

ROCKY MOUNTAIN CHAPTER IAEI

MARCH 15-16, 2012

- 1) Can a switched outlet be on a small appliance branch circuit for dining room lighting?

No, a switched outlet on a general purpose branch circuit may be installed for lighting according to Article 210.52(B)(1), exception no. 1. Article 210.52(B)(2) states: the small appliance circuits shall have no other outlets.

- 2) Is GFCI protection required for temporary wiring in exhibition halls used for display booths in a trade show?

Answer: No 518.3(B)

518.3 Other Articles.

(A) Hazardous (Classified) Areas. Electrical installations in hazardous (classified) areas located in assembly occupancies shall comply with Article **500**.

(B) Temporary Wiring. In exhibition halls used for display booths, as in trade shows, the temporary wiring shall be permitted to be installed in accordance with Article **590**. Flexible cables and cords approved for hard or extra-hard usage shall be permitted to be laid on floors where protected from contact by the general public. The ground-fault circuit-interrupter requirements of **590.6** shall not apply. All other ground-fault circuit-interrupter requirements of this *Code* shall apply. *See related UL*

- 3) Are fire pump motors for one and two family dwellings required to meet the requirements of UL (QXZF)?

Answer: Yes, NEC 695.10 requires Diesel engine fire pump controllers, electric fire pump controllers, electric motors, fire pump power transfer switches, foam pump controllers, and limited service controllers shall be listed for fire pump service. The category in the white book is Fire Pump Motors (QXZF), located on page 339 in the 2011 UL White Book.

- 4) We are replacing a piece of switchgear that is presently using a zig-zag transformer to provide a neutral. The neutral loads are minimal and it would cost \$250,000 to derive a neutral for the main distribution transformer. It is old switchgear that is not presently compliant with 450.5(A)(1-4) in that there is no common trip overcurrent protection between the main and the separate breaker that is feeding the zig-zag transformer. What type of device is required to meet this requirement in the code?

The references come from 450.5(A). With the installation of the new switchgear, the reconnection of the zig-zag transformer would have to be directly to the lines of the 3 phase 3 wire ungrounded system. The old independent trip device would have to be eliminated and the main for the switchgear would become the primary disconnecting device. On the derived secondary that is 3 phase 4 wire, a common trip type circuit breaker would have to be installed as the main disconnect and overcurrent protection of that derived system. Overcurrent protection can be provided by current transformers and overcurrent relay so that when an overcurrent condition exists, the ungrounded system main and/or the derived system main common trip circuit breaker would trip. These current transformers would have to be on all three phases and also on the neutral conductors. This means the main switch and the common

trip circuit breaker would need to have a shunt trip installed. It would also be permissible to have a differential relay setup across the transformer so that through faults would not trip the main but could trip the common trip circuit breaker for the downstream fault. The settings on the overcurrent relay(s) would also have to be set to sense single phase conditions on the load side and cause the main switch or common trip circuit breaker to open.

- 5) A utility interactive PV inverter has built in output overcurrent protection. The output conductors terminate in a non-fused disconnect prior to terminating in the utility transformer. Should there be overcurrent protection at the disconnect? And if not, wouldn't the inverter need to be service rated?

705.12(A) and 230.82(6) give the permission to connect the output conductors of the interactive PV inverter to the supply side of the service disconnecting means. The cable from the inverter to the conductors on the supply side of the service disconnecting means is protected from overcurrent produced by the inverter by internal inverter protection. This protection cannot however protect these same conductors from overcurrent produced by the normal or utility source. These conductors are required to be protected per 705.30 and 705.65(A), therefore overcurrent protection is needed for the disconnecting means. There is no requirement as to how far the disconnecting means and overcurrent protection can be placed from the supply side service conductors. The fusible disconnect utilized for isolating the PV inverter does not need to be service rated because it is not disconnecting the service. It is disconnecting the utility interactive inverter.

- 6) If an outdoor generator is equipped with a readily accessible disconnecting means, is an additional disconnecting means required where the ungrounded conductors service or pass thru the building or structure served?

Generally, "No"

700.12(B)(6) Outdoor Generator Sets. Where an outdoor housed generator set is equipped with a readily accessible disconnecting means located within sight of the building or structure supplied, an additional disconnecting means shall not be required where ungrounded conductors serve or pass through the building or structure. The disconnecting means shall meet the requirements of 225.36.

Exception: For installations under single management, where conditions of maintenance and supervision ensure that only qualified persons will monitor and service the installation and where documented safe switching procedures are established and maintained for disconnection, the generator set disconnecting means shall not be required to be located within sight of the building or structure served.

Identical rule in 701.12(B)(5) except no exception.

Identical rule in 702.12 except no exception.

- 7) Are the receptacles in a mental health facility located in a group therapy room considered a patient care area?

No, does not meet the definition of "patient care area". Definitions, Article 517-517.10(B)

- 8) Is AFCI protection required for an enclosed patio?

Answer: Yes. It would be up to the AHJ as to their definition of "enclosed patio".

210.12 Arc-Fault Circuit-Interrupter Protection. See related UL

Changed From 2008

210.12: Relocated definition of arc-fault circuit interrupter (AFCI) to Article 100.

(A) Dwelling Units. All 120-volt, single phase, 15- and 20-ampere branch circuits supplying outlets installed in dwelling unit family rooms, dining rooms, living rooms, parlors, libraries, dens, bedrooms, sunrooms, recreation rooms, closets, hallways, or similar rooms or areas shall be protected by a listed arc-fault circuit interrupter, combination-type, installed to provide protection of the branch circuit.

- 9) If portable stage and studio lighting equipment and portable power distribution equipment are used outdoors, does it need to be identified for outdoor use?

Answer: No, not if it is being used on a temporary basis See NEC 520.10 and 530.6, which states: Portable stage and studio lighting equipment and portable power distribution equipment shall be permitted for temporary use outdoors, provided the equipment is supervised by qualified personnel while energized and barriered from the general public.

In accordance with 520.10, portable indoor stage or studio equipment that is not marked as suitable for wet or damp locations is permitted to be used temporarily in outdoor locations. If rain occurs, this equipment is typically de-energized, and a protective cover is installed before it is re-energized. At the end of the day, this equipment is either de-energized and protected or dismantled and stored.

Portable Power Distribution Equipment is Listed under the category of the same name and category code (QPRW) located on page 328 in the 2011 UL White Book.

UL Lists stage and studio lighting under the categories STAGE AND STUDIO LUMINAIRES, ACCESSORIES AND CONNECTOR STRIPS (IFDZ) and LIGHT-EMITTING-DIODE STAGE AND STUDIO LUMINAIRES AND ACCESSORIES (IFEC) both are located on page 175 in the 2011 UL White Book.

- 10) Most backup generator packages designed for residential use with portable generators include 2-pole transfer switches. Is this acceptable?

This would be acceptable only if the generator neutral was not bonded to the frame so that the generator is not a separately derived system. Since many portable generators also are used to directly supply utilization equipment through cords connected directly to the generator, the neutral must be bonded to the frame so that there is a return path for ground fault current on the cord connected equipment grounding conductor (green wire). Where the neutral is bonded to the frame, and the generator is to be used for backup power to the residence, the transfer switch then must switch the neutral so that the neutral is not reconnected to ground downstream of the service as prohibited by 250.24(A)(5) and there is no other permission in Article 250 to allow the neutral to be reconnected to ground. This is the dilemma in trying to use a portable generator for both serving direct utilization equipment and also as a backup standby power source.

