Short Circuit Currents – Crest, rms Symmetrical and rms Asymmetrical

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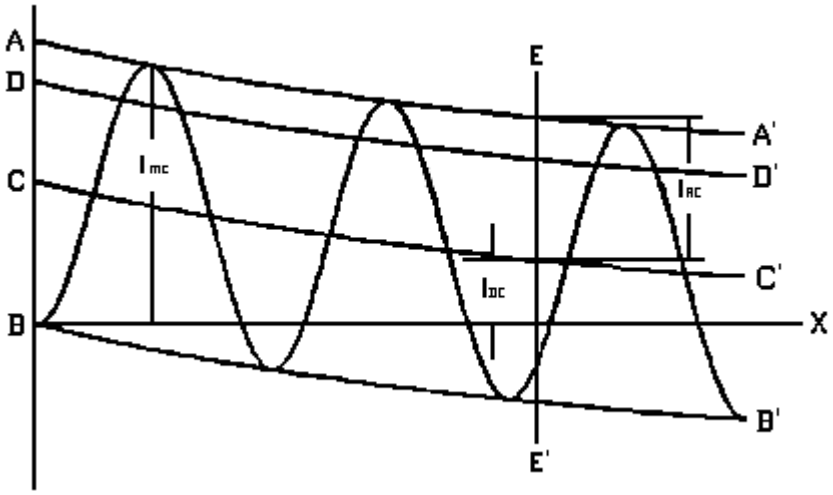
The figure below shows a typical short circuit current wave form and defines the various component parts of this wave. At the moment of initiation of a short circuit the ac current wave, which is normally symmetrical about the zero axis BX is offset by some value, creating a waveform which is symmetrical about another axis, CC'. The degree of asymmetry is a function of several variables, including the parameters of the power system up to the point of the short circuit and the point on the ac wave at which the short circuit was initiated. In a 3-phase circuit, there is usually one phase which is offset significantly more than the other two phases.



It is convenient to analyze this asymmetrical waveform as consisting of a symmetrical ac wave superimposed on a dc current. CC' represents the dc current, and the value of that current at any instant is represented by the ordinate of CC'. The dc component of the current normally decays rapidly, and reaches an insignificant value within 0.1 s in most power systems. The rate of decay is a function of the system parameters. When the initial value of the dc current is equal to the initial peak value of the ac current, the resulting waveform is said to be fully offset, or to have a 100% dc component. It is possible, in some power systems, to have an offset in excess of 100%, which may result in a waveform that has no current zeros for one or more cycles of the ac power frequency.

The ac component of the short circuit current will also decay, at a rate dependant on the system parameters. In general, the closer the fault is to generators or other large rotating machinery, the faster the decay will be.

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In the figure, I_{MC} is the crest, or peak, value of the short circuit current. It is the maximum instantaneous current in the major loop of the first cycle of short circuit current.

The rms symmetrical value of the short circuit current at any instant, such as EE', is the rms value of the ac portion of the current wave. Its value is equal to $I_{AC}/\sqrt{2}$, and it is shown graphically by the distance from CC' to DD'. The rms asymmetrical value of the short circuit current is the rms value of the combined ac and dc waves, and it is calculated by the formula:

$$I = \sqrt{\frac{(I_{AC})^2}{2} + (I_{DC})^2}$$

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