These terms were coined over the years to identify the appropriate short circuit current magnitude that engineers could use to rate the switchgears, switchboards, panelboards, circuit breakers, fuses, etc.But before I explain each term, let's get some basics out of the way.From circuit theory, at the point of short-circuit, the fault current is described by the following equation.$i(t) = \sqrt2 \frac{V}{Z}\sin(\omega t - \frac{\pi}{2}) + \sqrt2 \frac{V}{Z} e^\frac{t}{\frac{X}{2\pi fR}}$ AmpsIf you look closely, the fault magnitude is a combination of AC component (the Sine function) and DC component (the exponent e function). Both functions are plotted separately in Figure 1 below. Their combination yields the i(t) curve, also shown in the same figure.Figure 1: Fault current magnitude following a faultNow, let's look at each term and their context with respect to the fault curve.This term refers to fault current magnitude at ½ cycle point. At this point the curve is highly asymmetric around the x-axis.Figure 2: Asymmetrical RMS currentDuring the first half of a cycle, the fault current is at its largest magnitude – occurring at a moment when the voltage wave (not shown) is passing the reference axis.The asymmetry is brought on by the DC offset (as shown in Figure 1). With this offset, the RMS value of the asymmetrical current is about ~1.6 times the symmetrical current.A quick word on Root Mean Square (RMS) quantity: the RMS quantity of an AC signal (voltage or current) is a phantom quantity. It is created to compare the AC magnitude to that of the DC i.e. making sure you are comparing apples to apples. So, for example, a 5Amp RMS AC current is the same as a 5Amp DC current. However, the peak value of the AC quantity will be $\sqrt2 \times 5$ Amps = ~7 Amps.Now that we know RMS magnitude is NOT the same as peak, in 1987 the IEEE committee established the term (peak asymmetrical) to make it clear that the peak asymmetrical current generates the most destructive force and not the RMS quantity. How destructive? Well, peak asymmetrical current is about ~2.7 times the symmetrical current.To summarize, you haveSymmetrical fault current (i.e. no DC offset)Asymmetrical (RMS) fault current = 1.6 $\times$ symmetrical current magnitudePeak asymmetrical fault current = 2.7 $\times$ symmetrical current magnitudeThis is a half cycle rating and quite similar in meaning to RMS asymmetrical amps except it does not have the same unwieldy name.It highlights the ability of equipment like switchgear, switchboard, circuit breaker, etc to withstand RMS asymmetrical amps.This term highlights the capability of a circuit breaker to close into a fault at the 1/2 cycle point and stay in that position without destroying its poles.This term pertains to fault magnitude between the 2nd cycle and the 5th cycle. The curve is still asymmetric around the x-axis. But because the DC current decays a bit in this duration, the fault current magnitude at this point is less severe than at ½ cycle point.So, what is the significance of the interrupting rating? In medium voltage and high voltage systems, circuit breakers and fuses are capable of operating in 2 cycles to 5 cycles. Therefore, this term applies to these protective devices and their interrupting capability.Here's a picture of the circuit breaker nameplate with the interrupting rating listed. This breaker can interrupt a fault current of 63,000amps (or lower) at 3-cycle mark.Figure 3: Fault current interrupting capability and the time it takes for a circuit breakerFor switchgear, interrupting rating may also be specified as short circuit MVA. Why you may ask? The operating voltage of the power system fluctuates based on load. Also the fault current a device can interrupt is inversely proportional to the operating voltage. So regardless of what the operating voltage is, the product of (pre-fault) voltage and interrupting current rating is constant. It is logical to specify a SC MVA rating and not fret the voltage and current magnitudes.Short circuit MVA is given by$MVA_{sc}=\sqrt3 \times V_{L-L} \times I_L$where,$V_{L-L}$ = Line to line voltage in kVI_L = Interrupting current in kAThis term refers to fault current magnitude at the 8th cycle and beyond. In 8 or more cycles (typically 15), the fault current will decay to a symmetrical waveform which, ofcourse, would have no DC offset.Figure 4: Symmetrical RMS current. In this figure the waveform is symmetrical starting with the 5th cycle.Slow operating devices (like molded case breakers) typically used in low voltage systems (1000V and below) use symmetrical RMS rating. The spec sheets implicitly list their ratings in symmetrical amps.Low voltage panels too are rated by their symmetrical current rating.The $\frac{X}{R}$ ratio plays a significant role in how fast the DC current decays. In highly inductive circuits where $\frac{X}{R} > 15$, the DC current takes a while to decay. In other words, the equipment exposure to the asymmetry is prolonged.Fault current rating is only one piece of information that defines a protective device. In this article you've learnt the various terms associated with the fault current magnitude. I did an inspection at a house yesterday that failed to the service disconnect having an insufficient AIC rating. I used the infinite buss primary method at the