

Commonsense Engineering Safety Tips When Commissioning Plant

Version 2.04



Technology Training that Works



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Foreword

Dear Colleagues

As an old engineering colleague of mine, wryly remarked to me recently - engineering and technical graduates are often like babes in the wood when newly on-site as their practical and safety knowledge is almost non-existent. Despite an intensive 4 year (or longer) study program. My retort was that it didn't only apply to young engineers and technicians - and that "common sense is not so common around here" is often an appropriate expression on-site for even old hands. As we all know, electricity (well, energy) is extremely dangerous and can kill or maim if you are even a little careless. Fortunately most acts of carelessness result in a mild jolt (or electric shock), leaving no permanent physical reminder of the incident; but the unfortunate get life-long scars or worse.

We have compiled a list of tips from yourselves on working safely when commissioning a plant or with machinery from an electrical, mechanical, instrumentation and IT point of view – thanks to you, our wonderfully supportive global community of engineers and technicians.

We were quite overwhelmed with the quality and quantity of the safety tips. And are very grateful. We have done a little bit of light editing to remove spelling and grammatical errors but have left everything essentially as we received them. To liven things up we have put in some graphics.

We have tried to acknowledge everyone who contributed personally but for privacy reasons we had to obtain specific permission. Where this was lacking; we have simply used initials.

If you have any further suggestions or feel that you have been left out; please email me at tech@idc-online.com and I will ensure we add to this document.

I really hope these will make for a safer environment and must thank you all from my heart for being so generous with your time.

Yours sincerely

Steve Mackay



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Thanks for contributions from

Bob Allen
Chris Arbous
Larry Cant
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Bill Davies
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Electrical

- Watch out when taking measurements with your Fluke - don't think you can connect directly onto the bus bar to measure voltage.
- Make sure the cabinet has been clearly tagged and locked out before commencing work.

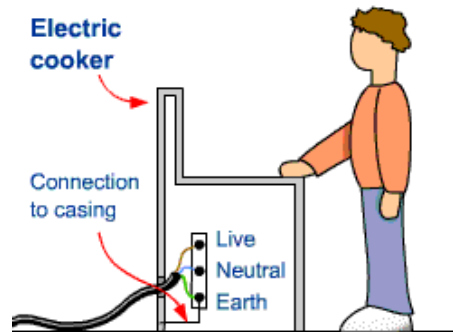


- Before going for a black start for a power station make sure there will still be auxiliary power for the stand-by generator.
- Make sure you have sufficient spare fuses.
- Make sure you have adequate lighting at night when troubleshooting a cabinet.



- When opening the electrical cabinet, make sure the door doesn't close on you inadvertently when you are taking measurements.
- If you are going to work on an electrical panel, ensure that it is disconnected from all electrical sources. Visible contact separation and locking against re-energisation are a minimum check. Ensure that earthing/grounding is firmly in place until your work is completed.
- Never assume that a part is dead unless it is visibly earthed.
- When you earth/ground a bus or conductor, ensure that there is no voltage using an appropriate test method. If you are using a removable earth clamp, connect the earth clamp first to the earth bar and then lightly touch one of the other clamps (normally there are three other clamps one for each phase) on each phase conductor. If there is no spark, then go ahead and connect the clamp.





- Live working (work on parts which are normally live) is permitted in rare cases. All other work must be done after isolation and earthing only.
- Sometimes you may have to check for voltage presence or measure the voltage under live conditions. If you are testing the voltage with respect to earth, place or connect the earth side measurement lead on the earth bus first and then place the other (usually RED) lead on the live part. Many people have received inadvertent electric shocks by reversing this procedure.
- Do not use uninsulated test-leads or tools with bare shanks when working on panels where live parts can be present. There is always a possibility of accidental short circuits.



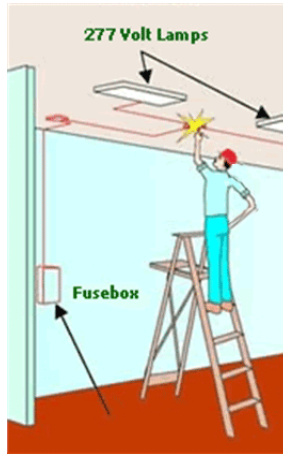
- When you finish working on any equipment, ensure that no tools or operating handles remain on the live parts. They can cause short-circuits unexpectedly and can injure or kill you or someone else when the equipment is racked in or switched on.
- Do not take any short cuts, especially when you are the person in-charge of a crew which is carrying out the work. Before you allow the equipment to be re-energized, ensure that everyone is in a safe location away from the equipment. Do not resort to any last minute tweaking after you return a work permit.

Contributed by: G. Vijayaraghavan

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- One thing that I was taught and tried to apply through the years is that when working with live equipment (especially high voltage equipment), if at all possible, keep one hand behind you or at least out of the way of any place where you can accidentally make contact and use the other hand for carrying out the measurement or work.



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- Also remove your watch and any rings or metallic ornaments that you might be wearing. They are potential points for shorting or making contact with something when you are "not looking" and can either causing burns due to heat generation or electrical shocks due to hooking onto live terminals, etc.
- Also, when working with RF (especially high power RF), be careful of open conductor antenna feeds and connections - the RF can arc onto your body and cause severe burns which take ages to heal.

Contributed by: RH

-
- What to do when you are required to lift a Neutral wire in a MEN system. Positively Identify the associated active core/s (by tracing, don't rely on numbering etc.) and ensure that they are isolated/locked out and tested for "dead".
 - Fit a current clamp meter around the neutral core to see if any current is flowing. Should read zero. (Not uncommon to find crossed up or co-joined neutrals by mistake)

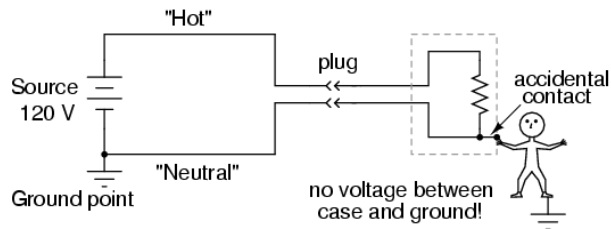
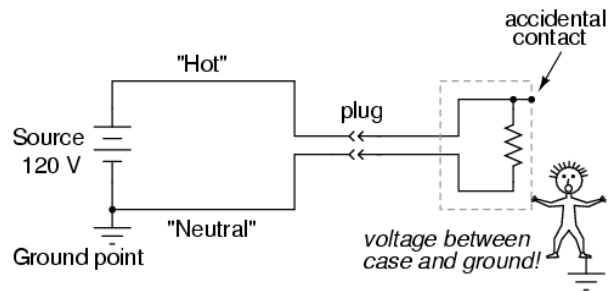


