TERCO

PST 2200
Power System Simulator Laboratory

CONTENTS

INTRODUCTION

Various kinds of simulation are used more often as an important aid to educate operating and servicing personnel. With a simulator you can train people to make sensible decisions and to act quickly and decisively under varying operating conditions. Moreover, you can demonstrate efforts which previously have been covered in theory only.

The Terco Power System Simulator has been designed for practical training of power engineers and technicians in realistic conditions, close to life situations in genuine environment.
A variety of training schemes programmed for:

- power management staff
- operators of power plants and substations
- maintenance personnel
- teaching of students
- research in universities

can be realised.

The Terco Power System Simulator has been developed in close co-operation with ABB of Sweden – one of the leading suppliers of power facilities world-wide – and Swedish State Power Board.

The result is, that a real power system has been copied for educational purposes.
All the Protective Relays (Static and Numerical) are supplied by ABB and are exactly the same as used in real power installations.

Our comprehensive manuals have been both written and tested together with the engineers from Swedish State Power Board, to reflect realistic conditions of operation as well as emergency situations, which may occur, and do occur, in every-day life of a power engineer or technician.

What is the main difference between TERCO Power System Simulator and an industrial power system?
Apart from scaled down size, and much lower cost, the main difference consists of three major points:

- The TERCO Power Simulator is prepared to stand human errors, performed by the students during the training.
- The TERCO Power Simulator includes facilities to produce simulated typical faults, in order to drill the students in resolute and correct reactions.
- The TERCO Power Simulator enables the students to survey both functions and malfunctions in a complete power system, from generation to utilisation.

The TERCO Simulator is successfully used for training and education in universities and power companies in 15 different countries throughout the world. The rich experience and know-how earned by us and our costumers is now at your disposal.

The Equipment

A Terco Standard Simulator is based on four modules:

- **PST 2210 Power Plant Module**
- **PST 2220 Transmission Line & Distribution Module**
- **PST 2230 Receiving Substation Module**
- **PST 2240 Load Module**

The modules can be bought and operated individually and completed later with remaining modules.
The standard solution is equipped with high technology state of the art protective relays from ABB.

The Terco Standard Power System Simulator comprises 5 metallic frame works.
Each frame holds 2 rows of 19 inch racks each. The size and design of the frames is made to meet modern ergonomical requirements, and it corresponds to modern industrial design.

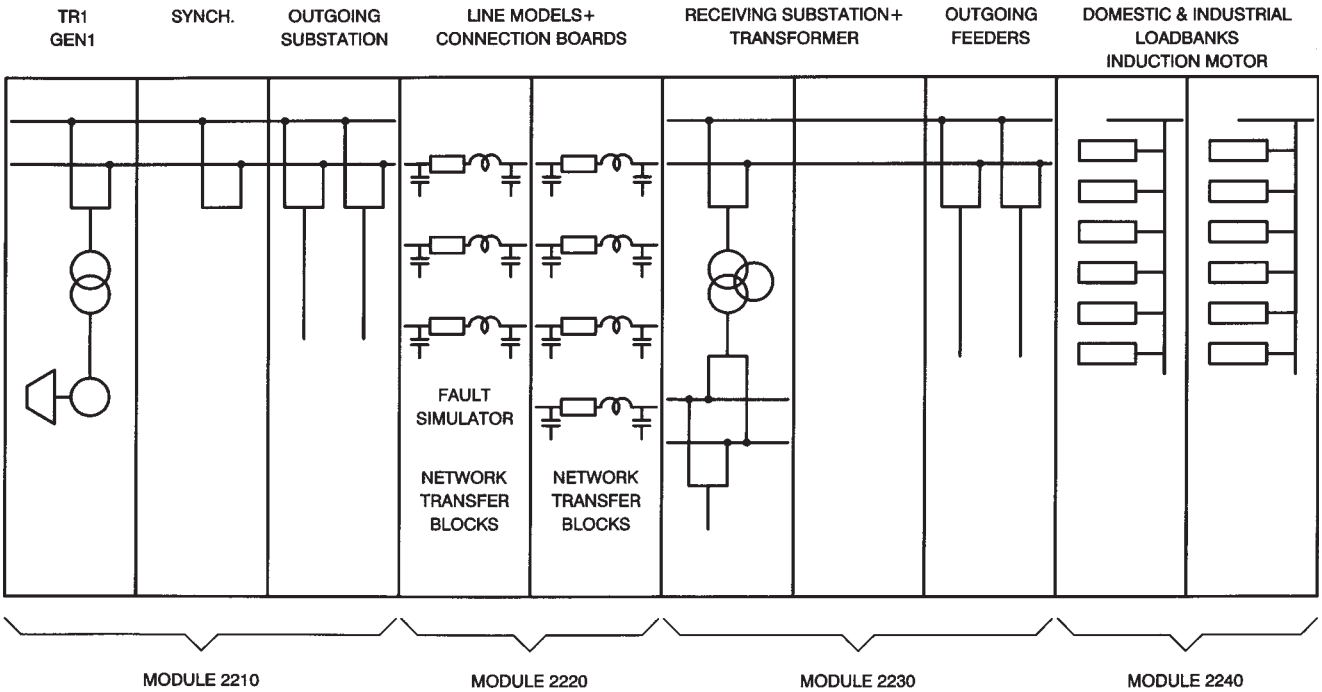
From the rear side of the frames there is full access to the wiring and components for easy service.

GENERAL INFORMATION

The picture above shows a 7 frame option with two complete and fully equipped turbine-generator sections, additional transmission lines, an extended receiving substation and a standard load module.

TERCO POWER SYSTEM SIMULATOR

Standard configuration.



General lay-out of the standard Power System Simulator

STANDARD CONFIGURATION

Module no. 1 PST 2210
POWER PLANT MODULE WITH HIGH VOLTAGE BUSBARS AND OUTGOING LINES.

Switchboard for the Power Plant Simulator including turbine + synchronous generator, rectifiers, instruments, synchronising- and phasing devices, step-up transformer, current- and voltage transformers, protective relays, indications. A-B-busbars, two outgoing lines (including protective relays, instruments and corresponding switchboard). Two or more turbine-generator sections can be delivered as option.

