WISCONSIN CHAPTER IAEI

82nd ANNUAL SEMINAR

CODE QUESTIONS

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APPLETON, WI

1. As a supplier, I just received a call from my of my contractors who says that on 20A circuits (kitchens and dining rooms), if they use standard duplex receptacles, they can use 15A. But if they use decora, the inspector makes them use 20A rated devices. What is going on?
   ANS: Section 210.21 of the NEC talks about outlet devices and Paragraph (B) deals with receptacles. I think the inspector is confused about something. Section 210.21 (B)(3) deals with the receptacle rating and says " Where connected to a branch circuit supplying two or more receptacles or outlets, receptacle ratings shall conform to the values listed in Table 210.21(B)(3), . . ." Looking at the Table it tells us that for a 20 ampere circuit rating (kitchen or dinette) we can use a 15 or 20 ampere rated receptacle. The only restriction is in (B)(1) where if we only supply a single receptacle it shall have an ampere rating not less than the branch circuit rating supplying it. So it says I can connect more than one single receptacle, duplex or decora (which some have 3 receptacles) and use Table 210.21(B)(3) to connect 15 or 20 ampere devices to a 20 ampere circuit as long as I have more than 1 receptacle. 2 singles, 1 duplex or a Decora receptacle are all more than 1.

2. Is it permitted to install a hasp on the cover of the panel containing the breakers for the motors of the fuel dispensing pump to satisfy the requirements of 514.13?
   ANS: No, a hasp on the panelboard does not meet the requirement in 514.13. "Each" dispensing device must be provided with a means to disconnect all voltage sources. It's the disconnecting means that must be capable of being locked in the open position, not the cover of the enclosure that the disconnecting means is mounted in. The Analysis of Changes, page 264, illustrates a lock-off device attached to each circuit breaker as one of the acceptable means. An individual switch that opens all of the circuits supplying the dispensing device would Also be acceptable, as long as the switch was capable of being locked off.

3. In determining the proper feeder conductor size and overcurrent protection where the feeder supplies several variable frequency drives for several motors I believe 430.122(A) applies. Under a condition where not all motors run at the same time would you still take the sum of all the power conversion equipment x 125% or base it on the largest load at any one time (x 125%)?
   ANS: 430.122(A) applies to feeder and branch circuit conductors supplying Adjustable Speed Drives. Sum all the ratings and multiply by 125% to determine the minimum ampacity of the feeder conductors. If any drive has a by-pass use the value determined by 430.6 for the motor and multiply by 125%; and then also calculate using rated input of that drive multiplied by 125% - the larger of the two calculations should be used. Section 430.62 is used to determine the short circuit ground fault protection (fuse or breaker) for this group of adjustable speed drives. 430.26 would permit the AHJ to determine a demand factor if all motors do not run at the same time.

4. I have three questions regarding the proposed change to 410.73(G) - Disconnecting Means, which will be effective on January 1, 2008. (1) Exception 5 -- Is this saying that where we have a number of banks of lights, in a place of assembly, with a wall switch for each bank (i.e., not a multiwire circuit), that we do need -- or don't need -- individual switches at each luminaire? (2) What assurance do we have that a qualified person, or an unqualified person, would be able to locate the disconnecting means in the luminaire? (3) What assurance do we have that a qualified person, or an unqualified person, would bother to turn the switch off if he did find it?
   ANS: 410.73 (G) Question #1: you not need individual disconnects at each luminaires; Question #2: Qualified, trained electrical workers and maintenance people should be able to find the switches. Qualified person is defined in Article 100 ("the person is required to be trained to recognize and avoid the hazards.") Note the NEW LICENCING LAW go into effect in 5 years: Question #3: We do not have any assurance. Failure to remove all sources of energy is a violation of OSHA 1910 & 1926 if there is an accident, large fines are going to be imposed: It's the employers responsibility to ensure power is turned off:
   NOTE: All the new fixtures that are coming out all have Snap Connector type disconnects within the ballast cabinet.

5. I am aware of the grounding requirements for Grounding Separately Derived Systems in article 250-30 but am unsure how to apply the exception to (4)(b) to my current project. I understand the common grounding electrode concept if used but it doesn't work in all cases. The existing building I am working in probably does not have effectively grounded building steel (it has concrete walls) so I need to get a G.E.C out to several transformers that are scattered throughout the facility. I understand that it will be necessary to bond any steel and water in the area of the new transformers but I still have a problem getting the G.E.C. to each transformer Assuming that it is infeasible to route a common 3/0 G.E.C between all transformers, is it acceptable to route the G.E.C with the primary feeders from the main service (service rated) if the feeder ground is sized per 250-66 for one transformer, or 3/0 for multiple transformers in the area? Using the exception of Section 250/30 (4)(b), am I applying this correctly? The G.E.C would go thru more than one panel to get to the transformer. Is it acceptable to splice this G.E.C. at the equipment ground bar in each panel? Are bonding bushings or suitable bonding methods required at every junction point if it is allowed to go through panels? Which panels are they referring to in the exception that are required to be suitable for use as service equipment, any panel along the feeder route or only the main service where the feeders originate?
   ANS: NO, you are not applying 250.30(A)(4)(b) properly. The equipment grounding conductor and the grounding electrode conductor are 2 different things and they shall not be the same conductor. To use 250.30(A)(4) you cannot diverge from any of the provisions in this section. You need to run a "Common Grounding Electrode Conductor" that will provide bonding to more than one transformer. You need to "tap" off an individual bond wire sized per par (b) to each transformer and make connections per par (c) from that single common grounding electrode conductor. Your building may have more than one of these bonding "systems". If you were to run the grounding electrode conductor along with the circuit conductors, bonding by bonding type locknuts or bushings would be required at all junction points if metal raceways or conduits are used. Issues with bonding this electrode conductor to any panel assembly it goes through would make this a nightmare. "Splicing" this wire, by use

of a panel's bus bar does not appeared to be allowed as the last sentence of (4) states that when it is run it should remain "without a splice or joint." 250.30(A)(3) exc 2 refers to a listed piece of equipment that is service rated that includes the separately derived system as part of the equipment such as a switchboard or motor control center with the transformer being part of the equipment where the grounding electrode conductor run to that equipment is of sufficient size for the separately derived system. If I understand your installation correctly I don't believe this is what you have.

6. I can't find Code section that gives the ampacity of copper bus bars size 4" x 1/2" copper bus bars. Can you help me to find it?
   ANS: 366.23 (A) copper bus in metal enclosure 1000 amperes / Square inch
   Aluminum bus in metal enclosure 700 Amperes / Square inch
   .5 x 4 = 2.0 square inches x 1000 amperes = 2000 Amperes:

7. I read that vending machines must be protected by GFCI 's. Won't GFCI's be constantly tripping from the constant switching within the vending machine or the refrigeration relay on the compressor of a refrigerated vending machine? Why wouldn't correcting the grounding of the machine be enough to cure the problem of electrocution? It sounds to me like the machines weren't properly grounded and that resulted in deaths.
   ANS: ground-fault circuit-interrupters (GFCI;s) are pretty much a proven and reliable device. I am not aware of any data collected by a reliable source that would indicate that constant switching within a vending machine or the activation of any relays used in conjunction with the compressor of a refrigerated vending machine would cause nuisance tripping of a GFCI. As far as correcting the grounding of the vending machines in the February 5 question, I have no knowledge as to whether they were effectively grounded in accordance with 250.138 or not but the grounding method required by this section requires a ground-fault to be of sufficient size to open the branch circuit overcurrent protective device. A lesser ground-fault could be imposed on the equipment and not open the protective device resulting in an energized housing. This could result in a person touching a grounded surface and the energized housing receiving a perhaps lethal shock. The use of GFCI protection, where the GFCI device opens the circuit it detects a ground-fault of 4 to 6 mA doesn't mean that when the housing becomes energized, the device will open. It means that when a circuit is established between the energized housing and ground, by an individual touching both the energized housing and a grounded surface the GFCI, not the circuit protective device, will open at 4 - 6 mA and the individual will probably receive a severe shock but not a lethal one.

8. Typical Motor control center (MCC) construction has the highest disconnecting means 6'-6" high in elevation compared to the bottom of the MCC structure. Industry practice is to mount the MCC on a 4 inch concrete pad which raises the switch and creates a code violation. Some inspectors flag this and other ignore the installation. Do the safety benefits of pad mounting the MCC outweigh the several inches in height violation? Are the handle extenders some manufacturer's supply an adequate fix for this issue?
   ANS: Article 430 does not address this situation. However, if the disconnecting means provided by the MCC is required to be "readily accessible" by any code section, then this would serve as a switch. These switches need to be no higher than 6'7" as measured to the "center of the grip of the handle ….when in its highest position" {404.8(A)}. Manufacturers

usually make this equipment to meet this requirement, even on a concrete pad. Generally handle extension may not help the situation, but that depends upon the configuration of the switch that they are attached to.

9. How do I size the bonding jumper for a cable tray that only has communication and data cables installed in the tray?
   ANS: In Article 392 "Cable Trays," Section 392.7 tells us to bond the cable tray sections with bolted mechanical connectors or bonding jumpers sized based on 250.102. Section 250.102(D) requires the equipment-bonding jumper to be sized based on the overcurrent device rating, per Table 250.122.
   If a cable tray contains only communications and data cables only, this isn't covered in the NEC. I went to the UL White Book for Cable Trays (Category CYNW) and found the same NEC reference for sizing the bonding jumpers. The NEIS has a standard for cable trays, NECA/NEMA 105-2002 "Installing Metal Cable Trays." Section 4.7.3.2 covers grounding and bonding for non-power applications. It states, on page 36: "Cable tray systems containing conductors outside the scope of NEC Article 250 (such as communications, data, signal cables, etc.) still require bonding and grounding for system operation and performance. "Metal trays containing these conductors shall be electronically continuous, via listed connectors or the use of an insulated #10 AWG (minimum) stranded bonding jumper." *Note: The State of Wisconsin does not adopt or reference NEIS installation standards.*

10. My question relates to Article 410.8(B) and recessed fluorescent luminaires in clothes closets. If a standard incandescent recessed lighting can is used in a clothes closet, and the installer uses compact fluorescent lamps (CFL) instead of incandescent lamps, is the fixture now classified as a recessed fluorescent luminaire? Is the trim installed required to completely enclose the fluorescent lamp as required in 410.8(B)(1), because down the road someone could replace the CFL with an incandescent lamp?
    ANS: A recessed incandescent luminaire (fixture) installed in a clothes closet is still classified as an incandescent and subject to the requirements of 410.8(B)(1) regardless of whether the lamp is changed to a compact fluorescent. The luminaire has a screw socket designed to accept an incandescent lamp, and as you say the CFL lamp can always be changed back to an incandescent. The only NEC reference I can find is 110.3(B), where the listing or labeling or manufacturer's installation instructions must be followed.

11. Is bonding required for the fire sprinkler system?
    ANS: YES. 250.50 requires all grounding electrodes listed in (A) 1 thru (A) 7 to be connected together to form a grounding electrode system. A sprinkler system that has at least 10 feet of metal in contact with earth is a grounding electrode. IF the sprinkler system does not have metal in contact with earth for this distance, then it is required to be bonded by 250.104(A).

12. I believe that there is a requirement to remove abandoned electrical conductors unless identified for future use. This was a requirement in the 1999 and 2002 Codes, but I can't find it in the 2005 NEC. Could you direct me to a location, or explain the thought behind removing this requirement if it has been removed?

ANS: Answer: look at NEC 372.13, 374.7, 390.7, 640.3(A), 645.5(D)(6), 725.3(B), 760.3(A), 770.3(A), 800.3(C), 820.3(A), and 830.3(A). This issue has been debated long and hard, but I believe now that some concrete requirements have been accepted relating to identified for future use."