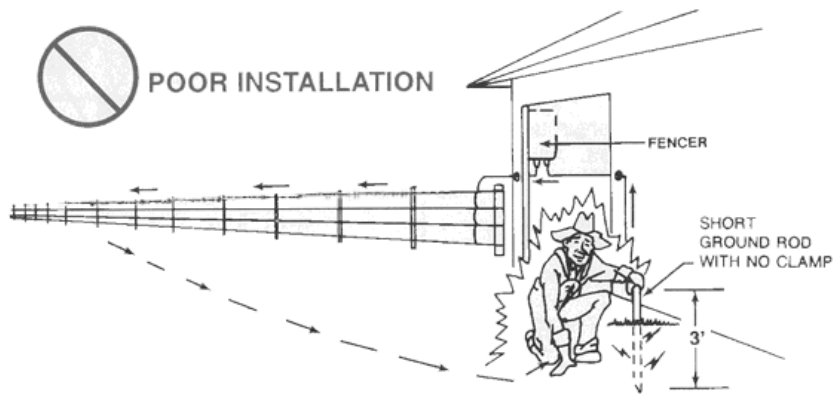
- Check any available drawings to see if feedback along Neutral wire is possible.
- Assume defensive posture and "crack" neutral wire connection bolt/screw and wriggle cable to see if any sparks are evident. If not continue working defensively and remove Neutral wire completely ensuring contact with personnel and equipment does not occur.
- Test neutral wire with volt meter to known earth.
- Bond/secure Neutral wire appropriately until work/testing is complete.



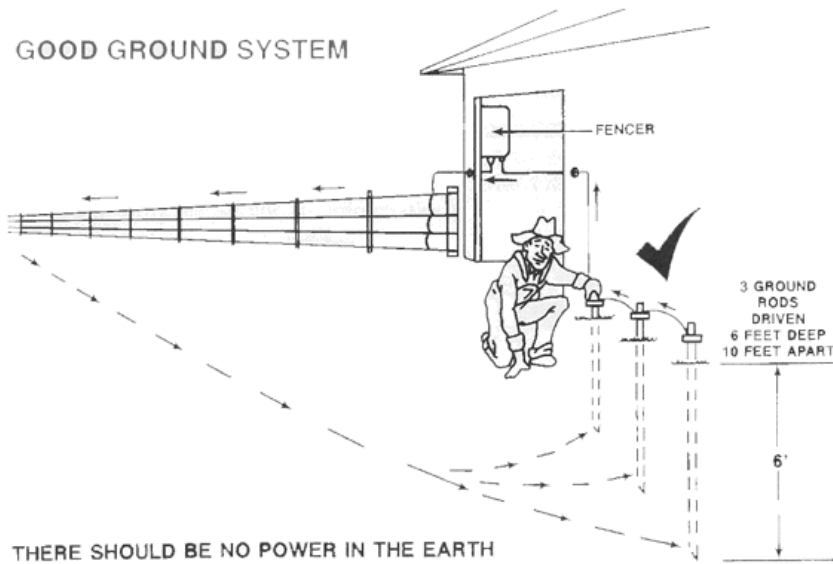
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- When required, follow reverse of above until neutral wire is solidly reconnected.
- Never assume a Neutral wire is "dead" or has zero potential. This is only the case when it is connected to a complete MEN system (earth/neutral bonding) or fully isolated.





TEST YOUR EARTH SYSTEM



Earth wire:

- Consider your earth wire and earth system as the most important piece of your installation.
- It will save yours or someone else's life and will stop equipment from major damage, by carrying the fault current to trip circuit protection devices.

Also remember:

- Water and electricity don't mix. (Exception: batteries and liquid resistance motor starters etc.)



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- Be very careful. Electrical current can flow in the strangest paths when water is involved, resulting in electrical shocks.

Contributed by: JH

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- Never remove a steel filler between breakers on a panel board thinking it is safe. I did so one time without de-energizing the panel board and the filler fell inward after taking out the second screw, causing an arc flash. I suffered an arc flash to my eyes, molten copper which had to be surgically removed resulting in blindness for a week and not knowing if my sight would return, burns to my wrist and arm and temporary deafness from the loud bang. I was lucky!

Contributed by: Tom Roberts

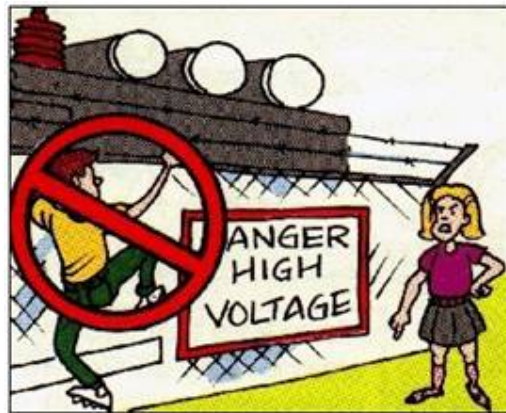
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- When working inside substations, on & near the switchgear, and where voltage transformers are present also pull the secondary winding fuses or circuit breakers. This will prevent the possibility of accidental back feed from your control circuitry or other circuitry on the secondary side. There was an incident in a power station 66 kV switchyard where all of the 66 kV side was in the process of being isolated & earthed. Somehow there was a back feed through the 110 V secondary winding on the VT which got stepped up to 66 kV resulting in a non lethal shock.
 - When finishing work involving current transformers (CTs) in electrical switchgear, substations etc, always ensure that unused or spare CT cores are shorted out, especially CTs used for protection. If energized when the circuit is open, very high voltages are developed across point that is open.
 - When entering any kind of substation through a gate, always open the gate into the substation. That way you will ensure that you are covered by substation earth grid from a step & touch potential point of view.
 - Wear good quality safety boots having soles with good insulating properties.
 - Remember need for safety clearances & know the clearances needed for various voltages (kV). As the voltages increase you don't have to touch a live part to get killed, you only need to get close enough to draw an arc.
 - No metallic ladders inside live substations.



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- Don't carry anything above shoulder height inside substations.
- Don't use metallic tape measures inside substations.
- Don't stand near HV/MV switchgear when it is being operated if possible – especially with oil filled breakers, and other types of metal clad circuit breakers.



Contributed by: GB

-
- Ok, so we should never work on live circuits, but we often do. So when (for example) screwing a live terminal-screw - screwdriver in (say) right-hand, keep your left hand in you pocket. In fact whenever there is a chance that one's hand might touch something electrically live, put the other hand out of harm's way in a pocket.
 - A bit of a nip across one hand is a lot better than a jolt across the body.

