Impact of Arc flash study

Bolted fault:
A short-circuit condition that assumes zero impedance exists at the point of the fault.

Voltage (Vac):
Enter an AC voltage between 208 V and 15,000 V. AC voltage levels outside of this range, and DC voltage levels.

Arc flash:
An electric arc event with thermal energy dissipated as radiant, convective, and conductive heat.

Arc-flash boundary:
A distance from a prospective arc source at which the incident energy is calculated to be 5.0 J/cm2 (1.2 Cal/cm2).

Arcing fault current:
A fault current flowing through an electrical arc plasma.

Electrode configuration: Choose from the following:
VCB: Vertical conductor (electrode) in a box

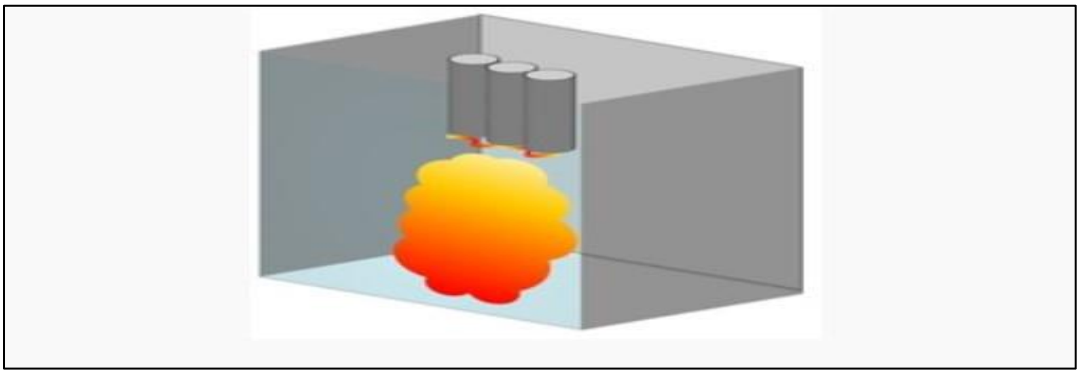

Figure 1:VCB Configuration

VCBB: Vertical conductor (electrode) in a box terminated in an insulating barrier.

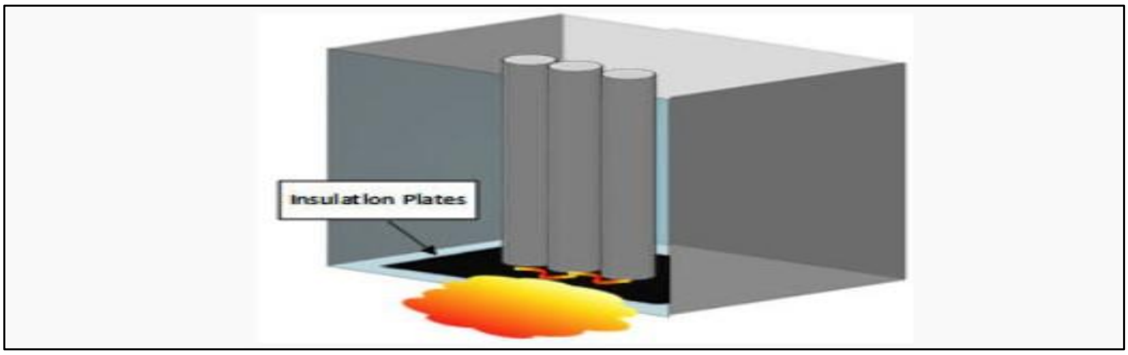

Figure 2:VCBB Configuration

HCB: Vertical conductor (electrode) in a box.