transformer (located very close to the house) and came up with 18,000 available at the transformer. Using the point-to-point method, I then calculated 13,500 available at the service, which consisted of a main circuit breaker rated 10,000 AIC. I spoke with a gentlmen from UL this morning about an unrelated topic, and this topic somehow got brought up. He then told me that the asymetrical fault current is about 1.414 times the symetrical fault current, so if my calculations were based on the asymetrical fault current, my breaker might be alright, because the breaker will be rated higher than 10K symetrical, and will be rated 10K symetrical. I hate to say it, but I don't really understand the difference here When doing a fault current calculation, are we calculating the symetrical or the asymetrical current? What is the difference? How long does the asymetrical fault last in comparison to the symetrical? Are we talking half a cycle? 5 cycles???? Thanks Re: asymetrical vs. symetrical fault current Ryan, When you calculate the values as you did, you have symmetrical fault current. The low voltage breaker that you evaluated had it rating in symmetrical fault current. Mention to the installer that had his installation fail, that the utility source on the primary of the transformer is never going to be infinite, so he should get a calculated value from the utility for that location, then have an actual calculation done using that available on the primary. The installation will then probably pass. Asymmetrical fault current is inclusive of the dynamics of a power system, including resistance and reactance. The value is not a direct calculation using a multiplier. The way we consider asymmetrical fault current in our symmetrical calculation, is by considering the X/R value. If it is high (greater than 6.6), then we use a multiplier to "derate" the equipment. See the article below, especially pages 3 through the end. [May 27, 2005, 09:19 AM: Message edited by: ron] Re: asymetrical vs. symetrical fault current Ron, thank you so much. I didn't expect a reply this soon. I'll take a look at the link and ask questions should I have them. BTW: Has anyone else ever turned down a house for AIC ratings? Re: asymetrical vs. symetrical fault current Ron, the electric utility will probably not do a fault current study on the primary side without a charge because of the amount of work involved. Using the actual impedance of the transformer is generally not a good idea either since the transformer may fail and be replaced with a lower impedance transformer. We use the lowest impedance transformer that we have in stock to develop our tables on GB7-060 to allow for that possibility. These values are in amperes, RMS symmetrical, at the secondary bushings of our transformer, assuming an infinite bus and a bolted fault. If you wish to be pragmatic about it, you can say that the transformer will probably never be replaced, the primary is not infinite and a new substation will not be built close to the home, and you will probably never have a bolted fault. In my opinion, front lot transformers that are sitting on the nose of an electrical service may deliver very close to the amount of fault current that we have listed. Those panelboards should be rated for the available fault current. Re: asymetrical vs. symetrical fault current Originally posted by ryan_618: BTW: Has anyone else ever turned down a house for AIC ratings? Our local POCO sets a "will not exceed" for single family at 10k. So it's kind of a non-issue for us since everything I've seen is 10k nowadays. Well, except for the custom house we had with a 1200amp 208/120 3 phase service. I think it was 1200, maybe it was 800. Re: asymetrical vs. symetrical fault current Larry, that is interesting since a 50 kVA transformer is normally 2% Z and is sometimes as low as 1?% Z. Assuming 2% Z, that would give you 10.4 kA and with the 10% ? that may be in the impedance, that will be as much as 11.4 kA available at the transformer. A 50 kVA @ 1?% Z and an additional 10% for error will give you 15.3 kA at the bushings of the transformer. If one of the lowest Z transformers is on the nose of a service and is a 50 kVA, how can the electric utility guarantee less than 10 kA? It is also interesting to note that a 10 kAIC circuit breaker will not handle a full 10 kA since it is tested with 5 or 10 feet of the appropriate size of conductor (#14 for a 15 A and #12 for a 20 A, etc.) The question I have at this point is how does your electric utility replace a 50 kVA with a 75 kVA if the 50 kVA becomes overloaded? Re: asymetrical vs. symetrical fault current Taking a 50 kva 240 volt at 2% impedance, Primary voltage 7200 volts and primary fault of 4000 amps, which I think is too high, the fault at the secondary of the transformer is about 9585 amps L-L and 14300 L-N. Adding a 75 ft 1/0 AL service drops the fault to 5833 amps L-L and 4900 L-N. [May 28, 2005, 11:16 PM: Message edited by: bob] Re: asymetrical vs. symetrical fault current Sorry Bob, we have a lot of substations fairly close to new subdivisions where the available fault current is much higher than that. In fact, we have to use a sectionalizing device in order to keep the taps from opening up from a small fault like a tree limb brushing the line. In order to keep the voltage drop down, we use 795 kcmil Al. for the first mile from the substation. In order to keep up the strength of our taps, we use 2/0 Al. In other words, we don't drop our fault current very fast and we start our with about 20 kA at the substation. Re: asymetrical vs. symetrical fault current Ryan This is an interesting topic. 