Farapayam Engineering Co.

Air Core Reactors

Reactors

► are either series or shunt connected. Series reactors are generally used as current-limiting reactors while shunt reactors are often used to provide reactive compensation. some of the applications are explained below.

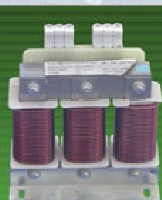
4mH/2000A/50KA Are furnace Series Reactors
Ahvaz - KSC

Type Of Reactors :

- ► Damping reactors for capacitor banks
- ► Thyristor controlled reactors
- ► Current - limiting reactors
- ► Neutral - earthing reactors
- ► Filter reactors
- ► Shunt reactors

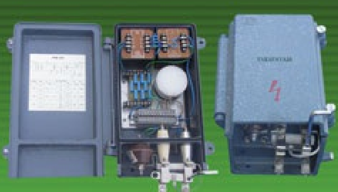
www.Farapayamco.com

Line Trap



Iron Core Reactor

Transducer



L.M.U

www.Farapayamco.com Hamdavi@Farapayamco.com Info@Farapayamco.com

Damping reactors for capacitor banks

► The transient switching and inrush currents of a shunt capacitor bank can be limited by a damping reactor connected in series with the bank. damping reactors are comparable to series reactors with low reactances.

Filter reactors

► The filter has two functions, namely to produce capacitive reactive power at basic frequency and to filter out harmonics, a harmonic filter is designed to have a small impedance between phase and earth or between the phases at required harmonic frequency. therefore the harmonic current will flow into the filter and not into the network. normally each required harmonic frequency has a separate filter circuit. for higher harmonic frequencies a wide - band filter is used. we manufacture filter reactors according to the customer's specification. our filter reactors may be equipped with off - load tappings to make an accurate tuning possible at required frequency. regulation is to meet the customer's demands.

Shunt reactors

► Shunt reactors are used to compensate for capacitive reactive power generated by long lightly loaded transmission lines. shunt reactors are switched on/off by breakers and are normally connected to the tertiary winding of the main transformer. reactors are available up to 36 KV voltage level and 100 MVA power.

Current - limiting reactors

► Current - limiting reactors are mainly used to limit short - circuit current, i.e . to prevent fault currents from rising to values dangerous for the equipment. normal types of breakers, cables and equipment can thus be used instead of those with higher short - circuit power rating . this means savings in money.

Neutral - earthing reactors

► A neutral - earthing reactor is connected between the neutral point of a three phase system and earth. its purpose is to limit the line to earth current of a directly earthed network or to reduce the line to earth current of an insulated line to a value suitable for protection.

Thyristor controlled reactors

► Thyristor controlled reactors, called TCR - reactors, are used in static var compensation systems.TCR - reactors are similar to the shunt reactors, but the current is continuously controlled by thyristor valves. the three phase reactor is delta connected. each phase reactor is split into two coils and the thyristors are connected between the coils. TCR - reactors are available up to 36 KV and up to 180 MVA power.