13. What is the maximum overcurrent protection that 4/0 AWG, 75C, aluminum transformer secondary conductors may have?
    ANS: The minimum rating of an overcurrent protective in a circuit is a rating that is within the ampacity rating of the conductor and is sufficient to carry the load. I'm adding the following comment in the hope that it will help you. Table 310.16 shows the allowable ampacity of a 4/0 AWG, 75C aluminum conductor to be 180 amperes based on the scope of this table. The basic rules are as shown in 240.4 where conductors must be protected against overcurrent in accordance with their ampacity as specified in 300.15(B), which brings you to Table 310.16 and in 240.21 where overcurrent for conductors must be provided where the conductors receive their supply. One of the exceptions to the basic rule for the location in the circuit of the overcurrent protection is found in 240.21(C) Transformer Secondary Conductors. This rule permits the overcurrent protection to be located where the transformer secondary conductors terminate. In general this overcurrent protective device must not exceed the ampacity of the secondary conductors and not less than the calculated loads supplied by the secondary conductors. The maximum overcurrent protection device allowed for this installation is 180 amps, and the closest standard size OCPD that does not exceed this rating is 175 amp per 240.6. Section:210.4, 300.15, 310.16, 240.21

14. I have a question on renewable-link fuses. I was taught for years that renewable-link fuses aren't legal, but can't find a good Code reference for that.
    ANS: Article 240.60(D) states, Class H cartridge fuses of the renewable link type shall only be permitted to be used for replacement in existing installations where there is no evidence of overfusing or tampering. Nearly every time I see this fuse type used the circuit conductor or equipment protected by it is has been severely overfused. What is the rationale behind the continued use of these devices? There has never been a Code requirement prohibiting the use of these renewable cartridge fuses, except where a fused switch manufacturer has instructions to that effect and NEC 110.3(B) would require conformance with the instructions. Section 240.60(D) is a new requirement in the 2005 NEC and is modeled after the wording in 240.51(B), where plug fuses of the Edison-base type shall be used only for replacement in existing installations where there is no evidence of overfusing or tampering. The new rule 240.60(D) permits the use of Class H renewable type cartridge fuses for replacement only in existing installations where there is no evidence of overfusing or tampering. The reference to Class H was to preclude the restriction of future types of current-limiting renewable fuses as might be manufactured. Section: 240.60(D)

15. Many inspectors say that the rebar or 4 AWG bare copper in the concrete footing is "the best ground." If this grounding electrode is so good, why does the Code only require a 4 AWG copper grounding electrode conductor for a 2000 ampere service to a concrete encased electrode "ufer", but requires a 3/0 GEC to the metal water piping system? It would seem to me the Code thinks the water pipe electrode is the better of the two.

ANS: Based on the resistance to ground of the concrete-encased electrode as determined by testing, a 4 AWG copper conductor will carry all of the current the concrete-encased electrode can dissipate into the earth in a given time frame. Using a larger grounding electrode conductor does not increase the ability of the concrete-encased electrode to dissipate the fault current. Underground metal water pipe offers considerably less resistance to ground and can dissipate large amounts of fault current and for that reason larger grounding electrode conductors are used. This would appear to justify your contention that an underground metal water pipe is considered "the better of the two" grounds. However, underground metal water pipe is not considered equally reliable as shown by 250.53(D)(2) which requires a supplemental electrode to be installed where a metal underground water pipe is used. This is partially due to many changes in the plumbing industry with supply piping becoming plastic when replaced. The fault current discussed here is that fault current described in 250.4(A)(1), and not fault-current carried by the grounded (neutral) conductor intended to open the overcurrent devices as specified in 250.4(A)(5). Section: 250.4(A)(1), 250.4(A)(5)

16. I am a municipal building official where we enforce the 2005 NEC. Section 334.12(A)(2) "Uses Not Permitted" states that nonmetallic cable cannot be installed above a suspended ceiling in other than dwellings. I was wondering what the reasoning is in this requirement?
ANS: This requirement resulted from the work of a Task Group on Nonmetallic-sheathed Cable for the 2002 NEC. Basically it reflects a concern relating to physical damage. Wiring in cavities is often subjected to abuse by other trades, and the cable could also be damaged in steel truss roof construction. The Task Force felt these types of damage would be more common in types of buildings other than one-family, two-family, and multifamily dwellings.Section:334.12(2). *Note in Wisconsin: Comm 16.327 allows this wiring in buildings without a 15 minute finish rating and an Official Code Interpretation by the Department of Commerce, allows nonmetallic cable to be installed above suspended ceilings in any occupancy or type of building where this cable form is allowed.*

17. In a bedroom there are two single-pole switches at the door, one intended for the paddle fan and one for the light on the fan. The paddle fan was hung on a fan-rated box, but with no light on the fan at time of the electrical inspection. The electrical inspector failed the installation. We think we met the requirement of section 210.70 (A)(1) and the definition of lighting outlet. Could you please clarify?
ANS: It appears you satisfied NEC requirements regarding wiring installation. However, the inspection authorities appear to be requiring that all lighting fixtures be installed before an occupancy permit will be issued. The way you have it, a person must walk into a dark room until they find a lamp. There's no switched receptacle to plug a lamp into.

18. Many people are using Compact Fluorescent Lamps (CFL) for retrofit in their homes. They are replacing normal A-type incandescent lamps with these new ones that supposedly give the equivalent of 60 or 100 watts of illumination light while consuming only 23 watts of energy. My question is, can luminaires that are marked for a maximum size of incandescent lamp be used safely with these new CFL lamps? I assume the heat given off by a 60W incandescent lamp isn't the same as a CFL that produces the same amount of light. Could you shed some fluorescent light on this?

ANS: The twisty lamps you are referring to are compact fluorescent lamps (CFL). Listed surface or recessed luminaires marked for a maximum incandescent lamp size are permitted to use CFL of the same equivalent wattage. This is because the maximum incandescent lamp size is selected to prevent overheating that could damage conductor insulation. Fluorescent lamps run cooler than incandescent, and in fact people generally replace an A-type incandescent with a CFL of smaller wattage. So permitting this kind of replacement doesn't create a safety problem with the use of these cooler running bulbs.

19. Can Type MC cable be run perpendicular to metal framing members with less than 1-1/4" clearance from screws and nails without the use of nail plates? NEC 330.17 refers to "through or parallel to framing members," which refers to Section 300.4(A), (C), and; (D), which make no mention of perpendicular to metal framing members.
    ANS: No,. So the answer to your question is no. The cable must be protected by a steel plate, sleeve, or equivalent.Section:300.4(D)

20. I know that you must fish the wire through the conduit after it is bent and installed. Why? Often it would seem much simpler to prestring the wire, bend to shape, install and finish. What is the problem?
    ANS: The difficulties you would encounter are numerous ,as you will recognize when you actually start installing conduit. Just remember: the basic rule is that you must be able to insert or withdraw conductors from an installed conduit system without damaging the conductors. NEC 300.18(A) contains the requirements regarding complete raceway systems prior to the installation of conductors. Section: 300.18(A)

21. I'd appreciate if you would direct me to the 2005 NEC that cover wiring method for 15- and 20-ampere devices such as switches and receptacles. I'm looking for the rule that says if such devices are removed from the circuit it won't interrupt the operation --- in other words, that wiring devices must be pigtailed to the branch-circuit conductors.
    ANS: NEC 300.13 Device Removal requires that, in multiwire circuits, the continuity of the grounded (neutral) conductor must not depend on connections on receptacles where the removal of the receptacle would interrupt the continuity of the grounded (neutral) conductor. This only applies to multiwire circuits as defined in 210.4 (shared neutrals) where opening the grounded (neutral) conductor might place a higher voltage across electrical equipment. So yes, the neutral must be pigtailed.Section:300.13

22. The secondary conductors of a transformer are less than 10 feet in length, do the secondary conductors have to terminate in a main breaker? **.**
    ANS: You can run secondary conductors up to 10 feet without overcurrent protection, if they comply with 240.21(C)(2). However, you must provide overcurrent protection for lighting and appliance branch-circuit panelboards. This protection is required to be located on the secondary side of the transformer [408.36(D)],

23. Does the NEC require bonding around raceway knockouts for 120V, 208V, or 240V feeders and branch circuits?
    ANS: You must bond all metal parts intended to serve as the effective ground-fault current path, such as raceways, cables, equipment, and enclosures, together to ensure they have the

capacity to safely conduct any fault current likely to be imposed on them [250.96(A)]. If the knockouts are damaged, the integrity of the fault current path is jeopardized, and you must then bond around them. If the knockouts are not damaged, no extra bonding is required

24. I'm remodeling an existing restaurant bar that has been open for over 20 years. The electrical inspector wants the electrical room brought up to today's code for working clearances, but there are no walls to take down to get the three feet of clearance and we aren't adding any load to the service and not adding any equipment to the room. Am I required to do this?
    ANS: In 1988, what was to NEC requirements? 110.16 (a) – (f) on pg 20 & 21 did require proper working space. There fore the inspector is right: if it's a violation when installed it's still a code violation and needs to be correct: Remember that there are requirement that at the time where not required like the door swing and hardware. Even in 1968 work clearances were still required (40 years ago).

25. I am working in a dwelling and the Home Inspector says we have to replace the Federal Pacific electrical panel because of their bad reputation. Is this required by code?
    ANS: No. There is a lot of FPE equipment in use around the country, serving satisfactorily. At one time there were issues with some circuit breakers. Breakers can be tested by qualified electricians. Check out CPSC.gov (consumer protection)

26. Is a "sleep center" considered a patient care area under Article 517? Customers sometimes are kept overnight to monitor their sleep habits. If this is a patient care area, would the beds be considered a "patient bed location" and require the 2 branch circuits, both emergency and normal. Or do they fall under 517.18(A), Exception 2.
    ANS: 517.2 indicates that this is a "Patient Care Area". The situation you are describing would be covered by 517.18(A), Exception 2 as this is a clinic and 2 branch circuits are not required..

27. Can Type NM and Type MC cable be installed in block walls or in concrete?
    ANS: NEC 334.10(A) permits Type NM cable to be installed in air voids in masonry block walls. NEC 334.12(A)(9) prohibits installing Type NM cable in poured cement or concrete. NEC 330.12(3) prohibits installing Type MC cable in concrete unless it is identified for direct burial. Installing Type MC cable in a block wall is not covered in 330.10 Uses Permitted. However the FPN to 330.10 states that Uses Permitted isn't an all-inclusive list. Because this use isn't prohibited by 330.12 Uses Not Permitted, it is allowed. As a general principle, if the NEC doesn't prohibit a particular type of installation this means it is permissible.

28. Can I use Table 310-15(B)(6) to determine the size of the service conductors to a mobile home?
    ANS: Answer: Yes, these are classified as a dwelling. If the calculated load exceeds 50 amperes, a permanent feeder must be installed in accordance with 550.10(I). NEC 550.31 permits using 310.15(B)(6) to size the feeder conductors to a mobile home.

29. Does NEC 422.51 require retrofitting all existing vending machines or changing the receptacles to provide ground-fault circuit-interrupter (GFCI) protection?
    ANS: The NEC does not require existing wiring to be changed.

30. On a multi-switched incandescent fixture (3-way, 4-way, etc.), does the Code permit installing a dimmer at one location and standard toggle switches for the others, or is each switch controlling that fixture required to be a dimmer? A plan reviewer is claiming that a dimmer is required for every switch controlling the fixture. We've had several designs pass plan check in this same jurisdiction showing only a single dimmer on a multi-switched fixture. I read NEC Article 404 on switches, but couldn't find a Code reference addressing this particular situation.
ANS: This is a design question. There is NO CODE section that will cover it. 404.2 cover the induction problems of 300.20. Snap Switches (WJQR) No requirements Dimmers (EQXT) or (EOYX) No requirement listed.

31. My question relates to grounding and bonding a separately derived system. NEC Section 250.30 is very clear on establishing a grounded conductor for a separately derived system. Section 250.104(d)(1) however requires bonding of the interior metal piping system in the area of the separately derived system. This recent change (last few years) is not necessarily being implemented. In most office buildings, I believe that all transformers installed on upper floors should need this bonding of the metal piping. Does 250.104(d)(1) Exception No 2 eliminate this bonding requirement?
ANS: No, the metal water piping system in the area of the separately derived system must always be bonded to the grounded (usually the neutral) conductor of each separately derived system. NEC 250.104(D)(1) Exception No. 2 eliminates bonding of the metal water piping system directly to the grounded conductor where the metal frame of the building is used as the grounding electrode for the separately derived system and the metal frame is bonded to the metal water piping system.

32. Are grounding conductor used with isolated ground receptacles required to have a green outer finish? Or can they be a different color?
ANS: NEC 250.119 contains the requirements for the identification of equipment grounding conductors. Insulated equipment grounding conductors 6 AWG and smaller are required to have a continuous outer finish that is either green or green with one or more yellow stripes. Being used as the equipment-grounding conductor for an isolated ground receptacles does not change the identification requirement shown in 250.119.Section:250.119

33. In our area builders commonly run 12-3 NM cable to an area, and then share the neutral to make two 120-volt circuits serving general outlets and receptacles. The AFCI requirement has eliminated this practice in bedrooms, but does 210.4 permit this practice in other areas? What Code rule covers "shared neutrals" on this type of installation?
ANS: Multiwire branch circuits are permitted by 210.4(A). They can be installed anywhere based on 210.4(A), (B), and (C). But multiwire branch circuits can't be used where shared neutrals aren't compatible with the wiring devices being used, such as ground-fault and arc-fault devices.