1. I do not know enough about calculating the PROPER AIC for the service. 2. More and more of these new houses/mansions are being supplied with 1200 amp or more services and the transformer is not located very far from the service, sometimes only 25 feet. I inspected an apartment building the other day with the transformer only 10 feet from the building's service. We inspected a new horse farm, with the primary transformer installed only feet away from one of the barns....Hmm I have asked the utility for the available fault current, and have yet to get it. Maybe now I will push the point. Re: asymetrical vs. symetrical fault current Charlie "As far as that goes, how does the electrician install a GFCI receptacle close to the service in the garage when most of them are rated to only handle 5 kA available? " You have left us hanging ... what are you trying to say, come on, let us have it. Re: asymetrical vs. symetrical fault current It is my understanding that the receptacle type GFCIs will only handle 5 kA of available fault current (the Bussman SPD says 2 kA on page 49). It doesn't take much #12 or #14 to drop a lot of available fault current but it has to be calculated. If fact, the #14 wire will not withstand much fault current if a lot is truly available. The Bussman SPD online book has more information on what conductors will handle. I believe Canada has information about how much fault current small wires can handle in their electrical code. Mike Holt also has some information on this site. Re: asymetrical vs. symetrical fault current Originally posted by sandsnow: Originally posted by ryan_618: BTW: Has anyone else ever turned down a house for AIC ratings? Our local POCO sets a "will not exceed" for single family at 10k. So it's kind of a non-issue for us since everything I've seen is 10k nowadays. Thats what ours says too. They base it on the fact that many, many houses have a minimum set-back of 25' from the property line...but that is not true for ALL houses. Also, what about temporary pedastals? They're right next to the transformer! Re: asymetrical vs. symetrical fault current Originally posted by pierre: Ryan This is an interesting topic. 1. I do not know enough about calculating the PROPER AIC for the service. Pierre, if what you are saying is that you don't know how to use the infinite buss primary method of calculation, lets fix that right now: Transformer kva/line-to-line voltage/imedance=current available. For example, the transformer I had at this house was 75KVA, 240 single phase, 1.7% impedance. 75000/240/.017=18,382 amps available at the transformer. We then consider the length, size, cable type, etc for teh service lateral to determine the available current at the service. This can be done using a calculator, such as the free one found at www.bussmann.com Re: asymetrical vs. symetrical fault current Charlie I recalculated using 20000 amps at the fault and the results were about the same. The combination of the primary impedance, transformer impedance and service drops the fault down to about the same figures I posted. We had a 37.5 mva 115/12.46 kv that had a bus fault of 7200 amps. 20000 seems high. Ryan If you are going to enforce this critera then you should include the primary fault(if the PCO will give it) and the service conductor impedance. To use of the infinite bus give you a figure that too high to base approval of an inspection. [May 29, 2005, 02:34 PM: Message edited by: bob] Re: asymetrical vs. symetrical fault current Sandsnow mentioned that the utility limits the fault current to 10k for all residental, I belive that this is only for services up to 320A, that use self contained meters. After that, you could be as high as 42k, which puts you into some pretty hefty switchgear. Check out this PDF, on pages 60-61 for So Cal Edison's requirements. mike SCE Electrical Service Requirements [May 29, 2005, 04:13 PM: Message edited by: mhulbert] Re: asymetrical vs. symetrical fault current Originally posted by bob: Ryan If you are going to enforce this critera then you should include the primary fault(if the PCO will give it) and the service conductor impedance. To use of the infinite bus give you a figure that too high to base approval of an inspection. Bob, I understand your perspective, and I agree with it. The problem is, the PoCo will not give me the true values, because they want me to assume an infinity on the primary. Re: asymetrical vs. symetrical fault current Originally posted by mhulbert: Sandsnow mentioned that the utility limits the fault current to 10k for all residental, I belive that this is only for services up to 320A, that use self contained meters. After that, you could be as high as 42k, which puts you into some pretty hefty switchgear. Check out this PDF, on pages 60-61 for So Cal Edison's requirements. Right, that's where I got it. Unless we're into a custom home, we're 200 max. Re: asymetrical vs. symetrical fault current Originally posted by charlie: Larry, that is interesting...... I'm not