- 11) What is the maximum ambient temperature allowed before de-rating of the wiring method is required?

Derating kicks in at 31 degrees C (or 87 degrees F) from Table 310.15(B)(2)(a) which is based upon 30 degree C ambient for use with Tables 310.15(B)(16) and 310.15(B)(17) and 41 degrees C (or 105 degrees

F) from Table 310.16(B)(2)(b) which is based upon 40 degree C ambient for use with Tables 310.15(B)(18) and 310.15(B)(19)

- 12) Why is a concrete encased electrode connection required to be accessible if you are connecting to the exposed rebar? Would it be acceptable to be use an irreversible crimp and then be not accessible?

See 250.68(A). Required to be accessible unless encased or buried for inspection purposes. No exception to the rule if irreversible crimp is made.

- 13) Are the branch circuit conductors supplying power to baseboard heater in a bedroom required to be AFCI protected if they are 240V?

No, Article 210.12 (A) only requires protection for 120 Volt circuits.

- 14) Why does an outlet located below a wet bar sink need GFCI protection but an outlet located below the kitchen sink does not need GFCI protection?

Answer: Yes. GFCI protection for sinks in dwelling unit kitchens remains under the existing provisions of 210.8(A)(6). If kitchen sinks were put under the revised wording of 210.8(A)(7), GFCI protection would apply to receptacles other than the kitchen countertop receptacles such as the receptacles for the disposal or dishwasher which are not countertop receptacles, but are generally within 6ft of the kitchen sink. The GFCI requirement for Wet Bar sinks fall under 210.8 (A)(7).

- 15) What fittings are approved to be used on the exterior of a building, weather proof or rain tight?

Answer: NEC 314.15 requires fittings to be Listed for Wet Locations. So weatherproof, raintight or marked for wet locations would be used. Fittings are typically Listed as wet locations or raintight.

- 16) Why is the factory cord on electric vehicle charging equipment not required to be sized at 125% as outlined in 625.2, 625.14, and 625.17?

Section 625.2 is definitions only and definitions cannot establish requirements, therefore a requirement or assumption of a requirement is not in 625.2. 625.14 establishes that vehicle charging equipment shall be considered a continuous load and from this one could infer that when applying load calculations, the nameplate load would have to be factored in at 125%. 625.17 only establishes the types of cables that can be used for vehicle charging equipment and again there are statements about minimum size of the conductors. Equipment listing information can be found under Category Codes FFTG and FFWA in the UL White Book. The testing of these systems as designed and constructed have already accounted for loading at 100% continuous and also some overload testing, therefore the cord has been investigated as having an adequate size without necessarily applying a 125% of conductor size ampacity from the NEC.

- 17) Why are refrigerators and freezers not found under article 440 when they are refrigerating equipment?

Ding, ding. Who says Article 440 does not apply? See 440.3(C) Article 422. Equipment such as room air conditioners, household refrigerators and freezers, drinking water coolers, and beverage dispensers shall be considered appliances, and the provisions of Article 422 shall **also** apply. See also 422.3 Other

Articles. The requirements of Article 430 shall apply to the installation of motor-operated appliances, and the requirements of Article 440 shall apply to the installation of appliances containing a hermetic refrigerant motor-compressor(s), except as specifically amended in this article. There is no amendment in the rest of Article 422, so Article 440 does apply.

- 18) When installing a standby generator that is located 30 feet from a building and it is not a separately derived system, is it required that a grounding electrode be installed to ground the housing of the generator itself?

Yes, if the generator apparatus is considered a structure. See 250.32(B)(1).

- 19) Is GFCI protection required for temporary wiring in exhibition halls used for display booths in a trade show?

This installation is covered by Article 518, Assembly Occupancies. Article 518.3(B) states that wiring shall be installed according to Article 590 Temporary Installations. However, 518.3(B) states that ground fault circuit interrupter requirement of 590.6 shall not apply.

- 20) Is there any movement to change the AFCI requirements when there are so many documented cases of nuisance tripping due to RFI and EMI appliances and electronic equipment?

Answer: I know that the NEMA manufacturers are working towards changing other product standards that will clean up manufactured products, such as, appliances, lights and so on, so not to conflict with the operation of AFCI's.

- 21) Are fire pump motors for one and two family dwellings required to meet the requirements of UL (QXZF)?

(QXZF)? This is a repeat of Q3

- 22) Is it required to bond an outside generator grounding electrode system (it is a separately derived system) to the building grounding electrode system? If it is not a separately derived system, is it required to have a grounding electrode system since it's a separate structure?

There is no requirement to directly bond the grounding electrode system for an outside generator to the grounding electrode system of the building or structure served. In fact this bonding is achieved by either the supply side bonding jumper from 250.30(A)(2) or 250.35(B). If the exception no 2 to 250.30(A)(1) is used then you would not have a supply side bonding jumper separately but in fact the neutral acts in that capacity with the dual system bonding jumpers being installed. For the second question, for outside permanent generators a grounding electrode and grounding electrode conductor would always be required without regard to if the generator was a separately derived system or not. The grounding electrode conductor would be connected to the frame or if required (it is a separately derived system) then additionally the neutral. The purpose of the grounding electrode and grounding electrode conductor is to maintain those exposed non-current carrying parts at the earth potential of the earth where the generator is sitting to minimize any difference that could pose a shock hazard.

- 23) If you extend existing circuits that have a shared neutral, is it required to install handle ties on the breakers if they were existing without the tie?

From an overcurrent protection standpoint we need to go to Article 240. 240.15(B) Circuit Breaker as Overcurrent Device. Circuit breakers shall open all ungrounded conductors of the circuit both manual and automatically unless otherwise permitted in 240.15(B)(1), (B)(2), (B)(3), and (B)(4). So, the basic rule requires a common trip, not a handle tie.

240.15(B)(1) Multiwire Branch Circuit. Individual single-pole circuit breakers, with identified handle ties, shall be permitted as the protection for each ungrounded conductor of multiwire branch circuits that serve only single-phase line-to-neutral loads. From Article 100, Branch Circuit, Multiwire. A branch circuit that consists of two or more ungrounded conductors that have a voltage between them, and a grounded conductor that has equal voltage between it and each ungrounded conductor of the circuit and that is connected to the neutral or grounded conductor of the system. Based upon the definition of a multiwire branch circuit, the circuit in question is a multiwire branch circuit. So if the multiwire branch circuit serves only line-to-neutral loads, an identified handle tie would be acceptable instead of a common trip. From Article 100 the definition of "identified" is Recognizable as suitable for the specific purpose, function, use, environment, application, and so forth, where described in a particular Code requirement.

240.15(B)(2) Grounded Single-Phase Alternating-Current Circuits. In grounded systems, individual single-pole circuit breakers rated 120/240 volts ac, with identified handle ties, shall be permitted as the protection for each ungrounded conductor for line-to-line connected loads for single-phase circuits. This allowance, limited to 120/240 volt circuits and line-to-line connected loads only, then provides for identified handle ties too.

