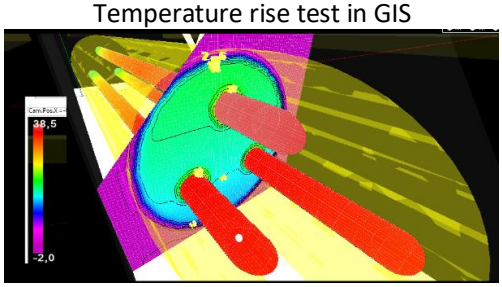
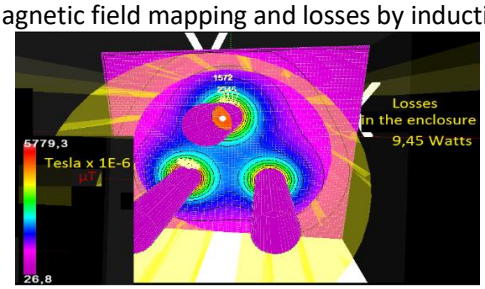
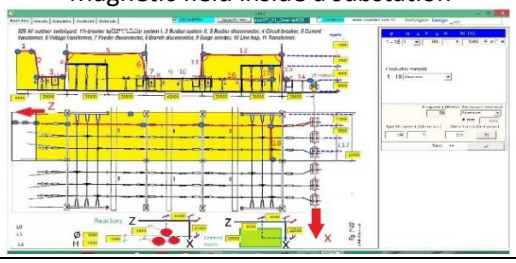
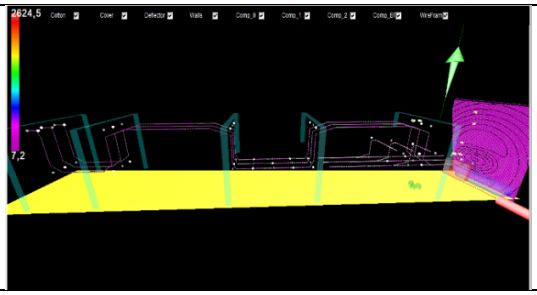
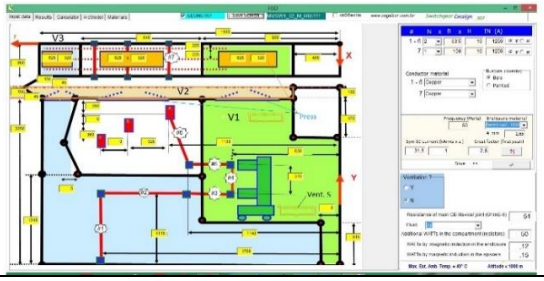
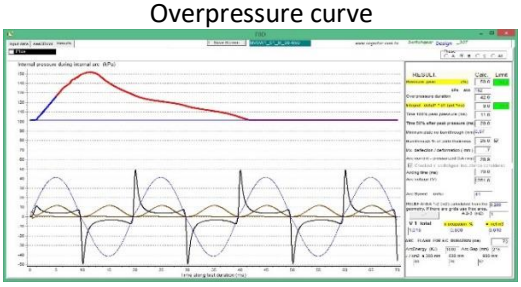
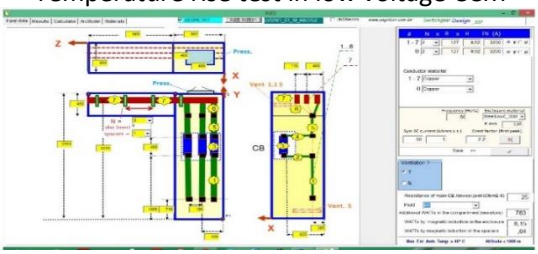
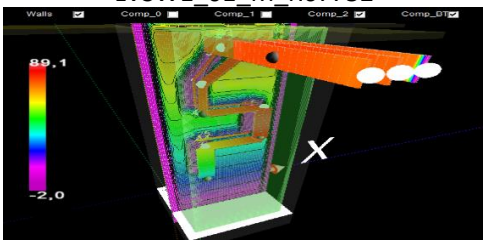
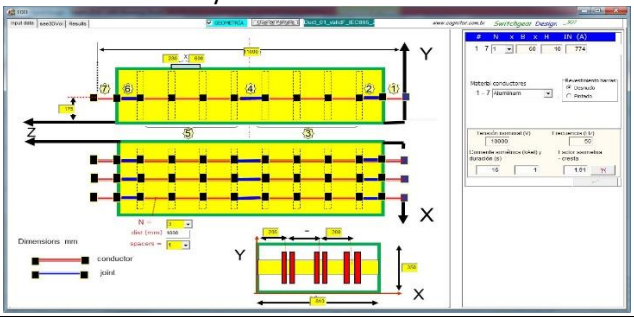
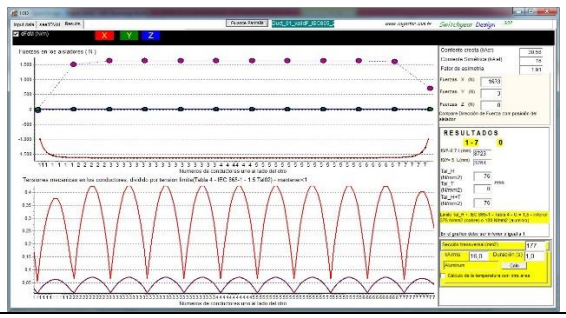
Training "**DESIGN OF SWITCHGEAR, SWITCHBOARDS, BUSWAYS & Substations**".