Contributed by: Ken Howell

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- It's amazing how you start to think of more things you regularly encounter once your mind gets on the safety track - there are really so many issues in the real world...
 - A small but important thing - don't wear a metal watchstrap, bracelet or finger-ring; and when working near moving machinery, don't wear a tie or anything that hangs loose.



- Also, make sure your hands are properly dry after washing them - the resistance of dry skin is of the order of kilo ohms, but that comes right down if they are even just damp. You don't have to be too careful with a 60V system, UNLESS your hands are wet! (Put a 9V battery on your tongue for a demonstration of this principle).
- When you add something to a machine or cabinet and you have to drill holes, saw, file etc. in metal enclosures to mount switches etc. above existing electrical/electronic components, don't just let the metal filings fall down all over the electrical stuff - tape a piece of cardboard or something on the back of the panel just below where the drill bit will come through, to catch the filings - either that, or cover the electrical stuff somehow to prevent "little flying short-circuits" from getting into the electrics or electronics. Then of course, don't forget to collect the filings and clean up once your holes or cut-outs are done. (With plastic filings, apart from the issue of neatness and not leaving messes all over the place, the only technical issue I can think of is that you don't want to cover a part that needs air-cooling, with a little mound of plastic that will starve it of its exposure to air).

Contributed by: Ian McMillan

-
- The first problem is that until the power is switched on we perceive there is NO danger (on new substation construction sites). This is because we come from an electrical background. The reality is that there are many hazards, electrical and non-electrical.
 - From my experience, a construction site should be treated like a turbine shutdown in a Power station. Permits are raised for mechanical and electrical works. This then controls access to areas and controls the progress and access especially when you have a transition from dead equipment to live equipment.
 - Many secondary system tests are conducted on construction sites with NO permits. And generally different civil/electrical groups rarely talk to each other.
 - A structured permit system would prevent access to hazards as it is controlled from ONE central control centre, as with a PS shutdown.

Contributed by: WP

-
- When a fault occurs, or things won't work as they should, believe instrument readings and alarms until they are proven false. It can be very damaging or fatal to think the plant is really OK and the alarms are erroneous.
 - When a trip/fault occurs it's important to visually stop and look, smell, listen and feel where these can be done safely.
 - Apply the earth with a solid firm action and sustain the earth. Let the protection operate to clear the fault. It's worse to expose yourself to the effects of flash & arc. This applies particularly in power circuits. Make sure the earths can survive the potential fault magnitude - this usually means use site-approved earths. Don't patch up an earth from whatever is available!

Contributed by: Bob Allen



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- I've been a technician and a sparky for 35 years. The only thing that nearly brought me undone was that my son used my meter while I was working on a high voltage circuit. He "blew the fuse" in the meter. I did find it before it was a fatal problem...
- I've now installed a "led" in the meter body in parallel with the leads with a series capacitor and suitable current limiting resistor. It does not effect the meter performance in any way and works from 100 volts to 440 ac or dc.

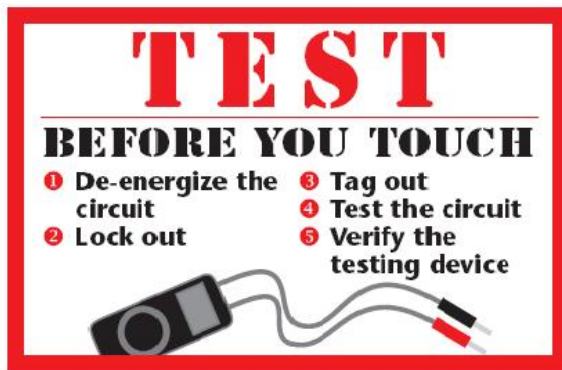
Many mates have done the same.

Contributed by: Lewis Pannell

- Sparky Rule No. 1 "TEST BEFORE YOU TOUCH" even if you have just isolated equipment.



Always test a circuit to make sure it is de-energized before working on it.



Test with proven testers

- A fuse in a distribution circuit (light & power or motor circuits) is more about protecting the cables than protection of the equipment!
- If a fuse "blows" it does it for a reason. They don't just blow ..."lets stick another one in and see" is a common response!

Contributed by: Bruce McGrath



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- Never work alone when working with electricity



Contributed by: SD

-
- Not so much a safety tip but related to your common sense theme....
"Measure twice, cut once."

Contributed by: JH

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- There is no such thing as a "mild" electrical shock, the lowest reported fatal electrical potential difference of which I am aware is said to have been recorded in South Africa where the victim had entered a swimming pool to repair low voltage underwater lights. The victim managed to puncture the callous tissue on both thumbs exposing him to a voltage through the heart which the coroner estimated to have been less than two (2) volts. Moral of the story, puncture the callous and we are all just a big bag of salty (conductive) water with a highly sensitive control system run by a pump which can be lose its timing (and go into ventricular fibrillation) as easy as blink with an application of 50hz.
 - Treat everything as live, treat all moving machinery as being about to move, treat all steam pipes as being hot to trot, treat all water pipes as being filled and at full pressure, treat anything with gas or oil in it as being about to explode, anything with vacuum as being about to implode and, no matter how low the voltage, treat all electrical equipment as having the potential with no warning whatsoever to make you totally, irrevocably DEAD!

Be alert, be paranoid, and be alive!

Contributed by: RG

-
- After turning off and tagging all switches, do a final check that the wire is dead. While not touching any other earth, brush the back of your finger across the wire to check for a tingle or shock.
 - Any electricity will cause the muscle to contract away from the wire or bus.

Contributed by: RD

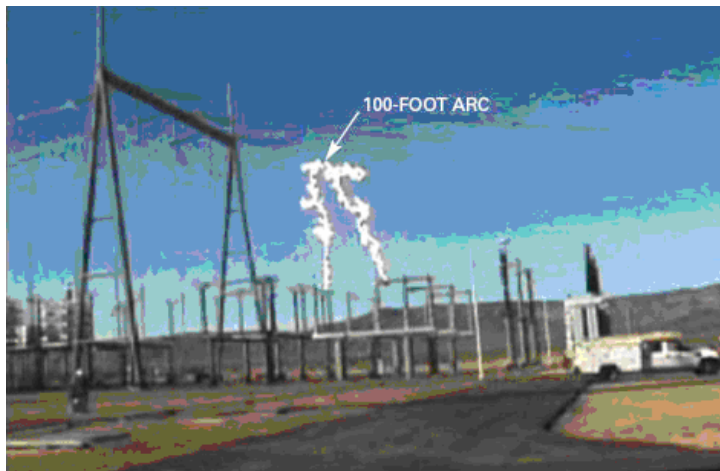
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- If it can go wrong, it might. i.e. If it can fail during commissioning or installation, you should anticipate and manage the risk of it doing so.