34. I know that smoke detectors are required in bedrooms. But are they required anywhere else, such as family rooms?
ANS: Comm 21.09 Smoke detectors.

(1) A listed and labeled multiple-station smoke alarm with battery backup shall be installed in all of the following locations:
    (a) An alarm shall be installed inside each sleeping room.
    (b) On floor levels that contain one or more sleeping areas, an alarm shall be installed outside of the sleeping rooms, in the vicinity of each sleeping room.
    (c) On floor levels that do not contain a sleeping area, an alarm shall be installed in a common area on each floor level.

    Note 1: Section 50.035(2), Stats., created by 1983 Wis. Act 363 requires the installation of a complete low voltage, interconnected or radio-transmitting smoke detection system in al community-based residential facilities including those having 8 or fewer beds.

    Note 2: Section 101.645(3), Stats., requires the owner of a dwelling to install a functional smoke detector in the basement of the dwelling unit and on each floor level except the attic or storage area of each dwelling unit. The occupant of such a dwelling unit shall maintain any smoke detector in that unit, except that if any occupant who is not the owner, or any state, county, city, village or town officer, agent or employee charged under statute or municipal ordinance with powers or duties involving inspection of real or personal property, gives written notice to the owner that the smoke detector is not functional the owner shall provide, within 5 days after receipt of that notice, any maintenance necessary to make that smoke detector functional.

    Note 3: Section 101.745(4), Stats., requires the manufacturer of a manufactured building to install a functional smoke detector in the basement of the dwelling and on each floor level except the attic or storage area of each dwelling unit.
(2) Smoke detectors required by this section shall be continuously powered by the house electrical service, and shall be interconnected so that activation of one detector will cause activation of all detectors.
(3) For family living units with one or more communicating split levels or open adjacent levels with less than one full story separation between levels, one smoke detector on the upper level shall suffice for an adjacent lower level, including basements. Where there is an intervening door between one level and the adjacent lower level, smoke detectors shall be installed on each level.
(4) Smoke alarms and detectors shall be maintained in accordance with the manufacturer's specifications.
(5) For envelope dwellings, at least 3 smoke alarms shall be placed in the air passageways. The alarms shall be placed as far apart as possible.

35. I am wiring a condominium and there are built –in bookcases in the living room covering 14 feet of wall. Is the space occupied by these bookcases considered wallspace per Section 210.502 of the NEC?

    ANS: Yes, bookcases are considered to be part of "wallspace" per 210.52(A)(2). Doorways, fire places, and "similar openings" are not included. As a bookcase is not an "opening" in the wallspace, the space they take up is used to determine how many receptacles are required and where they are minimally placed. Think of a traditional "study" that is wall to wall bookcases. If you didn't count the bookcases, there wouldn't be any receptacles to place a nice antique floor lamp and pull up your favorite reading chair.

36. Is the vent hood over a gas cooktop permitted to be connected to one of the small-appliance branch circuits required for a dwelling unit kitchen?
ANS: No. The vent hood is not permitted to be connected to one of the small-appliance branch-circuits. NEC 210.52(B)(2) states that these small-appliance branch circuits "shall have no other outlets." Exception No. 2 permits receptacles installed to provide power for supplemental equipment on gas-fired counter-mounted cooking units. This may appear to give a strong argument for a hood fan, but the intent is to provide electric power for indicating lights and controls on gas cooktops.Section:210.52(B)(2)

37. Can PVC Conduit be used under the floor for the Supply Power of the Fire Pump per NEC 230.6 (1) & (2)?
ANS: Yes, conductors in PVC beneath the concrete floor are outside the building. Remember that once the service conductors for the fire pump enter the building they are in the building and must be disconnected either by the fire pump controller or by a separate disconnect (service rated) capable of locked rotor currents while meeting the service rules of Comm 16 and the NEC.

38. As an inspector can I require Push Button switches over Lever switches for starting and stopping Chemical Pumps per NFPA 79.9.2.5.1.2 for safety concerns?
ANS: No, requiring pushbuttons for safety concerns is something for their engineer/designer and not something we would do as an inspector. We are looking for compliance with Comm 16 and the NEC. We have to remember that the code is for the practical safeguarding of persons and property and that it contains the provisions considered necessary for safety.

39. What is the required working space for an installation of an electric sign transformer, ballast, or power supply located above a suspended ceiling? The location is such that it is considered to be accessible. The equipment is securely fastened in place, independent of the suspended ceiling grid.
ANS: In this example, Three feet in the direction of access, 3 feet wide, and 3 feet high. rather than using the general requirements of 110.26, it is appropriate to use the specific requirements of 600.21(D) and (F). Section 600.21(D) makes it clear that the 3 feet by 3 feet by 3 feet is the requirement for the clear, unobstructed working space in this particular situation.

40. Does the metal sprinkler system of a building have to be bonded to the electrical service?
ANS: Yes, unless there is some compelling reason to believe that the piping is likely to become energized. NEC 250.104(B), Other Metal Piping, requires that metal piping systems that are likely to become energized must be bonded to the service equipment enclosure ,etc. The FPN suggests that this bonding will provide additional safety. *Note: If the water supply piping supplying the sprinkler system is metal and not the same piping used for the potable water for the building, it must be utilized as a grounding electrode for service grounding.*

41. We have received over a dozen phone calls regarding the wash machines tripping out the GFCI. Now, the builders want something in writing from the State why they are mandating this ridiculous code. If you could please issue a statement through e-mail to me I will forward the information to all the builders we do business with. Please keep in mind we are one of the

largest new home electrical contractors in the state and do business with no less then 50 building contractors. This has become a major issue for us and our customers. Thank you for your understanding regarding this matter.
ANS: The requirement for GFCI protection of dwelling receptacles is found in Section 210.8 (A) of the National Electrical code (NEC). The requirement you are questioning was new in the 2005 edition. Paragraph (A) Dwelling Units. says "All 125-volt, single-phase, 15- and 20-ampere receptacles installed in the locations specified in (1) through (8) shall have ground-fault circuit-interrupter protection for personnel." (7) was added and says "Laundry, utility, and wet bar sinks -- where the receptacles are installed within 1.8 m (6 ft) of the outside edge of the sink." The requirement ensures GFCI protection for individuals that use the receptacles for whatever purpose they can think of. Many people, myself included use the receptacle at the washer for power when I am using an extension cord and power tools in the basement. (7) does not have any exceptions for dedicated appliances. If the receptacle is within 6 feet of the sink it shall be GFCI protected. Comm 16.20 substitutes the following wording for (7); "Laundry, utility, bedroom and wet bar sinks -- where the receptacles are installed within 1.8 m (6 ft) of the outside edge of the sink." This adds the sinks for vanities that are installed in bedrooms to the requirement. The requirement is to GFCI protect any receptacles within 6 feet of these sinks. An alternative would be to keep the receptacle 6 feet from the sink which may not always be possible. The Code Making Panel (CMP) added the requirement and Underwriters Laboratories says that if the GFCI trips with the appliance, the appliance should be checked since the allowable leakage current for appliances is much less than the trip level for a GFCI. The 2008 NEC is proposing to eliminate all exceptions for GFCI installation since the reliability of the devices is high. If you have had a dozen call backs I agree it is too many but would ask 12 in how many homes? Are the devices breakers or receptacles? Are they a specific manufacturer or lot number that may have had problems? There are several possible causes as to why they are tripping. *Note: Comm 16.20(1) adds the word "bedrooms" to the list of rooms where receptacles adjacent to sinks need GFCI protection.*

42. NEC 680.26 (B) (5) Metal Wiring Methods and Equipment This sounds like it deals only with metal items that are used as part of a electrical wiring method, and appliances like heaters. Does this article apply to metal fences, metal window frames, metal strips larger than 4" in dimension? The handbook illustrates metal fences in the bonding grid. Does this apply to fences that are part of the pool only, or all metal fences.
ANS: While the title of Section 680.26 (B)(5) is Metal Wiring Methods and Equipment it is the equipment part that gets all the extra metal bonded. The department's position has always included metal within 5 feet horizontally of the pool to include a metal fence. We have asked that fences more than 5 feet from the pool but in proximity to an equipotential deck (rebar in the concrete) be bonded to ensure there is no difference in potential. It can be difficult to bond some items but failure to do so could be deadly. Paragraph 4 in the Section covers electrical equipment bonding and paragraph 5 expands it to all metal equipment within 5 feet of the pool.

43. The 2005 NEC requires all panelboards to have directories that clearly identify what circuit each breaker supplies. Would panelboards installed prior to 2005 be grand-fathered in? If so, are you required to properly label all the existing circuit breakers if you install one new

circuit? I work in industrial plant, and with all the panelboards that have been neglected in the past, this makes for a big problem to correct.
ANS: New requirements in the NEC are not retroactive to prior installations. Some municipalities have enforced earlier editions of the NEC, and later editions of the Code would have to be specifically adopted by that municipality. However, NEC 110.22 was accepted into the 1965 NEC as a general rule requiring each branch circuit to be marked at the point where it originates to indicate its purpose. In the 2002 Code, this requirement was moved to 408.4, making the requirement for circuit identification more specific to panelboards and switchboards.

44. What are the NEC requirements for using electrical metallic tubing (EMT) to physically protect NM cable?.
ANS: Since there isn't any information on the application it will be used for, here are the most common code sections. NEC 334.15(B) permits EMT to be used to protect NM cable. NEC 300.15(C) states NM cable used on a wall of an unfinished basement shall be permitted to be installed in a listed conduit or tubing (EMT). Conduit or tubing shall utilize a nonmetallic bushing or adapter at the point the cable enters the raceway. Metal conduit and tubing and metal outlet boxes shall be grounded. NEC 312.5(C) Exception and Comm 16.31 addresses the use of EMT and NM cable for entry to cabinets, cutout boxes and meter socket enclosures, and NEC 314.17 and Comm 16.32 addresses the use of EMT and NM cable for entry into outlet, device, pull and junction boxes.

45. How do I size the circuit conductors and protection device for a 25-hp, 208V, 3-phase fire pump design letter B motor if not supplied by an on-site generator?
ANS: NEC 695.6(C)(2) requires conductors supplying only a fire pump motor to have a minimum ampacity in accordance with 430.22 and shall comply with the voltage drop requirements in 695.7. With the information provided it appears 430.22 (A) would apply and it states conductors that supply a single motor used in a continuous duty application shall have an ampacity of not less than 125 percent of the motor's full-load current rating as determined in 430.6(A)(1). 430.6(A)(1) refers this instance to 430.250. Full load current for a 25hp 208V motor is 74.8 amperes. 74.8 amperes times 125% equals 93.5 amperes. Using the 75 degree chart in NEC 310.16 a #3 copper conductor would be required. NEC 695.6(D) prohibits automatic protection against overloads for a fire pump. Overcurrent protection is permitted in NEC 695.4(B)(1), 695.5(B); and 695.5(C)(2). Each section requires the overcurrent protection to be sized to carry indefinitely the locked-rotor current of the fire pump. Since the question only addresses the fire pump motor, we will not include calculations for jockey pumps or any other associated fire pump equipment. Since NEC 430.251(B) is not permitted to be used by 695.4(B)(1) and since there are no combination loads, there would be no way to determine the locked-rotor ampacity of the fire pump motor. If however, the letter B was the locked-rotor indicating code letter as is required on fire pumps, then Table 430.7(B) would be used. The 25hp 208V motor with code letter B would have a maximum locked-rotor current of 425.48 amperes. NEC 240.6(A) would require an overcurrent device of not less than 450 amperes. The conductor size remains at #3 copper.

46. Recently an electrical inspector told us that the service entrance conductors need to be sized at 100% of the service main circuit breaker rating. Is this correct or can we still use NEC 240.4 (B) to size conductors for services of 800 amperes and less?
ANS: The size of the service entrance conductors are determined by NEC 230.42, NEC Article 220 and NEC 310.15. It is permissible to use NEC 240.4(B) provided all the conditions are met and if the rating of the overcurrent device does not exceed 800 amperes. My guess is this service is not on a single family dwelling.

