18th Edition of BS7671 Brings New Problems (Version 2)

Regulation 702.55.4 (ii)

This was included in the 17th edition but I do not know of one site where it has yet been carried out.

My interpretation of this regulation is as follows:

The regulation states that access hatches for swim jet pumps must automatically switch off the electrical supply when they are opened, as sometimes 230V but often 400V is present to the motor.

Sounds easy, HOWEVER…

1 This means that there will have to be a SELV cable (24v DC ideally to the pit for this safety switching so any works under construction will need to have in a conduit installed as these regulations were in effect since 2015 and remain in effect from 1-1-2019 in the new regulations and ground works may have been finished now.

2 The lids of these pits vary from a light weight piece of plywood to very heavy concrete filled paving slab filled "beasts" that take a hoist to lift or two or more men (some thoughtful installers are using hydraulic assisted pit covers which still need to comply).

3 The problem is, what type of switch to use that won't get damaged when the lid is lifted by an engineer not knowing that there may be something attached to the underside to operate the switch?
(i) We cannot use a lever arm switch as when an engineer leans down into the pit he could inadvertently turn this back ON. It seems to me whatever guarding there is you could activate the switch.
(ii) We have tried optical reflective guard switches but when condensation got on them they have switched the pump off with the lid down.
(iii) I personally prefer a magnetically linked or metal sensing proximity switch if a robust and waterproof one could be found as an actuating magnet could be rebated into the underside of the lid. It would be long lasting and mechanically strong.
Alternatively, a metal proximity sensor would have a plate secured on the underside of the hatch or sense the metal of the hatch itself if it is of metal construction.

4 There are problems testing during maintenance. For most instances when the lid is lifted the engineer needs to run the pump so this safety circuit needs to be able to be over ridden.

(i) With a spare magnet or piece of metal kept in the plant room, the switch could be over ridden.
(ii) The question arises, 'Should there be a re-set as part of the controller once the lid has been lifted?' The override magnet could be put in position then a re-set button pressed in plant room to re-establish power?
(iii) I think that there should be an audible warning that the override is ON but this could fail and adds complication.

5 In addition to this, these pits are very prone to flooding. At little extra cost, a flood warning sounder could be added with a low voltage float switch.
(i) There are often submersible pumps in these pits to deal with ground water that may have to stay active during construction or maintenance when the lid may not have been installed. Though the regulation is primarily for the end user's safety during operation, there is no exception for works during construction

6 This regulation is obviously to prevent people from being able to touch live electrical equipment while in the pool or the surrounding area while in use, this being the case, what is the difference between a swim jet pit and mains powered cover drives pits, backwash pits with submersible pumps and some balance tanks with submersible pumps installed?

7 There are also the many installations where spa pumps and air blowers are installed in a crawl space "undercroft". They can all be equally dangerous and very often there is only one person on site.

8 The problem is a lock off isolator does not allow for commissioning or fault finding where the power needs to be ON.

9 I feel it is important that a Standards Committee looks at this regulation and the ways it can be implemented in order to provide a solution. A situation whereby use of a tool to open these covers may be acceptable but this exception needs to be written into the standards.

Earth Electrodes where a Swimming Pool Installation is Connected to a PME – (TNCS) supply.

A PME or TNCS supply is where the supply cable to the property uses a single conductor for earthing and neutral currents up to the service fuse (it is not permitted within the property).

There are many installations where a swimming pool is within the same metalwork structural area as the rest of the property making it difficult to make the pool area TT. In

this instance there is no alternative than to utilise the supply earthing which will often be PME. (Regulations 702.410.3.4.3.)

Note: Reg 415.1.1 requires an earth electrode with a test reading below 20 Ohms to be installed where a PME earthing facility is used as the means of earthing for electrical installation of a swimming pool or other basin (spa, pond?) The electrode must have a resistance to ground of 20 Ohms or less which is fraught with problems.

See BS7671 On-Site Guide Page 213 - 11.3.12 explains the problem.

A swimming pool or spa installation will almost always be connected to other parts of the installation by parallel earth paths which will almost always be copper water mains, copper gas services, metal oil boiler oil lines or heating pipework, all of which have connections in the pool area and the house making it impossible to make the pool area separate from the house on its own earth stake. Either the whole house may need to be put on an earth stake or insulating sections need to be placed in pipework in at least two places which is almost impossible with gas services unless underground.

The other thing to remember is that with the increasing amount of IT equipment, often cables go from a BMS or other item of home entertainment to pool equipment and are often wired in earthed screened cable where the screen is also the negative DC conductor and is earthed. This makes the system FELV not SELV (safety isolated from earth) and as such is not allowed to be within the pool area . The screens of coax cables for AV equipment have also been found to bridge the gap between TT and PME earthing parts of the building.

The serious problem with this is that if there is a fault to ground, the earth electrode will always be at a higher resistance than the coax data cable or oil line and all the fault current will use this path resulting in possible damage or fire as the conductor size is so small (hopefully protected by the RCD in real life). This can also have serious possibilities for electric shock or carrying electric currents in excess of their capacity and catching fire under conditions where the external supply cable becomes faulty or damaged. No RCD will protect against this situation as it won't see it.

In some parts of the country it will be very difficult to achieve a reading of 20 Ohms.

I, for one, would not be prepared to quote to install an earth electrode to get to this value.

This is not so much of a problem on a new installation whilst ground works are in progress, however, often the electrician only gets called in when the job is 99% completed. They may have metallic services to heat exchangers air conditioning duct work secured to structural steel work that goes throughout the property, so an earth electrode needs to be installed below 20 Ohms with all the paving work finished. This is

going to cause a BIG, BIG problem. Sometimes earth electrodes need to be installed over a wide area to get the resistance to ground reliably below 20 Ohms.