Module no. 2 PST 2220
TRANSMISSION LINES & DISTRIBUTION MODULE

Seven different artificial 3-phase transmission lines with possibilities to change and combine impedance elements by jumper positioning to constitute other OH HV-levels as well as cable models for distribution.
All models have coils, capacitors and resistors designed to withstand overload and surges for dynamic as well as static experiments.

Module no. 3 PST 2230
RECEIVING SUBSTATION MODULE WITH HIGH VOLTAGE SIDE

Receiving substation with one incoming line and two outgoing lines including a complete switchboard with instruments and corresponding protective relays. One step-down transformer including protective relays together with the corresponding transformer. Two or more incoming lines, and three or more outgoing lines can be delivered as option.

Module no. 4 PST 2240
LOAD MODULE

Load unit with single-phase and three-phase combinations of resistive, inductive and capacitive loads to simulate industrial as well as domestic loads of symmetrical as well as non-symmetrical types. An induction motor with a flywheel is also included.

GENERAL

Necessary switches, instruments, and over-load protections are included.
On each module current- and voltage transformers as well as protective relay blocks are connected mainly by jumpers. Protective relays etc. may be tested also together with external equipment.

On the transmission lines module, the impedance elements can be connected in different ways to design other main characteristics of other transmission links suitable to try different settings of the protections. This possibility of changing the structure of the impedance map is very useful when programming the distance protection.

PROTECTION

Full generator and transformer protection is provided for the simulated power plant and system protection for the artificial lines, when ordering the standard simulator.

All protective relays are easily accessible from the control desk where settings can be done easily as well as indications and tripping connections. All protections can be tried individually without interfering with the in-operation simulator because of the test blocks into which test handles can be put. (CT´s are automatically short circuited).
All modules / function blocks in the protective relays can easily be disassembled from the front.
All protective relays are of electronic type (Static and Numerical).

Any protective relay can be exchanged, combined or completed with other relays or relay functions because of the COMBIFLEX connection system. A micro-processor-operated 1 + 3 zone distance protection relay can be installed as option on one of the outgoing HV-lines of the HV-substation.

The distance protection can be programmed for different HV-levels and characteristics and operates for three-phase short circuits, fault R-S, S-T, T-R, R-earth, S-earth, T-earth and with underimpedance start. There are separate time settings for zone 2, 3 and 4. Each or all zones can be programmed for sensing in forward or reverse direction.

EXPERIMENTS

Experiments may be performed on the complete set-up of modules, on any of the four main modules individually or on protective relays individually by using an external relay tester e.g. MV 1427 (optional).

The protective relays may also be tested in combination with individually chosen line models and loads to provide experiment groups not to interfere with other experiments on protective relays on the remaining main modules.

Most protective relays are operated from individual set-ups of voltage- and current transformers included with terminals accessible from the control pulpit.

PST 2210, The Power Plant Simulator above is an extended version with two turbine-generator sections, fully equipped with all protective relays and step-up transformers. The standard version has one fully equipped turbine-generator section.

Module no. 1 PST 2210 POWER PLANT MODULE

The power generation is represented by a three-phase 1.2 kVA synchronous generator driven by a separately excitated 2.0 kW DC motor as turbine.

As option, the turbine / generator can be manually set for different kW / Hz characteristics and for different start- and stop ramps.

The operation mode of the turbine / generator can be chosen between manual- or automatic control regarding power (frequency) and reactive power (voltage).

Digital instruments:

Armature (stator) current
Armature voltage
Field current
Revolutions per minute
Reactive power
Active power
Rotor current for turbine / DC-motor

Generator:

The reactance is referred to the nominal values of the generator U and I.
The generator can be chosen either of the nominal power 1.2 kVA or 2.0 kVA as optional.
Both types are designed to be given parameters to simulate the real size generators.
The smaller type (specified above) is designed with cylindrical rotor and the bigger one, as an option, with salient poles.

The field controller is a static rectifier, which settings can be optimised by the student.
It can be used for automatic or manual control.

Transformer:

A 2 kVA transformer is used as a step-up transformer. The ratio is 1:$\sqrt{3}$. It is wound to withstand voltage surges without saturation (and thus tripping the differential protection).
External impedance elements may be added as an option to simulate different sizes / impedances of the transformer.

All windings are accessable externally to admit experiments on the transformer alone.

The step-up main transformer is supplying a double-bus system to the outgoing HV-substation.

The transformer can be given a rating of 50% or 100% by external resistive / inductive impedance elements, which are connected by a contactor relay operation from the control desk. Tappings on the secondary side of the transformer will make it possible to change the voltage +/- 5 %.

The transformer has its windings accessible externally to make it possible to perform tests like no-load test and short-circuit test.
Primary as well as secondary voltages and currents can be read on instruments.

Electronic Relay Protections:

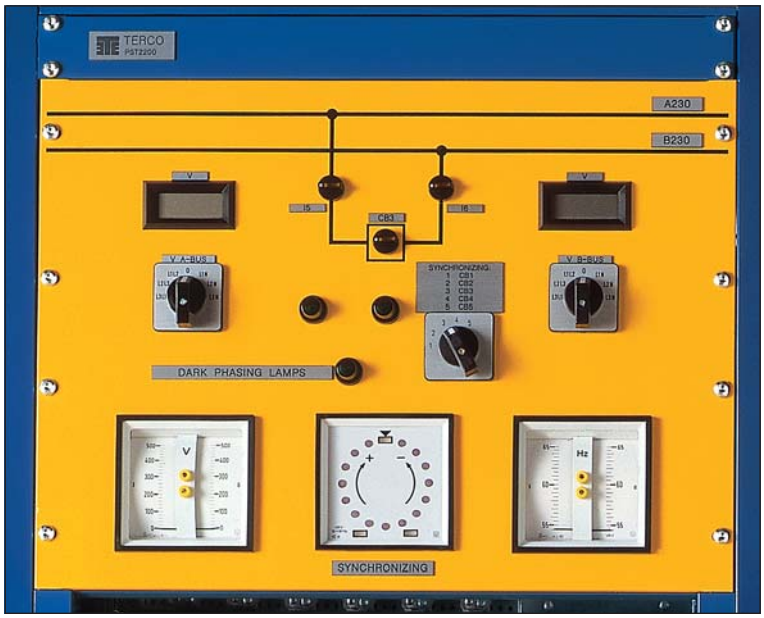
The Electronic Relay Protections for turbine / generator / step-up transformer comprises as a standard the following facilities:

- Differential protection for the generator
- All-over differential relay for generator-transformer
- Three-phase overcurrent relay for the generator
- Over voltage relay
- Rotor Earth-fault relay of injection type
- 95% Stator Earth-fault relay

Optional protection:
- Reverse power relay for the generator
- Negative-sequence protection relay
- Thermal overload relay for the generator

All protections are available for connecting by 4 mm outlets via a testhandle.