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- IEEE Std 141 Electrical Power Distribution: "A system that cannot be maintained because of the needs of a continuous process is improperly designed"



Contributed by: RP

-
- This one-liner is relevant to all proposed work - even at home...and not just from an electrical perspective. I have been involved with picking up the pieces after the event on a number of occasions where a person has 'challenged' its worth...ENSURE THAT THE SYSTEM THAT YOU INTEND WORKING ON IS DE-ENERGISED and have someone check that it is BEFORE work commences.



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- Obviously, there are a number of controls that are available to maintain a safe environment while the work proceeds and we must continue to be pro-active in their implementation in order to protect everyone involved, including those that may not fully understand the ramifications of their actions.

Contributed by: Graham Wright

-
- An example of incompetence from my own experience dating back a few years now - battery backed UPS systems are a particular danger and contact with 110VDC can give a nasty belt. Connecting up battery packs and commissioning these systems is a specialist job and not to be attempted unless you are very sure of your competence.

Contributed by: DS

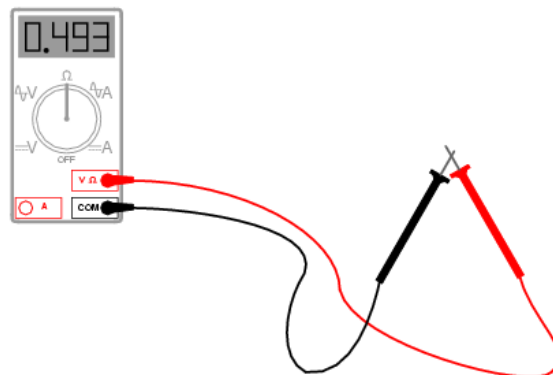
-
- Inspect EVERYTHING personally, compile your own snag/punch list - the electrical installer, contractor, consultant engineer, etc. pack up and leave after the job is complete and don't have to live with the installation on a daily basis.
 - inconvenience yourself by commissioning emergency lighting installations at night so that you can really experience the level of light provided when they're really needed.
 - pay close attention to the minute details when commissioning so that the systems do exactly what they're supposed to do in every situation.
 - Vacuum (don't blow) all loose copper and steel swarf, off-cuts, etc. from electrical distribution panels from the top down through the panel. These loose bits can and do cause nice flashes when they eventually fall into something live.

Contributed by: Brendan Cronin

Dangers of working on HVAC equipment

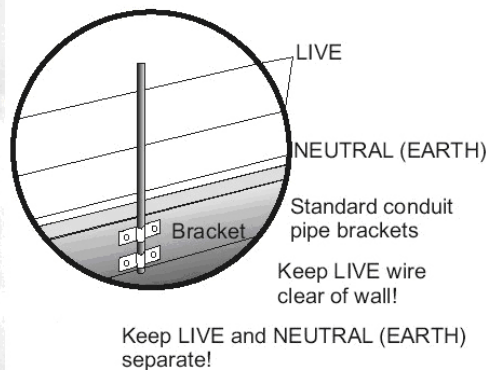
Some basic safety practices for using test instruments:

- Test your leads and meter before use. When your life depends on the reading obtained it is important to do this. Your leads could be open circuit or the fuse blown. As a result you could be touching a live circuit.



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- Check the range you are using and jacks plugged in on your meter before attaching to the circuit. If you have the leads in the amperage jacks and you apply it to 600 volt (or higher) you can be burned by the flash at your meter.
- Always use flash arrested fuses rated and specified for the test instrument (previous reason).
- We used a practical test assignment to reinforce the lessons covered in class and written work (see attached). We also showed them photos of electrical burn victims through a consultant whose wife worked in the Hamilton area burn unit. After the presentation we had them test a fuse on a 3 phase circuit. Let me tell you, this got their attention. Many would be visibly shaking and thinking carefully when making the test. I never advocated having a “respect” for electricity (you hear this all the time). I preferred they have a “fear” of electricity first and foremost to make them slow down and follow procedure in every situation.



Contributed by: Bill Davies

Another common-sense prompter ...

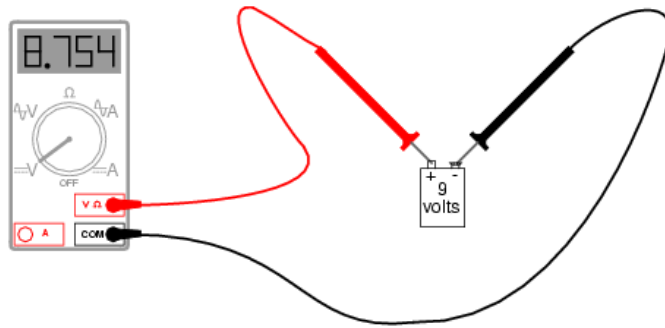
- When working on an electrical cabinet within a group of cabinets, confirm what number cabinet it is from a common start point – for instance the 3rd cabinet from the left in a group of 7 when viewed from the front will be the 4th from the left when viewed from the rear. Many well meaning electricians have inadvertently started working on a cabinet that was assured to be dead when in fact it was live – due to counting the cabinet incorrectly.

Contributed by: Steve Oldfield

A useful point when working on electrical / electronics equipment:

- It is a good practice to never assume that a piece of equipment is electrically "dead". Trust your multimeter and not your instincts! It only takes a few seconds to do a basic voltage check on the correct range of the multimeter - (very important to prevent damage to the poor multimeter!) This will save nasty surprises and yourself from possible embarrassment.





Contributed by: Kevin Williams

A tip resulting from a nasty little experience received some years ago while working on an inverter drive and its hefty filter,

- Beware of leakage currents from enclosed mains filters or other high leakage devices; ensure they are correctly bonded to earth before commencing work on them.



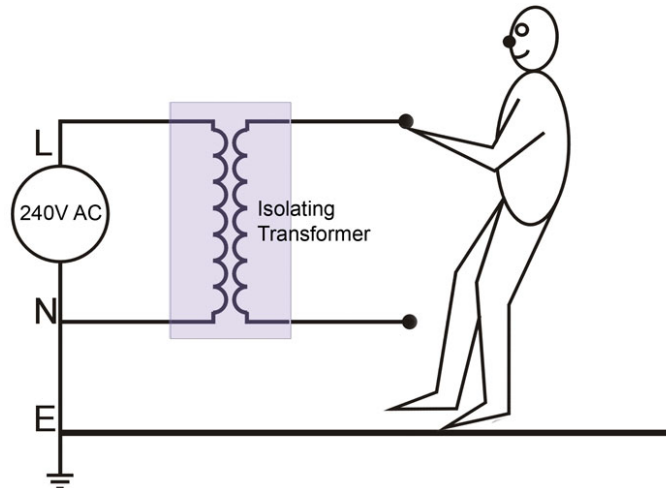
Contributed by: DB

Regarding plant safety - a few points:

- The standard way of protecting users of electrical equipment is to have a safety-earth connection to metal enclosures. This works fine until your earth connection becomes disrupted somehow - corroded lugs or wires, etc. Also, if lightning strikes "in the wrong place", your mains utility earth can suddenly have many thousands of volts relative to a 'local earth' (the floor a person by a machine is standing on) induced on it, and the safety-earth becomes the very carrier of lethal voltages. Wherever possible, the use of isolation transformers in front of equipment is safer, and worth the little extra capital outlay.



