Limiting Arc Flash Exposure

Course Number: EE-02-910

PDH: 2

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LIMITING ARC FLASH EXPOSURE

Exposure to arc flash can be fixed in three ways:

1. Avoiding arc flash hazards.

2. Limiting the level of arc energy discharged.

3. The adequate use of personal protective equipment (PPE).

Arc flash incidents can be cut down by following processes correctly, use of adequate equipment, proper preventive care, planning and coordination of operation, as well as skill improvement and real experience. Also crucial is the mental and physical circumstances of the staff such that the dropping of equipment and tools, accidental touching, etc., are averted. Taking care of the causes of arc flash is the main scheme for averting exposure.

Incidents may happen despite care taken to avert them. In such circumstances, it is always better if the incident energy is low and staff are ready for the worst by implementing adequate PPE.

AVERTING ARC FLASH INCIDENTS

Arc flash can be averted by realizing its causes and taking steps to mitigate them. The different causes of arc flash are listed below. The mitigation steps are discussed in the following paragraphs. Summary of causes:

- Dust, impurities, and corrosion at contact surfaces producing heat, loosening contact and creating sparks.

- Sparks developed during racking of breakers, replacement of fuses, breakers/fuses closing into faulted and energized lines.

- Break down of insulating materials.

- Snapping of leads at connections due to force – human, rodents or birds.

- Incidental touching and dropping of tools, devices or metal parts.

PREVENTIVE SERVICE

Preventive service procedures are developed in most companies that need high reliability of supply or process persistence. Preventive service also gives a safer workplace.

Improve maintenance service when carrying out reviews, preventive service, or even breakdown service by including methodologies that address arc flash hazards. This limits the total cost of applying an arc flash program. Implement the following in service practices:

1. Rodents and birds getting into panels and switchgear are not uncommon. These can cause short-circuits and eventually arc flash. This hazard can be precluded by closing all open areas of devices with wire net or sealant so that they cannot enter.

2. Use terminals that are resistant to corrosion. It can cause snapping of small wires that in turn may cause sparks and fumes when the tip of the wire touches the metal enclosure or other phase conductor. Regularly find corroded terminals and elements if the electrical devices are at a chemical plant or near a marine atmosphere. Electrical contact grease is usually used in joints and terminations. This will cut down corrosion.

3. Find loose and overheated connections. Impurities or dust at the terminal connectors can cause higher contact resistance, heating the terminals. A sign of such situation is colouring of the nearby insulation. Cable insulation heating can damage the insulation - another cause of flashover. Infra-red thermography can give precious information on poor connections and overheated electrical conductors or terminations.

4. If feasible, insulate exposed metal elements. If heat dissipation is not really required from the exposed metal element, and insulating it with some insulating tape or cover is not an issue, then it is better to complete it, rather than to keep them exposed. Insulation prevents arcing. For example, if staff drops an uninsulated spanner, that touches bare bus bars of two phases, a short circuit current will occur. Nevertheless, this will not occur if the spanner or the bus bar is insulated.

5. Ensure that relays and breakers function properly. Failure could cause prolonged exposure to arc flash that could lead to death. Routine maintenance and relay testing are completed in companies with good maintenance procedures. Relay test frequency may be every few years, depending upon the manufacturer's recommendations and company policy.

6. Contacts pitting takes place when fuses operate. Replace fuse contacts holder or the fuse holder, when unreasonable pitting is detected.

7. When a fuse melts, ensure that the fault has cleared before putting a new fuse. Closing a circuit on to a fault can cause sparks that could lead to arc flash.

8. Control and instrumentation wire should be kept in proper condition. It is not unusual for these wires to become bundled and messy. Occurrence of arc blasts can happen while opening covers of such switchgear/MCC.

9. Check out for excessive moisture or water/ice on insulating surfaces of devices. This may lead to flashover, especially on high voltage devices.

WORKING ON LIVE EQUIPMENT

1. It is always preferred to work on de-energized devices, regardless of the hazard risk category (HRC). When operation on live devices is inescapable, then reasoning and written authorization is needed. Integrate this precautionary step into the work routine.

2. Always use insulated tools. Dropping of tools can lead to momentary faults, sparks and arcs. Insulated tools and devices can help reduce and remove this type of incident.

3. Torque control: When using spanners, wrenches or screwdrivers to fasten or loosen a connection use adequate torque. When excessive force is needed, it is not unusual to lose control. Slipping of screws or nuts and bolts may lead to accidental touching. Fasteners that are corroded or heated can be hard to loosen. Work off line if loosening is challenging.

4. Do not use paint, cleaning chemicals, spray, etc., on live exposed metal elements. The fumes or spray may be conductive and it may decrease the insulting features of air and allow an arc to strike through. Spraying directly on live conductor can also give a conducting path that will end up in electric shock.

CUTTING DOWN INCIDENT ENERGY ON STAFF

The incident energy exposure can be cut down by appropriate system design or operating sequence. Several ways to cut down the energy on an existing system are shown below:

1. Cut down the fault level

2. Cut down the exposure time

3. Remote operation

4. Remote racking

CUTTING DOWN THE FAULT LEVEL

Fault level can be cut down in the following ways:

1. Change system arrangements to cut down available fault current/smaller kVA transformers.

2. Current limiting fuses/breakers.

3. Current limiting reactors.

SYSTEM ARRANGEMENT

Cutting down the fault level depends on the existing system arrangement. Double ended load centres with closed tie in normal service (Figure 1) are a basic example where the fault level can be decreased by either opening the tie or one incoming breaker. The short circuit current will be decreased by roughly 50% and the incident short circuit current energy will also be decreased, even though not inevitably in the same proportion. If the bus has two power sources or a source and a normally closed tie as presented in Figure 2, opening one of the sources (or tie) will decrease the fault level while servicing on the devices is completed. For both cases, the loading and relay setting need to be verified to ensure that the opening of a breaker does not overload the other power source.

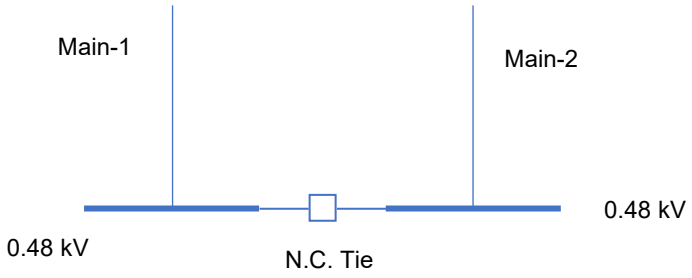

Figure 1. Double-end load center configuration

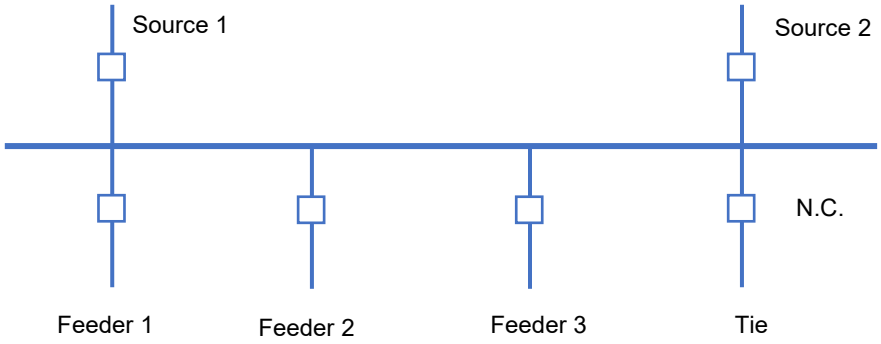

Figure 2. Dual sources

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