47. 210.8(A)(7) requires that receptacles installed within 6 ft (1.8 m) from the outside edge of a sink shall be GFCI-protected. There are no exceptions to this rule. What is your thought about a receptacle in another room just around the corner from the sink? Seems to me that someone could plug in something in "the other room" and get close to the sink. My opinion is that GFCI protection is required. No exception....just within 6 feet...on the wall...in another room...around the corner...inside a cabinet above the sink area...on the ceiling...on the floor...measured horizontal....measured vertical...the way the crow flies...whatever.
ANS: Comm 16.20(1) agrees.

48. Does the NEC specifically state that a generator must be grounded to the earth if its wiring is connected to the premises via a transfer switch that does not open the neutral?
ANS: NEC 250.110 and NEC 250.112 requires all equipment fastened in place or connected by permanent wiring methods to be grounded this includes generators. NEC 250.34(A) does not require the frame of a portable generator to be grounded to the system supplied by the generator under the following conditions: (1) the generator supplies only equipment mounted on the generator, cord-and-plug-connected equipment through receptacles mounted on the generator, or both, and (2) the non-current-carrying metal parts of equipment and the equipment grounding conductor terminals of the receptacles are bonded to the generator frame. NEC 250.34(B) for vehicle mounted generators mirrors the requirements of the portable generator but adds that the generator must be bonded to the frame of the vehicle.

49. I'm installing a hydro massage tub in a showroom of a plumbing supply house. The tub is for display use; only however it does have running water connected to it and it will be displayed with water from time to time. I don't see customers using this but I guess they could. Does the Code requires that I comply with Article 680 as it applies to GFCI protection for the tub and the receptacle outlet located between 5 and 10 feet away as in required by 680.43A? This display area is frequently renovated to display new plumbing items.
ANS: Since you are citing NEC 680.43, I will assume this is not a hydromassage bathtub, and falls under the category of spas and hot tubs. NEC 680.40 requires compliance with Part I and Part IV of Article 680. There is no exception for display areas, temporary areas or any other similar situations. The fact is the dangers of electricity and water are still present whether someone is sitting inside the hot tub or spa, or just standing next to one that is filled with water. Accidents happen and the code is written to help protect persons when these accidents occur. You indicated there is a water connection, thus the hazard. If this is truly a hydromassage tub (whirlpool tub), then only receptacles within a 5’ horizontal zone need GFCI protection per 680.71.

50. Does NEC Section 760.21 mean that smoke detectors in bedrooms are not be required to be on arc-fault circuit interrupter protected circuits?
ANS: Comm 16.21 states NEC 210.12 (arc-fault circuit-interrupter protection) does not apply in Wisconsin. Even outside of Wisconsin NEC 760.21 does not apply to these items as they are really “smoke alarms” and these do not constitute a “fire alarm system” as covered under the requirements of Article 760.

51. When determining the placement for receptacles in a dwelling, is the wall space behind a door required to be considered?
ANS: NEC 210. 52 does not exempt the area behind a door. If the wall space is wider than 2 feet and is unbroken along the baseboard, a receptacle would be required to be installed on the wall behind the door.

52. Can Type NM cable be used in commercial buildings? Are there exceptions where it can be used?
ANS: NEC 334.10(3) permits the use of Type NM cable in "other structures that are of Types III, IV, and IV construction except as specifically prohibited in 334.12. Commercial structures are not specifically prohibited in 334.12 and NM cable may be used if the commercial structures are of Types III, IV, and V construction. For further information relating to construction types, see Annex E in the NEC or check with the building department in your area.Section:334.10(3), 334.12 See also Comm 16.327 and Interpretation.

53. What is historical data as mentioned in Comm 16?
ANS: In the introduction of Comm 16 there are three paragraphs explaining History Notes and when they were implemented and how information is historically edited.

54. Does the NEC require a rooftop mast to have a neoprene or rubber gasket to seal it to the roof? What about flashing around the mast?
ANS: NEC 225.17 and NEC 230.28 require fittings for the mast to be identified for use with masts. Such fittings have rubber or neoprene seals to seal the pipe to prevent water from passing along the pipe and into the structure. Comm 21.27(4) of the Uniform Dwelling Code (UDC) code also requires the use of a flashing to seal the penetration in the roof and requires the mast be designed and installed so as to prevent the entry of moisture into the structure.

55. We are installing raceways in the floor of a building where they will be driven over by large trucks of all sorts. We are encasing the raceways in the concrete floor which is 5 inches in thickness. Does the NEC specify a burial depth for these indoor raceways.
ANS: NEC 300.5 does not require a burial depth under a building for a raceway. As long as the raceways are under the concrete, there should be no problems. The architect and engineer is responsible for making sure the concrete is of sufficient strength and depth to provide protection from damage due to heavy equipment.

56. When the state of Wisconsin adopts a code or standard such as the NEC what is the impact on projects that are in mid stream? Are they required to comply with the new code? Is there a cutoff date that determines which edition of the code they are required to meet?

ANS: The code in effect is generally applied on the date of plan receipt for approval (State) or on the date of the electrical permit (local). If a project is being designed it would be subject to the new code until plan submittal or permit date.

57. In an apartment complex that we are wiring we have a situation where a water heater and furnace are located adjacent to each other in an equipment closet. The plans call for us to locate a disconnect switch for each on opposite walls, just inside the door, adjacent to the water heater and furnace respectively. The plumbing contractor has installed water and drain lines above the area our disconnects are to be located. We feel this installation violates 110.26(F). The engineer on the project states the installation does not violate this section as the wording does not specifically mention disconnect switches. Do you agree?
ANS: The engineer's decision is correct. Disconnect switches aren't specifically mentioned in 110.26(F). The intended use of disconnect switches generally puts them in areas where other equipment must be located, and this isn't detrimental to the operation of the disconnect switches. The area you are discussing is not dedicated to the disconnect switches --- as it would be in a designated electrical room.Section:110.26(F)

58. Can Table 310.15(B)(6) be used to size service conductors for a duplex?**.**
ANS: Maybe. Table 310.15(B)(6) is only suitable to size 3-wire, single-phase, 120/240V service or feeder conductors (including neutral conductors) that serve as the main power feeder for an individual dwelling unit. So you can size the individual service conductors to each unit using this table, but not the service conductors for both units.

59. What are the limitations on the use of rigid nonmetallic conduit in an underground application serving a gasoline dispenser?
ANS: Rigid nonmetallic conduit can be installed underground below a Class I location if the raceway is covered with not less than 2 feet of earth, concrete, or asphalt [514.8, Exception 2]. However, threaded rigid metal or threaded intermediate metal conduit must be used for the last 2 feet of the underground run.

60. Can I install a panel in a residential bathroom? What about in a bedroom?
ANS: The NEC does not permit overcurrent protection devices to be located in the bathrooms of dwelling units, or guestrooms/guest suites of hotels or motels [240.24(E)]. However, nothing in the Code prohibits panels from being installed in a bedroom.

61. I'm looking in the code book to find the 25 foot rule on the proximity of a receptacle for servicing HVAC equipment and I can't seem to find it.
ANS: You're looking for 210.63.

62. What type of fitting can I use to terminate ground wires in a metal box?
ANS: The termination of equipment grounding and bonding conductors must be by exothermic welding, listed pressure connectors of the set screw or compression type, listed clamps, or other listed fittings [250.8]. In addition, equipment grounding (bonding) conductors that enter a metal box must be bonded to the box by a grounding screw that serves no other purpose or a listed device (like a ground clip) [250.148(C)].

63. When we use Section 312.5(C) Exception (g) or Comm 16.31, is it to be interpreted that you are limited to 40% fill and the derating factors of 310.15(B)(2)(a) apply, or can you use Chapter 9 Table 1 Note (2), call it a sleeve and stuff it full, or call it a nipple and not exceed 60% fill? What if the raceway is less than 24 inches in length?
ANS: Table 1 of Chapter 9 note 2 states "Table 1 applies only to complete conduit systems and is not intended to apply to sections of conduit or tubing used to protect exposed wiring from physical damage. This could apply where you protect NM cable on a basement ceiling, or in an exposed garage, etc. NEC 312.5(C)(g) states "where installed as conduit or tubing, the allowable cable fill does not exceed that permitted for complete conduit or tubing systems by Table 1 of Chapter 9 of this Code and all applicable notes thereto". Therefore in order to use NEC 312.5(C) and Comm 16.31 you are required to follow the rules of (a) through (g). Section (g) for the purpose of this code section would supersede the requirements of Note 2 to Table 1 of Chapter 9. Thus it cannot be called a sleeve or a nipple, and if the raceway is between 12 and 24 inches, the requirements of (g) still apply.

64. There are a number of references similar to 725.61(B)(1) that deal with penetrating more than one floor. Is a floor something you stand on, indicating you could go between a basement and the first level with cheaper cable, or is it the area between two boundaries?
ANS: The Wisconsin Building Code 1002 Definitions defines these as floor areas. The basement is one floor, the ground floor is another floor, the first floor is another floor and so on. Anytime you pass from one floor area to another floor area, you have penetrated a floor. If you went from the basement to the first floor, you have penetrated a floor. When penetrating more than one floor, different issues come into play, such as strength of cable, construction to prevent the conductors from collapse where the weight is supported, and other considerations for the construction of such cables, such as the need to prevent the spread of fire or smoke. Thus the increase in cost.

65. NEC 230.70(A)(1) requires the service disconnect to be installed at a readily accessible location inside or outside a building. Section 230.72 requires the two to six disconnects to be grouped allowing access to the occupants in multiple occupancy buildings. Does grouping allow disconnects to be mounted inside and outside or must they all be located either in or out?
ANS: NEC 230.72 language does require these disconnects to be grouped together, either all service disconnects must be located outside or all service disconnects must be located inside of the building, the language in 230.72(A) does not allow a mixture of service disconnects to be located inside and outside of the building.

66. Could you explain what if any are the restrictions on the cord, cable, or wires used in the string of temporary lights for jobsites? Can they be hardwired or if they come with a male cord cap can we plug them in or could a male cord cap be applied if not included on the string of lights?
ANS: NEC Article 590 covers the requirements for temporary wiring on jobsites. Specifically 590.4(C) requires all branch circuits supplying temporary wiring, such as the string of lights, must be cable assemblies or multiconductor cords or cables identified for hard usage or extra hard usage as identified in Table 400.4. NEC 590.4 (C) allows NM cable to be utilized for temporary wiring, 590.2(A) does require the wiring method comply all other requirements in

the NEC, such as Chapter 3 requirements, specifically Article 334 which would apply to the installation of NM cable for such items as physical protection of the cable. The temporary string of lights can be hardwired into a panelboard or approved power outlet. Receptacle circuits on job sites shall not supply lighting circuits. 590.4(C) indicates the branch circuits shall originate from "an approved power outlet", these are defined in NEC 100 as "an enclosed assembly that may include receptacles…..". These are typically found in Mobile home or RV parks where these vehicles or homes plug into for power.

67. Could you tell me if there is any wording in the NEC that would prohibit solid conductors of the sizes above #8 to be terminated on a standard lug in a meter or panel, or maybe it is a requirement of the manufactures of the equipment, I'm not sure. I know that MI cable has to be high pressed to a stranded conductor when it enters the enclosure.
ANS: Answer: solid conductors in a size larger than 8 AWG are not recognized in the NEC. Check out Chapter 9, table 8 for stranding requirements for 8 AWG and larger. NEC 310.3 does not allow solid conductors #8 and larger to be installed in raceways, solid conductors larger than #8 sometimes are utilized as grounding electrode conductors and terminating these conductors into a lug would be permissible if the lug was indeed listed for the specific conductor being used. The conductors used in Type MI cable are solid and high pressed connections are used for a change to open wiring larger than 8 AWG in an enclosure. What about #6 solid used for GEC?

68. Whenever the code requires a wire for bonding (example #8 wire), it is required to be solid wire. I was wondering why can't it be stranded wire? The size of the wire is the same.
ANS: Your statement is true with respect to swimming pools in Section 680.26(C) of the NEC. There is a possibility that one or more strands may break off for a variety of reasons such as corrosion. I am not aware of any other Code section that requires a solid conductor for grounding.

69. At an industrial plant, our electrician used an existing air line as support to drop the 12-3 MC down to a light. The local inspector approved this. Now the plant says it's a Code violation, citing 300-11. This only seems to talks about hanging from ceiling tie wires or using raceways as supports. Can you help?
ANS: I don't see anything in NEC Section 300.11 that pertains to your installation. There may be other rules that prohibit supporting other services from their piping.