All necessary current transformers are included and the terminals are available from the desk.



Synchronising panel of the Power Plant Module.

HV Busbars
The HV busbars comprise an A-B system with inter-connections for load transfer.

All breaker functions are operated by contactor relays. The busbars are equipped with the following instruments:

- Digital volt- and ammeters for all phases
- Synchronising instruments including synchronoscope
- Voltage selector switches.

HV Outgoing Substation

The HV outgoing substation comprises two outgoing lines which can be connected to a radial network or a grid network (depending on the connections of the transmission line module).

The HV outgoing substation is equipped with the following instruments:
- Digital volt-, ampere- and power meters for both lines
- Voltage selector switches

All switches / breakers are operated by contactor relays.

Electronic Relay Protections for HV outgoing substation

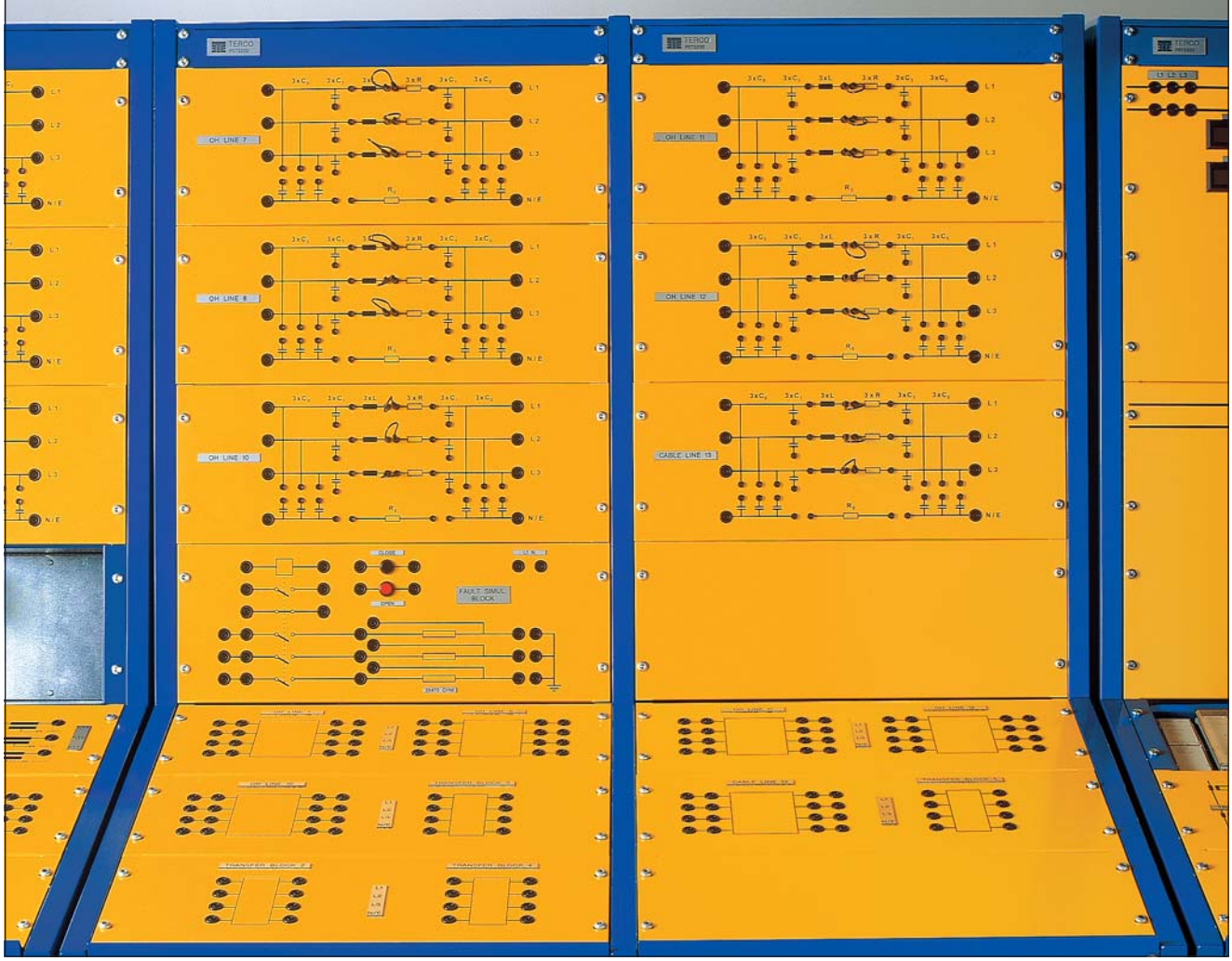
The Electronic Relay Protections for HV outgoing substation are constituted by:
- One three-phase over current relay with directional earth fault protection for Line 1
- One three-phase over current relay with directional earth fault protection for Line 2.

As options are available:
- Static 3+1 zone distance protective relay
- Static impedance protective relay.

All protections are available for connecting by 4 mm outlets via a test handle. All necessary current transformers and voltage transformers are included and the connections available from the desk.

The control elements fitted are mostly of the same industrial type as those used in control rooms of power plants and substations.
Circuit breakers are push-button operated with lamp indications for the breaker status. Isolators are manually operated and the physical position indicating open or closed position.

Turbine Generator Set: The power is generated by a 3-ph synchronous generator driven by a separately excitated DC-motor as turbine. The electrical machines set is electrically fully connected and mechanically mounted on a machine bed.