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- When designing equipment, always consider both the most likely as well as all possible failure modes - ask "what will happen if this fails in this way (eg. IGBT blows short-circuit), and what will happen if it fails in that way (eg. IGBT blows open-circuit)...??", attempting to exhaust all possibilities, for example remembering that open-circuits in wiring & switches are more likely than short-circuits but short-circuits are always a possibility, and short-circuits in blown semiconductors are more likely than open-circuits but the latter's always possible. With limit switches and safety interlocks, always use "normally-closed" circuit configurations whenever possible, and use backup/redundant systems whenever possible. (This is a whole study in itself – in certain applications, even redundant voting circuits are justified).
- While on this subject: Don't trust transformer less UPS's and inverters - although they're cheaper, the day you have an IGBT/MOSFET fault and a fuse doesn't blow quick enough, you put 400V DC onto your sensitive AC-powered equipment. (Of course you can always add a transformer to transformer less UPS/inverters).
- I say, don't just rely on a visible earthing or the fact that you think you have unplugged the equipment, before you touch connections on equipment - check with a DVM, You can also use your DVM to check between the ground you are standing on, and the point you are about to touch.
- Before working on a machine or panel, always think "Who might need to know that this equipment is being worked on?" and inform them, as well as of course locking-out equipment ON switches or circuit-breakers. This is particularly important in complex inter-dependent systems where inter-dependent machines or components are physically separated – for example, operators of a pump several kilometers away may need to know that you are working on a safety-valve and they should not switch the pump on!
- When designing equipment, always over-rate by a good margin – NEVER use a 40Amp IGBT to drive 40A - it is like driving your car at full-throttle all the time - it will not last; In the same vein, spend a little extra money protecting sensitive equipment with fuses, MOVs etc. - equipment that is reliable is ALWAYS safer than equipment that is not.

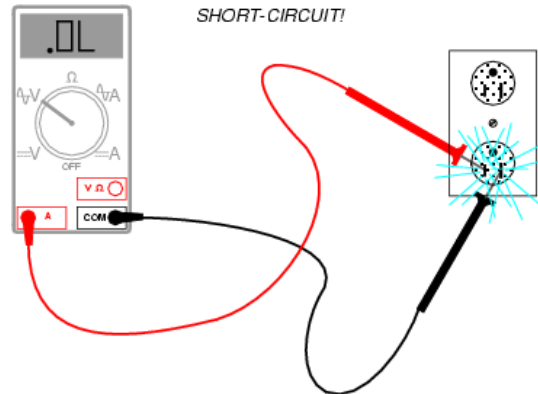
Contributed by: Ian McMillan



- Always check the electrical drawings match the instruments supplied, as the installation electrician will have followed the electrical drawings. Connecting 240v AC to a 24v DC flow meter is never good.

Contributed by: Richie Muia

-
- When using a Multimeter ensure that you do not measure AMPS by mistake across a voltage source.



- If somebody has done this, your in-line current may read ZERO due to a blown fuse.

Contributed by: Martyn Steadman

-
- Always close and lock electrical panel doors when switching on power for first time. Internal faulty switchgear can cause serious injuries. This did happen to me when a large contactor was internally faulty. Normal commissioning practice is to check for short across phases, but engineers seldom test contactor integrity.

Contributed by: Philip Snyman

Instrumentation and Electronics

- Make sure you don't inadvertently put the PLC into run mode.

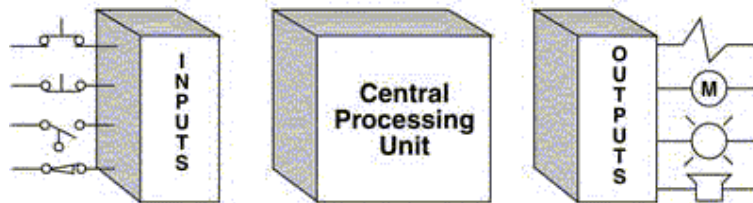
Contributed by: SGM

- When removing instrumentation from panels make sure the panel is isolated. Old panels may not have insulated lugs and getting hooked across two 240 V switches makes for 415 V going through you.

Contributed by: Leanne Pyle

Always keep a PLC commissioning log book.

- Log every Input or Output that is "forced", they can soon be forgotten about. Log all changes to Counters, Timers etc.
- Leave the log where anybody who can alter the PLC program/settings can update it.



Serial no:	Input	Conditions	output
1	x	XXXXXX	XX
2	XX	XXXXXX	XXX

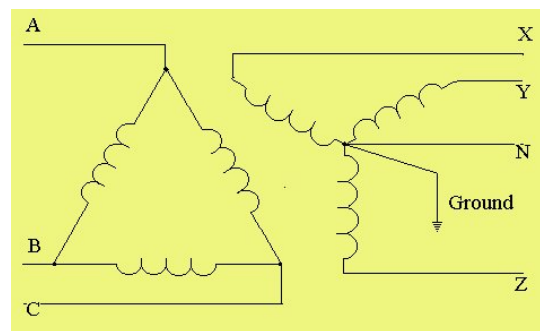
Contributed by: Robert Hewitt

- Take off your wristwatch before plunging into an energized cabinet - human skin is not a bad insulator if you let it work for you.
- Don't assume that earth potential is uniform - particularly if the plant has been designed in USA. A frame grounded to the transformer star point, and a 'clean' instrument earth can be a thousand volts apart if a power system fault appears. And some folk insist on separating them...
- Isolated earth doesn't necessarily mean safe - 240VAC can float nicely on a 4-20mA signal, but your fingers will pick the difference. A supplier provided an isolated analog output by removing the earth link from his power supply.
- Not all 4-20mA circuits are 1-5V across a 250 ohm resistor - 14 to 10V may surprise you (at least one designer did!)
- Don't assume that all range resistors are 250 ohm - beside the traditional 62.5 ohm, and other deliberate ones, a bundle of 240 ohm precision resistors randomly installed gave delight to one FAT.
- And bless the PLC manufacturer who standardized on 0-10V input cards, or who decided that analog inputs should go FFFF at 20.01mA.





- Not all supply transformers are the same flavor - two three-phase sources in a single 240V circuit-breaker board feeding HMI screens - one from star-star, the other from star-delta transformers. And we were wondering where a 50-odd volt difference came from.