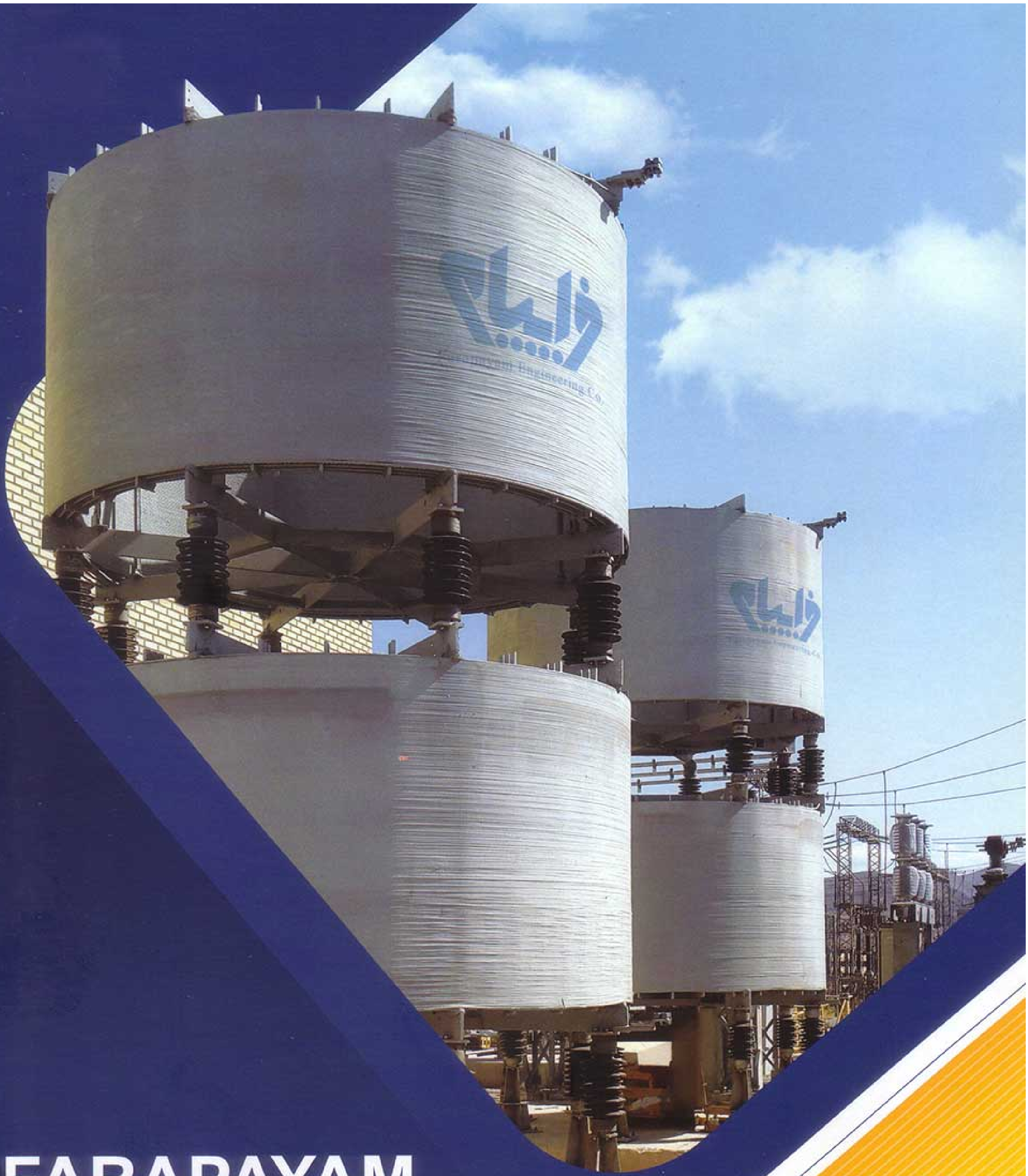
Test

► All reactors are tested according to the IEC 289/VDEO 532 or other on required following routine and type tests. in addition we have made special short - circuit current withstand test for some of our reactors at KEMA, CESI & VVA laboratories, in the Netherlands, Italy & Russia.

www.Farapayamco.com Hamdavi@Farapayamco.com Info@Farapayamco.com

info@Farapayamco.com

Office : Unit 12, Bahram bldg., No 4, 32th St., Gandhi St., Tehran - Iran
Factory : No 175, Sixth Golestan alley, Baharestan industial city, Kamalshahr, Karaj - Iran
Office Telefax : (+98 21) 88208436 - 7 Factory Telefax : (+98 261) 4760477 - 9



FARAPAYAM

www.Farapayamco.com

Factory:

No 175, Sixth Golestan Alley, Baharestan industial city, Kamalshahr, Karaj-Iran.

Factory Telefax: (+9826) 347 60 477 -9

Hamdavi@Farapayamco.com Info@Farapayamco.com

Air-Core Reactors (ACR) provide a linear response of impedance versus current which is essential for numerous applications. The dry type design is maintenance free and environmentally friendly.

For both industrial environments and networks, Farapayam offers a broad range of cost-effective solutions:

- **Current-limiting reactors**
limit the fault currents to levels compatible with existing protection/control equipment and as a result provide for a very cost-effective solution.

- **Neutral-earthing reactors**
are connected between the neutral of a power system and earth to limit the line-to-earth current to a desired value under system earth fault conditions.