About I E C 61439 & I E C 62271- 200 / 201 / 1 & I E C 62271-307 -- Internal arc, temperature rise, electrodynamic forces, magnetic & electric fields for EMC problems and the use of software SwitchgearDesign.

LINKS TO CHECK THE CHAPETRS of the TRAINING IN

http://www.cognitor.com.br/ChaptersResumePrices2019.html

Temperature rise test in GIS 	Magnetic field mapping and losses by induction 
Magnetic field inside a substation 	
Internal arc test in medium voltage cubicle AIS 	Overpressure curve 
Temperature rise test in low voltage CCM 	LVSW1_01_M_R67752 
Electrodynamic forces in a bus duct 	Forces in insulators and stresses in conductors 

COGNITOR - Design of Testing Laboratories, Equipment for Substation and Testing Simulations.

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Training "**DESIGN OF SWITCHGEAR, SWITCHBOARDS, BUSWAYS & Substations**".
About I E C 61439 & I E C 62271- 200 / 201 / 1 & I E C 62271-307 -- Internal arc, temperature rise, electrodynamic forces, magnetic & electric fields for EMC problems and the use of software SwitchgearDesign.

ABOUT THE TRAINING (VIDEOS + PDF)

This training is handmade for manufacturers and users of high to low voltage equipment as well as certification companies and testing laboratories. It is useful for whom want to know sound engineering design concepts and to apply these concepts in the design and use of equipment for power substations. The participants review design concepts and learn to use the software SwitchgearDesign developed by Sergio Feitoza, the lecturer of the training. Sergio is an electrical engineer experienced in laboratory testing operation and design, specifications and in preparing IEC technical standards. SwitchgearDesign permits to develop substation equipment simulating their performance during type tests before going to do a real test in laboratory.

Curriculum and publications by Sergio: http://www.cognitor.com.br/curriculum.html

ABOUT SWITCHGEARDESIGN: in addition to the existing version for desktop, it is now becoming accessible for use in your browser using cheap CREDITS by hour of use. With it, equipment designers can accelerate the development of innovative products without expenses with testing laboratories.

However, if you prefer that we do the calculations and simulations to develop your products, patents or even inventions we can help you to do it. We conduct test results extrapolation studies in line with IEC 62271-307. to verify, based on the test report of an already tested equipment, whether or not other untested equipment would pass the same tests. More and more companies accept these studies to avoid high testing costs.

The program of the course cover t:

- Specification and testing of MV and LV switchboards, switchgear, transformers, circuit breakers, isolators, fuses, busways, etc..
- Understanding on how to reduce the need of expensive testing according to IEC62271-1 / 100 / 200 /307 (medium – high voltages) and IEC 61439 (low voltage)
- Laboratory tests (breaking, short circuit, internal arc, heating, electro dynamical forces and others)
- Methods of calculation of electrical and mechanical effects and how to improve the design.
- Magnetic and electric fields mapping in substations to solve EMC problems
- How to use SwitchgearDesign to simulate and design your equipment for temperature rise, short time and crest current (electrodynamic forces) and internal arc tests.

If your company is interested in a 2 days "In Company" training or even in the design of Testing Laboratories, please contact me in the directions below. I will be pleased to answer your questions.

With Kind Regards

Sergio Feitoza Costa

(Lecturer of the training, designer of high power testing lab and author of the simulation software SwitchgearDesign)

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OBJECTIVE OF THE TRAINING

In the design of switchgear, busways, isolators and other equipment for substations, three of the most expensive requirements to attend are usually:
-- the temperatures not to be exceeded, in normal use
-- to withstand overpressures during internal arcs and
-- to withstand the electro dynamical forces that can damage insulators and bend bus bars.

The smaller is the equipment and higher are the currents, the harder it is to meet these requirements and to optimize the design for the minimum use of copper, aluminum and supports for the bus bars.

Many products in the market are oversized in some respects and deficient in others because tests are expensive, and the manufacturer want to avoid the possibility failures in the tests and consequently their repetition. Nevertheless, with the use of sound concepts plus simulation techniques it is possible to optimize designs employing less copper, aluminum, insulators, and doing this to reduce the use of the world resources.

