LIFE OF POWER CAPACITORS

The life of a capacitor is influenced by the following three parameters:

- Temperature
- Voltage
- Current

Temperature

For a capacitor, the temperature depends upon the following parameters:

- Ambient temperature at which capacitor is being operated
- Amount of over current that flows through the capacitor
- Power loss of the capacitor (dielectric power loss and resistive power loss)

The increase in temperature results in faster degradation of the dielectric. For every 10°C rise in temperature, the life of the capacitor is halved. Faster the degradation of the dielectric, lower will be the life of the capacitor.

Increase in temperature beyond a certain limit may result in expansion of impregnation and dielectric material. This may result in bulging of capacitors. In worst case, capacitor may even burst, if it does not have an over-pressure disconnector.

The capacitor must thus be operated at rated ambient temperature for a long operating life.

Capacitors are classified in temperature categories, each category being specified by a number followed by a letter. The number represents the lowest ambient air temperature at which the capacitor may operate. The letters represent upper limits of temperature variation ranges.

Letter symbols for upper limit of temperature range as per IEC 60831 are as follows :

Symbol	Ambient Temperature		
	Maximum	Highest mean over any period of	
		24 h	1 year
A	40	30	20
B	45	35	25
C	50	40	30
D	55	45	35

Voltage

The increase in system voltage has the following effects on the capacitor:

- **Dielectric degradation**
  If the voltage increases beyond a certain limit, the dielectric material will breakdown. This critical voltage is called the dielectric breakdown voltage. Breakdown can result in an internal short circuit causing the capacitor to fail permanently.
- **Increase in current flow through the capacitor**
  As capacitors are linear in nature, with increase in voltage, the capacitor current also increases because X_C remains constant ($I_C = V/X_C$). This results in overloading of the capacitor, which may reduce the life of the capacitor. Over voltage limits of the capacitors are +10% for 8 hrs in 24 hrs, +15% for 30 min in 24h, +20% for 5 min in 24 hrs and +30% for 1 min in 24 hrs.

Current

The parameters that are related to current, which affect the life of the capacitor are:

- **Inrush current**
  Whenever the capacitor is switched on, it draws a huge inrush current which goes up to levels even greater than 100 times the capacitor rated current. Frequent switching of the capacitor without proper inrush current limiting devices will affect the life of the capacitor as it is heavily stressed during each switching operation. Switching frequency and amplitude of inrush current thus influences the life of the capacitor.
- **Over-load current**
  Continuous overload of capacitor is mainly because of harmonics and continuous over voltage. Overloading results in local hot spots and may lead to an internal short circuit.

To conclude, all the above parameters should be within the rated value in order to exploit the maximum life of the capacitor.