sure what to do with that. I mean, I'm not an engineer, so who am I to correct them??? Re: asymetrical vs. symetrical fault current Bob, I owe you and everyone else a big apology. I am now back home (I was visiting my daughter and her family) and am looking at the reference material. Our 40 MVA transformers put out 9700 amperes of fault current and it goes down to 7786 amperes at one mile from the substation. It goes down to 4602 when you reach two miles. These are both with our standard configurations and on the mainline. We do not do calculations of our taps or underground off the mainline. The first mile is calculated with 795 kcmil Al. and the second mile is calculated with 397.5 kcmil Al. Re: asymetrical vs. symetrical fault current Charlie Using 10000 amps, 2% transformer the fault is 14ka L-L and 22ka L-N. Add 75 ft 1/0 triplex the fault is 5800 amps L-L and 3900 L-N. Published by Nikola Zlatanov* The amount of current available in a short-circuit fault is determined by the capacity of the system voltage sources and the impedances of the system, including the fault. Voltage sources include the power supply (utility or on-site generation) plus all rotating machines connected to the system at the time of the fault. A fault may be either an arcing or bolted fault. In an arcing fault, part of the circuit voltage is consumed across the fault and the total fault current is somewhat smaller than for a bolted fault, so the latter is the worst condition, and therefore is the value sought in the fault calculations. Basically, the short-circuit current is determined by applying Ohm's Law to an equivalent circuit consisting of a constant voltage source and a time- varying impedance. A time-varying impedance is used in order to account for the changes in the effective voltages of the rotating machines during the fault. In an AC system, the resulting short-circuit current starts out higher in magnitude than the final steady-state value and asymmetrical (due to the DC offset) about the X-axis. The current then decays toward a lower symmetrical steady-state value. The time-varying characteristic of the impedance accounts for the symmetrical decay in current. The ratio of the reactive and resistive components (X/R ratio) accounts for the DC decay, see Figure 1.3-1. The fault current consists of an exponentially decreasing direct- current component superimposed upon a decaying alternating-current. The rate of decay of both the DC and AC components depends upon the ratio of reactance to resistance (X/R) of the circuit. The greater this ratio, the longer the current remains higher than the steady-state value that it would eventually reach. The total fault current is not symmetrical with respect to the time-axis because of the direct-current component, hence it is called asymmetrical current. The DC component depends on the point on the voltage wave at which the fault is initiated. See Table 1.3-2 for multiplying factors that relate the rms asymmetrical value of total current to the rms symmetrical value, and the peak asymmetrical value of total current to the rms symmetrical value. The AC component is not constant if rotating machines are connected to the system because the impedance of this apparatus is not constant. The rapid variation of motor and generator impedance is due to these factors: Subtransient reactance (xd”), determines fault current during the first cycle, and after about 6 cycles this value increases to the transient reactance. It is used for the calculation of the momentary interrupting and/or momentary withstand duties of equipment and/or system. Transient reactance (xd’), which deter- mines fault current after about 6 cycles and this value in 1/2 to 2 seconds increases to the value of the synchro- nous reactance. It is used in the setting of the phase OC relays of generators and medium voltage circuit breakers. Synchronous reactance (xd), which determines fault current after steady-state condition is reached. It has no effect as far as short-circuit calculations are concerned, but is useful in the determination of relay settings. Transformer impedance, in percent, is defined as that percent of rated primary voltage that must be applied to the transformer to produce rated current flowing in the secondary, with secondary shorted through zero resistance. Therefore, assuming the primary voltage can be sustained (generally referred to as an infinite or unlimited supply), the maximum current a trans- former can deliver to a fault condition is the quantity of (100 divided by percent impedance) times the transformer rated secondary current. Limiting the power source fault capacity will thereby reduce the maximum fault current from the transformer. The electric network that determines the short-circuit current consists of an AC driving voltage equal to the pre-fault system voltage and an impedance corresponding to that observed when looking back into the system from the fault location. In medium and high voltage work, it is generally satisfactory to regard reactance as the entire impedance; resistance may be neglected. However, this is normally permissible only if the X/R ratio of the medium voltage system is equal to or more than 25. In low voltage (1000 V and below) calculations, it is usually worthwhile to attempt greater accuracy by including resistance