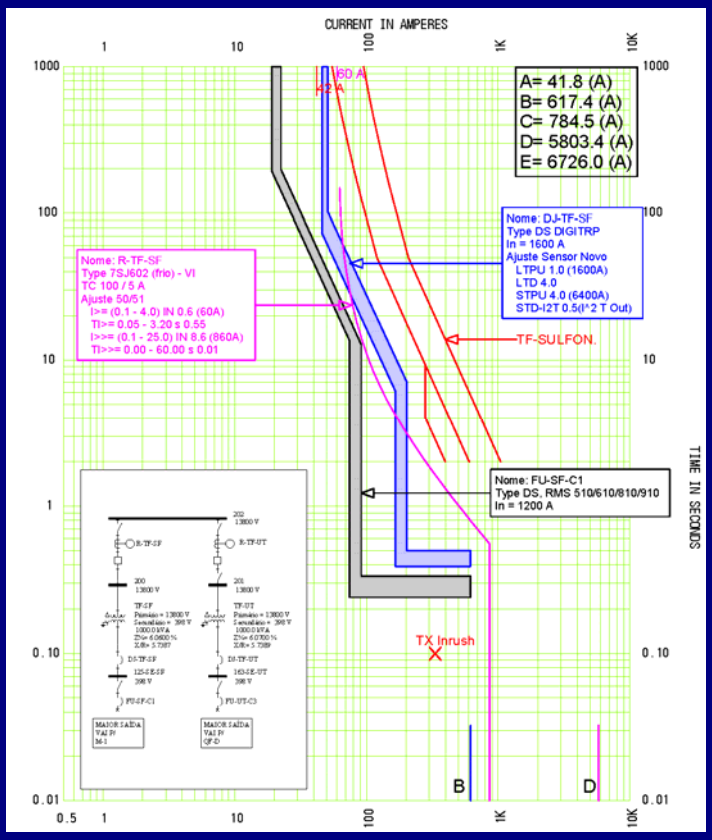

INDUSTRIAL ELECTRICAL POWER SYSTEM PROTECTION, COORDINATION & SELECTIVITY TRAINING

WWW.ENGEPOWER.COM **TEL: 55 11 3579-8777**

INDUSTRIAL ELECTRICAL POWER SYSTEM SHORT CIRCUIT, PROTECTION, COORDINATION & SELECTIVITY TRAINING PROGRAM

EngePower®

TARGET PUBLIC

Engineers and technicians who work in design, consulting, maintenance and operation of electrical systems.

PURPOSE

Provide to the participants important knowledge about practices and calculations of three-phase, phase to phase, line to ground and arc faults (short circuit), and to present concepts of protective devices and the study of coordination and chronological, current and logical selectivity allowing participants to evaluate a study.

STRUCTURE

The training has been re-squeduled to a better teaching efficiency. Two days are for Short Circuit (Chapter 1 to 3) and 2 days for Protection & Coordination. Half of the last day is reserved for practical exercises of short circuit and selectivity. The training is presentated on data-show.

TRAINING PROGRAM

CHAPTER 1 - BASIC CONCEPTS (Per Unit Calculation, Symmetrical Components, Types of Power System Neutral Grounding, ΔY e YΔ Conversion, Thevenin Theorem, Resistive, Inductive and Capacitive Circuits)

CHAPTER 2 - DATA SURVEY (Inform participants the required data to perform short circuit and Coordination and Selectivity Study)

CHAPTER 3 - SHORT CIRCUIT STUDY (Short Circuit Current, Nature of Short Circuit Current, Short Circuit Simmetry, Assimmetry Factors, Short Circuit Sources, Short Circuit Current Strenghts, Subtransient and Transient Short Circuit Periods, Sequence Circuits, most common fault types : Three-Phase, Phase-to-Phase, Line to Ground and Arcing Faults, Generator´s Decrement Short Circuit Current, Sequence Impedances, Short Circuit Particularities, ANSI Short Circuit, IEC Short Circuit, ANSI x IEC Comparison, Short Circuit Current for

Equipment Evaluation, The importance of X/R in the arc extinction, fault calculation summary, exemples)

CHAPTER 4 - CTs, PTs and Rogowski Coils for Protection Services (CTs understanding: Standards, Definition, Terminology, Specification Data, How to connect a CT in the circuit, Equivalent Circuit, Polarity, Safety, Accuracy, saturation, AC saturation, DC saturation, CT impedance, protective devices impedance, time to saturate, CT saturation effects, measures to reduce or avoid saturation effects, auxiliary TCs, CT x Relay Coordination, CTs installed in capacitor bank circuits, CTs transient modeling, CT saturation effects on digital relays. PTs: Standards, Definition, Specification Data, Accuracy, Rated Power, Rated Thermal Power, Connection Group, Overvoltage Factors, Short Circuit Strenght, Most common ways to connect a PT in the circuit, PTs Transient Modeling, Rogowski Coils: Definition, Operation Principle, History, Main Advantages, Accuracy and Calibration Factor, Currents, Accuracy Classes, Main Manufacturers, other applications, voltage and current sensors)

CHAPTER 5 - PROTECTIVE DEVICES (Terminology, Most Common Protective Devices, Relays: Definition, Main Relays Requirements, Relay Universal Torque Equation, Understanding of electromechanical relays, static and digital, LV Breakers, links and fuses, overcurrent relay, directional relay, differential relay, directional active power relay, under and overvoltage relay, zero sequence voltage relay (59N), Lockout relay (86), restraint voltage overcurrent relay (51V), frequency relay, df/dt relay, ANSI numbering code)

CHAPTER 6 - AUXILIARY CIRCUITS (Purpose, Characteristic of electrical quantities durging a short-circuit, essential load supply, DC No-Break (Battery Charger), AC No-Break, DC NB x AC NB, Typical one-line diagram, Tipical Circuit Breaker Schematic Diagram)

CHAPTER 7 - GROUND FAULT PROTECTION (Standards and Guides, Origin of ground faults, Ground fault characteristics, Ground fault current value, NEC 230.95 Section, Comparison of I^2t during a ground fault for solidly ground system, low resistor grounding system, high value resistor grounding system, Arc specific protection, Arc fault damage, Practical Cases)

CHAPTER 16 –PRACTICAL EXEMPLES (With PTW – DEMO Software)

Instructor : Cláudio S. Mardegan, engineering graduation by EFEI in 1980, 30 years of experience in Industrial Electrical Power System Protection, is the ENGEPOWER´s CEO, consultant of big national and multinational corporations.