BACK TO THE FUTURE
VISIBLE ISOLATION: YES, PLEASE

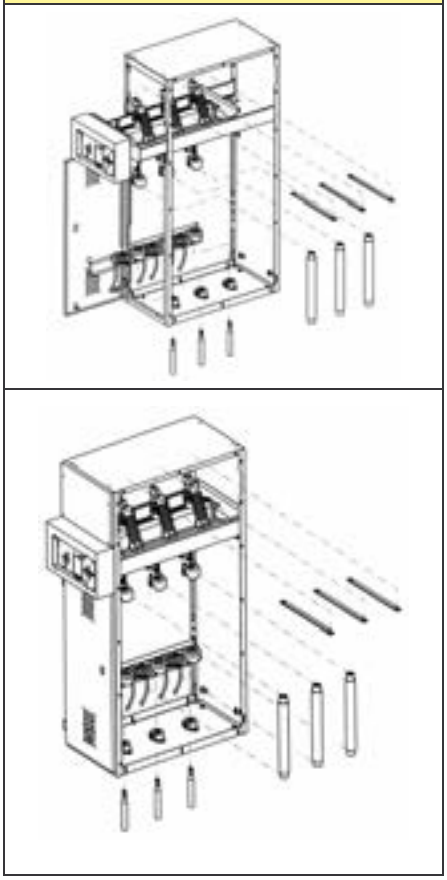
TRANSFORMERS ISOLATION AND PROTECTION

One of the most important elements in the substations is the isolator. Omnipolar isolators installed at the power supply delivery point separate the receiving installation from the feeding one, thus protecting the transformer that considering the capital invested to realize the substation represents one of the main ratios. The isolators are absolutely indispensable when several transformers are installed in the substations, because independently of the number of transformers installed in the same substation, each transformer must be isolated and protected against overloads. Overload switches or a system of safety fuses in conjunction with the isolator can be used to protect the transformers against the overcurrent.

VISIBLE ISOLATION: THE TRIUMPH OF THE SAFETY IN THE PAST

The isolator does not only function as a protection for the equipment, it also allows the operator, who has the job to localize troubles and perform repair and maintenance operations near energized parts to work in safe conditions. For this reason, the isolators shall be arranged so that the operator can immediately realize the circuit electrical conditions before making any intervention. It is worth remembering that the isolators are devices through which a machine or a circuit is put in contact or separated from the po wer supply circuit. For this reason they must be clearly visible, immediately recognizable in order to determine unequivocally their position: closed or open (ON or OFF). According to the former Safety Standard, which took into consideration the decree of the President of the Republic dated 27 April 1955 n° 547 the isolation had to be clearly visible. The new Standard in the field of Medium Voltage refers to the Low Voltage Standard and introduces the concept of visible isolation already present in some European countries. In this second case, the isolator is no more visible, however a position indicator connected to the equipment moving contacts indicates the open and closed position. This is due to the fact that in the case of a visible isolation there are some problems deriving from the evolution of gases after a certain number of load operations which in consequence of an interruption of current dirty the inspection windows and make visibility precarious. This leads to a subjective and not objective evaluation of the disconnection. On the contrary, in case of a visible isolation there is no risk of making a wrong evaluation. But is this true? It is possible that the use of so complex equipment may lead to the occurrence of troubles, isn't it? And in the case of a possible internal breakdown of the parts, also only partial of a phase or in case of lack or accidental deterioration of the gas, when considering the restricted space of separation between the poles, the Indicator could show a mechanical isolation that in reality brings elements under voltage, couldn't it? And do users feel safe when working on such equipment relying on a position Indicator rather than on what they can see? The firm Contactplasma, for many years leader in the field of electromechanical low and medium voltage installations and in the field of planning and technical

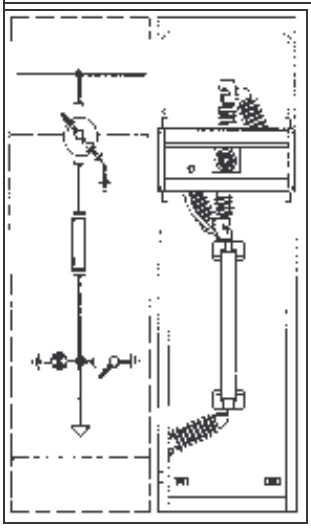
AIR 24kV fig. 5,6



advice, holder of many patents, in consideration of the users' safety, one of the Primary Aims of its studies about innovation, does not believe that the visible isolation is a suitable solution. For this reason on occasion of INTEL 99 it will present a new absolutely innovative isolator: the TGA 24kV (fig. 1, 2, 3, 4) or AIR 24 (fig. 5, 6, 7, 8, 9).