with reactance in dealing with impedance. It is for this reason, plus ease of manipulating the various impedances of cables and buses and transformers of the low voltage circuits, that computer studies are recommended before final selection of apparatus and system arrangements. When evaluating the adequacy of short-circuit ratings of medium voltage circuit breakers and fuses, both the rms symmetrical value and asymmetrical value of the short-circuit current should be determined. For low voltage circuit breakers and fuses, the rms symmetrical value should be determined along with either: the X/R ratio of the fault at the device or the asymmetrical short-circuit current. Figure 1.3-1. Structure of an Asymmetrical Current Wave The following Figure 1.3-2 describes the relationship between fault current peak values, rms symmetrical values and rms asymmetrical values depending on the calculated X/R ratio. The table is based on the following general formulas: Where: I = Symmetrical rms current Ip = Peak current e = 2.718 ω = 2πff = Frequency in Hzt = Time in second The assymmetric fault currents can exceed the symmetrical, it really depends on your x/r ratios. As mparent notes, the total asymmetrical current is a function of the system X/R ratio at the fault point. The higher the X/R ratio, the greater the possible asymmetry. The asymmetrical current ALWAYS reaches a maximum value in the first half cycle of the fault. This is a transient that damps out after few cycles. In a highly inductive circuit such as a power distribution system (neglecting the loads), the current lags the voltage by nearly 90 degrees. When the fault occurs at a zero voltage crossing, this forces the current waveform to be displaced from the normal balanced waveform. This is essentially a dc transient. Breakers have a symmetrical rating for fault currents but this is based on a maximum X/R ratio (or power factor) used during breaker testing. If the X/R ratio of your system exceeds the test value, the breaker must be de-rated. Also, the magnitude of the asymmetrical current also depends on the phase angle of the voltage at the time the fault is initiated. The worst case is when the fault occurs at a voltage zero. If you're lucky, there is no asymmetrical current, but of course, you can't count on this. dpc For a given transformer and when 11 kV supply network short circuit power is much higher than nominal transformer nominal power (generally it is so), then no appreciable difference does exist between balanced s.c. (three phases to neutral) and an unbalanced s.c. (one single phase to neutral) while both s.c. currents are higher than that of an unbalance s.c. (phase to phase) When s.c is considered from any line to ground, then grounding impedance plays a very important role on umbalanced or assymetric s.c. in the case of one single phase to ground, as grounding impedance increases the s.c. impedance path reducing thus s.c. current values Julian I'm no expert. I think responses from mparent and dpc are correct. I'm sure you are already aware of the definition, but there is some info in Powell Tech Brief #22 at I'll cut and paste below: The figure below shows a typical short circuit current wage 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. In the figure, IMC 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 , 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((Iac(2)/2 + Idc). From the last line we see the assymetrical current is higher than symmetrical whenever dc is present. DC is present whevever load is increased (due to fault) in a step fashion. If we look at the fact that voltage accross system impedance will be increasedn suddently, we see I=1/L*Integral(Vmaxsin(2pift))dt which will have dc offset depending upon the phase at which the fault occurs. So we have not addressed the path in which the dc current flows, which I suspect was your real question. Does anyone have more comments on that? I think we are referring to different concepts, hence the so different answers to lyledunn question. In case we are talking about asymmetrical transient currents,Electricpete reference text is right,and the máximum current peak could reach twice the value of steady s.c. current peak (even more when transformer is close to generator). On the contrary, if we refer to asymmetrical faults, i.e short circuits of one or two lines to neutral, ground or each other, then my former post sould be taken into consideration Julian Just a couple of points here - - The term "asymmetrical" in this context is usually taken to have the meaning that electricpete has assumed - The term "unbalanced" could be used to describe the meaning assumed by 230842 - Depending on the system grounding arrangements, it is entirely possible for the ground fault current level to exceed the 3-phase fault current hi friends, I am not much competent like you all but i have read some where that Asymmetrical current is vector sum of AC and DC components of current at the time of inrush current.Symmetrical current is vector sum is positive sequence, negative sequenceand zero sequence currents. Suggestion: The asymmetrical current must contain the dc component called dc offset. This is causing the asymmetrical current to be greater than symmetrical. If there is no dc offset then the current is only symmetrical; however, it