- Compressed air offers a mass of fun. Try applying 700 kPa to a 20-100 kPa actuator (not hard if a regulator fails!) and watch the top works go into orbit. Similarly, a blocked relief port on supply to a pneumatic DP transmitter may just give a noisy output, but your calibrator may die if you plug it in. Feeling whether a filter drain is plugged can blast a hole in your hand, and gangrene is so permanent.
- RTFM needs to be drummed into every newbie - and his seniors. Read the MSDS before you need the first aid treatment, not after. How many plants carry the recommended antidote for glycol poisoning - most ban it except in the boardroom.
- Nitrogen is a great blanketing gas to keep electrical equipment safe in a hazardous area - until the tech puts his head inside. It works as an emergency backup on instrument air too - then someone plugs in an air-fed respirator.
- The electrical inspector from the supply authority, who insisted on meggering every wire, including the IS circuits, and reported a lot of bad insulation.
- My long-term favorite was the lad who 'borrowed' a length of 12mm OD tube supplied with a European compressor and thought it was 1/2", like all the other tubes on site. Chopped it into little pieces for 7000 kPa installation and left the site before the first section was tested. It held pressure for several seconds before it self-disassembled past my ear.



- Or the economical soul who bought ERW tube when the specifications said seamless. That little 1mm wide flat on the OD makes for needing a fitter with a strong right arm to tighten the tube fittings.

Contributed by: IHG

Some 'not so obvious' commissioning problems experienced:

- DP Flow measurement loops reading low due to two square root extractions, one in the transmitter and one in the DCS or panel inst.
- Multiple or no 24vDC power supplies when signal conditioning or isolation components are added to an instrument loop. i.e. more than one item trying to power the same loop.
- Open circuit 'spare' analogue inputs generating interference, affecting readings on adjacent 'in-service' analogue inputs.
- Smart transmitters accidentally left in 'loop check' mode i.e. fixed output.
- Thermocouples or resistance bulbs not long enough for the thermowell giving low or long lag readings (not good on high temperature ESD systems!). Normally only applies to install upgrades re-using existing thermowells. Check all temperature probes hit the bottom of the thermowell before the connector block hits the bottom of the connection head. Thermowell exposed length is usually adjustable to accommodate small variations in length.
- Thread mismatch on instrument impulse line fittings when upgrading old plant e.g. 1/4" BSP and 1/4" NPT. A fitting held in by only a couple of threads can pass a pressure test but can fail when on-line especially if any lateral force is applied to the tubing.
- Incorrectly made up compression fittings, can pass pressure tests but fail later when on-line. Ensure all pipe fitters are trained in correct make up of the specific fittings to be used. Using a gauging tool to check 'pull up' after installation can reveal some of these. Use in conjunction with disassembly and inspection of a percentage (say 2%) of fittings initially, more if this reveals any problems.
- DP level installations fluid density mismatch with values used in calibration calculations leading to overfilling of tanks.
- Transit stops left in position on new equipment

Contributed by: Ron Wilkinson

-
- If an instrument has been put into 'Hold' or 'Cal' mode to carry out work, check if this state will time-out after a given period (This is sometimes set by manufacturers and will happen if there are no keys pressed).

Contributed by: Larry Cant

-
- ground all equipment racks, cable trays, cable ladders, etc. it may save you a fortune in the long run.
 - install high quality UPS to power everything in a Communications centre, it provides active permanent power filtration and stability, not just backup power in an outage.

Contributed by: Brendan Cronin



Mechanical

Stationary hydraulic power units and mobile hydraulically operated machines.

Here are some safety tips:

- Before isolating the machine, bring all the moving components to a safe position. Consider what would happen if the hydraulic actuator (either a motor or a cylinder) is removed or if the hydraulic lines to it are removed. If the work piece or arm can fall – sling it, or take the necessary precautions.
- If there are accumulators present, then one must blow them down. Any good hydraulic system will have a blow down valve. This will release any stored energy.
- When removing any component, isolate the fluid supply, or if necessary, drain the reservoir of oil. Uncontrolled spillages are dangerous.
- When breaking a line, it is normally possible to loosen it first and then move it from side to side, without actually disconnecting it. If there is still oil under pressure in the line, you will quickly find out and the situation can be recovered.
- Hot oil and oil under pressure is extremely dangerous – always wear safety glasses. A high pressure oil leak, which sprays oil mist into a room, presents a serious fire hazard.

Contributed by: Chris Arbous

-
- When installing new equipment there needs to be a definite procedure and follow up to ensure Mechanical installation guys are locked out. When the first available disconnect is installed for lockout it should be done. We have learned from experience that mechanical guys working around the clock can get missed easily.

Contributed by: Davey K Simpson

-
- Tip: Rather be too slow than too fast when opening steam & compressed air valves.

Contributed by: GH

Sometimes it is those small areas we tend to pay less attention as we go on with our daily engineering work, here is a reminder to everyone:

- Make sure you have a fall-back plan whenever you climb a ladder or structure 1.5m above ground.





Contributed by: HM

-
- Some large rotary equipment has severe safety implications if driven the wrong way. To avoid this it is common practice to bump the motor with coupling removed to check rotation. If rotation is wrong this is corrected by swapping over any two phases. I was involved in a case where this was done but then just before start up a large transformer was replaced and the installation company got the phases switched. The resulting accident was expensive and could have involved serious injuries.

Contributed by: Dennis Jewitt

-
- Always ensure remote or auto start functions are isolated before working on diesel powered equipment.

Contributed by: GA

-
- Ensure that when isolating mechanical equipment also consider potential energy i.e. blades on a large fan moving under gravity or wind.

Contributed by: PL

-
- I always stress to our new plant operators to watch out for the Stored Energy that you can not see.
 - The UPS back up generator that can start automatically after a time delay.
 - The battery powered small backup UPS under the desk in the office that the office worker has plugged in an extension cord that goes into the next office.
 - The Nitrogen accumulator sphere that provides smoother ride on the front end loader bucket that is fitted in the hydraulic line.
 - The hydraulic ram on the bucket arm that becomes pressurized when the jack that was holding up the machine to change the tire is lowered.
 - The compressed air in the reserve cylinder the spray painter uses to take out the pressure fluctuations.
 - The water in the tank up the hill that can feed back into the pump site well where you are working on electrical wiring.



Contributed by: Kevin J Kelly

-
- An example: don't touch things to get a temperature reading! Shiny (low emissive) items give no indication of their potentially skin frying temperatures. Examples: kettles, chip fryers, exhaust pipes.

