TECHNICAL BULLETIN — 001c
Approach Boundaries

As shown in Figure 1, NFPA 70E defines four different approach boundaries for personnel safety. Note that the flash boundary is shown as a dashed line because, as we will describe later, its actual location varies as a function of short circuit current and tripping time. The red boundaries (solid lines) are shock related boundaries. The flash boundary (blue, dashed line) is an electrical arc energy boundary.

Limited Boundary

The limited boundary is for unqualified personnel. No unqualified person may approach any exposed energized conductor any closer than the limited approach boundary. The limited approach boundary is determined by referring to Table 130.2(C) in NFPA 70E - Page 25. (2004 Edition.)

Note that in the 2004 Edition NFPA includes the concept of movable or fixed conductors which were first defined in the 2000 edition. Workers may approach non-moving conductors (fixed buswork for example) more closely than those which may move (overhead lines for example).

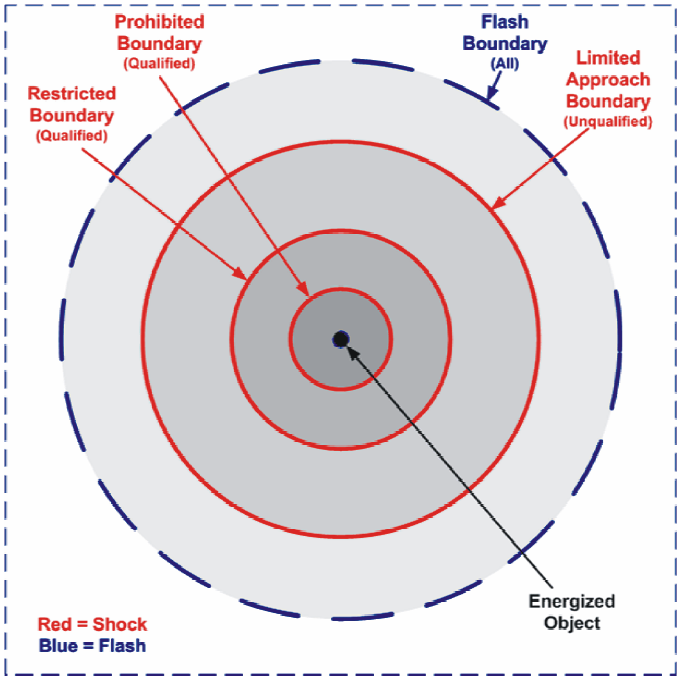

Figure 1 NFPA Approach Boundaries

Restricted Boundary

Generally, qualified persons are not allowed to approach exposed, energized conductors any closer than the restricted approach boundary unless they are wearing appropriate personal protective equipment (PPE) and they have a written, approved plan for the work they are to perform. They must break the restricted boundary only to the extent that is absolutely necessary to perform their work. The restricted boundary is determined using Table 130.2(C) in NFPA 70E - Page 25. (2004 Edition.)

Prohibited Boundary

Crossing the prohibited approach boundary (qualified personnel only) is considered the same as actually contacting the exposed energized part. In addition to the requirements for restricted boundary approach, personnel must perform a detailed risk assessment before the prohibited boundary is crossed. The prohibited approach boundary is determined by referring to Table 130.2(C) in NFPA 70E - Page 25. (2004 Edition.)

Flash Protection Boundary

The radiant energy released by an electric arc is capable of maiming or killing a human being at distances of up to ten or even twenty feet. In addition to radiant heat, the molten material, objects ejected, toxic arcing products, and the acoustic energy of the electrical arc and blast can also be lethal. The flash protection boundary is the closest approach allowed by qualified or unqualified persons without the use of arc protection PPE. The flash boundary distance is defined as the distance at which the unprotected person may receive a second degree (just curable) burn.

For systems of **under 600 Volts ac** 70E sets up two possible ways to calculate the flash boundary.

1. For locations with a total fault exposure of less than 5000 Ampere-seconds (fault current in amperes multiplied by clearing time in seconds), a flash boundary of four (4) feet may be used.

2. Above 5000 Ampere-seconds, or under engineering supervision for all levels, the following formulas may be used:

$$D_c = \sqrt{2.65 \times MVA_{bf} \times t} \quad (1)$$

– or –

$$D_c = \sqrt{53 \times MVA \times t} \quad (2)$$

Where:

D_c =	The flash boundary radius in feet
MVA_{bf} =	The bolted fault MVA at the point of exposure
MVA =	The maximum fault MVA from the transformer feeding the circuit
T =	The time of exposure (based on protective device operation

Equation (1) provides generally smaller distances.

For voltage levels **in excess of 600 Volts**, other formulas may be used. Note that for exposures of greater than 0.1 seconds the flash boundary is defined as that distance at which the worker is exposed to 1.2 cal/cm^2. For exposure of less than or equal to 0.1 seconds the flash boundary is that distance at which the worker is exposed to 1.5 cal/cm^2.

In Summary for Flash Boundary

- ★ When an energized conductor is exposed, absolutely no one may approach closer than the flash boundary without wearing appropriate arc protection.
- ★ The application of Equation (1) will provide the smaller flash boundaries.
- ★ Equation (1) may not be applied without an accurate, up-to-date short circuit analysis at the point of exposure.
- ★ If the flash boundary is smaller than the limited approach boundary, the limited approach boundary is the closest that un-qualified persons may approach.