PST 2220 Transmission Line and Distribution Module.

Module no. 2 PST 2220 TRANSMISSION LINE & DISTRIBUTION MODULE

The Transmission Line and Distribution Module comprises:

Type	Voltage	Transmission ability	Length
One HV double pi-link solid earth	130 kV	115 MVA	100 km
One MV pi-link with	40 kV	20 MVA	50 km
One double pi-link with resistive or solid earth	11 kV	5 MVA	15 km
One double cable pi-link with resistive or solid earth	11 kV	5 MVA	10 km

All the different voltage levels can be adapted according to customers demands.

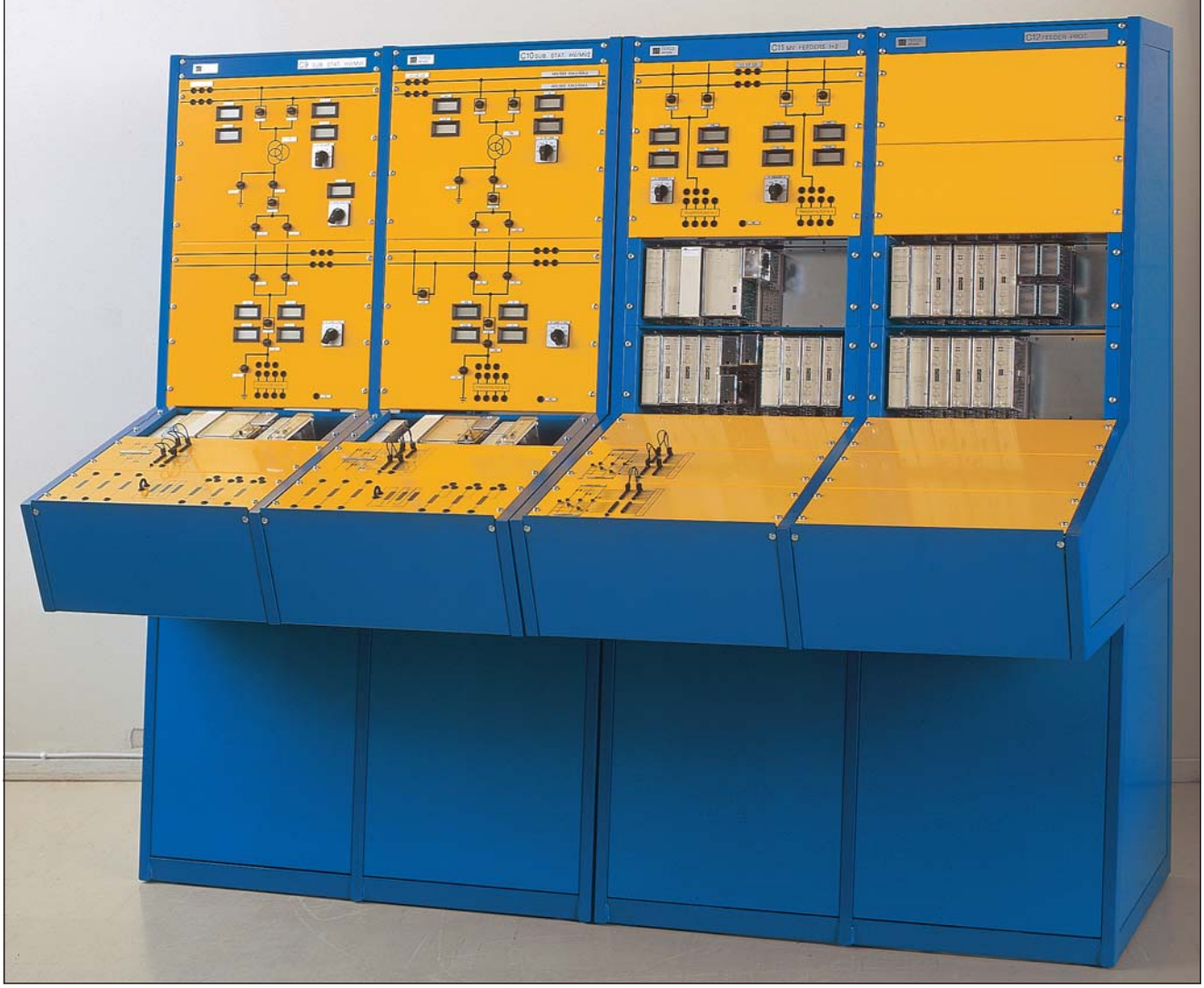
All line models (artificial transmission lines) have the same ratings in the model scale: 400 V, 2 A. This means, that it is easy to compare the characteristics and typical behaviour of a high voltage, middle voltage and distribution voltage OH-line as well as a distribution cable when for example running at 100 % transmission ability. The transmission models are built for both static and dynamic experiments with overload / overvoltage ability.

Each artificial line model consists of a three-phase pi-link and an earth link. The models are set up on the line model board of the module where the internal connections are chosen by the means of jumpers and lab.-leads. All line models are accessible not only on the line model board, but also in parallel as four + four pole blocks in the desk section to give possibilities to arrange radius, grid or mixed networks in a very simple way.

All line models also have parallel four + four pole blocks to provide easy facilities of connecting to Receiving Substation in Module 3 and the distribution networks with load banks of the low voltage switchgear in Module 4.
A fault simulator is also built-in as a separate panel in the Transmission Line and Distribution Module.
It has push button operated contactor relays which together with built in resistors can be used to simulate faults of the types:

- Three-phase short circuits
- Two-phase short circuits
- Short circuits with limited over current
- Isolation Earth fault with limited current.

On the transmission lines modules, the impedance elements can be connected in different ways to design other main characteristics of other transmission links suitable e.g. to try different settings of a distance protection.



PST 2230 Receiving Substation Module: This picture is an optional version of two incoming lines, HV-busbars, step down transformers (as incoming standard it is one of each), middle voltage busbar and two outgoing lines.

Module no. 3 PST 2230 RECEIVING SUBSTATION MODULE

The receiving substation comprises one incoming line, HV-busbars, transformer, middle voltage busbars, and two outgoing lines. Other combinations are optional.