From a disconnecting means standpoint we need to go to 210.4(B) Disconnecting Means. Each multiwire branch circuit shall be provided with a means that will simultaneously disconnect all ungrounded conductors at the point where the branch circuit originates. So, this would require either a handle tie or common trip.

Now the requirements listed above, which pretty much mandate handle ties or common trip, are for new installations. The question covers existing installation where there is no handle tie. It is up to the AHJ and local rulemaking as to whether or not the old part of the circuit has to be brought up to the new Code requirements. The new circuit extension certainly must be installed per any new requirements.

- 24) Why is it a violation to have a junction box with a fixture whip within 12" of a 2X4 troffer, per 410.117, and not a violation if installed as MC Cable?

This section is intended to apply to a recessed incandescent luminaire that requires a high temperature supply such as 105°C. The high-temperature conductors connect to normal temperature rated branch circuit conductors. Type AC and Type MC conductors are permitted for the "tap" only if they have wire with an adequate temperature rating.

- 25) Is any other equipment allowed on a circuit used for central heating equipment? If so what?

Article 422.12 requires an individual branch circuit. Exception 1 allows auxiliary equipment such as a pump, valve, humidifier, or electrostatic air cleaner directly associated with the heating equipment to be connected to the same branch circuit.

Exception 2 allows permanently connected air conditioning equipment to be connected to the same branch circuit.

26) What types of wiring methods may be used for service entrance conductors?

Answer: See Below:

Answer: 230.43 Wiring Methods for 600 Volts, Nominal, or Less.

Changed From 2008

• 230.43: Revised to permit all rigid nonmetallic raceways and nonmetallic underground conductors in conduit (NUCC) as service wiring methods.

Service-entrance conductors shall be installed in accordance with the applicable requirements of this *Code* covering the type of wiring method used and shall be limited to the following methods:

- (1) Open wiring on insulators
- (2) Type IGS cable
- (3) Rigid metal conduit *See related UL*
- (4) Intermediate metal conduit *See related UL*
- (5) Electrical metallic tubing *See related UL*
- (6) Electrical nonmetallic tubing (ENT) *See related UL*
- (7) Service-entrance cables *See related UL*
- (8) Wireways *See related UL*
- (9) Busways *See related UL*
- (10) Auxiliary gutters *See related UL*
- (11) Rigid polyvinyl chloride conduit (PVC) *See related UL*
- (12) Cablebus
- (13) Type MC cable *See related UL*
- (14) Mineral-insulated, metal-sheathed cable *See related UL*
- (15) Flexible metal conduit not over 1.8 m (6 ft) long or liquidtight flexible metal conduit not over 1.8 m (6 ft) long between raceways, or between raceway and service equipment, with equipment bonding jumper routed with the flexible metal conduit or the liquidtight flexible metal conduit according to the provisions of **250.102(A), (B), (C), and (E)** *See related UL*
- (16) Liquidtight flexible nonmetallic conduit *See related UL*

Section **230.43(15)** permits no more than 6 ft of flexible metal conduit or liquidtight flexible metal conduit to be used as a service wiring method. Because of the high levels of fault energy available on the line side of the service disconnecting means, a bonding jumper must be installed where these raceway types are used for service conductors. The bonding jumper is allowed to be installed inside or outside the raceway, but it must follow the path of the raceway and cannot exceed 6 ft in length. In order to minimize the impedance of the ground fault current return path, the bonding jumper must not be wrapped or spiraled around the flexible conduit.

- (17) High density polyethylene conduit (HDPE) *See related UL*
- (18) Nonmetallic underground conduit with conductors (NUCC)
- (19) Reinforced thermosetting resin conduit (RTRC)

27) Are rain-tight hubs listed for bonding purposes on the line side of a service?

Answer: No for a standard myers hub that connects to the enclosure through a knock out and secures with a locknut. These are Listed as a Conduit Fitting, (DWTT) in the white book. The hub would also need a bonding locknut, these hubs would additionally need to be Listed as Grounding and Bonding Equipment (KDER) located on page 208 in the 2011 UL White Book.

See NEC 250.92(B) does not permit standard locknuts as the only bonding method of service raceways and gives you a list of what can be used to assure the bonding, one of those is a bonding locknut.

28) When installing a standby generator that is located 30 feet from a building and it is not a separately derived system, is it required that a grounding electrode be installed to ground the housing of the generator itself?

Yes. 250.30(C) and 250.32(C)(2) would require that for outside permanent generators a grounding electrode and grounding electrode conductor would always be required. The grounding electrode conductor would be connected to the frame. The purpose of the grounding electrode and grounding electrode conductor is to maintain those exposed non-current carrying parts at the earth potential of the earth where the generator is sitting to minimize any difference that could pose a shock hazard.

29) Can a circuit breaker be used as a motor controller?

See 430.83 (2) Circuit Breaker. A branch-circuit inverse time circuit breaker rated in amperes shall be permitted as a controller for all motors. Where this circuit breaker is also used for overload protection, it shall conform to the appropriate provisions of this article governing overload protection. See also 430.111 Switch or Circuit breaker as Both Controller and Disconnecting Means. A switch or circuit breaker shall be permitted to be used as both the controller and disconnecting means if it complies with 430.111(A) and is one of the types specified in 430.111(B).

(A) General. The switch or circuit breaker complies with the requirements for controllers specified in 430.83, opens all ungrounded conductors to the motor, and is protected by an overcurrent device in each ungrounded conductor (which shall be permitted to be the branch-circuit fuses). The overcurrent device protecting the controller shall be permitted to be part of the controller assembly or shall be permitted to be separate. An autotransformer-type controller shall be provided with a separate disconnecting means.

(B) Type. The device shall be one of the types specified in 430.111(B)(1), (B)(2), or (B)(3).

(2) Inverse Time Circuit Breaker. An inverse time circuit breaker operable directly by applying the hand to a lever or handle. The circuit breaker shall be permitted to be both power and manually operable.

30) What is the formula to calculate the allowable ampacity of a 4 inch wide piece of copper busbar that is ¼" thick and 4' long?

See 366.23(A), 1000 amperes per square inch. $4 \times .25 \times 1000 = 1000$. The length is immaterial.

31) A heating, air conditioning and refrigeration equipment GFCI service receptacle needs to be installed within 25 foot of the unit. Since all service personnel carry 50' cords, do you think this rule should be changed?

No, there is nothing to require a service man to carry a 50' cord. NEC 210.63

32) Is AFCI protection required for an enclosed patio?

Answer: See Answer on Question #8

33) Are chase nipples recognized for bonding purposes between two metallic enclosures on the line side of the service disconnecting means? On the load side of the service equipment?

Answer: Listed chase nipples are Listed as Conduit Fittings (DWTT) located on page 112 in the 2011 White Book, On the line side of the service disconnect, I would say no for the same reason as we discussed in question 27, 250.92 (B) would require that you use bonding locknuts or bushings, etc. Those are Listed under Grounding and Bonding equipment (KDER) located on page 208 in the 2011 UL WB. On the load side of the service disconnect then they are fine, see 250.96(A) and 250.97, Listed conduit fittings would meet those requirements.

34) In a solar photovoltaic installation, can the EMT raceway system between the modules and the inverter be recognized as the equipment grounding conductor or is it necessary to install an equipment grounding conductor in the raceway?

