The Electrical Expert
Forensic Analysis & Expert Witness

6/5/2012

Mark Norris
5527 Camelot Street Dr.
Charlotte, South Carolina, 28270

Re: INSPECTION POOL AREA VOLTAGE GRADIANT
"ELECTRICAL SHOCKS"

Dear Mr. Norris,

Pursuant to my inspection of your home starting on 6-1-2012 resulting from you experiencing electrical shocks getting out of your pool I found the following:

It is not uncommon for Electricians to confuse bonding with grounding in the electrical code. Grounding and bonding are two different topics. Grounding is utilized to maintain all of the equipment in your yard at the same potential as the Utility ground at your service meter.

Bonding is utilized usually with bare conductor to connect pieces of electrical equipment together that are in close proximity to prevent electrical shock if somehow a potential difference is created between two pieces of equipment that you could touch at the same time.

In your case you have sub-panel to service all of your pool equipment. As required by code there is a ground wire pulled in from the main panel to the service panel. All of the equipment fed from the service panel is grounded via a green insulated wire where the source ground is fed from Duke power ground as required n Article 680.25.

Your motors for example were already grounded internal to the motor via a ground insulated conductor, coming from the ground block at the sub-panel in compliance with section 680.25 of the code. , THE BONDING WIRE MUST BE CONNECTED TO THE SAME GROUND FEEDING THE MOTORS COMING FROM THE DUKE POWER GROUND SOURCE. In your case all bonding wire in the pool pump area was connected to bare copper grounds in the ground coming from the pool, thus creating another separate ground rod other than the utility ground CAUSING CIRCULATING CURRENT IN THE GROUND GRID THAT CAUSED THE VOLTAGE PROBLEMS YOU ARE EXPERIENCING.

Consequently, I found the pool pump, pool cleaner pump, and salt water cell, pool light and pool liner ground all bonded together and connected to a separate bare copper ground, thus creating a secondary ground that causes circulating current to flow between the two grounding points.

YOU SHOULD NEVER CONNECT BONDING WIRE UTILIZED FOR BONDING EQUIPMENT TO A GROUND OTHER THAN THE SOURCE GROUND FEEDING THE EQUIPMENT YOU ARE BONDING TOGETHER.

QUESTION: How do you know if you are experiencing voltage problems resulting from circulating current in the ground?

ANSWER: The way you test for ground current, is to turn off all power to your home at the main. Verify you still have voltage in your yard. Have a qualified electrician lift the ground wire that goes from the main service panel to the sub-panel. If the voltage goes to zero than you have circulating current in your ground grid. The only way you get circulating current in your ground grid is by having redundant grounds caused by improperly grounding equipment to the wrong grounding point.

We cannot control how much unbalanced load is in the ground from the utility. The concept is to have everything in your yard at equal potential (*MANDATORY ZERO VOLTS*) so you do not get shocked. The reason a bird sitting on an energized wire does not get shocked is because his feet are at the same potential. The same concept applies here. If your home is not BONDED AND GROUNDED PROPERLY resulting in circulating current, the voltage is developed by the resistance in the conductors and the soil.

CONCLUSION: ZERO VOLTS – PROBLEM SOLVED

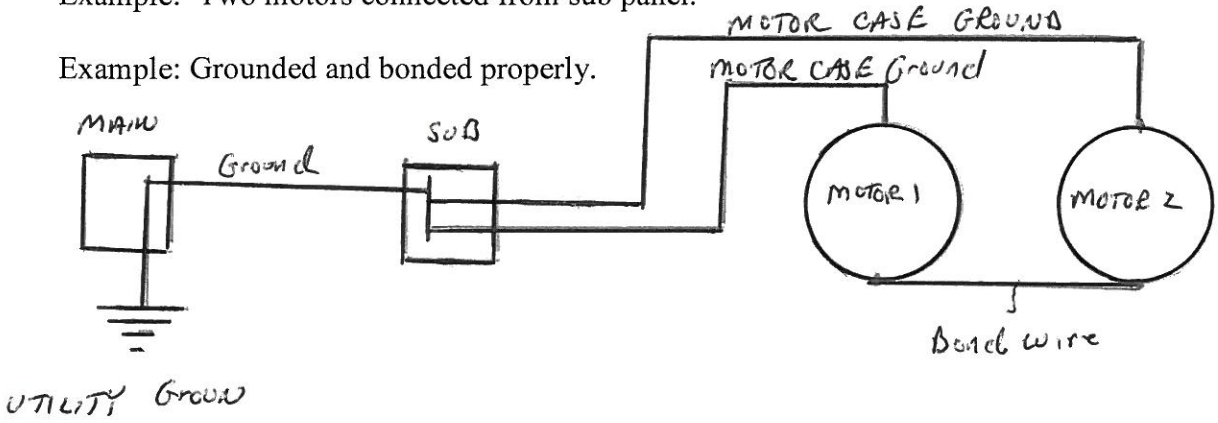
I separated all of the bonding wire and isolated (lifted) each circuit ground at the sub panel so I could identify which circuits were causing the problem. I re-connected the bond wires to the correct grounding source in compliance with section 680.25. I verified each piece of equipment was properly grounded. I found two wires coming in from under ground which is believed to be from the light and the pool liner. **Both had circulating current which means there are two grounds.** You should only have one ground back to the source. I lifted those two wires that were improperly connected and confirmed I still had continuity, meaning the equipment is still grounded (i.e. had continuity) back to the Duke Power ground from the ladder, light, pool deck et.