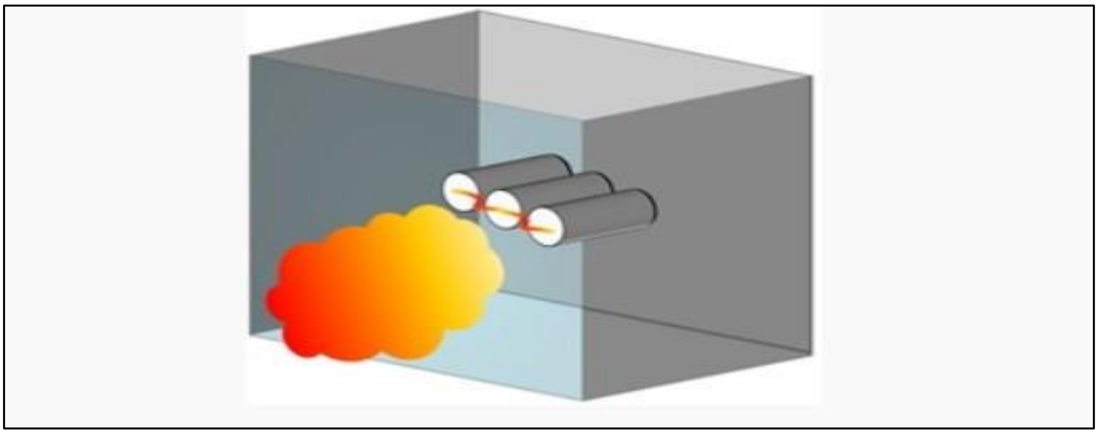

Figure 3:HCB Configuration

VOA: Vertical conductor (electrode) in open air.

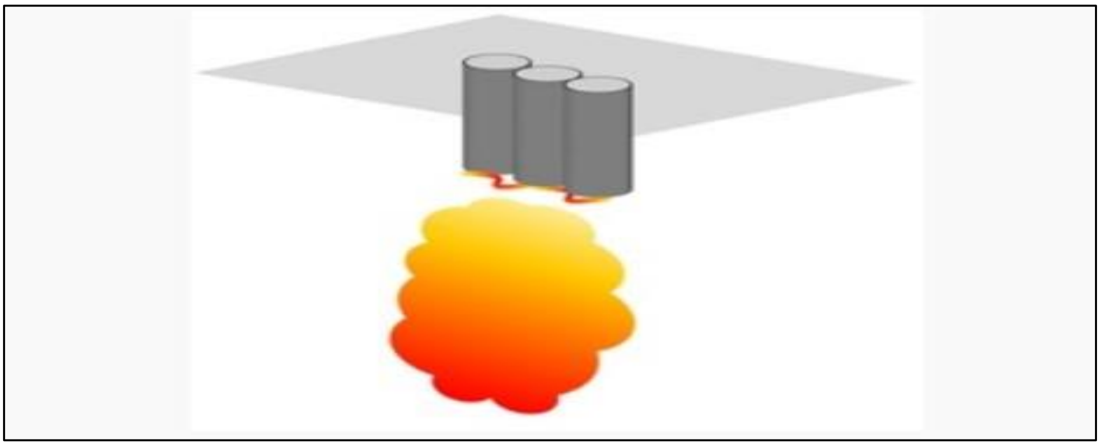

Figure 4:VOA Configuration

HOA: Horizontal conductor (electrode) in open air:

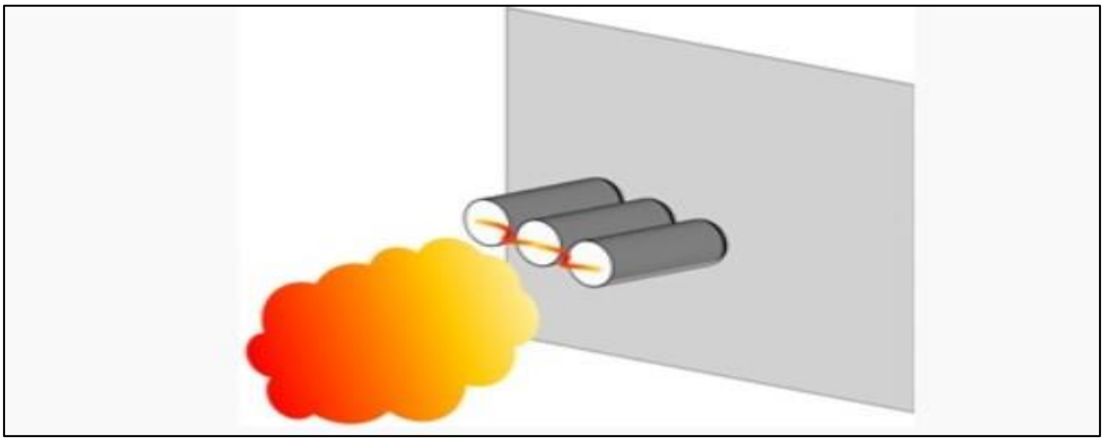

Figure 5:HOA Configuration

Conductor gap (mm):

The distance between the conductors (electrodes). This value is always in mm. It is pre-populated with typical values from IEEE 1548 2018, based on the selected Equipment Type.

