

1. I found this tank had been installed at an existing tank site late yesterday afternoon. This is a diesel tank. There is a solar panel attached to the roof, which powers a battery. The battery powers the pump for the diesel tank. As this is not gasoline, I did not immediately hit the panic button. Since its DC, do the requirements of the NEC apply?

Answer: Yes, NEC 514

It is a Motor fuel Dispensing Facility as covered by Article 514 of the National Electrical Code (NEC). The nice part is that it appears to be diesel fuel only and as such Section 514.3 (A) of the NEC would leave it as an unclassified area since the flammable liquids handled do not have a flash point below 100 degrees F. This allows any suitable NEC Chapter 3 wiring method as well as that allowed by Article 690 for Solar Photovoltaic Systems.

That being said, it is still a Motor fuel Dispensing Facility and NFPA 30 A as well as the NEC require the emergency disconnect for power to the dispensing device. This would include disconnection of the battery.

2. I have fast food restaurant that is being built and they have a number of cords and plug connected pieces of equipment and monitors; with the cords run inside of 3"inch by 3" inch stainless steel tubes with other communication and circuit wiring. Is this allowed or were there changes made to the code?

Answer: No, per 400.8

Per NEC 400.8(6),and (10) page 247, Uses Not Permitted for Flexible Cords, the tubing is not an approved raceway.

Normally, the cord has to be visible from plug (cord connector body) to the point it terminates in an appliance or piece of equipment. The only other thing that you may wish to review is if it is part of a listed food service equipment assembly and having it use in that manner indicated.

3. A new industrial installation has two customer owned high voltage sub-stations. It has an underground primary lateral from the metering and switch location to a raised platform area, 4-foot high, off of grade level. The switchgear is enclosed with no live parts exposed. There is a moat around the transformers and switch gear that is 24" wide and 18-inches deep for oil containment. Does this installation have to be guarded? What are the work space requirements?

Answer: Enclosed switch is typically considered guarded. NEC 110.31 (D), 110.32, and 110.34

Starting with 110.31(D), page 39, enclosed equipment accessible to unqualified persons has very specific requirements.

Vent openings must be guarded

Protection from vehicular traffic

Exposed hardware shall be designed so that it cannot be readily removed

Covers shall be locked, bolted, or screwed on.

Working spaces are covered in 110.32. Sufficient space shall be provided and maintained to permit ready and safe operation and maintenance. Does the moat location create a safety hazard?

A permanent stair or ladder is required to give access to the working space around electrical equipment on elevated platforms per 110.33(B)

4. A large industrial site has one service supplying with three buildings. There also is one generator to provide back-up power to the three buildings. Outside of the building is the 1500 KVA utility transformer. Does the generator have to be spaced 20-feet away from the transformer? The buildings have battery back up exit and emergency lighting.

Answer: Probably not because supplies optional systems. SPS 316.700 and 316.701

I believe that you are referring to the requirements in SPS 316.700 and 316.701 pg. 6. The requirement for 20-foot separation between the transformer and the generator would not apply to buildings as long as the generator is considered as an optional stand-by system under NEC 702. If the generator ends up supplying any emergency or legally required loads, the spacing or a protective barrier is required.

5. I am designing the electrical system in a Limited Health Care facility. For security reasons and for occupants use they have two interior, open air, court yards. The courtyards are accessed via four doors from the interior hallway. Do I need to provide emergency illumination at the doors or on the stoops? In the courtyard? The doors do not have exit lights above them?

Answer: Probably not. IBC 2009, Section 1006.3

The requirement for emergency illumination applies to the means of egress from rooms or spaces that require two or more exits. The interior courts may have four doors, however none of the doors have exits signs. Typically only required exits would have signs. If the courtyard is small such that only one exit is required, emergency illumination would not be required.

