

# Turbo Engineering Limited



.....Turbo for better future



## Medium Voltage Metal Clad Switchgear

Flexible, economical switchgear is available with indoor or outdoor construction.

- ✓ Up to 36kV
- ✓ Insulated bus capacities up to 1250 Amps
- ✓ Indoor or outdoor construction
- ✓ Protected aisle, walk-in or self-contained power house construction
- ✓ Vacuum circuit breakers (VCB) or Load Break switches (LBS)
- ✓ Induction disc or solid-state microprocessor relays
- ✓ Fusible or non-fused disconnects
- ✓ State-of-the-art relaying and metering provisions
- ✓ Electrical or manual operation
- ✓ Solid-state multi-function meters
- ✓ CT and PT provisions for most utility companies



*Indoor Metal Clad Switchgear*



*Outdoor Walk-In Metal Clad Switchgear*



## Low Voltage Switchboards & Switchgear

- ✓ Up to 6300 Amps
- ✓ Indoor & outdoor construction
- ✓ Moulded case circuit breaker (MCCB), Air Circuit Breaker (ACB)
- ✓ CT and PT (for metering and protection) provisions for any utility company
- ✓ Fixed and drawn out designs
- ✓ Custom designs available

*600V Switchboard*



*Outdoor Metal Enclosed Switchgear*



*Indoor Metal Enclosed Switchgear*





## Unit Sub-stations



*Skid-Mounted  
Unit Substation*

**Integrated unit sub-stations** can be custom designed to fit your exact requirements. The primary can be protected with a load interrupter, network protector or circuit breaker. Some can be skid or trailer-mounted for portability.

- ✦ Indoor or outdoor
- ✦ Dry or liquid-cooled
- ✦ Up to 36kV primary
- ✦ Portable, skid or trailer mounted
- ✦ Extremely compact designs



*Indoor Unit Substation*



*Mobile Unit Substation*



## Manual / Automatic Transfer Switches

TEL introduces a full line of transfer switches featuring bolted pressurecontact technology, with sizes ranging from 400 through 4000 amp in 2, 3, and 4 pole arrangements. NEMA 3R enclosures are standard. Check with TEL for other available types..

- ✦ Fusible
- ✦ Silver plated copper current carrying parts
- ✦ Fault current ratings  
(to 50 KA when fused)
- ✦ Visible contacts (door covers blades)
- ✦ Load break design
- ✦ Quick make - Quick break
- ✦ Designed for lugs or bus bars
- ✦ Lockout for up to 3 padlocks





## Application

Turbo Engineering Limited substation transformers are designed for use in distribution applications and are designed for ease of installation and first cost savings. All ratings are designed in accordance with applicable CSA, ANSI, NEMA and IEEE standards.

## Ratings

- kVA ratings - 100 kVA to 3000 kVA or 5 MVA to 10 MVA or More
- Primary Voltage - 11 kV or 33 kV through 75 kV - 150 kV BIL
- Secondary Voltage - 415 Volt or 11000 Volt
- Frequency - 50Hz
- Temperature rise 65° C
- Consult **TEL** for ratings not shown
- Tappings - Off Load or On Load ranging from + 5% to - 7.5%

## Standard Features

- Magnetic liquid gauge
- Dial type thermometer
- Pressure vacuum gauge
- Buckholz relay for protection
- Conservator and Breather
- Primary clamp type eyebolt (5/8") connectors
- connect on - 1" pipe plug
- NEMA two hole ground pad
- Corrosion resistant nameplate
- Provisions for jacking and lifting
- Base suitable for rolling or skidding
- Welded cover with handhole
- Rugged steel plate tank reinforced with steel channel selections for strength and rigidity
- Externally replaceable high and low voltage bushings
- 1" drain plug - supplied with drain valve and sampling device 750 kVA and above.

## Standard Tests

Each unit is subjected to the following tests:

- Resistance
- Ratio
- Polarity
- Phase relation
- Core loss
- Exciting current
- Impedance
- Load loss
- Applied potential test
- Induced potential test
- Quality control impulse test
- Pressure leak test

## Optional Features

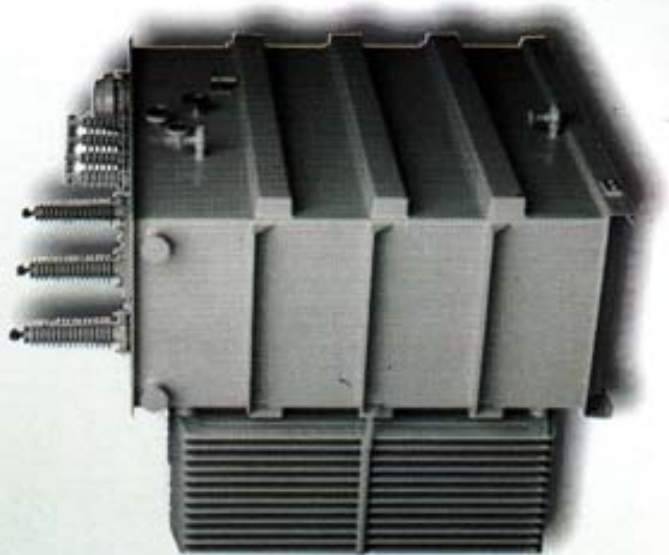
- 60 cycle
- 55/65° C temperature rise
- Primary or secondary throats
- Primary or secondary terminal chambers
- Full length primary or secondary chambers
- Pressure relief device
- Wind temperature indicator
- Sudden pressure relay
- Gauges and relief devices with alarm contacts
- Provisions for forced air cooling
- Forced air cooling minus fans
- Forced air cooling
- Delta-wye switch
- Loadbreak terminals
- Stress cones
- Lightning arresters
- Internal loadbreak switch - 600 amp and below
- Primary fusing - current limiting
- Primary fused interrupter switch
- Potheads and terminators
- Secondary moulded case breakers