70. We are providing a service for a mobile home, which is prohibited from having the meter base mounted on it by Section 550.32(A). I need to install a grounding electrode at the service disconnecting means, but do I need another grounding electrode at the mobile home? If so, do I need to connect them to each other?
ANS: No, Section 550.32(A) requires the grounding electrode at the disconnecting means to be in accordance with 250.32 where (A) requires a grounding electrode to be installed in accordance with 250.50. A ground rod is probably the only electrode that would be installed at the disconnecting means. NEC 250.53(B) requires that these electrodes be spaced at least 6 feet apart. There is no additional requirement to install a second electrode at the dwelling which is supplied by a feeder with an equipment grounding as well as grounded conductor.

71. Can anything be done about individual municipalities adopting their own electrical codes instead of just following the NEC? Some of the requirements are way out of line when it comes to safety requirements for electrical installations.
ANS: The National Electrical Code (NEC) is made available for use, by reference, to both public and private users. Many municipalities adopt the NEC by reference, but then amend certain requirements by ordinance to meet what they feel are essential needs of their community. This is done to enhance safety and ensure installations that are adequate for the conditions in that municipality. The State of Wisconsin adopts the NEC as a statewide minimum standard. I agree that many of these local municipal amendments could be considered excessive design requirements. But the only way to change that would be continued education by organizations like the NFPA and the IAEI.

72. Am I required to install the secondary circuit conductors of a low-voltage lighting system (less than 30V) in a raceway or cable like power conductors?
ANS: If the low-voltage conductors will be concealed or extended through a building wall, they must be installed using any Chapter 3 wiring method, such as within a raceway, cable, or enclosure, just like power conductors per Section 411.4(A)(1). In addition, if the low-voltage wiring is supplied by a Class 2 power source, it can be installed using the requirements of 725.52. This means you can use 150V cable in accordance with section 725.82(G), boxes are not required, and the Class 2 conductors cannot be mixed with power conductors in raceways or enclosures unless separated by a barrier

73. Could an electrician use the same DUPLEX receptacle for both the dishwasher and waster disposer (assuming they are in adjacent spaces)? If one cuts the tab, and switches only the one half into which the disposal is to be plugged, leaving the other half constantly hot for the dishwasher, would this satisfy the requirements?
ANS: Yes, a split duplex receptacle can be used for the disposal and the dishwasher, if each of the two receptacles is on its own circuit. NEC 210.7(B) will require a means to disconnect these 2 ungrounded circuits simultaneously at the panelboard they originate from, a 2 pole circuit breaker or 2 single pole breakers with an “approved” handle tie is typically utilized to accomplish Code compliance.

74. Our 911 center wants to install optical fiber to the antenna on the top floor of a 16 story building. Can we use the elevator shaft for the installation if we install it in a raceway?
ANS: No, Section 620.37 of the NEC permits only such electrical wiring, raceways, and cables used directly in connection with the elevator to be installed inside the hoistway.

75. Can a parking lot luminaire be connected to the sign circuit feeding an electric sign in the same parking lot? NEC 600.5(A) states that if the sign circuit supplies the sign or outline lighting on the building, no other loads can be served. But I don't know if the same would apply to a circuit if the sign were not on the building.
ANS: I don't know of any thing in the NEC that prohibits supplying an electric sign in a parking lot with the same circuit as the parking lot luminaires. NEC 600.5(A) applies to the required 20-ampere sign circuit for each commercial occupancy in a commercial building.

76. NEC 250.122(F) states that where conductors are run in parallel, the equipment-grounding conductor (where used) shall be paralleled in each conduit or cable. Section 250.122(F)(1) states each parallel equipment-grounding conductor shall be sized on the basis of the ampere rating of the Overcurrent protective device protecting the circuit conductors. We have a switchboard with a 3000 A main at 277/480v. From this switchboard there are 8 parallel runs of 500 kcmil copper conductors feeding directly to the busbars in a second switchboard. Does each paralleled equipment-grounding conductor have to be 400 kcmil per Table 250.122?
ANS: Yes, each paralleled equipment-grounding conductor must be sized on the basis of the ampere rating of the overcurrent device protecting the circuit conductors in the raceway using Table 250.122. The reason is that if a ground-fault occurs in one of the paralleled raceways (assuming metal raceways), the fault will be fed from all the conductors of the grounded phase and not just the grounded phase conductor in that raceway. In other words, the fault is fed from 8 different conductors of the same phase. The seven phase conductors from the other paralleled runs feed the fault from the opposite direction, that is from the load back. These grounding paths are longer and have higher impedance. For this reason the equipment-grounding conductor in each raceway must be capable of carrying the major portion of the ground-fault.Section:250.122

77. The last sentence of Section 230.28 of the NEC, Service Masts as Supports state that only power service drop conductors shall be permitted to be attached to a service mast. Additionally, 820.44(C) on masts states that aerial cable is permitted to be attached to an above-the-roof raceway mast that does not enclose or support conductors of electric light and power circuits. Why as I travel across the country do I see service masts with the electric service drop conductors and the CATV drop conductors attached to the same rigid conduit mast?
ANS: In the 1993 NEC a new FPN for Section 230-28 was added clarifying the intent was to allow only power service-drop conductors to be attached to a service mast. For the 1996 NEC the FPN to 230-28 was deleted and a new last sentence was added to 230-28, which reads "only power service-drop conductors shall be permitted to be attached to a service mast." For the 2005 NEC, 230.28 still permits only service-drop conductors to be attached to a service mast. As to why you still see CATV drops attached to service masts, either they were there prior to 1996 or someone is not paying attention to the current Code requirements.

78. When applying the provisions of NEC 110.9 to the AIC rating on circuit breakers, can each branch circuit overcurrent protective device (OCPD) be protected by a sufficiently rated main breaker in the panel? Or does each main and branch circuit OCPD need to be rated for the fault current available at its terminals? As an example: You have 50,000 amps of fault current available from the utility. You install a 50,000 AIC main breaker. Can you install a 10,000 AIC branch circuit breaker in that panel or will it need to be rated for a minimum of 50,000 AIC also?
ANS: Section 240.86 of the NEC permits a series rated installation such as you are describing. A series rated system is one where the available short-circuit levels are above the interrupting ratings of the load-side circuit breakers but not above the interrupting ratings of the main device (fuses or circuit breakers). This series-rated concept is restricted to compliance with 240.86(A), which requires the series rating to be selected by a licensed professional engineer for existing installations or compliance with 240.86(B) for tested

combinations that can be used in any new or existing installation. Manufacturers of panelboards and switchboards typically have their equipment already tested by 3rd party testing lab and the information is available from the manufacturers as to what combinations are permitted, so you could have the 50,000 rated AIC main and have the 10,000 AIC branch breaker, if this combination was approved by the manufacturer and testing lab, then this would be Code compliant.

79. What is the intended use for UL Listed ground clips, and are there any limitations for using these clips on round outlet boxes?
ANS: Ground clips are intended to be used to connect the grounding conductor of nonmetallic-sheathed cable to an outlet box, or to connect the bonding jumper from a receptacle or switch to an outlet box. Ground clips Listed by Underwriters Laboratories Inc. have only been investigated for use when pressed on the flat surface of a square, rectangular or octagonal box to hold a grounding conductor against the side wall of the box. They have not been evaluated for use on round boxes. UL Lists ground clips under the product category "Grounding and Bonding Equipment (KDER)." Guide Information for this product category can be found in UL's Online Certifications Directory at www.ul.com/database

80. Sections 422.16(B)(2)(4) and 422.33(A) seem to make it a violation to place the receptacle for a built-in dishwasher behind the dishwasher. I read an opinion saying it was not a violation, based on Article 100 - Definitions. The writer stated that "Accessible" as defined in the Code allows the receptacle to be placed behind the dishwasher. Article 100 contains two different definitions for "Accessible" one as applied to equipment, and one as applied to wiring methods. The writer used the latter definition, which states: "Capable of being removed or exposed without damaging the building structure or finish or permanently closed in by the structure or finish of the building."
ANS: Section 422.16(B)(2)(4) of the NEC does permit the receptacle to be located in the space occupied by the appliance or adjacent thereto; however, (5) states that the receptacle must be accessible. The receptacle is a part of the wiring method and must not be permanently closed in by the structure or finish of the building. If the receptacle is located behind the dishwasher, then the plug has to be within reach when plugged in. The State of Wisconsin does not recognize a dishwasher's "unit switch" as meeting the requirements for a disconnecting means, as they do not always turn off all power throughout the assembly, especially the control power to the keypads.

81. In some states, hardwired smoke detectors are required to be installed on a lighting circuit ahead of any switches. In my opinion installing smoke detectors on a receptacle circuit is a mistake, because lights are used more often than receptacles in some parts of some dwellings.
ANS: Hardwired smoke detectors can be installed on any lighting or receptacle circuit where not prohibited. Dwelling unit smoke alarms aren't covered in the NEC, but are within the scope of COMM 21.09(2) for 1 & 2 family dwellings in Wisconsin. 21.09(2) requires the smoke detectors to be continuously powered by the house electrical service and interconnected so activation of 1 detector will activate all detectors within the dwelling unit. The commentary by the State of Wisconsin in 21.09(2) suggests connecting the smoke detectors to a lighting circuit is advisable, but this commentary is not mandatory. And it really doesn't matter whether smoke alarms are supplied by a lighting circuit or a receptacle

circuit or their own separate circuit. Listed smoke alarms have a battery backup system and the smoke alarm will serve its purpose whether or not the branch circuit is energized. AFCI protection is not required in the State of Wisconsin for those outlets in dwelling unit bedrooms as NEC 210.12 is deleted by Comm 16.21.

82. We have a contractor installing pedestals for meter bases. These are remote from the house and contain only the meter and a main disconnect. Our question is, are we required to ground and or bond the panelboard at the house? The contractor installed a fourth wire from the meter/main disconnect to the panelboard, but how do we handle the water service and the rebar in the footings? It's our understanding that they can't be bonded at the panelboard. Should we be requiring a second ground rod at the pedestal?
ANS: The house is considered a separate building on the same service and the requirements of 250.32(A) and 250.32(B)(1) or (B)(2) must be followed. A grounding electrode system must be installed at the house. If your installation follows (B)(1), an equipment-grounding conductor (fourth wire) must be run with the supply conductors and connected to the house panel ground bus. A grounding electrode conductor must be run from the ground bus in the dwelling unit panel to the underground metal water pipe and to the concrete-encased electrode per 250.50. The concrete-encased electrode will serve also as the supplemental electrode required for the metal underground water pipe (250.53(D)(2). The grounded (neutral) conductor must not be connected to the grounding bus in the house panelboard. If you don't want to run a fourth wire you can follow (B)(2), and the grounded (neutral) conductor run with the supply conductors must be connected to the neutral bus which must be bonded to the ground bus and the grounding electrodes. When using (B)(2) you cannot have a continuous metal path between the grounded systems in each building or structure such as a metal conduit enclosing the feeder conductors between the structure and the building or have telephone or cable TV lines that run between this utility supply point and the building. And yes, you must install a second ground rod (or pipe or plate) at the pedestal if the ground rod does not have a resistance to ground of 25 ohms or less. Comm 16.26(2) requires not less than 2 supplemental electrodes where they are rod, pipe or plate type made electrodes.

83. Can one continue to use NEC 310.15(B)(6) for subpanels fed from a main panelboard? The main panelboard is rated 200 amperes with 42 pole spaces. Can I take a 3-pole, 100-ampere circuit breaker and use 4 AWG copper or 2 AWG aluminum to feed a subpanel? Is this subpanel feed still considered a main power feeder as required by the NEC for use of this table?
ANS: NEC 310.15(B)(6) only applies to 120/240-volt, 3-wire, single-phase services or feeders; so of course a 3-pole circuit breaker would not be involved. Just in case that was a typo and you meant "2-pole," the answer is still no. Only the feeder conductors that serve as the main power feeder are permitted to use Table 310.15(B)(6). The main power feeder is defined as the feeder between the main service disconnect and the lighting and appliance branch-circuit panelboard. Your subpanel is not fed directly from the main service disconnect.Section:310.15(B)(6)

84. Why does Table 310.15 (B)(6) allow the use of smaller conductors than Table 310.16?
ANS: This permitted ampacity change for conductors used as 120/240 volt, 3-wire, single phase service-entrance conductors, service lateral conductors, and feeder conductors that serve

as the main power feeder to each dwelling unit of one-family, two-family, and multifamily dwelling units has been in the NEC in one form or another since at least 1958. Prior to 1971 it included only aluminum conductors but in 1971 copper conductors were added. The ampacity change for conductors used for these purposes came as a result of a study made by the utilities that determined there was a significant difference between residential connected loads and demand loads, as shown by meter readings taken from these types of dwelling occupancies.