*Table 1:*Conductor *gap*

Equipment class	Typical bus gaps (mm	Enclosure Size (H × W × D	
		SI units (metric)	Imperial units
15 kV switchgear	152	1143 mm × 762 mm × 762 mm	45 in × 30 in × 30 in
15 kV MCC	152	914.4 mm × 914.4 mm × 914.4 mm	36 in × 36 in × 36 in
5 kV switchgear	104	914.4 mm × 914.4 mm × 914.4 mm	36 in × 36 in × 36 in
5 kV switchgear	104	1143 mm × 762 mm × 762 mm	45 in × 30 in × 30 in
5 kV MCC	104	660.4 mm × 660.4 mm × 660.4 mm	26 in × 26 in × 26 in
Low-voltage switchgear	32	508 mm × 508 mm × 508 mm	20 in × 20 in × 20 in
Shallow low-voltage MCCs and panel boards	25	355.6 mm × 304.8 mm × ≤203.2 mm	14 in × 12 in × ≤8 in
Deep low-voltage MCCs and panel boards	25	355.6 mm × 304.8 mm × >203.2 mm	14 in × 12 in × >8 in
Cable junction box	13	355.6 mm × 304.8 mm × ≤203.2 mm or 355.6 mm × 304.8 mm × >203.2 mm	14 in × 12 in × ≤8 in or 14 in × 12 in × >8 in

For below cases the arc flash study has been performed and impact of arc flash parameters has been observed. following cases are

Case:1=Increasing Voltage Level O.415kV to 3.3kV

Case:2= Increasing Voltage Level 3.3kV to 6.6kV

Case:3= Increasing Voltage Level 6.6kV to 11kV

If I increase the system voltages in the Above Three cases, what are the impacts in Arc Flash parameters are (Incident Energy, Arc flash Boundary, Arcing Current) See in below.

Taken input parameters:

Normal voltage = 0.415 kV

Bolted faulted current = 20 kA

Conductor gap = 32 mm

Working distance = 24 inch

Equipment type = Switchgear

Height, Width, Depth = 660 mm

Electrode configuration = HCB

Fault clearing time = 0.200 sec

Impact of arc flash for the above parameters

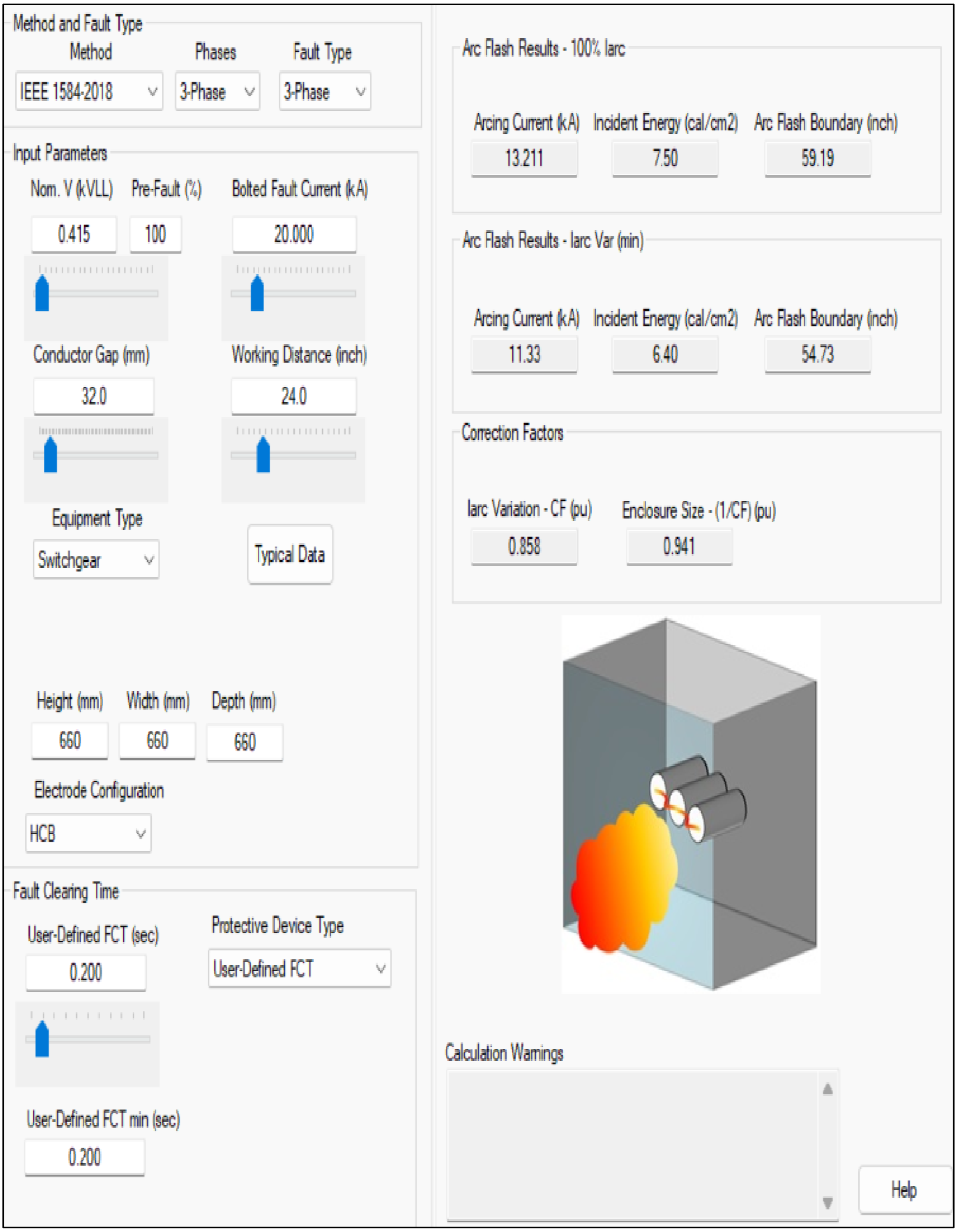

Figure 6:Reference Case

I used 0.415 kV as my reference voltage. I've set the voltage level to 0.415 kV in the image above. At that moment, take note of the incident energy, arc flash boundary, and arcing current values, which are 7.50 Cal/cm2, 59.19 inch, and 13.211 kA respectively. Three Cases in which we changed the voltage levels are also listed below. And another input parameters are I have taken all parameters always same Bolted Fault current(kV), Conductor gap(mm), Working distance(inch), Equipment type-high(mm),Width(mm).Depth(mm),Electrode configuration and Fault Clearing time.