The base reference is 690.43(A) and (B) that sends the user back to 250.110, 250.134 and 250.136. These reference in Article 250 would allow any of the equipment grounding conductors identified in 250.118 and 250.118(4) specifies EMT. Since there is no specific requirement in Article 690 that the equipment grounding conductor be of the wire type and with the above references directly from 690.43, it does not appear that a wire type equipment grounding conductor must be installed in a valid metal raceway system such as the EMT in the question.

35) We are back feeding from a PV inverter to the MDP. There is no room for breakers, so can we drill and attach to the bus bar if we have overcurrent protection ahead of the connection?

This opens a huge can of worms. First are we attaching to the line side of the service disconnecting means or downstream. If it is on the utility side or line-side of the main, the connection is permitted per NEC. 705.12(A) and 230.82(6). If the utility interactive inverter is connected downstream of the main, but in the panel itself, it must comply with 705.10(D). 705.10(D) requires that a dedicated circuit breaker or fusible disconnecting means be utilized. The wording of the question seems to conflict with this requirement, independent of whether or not overcurrent protection is provided ahead of the connection.

Another significant issue, independent of the point of attachment, is the modification to a listed piece of equipment. When these type of "TAPS" are made several requirements must be taken into consideration: Bus modification at the point of drilling, lug size and clearances, conductor short circuit

withstand ratings, just to mention a few. The last item to complete the installation is a field listing by a NRTL to re-list the equipment.

- 36) Are two ground rods required for a separate structure fed by a feeder when the source building already has 2 ground rods installed at that location?

All grounding electrodes that are present at the separate structure are to be bonded together to create a grounding electrode system. It is connected to the equipment grounding conductor that is run with the feeder. See 250.32(A). If no grounding electrodes are present, install one or more from 250.52(A) in compliance with 250.53.

- 37) What is the maximum number of #12awg THHN conductors allowed in a 3/8" flex metal conduit supplying a motor circuit?

2, if the fittings are on the inside and 3 if the fittings are on the outside. NEC Table 348.22.

- 38) I have been hired to install under cabinet luminaires in a kitchen. Is it permissible to fish up from the countertop receptacles to supply power to these luminaires that have a switch on them?

Answer: NO. 210.52(B) Dwelling Unit Receptacle Outlets.

(2) No Other Outlets. The two or more small-appliance branch circuits specified in **210.52(B)(1)** shall have no other outlets.

- 39) Can a reducing bushing be installed on a conduit seal that is in excess of 25% fill in a hazardous location?

Answer: I assume this is would be in order to comply with 501.15(C)(6). In trying to read into the question, I believe he is asking, for example, if a 3/4 in to 1 in reducer is installed into a 1 in fitting, can the % fill in the fitting be based on the 25% fill for a 1 in conduit while the actual conduit fill is based on a 3/4 in conduit and this could be greater than 25%. There is nothing in the Code that would prohibit this. In fact, that was common practice 15-20 years ago before oversized fittings were readily available.

- 40) Are raintite hubs listed for bonding purposes on the line side of a service?

Some are – see Tom's answer to question 27.

- 41) What is the minimum size SOW cord that may be used to supply a 30 horsepower, 3 phase, 460 volt motor?

Per Table 430.250 the full load current is 40 amperes. 430.22 requires an ampacity of 125% of motor full load current. 1.25 times 40 = a required ampacity of 50 amperes. Table 400.5(A)(1) Column A gives the ampacity of 4AWG as 60 amperes, which would cover the requirement.

- 42) What is the support spacing for Metal Clad Cable, Type MC, containing four or fewer conductors sized no larger than 10 AWG?

Every 6 ft and within 12 inches of the box. See 330.30(B).

- 43) Where should a disconnecting means be located for conductors that only cross through a structure or building?

Article 225.31 requires a disconnect for conductors that supply or pass through a building or structure. Article 225.32 requires the disconnect to be inside or outside nearest the point of entrance of the conductors. It must be readily accessible.

- 44) Are the branch circuit conductors supplying power to baseboard heater in a bedroom required to be AFCI protected?

Answer: if it is a 120v 15 or 20amp heater then I would say- Yes. If it was not 120v then no. 210.12(B)

210.12 Arc-Fault Circuit-Interrupter Protection. See related UL

Changed From 2008

- 210.12: Relocated definition of arc-fault circuit interrupter (AFCI) to Article 100.

(A) Dwelling Units. All 120-volt, single phase, 15- and 20-ampere branch circuits supplying outlets installed in dwelling unit family rooms, dining rooms, living rooms, parlors, libraries, dens, bedrooms, sunrooms, recreation rooms, closets, hallways, or similar rooms or areas shall be protected by a listed arc-fault circuit interrupter, combination-type, installed to provide protection of the branch circuit.

Definition: Outlet. A point on the wiring system at which current is taken to supply utilization equipment.

Definition: Utilization Equipment. Equipment that utilizes electric energy for electronic, electromechanical, chemical, heating, lighting, or similar purposes.

- 45) What type of metal halide lamp is required in open type luminaires?

A type O lamp. See 410.130(F)(5), **Metal Halide Lamp Containment.** Luminaires that use a metal halide lamp other than a thick-glass parabolic reflector lamp (PAR) shall be provided with a containment barrier that encloses the lamp, or shall be provided with a physical means that only allows the use of a lamp that is Type O.

Also see HIGH-INTENSITY-DISCHARGE-LAMP-TYPE LUMINAIRES (IEWX) on page 167 in the 2011 UL White Book. The Guide information states:

Luminaires intended for use with metal halide lamps and not provided with a suitable lamp containment barrier, are marked "CAUTION – RISK OF FIRE, DO NOT USE A LAMP IDENTIFIED FOR USE IN ENCLOSED LUMINAIRES."

- 46) In an industrial application, I want to feed a motor control center from a 1200A breaker using four parallel runs of 500KCLM three conductor CU cables, (w/Ground). It appears that, in order to comply with NEC 250.122(F), the copper grounding conductor in each cable would need to be #3/0. But the standard manufactured 3-conductor 500KCLM cable only has a #2 ground. If the cables are run in a single cable tray, will a single #3/0 ground meet the requirement of 250.122(F)? If not, is there any way that the grounding requirement can be met while using parallel runs of cable?

- 47) What ampacity do motor circuit conductors supplying a varying duty motor with a 30-and/or 60- minute rating have to be?

430.22 (E) states that Conductors for a motor used in a short-time, intermittent, periodic, or varying duty application shall have an ampacity of not less than the percentage of the motor nameplate current rating shown in Table 430.22(E), unless the authority having jurisdiction grants special permission for conductors of lower ampacity. Table 430.22(E) shows the ampacity for a varying duty 30- and 60-minute motor to be 150% of motor nameplate current.

- 48) What type of a grounding electrode system is required for the inverter of a small wind turbine?
I scanned Article 694 and don't find a specific rule. If stand alone, 250.30 for separately derived systems would apply. If interconnected, comply with Article 705.

694.40 (C) Tower Grounding.