Contributed by: Harold Heyworth

-
- Closely supervise the installation of specialist equipment (particularly that which the installer knows nothing about and is only providing the pipe work). It is installed the right way around with inlet and outlet correctly connected.
 - Read the equipment manuals, there's a fascinating amount of information there that, sometimes, even the agent/installer knows nothing about.

Contributed by: Brendan Cronin

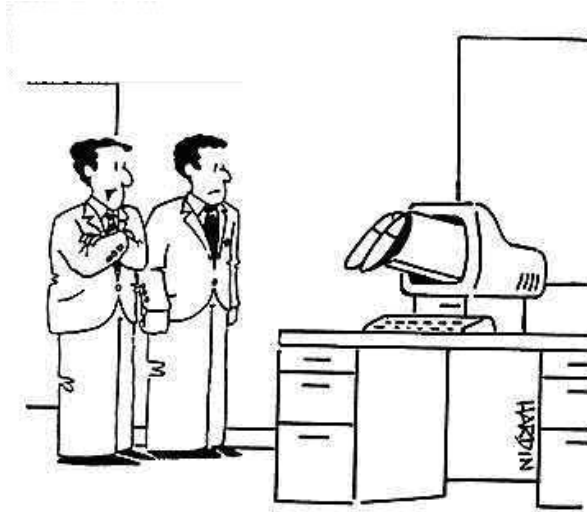
-
- There is such a thing as too much grease. (Over greased bearings = overheating).

Contributed by: Bruce McGrath



IT

- Assume the software is not working until it has been tested



"Everything was fine until he pressed 'upload'."

Contributed by: SGM



General Commissioning Tips

- A proper Risk assessment is invaluable during commission. It makes the participants aware of any possible threats of all types of energy sources. It has become a part of my life when planning and executing commissioning activities and even the young and less experienced members of the commissioning team become aware of each and every threat through participation in the Risk assessment procedure.

Contributed by: Andries du Toit

-
- I come from a very practical background having started in 1983 as an apprentice electrician in a very small contracting company and then moved on to Eskom, South Africa, where I did operating, maintenance and installation work of 230V - 132kV power lines. Cables and substations. I trained in live line work and became an instructor. I then left Eskom and have been involved with a consulting company for the last 12 years.
 - There was an older Supervisor who taught new operators in Eskom. He Drilled into you a simple philosophy - "Where am I? What am I going to do? And What can happen?"
 - I believe that if you stop and ask yourself those three questions before You take action then many problems would not happen.

Contributed by: LD

You can add these:

- Never assume anything! Ask.
- Don't bet your life the documentation matches the installation. If it has been worked on more than twice, assume it does not match.

Contributed by: Bruce Paterson

-
- Here is a rather good tip my father gave me the first time I was on site up in the Athabasca Oilsands (south east of Fort Mac).
 - He said "*Never put your fingers anywhere you would not put your 'tool'*". Sounds funny, but this simple bit of advice made me think twice on many occasions, and I still have all my digits.
 - Safety sounds good on paper, but up in the middle of the bush, no one looks out for you but you.

Contributed by: DG

The Rules:

- Never assume anything! Your best mate might end up killing you because you thought he would do the right thing.
- Be sure about what you are about to do, what others are doing and what will be done. Don't wear blinkers.
- 'Should' is a banned word, use definite terms like 'Shall', 'Must' and 'Will'.



Technology Training that Works

- Don't be afraid to ask dumb questions. Chances are others want to ask the same thing.
- If in doubt, don't!

Contributed by: GR

- When faultfinding, use your eyes first and not your tools!

Contributed by: VP

I feel I have a couple of tips that I use after many years in the industry.

- With regards to electrical equipment always consider them to be live until it is fully isolated and tested to be not.
- When returning to work from a break assume that things have changed and recheck for live power etc.
- Upon arriving at site always do a job safety analysis even if you are familiar with the site as things do change and this gets safety foremost in your mind.
- If you are unsure, ask questions.

Contributed by: Graeme Fedley

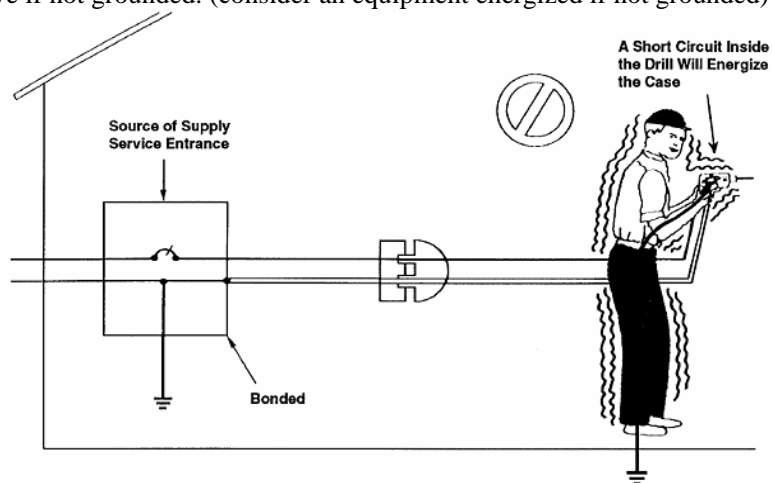
Commissioning tips - sage advice:-

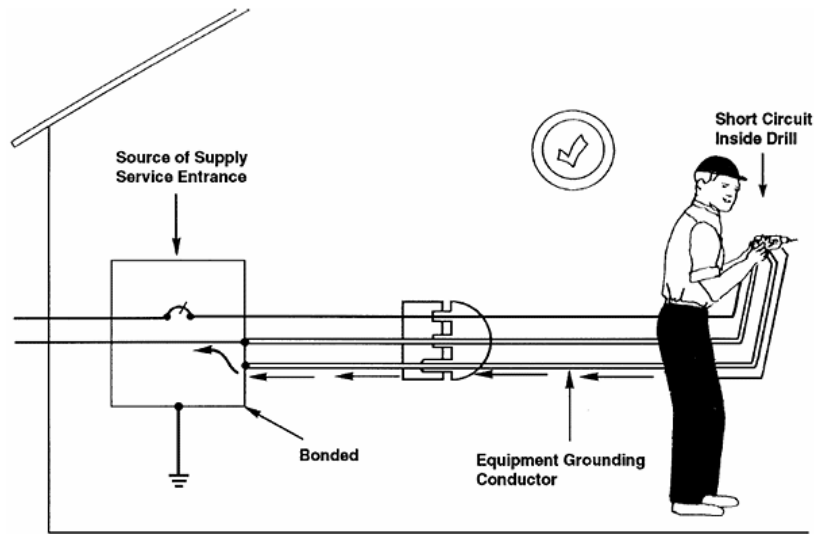
- How about?
- Commissioning is - when the frisky tom cats of innovative design, value engineering and supreme optimism meet the sharpened scalpel of reality.

