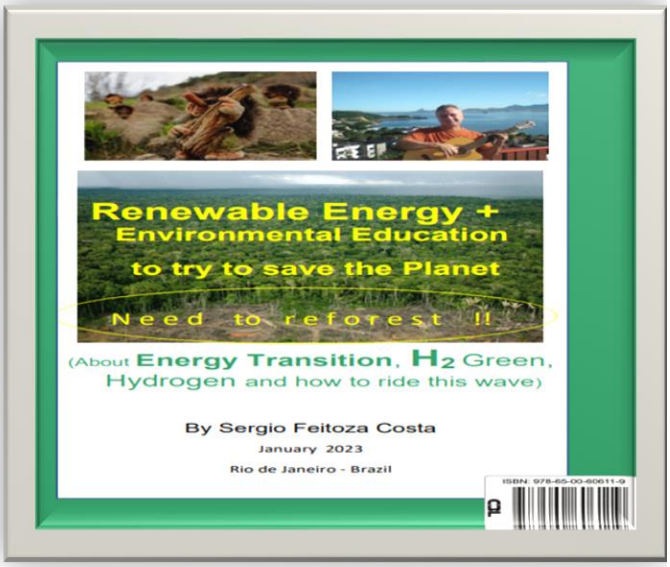
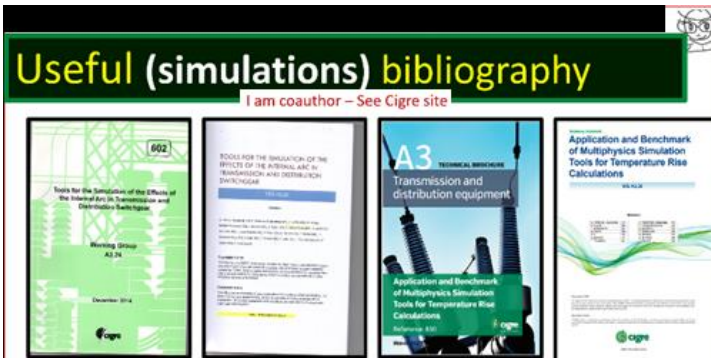








Será publicada em breve um livro ("Brochure Cigré) sobre o tema "Contemporary Solutions for Low Cost Substations in Developing Countries". Sergio escreveu os textos iniciais dos capítulos "Equipment Selection" e " Training and Development"



Sergio Feitoza, author of this article, helped to design, construct operate and to manage this set of 14 testing labs. including High-Power, High voltage, EMC, Ex, …

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