Case:1=Increasing Voltage Level O.415kV to 3.3kV

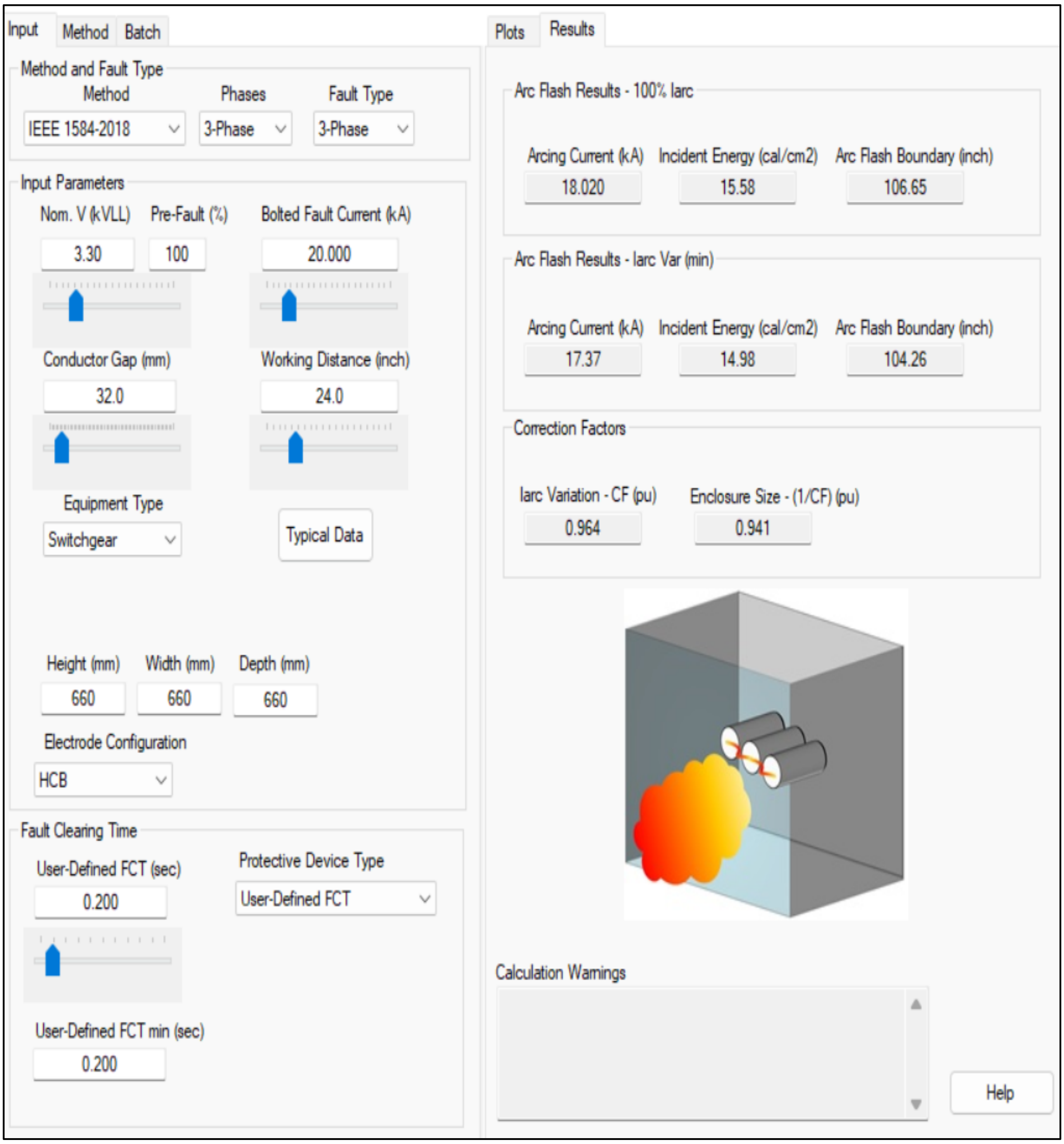

Figure 7:Case:1

When comparing with Reference case, I have increased the voltage level from 0.415kV to 3.3kV and another all-input parameter are as previous case. Above the results are incident energy, arc flash boundary and arcing current always increases. The results are tabulated in table:2.