85. Could you give me your understanding of Section 680.26(C) Does this mean that a 3-foot grid must be installed around all in-ground pools?
ANS: Yes, a 3-foot equipotential bonding grid must cover the pool deck extending 3 feet horizontally from the inside walls of the pool. This grid can use any of the methods specified in 680.26(C)(1), (2), or (3).

86. With an "Arlington" add a depth ring, how far can the box be set back from the finished wall, how much of the insert has to overlap the box?
ANS: The UL white book, catergory "QCMZ" has the requirements for Box extenders, it reads as follows: Box extenders are components installed in or on a box that is mounted in a finished structure intended to extend the electrical enclosure up to the new finished surface. The box extender rests on the edge of the existing box (fixed depth) or extends into the box (adjustable depth). The flange of the box extender, if provided, rests on the finished surface. The manufacturer's instructions indicate the box extenders can extend a box up to 1 ½". So in summary, the plastic box extenders by Arlington Industries can extend a box up to a maximum of 1 ½" and the box extender can seat against the front of the box and there is no minimum overlap required by UL or the manufacturer.

87. With a standard 2x4 lay in luminaire in a suspended ceiling there are bend out clips. Are these the "Listed Clips" the code allows?
ANS: These bend out clips are typically found on the fluorescent lay in fixtures, these luminaries are found in the UL White Book under the category code "IEVV". The information in "IEVV" indicates the integral clips are marked with use on the particular type of ceiling grid system they have evaluated with when they were approved by UL, therefore the luminaries must be marked with the particular grid system they were listed for and must be installed per the instructions provided with the luminaries. If the luminaries you have installed has met the above listing requirements, then this installation complies with NEC 410.16(C) and the bend out clips are acceptable.

88. Section 210.21(B)(1) of the NEC requires a single receptacle with an ampere rating "NOT LESS THAN" that of the branch circuit. Does this mean that, on a 15-ampere dedicated branch circuit, a 20-ampere (or greater) single receptacle may be installed?
ANS: No, Section NEC 210.21(B)(3) of the NEC does not permit receptacles rated over 15 amperes to be installed on 15-ampere circuits. Someone looking at a 20-ampere receptacle would naturally assume that the circuit is also rated 20-amperes.

89. Recently one of my students came to me with a question concerning the connection of a small condensate pump for a heat pump installation above a suspended ceiling, which just happens

to be a return plenum. According to what we found in the Sections 300.22 (B) and 400.8(2) and (5) of the NEC, it will not allow cord and plug wiring methods for this installation. Article 400.7(6) and (8) if it could be applied allows utilization equipment and appliances to be cord and plug connected for ready removal for maintenance and repair but it doesn't seem to apply because of 300.22 (B) and 400.8(2) and (5). I know that 90.1 (B) says that for a safe installation the installation itself may not be necessarily efficient or convenient but that means a small condensate pump such as this will now take the experience of an licensed electrician to change out rather than an worker from the maintenance staff to prevent water damage to a building just because it is no longer working.

ANS: While sections 400.7(A)(6) and (8) permit the use of flexible cords for those applications, they do not specifically permit the use in areas where not permitted in 400.8(2) or (5) or in applications covered by 300.22(C). The benefits derived from following the requirements for safety as outlined in the NEC far outweigh any inconveniences encountered.

90. I understand the dedicated space required above electrical equipment for protection of equipment and getting conduits in and out. But what if we have self-standing equipment sitting on a raised floor and the raceways are in and out from the bottom, is the 3 ft.(approx) bottom space below the switchboard, or UPS, from the slab to the raised floor a dedicated space?

    ANS: I don't know of anything in Article 408 Switchboards and Panelboards, Article 645 Information Technology Rooms, or Article 110 Requirements for Electrical Installations that would specifically cover the situation you are describing. NEC 110.26(F) covers the dedicated work space for switchboards, panelboards, distribution boards and motor control centers, there is no exception for equipment which is presently installed with underground conduits, the future might necessitate the need for overhead conduits, therefore this dedicated space is always required, whether the conduits enter the bottom or the top of such equipment.

91. Does Section 517.32(F) of the NEC require that all elevators in a large hospital be connected to the life safety branch of the essential electrical system? Or does this refer only to the cab lighting, control, communications, and signal systems of elevators?

    ANS: No, connection of the elevator(s) to the emergency/life safety or critical branch is not required by Section 517.32(F). Section 517.34(B)(2) requires at least one elevator to be supplied from the equipment system power source during interruption of normal power. NEC 517.32(F) only requires the elevator cab lighting, control, communications, and signal systems of all elevators to be supplied by the life safety branch. This includes elevators that aren't powered by the equipment system power source during interruption of normal power. The building code has additional requirements for standby power for elevators.

92. A question has been brought up about how to measure linear wall space per NEC 210.52(A)(2)(1). In this case a basement is made into living space and the steel columns for the main beam are not incorporated into a dividing wall. Instead the columns are framed out such that they are now (for sake of description) 8"' square. Does this constitute an 8" wall 8" thick or does it become 32" of linear wall space thus requiring a receptacle outlet (due to being over 24")? Some strange designs have this happen in first floor living rooms but it is more prominent in basements.

ANS: The question is on the definition of wall space. Section 210.52 (A)(2) of the NEC defines wall space as including the following "(1) Any space 600 mm (2 ft) or more in width (including space measured around corners) and unbroken along the floor line by doorways, fireplaces, and similar openings." Is a post included as wall space? Yes this appears to meet the 24 inch rule as cited in Section 210 of the NEC. The post itself would not meet the wall definition but the addition of framing around a column may move it into the wall space category.

93. I am working on a new 11 story condo project that has 3 levels of parking below. The building above the parking will have 3 levels of commercial/retail space and 8 floors with 112 condo units. The owner/architect/electrical engineer would like to see the following. (1)-1600 amp-3 phase120/208 volt service for the condo units. (1)-800 amp-3 phase-277/480 volt service for the 3 commercial/retail floors, 3 parking levels, and the entire common area. (1)-400 amp 3 phase 480 volt service for the 150HP fire pump. The electrical engineer involved would like to see 480 volts for the common area/fire pump due to the size of the fire pump motor, elevators & stairway pressurization fans. Our utility would provide 3000 amp 120/208 for the entire building and 480 for the fire pump service, but they do not like the idea of having the 480 volt transformer sitting idle except when the fire pump is running. We know that we are allowed the separate fire pump service, located away from the main service, but based on this information, and article 230 of the NEC, are we allowed to have 2 services for this building? They will be 2 separate voltages. The capacity requirements are over 2000 amps, and the voltage is under 600 volts.
ANS: Section 230.2 of the NEC says a building shall be supplied by only one service. Paragraph (A) allows additional services for a fire pump and paragraph (D) allows additional services for different characteristics such as voltage. Yes, the building in question could have two services at different voltages and a third service for a fire pump. I would probably set it up with a 120/208 service and then a 277/480 volt service which I would tap ahead of the main (probably in the CT cabinet) for the fire pump. This would avoid the separate meter and/or transformer for the fire pump.

94. Does NEC 422.51 require retrofitting all existing vending machines or changing the receptacles to provide ground-fault circuit-interrupter (GFCI) protection?
ANS: It all depends on how the authority having jurisdiction (AHJ) in that area interprets the rule. I don't believe that the NEC requires existing wiring to be changed; but I also feel that this new requirement should be enforced by jurisdictions that adopt the NEC for new installations. The U.S. Consumer Product Safety Commission reported four electrocutions involving vending machines in four separate incidents since 1995; three more incidents that were nonfatal shocks.

95. My question is related to NEC 250.52 on underground electrodes. 250.52 states that you can't use underground gas piping or structures and you can't use aluminum. I was wondering why there is no similar prohibition on galvanized piping. We had a well that was connected to three buildings with a galvanized water piping. We had to replace the well and in the process I discovered that who ever installed the electrical service didn't install copper rods, but only used the piping as the grounding electrode. The galvanized pipe had decayed over the years and I don't believe it was an effective ground anymore. I added threaded ground rods to get

the effective ground needed (16 ft down). Is using galvanized pipe exclusively for a grounding electrode an acceptable practice?
ANS: There was a time when only the underground metal water piping system was required as a grounding electrode. As far back as at least the1959 NEC a metal underground water piping system, where available, was required to be used as the grounding electrode. Where the buried portion was less than 10 feet or there was some likelihood of the piping system being disconnected or isolated, the metal water piping system was required to be supplemented by another type of electrode. The 1978 NEC introduced the requirement that underground metal water piping must always be supplemented by an additional electrode. I am not aware of any restrictions on the use of galvanized pipe for direct burial other than using corrosion protection in corrosive environments. Arcing at loose connections in the grounding electrode system may occur since a small portion of the neutral current does return through the earth, depending on the resistance to ground of the electrode.

96. Can 10 AWG THHN stranded copper wire be used for an ac rooftop unit requiring a 40-ampere minimum circuit breaker size? NEC 240.4(G) directs you to Article 440, Parts III and VI. However, I'm unclear what wire size is permitted.
ANS: The references are to branch -circuit short-circuit and ground-fault protection, and to motor compressor and branch-circuit overload protection. The nameplate on the unit permits a minimum circuit ampacity, which generally is the fan motor current plus 125% of the compressor current. The nameplate also gives you the minimum and maximum overcurrent protection sizes. These settings are based on NEC 440.22, where the branch-circuit short-circuit and ground-fault protective device is permitted to be 175% of the minimum circuit ampacity but can be increased to 225% where the protection is not sufficient for the starting current of the motor. For example: A compressor with a rated load current of 17.8 amperes and a fan with a full load ampere rating of 1.5 amperes would have a minimum circuit ampacity of 17.8 amperes times 1.25 or 22.25 amperes plus 1.5 amperes or 23.75 minimum circuit amperes. The minimum circuit ampacity times 175% equals 41.5 or a minimum overcurrent protection rating of 40 amperes. The minimum circuit ampacity of 23.75 amperes times the maximum percent permitted of 225% equals 53.4 or a maximum overcurrent protection of 50 amperes. A 10 AWG copper conductor protected by a 40-ampere rated overcurrent device would be suitable for this unit with a 50-ampere rated device if the unit will not start.

97. Do I have to use bonding jumpers around listed reducing washers?
ANS: No. According to the *UL Guide Information for Electrical Equipment* (White Book), listed metal reducing washers are considered suitable for grounding in circuits over and under 250 volts where installed per the NEC. This information can be found in section QCRV (Outlet Bushings and Fittings), Page 194 of the 2006 UL White Book. *Caution should be taken if the cabinet is painted as this may inhibit bonding per 250.96(A).*

98. With the new emphasis on security, surveillance cameras are becoming more commonplace. My firm is working on a project where new security cameras will be installed in a parking lot on existing street lighting poles. These cameras will have low voltage power for the camera and for controlling the pan-tilt-zoom features along with a coaxial cable for the video feed. The street lights have 277V single-phase power inside the pole as well. What we are

struggling with is the separation and securing of these different wiring systems. If we install an EMT conduit inside the 40-foot pole, how would the contractor affix it securely inside this pole according to the Article 358? We see other installations on traffic light poles where the coaxial cable simply enters the pole, but we do not know if these installations are code compliant?
ANS: NEC 725.55 requires separation of Class 2 and Class 3 circuits from electric power circuits placed in the same enclosure. NEC 820.44(F)(1) requires a 4-inch separation or a permanent barrier between coaxial cable and electric power circuits. Based on this you will have to install your low voltage and coaxial conductors in a separate raceway. Liquidtight Flexible Nonmetallic Conduit (LFNC) 356.30(2) permits installation of the conduit without securing where it is fished. Similar permission is shown for Liquidlight Flexible Metal Conduit (LFMC) in 350.30(A)) Exception No. 1. It would be advisable to check 300.19 for information on supporting conductors in vertical raceways.