(1) Auxiliary Electrodes. A wind turbine tower shall be connected to one or more auxiliary electrodes to limit voltages imposed by lightning. Auxiliary electrodes shall be permitted to be installed in accordance with 250.54. Electrodes that are part of the tower foundation and meet the requirements for concrete encased electrodes in accordance with 250.52(A)(3) shall be acceptable. A grounded metal tower support shall be considered acceptable where meeting the requirements of 250.136(A). Where installed in close proximity to galvanized foundation or tower anchor components, galvanized grounding electrodes shall be used.

Informational Note: Copper and copper-clad grounding electrodes, where used in highly conductive soils, can cause electrolytic corrosion of galvanized foundation and tower anchor components.

Where the cables are run in parallel, 250.122(F) does require that in each cable the equipment grounding conductor must be full sized per Table 250.122, therefore in this case a 3/0 copper. This would require the ordering so special cable to provide for this situation. Per the question, these cables are routed together in a cable tray where it is permitted in 250.118 to use the cable tray as an equipment grounding conductor where listed for that purpose or a single correctly sized equipment grounding conductor could be installed in the cable tray for all the contained circuit conductors. I believe the installation as posed in the question with the 3/0 copper in the cable tray would be a compliant installation.

- 49) Is an above grid return air plenum considered a hollow space for the installation of a transformer smaller than 50Kva?

No. The application of 450.13(B) for Hollow Space Installations of transformers 50KVA and smaller is for accessibility requirements only to allow inspection and maintenance activities by qualified personnel. The requirements of 300.22(C) involve placing of electrical equipment, not properly rated, into environmental air spaces including suspended grid ceiling spaces for return air applications. Provisions of 300.22(C) are not negated by application of 450.13(B).

Follow-up comment following the meeting: The purpose of 300.22(C) is to prevent the introduction of potentially hazardous air-borne products of combustion into an environmental air handling system and subsequent spread throughout a space. Wiring methods in environmental air spaces are called to be contained in an enclosure or a rated outer jacket during a fire either from a separate external source. The transformer is normally provided with a steel enclosure, but cooling for the equipment is normally

accomplished by convection through openings in the enclosure construction. Failure of dry type transformers can be normally accompanied by substantial discharge of heat and smoke that is not contained within the equipment steel enclosure. While a dry type transformer can be installed in a ceiling space as allowed by 450.13(B), it should be only in ceiling space with ducted return air and not in return plenum space.

50) How do you enforce working clearance for equipment located above a drop ceiling?

There are too many variables to give a concise answer. 110.26(A), (E) all may apply depending on the equipment installed.

51) How can the NEC continue to mandate the installation of AFCI protection when the manufactures and UL both acknowledge these devices nuisance trip due to RFI and EMI from appliances and electronics?

First advice is to always call the manufacturer directly when there is an issue. The NEMA website afcsafety.org is another feedback point BUT there can be delays in the information getting to the manufacturer. Again, please call the manufacturer directly as they are committed to resolving such issues.

UL and Manufacturer's continue to take action to chase and resolve such issues. There are many unwanted tripping tests required in the product safety standard for AFCIs, UL 1699, but unlike Europe, the US has very little requirements for conducted and radiated emissions. The FCC has set some requirements but many standards do not require compliance. I can confidently say that we have no unresolved unwanted tripping problems and that the magnitude of the problems others have is very small but until it is zero we must continue to work all angles. We must also recognize that if we continue to let anybody emit whatever they want whenever they want other devices in resi systems may be at risk of malfunctioning (think smart grid). It was not possible to know of, understand and resolve all unwanted tripping problems in the lab. Field experience was necessary. Mfgs continue to work on product improvements and the problems get fewer and fewer.

Industry Actions:

NEMA has published a white paper addressed to appliance manufacturers.

Proposals to 5 UL Lighting Standards for FCC compliance

2014 NEC Proposal to require FCC Compliance Marking – Not accepted

52) Is an electric heat floor matt in a bathroom required to be GFCI protected no matter what the voltage is?

I went to 424.99 © (1 thru 5) Ground-fault protection for personal shall be provided regardless of the type of electrically heated floor system. Shall function when a low-or high-resistance line-to-line, line-to-grounded conductor, or line-to-ground fault occurs, such as the result of a penetration of the element or element assembly.

53) Why does an outlet located below a wet bar sink in a cabinet (not readily accessible) require GFCI protection when it is located within 6' of a sink?

First, I would argue a receptacle in a cabinet below a wet bar sink IS readily accessible (See Art. 100 definition of readily accessible). 210.8A7 requires GFCI protection for ANY receptacle installed within 6 feet of the outside edge of the sink. The 6-foot dimension appears in various places throughout the NEC because this is the standard length of cords supplied with lamps and appliances.

54) What wiring methods are acceptable for use in an underground RNC conduit?

I'm assuming the question is actually referring to what type of wire/conductor is acceptable, as Rigid Nonmetallic Conduit is a raceway as defined in Article 100: Raceway: An enclosed channel of metal or nonmetallic materials designed expressly for holding wires, cables, or busbars, with additional functions as permitted in this Code.

Therefore, if we refer to the definition in Article 100: Location, Wet. Installations underground or in concrete slabs or masonry in direct contact with the earth; in locations subject to saturation with water or other liquids, such as vehicle washing areas; and in unprotected locations exposed to weather.

HB: The inside of a raceway in a wet location and a raceway installed underground are considered wet locations. Therefore, any conductors contained therein would be required to be suitable for wet locations.

310.10(C) – uses permitted: (C) Wet Locations. Insulated conductors and cables used in wet locations shall comply with one of the following:

- (1) Be moisture-impervious metal-sheathed
- (2) Be types MTW, RHW, RHW-2, TW, THW, THW-2, THHW, THWN, THWN-2, XHHW, XHHW-2, ZW
- (3) Be of a type listed for use in wet locations

55) What wiring method shall be used for DC photovoltaic source and output circuits inside a building, without a disconnect switch on the outside of the building at the point of entrance?

Approved wiring methods for the DC application indicated are **metal raceways, Type MC metal-clad cable, or metal enclosures** from the point of entry into the building to the disconnecting means. The code reference for this requirement is 690.31(E).

56) What length of time do fluorescent exit fixtures or egress luminaires that are energized only during a failure of the normal supply have to operate for?

1.5 hours 700.12 (F)

57) Can 2 single pole circuit breakers be installed with tie handles, so that each leg of a multi-wire branch circuit is protected by a single overcurrent device when feeding furniture partitions?

Yes, where connected with a Chapter 3 wiring method.

605.8(D) does not permit multiwire circuits for freestanding-type cord and plug connected partitions.

210.4 Multiwire Branch Circuits.

(A) General. Branch circuits recognized by this article shall be permitted as multiwire circuits. A multiwire circuit shall be permitted to be considered as multiple circuits. All conductors of a multiwire branch circuit shall originate from the same panelboard or similar distribution equipment.

FPN: A 3-phase, 4-wire, wye-connected power system used to supply power to nonlinear loads may necessitate that the power system design allow for the possibility of high harmonic currents on the neutral conductor.

(B) Disconnecting Means. Each multiwire branch circuit shall be provided with a means that will simultaneously disconnect all ungrounded conductors at the point where the branch circuit originates.

(C) Line-to-Neutral Loads. Multiwire branch circuits shall supply only line-to-neutral loads.

Exception No. 1: A multiwire branch circuit that supplies only one utilization equipment.