Digital instruments:
Voltage, current and power meters for incoming power
Voltage between busbars of incoming power
Voltage selector switches for incoming line
Voltage, current and power meters for outgoing power
Voltage between busbars of outgoing power
Voltage selector switches for outgoing lines

Electronic Relay Protections:
- Busbar overcurrent protection
- Transformer differential protection
- HV / MV overcurrent protection
- Neutral point voltage earth fault protection
- Overcurrent (three-phase) and directional earth fault protection for outgoing Line 1
- Overcurrent (three-phase) and directional earth fault protection for outgoing Line 2
- Multifunction motor protection relay for outgoing Line 2 (optional)
- Auto-reclosing relay in combination with the protection for outgoing Line 1 (optional).

All protections are available by 4 mm outlets via a test handle. All current- and voltage transformers are included and most terminals are available from the desk.

The step down transformer can be operated individually and all the terminals are available from the desk. All breakers are operated by contactor relays.

Possible earthing methods are: a) solid or resistive earth b) insulated earth c) Petersen coil

PST 2240 Load Module.
The picture shows an option with two motor protections.

Module no. 4
PST 2240 LOAD MODULE

Low Voltage Distribution

The Low Voltage Distribution is constituted by a busbar to which the substation can be connected by the outgoing lines or by one or more transmission models.

From the busbar there are 6 outgoing groups to which loads can be connected. Each outgoing group is equipped with manually operated switches or selector switches.

All distribution groups are available by 4 mm safety outlets to which loads can be connected with or without external instruments.

Instruments as optional:
- Voltage and frequency on incoming busbars
- Voltage selector switch
- Ammeter on each outgoing group
- kWh-meter

Load Group

The load module consists of groups of single phase and three-phase industrial and domestic loads.

The loads are of resistive, capacitive, inductive and active (motor) types: Three 3-phase groups can be varied in small steps which together with the other loads will cover load possibilities from 0–150 % of nominal power.

By jumpers and switches it is possible to create single phase loads as well as other non-symmetrical loads.

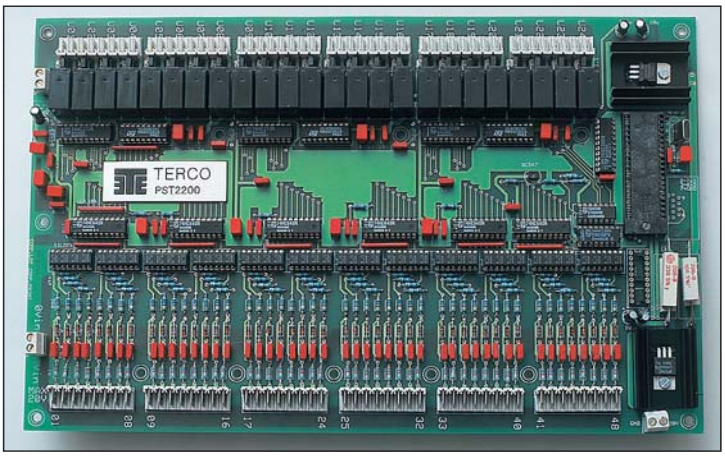
One motor with flywheel is enclosed to the load module. Several motors can be added as optionals to make it possible to study the dynamics of the system as well as the mechanical load sharings between two or more machines. The motor together with the flywheel will constitute a suitable load for the microprocessor operated motor protection (optional) on the outgoing line of the middle-voltage substation.

The Load Module comprises:
- 6 resistive 1-phase load groups connectable by switches
- 6 capacitive 1-phase load groups connectable by switches
- 6 inductive 1-phase load groups connectable by switches
- 2 three-phase controllable resistive loadbanks
- 2 three-phase controllable capacitive loadbanks
- 2 three-phase controllable inductive loadbanks
- 1 induction motor with flywheel and mechanical brake, 0,25 kW

One induction motor Dahlander with flywheel and mechanical brake, 0,25/0,12kW (optional).

Other optional machines may be mounted on a metal basement or can be delivered on an external machine bed.

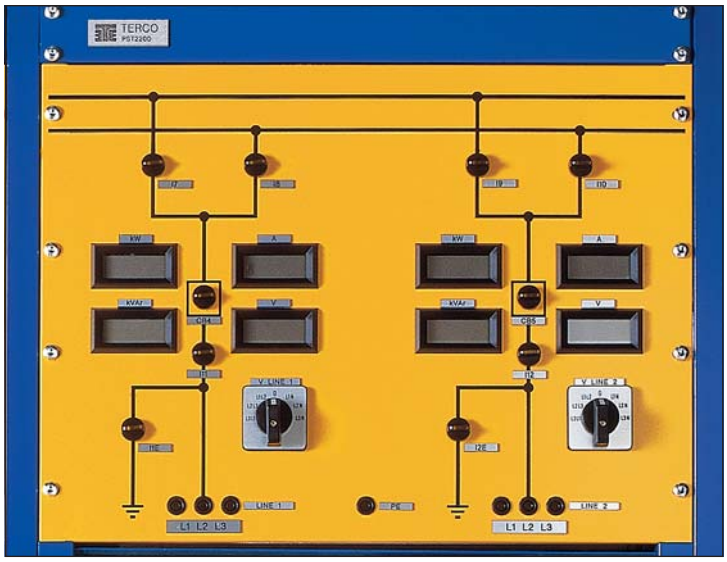
MEASURING DETAILS



Circuits: A 24 Channel Logical Blocking Unit.