99. I had a contractor ask about running overhead wires on a farm. He wants to add a sunlight resistant fifth wire to an existing quadplex cable? Is there a problem with the additional load on the messenger? Section 547.9(B)(3)(b)(2) requires the equipment ground to be the same size as the ungrounded wire. Apparently installers are using the bare messenger wire of overhead triplex for the equipment ground. This wire by design is smaller than the other wires and due to the special steel wire used for physical load characteristics, it appears to be less capable of carrying current per circular mil than the normal aluminum insulated conductors. Is this code compliant? Would the correct installation be to add the extra wire (if allowed) as a full size conductor and use it as an equipment ground wire to meet this code section? In this case the messenger wire could be used for the grounded (neutral) conductor.
ANS: The use of this reduced bare conductor as the equipment ground is not code compliant. Adding a code compliant full size wire to be used as an equipment ground may meet the code, but the manufacturer of the cable assembly has to provide the information about whether or not this assembly's strength allows support of the additional wire. The bare conductor – the messenger – may be the same size as the ungrounded conductors according to at least one manufacturer's website. NEC 225.4 Exception and 250.184 Exception 2, allows the bare messenger to be utilized as the grounded conductor. A check in the UL White Book does not show this as a listed assembly. The separate conductors themselves usually are listed, but not the assembly.

100. If an outdoor generator has a disconnect, do I need an additional disconnect where the conductors enter the building?
ANS: Where an outdoor-housed generator is equipped with a readily accessible disconnecting means located within sight of the building or structure, an additional disconnecting means isn't required on or at the building or structure for the generator feeder conductors that serve the building or structure. In sight is defined as visible and less than 50 feet distant. The language is found in Sections 700.12(B)(6), 701.11(B)(5) and 702.11. See also Article 100 for the definition of "in sight of".

101. Some inspectors require a separate (single, not duplex) receptacle for a refrigerator circuit installed per Exception No. 2 to Section 210.52(B)(1). The code says an individual branch circuit but does that mean a single receptacle?

ANS: No. The Code states that "The receptacle outlet for refrigeration equipment…." 1) An "outlet" is a point on the wiring system at which current is taken by utilization equipment. 2) Receptacle Outlet – An outlet where one or more receptacles are installed. These Article 100 definitions point you in the correct direction in that they allow more than one piece of equipment at this "outlet" and the outlet may be a duplex.

102. If I'm installing a 15KV circuit in a conduit, can the ground wire for that circuit have 600 volt insulation or does it require 15KV insulation? Or should it or could it be a bare wire?
ANS: if you are running the circuit in a metal conduit, the equipment grounding conductor can be the metal conduit or it can be a bare conductor or a conductor with 600V insulation.

103. What is the difference between Section 250.34 and 702.10(A) and (B)? When should each be used for grounding a portable generator?
ANS: 250.34 pertains to portable generator grounding and if you note the "conditions" for use of this code section, equipment run by the generator has to be mounted on the unit or vehicle or cord connected to the generator. Portable generators are not permitted as the alternate source of power for emergency {Art 700}or legally required standby systems{701}. They are allowed for optional standby systems provided they are bonded to the premises ground system for non-separately derived systems or are provided with a grounding electrode system if they are separately derived system.

104. Where in the Code are the maximum heights allowed for disconnects and circuit breaker panelboards? Is there also a minimum height?
ANS: Section 404.8(A) of the NEC requires that all switches and circuit breakers used as switches must be located so that they may be operated from a readily accessible place. The center of the grip of the operating handle of the switch or circuit breaker, when in its highest position, must not be more than 6'-7" above the floor or working platform. There are three exceptions to this rule for busway installations, for motors and appliances, and for hookstick operable isolating switches. The NEC does not have any minimum height requirements for mounting electrical equipment.

105. Is there a Code reference that talks about cold galvanizing rigid metal conduit after it has been cut and threaded?
ANS: There is no requirement for cold galvanizing rigid metal conduit RMC) after it has been cut and threaded however, Section 300.6(A) requires that where corrosion protection is necessary and the conduit is threaded in the field, the threads shall be coated with an approved electrically conductive, corrosion-resistant compound.

106. Section 210.8(B)(1) states that all 125-volt 15- and 20-ampere receptacles in commercial kitchens must have GFCI protection. For residential kitchens the NEC requires receptacles serving countertops to be GFI protected, allowing the refrigerator or freezer outlets to be standard-type devices. Section 210.8(A)(2) Exception No. 2 takes care of freezers in garages. It has been my experience that lightning can trip GFCI's (a friend lost an insurance claim on a garage freezer failure). Is there any rule in the code that would allow commercial kitchen cord and plug refrigerators or other cold storage equipment to be exempted from GFCI protection?

ANS: There is no exception in the NEC; however, in Wisconsin there is an exemption, COMM 16.20(2)(b) amends NEC 210.8(B), only countertop receptacles in commercial and industrial kitchens are required to be GFCI protected, receptacles used for refrigeration equipment are not required to be GFCI protected if such receptacles are not installed to serve the countertop surfaces. COMM 16 does not amend the GFCI requirements in 210.8(A) for the refrigeration equipment for residential occupancies and are required to follow the NEC. During the adoption of the 2008 NEC, Wisconsin may not keep this provision. Stay Tuned.

107. We are building a 6 story hotel/condominium project and the building construction is Type II with metal studs. We have been told that nonmetallic sheathed cable, (NM) (Romex) can be used in the metal stud walls of the units. Is this true? Could we use electrical nonmetallic tubing (ENT) (smurf tube) for the installation?
ANS: No, Article 334 in the NEC covers the use of NM cable. Section 334.10 says that NM is permitted in (1) one and two-family dwellings, (2) multifamily dwellings of Types III, IV, and V construction except as prohibited in 334.12 and (3) other structures permitted to be of Types III, IV, and V construction except as prohibited in 334.12. The second sentence in (3) is deleted in Comm 16. From here we go to Section 334.12 (A) which says that Type NM cable shall not be permitted in any dwelling or structure not specifically permitted in 334.10 (1), (2), or (3). In addition 334.12 has a lengthy list of other types of occupancies and uses where NM is not permitted. The installation of NM cable in a Type II building would be in violation of Article 334 of the NEC. Yes, Article 362 of the NEC covers Electrical Nonmetallic Tubing (ENT). Section 362.10 is Uses Permitted and allows ENT to be exposed or concealed in buildings not exceeding 3 floors above grade. In any building exceeding three floors above grade the ENT shall be concealed within walls, floors, and ceilings where the walls, floors, or ceilings provide a 15-minute finish rating. The Exception allows the use of ENT in these buildings exposed or concealed, where a fire sprinkler is installed in accordance with NFPA 13-2002. ENT could be used in the Type II building you mention provided it is concealed by a 15-minute finish rating or the building is protected by fire sprinklers in accordance with NFPA 13 – 2002. There is no similar provision for the use of Type NM cable.

108. I recently saw an advertisement for red conduit that is to be used for emergency circuits. Is this a Code requirement?
ANS: No, Section 700.9 requires all boxes and enclosures, including transfer switches, generators, and power panels for emergency circuits, to be permanently marked as components of an emergency system, but this does not apply to raceways.

109. NEC 90.4 states that the AHJ has the responsibility for making interpretations of the rules in the Code and for granting the special permission contemplated in a number of the rules. Section 90.5 (B) states that permissive rules are characterized by the terms "shall be permitted." Should we conclude that "shall be permitted" language many places in the NEC means the AHJ must give permission before an installation is acceptable?
ANS: No, the authority having jurisdiction (AHJ) has the responsibility to interpret the specific requirements shown in the Code. Where a requirement is shown as "shall be permitted," it isn't necessary to get special permission or permission from the AHJ. But the

installation is subject to the approval by the AHJ to verify that it does conform to the permitted parameters.

110. Can “line” and “load” conductors for a feeder or motor be installed in the same raceway?
ANS: Service conductors cannot be installed in the same raceway with feeder or branch-circuit conductors per Section 230.7, but line and load conductors for feeders and motor circuits can be placed in the same raceway or enclosure.

111. I have worked mostly commercial and industrial and am a little out of the loop on residential. My question is about the size of conductors in a residential dwelling. In what rooms is it required that a 12 AWG conductors be used for general outlets circuits? I know that 12 AWG must be used in kitchen counter top circuits, bathroom circuits, and laundry room circuits. But, where else is this required by the NEC?
ANS: Check out 210.11(C). Note that (1) refers to small-appliance branch circuits for all receptacle outlets specified by 210.52(B). A minimum of two small-appliance circuits are required and both must feed the receptacles that serve countertop surfaces as well as receptacle outlets in the kitchen, pantry, breakfast room, dining room, or similar area of a dwelling unit. (2) references laundry branch circuits and (3) references Bathroom branch circuits.Section:210.11(C)

112. Our electricians have encountered inspectors that interpret 210.52(C)(1) in regard to counters and the 2-foot rule in this way. A 2'x 8' counter that starts against a left wall would require a receptacle on the 2' piece of wall a then again at the back of the counter wall not more than 2' requiring 2 receptacles on back wall. That makes a total of three for this 8' counter. Is this correct? We never used to count the wall to the left where a counter started, only the back wall but as I read the current text it seems to confirm the inspector. Which is correct? What is the intent of code here?
ANS: The intent of 210.52(C)(1) is to provide a receptacle outlet for each 4-foot length of counter top space. The 2-foot wall space at the end of the counter top is provided for by the receptacle outlet on the back wall.

113. What is the requirement for mounting a double exterior spotlight on a plastic soffit or facia? Should the box and fixture be weather-sealed? Does a non-sealed pancake box attached to a floodlight fixture (non-sealed) comply with the NEC?
ANS: Using the pancake box is acceptable where only two circuit conductors are in the box. NEC 410.10 permits the fixture canopy to be used together with the outlet box to provide adequate space for the fixture conductors and their connecting devices. The pancake box doesn't have adequate cubic inch capacity for more than two 14 AWG conductors. NEC 410.4(A) requires that fixtures installed in wet or damp locations be installed so that water cannot enter wiring compartments. This means that the fixtures must be constructed and marked "Suitable for Wet Locations." The construction of the fixture is such that water cannot enter the fixture itself, but doesn't necessarily mean that the fixture will automatically be sealed when mounted. It may be necessary to utilize other methods to seal the fixture to the mounting surface such as gasketing or caulking.

114. We have a switch mounted with two screws and no fiber washers to a plaster ring which will be secured to a metal 1900-style 4" square box. An instructor says the grounding screw on the switch yoke must be bonded to the equipment grounding conductors coming into the box with a bonding conductor. I see in 250.146(A) that this is required for receptacles, but not for all devices. However, the more detailed explanation in the 2005 NEC Handbook, Exhibit 250.52, uses the phrase "Cover-mounted wiring devices such as on a 4-in. square covers, are not considered grounded". That seems to imply it would include both switches and receptacles. Does the NEC require a bonding wire for all wiring devices, or just receptacles.
ANS: The intent is for the yoke of a switch to be effectively grounded, and to provide a means to ground metal face plates whether or not a metal faceplate is used. A cover mounted switch (or receptacle) requires an equipment bonding jumper per Section 404.9(B)(1).

115. Our engineer is finishing a prototype of a 125 Volt piece of equipment and he has a double fuse block with a fuse in both the grounded and ungrounded conductor. I don't think it is right but cannot find a reference in the NEC. Can you help?
ANS: He is not allowed to do that. Check out Section 240.22. Typically the installation of a fuse in a neutral/grounded conductor is not allowed by code.

116. Can I use 12-3 NM cable to wire the bathroom GFCIs and laundry circuit in a dwelling?
ANS: Sure, if you use a GFCI receptacle for the first outlet for the bathroom receptacle circuit, and all down-stream receptacles are supplied through the GFCI receptacle. Be aware that the continuity of the grounded (neutral) conductor of a multiwire branch circuit (before the GFCI receptacle) must not be interrupted by the removal of a wiring device. Therefore, the grounded (neutral) conductors before the GFCI receptacle must be spliced together, and a pigtail must be provided for the wiring device [300.13(B)].

117. Can I put standard 4-lamp T8 fluorescent fixtures on a 30A circuit without individual fusing?
ANS: NEC 210.23(B) permits the use of 30-ampere circuits to supply fixed lighting units with heavy duty lampholders in other than a dwelling unit. However the terms "heavy duty" and "heavy duty lampholders" are not defined in Article 100 of the NEC nor as far as I can determine in UL Standards. The term heavy duty lampholder is used in 210.21(A) where it says that where "connected to a branch circuit having a rating in excess of 20-amperes, lampholders shall be of the heavy duty type. A heavy duty lampholder shall have a rating of not less than 660 watts if of the addendum type, or not less than 750 watts if of any other type." This may qualify as a definition. I do not believe that the fixtures you are questioning would qualify as having heavy duty lampholders and are limited to 15 or 20-ampere circuits. Section:210.23(B)

118. In general, what are the requirements with respect to branch circuits for lighting and power when wiring an elevator hoistway pit area?
ANS: As per 620.24(A), "A separate branch circuit shall supply the hoistway pit lighting and receptacle(s). Required lighting shall not be connected to the load side of a ground-fault circuit interrupter." As per 620.24(B), "The lighting switch shall be so located as to be readily

accessible from the pit access door." As per 620.24(C), "At least one 125-volt, single-phase, GFCI type duplex receptacle shall be provided in the hoistway pit."