Buyers of electric products want products with reports attesting that they meet the requirements of technical standards. The availability of testing laboratories is small all over the World, by this reason tests are expensive, and there is a waiting time to do them. The cost of just one day of a high-power laboratory test can exceed 6000 U$D not including the prototype construction and transportation to the lab.

Simulations permit to economize dozens of testing days and are each time more known and accepted by users to replace laboratory tests in the development phase and even to replace type tests in several situations. Few people know that IEC and CIGRE working groups are advancing fast in this theme.

> THE OBJECTIVE OF THIS COURSE is to show how to develop an optimized high-quality equipment design based in the good knowledge of the IEC technical standards specifications, design concepts and the possibility of replacing expensive tests by low cost computer simulations.

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THE CHAPTERS OF THE TRAINING (VIDEOS + PDF)

1 to 4 – GENERAL INFORMATION AND OTHER FAST ITEMS

(free videos in http://www.cognitor.com.br/ChaptersResumePrices2019.html)

Chapter 5 -STUDIES MAKING THE BASE OF THE SPECIFICATION OF CURRENTS & VOLTAGES.

- Load flow and definition of the normal currents.
- Short circuit studies and definition of currents and duration.
- Basic concepts of the "free" software ATP / ATPDRAW (currents and voltages transient calculations).

Chapter 6 - OVERVOLTAGES AND INSULATION COORDINATION.

- Transients and insulation coordination.
- Techniques to reduce over voltages (synchronizers, pre insertion resistors, surge arresters)
- Why to use higher or lower levels of withstand industrial frequency and impulse voltages?
- Some aspects of electric fields and distances in installations
- Some high voltage tests (impulse, AC voltage, corona, RIV, …)

Chapter 7 – TEMPERATURE RISE – CONCEPTS, CALCULATIONS AND SIMULATIONS

- Concepts and testing: reduction of lifetime, supportability of materials to temperatures and durations.
- Importance of the ventilation and contact resistances in switchgear, etc…
- Concepts about overloads in Transformers
- Temperature rise tests and testing simulations with the use of SwitchgearDesign.

Chapter 8 - ELECTRODYNAMICAL FORCES & STRESSES DURING SHORT CIRCUITS.

- Magnetic effects and electro dynamical forces under short-circuit currents.
- Calculation of the forces and mechanical stresses.
- Limit values for insulators and busbar conductors.
- Short time withstand current and peak withstand current tests and corresponding testing simulations (including use of SwitchgearDesign).
- Some aspects of magnetic fields in installations

Chapter 9 – INTERNAL ARC TESTS – Concepts and simulations with IEC 62271-200 /307 (medium voltage), IEC TR 61641 (low voltage).

- Internal arc in switchgear (medium and low voltage).
- Technologies to control the effects of arc and to attend testing requirements.
- Did we arrive to the limit of equipment dimensions reduction?
- Information on Internal Arcs, Explosions and Fires in power transformers. Information on power arcs in insulators strings and tests
- Simulations, calculations and design criteria for Internal arc overpressures (with SwitchgearDesign).

Chapter 10 - MAGNETIC FIELDS AND THEIR EFFECTS (CONCEPTS and MAPPING)

The electromagnetic fields in substations due to the high currents and high voltages produce different effects on people and objects nearby. High levels of permanent magnetic or electric fields have impacts on the health of people exposed to them. These effects depend on the field strength and duration of exposure. There are specific legislations specifying the maximum values that should not be exceeded. Permanent magnetic fields can also cause effects of magnetic induction and overheating in metal parts near to their source. In addition, transient magnetic fields produced by high currents at rated frequency (short circuit) or higher frequencies like in the switching of capacitive circuits, can induce high voltages in the control circuits and other closed circuits in substations.
This chapter is based on the Technical Report Cognitor 76 / 2016 - Magnetic & Electric Fields In Substations & Neighborhood (Mapping for *health legislation and to solve EMC problems)*. The objective is to show how to calculate the values, which may occur, depending on the geometry of the object under study and the values of currents and voltages involved. The object may be a complete substation or an enclosed metallic equipment. The main applications are:

- To verify if the values of electromagnetic fields in a substation are lower than the reference levels established in references like ICNIRP "Guidelines for Limiting Exposure to Time-varying Electric and Magnetic Fields (1 Hz to 100 kHz)". There you find limits for human exposure to electric and magnetic fields in generation, transmission and distribution installations.
- To see if the magnetic field acting in a metal plate or part is enough to produce overheating by magnetic induction
- It is presented the, step-by-step description on how to use SwitchgearDesign to the mapping of magnetic fields in complete substations or in switchgear, AIS, GIS, busbar systems and parts of substations.