- **Smoothing reactors**
reduce the harmonic currents and transient overcurrents (ripple) in DC systems.

- **Harmonic filter reactors**
are usually connected with capacitors and resistors in filter circuits to reduce harmonic content in the network which cause higher losses, high neutral currents and interference with computer and telecommunications equipment and which are responsible for high harmonic distortion levels.

- **Shunt reactors**
compensate for the capacitive currents of long transmission lines or cables, allowing more active energy to pass through the system.

- **Discharge reactors**
are used in the bypass/discharge circuit in series compensation systems to limit the capacitor discharge current.

- **Arc-furnace series reactors**
provide the necessary power factor correction and limit the unstable arc-furnace current and voltage.

- **Power flow control reactors**
control the current into two or more parallel circuits.

- **Damping reactors**
limit the inrush and outrush currents of capacitor banks.

1-Applications:

1.1- Current limiting reactors

Current limiting reactors (1)

are series connected to the transmission/distribution line or to the feeder in order to limit the short-circuit power on the load side of the reactor. The reactor limits the short-circuit current to a level which can be handled by the components installed in the electrical system, such as breakers, switches or fuses.

Other special applications of current limiting reactors are:

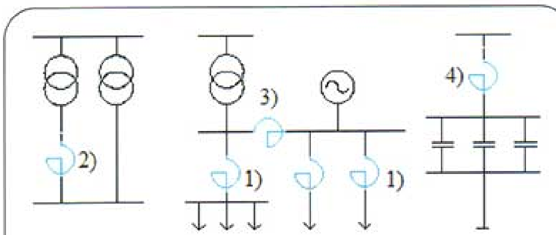
Load balancing reactors (2)

for load sharing in parallel circuits

Bus tie reactors (3)

installed between two different bus systems

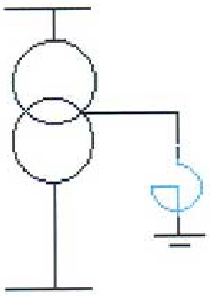
Capacitor inrush current limiting or damping reactors (4)



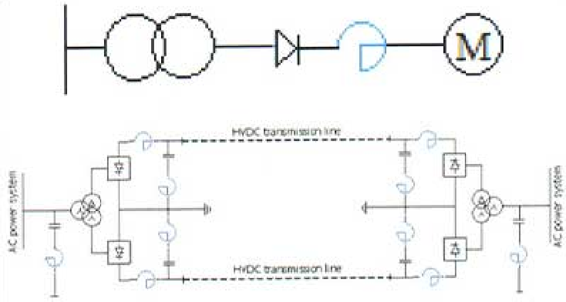
1.1- current Limiting Reactors

1.2- Neutral grounding reactors

Neutral grounding reactors are used for low-impedance grounding of the neutral point of three-phase networks in order to limit the fault current in the event of a phase-to-ground short-circuit (fault current will be limited to the level of the phase-to-phase short-circuit current). One reactor terminal is connected to the neutral of the network and the other terminal is grounded.
During normal operation of the power system the current flow through the reactor is almost zero, since it is only driven by the imbalance of the three-phase network.



1.2- Neutral Grounding Reactor



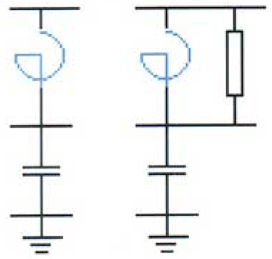
1.3- Smoothing Reactor in DC or HVDC Network

1.3- Smoothing reactors

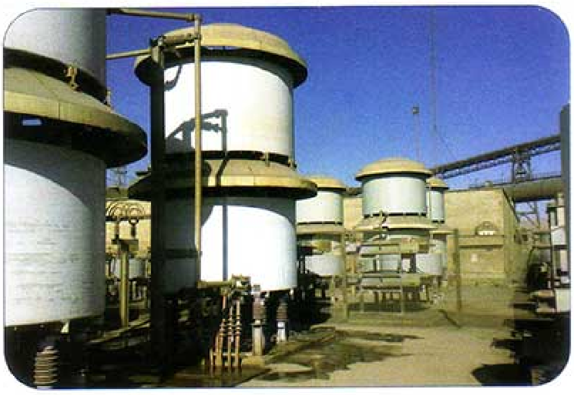
Smoothing Reactors are serially connected reactors inserted in DC systems to reduce harmonic currents and transient over currents and/or current ripples in DC systems. They are necessary in order to smooth the direct current wave shape to reduce losses and improve system performance. Smoothing Reactors are used in HVDC links and industrial applications including traction systems, variable speed drives, UPS systems, etc.