Contributed by: Mark Horton

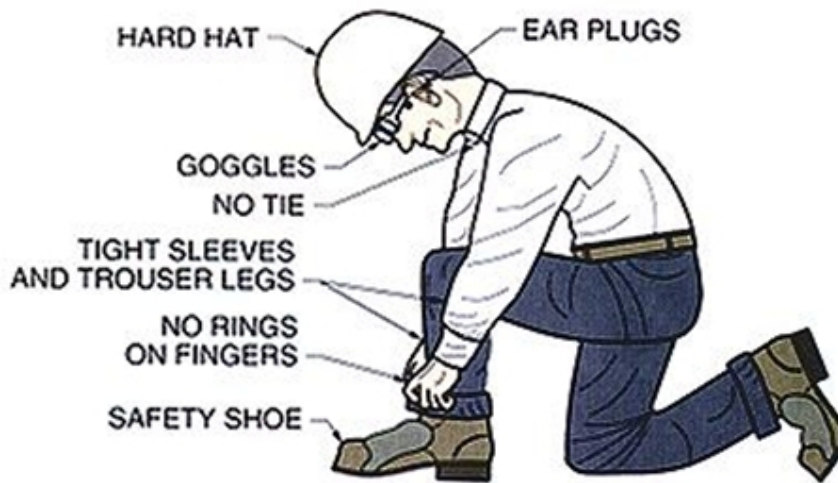
The following are suggested based on my experience as utility electrical engineer.

- Trust test equipment or sensor to verify dangerous potential than your personal belief or knowledge or experience or attached label to identify a dead (not energized) equipment. (Few occurrences happened by identifying wrongly the de-energized equipment)
- Live if not grounded. (consider an equipment energized if not grounded)





- Safeguard by barricade, warning sign and supervision where unusual voltage applied/available. (Perhaps a test site where high voltage testing is performed in the field, safeguard at all places where high voltage will appear)
- Wear personal safety gears (helmet, safety shoe, goggle etc)



- Electricity is your friend if you use it safely.
- Safety first, work next.
- I am responsible for my own safety. No body else.

Contributed by: PT

-
- Check your wedding ring and maybe your watch or other jewellery. Especially in Electrical.
 - Tuck your tie into your shirt while on site. It might save your neck.

Contributed by: AP



Technology Training that Works

My safety tips are for trenching for cable installation:

- Never walk behind a digger (it's kind of like a horse, it may kick you if it doesn't know you are there!)
- Always ensure you have established eye contact with the machine operator and you have made your intentions clear to the operator if you are going to move within the operating area (reach) of the machine.

Contributed by: MT

-
- One of the most important things for everyone to understand is not to be bullied into doing an action, a test unless the intention and all contributing issues are clearly understood. Too often a young engineer is considered to be the most senior person in a group of trades people and given the larger responsibility in testing, isolation or a general procedure, and they simply don't understand the issues and are intimidated into leading by example. If unsure, they must ask or refuse to undertake a particular action.

Contributed by: GB

Here are two points:

- Have a small reminder of safety each day. In the electrical industry we have a tailgate session. A session where hazards are identified on site and the 'eliminate, isolate and reduce' theory is used.



- Second, have health and safety meeting, but not too frequently. We found that once a month just turns into a bitching session. We conduct a meeting 4 times a year and the meetings have been very productive and focused.

Contributed by: Peter Hemming

-
- Always check that documentation that is being used to script a program is current and available to commissioning technicians and engineers.
 - Checking of equipment status against an up to date diagram should give some overview before testing starts. (e.g. equipment may be found in service position when pressure testing is about to start).

Contributed by: JH

Good one that comes up loads for me when commissioning, across many industries.



- When a perceived control issue is reported, never assume the problem has been described correctly; always fully check the background for yourself.
- For example: Urgent panic from Project Manager: The flow control of that set of pumps isn't working properly, can you look at the design and revise the philosophy/ software accordingly.
- Actual problem: one pump ragged up, just needs cleaning - control system perfectly fine!

Contributed by: Neal Dudley

-
- Keep one hand in a pocket (prevents connection across your chest!)
 - Keep both hands in your pockets and watch the apprentice!
 - Wear wellies!
 - Remove watches, rings and ties (mechanical moving parts only)

Contributed by: Bob Moreton

Here are points I have found useful -

- Firstly the issue of competence under the CDM regulations. If you are going to do anything practical at all, college degrees and even undocumented experience are unlikely to be enough. My observations worldwide with offshore and onshore process plant commissioning is that competence is a rare enough commodity. We now use documented limits to our commissioning engineers' competencies and record training and site experience they gain against these. We can if necessary add to their capabilities. We are all chemical engineers but often face E&I issues on site. The defined limits to our competencies helps avoid the natural tendency to 'have a go'. A helpful web link is attached below.

www.hse.gov.uk/construction/cdm/session7.PPT

Contributed by: DS

-
- Never assume, it makes an ASS of U and ME!

Contributed by: DW



Technology Training that Works

Controversial

These tips may be acceptable in some countries but not recommended at all – or do you want to be sacked ?

I STRONGLY disagree with the following tip:

- If you have ensured that everything is disconnected and still are unsure and want to ensure that an LV bus or terminal is dead; do so by touching the part in question with the back of your fingers with the palm open and facing you. If the part is live, the shock causes the fingers to curl and the arm to move towards the body (both are involuntary reflex actions), thus breaking the contact. Touching in any other way can be fatal.
- I would hate to see this included in any book produced. In most businesses this would be a sackable offence as it goes against all safety rules that we enforce upon our employees.

Contributed by: LB

You wrote in your last letter as safety tip:

- "If you have ensured that everything is disconnected and still are unsure and want to ensure that an LV bus or terminal is dead; do so by touching the part in question with the back of your fingers with the palm open and facing you. If the part is live, the shock causes the fingers to curl and the arm to move towards the body (both are involuntary reflex actions), thus breaking the contact. Touching in any other way can be fatal."
- This was probably an acceptable method 20 years ago but now it is far from that.
- If I want to check that an LV bus or terminal is dead I will use a multimeter, a lamp test or a non contact voltage detector. In no circumstances I would use my hand to do that. If I do not have any of this then I am not prepared to do the job and it is better not to do it.

Contributed by: Adrian G.

-
- Our policy on any switchboard is to have fully insulated busbars . Where it is not possible to insulate the busbar joints then protective barriers are installed in front of them. Thus there are no live bars to carry out the practice of brushing the busbars with the back of the hand (which was a method as you say 30 or more years ago)
 - This method is not allowed today , just by occ health and safety reasons alone, apart from the electrical issues.

Contributed by: Graham Rasmussen



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