Exception No. 2: Where all ungrounded conductors of the multiwire branch circuit are opened simultaneously by the branch-circuit overcurrent device.

FPN: See 300.13(B) for continuity of grounded conductor on multiwire circuits.

(D) Grouping. The ungrounded and grounded conductors of each multiwire branch circuit shall be grouped by wire ties or similar means in at least one location within the panelboard or other point of origination.

Exception: The requirement for grouping shall not apply if the circuit enters from a cable or raceway unique to the circuit that makes the grouping obvious.

605.6 Fixed-Type Partitions.

Wired partitions that are fixed (secured to building surfaces) shall be permanently connected to the building electrical system by one of the wiring methods of Chapter 3. Multiwire branch circuits supplying power to the partition shall be provided with a means to disconnect simultaneously all ungrounded conductors at the panelboard where the branch circuit originates.

605.7 Freestanding-Type Partitions.

Partitions of the freestanding type (not fixed) shall be permitted to be connected to the building electrical system by one of the wiring methods of Chapter 3. Multiwire branch circuits supplying power to permanently connected freestanding partitions shall be provided with a means to disconnect simultaneously all ungrounded conductors at the panelboard where the branch circuit originates.

18-257 Log #550 NEC-P18
(605.6)

Final Action: Accept

Submitter: Margarito Aragon, Jr., Aragon's Electrical Consulting

Recommendation: Delete the second sentence.

605.6 Fixed-Type Partitions.

Wired partitions that are fixed (secured to building surfaces) shall be permanently connected to the building electrical system by one of the wiring methods of Chapter 3. ~~Multiwire branch circuits supplying power to the partition shall be provided with a means to disconnect simultaneously all ungrounded conductors at the panelboard where the branch circuit originates.~~

Substantiation: To conform to the Style Manual. Section 210.4(B) already requires the disconnecting simultaneously of all ungrounded conductors on multiwire branch circuit and applies per 90.3

58) What is the conductor ampacity deration required for 4 U.S.E. service entrance conductors protected by 10ft RMC conduit above ground?

In section 310.104 (A) on page 170 table USE see note 5 refers you to 340.80 says that UF cable is 60 degree C. in.310.15 (B)(16) Ampacities 60 degree column #4 70 amps. If there are 4 current carrying conductors you would derate in conduct 80% - 310.15 (B)(3)(A).

59) What size and type of conductor is required to bond a hydro massage bathtub to any associated metal piping?

680.74 - #8 solid copper

60) When #4 and larger conductors are pulled into an auxiliary gutter, does the 6 and 8 times rule apply? (Pull, Junction Boxes & Conduit Bodies-314.28-length of box/conduit body for straight or angles pulls-sizing) **Yes**-but only when used as a pull box, then 366.58(B) requires that when insulated conductors 4 AWG or larger are pulled through an auxiliary gutter, the distance between raceway and cable entries enclosing the same conductor shall not be less than that required in 314.28(A)(1) for straight pulls and 314.28(A)(2) for angle pulls.

61) What is the required allowance for calculating conductor fill for a looped, unbroken conductor not less than twice the minimum length required for free conductors in NEC 300.14?

Applying minimum length provisions of 300.14 will result in utilizing 314.16(B)(1) requiring that the unbroken conductor shall be counted twice in applying Table 314.16(B) to calculate total minimum box volume.

62) Can a 120V, 1000W electric hot water heater be cord and plug connected as the disconnecting means?

It depends on the water heater. It must be listed for cord and plug connection. 422.16 (A) (2)

63) In a barn with a caretakers living quarters, would the barn be required to be on an arc fault breaker?

Yes. The requirements of 210.12 (A) & (B) apply to dwellings. Does this meet the article 100 definition of a dwelling?

64) Do all vending machine GFCI receptacles require being readily accessible? Does a water fountain GFCI receptacle need to be readily accessible?

Yes. In 422.51 for GFCI protection as part of a vending machine in cord-connected. And must be readily accessible by the code 210.8 (A)-(C) covers receptacles. 422.52 Electric Drinking Fountains same rule applies.

65) Is it required to have a listing for Solar Panel on clips and supports of the Solar Panels?

In Colorado, all electrical equipment must be listed and labeled and used in accordance with the manufacturer's listing and labeling instructions, per 110.2 and Board Rule 6.7. The modules must be installed in accordance with the manufacturer's instructions. If they specify a certain racking system, that must be used as it is a part of the listing.

66) How far does a Class I, Division 2 area at an open paint spray extend? Is there any other method of sealing the conduit that is approved other than sealing compound leaving a Class I, Division 2 area? 516.3(B) identifies those areas designated as Class I Div I.

A grounding electrode system is not specifically required in Article 694. Article 694.62 refers you to Article 705.50 which refers you to Article 250 for the grounding requirements.

516.3(C)(2) addresses Class I Div II locations for Closed-Top, Open-Face, and Open-Front Spraying. If spray application operations are conducted within a closed-top, open-face, or open-front booth or room, any electrical wiring or utilization equipment located outside of the booth or room but within the boundaries designated as Division 2 or Zone 2 in Figure 516.3(C)(2) shall be suitable for Class I, Division 2, Class I, Zone 2, or Class II, Division 2 locations, whichever is applicable. **The Class I, Division 2, Class I, Zone 2, or Class II, Division 2 locations shown in Figure 516.3(C)(2) shall extend from the edges of the open face or open front of the booth or room in accordance with the following:**

- (a) If the exhaust ventilation system is interlocked with the spray application equipment, the Division 2 or Zone 2 location shall extend 1.5 m (5 ft) horizontally and 900 mm (3 ft) vertically from the open face or open front of the booth or room, as shown in Figure 516.3(C)(2), top.
- (b) If the exhaust ventilation system is not interlocked with the spray application equipment, the Division 2 or Zone 2 location shall extend 3 m (10 ft) horizontally and 900 mm (3 ft) vertically from the open face or open front of the booth or room, as shown in Figure 516.3(C)(2), bottom.

Second part of question: "Is there any other method of sealing the conduit that is approved other than sealing compound leaving a Class I, Division 2 area?" 501.15(B)(2) requires seals at the Class I, Div II boundary, therefore 501.15(C), which covers specific requirements for seals in Class I, Div I & II locations is applicable. 501.15(C)(1) covers fittings and requires enclosures for connections or equipment be provided with an integral means for sealing, or sealing fittings listed for the location shall be used. Sealing fittings shall be listed for use with one or more specific compounds and shall be accessible.

501.15(C)(3) The sealing compound must have a minimum thickness of not less than the trade size of the conduit and in no case less than 5/8 in. Conduit fittings for sealing are to be used only with sealing compound that is supplied with the fitting and specified by the manufacturer in instructions furnished with the fitting.

- 67) Why is the factory cord on electric vehicle charging equipment not required to be sized at 125% as outlined in 625.2, 625.14 and 625.17?

The electric vehicle charging equipment is an identified and listed assembly, **including the factory-installed cord and plug**. All other electric vehicle supply equipment components indicated in 625.13 shall be permanently connected and fastened in place using fixed wiring methods and sized per 625.14, which identifies the load as being a "continuous load". Under definitions in Article 100, page 70-27, a "continuous load" is defined to be in full operation for 3 hours or more. The requirement for application of 125 percent load factor for continuous loads pertains to fixed wiring **circuit ampacities and overcurrent protection** as indicated in 210.19(A) and 210.20(A), 215.2(A)(1) and 215.3

- 68) What type grounding electrode system is required for the inverter of a small wind turbine?