1.4- Harmonic filter reactors

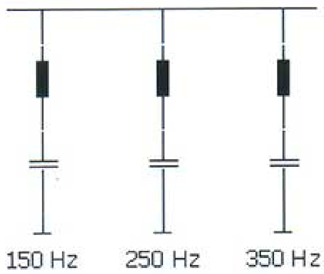
Harmonics are generated by non-linear components and loads in the power system. These elements are characterized by a voltage drop which is not proportional to the current flow. Harmonic currents may have an adverse effect on different electrical components. If electric power systems are used for telecommunication purposes as well, harmonic currents may affect the quality of the signal transmission. Therefore harmonic currents have to be eliminated by filters. If several harmonic frequencies need to be eliminated, a number of filters with different resonance frequencies will be connected to the bus system, for instance the 3rd, 5th and 7th harmonic of the fundamental frequency (50Hz or 60Hz).



1.4- Harmonic Filter Reactor



If fine tuning of the filter is required, the filter reactor may be equipped with taps for inductance adjustment.

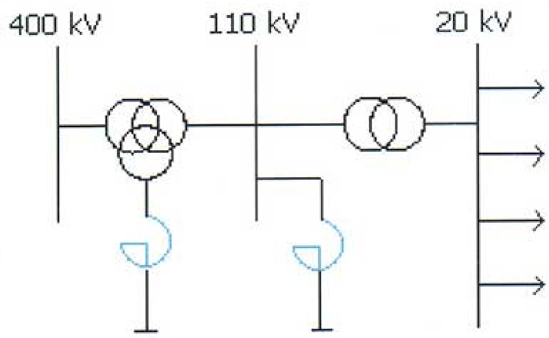


1.4- Harmonic Filter Reactor

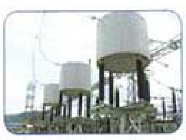
1.5- Shunt reactors

Under normal operation of a power system the current is essentially determined by the connected ohmic and inductive loads.
High voltage transmission lines and cables however have an inherent capacitance, causing a capacitive charging current. Thus capacitive VArs are generated. In lightly loaded lines or cables this capacitive current will increase the voltage at the end of the line. By the use of shunt reactors the capacitive VArs will be compensated and the voltage increase at the end of the line will be limited. The efficiency of the power system will be increased by allowing the transmission of more active energy.

For system voltages up to 115kV, air core shunt reactors can also be directly connected to the system. In high power and high voltage systems, shunt reactors should be used with RC snubber filters because in such systems switching transient voltages are extremely high and the switching devices can be damaged. Air core shunt reactors are normally connected to the tertiary winding (e.g. at 20kV) of the high voltage transformer (e.g. 400 kV/110 KV transformers).



1.5- Shunt Reactor connected to tertiary Winding of HV Transformer or direct








Air Core Shunt Reactor versus Oil immersed Shunt Reactor

Environment and Fire Hazard

- Since dry type transformers have no insulation oil, there are no fire hazard and environmental concerns
- No oil containment system needed
- No fire walls are necessary

Insulation to ground provided by support insulators

- Major insulation to ground is provided by support insulators. This is a significant feature which adds to the reliability of a dry-type aircore reactor, due to the self healing nature of porcelain in case of a dielectric breakdown
(flash-over) to ground.
- Oil-immersed iron-core reactors utilize a complex oil and paper insulation system. A dielectric failure to ground (winding to tank or core) could result in severe damage to the reactor.
- Air Core Shunt Reactors are also not using Bushings which eliminates a possible failure location.
- Simpler protection since faults to ground are very unlikely

Transport and handling

- The weight of dry-type air-core reactors is significantly lower when compared to oil-immersed iron-core reactors.
- Due to their construction, transportation of drytype aircore reactors is very secure. This is animportant consideration for long transport distances, especially for transportation by truck or train.
- Dry-type air-core reactors are much easier to handle during installation. No complicated drying procedures and oil filling on site after long distance ship transports
- Easier handling during transportation and installation can result in considerable cost savings.