From a technical standpoint, it should be noted that the ground voltage in your back should be equal potential to the source utility ground. Therefore all ground wires to ground motors, pumps, lights, equipment etc. . should be radial feeders from the source ground (i.e. no loops creating a circuit) so that those points are always the same potential which means "equal potential to the source" so there is never a potential difference creating a shock hazard. Remember if you create a loop for current to flow, you will have a voltage difference.

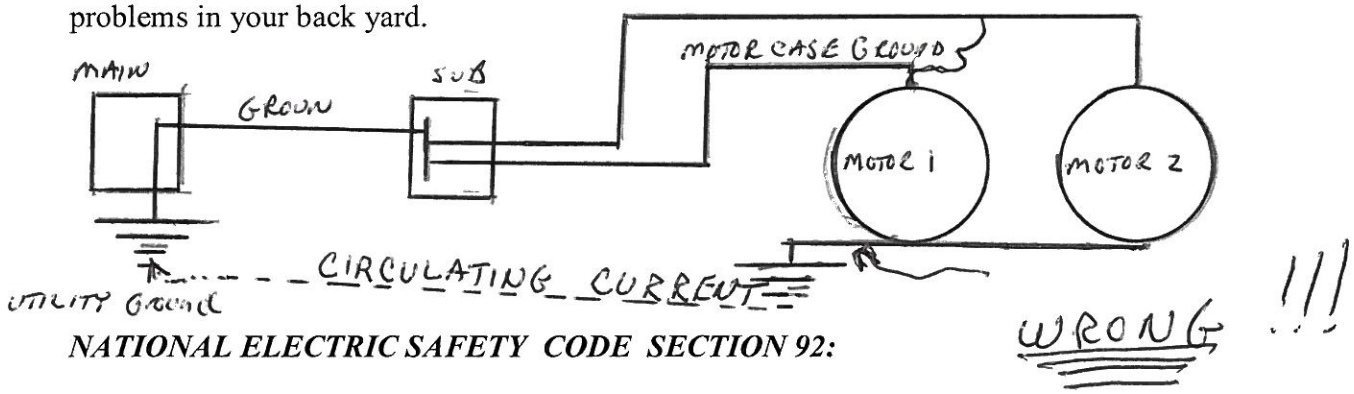
WARNING: If anyone is experiencing voltage problems in their yard, it could become very dangerous during a utility fault on the system which would result in high ground current increasing the circulating current in your yard, raising the potential difference and increasing the risk of injury.

Example: Two motors connected from sub panel.

Example: Grounded and bonded properly.



Example B: Grounded and Bonded improperly causing circulating current which results in voltage problems in your back yard.



NATIONAL ELECTRIC SAFETY CODE SECTION 92:

POINT OF CONNECTION OF GROUNDING CONDUCTOR

D, Current in grounding Conductor. Ground Connection points shall be so arranged that under normal circumstances there will be ***NO OBEJECTIONABEL CURRENT FLOW OF CURRENT, OVER THE GROUNDING CONDUCTOR..*** ground connection points shall be so arranged that under normal circumstances there will be NO OBJECTIONABLE CURRENT FLOW over the grounding conductor due to the use of multiple grounds, one or more of the following should be used:

1. Abandon one or more of the grounds.
2. Change locations of the grounds
3. Interrupt the continuity of conductor between the ground connections.

It should be noted that your installation was installed and permitted and signed off by the inspectors in violation of the National Electric Safety Code section 92.

Please feel free to call me on my cell at (714) 448-7145 should you have any questions.

Sincerely,

Edward L. Clark Jr.
The Electrical Expert