AIR 24kV fig. 7,8

Unlike the products present on the market, it has been conceived so as to ensure a visible safety. The isolator TGA 24 24 kV is completely different from the ones we have experienced till now because a single device makes disconnection possible in gas and isolation in air. As a matter of fact, this device is composed of a circuit-breaker and an isolator, connected each other as far as their operation is concerned and it is characterized by the fact that the circuit-breaker is arranged in gas and the isolator in air (see fig. 1, 2, 3, 4). Furthermore the circuit-breaker can be opened in gas before the isolator is opened too, and it can be closed in gas, in position "isolated", before the isolator is closed in air. The isolation can be therefore inspected at any time by the operator, who can be sure of a real opening of the equipment, of the deactivation of the circuit and of earthing, under any circumstances.



TGA 24 kV or AIR 24 (European patent in 16 countries)

The TGA 24 kV (fig. 1, 2, 3, 4) or AIR 24 (fig. 5, 6, 7, 8, 9) is a combination of the positive features of gas and air equipment. Several years ago, to get round the problems of space and to allow positioning the substations in hardly accessible places, the technological innovation in the field of Medium Voltage switchgears induced the most important manufacturing firms to build more compact equipment. This equipment is composed of hermetic case filled with insulating gas (SF6). The sulphur hexafluoride allows decreasing the distance between the energized elements and therefore the dimensions of the equipment. However this kind of gas has some drawbacks. The quantity of gas to be used is huge and it can become dangerous for the operators in case of accidental explosion.

The deterioration of the gas, due to the electric arc, can make it im-possible to inspect the isolation through the inspection window, or it can indicate a mechanical isolation, which does not coincide with a real electric isolation, given the narrow space separating the energized parts.

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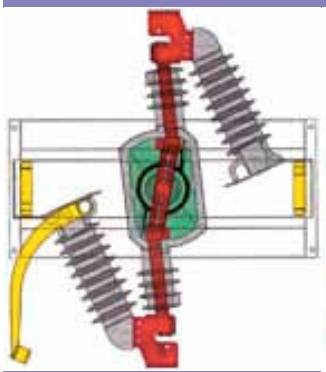	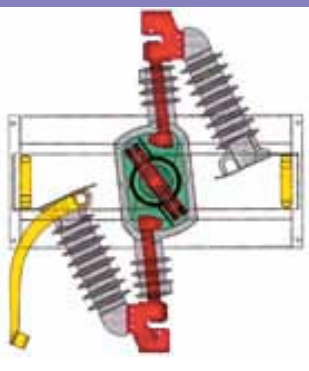	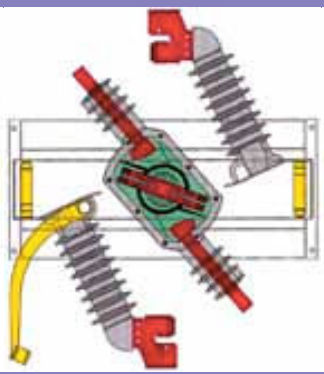	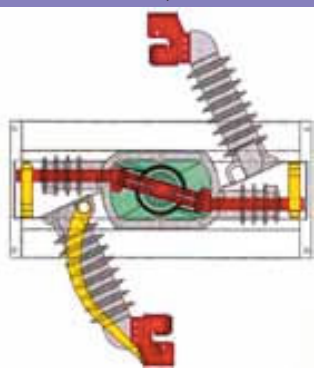
TGA 24kV fig.1	TGA 24kV fig.2	TGA 24kV fig.3	TGA 24kV fig.4

The Position Indicator itself cannot be considered suitable for this case too, as well as for the case of a possible internal breaking of the parts, also only partial of a phase. The same drawbacks can occur