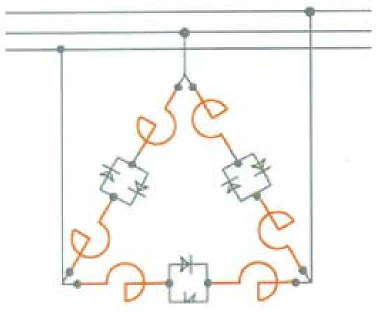
Economics

- The initial investment cost for dry-type air-core reactors is typically lower when compared to oilimmersed iron core reactors.
- Spare reactors: possible to buy only one spare 1-phase instead of a 3-phase oil filled reactor

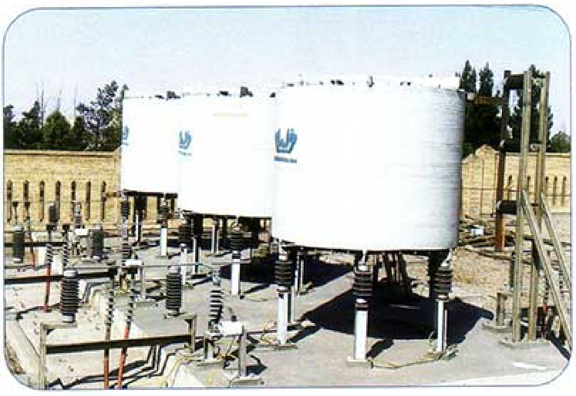
- Evaluating the total installation cost and operation expenses, dry-type air-core reactors provide a significant cost advantage since:
• no need for oil collection system
• no need for fire protective walls and fire extinguishing system
• no need for auxiliary systems, such as oil pumps and fans for cooling...
• no need for dissolved gas analysis
• no risk of bushings failure

1.5.1- Reactors for Static Var Compensation (SVC)

In order to improve power system transmission and distribution performance and stability, Static Var Compensation (SVC-) systems are installed by electric utilities.
These fast-operating compensation systems provide the reactive power needed to control dynamic voltage swings under various system conditions.
They further provide a means to control the power flow. Therefore the power industry also uses the term FACTS (Flexible AC TransmissionSystems), which covers all technologies that enhance stability, capacity and flexibility of AC power systems.
Thyristor controlled reactors called TCRs are major components of an SVC system.
The reactive power consumption of these reactors can be continuously controlled by thyristor valves. They are commonly used in combination with switched shunt capacitors to provide variable reactive power as required.

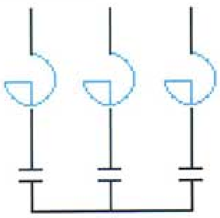


1.5.1- Thyristor controlled Reactors



1.6- Damping Reactor

This reactor is series connected with one or more capacitor banks to limit the inrush currents that occur during their switching operation. It is designed to offer a specified impedance and to withstand the rated current and the fault current in the event of a short-circuit associated with a high frequency discharge current of the capacitor bank.

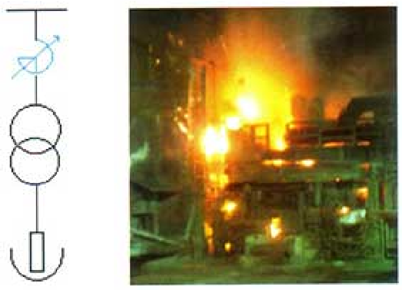


1.6- Damping Reactors

1.7- Arc-furnace series reactors

Series reactors are installed in the feeder system of an electric arc furnace (EAF) on the primary side of the furnace transformer in order to improve the efficiency of the furnace, especially during the melting process. By increasing the source impedance of the EAF power supply, the electric arc will be stabilised, the consumption of the graphite electrodes and the tap-to-tap time (melting cycle) will be reduced.

The series reactors are commonly equipped with taps, typically in the range of 40 to 100% of the maximum inductance (usually in steps of 15% or 20%), to optimize the power factor for a certain melting process/cycle.

