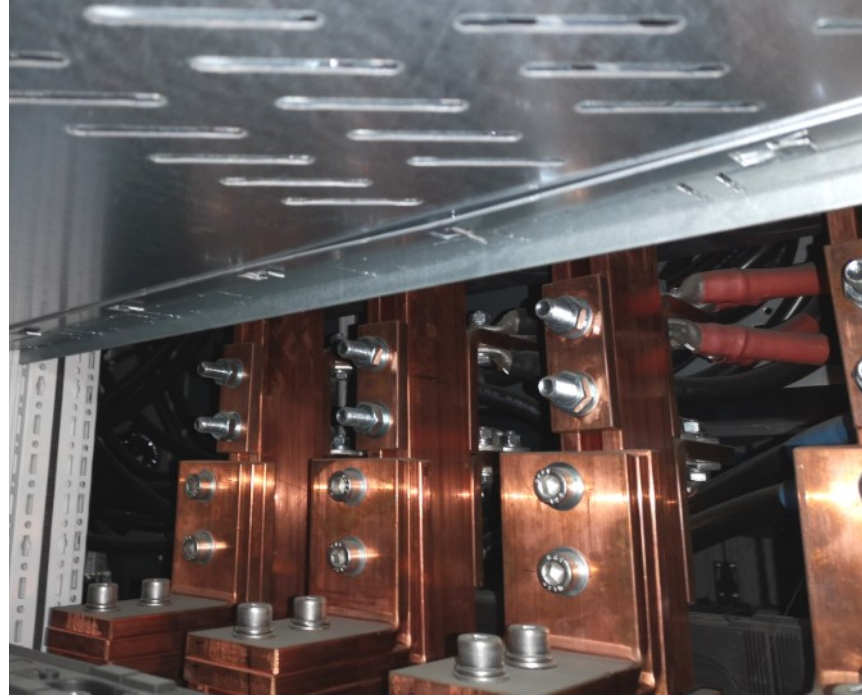


Big Systems: Examples - 1



© 20/09/2024



Examples - 2



20/09/2024



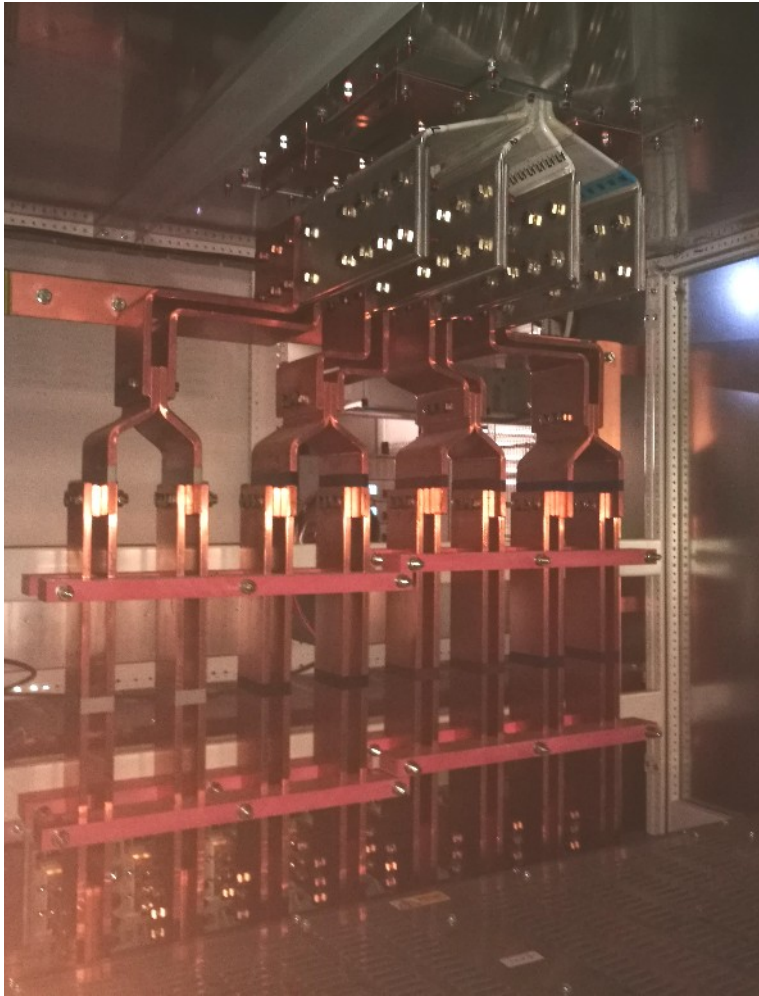
Examples - 3



20/09/2024

Tangle Tamers
Electrical Engineers Ltd

Examples - 4



20/09/2024



Tangle Tamers
Electrical Engineers Ltd

Why Worry ?

TNT has about 4,200,000 J/kg explosive energy

RDX about 50% more

Blends of the two with some plasticiser form many common military explosives

Hand grenades typically contain around 150 to 200 grammes of explosive

Typically about a 1,000,000 J explosion



20/09/2024



Why Worry ? - 2

We work on substation output panels,
often 1 – 3.5 MW

1,000,000 to 3,500,000 J/S continuous

Typically 15,000,000 to 70,000,000 J/S fault

ACB incomers are often delayed 0.1S to 0.3S

1,500,000 to 21,000,000 J fault energy

From a grenade or two to a 10 pound bomb, if
or when it goes wrong



20/09/2024



Copper Loss Energy Estimates

Copper loss gives a lower estimate of fault energy. From the web:

Specific heat of Copper $\sim 0.368 \text{ kJ/kg}^\circ\text{C}$,
Latent heat of fusion $\sim 206 \text{ kJ/kg}$

Latent heat of vaporisation $\sim 4,740 \text{ kJ/kg}$

Boiling point of Copper $\sim 2562 \text{ }^\circ\text{C}$

So from room temperature to vapour,
Copper takes just under 6,000,000 J/kg

Using the equivalent of $\sim 1\frac{1}{4} \text{ kg}$ of explosive to vaporise just 1kg of copper

20/09/2024



Tangle Tamers
Electrical Engineers Ltd

The Message - 1



=



20/09/2024

Tangle Tamers
Electrical Engineers Ltd

The Message - 2

Be cautious, careful and thorough when you're working on electrical systems.

Medium and high voltage fault levels are normally even bigger than for 230/400 V mains systems.

Do not put big electrical equipment near life- and mission-critical systems, vulnerable people and things.



Arc Flash - Other People's Videos

<https://www.youtube.com/watch?v=6hpE5LYj-CY>

<https://www.youtube.com/watch?v=-iClXrd50Z8>

<https://www.youtube.com/watch?v=CtmxTj9pKqg>

<https://www.youtube.com/watch?v=HPUuRizKV3o>

<https://www.youtube.com/watch?v=ID2e0jv11og>

There is a lot of material on the web about this, including fatalities and major injuries. Have a browse. Work safe. Be safe.



20/09/2024

Tangle Tamers
Electrical Engineers Ltd



=



© 20/09/2024 – feel free to share
this paper as it is