6. I was asked to install a generator for a light house on an island. The normal supply is an underwater primary cable to a transformer on the island. What is the classification of this system? Does NEC Article 700, 701, or 702 apply? The generator set has a 500 gallon diesel fuel tank below the unit and a transfer switch next it. Do I need to have a disconnect at the light house building that is 50 feet away from the generator?

Probably NEC 702. Probably not. NEC 445.18 and 702.11, and 225.36.

7. I am inspecting a large industrial complex. Most of the wiring utilizes cable tray with single conductor cables. A single cable tray containing three feeders leaves the main building and that supplies another building. The feeders terminate in switchboards that do not have a "main disconnect". Can this be permitted?

Answer: Yes. NEC 225.30(E) and NEC 225.32 Exception No 1 Documented Switching Procedures.

NEC 225.30(E) permits additional feeders as long as the facilities has Documented Switching Procedures.

NEC 225.32 Exception No 1 permits the building disconnecting means to be located elsewhere on the premises for installations under single management where documented safe switching procedures are established and qualified individuals monitor the installation.

8. At a large industrial processing center they have a primary metering installation and then 25 KV primary voltage cables run around the site in an underground duct bank. The ducts banks end at underground manholes or vaults that are about 10-foot by 16-foot in size. Inside of the vaults they have metal supports for the primary cables. Do the metal brackets need to be grounded?

Answer: Yes. NEC 250.110-(1) and NEC 250.190

Metal parts of fixed equipment that may become energized must be grounded. NEC 250.110 lists several conditions that would apply to these brackets. They are within 8 feet vertically of ground and subject to contact by persons. They are in a wet or damp location. NEC 250.190 would also apply to this over 600-volt installations and essentially would require grounding for the same reasons.

9. I have an interesting code question. One of our clients is an industrial facility. They have a portable conveyor, it is on wheels, that when it is in use is closer than 36" in front of a panelboard. Is this acceptable if it is capable of moving ?

Answer: No, 110.26(B)

Not as far as the NEC is concerned. NEC 110.26(B) Clear Spaces indicates "Working space required by this section shall not be used for storage".

10. Lighting retrofit projects are very popular right now in Wisconsin due to Focus on Energy, We Energies, ARRA, and other funding sources offsetting the cost of retrofitting lamps and ballasts in fixtures. If we retrofit only lamps and ballasts in existing luminaires throughout a building, but are not replacing any luminaires, then are we required to update the controls? I also will ask the same question for lighting retrofit kits. If we replace the "guts" of a fixture which essentially changes the energy usage, distribution, and efficiency of a fixture, but do not replace the luminaire, are we required to update the controls?

Answer: No. No. IEBC

This is an existing bldg. Modifications to an existing building code shall follow the requirements of the 2006 International Existing Building Code (IEBC). IEBC 607 as amended by Comm 66.0607 will require that those areas of the bldg with alterations and additions to meet the current IECC, but will not require the unaltered areas to be brought up to the current code.

The 2006 IECC has two compliance paths. One is to apply IECC 505. Another compliance path is to apply IECC 501.2 which allows the use of ASHRAE 90.1-2004 as amended by Comm 63.0501 (i.e. you must still address light reduction inclusive of day lighting).

Per ASHRAE 90.1-2004 Section 9.1.2, the replacement of lighting systems shall comply with the lighting power density and control requirements. The exception is that alterations which replace less than 50% of luminaires in a space do not need to comply with those requirements provided they do not increase the interior lighting power.

Historically, the Dept. has recognized the replacement of ballasts, lamps/bulbs, or the movement of whole fixtures within the SAME space, as maintenance. It would seem that you are going to keep the fixture, but replace the guts. Such action is acceptable and does not trigger the code assuming you do NOT increase the lighting load when performing this transition. Review Comm 66.0901 of the IECC which is specific to a change in occupancy. There are similar references throughout the codes.

If you do not change the location of controls or type of controls, the current requirements of the code will not be required to be applied. On the other hand, if you had a conference room which is changed to multiple offices, the area of alteration (i.e. the former conference room) will be required to address current control requirements.