Case:2= Increasing Voltage Level 3.3kV to 6.6kV

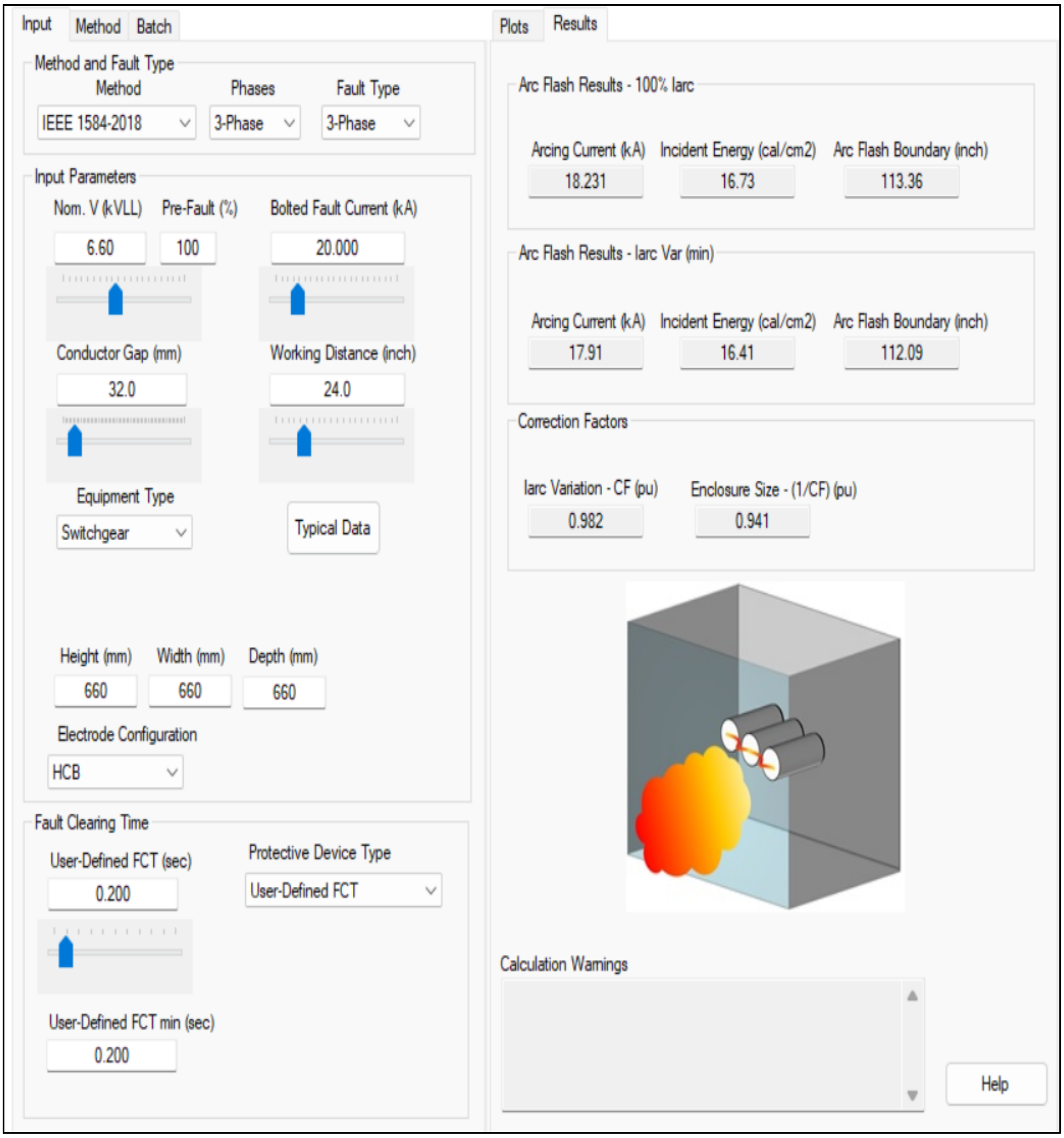

Figure 8:Case:2

When comparing with Reference case, I have increased the voltage level from 03.3kV to 6.6kV and another all-input parameter are as previous case. Above the results are incident energy , arc flash boundary and arcing current always increases comparatively Case 1. The results are tabulated in table:2.