A grounding electrode system is not specifically required in Article 694. Article 694.62 refers you to Article 705.50 which refers you to Article 250 for the grounding requirements.

69) What loads and for how long must a fire pump primary overcurrent device be selected to carry?

695.3(A) Individual Sources – Utility service or dedicated feeder or On-site Power Prod

695.3(B) Multiple Sources – Individual sources (2 or more) or Individual source and on-site gen

695.3(C) Multibuilding Campus – feeder sources or feeder and alt source

The fire pump can be connected directly 695.4(A) or through a disconnecting means and overcurrent device in 695.4(B).

695.4(B)(1)(b) *Feeder Sources*. For systems installed under the provisions of 695.3(C) only, additional disconnecting means and the associated overcurrent protective device(s) shall be permitted as required to comply with other provisions of this *Code*.

695.4(B)(2)(a) *Individual Sources*. The overcurrent protective device(s) shall be rated to carry **indefinitely the sum of the locked-rotor current of the fire pump motor(s) and the pressure maintenance pump motor(s) and the full-load current of the associated fire pump accessory equipment** when connected to this power supply. Where the locked-rotor current value does not correspond to a standard overcurrent device size, the next standard overcurrent device size shall be used in accordance with 240.6. The requirement to carry the locked-rotor currents indefinitely shall not apply to conductors or devices other than overcurrent devices in the fire pump motor circuit(s). [20:9.2.3.4]

70) How many threads need to engage for a factory threaded NPT conduit entries in a classified area?

Refer to 500.8 (E) (1) NPT (National Standard Pipe Taper Thread) entries into explosionproof equipment shall be made up with at least five (5) threads fully engaged. (Exception): For listed explosionproof equipment, joints with factory threaded NPT entries shall be made up with at least 4 ½ threads fully engaged.

71) Do lay in light fixtures have to be independently supported from the structure?

Not per the NEC, though there may be other reasons, such as project specifications, Building Code requirements, or ceiling system manufacturer requirements that could require independent support. 410.36B requires a luminaire supported by the grid be secured to the grid but, once independent support is provided, it is no longer supported by the grid and 410.36B would no longer be applicable.

72) What is the ampacity of 350 KCMIL, USE aluminum conductors installed as service conductors for a multi-family dwelling building with a 120/208 volt, 3 phase supply?

250 amps per Table 310.15(B)(16).

Section 310.15(B)(7) (and Table 310.15(B)(7) is only applicable for 120/240-Volt, 3-Wire, Single-Phase Dwelling Services and Feeders.

73) Does a free standing building designed for a bank with windows designed for security require show window receptacles around the whole bank?

No. The term “show window” defined in Article 100, page 32 defines the purpose of the show window to be for “**display of goods or advertising material.**” If the bank windows are designed, as stated, for security purposes, then the show window lighting load requirement of 220.43 does not apply.

74) Can a transformer be installed on a roof if rated for outdoor use?

Yes if rated for outdoor use. Article 450.22

75) What is the minimum size THHN aluminum feeder conductor, protected by a 100 ampere circuit breaker with 75 C degree rated terminals supplying a three phase service in a car wash?

THHN – Dry and Damp Locations only, NOT wet 310.10(B)

Table 310.15(B)16 –Although the THHN is rated for 90C and this would suggest a #2 was acceptable the conductors must be sized at #1 AWG based on equipment termination rating

110.14(C)(1)(a)(3) allows the use of 75C instead of 60C where the equipment is listed and identified

76) Since the tables in 725 do not show cables that are listed for a wet location, do you need to have LV conductors install in a slab on grade listed for a wet location?

I take the question talking about 725.179 (G) Table. In 725 #4 under “Listing Requirements” on page 649, will give the use of the type cable characteristics. (E) The only one I see for wet location is PLTC. In article 100 Definitions defines Wet Location as installations underground on in concrete slabs or masonry in direct contact with the earth; in location subject to saturation with water or other liquids, such as vehicle washing areas; and in unprotected locations exposed to weather.

77) When does 310.15(B)(2)(b) , 104 F, apply?

I am not sure exactly what the question is. There is no Article 310.15B2b so I assume the question refers to **Table** 310.15B2b. The word ‘ambient’ means around or surrounding. In this case, the term refers to the air temperature surrounding the conductors. The ampacities found in Table 310.15B16 are based on an ambient temperature of 30 deg. Celsius. Table 310.15B2a is to be used for temperature correction where the ambient temperature exceeds 30 deg. Celsius. Current flow causes heat in a conductor. If the air around the conductor is hotter, it cannot safely carry as much current as it could if it were cooler. Notice Table 310.15B2a; at 30 degrees C., the conductor ampacity correction factor is 1.00, meaning it can carry whatever Table 310.15B16 says it can. As the temperature increases, the table reduces the allowable ampacity of the conductor. On the other hand, as the temp decreases, the ampacity increases. The temperature correction factors work in both directions.

Tables 310.15B18 through 310.15B21 are for use with various conductor types, based on 40 degrees Celsius ambient. Table 310.15B2b is to be used for temperature correction for these conductors.

78) What is the classification for conduit under a commercial garage concrete floor?

Unclassified-511.3 includes provisions for area classification, none of which include the area under the floor. Rewrite in the 2005 NEC® - Gone are any references in this articles to raceways buried beneath a concrete floor or directly buried in the earth as being in a hazardous (classified) location. Using the concept developed by the NFPA 30A Committee, Code-Making Panel 14 removed the hazardous classification requirements for underground raceway installations.

79) Do I need solid bar battery interconnections or can I use flexible cables for the battery connections on a photovoltaic system.

No. Connections on a battery system for a photovoltaic application are not limited to a solid bus bar. NEC paragraph 690.32, titled: *Component Interconnections* reads: "...fittings and connectors shall be equal to the wiring method employed in the insulation, temperature rise, and fault current withstand, and shall be capable of resisting the effects of the environment in which they are used." Methods including solid bus bar, flex braid or cable are potentially allowed, if meeting the stated criteria.

80) If a home has a large fountain in the main living room, is the wall of the fountain considered wall space and require outlets? Does article 680 overrule the wall space requirements?

No the wall space would be treated similar to a fireplace or other break in the wall, Article 210.52. Article 680 does modify the requirements in 210 in regards to the fountain.

81) If I am wiring 5 208V 3 phase welders for welders in a shop. They are positioned on production lines and there will never be more than one welder operating at a time. Can I put them on the same circuit?

Yes, there are allowances in Article 630.31 to install multiple welders. 630.11(B) provides the general conductor sizing but the exception allows more flexibility where there are controls to lower welder duty cycles and simultaneous use.

82) How many receptacles shall be readily accessible in a guest room or guest suite?

Two. Refer to 210.60 (B). At least two receptacles outlets shall be readily accessible. Where receptacles are installed behind the bed, the receptacles shall be located to prevent the bed from contacting any attachment plug that may be installed or the receptacle shall be provided with a suitable guard. In 210.52 (A) The total number of receptacles outlets shall not be less than the minimum number that would comply with the provisions of that section.