Logic Blocking Unit

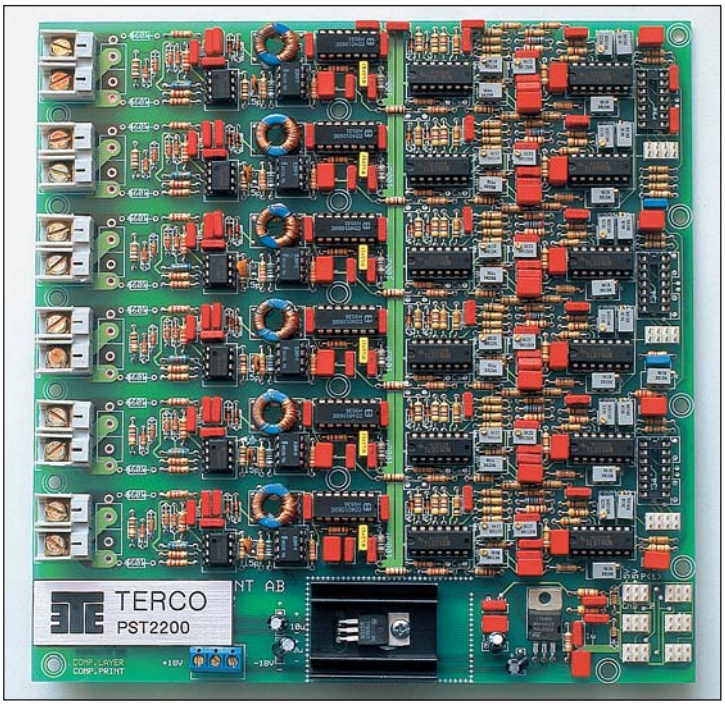
The logical blocking unit uses a micro-processor to determine whether an isolator can be operated or not. All isolators and circuit breakers in the simulator are assigned to a form where the user gives the conditions for operation or not. The corresponding contactor relays give status to the microprocessor which in less than a msec compares all conditions with the demand of the user turning the switch on the front. When upgrading the simulator with more circuit breakers and isolators, the user simply has to reprogramme the micro-processor to fit the new constellation.



Picture showing some of the instruments.

Digital Instruments

The simulator contains, depending on options, normally 60 instrument amplifiers of which 8 are spares for upgrading.
A typical group of instruments will consist of one wattmeter, one VAr – meter one ammeter and one voltmeter which by means of a selector switch can be connected for measuring line to line voltages or line to neutral voltages.



Circuits: A 6 Channel Measuring Module.

Channel Measuring Unit

Each measuring module has six signal amplifiers, all of them galvanically isolating the power side from the signal side. All channels are easily adapted for measuring AC or DC or mixed quantities. Calculation of power and reactive power is performed by multipliers and addition circuits. On the output terminals all signals are available as instant values and as buffered mean values within +/-10V. This will simplify future upgrading of the simulator for computer control.

DIFFERENT SET-UPS OF AN EXTENDED POWER SYSTEM SIMULATOR

Different set ups of the Power System Simulator. Due the modular system, the system can be arranged in different ways depending on the available space.

SCADA System for Power System Simulator

Terco SCADA system (Supervisory Control and Data Aquisition) is a computerized supervisory, control and display system to be used with Terco Power System Simulators (PSS and PST program).
It will display all main instruments either as readouts or as graphs. All breakers and isolators belonging to the simulated power system can be operated from the PC.
Operational status of the simulator is followed on a one-line diagram on the monitor, where the status of each breaker and each isolator is indicated together with all instrument readouts.

Please ask for our separate SCADA leaflet.

List of Some Typical Experiments

Under normal conditions

- Settings of field control parameters, settings of turbine control rectifier parameters, settings of start- and stop ramps (=intake gate opening and closing)
- Checking AC-supply, DC supply, alarm indications, acknowledge- and cancel procedures, status indications of isolators and breakers. Start order.
- All performance diagrams of the generator can be studied.
- Vector group of system transformer is checked.
- Differential relays can be tested by resistive faults or trim faults caused inside the protective zones.
- Load distribution can be varied using auxiliary transformers to keep the currents within certain limits. This can also be studied by use of parallel lines where the line parameters are different. (Arranged for example by jumper connectors in the transmission module).
- Generator performance under steady state and dynamic conditions can be studied for different types of loads.
- Difference between manual and automatic control of voltage = reactive power control.
- Difference between manual and automatic control of speed = active power control.
- Rapidity of field control v.s. stability. Optimizing gain and time constants of voltage and current controllers.
- Feedback systems.
- Voltage differences, frequency differences, phase difference, timing, instruments, blockings (synchronising).
- The dynamic characteristics of the controller can be examined.
- All protective relays can be tried individually with or without load with a relay testing unit of injection type (optional) where tripping levels are checked together with operating characteristics in the complex RX-plane as well as pick-up and tripping times by a built-in six digit timer.
- Characteristics of overcurrent and underimpedance starting elements can be obtained by means of loads and system feed provided underimpedance protection is included..
- The tripping characteristics of a modified impedance relay can be determined by experiment (optional choice).
- Impedance maps can be calculated easily to give information for an optimised selectivity plan of protection.
- By means of a ring main feed from one end various methods of protection can be studied, e.g. employing directional overcurrent relays or non-directional relays with instantaneous opening of the main grid.

Under fault conditions:

- The reactances and time constant of the synchronous generator are of decisive importance for its transient behaviour. This can easily be studied in several ways. Also symmetrical and asymmetrical faults can be studied.
- Different types of system earthing methods can be studied: isolated, high resistance, low resistance and Petersen coil.
- Connecting the infinite busbar system in different parts of the network. Influence on fault currents and short circuit currents.
- Influence on fault currents and short circuit currents and relay protections. Settings of relays. Selectivity.
- Transient behaviour of generator can be shown when it is not correctly synchronised with the system.
- Single-phase and three-phase fault interruptions can be demonstrated for different lengths of transmission lines and different values of power transmitted.
- The generator protection scheme is checked under conditions of deliberate maloperation of the generator and especially introduced faults.

- Overcurrent and under-voltage relays for motor protection operating in conjunction with the system relays can also be shown.
- Signalling, indications warnings, trippings, actions in the fault announciator system.

The list of experiments can be made much longer but these are a selection of experiments.

Regarding Protective Relays

- Connecting current and voltage transformers in different single- and three-phase configurations.
- Overcurrent protection
- Overcurrent protection with time lag overcurrent relays
- Over- and under voltage relays
- Neutral point protection
- Independent time characteristics
- Directional overcurrent protection
- Earth fault protection
- Directional earth fault protection
- Differential protections
- Design principles
- Instantaneous measuring relay
- Influences of the DC-component
- Directional relay for power
- Signal relays + Auxiliary relays
- A typical feeder protection.
- Microprocessor operated 1 + 3 zones distance protection, programmable for low / high impedance isolated / impedance earthing, under impedance tripping, phase-phase, earth fault etc (optional).
- Auto-reclosing, high speed or time delayed, 1 or several shots, memory functions, counter etc (optional).