may contain a symmetrical transient. DC offsets are often present in faults that are very close to generators or transformers. Further away from generators or transformers, the dc offsets can be negligible. Normally, the asymmetrical current is also expressed in asymmetrical rms values. The electricpete reference link has the following: on technical briefs and then on PTB#22 When the initial short circuit current Ik" (without the DC component) is considered, then some experimentation with a short circuit program confirmed julian's findings. An additional observation is that in the case of a line to line to neutral fault, the current can be larger than in the case of a 3-phase fault, depending on the impedances in the network. You can check these points with a short circuit program, for example with the one at Well, once more. I started to wonder, how did I get that result. With the help of some more calculations and a textbook I realized the obvious: If the zero sequence impedance is smaller than the other impedances, then the line to neutral and line to line to neutral fault currents can be larger than the 3-phase fault current (always the Ik", without the DC component, that is). But such a situation is rather unlikely in a distribution network. Or is it ? (That was a good refreshing homework assignment. Oops.., maybe it really was one Here is some possible explanation of the asymmetrical and symmetrical SC values on a three phase SC: The peak asymmetrical value of the current after initiation of a SC could be calculated as a function of the symmetrical rms value of the initial short circuit current at the instant the SC occurs as follow: Ipeakasymm = k.Irmssymm Eq (A) Approximately the following relation could model the asymmetrical factor for a three-phase SC as a function of X/R: k=1.0220+0.96899.e-[3.0301/(X/R)] Eq (B) Considering two extreme cases: a- X/R=infinite...........k(inf)=2 (perfect asymmetrical) b- X/R=0...................k(0)~1 (perfect symmetrical) SC in real life should be between the two cases above. Therefore, the asymmetrical three-phase SC should be greater than the symmetrical SC of the same circuit. Special case: c- X/R < 0................k(0 Result from Eq (A). NOTE: I am not sure if this result represent a realistic situation. (Any further comment is welcome). Hypothetical R & X values: For R < 0. This value may not be realistic even for circuit with superconductor with Rmax=0. For X< 0 . We know that capacitor do not contribute to SC. Is the DC component in this case negative ?. Even if this is the case, the other two phase may not be negative. The short answer is no the Earth Fault or Asymmetric Fault current will never be higher than the Short Circuit or Symmetric fault current speaking from a practical point of view. Earth fault protection of equipment using Core Balance Transformers on the individual machines, and current transformers monitoring the fault current in the neutral point of the transformer can detect fault currents of a few milliamps. We can even limit the amount of Earth fault current returning to the transformer through the neutral point by connecting a resistance or impedance between the transformer neutral and earth, usually rated for up to 10 seconds to allow the fault protection time to operate. Its only fairly recently that symmetrical fault current protection passed the HRC fuse level. It isn't clear what the original post is asking. By definition, the asymmetrical current is always higher than the symmetrical current because of the DC offset. As has been said already, the amount of the offset is a function of the system X/R ratio and the time of the fault on the sinusoidal waveform. If the question is related to balanced three phase faults versus unbalanced single-line-to-ground faults, then the answer depends on the location of the fault and the configuration of the transformer windings. For a delta-wye transformer with the secondary neutral solidly grounded, the maximum current for a bolted SLG fault at the transformer terminals will always exceed the maximum current for a bolted three phase fault at the terminals. The difference becomes more pronounced as the primary system impedance increases with respect to the transformer impedance. The reason is that for a fault at the transformer terminals, the zero sequence network only includes the transformer impedance. The positive sequence network includes the primary system impedance plus the transformer impedance. As the fault moves away from the transformer secondary terminals, then the zero sequence network also includes the secondary system zero sequence impedance to the fault. At some location, usually not far from the transformer, the maximum three phase fault current will exceed the maximum SLG current. If the transformer is grounded wye-grounded wye connected, then the maximum three phase fault current will nearly always be higher than the maximum SLG fault current because the primary system zero sequence is included in the SLG fault network. If the sequences impedances are known at the fault location, a quick empirical way to determine the worst-case of short circuit fault is suggested as follow: For Three Phase: Z2/Z1 1.41 (Z2/Zo)-1.5(Z2/Zo)^2 + 1.1(Z2/Zo)^3 If Z2/Z1 result between the two cases above the worst SC is phase-to-phase.