83) Is Type NM-B allowed to be used in other spaces used for environmental air-handling purposes other than ducts or plenums, such as the space above a suspended ceiling?

No. 300.22C1 covers acceptable wiring methods and does not permit the use of NM cable. 334.12A2 also expressly prohibits the use of NM cable exposed above a suspended ceiling in anything other than one- and two-family dwellings.

84) Schedule 80 PVC is listed for "subject to physical damage". I am installing temporary wiring from an existing panelboard to a temporary office trailer on a construction site where the ground is frozen. Is it permissible to run this conduit on top of the ground, securing it with two hole straps using fence

post spikes driven into the ground? The conduit will be hugged against the construction fence surrounding the project site.

90.4-I don't see where this would be a problem, as long as the conduit is routed in a manner that won't subject it to any vehicle traffic, forklifts, etc. and the installation is temporary. This is the call of the AHJ.

85) Is it permissible to install aluminum SER cable in an underground PVC raceway between a house and a garage?

No. Aluminum SER Cable, or more appropriately Type SE, Style R, is a type of SE cable and falls within the provisions of Article 338. Under NEC 338.12 (A) (2), Service-entrance cable (SE) shall **NOT** be used in locations "Underground with or without a raceway".

86) Who's responsible for designating the classification of hazardous locations, and is it required to be listed on the drawings?

The design team or other professionals who deal with all aspects of building, fire codes, and electrical code. Article 500.4 and see IEAI Hazardous Locations manual.

87) Can industrial control cabinets be used as a raceway?

Yes, with restrictions.

409.104 Wiring Space.

(A) General. Industrial control panel enclosures shall not be used as junction boxes, auxiliary gutters, or raceways for conductors feeding through or tapping off to other switches or overcurrent devices or other equipment, unless the conductors fill less than 40 percent of the cross-sectional area of the wiring space. In addition, the conductors, splices, and taps shall not fill the wiring space at any cross section to more than 75 percent of the cross-sectional area of that space.

88) Are pendant luminaires allowed in a clothes closet? What types for luminaires are allowed?

In 410.16 (B) Pendant luminaires are not permitted. Surface-mounted incandescent, fluorescent and recessed incandescent. Look at your figure on page 280 on storage space. In 410.16 (C) Locations gives the distance in front of the storage areas. (1) 12 in, for surface-mounted incandescent or LED Luminaires with complete enclosed fixture. (2) (3)(4) 6in. Surface-mounted fluorescent, recessed incandescent or LED Luminaires and recessed fluorescent luminaires. 410.2 Definitions for Closet Storage Space.

89) Can an island GFCI receptacle be installed under a countertop overhang of 9" beyond base point?

No. 210.52C5 Exception specifies receptacles shall NOT be located below a countertop where it extends more than 6" beyond the support base.

90) What is the maximum vertical length 250 MCM Cu conductors can run in a wireway without support?

60 feet – 300.19 Supporting Conductors in Vertical Raceways. (A) Spacing Intervals — Maximum. Conductors in vertical raceways shall be supported if the vertical rise exceeds the values in **Table**

300.19(A). One cable support shall be provided at the top of the vertical raceway or as close to the top as practical. Intermediate supports shall be provided as necessary to limit supported conductor lengths to not greater than those values specified in Table 300.19(A).

91) Where is the distance the equipotential bond wire is required to be installed, measured from the edge of a concrete pool, without a deck?

The equipotential bonding system for this example is defined in Paragraph 680.26 (B) (2) (b) where perimeter surfaces extending 3 feet from the pool interior wall (and following the contour of the pool) consists of a paved or unpaved surface. At least one conductor is required, minimum **#8 AWG**, solid copper, located between **18 inches and 24 inches horizontally from the pool wall, buried 4 to 6 inches** below the subgrade surface and bonded to the pool reinforcing steel or copper conductor grid at four locations. Clarification of this requirement is well documented and diagrammed in Chapter 15 (pages 284-285) of *Soares Book on Grounding and Bonding*; an excellent resource tool for the inspector, contractor, or engineer.

92) Can service equipment be mounted over an open window well if protection from falling in the window well is put over the well?

Yes if an adequate cover is provided over the window well. Article 230.70 (A)(1) requires ready access.

93) Any emergency system in a residence, would it require to be on an arc fault breaker?

No, not unless the selective coordination requirements of 700.27 are met.

210.12(A) provides the requirements for AFCIs in dwellings but Article 700 is permitted to amend or place additional requirements. Since a dwelling is not an assembly occupancy the inclusion of the emergency system may be related to healthcare and there may be additional requirements beyond article 700.

94) Can a switched receptacle be on a small appliance branch circuit for dining room lighting?

No. 210.52 (B) (1) Must be supplied from a general purpose branch circuit. Look at 210.70 (A)(1) In other than kitchens and bathroom, one or more receptacles controlled by a wall switch shall be permitted in lieu of lighting outlets.

95) Is the room side of a kitchen Island counter, to be considered wall space, i.e. when there is a kitchen nook that is part of the same area and the counter back side is facing the nook?

It depends! Generally, my answer is no, if we're talking about an island constructed primarily of normal, cabinet-type materials. Only one receptacle outlet is required on an island of this type unless separate spaces have been created per 210.52C4. But, not all islands are created equally! If the island is constructed of normal building materials, such as 2x4s and drywall, the receptacle spacing requirements of 210.52A could come into play. This is going to be a highly subjective call and I recommend reviewing it with your AHJ to see how they are going to call it. Every job could be slightly different from the one before it.

96) Why is sealtight limited to 6ft outside the hot tub? Should it not be up to the inspector to determine if it is subject to physical damage?

680.42(A)(1) Flexible Conduit. Liquidtight flexible metal conduit or liquidtight flexible nonmetallic conduit shall be permitted in lengths of not more than 1.8 m (6 ft) external to the spa or hot tub enclosure in addition to the length needed within the enclosure to make the electrical connection.

I am not sure why the length is limited to 6 feet; other than the requirements in 680 include enhanced electric shock protection in this wet environment, which include among other things (like GFCIs, low voltage equipment, bonding etc.), robust physical protection requirements for circuit conductors-thus rigid wiring methods afford added protection.

Assignments:

Panel 1

Mike Forister	1, 7, 13, 19, 25, 31, 37, 43
Don Iverson	2, 8, 14, 20, 26, 32, 38, 44
Tom Lichtenstein	3, 9, 15, 21, 27, 33, 39, 45
Chuck Mello	4, 10, 16, 22, 28, 34, 40, 46
Vince Saporita	5, 11, 17, 23, 29, 35, 41, 47
Phil Simmons	6, 12, 18, 24, 30, 36, 42, 48

Panel 2

John Benson	49, 55, 61, 67, 73, 79, 85, 91
Steve Conrad	50, 56, 62, 68, 74, 80, 86, 92
Chad Kennedy	51, 57, 63, 69, 75, 81, 87, 93
Danny King	52, 58, 64, 70, 76, 82, 88, 94
Grant Hammett	53, 59, 65, 71, 77, 83, 89, 95
Tim McClintock	54, 60, 66, 72, 78, 84, 90, 96