Simple adage, "what you touch is what you bring up to code"...Not a perfect saying, but it is always a good starting point."

Note that plans are required to be on-site and be properly prepared by a WI registered engineer, architect, electrical designer, or master electrician who will specifically be installing the system. Those lighting systems associated with a

new bldg, bldg addition, or a first time tenant build out which are involved in a bldg associated with State review must be submitted for lighting plan conditional Go to the following site for additional information.

<http://commerce.wi.gov/SB/SB-CommBldgsLight0209.html>

11. In an apartment unit that has a panel do we need to provide circuit breakers locks or other type of disconnect for a hard wired cook top circuit?

Answer: Yes. 422.31

The appliance is not motor operated so you have two options. You do need to provide a disconnecting means for the appliance that meets either NEC 422.31(A) or (B). Either a disconnect within sight or a permanently installed "lock-off" means at the branch circuit breaker is permitted.

12. The electrician installed a 24 hour timer in the supply conductors to a sign. The timer has a single "on" tab and a single "off" tab. It is within sight of the sign controller. It also is in a lockable box. When servicing the sign, could one simply use the manual override switch as the disconnect? Or just remove "on" tab?

Answer: No. 600.6(A)(2).

The manual over ride in a typical timer may disconnect power to the sign controller. But it may only break one of the hot legs. The required disconnecting means must open all un-grounded supply conductors. In addition, 600.6(A)(3) requires that the disconnect be capable of being locked in the open position. The provision for locking, or adding a lock to the disconnect must be permanently in place at the switch. This is not typically the case with a timer.

13. Does an existing industrial building require upgrade the exit signs to provide emergency heads on the exterior of the building. There is a change of occupancy which prompted the inspection by the local building inspector. No new construction or remodeling is being done. Existing exit lights are battery back-up but cannot support remote heads.

Answer: No, not by State Code. IEBC 912.4

If there is no change in hazard category, the Wisconsin Commercial Building Code would not require changes to existing lighting. Wisconsin adopts the International Existing Building Code, 2009 Edition. Chapter 9 covers Change of Occupancy. Section 912.4 Means of egress, general, could be applicable upon change of occupancy. It requires that the means of egress

comply with Chapter 10 of the current version of the International Building Code if the occupancy hazard category goes to a higher hazard (lower number) as shown in Table 912.4. If this is the case, the entire means of egress would have to be reevaluated with respect to the current Code requirements. A local ordinance could be more restrictive.

14. A trucking company customer would like us to install receptacles in their parking area for engine block heaters for the semi tractors. Do I need to GFCI protect the receptacles if I use a single receptacle for each parking space?

Answer: Yes; 210.8(B)(4)

All 125 volt single phase 15 and 20 ampere receptacles located outdoors are required to be GFCI protected. Also 406.8(B)(1) would require a cover that is weather-proof whether or not a plug is inserted, and the receptacle is required to be a listed weather-resistant type. 406.4(D)(6) in the 2011 NEC will require weather-resistant receptacles be installed when replacing a receptacle that is required to be weather-resistant by the code.

15. I installed liquid-tight flexible conduit to some air conditioning units at a small office complex we were wiring. The inspector red tagged the job because the liquid-tight was not listed. I contend if the distributor can sell it to me it should be OK. What do you think?

Answer: The inspector is correct; 350.6

350.6 requires LFMC and it's fittings to be listed. Similar requirements are found in all of the raceway articles. One proper use fo the unlisted product is were it is used in a piece of equipment where the overall product is listed. One example is a listed manufactured wiring system.

The supply house can sell what ever they want. The end user is responsible for applying it in a Code conforming manner.

16. On a new restaurant project we GFCI protected the kitchen receptacles that were installed to serve the counter tops. The inspector wants us to GFCI protect all of the receptacles in the kitchen including the refrigerators. Is this correct?

