Pulse Capacitor Development Facility at CnID, BARC, Trombay

Technology of High Voltage Pulse Capacitor

Greater indigenization in advanced technology domains in spirit of 'Atmanirbhar Bharat'

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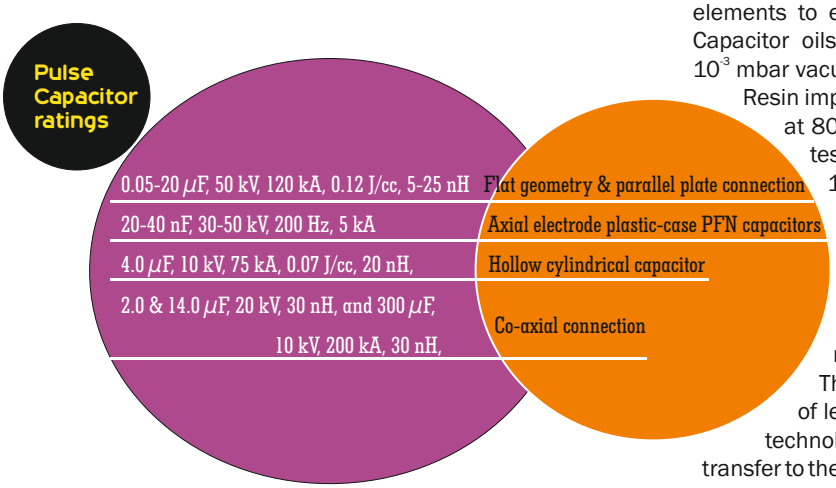
The technology of high-voltage (HV) low-inductance capacitors has numerous applications in domains such as fast x-ray and neutron sources, lasers, high power microwave generators, electron beam accelerators, plasma generation and electromagnetic welding in materials, industry, medical appliances, scientific R&D, nuclear energy, space and defense sectors. By virtue of fast discharge and low footprint, high current film-foil capacitors are amongst the most-sought-after technologies in the day-to-day working of scientific R&D centres and also industries.

However, their availability in the domestic market remains a key concern. This issue could be addressed through incorporating advanced electrical designs and fabrication processes in the existing capacitor industry to achieve desired characteristics, including low inductance, high energy density, high current capability and enhanced lifetimes.

Foils made using pure aluminium and bi-axially oriented 'hazy' polypropylene films (for absorption of impregnating oil) are wound in alternate layer configuration. This is in tune with the design specifications worked out in BARC for new extended foil & internal series configurations. The capacitor elemental windings of film-foil were carried out on a custom-made seven-segment internal series automatic capacitor winding machine and a semi automatic machine in Class 10000 environment. Film-foil rolls were placed in the respective feeders as per the design configuration. Round and flat elemental windings were developed using split mandrel technique.

The newly developed process for "On-line" impregnation capacitor winding is preferred for oil-free (dry) capacitors. A low viscosity electrical grade thermally curable epoxy resin was utilized as an impregnant during elemental winding. Interconnections of elements were prepared using high power soldering set-up for high peak currents and crimping of conducting foils for up to 10 kA applications. Thicker copper strips (up to 400 μm) were used for electrical connections during soldering between two series/parallel capacitor

Pulse capacitors of various ratings and configuration developed at CnID.



elements to ensure low resistance and mechanical rigidness. Capacitor oils functioned as an impregnating medium under 10^{-3} mbar vacuum in an oil impregnation-cum-heating pilot plant. Resin impregnated capacitor elements were thermally cured at 80°C for three hours. The fabricated capacitors were tested electrically as per "Bureau of Indian Standard 13666". More importantly, this technology - developed in-house - had been utilized and supported through test results of various bespoke designs and fabricated capacitors as per the requirements of APPD, APD & CnID users in BARC. Pulse capacitors were fabricated and utilized with a maximum rating of 100s of kA and life of 10^7 shots. These capacitors also have extremely low inductance of less than 50 nH and resistance of up to 30 mΩ. The technology of low inductance pulse capacitor is ready for transfer to the Indian industry.

Authors deeply acknowledge the support provided by the CnID, RCnD, TSD, APPD, APD in BARC. Special thanks to R. K. Sadhu, Ex-head, ATSS, E&I Group and Archana Sharma, Director BTDG, BARC, for their fruitful discussion and guidance during the project activity.

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