

## EXECUTIVE SUMMARY

0.1 Surge arrester is an important equipment from the point of view of protection of HV apparatus from the over voltages caused due to lightning and switching phenomenon.

a) *Lightning phenomenon* : When the electric gradient in a thunder cloud is above 100 V/cm. a discharge is initiated from the cloud to the ground [2]. The discharge current ranges from 25 KA to 80 KA. A value as high as 270 KA has been recorded [1]. The current at the substation is about 10-20 KA because of the impedance involved in the circuit. Surge arresters bypass these high currents and protect the apparatus from lightning surges.

b) *Switching phenomenon* : Over voltages due to switching operations such as energisation of a line and load rejection can also cause damage to power system apparatus. For systems with voltages above 300 KV switching surges are prominent [4]. Surge arrester protects the apparatus from these high switching over voltages.

0.2 Indian manufacturers are supplying surge arresters for use in systems upto a voltage of 400 KV. At present there are four manufacturers in India namely ELPRO, WSI, JAYSHREE & OBLUM manufacturing both nonlinear resistor type with gaps and gapless metal oxide type arresters. However manufacturers have indicated that non linear resistor type arresters have been phased out of manufacture.

0.3 The four Indian manufacturers have collaboration arrangements for manufacturing surge arresters as given below:

WSI	-	Westing House (USA)
OBLUM	-	ABB (Sweden)
ELPRO	-	GE (USA)
JAYSHREE	-	ABB (Sweden)

- 0.4 While WSI have indicated that they can supply surge arresters for application for system voltages upto 800 KV, the other three manufacturers i.e. ELPRO, OBLUM & JAYSHREE have indicated that they can supply upto 400 KV.
- 0.5 International manufacturers are marketing gapless metal oxide arresters for use in system voltage upto 800 KV.
- 0.6 There were originally three types of surge arresters. They are :
- a) Expulsion type arresters.
  - b) Nonlinear resistor type with gaps.
  - c) Gapless metal oxide arresters.

Out of the above, expulsion type is not being used presently. Non-linear resistor type with gaps was used till middle of 70's and is being phased out but conventional gap types with silicon carbide blocks are still being used. Gapless type finds the maximum use.

All arresters are provided with pressure relief device in order to control the explosion of an arrester due to its failure. Leakage current monitor is also provided. This is used to predict the deterioration of arrester with passage of time.

- 0.8 Heat sink is provided for gapless metal oxide arresters in order to cool the metal oxide blocks and to protect the arrester from going into a 'Thermal runaway' condition.
- 0.9 Gapless metal oxide arresters have superior characteristics in respect of :
- a) Improved protective level.
  - b) Thermal properties.
  - c) Pressure relief.
- 0.10 All the four Indian manufacturers are manufacturing gapless metal oxide arresters with characteristics similar to arresters that are being manufactured

abroad. As such there are no technology gaps for surge arrester for ratings upto 20 KA for 100 KV to 400 KV system application.

- 0.11 While three of the manufacturers are importing additive oxides of high purity and make blocks therefrom, the remaining one imports the block as such.
- 0.12 The insulator housings, components for providing sealing and pressure relief arrangement in lightning arresters are indigenously available. Each manufacturer has his own technology for the same.
- 0.13 Gapless metal oxide arresters for use as part of Gas Insulated Substations are not being manufactured in the country. This needs to be examined as it may find a wider application in India, in the near future.
- 0.14 Surge arresters for HVDC applications are to be developed in India as HVDC transmission may find wider application in India. WSI have indicated that they can supply arresters for HVDC application and that they had submitted offer for HVDC projects that are presently under execution in India.
- 0.15 Bureau of Indian Standards may expedite issue of standard for gapless metal oxide surge arresters.
- 0.16 Reliability of surge arresters with respect to withstanding temporary over voltages and switching surges could be given high importance, since statistical data available with Central Electricity Authority reveal that 30% of major failures in surge arresters are due to these. It is also necessary to undertake system studies particularly with respect to energy dissipation requirement and capability to withstand temporary over voltage for applying correct type of arrester to the system.
- 0.17 Testing facility for discharge current of 20 KA and pressure relief capability of surge arresters could be installed in a national research institution so that all manufacturers and R&D organisations can utilise the facility.

0.18 R&D efforts in India by manufacturers and national institutions are on a limited scale at present. Since material technology associated with metal oxides used for surge arresters is confined to only few manufacturers and is not readily divulged or discussed widely, it is recommended that a national institution may be entrusted the R&D work associated with improvement/development of metal oxide material technology. This will help in a better understanding and application of the metal oxide material technology on a wider scale. The following items are recommended for study expeditiously.

- a) Development of metal oxide arresters for 800 KV system with 20 KA discharge current.
- b) Study and development of metal oxides which can handle higher discharge energies and offer better protective levels and thermal stability.
- c) Development of surge arresters for HVDC applications.
- d) Development of surge arresters with SF<sub>6</sub> gas as insulation.
- e) Development of modular type surge arresters for GIS applications.
- f) Study of pollution performance of surge arresters.