also in case of accidental leakage of gas, if the operator is not able to keep the pressure switch under control. Such leakage is possible in consideration of the dimensions the armour-plated compartments shall have to contain the isolator and the right quantity of gas and of the structural difficulties connected with their tight closure. *The TGA 24kV or AIR 24 solves all these problems and preserve the compactness of compact SF6 circuit-breakers. The isolator's disconnection occurs in SF6 and this makes it possible to reduce the compartment size, however the isolation takes place in air once disconnection has been carried out.* This allows using very small quantities of gas because the case housing the circuit breaker is very small. The isolation takes place in air and it is possible for the operator to easily check for it. The operator's safety is ensured. The drawbacks due to the deterioration of the gas, to the internal parts breaking or to the incorrect indication of the position devices (mechanical isolation not corresponding to electric isolation) can be overcome and solved. The operators can work in safe conditions as they can check whether the isolation has taken place or not, due to the fact that it is visible. The quantity of necessary gas is very small and furthermore a relief valve is provided to the gas along a pipe on the backside of the switchgear in case of breakdown and in allows to any of the modules from the system without stopping the whole assembly. case of accidental explosion. On the shaft side, among the load-carrying elements shaped for the contacts, there is a winged element. When in loop distribution networks, the shaft rotates, this winged element routes and mixes the gas present inside the case; it makes the arc extinguishing easier and ensures a uniform distribution of gas. Contactplasma isolators are power isolators and can be operated under load. For this reason they are able to protect the installation down-stream the equipment against unbalanced loads caused by the network. The possibility to operate an isolator under load is very important when in a plant many transformer are assembled depending upon a single circuit-breaker because the power isolator allows to remove any of the modules from the system without stopping the whole assembly. The TGA 24kV can be equipped with three types of operating mechanisms. **T1** is the classic quick trip operating mechanism, dead centre position overcoming. Closing and opening speeds are independent of the

CHARACTERISTICS OF THE PRODUCTS PRESENT ON THE MARKET AT THE MOMENT

a) busbar compartment and users compartment segregation by metal partitions ;
b) isolation in air ;
c) disconnection in air ;
d) isolation in air visible on all parts ;
e) compartment size 700 x1150 x 2250 ;
f) making in air.

a) busbar compartment and users compartment insulating segregation ;
g) isolation in SF6 ;
h) disconnection in SF6 (big volume and quantity for isolation) at pressure 0,5 BAR=150 Kpa;
i) visible isolation through inspection windows thanks to the clearness of SF6;
j) compartment size 500 x 900 x 1700 ;
k) making in SF6.

CONTACTPLASMA PRODUCT: AIR 24kV fig.9

l) busbar compartment and users compartment segregation by metal partitions ;
m) isolation in air ;
n) disconnection in SF6 (reduced quantity only for discon-nection) at pressure 0 BAR = 100 Kpa ;
o) isolation in air visible on all parts ;
p) compartment size 460 x 900 x 1700 ;
q) making in air .

operator and are determined by a single spring. The equipment provided with this type of operating mechanism are widely used in loop distribution networks.
The operating mechanism type **T2** is composed of two springs, a closing and an opening one, which are charged by the operator during the closing operation. A mechanical tripping device causes the equipment opening, which can be carried out manually by means of an operating rod or electrically by means of an opening coil and/or automatically by means of M.V. fuse striker. The equipment provided with this type of equipment can be remote controlled and is usually used to protect transformers with up to 1250 kVA power.
The operating mechanism type **TN** is not equipped with springs and therefore the closing and opening speed depends upon the operator. This operating mechanism is only used when an off-load isolator is provided for.
All operating mechanisms can be motorized on request.

INSULATING OR METALLIC BARRIER

For safety reasons, it is advisable that a switchgear is planned so that no dangerous leakage current can pass from the inlet to the outlet clamps of the isolator. This safety precaution is satisfied when a possible leakage current is put to earth through a safe earthing connection or when the insulation is really protected against pollution during operation.
While planning the equipment TGA 24kV all these things have been taken into consideration and the separation between inlet and outlet has been realized by means of a metallic structure and a rotating body whose bushing bars, in isolated position, are put to earth.
This solution puts the operators responsible for operation and maintenance in the condition to work in **top safety** (also visible), because even if by some unfortunate chance the insulation has a breakdown, due to wear, incorrect operation and/or other, the voltage coming from the terminal fixed on a resin isolator will be discharged on the supporting frame connected to earth. All this is possible only with compact equipment like the TGA, which provides for the disconnection in a SF6 case, but for the isolation in air. Not all insulators can do the same.

FUSES

The medium voltage fuse is usually used in conjunction with switchgear to protect the transformers. This way a remarkable benefit is achieved from an economic point of view because there is no need to use circuit breakers (at least up to 2000 kA power).
Through the fusion of one or more components, expressly studied and calibrated for this purpose, the fuse opens the circuit where it is inserted and disconnects the current when it is over the value given for a sufficient time.
The fuse can be complete with a striker that comes out strongly when the fuse blows and releases the equipment opening device with which it is combined. This way when a single fuse blows, the circuit three-phase disconnection is accomplished.

EARTHING SWITCH

As the TGA is a two-position (open-closed) switchgear, it is usually supplied with a built-in earthing switch interlocked with the equipment itself.
The earthing switch is a «off-load isolator», however it is provided with making capacity on short-circuits. The insulation level is the same as for the TGA.