Chapter 11- TECHNICAL SPECIFICATIONS AND MAIN TESTS FOR THE PURCHASE OF HIGH VOLTAGE CIRCUIT BREAKERS, DISCONNECTORS, SURGE ARRESTERS and OTHER EQUIPMENT

It includes a summary of the main specifications made by power utilities and large users of electricity. It is explained first, why the more efficient specification is just the technical standard with a few additions. We present typical errors that occur when the company instead of referring to standards, starts preparing new texts including unverifiable requirements. Examples will be used for main substation equipment.

The concepts of type tests will be presented, like:

- Withstand voltage (Impulses and AC)
- Temperature rise.
- Rated short-time withstand current and crest.
- Radio interference voltage
- Visual corona test.
- Breaking and making tests on circuit breakers, switches and fuses including TRV.

Chapter 12 - TECHNICAL STANDARDS FOR LOW VOLTAGE SWITCHGEAR AND CONTROLGEAR (IEC 61439 AND IEC TR 61641

Here we present some aspects of the IEC 61439 (Low-voltage switchgear and controlgear assemblies) and of IEC TR 61641 (low-voltage guide for testing under conditions of arcing due to internal fault). IEC 61439 is originated from the previous series IEC 60439 where a new concept was implemented. Suppose that there is a certain switchgear design type, which was completely type, tested and there is another untested switchgear for which we wish to avoid repeating some tests. The standard permits some tests to be replaced by calculations or simulations if the basic design of the untested equipment was the same and the differences between both were not considerable. The two tests, which could be replaced by calculations in IEC 60439, were the temperature rise test and the short time current tests (electro dynamical and thermal stresses).

IEC 60439 evolved to the IEC 61439 series, initially published in 2011, which brought a new concept named "design rules". In this series of standards, the wording "testing" is replaced by "design verification". The design verification may be done by tests, by certain design rules and by calculations / simulations. We explain how to use the design rules to avoid onerous tests.

Internal arc tests in low voltage switchgear are becoming a "must" for the equipment buyers although this test is not a type test in the current version of IEC 61439. IEC TR 61641:2014 gives guidance on the method of testing of assemblies under conditions of arcing in air due to an internal fault. The purpose of this test is to assess the ability of the assembly to limit the risk of personal injury, damage of assemblies and its suitability for further service as a result of an internal arcing fault. It includes arcing classes to define the different forms of protection provided against arcing faults;

(i) personnel protection,

(ii) damage restricted to part of the assembly, and

(iii) Assembly suitable for limited further service.

Chapter 13 - TECHNICAL STANDARDS FOR MEDIUM VOLTAGE SWITCHGEAR AND CONTROLGEAR (IEC 62271-200) AND IEC 62271-307 FOR EXTENSION OF THE VALIDITY OF MEDIUM VOLTAGE SWITCHGEAR TEST REPORTS

This chapter includes some fundaments and details of the IEC 62271-200. This standard specifies requirements for medium voltage metal enclosed switchgear and controlgear for indoor and outdoor installation. Enclosures may include fixed and removable components and be filled with fluid (liquid or gas) to provide insulation. It includes definitions, classifications and testing procedures as well as classification and procedures for internal arc tests. IEC 62271-200 is to be read in conjunction with IEC 62271-1 and some requirements of both are explained.

After, we present the fundamentals of the recent IEC Technical Report TR 62271-307: 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. It includes the possibility of extending the validity of reports to avoid tests in medium voltage switchgear. Sergio Feitoza is co-author of the IEC working group which prepared this TR.

This document allows, observing certain rules that a test report carried out in a certain type of switchgear to be used as a basis for a study that would replace tests on an untested one of the same family. It is aimed at extending the validity of test reports to avoid the unnecessary repetition of tests of IEC 62271-200 and 62271-201 standards.

Chapter 14 - IEC 890 and IEC 62208: Enclosures for cubicles and switchboards (calculations and specification)

We explain how to do calculations of the temperatures of fluids inside enclosures filled with the typical components of switchgear (IEC 60890) and how to specify empty enclosures to be used for switchgear (IEC 62208). IEC TR 60890 presents a method of (air) temperature-rise assessment by extrapolation for switchgear and controlgear. This method is applicable to enclosed assemblies or partitioned sections of assemblies without forced ventilation. This method is based on the dimensions of the switchgear, the power dissipation, the size and existence of ventilations openings and the number of partitions. The results that can be obtained by this easy method are very good and consistent for the ones playing with temperature rise tests simulation.

IEC 62208 is a standard to enable the specification of empty enclosures for switchgear and controlgear assemblies. It applies to empty enclosures, prior to the incorporation of switchgear and controlgear components by the user, as supplied by the enclosure manufacturer. This standard specifies general definitions, classifications, characteristics and test requirements of enclosures to be used as part of assemblies. Although prepared with focus in the IEC 61439 series (low voltage) the concepts are also interesting for medium voltage switchgear.