Technical information:

Power input : 3-phase 400 / 230 V, 50 & 60 Hz

Standards
All units, included in the Terco Power System Simulator, correspond, in all significant points, to IEC recommendations.

The turbine / generator / step-up transformer:

- DC-machine 2.0 kW, simulating turbine
- 4-pole synchronous generator, 1.2 kVA, cos phi 0,8
- Static rectifier for speed control
- Static rectifier for voltage / VAr control
- Step-up transformer 230 / 400 V, 2.0 kVA

Generator data:

Voltage	3 x 230 V
Nominal current	3,5 A
Frequency	50 Hz/60Hz
Speed	1500 rpm / 1800 rpm
Synchronous reactance	97 %
Transient reactance	17 %
Subtransient reactance	8 %

Transmission Line

Type	Transmission Voltage	Aibility	Length
HV double pi-link solid earth	130 kV	115 MVA	100 km
MV pi-link	40 kV	20 MVA	50 km
Double pi-link with resistive or solid earth	11 kV	5 MVA	15 km
Double cable pi-link with resistive or solid earth	11 kV	5 MVA	10 km

Single-phased Load groups

Resistive	6x200 W
Capacitive	6x200 VAr
Inductive	6x200 VAr

3-phase Loadbanks controllable in 6 steps

Resistive	2x3-ph 0–900 W
Capacitive	2x3-ph 0–900 VAr
Inductive	2x3-ph 0–900 VAr

- 1 induction motor with flywheel and mechanical brake 0,25 kW

Optional

- 1 induction motor Dahlander with flywheel and mechanical brake 0,25/0,12 kW

STATIC PROTECTIVE RELAYS

Level 2

POWER PLANT MODULE PST 2210-2
Turbine / Generator / Step-up Transformer:

- All-over Differential Protection
- Three-phase O/C Protection

Power Plant Substation outgoing HV-lines:

- Three-phase O/C and Directional Earth Fault Protection, Line 1
- Three-phase O/C and Directional Earth Fault Protection, Line 2

RECEIVING SUBSTATION MODULE PST 2230-2

- Busbar Overcurrent Protection
- Transformer Differential Protection
- Three-phase O/C and Directional Earth Fault Protection, Line 1
- Three-phase O/C and Directional Earth Fault Protection, Line 2

Level 3 (standard)

POWER PLANT MODULE PST 2210-3
Turbine / Generator / Step-up Transformer:

- Differential Generator Protection
- All-over Differential Protection
- Three-phase O/C Protection
- Over Voltage Protection
- Rotor Earth Fault Protection
- 95 % Stator Earth Fault Protection

Power Plant Substation outgoing HV-lines:

- Three-phase O/C and Directional Earth Fault Protection, Line 1
- Three-phase O/C and Directional Earth Fault Protection, Line 2

RECEIVING SUBSTATION MODULE PST 2230-3

- Busbar Overcurrent Protection
- Transformer Differential Protection
- HV / MV Overcurrent Protection
- Neutral Point Earth Fault Protection
- Three-phase O/C and Directional Earth Fault Protection, Line 1
- Three-phase O/C and Directional Earth Fault Protection, Line 2

Customer adapted protections

At customers request more sophisticated protections can be chosen in addition to e.g. level 3.

POWER PLANT MODULE
Turbine / Generator / Step-up Transformer:

- Reverse Power Relay for the Generator
- Negative-sequence Protection Relay
- Thermal Overload Relay for the Generator
- Busbar Overcurrent Protection

Power Plant Substation outgoing HV-lines:

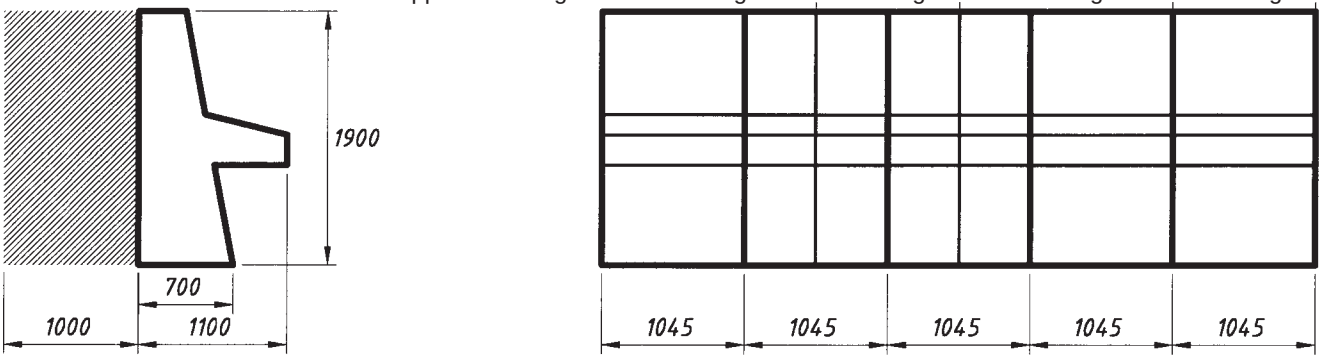
- 3 + 1 Zone Distance Protection
- Impedance Relay

RECEIVING SUBSTATION MODULE

- Auto Reclosing Relay
- Distance Protection for Incoming Line
- Busbar Overcurrent Protection
- Multifunction Motor Protection

Picture showing some of the Static Protective Relays in the Power Plant Module.

Weights and Dimensions



How to order:

Power Plant Module	Transmission Line & Distribution Module	Receiving Substation Module	Load Module
PST 2210-1 PST 2210-2 PST 2210-3	PST 2220	PST 2230-1 PST 2230-2 PST 2230-3	PST 2240

Level 1. Without static relay protections (normal protection by fusing included).

Level 2. A minimum level when the simulator has a choice of the most important types of static protective relays built-in.

Level 3. (standard) Includes a standard set-up of static protective relays typical for small size real power plants and substations.

More sophisticated protections can be chosen as optional and adapted to customers request.