My interpretation is that this includes where a garden socket is installed. Also of concern are spas on patios connected to a socket on an existing ring circuit, this will be extremely expensive to install a 20 Ohms earth stake. Probably the best solution, if anything outside is to make the socket TT with a local earth electrode that is allowed to be up to 200 Ohms but ideally a maximum of 100 Ohms if this is practical.

Selection of RCDs (re: Swimming Pool Installations) Regulation 531.3.3 18th Edition BS7671

This problem has been creeping in over the last few years.

There are two problems:

i. Nuisance tripping

ii. RCD effectiveness (its ability to protect life) blocked by DC element and harmonics caused by the RFI/EMC filters and variable speed electronic drives.

1 Nuisance tripping is what it says; a nuisance and not always a safety issue. However, it can cause the user to become annoyed and decide to remove or replace the device or can create multiple service calls with increasing frustration from the customer (and the engineer).

2 RCD blocking is a seriously dangerous problem and, with more variable speed drives and certain types of low voltage power supplies, we are beginning to see this happen. Very recently, a colleague tested an installation and the RCD failed to operate within the required time. He changed the RCD, the new unit also failed the test, he tested both RCDs with nothing other than the tester connected, both were OK. The problem only occurred when one LED emergency light was connected.

Manufacturers say to test RCDs on their own, but it is what happens in practice that matters.

THIS IS GOING TO BE A MAJOR SAFETY ISSUE where variable speed drives, inverter AC units and other electronic power supplies and controllers are utilised.

We now rely on RCDs for so many circuits. We do not know what end customers will connect to installations. In my office the PCs and printers on RCD protected sockets in recently issued leakage figure well exceed the 6mA for a type AC RCD.

Items of equipment potentially used in a swimming pool installation that may affect RCD correct operation:-

- **Any speed controlled pump**
- **Inverter heat pumps**
- **Some central heating pumps**
- **LED lighting**
- **Salt generators**
- **Ionisers**
- **Some chemical controllers**
- **DC pumps**
- **Air handling units**
- **Possibly some cover drives**

I am told that manufacturers are supposed to advise what type of RCD each piece of equipment requires. I have yet to see only one product data sheet that includes this information.

A major problem is that the leakage varies with speed and load and is affected by the cable length between the speed controller and motor. The longer the cable (that must be screened), the greater the leakage.

I believe that we need to know what the leakage current is on every piece of equipment.

The major problem is that we do not know what the leakage is from any of these devices. The leakage current is going to vary dependant on speed for pumps and load on other devices. Installers will upgrade pumps or heat pumps and not think that the RCD may need to be changed. The greatest risk is that it could be blocked from operating when needed and nobody will know about this until it is too late and a fire or electrocution has occurred.

We have undertaken several installations this year where we have had to fit individual RCDs on each speed controlled pump because the leakage from two pump speed controllers have exceeded the capabilities of a single 3 phase type B RCD which will not be blocked by the variable speed drive.

As well as the extreme additional cost of type B RCDs, there was also extra enclosure size required to house the extra components (not forgetting that wall space is often at a premium in plant rooms).

(See chart in Voltimum article referenced below regarding RCDs.)

These RCD are very expensive, 3 phase versions cost to us in excess of £550.00.
The second cost problem is that there may have to be an extra Isolator and several RCDs. That will make the enclosures larger.

To sum this up, we now have an industry whose electrical installations are totally reliant on the use of RCDs for safety that can be rendered inoperative because of the energy saving equipment we are newly connecting or retrofitting to it.

There is an excellent article written by Chaz Andrew, Technical Manager at Doepke which can be read on the Voltimum website which goes into more depth. The link is:
https://www.voltimum.co.uk/articles/rcds-and-18th-edition?b=VOU&ca=ARTICLE&t=NORM%2CPANL&utm_campaign=18_07_31_VoltiTech&utm_medium=email&utm_source=newsletter&p=E

As far as surge protection and arc fault detection is concerned, it would appear that where the equipment being protected exceeds the value of providing this, the regulations are saying that this must be installed. Our installations do protect high value equipment supplied by you, especially the electronics involved with water sanitation and energy control such as inverter controlled pumps, DC vary speed pumps and invertor heat pumps.

Electair Exports intend to:

1. Redesign our control panels to allow for higher earth leakage faults, details later.

2. To design a swim jet pit protection unit once the Standards Committee have had a time to recommend on this.

3. To produce a heat pump connection unit that allows for larger heat pumps to be added to existing installations with a separate RCD protection and pump interlocking so that adding an inverter heat pump to an existing installation will avoid needing major works on the existing controls.

4. Subject to finding the correct sensing coils, we intend to put together a test rig (which will include a 4G transmitter) that will monitor the AC leakage and the DC disturbance on new installations. Control panels manufactured by Electair from 2019 onwards will have the test rig loaned for a one week period, free of charge, including transit time, allowing three days on site . Any other person wishing to use this test rig on existing installations or other manufacturers' equipment may hire the same at a cost of £100 per day or part thereof plus VAT including transit.

For this system to provide remote monitoring and print out, this rig will require either a 4G phone connection or LAN connection to the internet and will be connected to our Electair Connect monitoring website. You will be provided a login to access this.

On the unit there will be switches you can select as to which load you are monitoring. You will be able to see on the printout from our website the test results over that three day period on site the loads you had switched on at that particular time. More information will be available shortly.

5. As information becomes available, we will publish what leakage currents can be expected from various makes of equipment on our website.

I would be very interested to hear the opinions of the Standards Committee on this. Any other comments would be welcomed, please email me at roger@electair.co.uk