119. Our local tech school is putting on a new addition and remodeling a large part of the building. The entire addition and part of the remodeled portion will contain training for various medical fields. The plans show rooms (for example) labeled respiratory care lab, Phlebotomy, operation room, EMS labs, and exam rooms. In these rooms, students learn to draw blood and take care of patients (other students – I guess at this point), including the use of sophisticated equipment, which will help them gain careers in the health care field. Do these areas need to be wired per Article 517 with redundant ground paths, etc.?
ANS: No, since they are not doing patient care. The Tech school in Wausau is a good example in that everything looks like a hospital but is not. There is no requirement for the redundancy but it is up to the designer/owner to what extent they want to replicate actual installations in a hospital.

120. We have a 150 KVA transformer, 480 primary with a 225 breaker on the feeder which is not in the same room. The engineer calls for the safety disconnect at the transformer location. The transformer has a full-load current of 180 amps on the primary. Would the disconnect have to be sized for the 180A (200A disconnect) or for the available current via the 225A breaker if the transformer was to draw more than it's stated primary current?
ANS: The NEC doesn't require a disconnecting means in sight from a transformer. This disconnect is, as you call it, a safety switch. It protects a person who may be working on the transformer from someone energizing the transformer by turning on the disconnect in another room. The NEC does not require a locking type disconnect for a transformer. This disconnect is not required to be opened under load and a 200A no-fuse disconnect switch could be used.

121. Table 310.15(B)(6) gives you conductor types and sizes for 120/240, 3-wire, single-phase dwelling services and feeders. Are you permitted to parallel conductors for a residential 400-amp service?
ANS: Yes, you are permitted to parallel conductors for a residential service rated 400 amperes or any other rating that meets the requirements of 310.4. However you can't use Table 310.15(B)(6) to size the conductors being paralleled since the table indicates which conductors must be used for each service or feeder rating. The comment shown in the NEC handbook regarding Table 310.15(B)(6) specifically says that if a SINGLE set of 3-wire, single-phase service entrance conductors supplies a dwelling unit, the reduced conductor size may be used.

122. Is there is any provision in the NEC that requires use of a single receptacle (as opposed to an ordinary duplex) on an individual branch circuit?
ANS: check out the definition of "Branch Circuit, Individual" in Article 100. It supplies "only one utilization equipment." If that utilization equipment is cord-and-plug connected, then a single receptacle must be used so that other utilization equipment may not be used simultaneously on this circuit. NEC 210.21(B)(1)requires a single receptacle on an individual branch circuit to have an ampere rating not less than that of the branch ciruit.Section:210.21(B)(1), Art 100 Definitions

123. Is liquidtight flexible metal conduit (LFMC) permitted under the raised floor of a computer room? If yes, must it be secured?

ANS: It depends on what you mean by a computer room. If you are talking about an information technology equipment (ITE) room as per 645.4, the answer is yes. However, it must be secured in accordance with 300.11 [645.5(D)(2)]. *Note*: Power cables and associated boxes that are listed as part of, or for, information technology equipment are not required to be secured in place [645.5(E)]. If the computer room does not qualify as an ITE room, and the raised floor is not used for environmental air, the answer is still "yes" if secured in accordance with 300.11. But, if the computer room does not qualify as an ITE room, and the raised floor is used as an environmental air space (for air-conditioning) then LFMC can't be used at all in this space [300.22(B)(1)].

124. Can hydraulic elevator equipment be located within the same room as the fire pump? The structure is a four story residential building."

ANS: No, We have reviewed NFPA 20, 2003 edition, as the applicable standard. Our informal interpretation is that the fire pump should be protected by an enclosure and should be free of storage and other equipment not related to the fire pump equipment.

The intent is the keep the fire pump and controller equipment from damage during a fire. Section 5.12 indicates that the fire pump and equipment shall be protected against possible interruption of service though damage caused by explosion, fire, flood, earthquakes, rodents, insects, windstorm, freezing, vandalism, and other adverse conditions. The annex section A.5.12 also indicates the room containing the fire pump room should provide protection to keep the equipment free from fire that could drive away the pump operator or damage to the controls or equipment

125. When installing a disconnect switch for an overhead bridge crane in a manufacturing facility, how high can the disconnect be mounted? NEC 610.31 appears to require that it be installed at floor level if the words "readily accessible" in 610.31 is interpreted as the NEC defines it in Article 100. However, 404.8(A) Exception No.2 and Exception No. 3 appear to allow that same disconnect switch to be installed well above the floor. In the past, we've believed that installing the disconnect switch at a higher level is safer for the maintenance personnel working on the crane, since it makes the switch more visible to them and removes the switch from the general clutter that tends to gather at or near floor level in a manufacturing facility.

ANS: NEC 610.31 is explicit in the requirement that the disconnecting means be readily accessible and operable from floor level. It is not the intent that 404.8(A) Exception No. 2 & 3 modify that rule. Section:610.31, 404.8(A) requires the placement of these switches has the "center of the grip of the operating handle of the switch or circuit breaking, when in the highest position, is not more than 2.0 m (6 ft 7 in.) above the floor or working platform."

126. We have a delta-to-wye transformer fed from a 480v load center, that supplies a 120/208-volt panel. We have different ideas about where the neutral and ground should be bonded. One group says the load center ground, transformer ground bus, and ground and neutral in the panel should all be bonded together. Another group says it should be bonded either in the panel or the transformer not both. What is correct?

ANS: NEC 250.30 shows the requirements for grounding separately derived systems. NEC 250.30(A)(1) permits the system bonding jumper to be connected between the ground bus and the neutral bus in the transformer or it may be connected between the ground bus and the neutral bus in the system main disconnecting means. NEC 250.30(A)(1) Exception No. 2 permits a system bonding jumper at both the transformer and the disconnecting means where doing so does not establish a parallel path for the grounded (neutral) conductor (if PVC raceway is used). *Bond only at one location or the other if a metal raceway is used to contain the conductors that run between the two or a parallel path will be established.*

127. Can the automatic transfer switch, circuit breakers, motor control centers etc. be placed in the same room as the standby power generator ?
ANS: Yes, control equipment directly associated with the generator set, can be installed in the same room. If we reference NFPA 110, the Standard for Emergency and Standby Power Systems, section 7.2.1, it states : "The EPS (emergency power supply) shall be installed in a separate room for level 1 installations. EPSS (emergency power supply systems) equipment shall be permitted to be installed in this room". Section 7.2.1.1 states that the room housing the generator set shall have a minimum 2-hour fire rating and section 7.2.1.2 states that no other equipment, including architectural appurtenances, except those that serve this space, shall be permitted in this room". However, section 7.2.2 says "Level 1 EPSS equipment shall not be installed in the same room with the normal service equipment, where the service equipment is rated over 150 volts to ground and equal to or greater than 1000 amperes".

128. Why is Electrical Metallic tubing (EMT) not allowed as a wiring method from the from a fire pump controller to a fire pump motor? It is certainly as good as MC cable or LFMC.
ANS: Per 695.6(E), EMT is not a permitted wiring method for this installation.

129. One of the electrical designers I am working with claims that the dedicated space required in Section 110.26 (F) includes industrial control cabinets, disconnects for equipment, and other types of electrical equipment. I do not believe this equipment falls under 110.26 (F). Is there another article that covers this? I agree 110.26(F) requires the dedicated space to apply to switchboards, panelboards, distribution panels, and motor control centers.
ANS: Section 110.26 (F) does not apply to a single disconnect, or a single motor controller. I don't know of any other articles that would require dedicated space above or below equipment. Also don't forget about the working space requirements in 110.26(A) which does apply to a wider range of electrical equipment. Because industrial control panels are typically constructed for a particular process or piece of equipment I would agree that probably, in most cases, they would not require the dedicated equipment space because after the initial installation there are not provisions to add additional motor starters, circuit breakers, or other circuits as you would have in an MCC or panelboard.

130. Typically an elevator controller comes equipped with fused overloads as part of the control panel. Can these overloads be substituted for the overcurrent protection device provided in a disconnect. I know they are sized to protect the elevator motor but they are essentially yet another level of circuit protection.

ANS: No, if you look at NEC 620.51 (A) it requires a fused motor circuit switch or circuit breaker as the disconnecting means.

131. We are currently working on an elevator design in an existing building. The elevator equipment room and shaft will have sprinkler protection. When I look in the NEC with regards to elevator disconnects. I see that an additional disconnect with overcurrent protection is needed for the elevator in the elevator equipment room. We currently have a lockable breaker in the Main Distribution Panel with the elevator sprinkler shunt trip device on it. What is the purpose for the second set or overcurrent protection devices? Are they necessary? Can we have the shunt trip device on the overcurrent protection device in the elevator equipment room if it is being sprinklered? It seems like we are being redundant on the overcurrent protection needs for the elevator. Maybe you can shed some light on the situation.
ANS: Article 620 of the NEC (National Electrical Code) has the disconnect requirements specified in Section 620.51. You ask about the purpose of the disconnect in the machine room. It is required at that location so that a technician working in or on the controller or elevator has a means to disconnect the power. The requirement is similar to that for motors found in Section 430.102 where an individual disconnect is required to be in sight from the controller. Elevator machine rooms are often supplied with a feeder and the disconnect is in the panel in the machine room. In the situation you describe it would be acceptable to install the shunt-trip device in the machine room. I agree there appears to be redundancy in protecting the elevator equipment but it is really no different than any large motor where the conductors have protection and at the controller a second disconnect usually with motor protective devices is installed as required by Section 430.102 of the NEC. The purpose of the disconnect in the elevator machine room is to disconnect power from the controller and machine without the service person having to locate the source in a large building. Imagine trying to find a disconnect in the Sears Tower when you are servicing an elevator. There is no specified location for the shunt-trip device and it can be installed on the circuit at any location up to and including the machine room.

132. I wired interior walls of two restrooms in a Type III B with NM-B cable. The inspector does not want to accept the wiring method since the exterior walls are fire-rated. Is the use of NM in this building acceptable?
ANS: Yes it is acceptable to wire with NM cable. The Department considers Type I and Type II buildings to be fire-rated construction. Type III buildings may have fire-resistant components but are not considered fire-rated for purposes of the electrical code.

133. Section 215.2 of the NEC, the second paragraph says that in sizing the feeder "grounded conductor" it shall not be smaller than that required by 250.122. What is meant by this?
ANS: When sizing the grounded conductor (neutral) of a feeder, you need to size it no less than the calculated load as determined in 220.61. 215.2(A)(1) further restricts this calculated load by requiring a minimally sized wire to be no smaller than the equipment ground wire as determined by 250.122.

134. I was told that I’m not allowed to install bedroom lights on an AFCI circuit. Is this true?
ANS: No. All 15A or 20A, 120V branch circuits that supply outlets (including lighting and smoke alarm) in dwelling unit bedrooms must be protected by a listed AFCI device so you must install these lights on a AFCI circuit. Wisconsin does not adopt 210.12 as it deletes this section in Comm 16.21.

135. We installed a service and the inspector said the conductors had to be buried 24 inches deep. I can't find anything over 18 inches in the NEC. Where would he get this requirement?
ANS: According to Column 1 of NEC Table 300.5 if you run direct-burial cable(open conductors), metal conduit, or nonmetallic conduit under streets, roads, alleys, driveways, or parking lots the minimum burial depth is 24 inches --- unless 2-inches of concrete is used to encase the raceway. So check out NEC Table 300.5 and see where you fit in.

136. When determining conduit fill using type USE cable with aluminum conductors, why isn't USE listed in tables used for conduit fill? Is there an alternative (shorter) method to determining conduit fill without using conductor dimensions for this type of wire?
ANS: USE conductors are listed for direct burial so conduit fill isn't generally a consideration. Chapter 9, Table 1, Note 2 explains that the tables applies only to complete conduit systems. It doesn't apply to sections of conduit used to protect exposed wiring from physical damage, such as direct burial conductors emerging from the earth at meters. If installing these cables in a complete raceway system, you have to use the manufacturer’s information on cross sectional area to determine your conduit fill.