Losses at	Rated Power																	
	No Load	100	150	200	250	315	400	500	630	750	800	1000	1250	1500	1600	2000	2500	3150
W	238	340	425	480	560	810	950	1140	1265	1300	1600	1660	1810	1870	2070	2400	3500	
W	1370	1860	3060	3565	4338	4950	5700	6650	7360	8500	10900	11500	16000	16700	18000	19500	22600	
Impedance voltage	%	4	4	4	4	4.5	4.5	4.5	4.5	4.75	5	5	5.5	6	6	6.5	7	
Power Factor =1	%	1.47	1.38	1.6	1.44	1.37	1.33	1.29	1.1	1.14	1.1	1.12	1.06	1.2	1.25	1.1	1.18	1.19
Power Factor =0.8	%	3.54	3.67	3.76	3.72	3.65	3.61	3.6	3.45	3.49	3.64	3.7	3.75	4.15	4.55	5.2	5.32	5.3
Regulation at	%	97.9	98.25	98.05	98.31	98.35	98.51	98.49	98.75	98.67	98.77	98.75	98.85	98.7	98.65	98.75	98.74	98.75
Efficiency (PF=1)	%	98.22	98.5	98.35	98.62	98.63	98.76	98.74	98.95	98.9	98.98	98.98	98.05	98.94	98.9	98.1	98.9	99.05
at 100% Load	%	98.49	98.72	98.54	98.8	98.81	98.85	98.91	99.1	99.05	98.15	98.2	98.15	98.9	99.3	99.35	99.62	
at 75% Load	%	97.31	97.82	97.58	97.88	97.95	98.15	98.11	98.44	98.35	98.45	98.55	98.35	98.3	98.45	98.46	98.45	
at 50% Load	%	97.77	98.18	97.94	98.24	98.33	98.48	98.45	98.71	98.65	98.74	98.82	98.7	98.63	98.76	98.75	98.74	
Efficiency (PF=0.8)	%	98.11	98.41	98.22	98.5	98.53	98.71	98.63	98.84	98.82	98.91	98.95	99.05	99.02	99.85	99.1	98.98	99
Approximate Volume of Oil	Litres	185	210	230	290	310	400	410	500	600	640	790	850	1000	1100	1200	1500	1900
Length	mm	1170	1200	1400	1570	1610	1610	1440	1500	1700	1700	1800	1850	2000	2100	2150	2200	2400
Breadth	mm	900	920	1000	1090	1150	1170	1350	1410	1440	1500	1800	1800	2200	2200	2240	2320	2600
Height	mm	1440	1450	1520	1600	1610	1640	1800	1800	2100	2150	2200	2250	2500	2500	2670	2700	2930
Approximate Weight	Kg	650	780	910	1190	1280	1520	1780	1950	2500	2650	3250	3700	4500	4800	5300	5800	6400

- Technical data may be changed as a result of design improvement
- Customised ratings are also available up on requirement of the clients.





### What is power factor?

#### Special electrical requirement of inductive loads

Most loads in modern electrical distribution systems are inductive. Examples include motors, transformers, gaseous tube lighting ballasts, and induction furnaces. Inductive loads need a magnetic field to operate. Inductive loads require two kinds of current: Working power (kW) to perform the actual work of creating heat, light, motion, machine output, and so on. Reactive power (kVAR) to sustain the magnetic field. Working power consumes watts and can be read on a wattmeter. It is measured in kilowatts (kW). Reactive power doesn't perform useful "work," but circulates between the generator and the load. It places a heavier drain on the power source, as well as on the power source's distribution system. Reactive power is measured in kilovolt-amperes-reactive (kVAR). Working power and reactive power together make up apparent power. Apparent power is measured in kilovolt-amperes (kVA).