Case:3= Increasing Voltage Level 6.6kV to 11kV

Table 2:Case:3

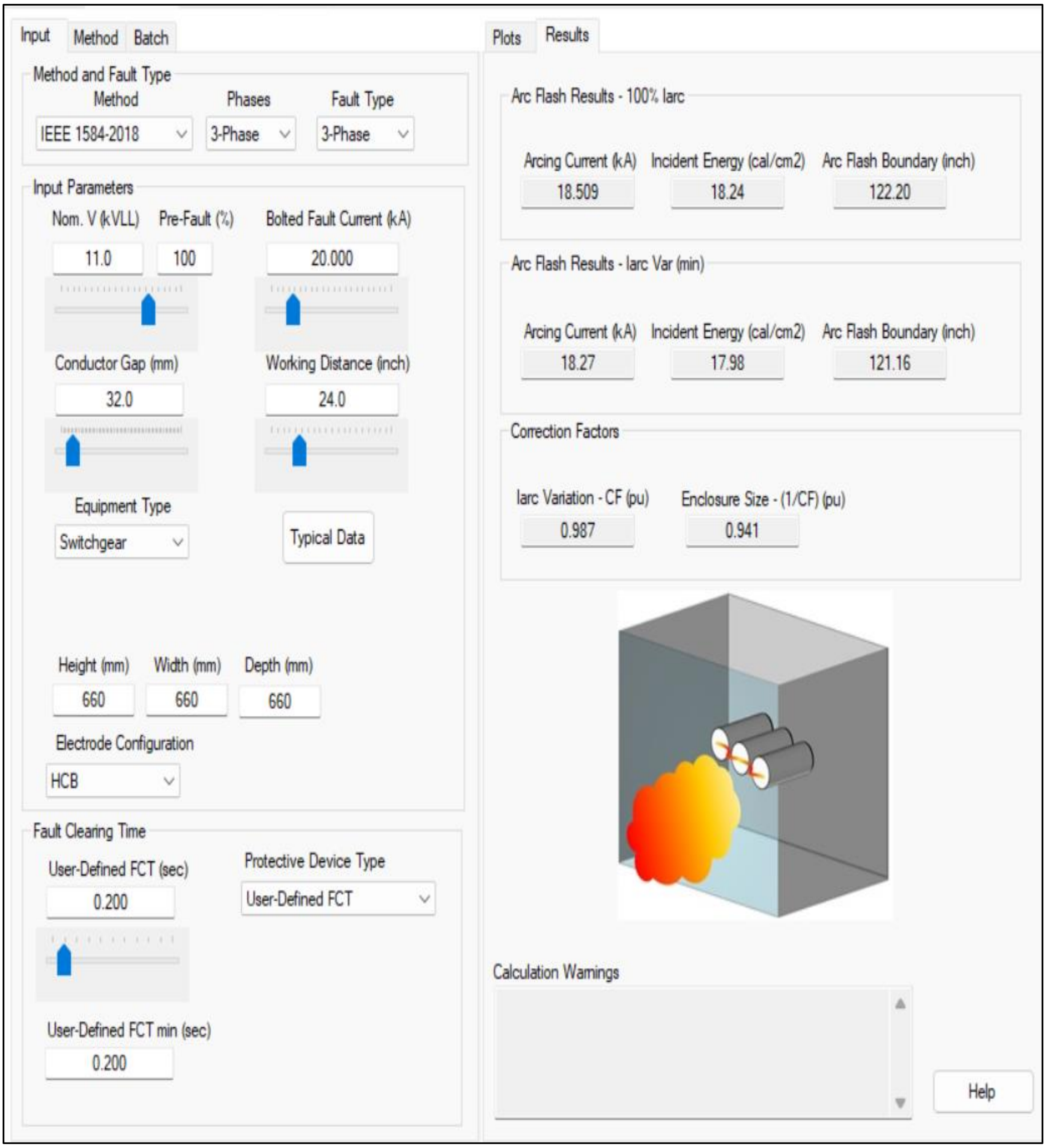

Figure 9:Case:3

When comparing with Reference case, I have increased the voltage level from 03.3kV to 6.6kV and another all-input parameter are as previous case. Above the results are incident energy , arc flash boundary and arcing current always increases comparatively Case 1 & Case2. The results are tabulated in table:2.

Table 2: Input & Output results

Inputs									Outputs		
Case NO	System Voltage (kV)	Fault curren t(kA)	Conductor gap(mm)	Working distance (inch)	Equipment type	Electrode configuration	Height, Width, Depth, (mm)	FCT (s)	Arcing current (kA)	Incident energy (Cal/cm2)	Arc flash boundary (Inch)
Reference case	0.415	20	32	24	switchgear	HCB	660	0.200	13.21	7.50	59.19
Case 1	3.3	20	32	24	switchgear	HCB	660	0.200	18.02	15.58	106.65
Case 2	6.6	20	32	24	switchgear	HCB	660	0.200	18.23	16.73	113.36
Case 3	11	20	32	24	switchgear	HCB	660	0.200	18.50	18.24	122.20

Conclusions:

From the above cases, it is observed that the Variation in system voltage, results in Arcing current Variation. Arcing current has a significant impact in incident energy, proportionately influencing in Arc flash boundary.