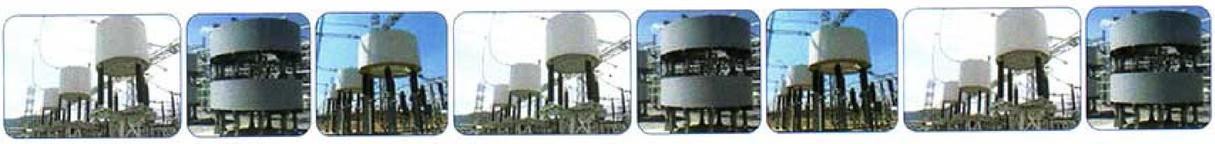


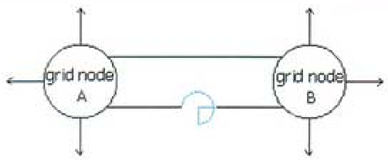
1.7- Arc Furnace Reactor

1.8- Discharge Reactor

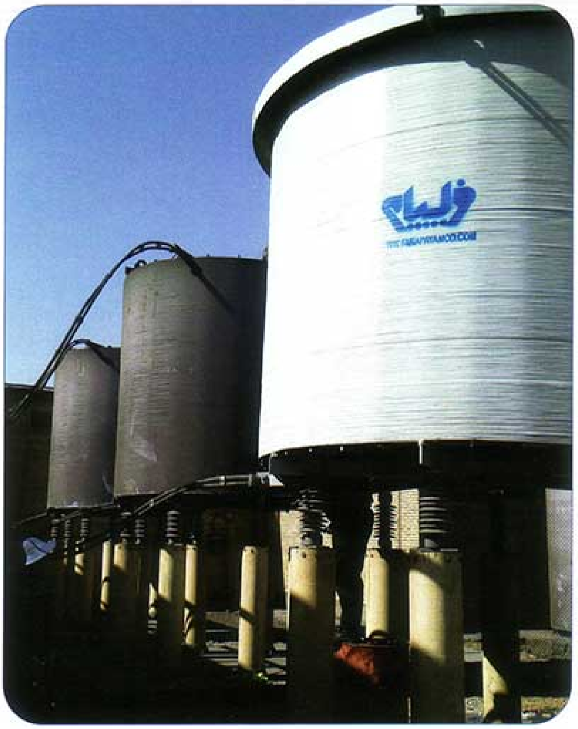
This application includes reactors for series compensation systems which use capacitor banks series connected to the transmission lines. They:

- improve voltage regulation
- improve system transient stability
- increase transmission line capacity
- reduce electrical losses and save costs.





1.8- Power Flow Reactor



1.9- Power Flow Reactor

To optimise and to control the impedance of the transmission path, Power flow reactors are connected in series to the high voltage transmission line.

2- Accessories

- **Bird barrier (on request)**
- **Corona Rings**
- **Pedestals**
- **Insulators**
- **Enclosures (on request)**
- **Tapping**

3- General Technical Specifications

Technical Specification	
Voltage	upon request
Power	upon request
Type	Air core, dry type
Frequency	50 Hz / 60 Hz
Installation	Enclosure available on demand, side-by-side, delta or vertical arrangement
Winding	Aluminium or copper winding
Painting	RAL 7035 or other colors on demand
Temperature	-40°C to 55°C
Insulation class	F class or custom
Cooling	AN (air-natural) cooling method
Standards	IEEE, IEC and others
Options	- Taps - Enclosure

4- Inquiry Data

- Rated inductance (mH) or impedance (ff) • Rated current (A) • Harmonic currents (A)
- System voltage (kV) • BIL (kVp) • Rated frequency (Hz)
- Thermal short-time current (kArms)/duration (s)
- Mechanical short-time current (kAp) • Mounting arrangement
- Rated power (MVAr): for shunt reactors
- Additional information: seismic conditions, wind load, pollution level, salt spray, space limitations, operating altitude, compliance standard, ambient temperature, humidity, ice load, duty cycle, tap requirements, noise requirements, etc.

FARAPAYAM

Farapayam Engineering Co.

www.Farapayamco.com