Of course, it is also possible to deliver Transmission Line Modules specially designed for the customers demand. The simulator may be upgraded from level to level and also in between.

Guarantee & Terms

Turn-Key Delivery and After-Sales Back-Up

The complete Power System Simulator is supplied on turn-key basis, with supervision of installation, commissioning and on-site training to be performed by Terco engineers.

Further training in Sweden or on site can be arranged on request, subject to a separate agreement.

Individual item specified in this catalogue, can also be delivered on request.

The GUARANTEE is valid 12 months from delivery.

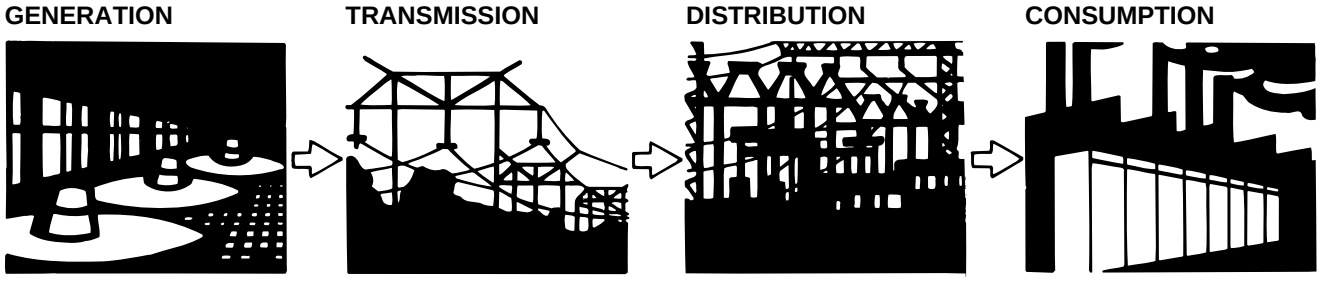
The guarantee covers repair or exchange of defective parts, due faulty design or workmanship at our factory.

Detailed conditions of guarantee are specified in our Terms of Guarantee.

All overseas deliveries are effected in special, made-to-order wooden crates, extremely sturdy and damage-resistent.

Sets of spare parts for 2–3 years of normal operations are included in the moduls, whereever necessary. The regular after-sales service is performed by the worldwide network of Terco representatives, with the advice and support of our engineers.

TERCO reserves the right to make changes in the design, modifications or improvments of the products at any time without incurring any obligations.



POWER SYSTEM SIMULATOR PSS 1200
TERCO also manufactures another power system simulator, the PSS 1200.
This simulator has the same mimic structure but all components are built-in into industrial racks which are possible to open at the front.
Please ask for our special brochure.

High Voltage Power System Model
1. Power Station Simulator incl. Turbine-Generator
2. Basic Loads and Measurements
3. Advanced Loads and Measurements
4. Substation Simulator

Industrial Power Distribution Model
5. Oil Immersed Transformer
6. Low Voltage Switchgear with industrial load models.

The modular system was chosen due to its flexibility and adaptability, both to the size of student groups and to available laboratory space.

Power Station Simulator

This is a model of a typical power station, containing a turbine-generator unit, transformer, high-voltage switch-gear and two outgoing lines. It is made up of two sep. sections:

The Turbine-Generator Model, consisting of a converter controlled DC-Machine, which simulates the turbine, and an ordinary, small size synchronous generator.

The Control Room Section, consisting of five cubicles, with mimic diagrams and laboratory terminals on front panels. This section contains advanced equipment of exactly the same type, as used in real power stations:

All protective relays are of modern, electronic (solid state) type and belong to the ABB Combiflex system.

Substation Simulator

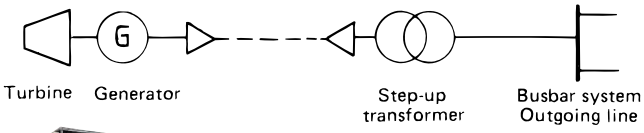
This is a model of a simple substation, designed for one in-coming high voltage line, connected to duplicate busbars, a transformer, low voltage dubplicate busbars and two outgoing feeders. The Substation Simulator contains also advanced equipment of the same type as used in real substations:

All equipment, including the transformer and the protective relays, are located in two cubicles, with mimic diagrams and laboratory terminals on front panels.

Education and training

It is our belief that a good result in training power people, etc. is only achieved by well trained teachers / instructors, good curricula with sufficient time for hands-on training and relevant equipment.

Power Station Simulator MV 1231



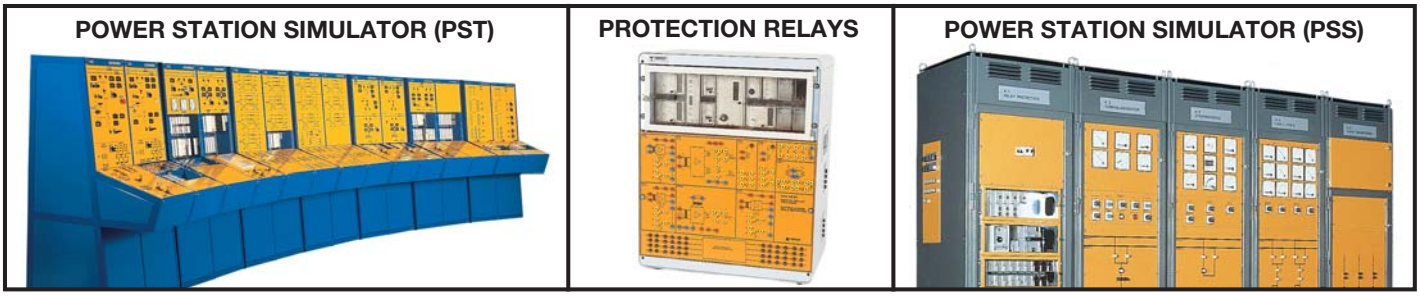
Substation Simulator MV 1220

TERCO has the possibility to offer training, in Sweden or at site, of technical people in POWER SYSTEMS, INDUSTRIAL ELECTRONICS, POWER ELECTRONICS, ELECTRICAL MACHINES, and MOTOR DRIVES.

Please contact us for further information.

Terco Headoffice

Terco headoffice and factory outside Stockholm, Sweden.



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