#### Fundamentals of power factor

Power factor is the ratio of working power to apparent power. It measures how effectively electrical power is being used. A high power factor signals efficient utilization of electrical power, while a low power factor indicates poor utilization of electrical power. To determine power factor (PF), divide working power (kW) by apparent power (kVA). In a linear or sinusoidal system, the result is also referred to as the cosine  $\theta$ .

$$PF = \frac{kW}{kVA} = \cosine \theta$$

For example, if you had a boring mill that was operating at 100 kW and the apparent power consumed was 125 kVA, you would divide 100 by 125 and come up with a power factor of 0.80.

$$\frac{(kW) 100}{(kVA) 125} = (PF) 0.80$$

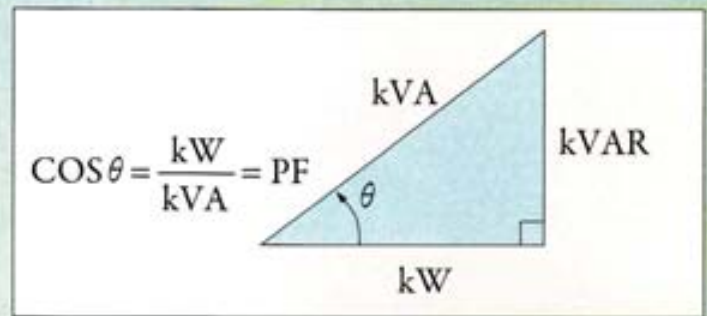


Figure 1: Power Triangle :

NA : right power triangle is often used to illustrate the relationship between kW, kVAR, and kVA.

#### PFI:

Automatic power factor improvement plant in different KVR in 5 to 14 steps ranging from 60 KVAR to 1800 KVAR. Sheet steel fabricated, floor mounting, tropicalized design, indoor type, and Low-tension switchgear for 3 phase. 4 wire, 50 Hz, 415V Ac system and shall be supplied complete with TP+N bus-bars suitably sized & properly insulated arrange to withstand & short current of 50 kA for 1 Sec. The boards are designed & constructed in accordance with BS54486/IEC439. The panel shall fully comply regulations of the 15th edition IEE wiring regulation for isolation & switching. Lockout for up to 3 padlocks High Quality of High Voltage switchgear & PFI provided by **Turbo Engineering Limited**.



Figure 2 : Power Factor Improvement (PFI) Plant





## New-Used-Reconditioned & Emergency Replacement

TEL sets the standard in the power apparatus industry with new, used, reconditioned and emergency replacement equipment. Every item that our highly skilled engineers and technicians meets or beats all relevant performance and safety standards, and is backed by a rock solid warranty. Our reconditioning procedures exceed all industry approved testing processes.

Coming to TEL for rebuilt equipment puts you ahead. Technology has advanced considerably since the equipment we recondition was first designed and built. TEL retrofits today's technology to your equipment, - bringing your facility and the safety of your employees into the 21st Century.

TEL's experts test, repair, modify and recondition a broad range of electrical products. Engineering and service is available for circuit breakers, switchgear, transformers, motors and motor controls.

Whatever it takes, from locating components to redesigning, rebuilding and testing, TEL's staff fulfills your needs faster. Other companies might require weeks for what TEL does overnight.

Call TEL, and you'll be safely back online in no time.



*Before*



*After*



## Service, Parts & Accessories

TEL can provide components, parts and accessories for circuit breakers, switchgear, and motor controls. Whether you need fuses, live parts, contactors, pilot devices, coils, relays or other replacement parts, call TEL. In the rare event that we don't have it on our shelves, we can find it through our Locator Network.

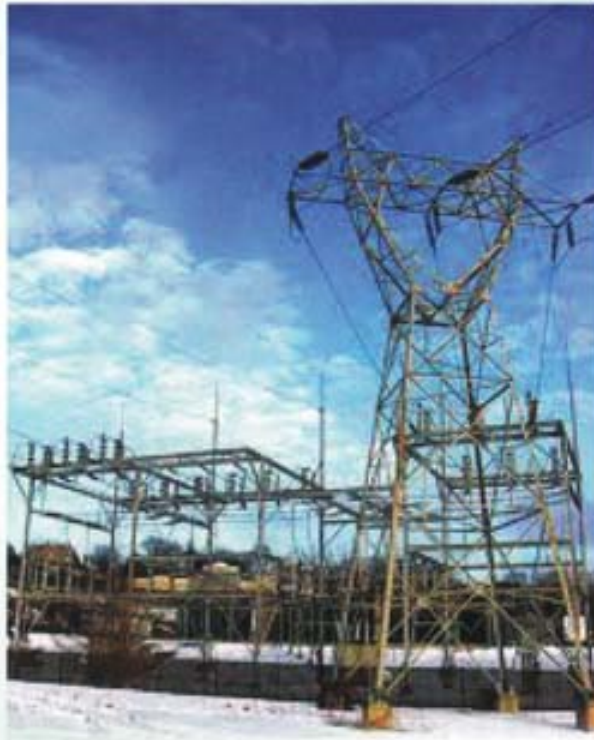
Send TEL your breakers and switches that are in need of repair or modification. TEL tests, repairs, modifies and services a broad range of products. Engineering service is also available for everything from switchgear and motor controls to circuit breakers and transformers.







*Turbo Engineering Limited*



## **Engineering Power and Control Solutions**

Engineering & System Studies

Power Systems Products

Transformer Services

Shop Services

Electrical Construction

Switchgear Solutions

Field Services

Training

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