Answer: Yes; 210.8(B)(2)

Receptacles located in kitchens in other then dwelling units are required to be GFCI protected by 210.8(B)(2). The definition of a kitchen in Art. 100 is described as an area with a sink and permanent provisions for food preparation and

cooking. All 15 and 20 ampere 125 volt single phase receptacles in this area would be required to be GFCI protected.

17. We are installing a “computer room” as part of a new office/factory project. The owner does not want the disconnecting means required by 645.4(1) installed because she is worried about the equipment being inadvertently turned off. Is there a way we can eliminate this disconnect?

Answer: Yes; 645.4

What you are referring to as a computer room is addressed in Art. 645. 645.4 lists 5 items that are required to designate a room an information technology room. (1) Installing a disconnecting means complying with 645.10. (2) A separate HVAC system. (3) Listed IT equipment. (4) Room is occupied only by personnel required for maintenance and operation of the room. (5) Separation from other areas by fire-resistant construction. 645.10 requires a disconnecting means for all electronic and IT equipment and the HVAC system be located at a readily accessible area at the principle exit. If you choose not to comply with the 5 items listed, it would not be an NEC IT room and you would lose the less restrictive wiring methods that Art. 645 allows. Examples are cords under raised floors and Type DP cables.

18. I am installing a standby generator with 2 automatic transfer switches at a new gas station/convenience store. One of the transfer switches is for the emergency egress lighting and the other is for operating the remainder of the loads. Because of the cost the owner would like us to install a smaller generator and he will turn off some of the load if necessary. I don't think this is code compliant. What do you think?

Answer: You are correct. 700.5(A)&(B), 702.5(B)(2)

700.5(A) requires the emergency system to have adequate capacity for the load to be served. (B) Indicates the emergency system is allowed to also supply legally required or optional systems where it has adequate capacity for all loads or where automatic selective load pickup and load shedding are provided. 702.5 requires adequate capacity even if you were only supplying optional loads.

19. We have a contract to install several ceiling mounted projectors in some classrooms. The specifications called for the 120 volt receptacles to be installed above the suspended ceiling. I don't think the Code allows this but cannot find it in the NEC. Am I correct?

Answer: Yes. 400.8(5)

Receptacles can be mounted above a ceiling however 400.8(5) does not allow flexible cord above a ceiling so in this case they would not be able to use the receptacles to power the projectors.

20. For a recent installation we paralleled 3 sets of copper 350 KCMIL XHHW conductors for a 1000 ampere 120/208 volt feeder in separate raceways. The inspector failed the installation saying the conductors are not large enough for a 1000 ampere breaker supplying the feeder. What do you think?

Answer: The inspector is correct. 240.4(C), Table 310.16

350 KCMIL XHHW conductors are rated at 310 amperes each. $3 \times 310 = 930$ amperes.

240.4(C) indicates for devices rated over 800 amperes the ampacity of the conductors shall be equal to or greater than the overcurrent device protecting them.

21. We installed a 75 KVA 120/208 volt 3 phase transformer to supply lighting and receptacles for a recent project. The primary is 480 volt 3 phase and is protected by a 125 ampere circuit breaker. For the secondary we supplied two-200 ampere panelboards. Each panel has a 200 ampere main breaker. The inspector has indicated the mains in the 2 secondary panels cannot add up to more than 300 amperes. I think he is wrong, what do you think?

Answer: You are correct. Table 450.3(B), 240.6

The inspector is probably looking at the requirement in Table 450.3(B) that secondary protection shall be sized at 125% of the secondary current and when using multiple secondary overcurrent devices, as allowed by Note 2 to the Table, they cannot add up to more than what would be allowed for a single one. The primary of a 75 KVA 3 phase transformer at 480 volt is 90 amperes. The first line in Table 450.3(B) indicates that where primary protection is not more than 125% secondary protection is not required. $90 \times 1.25 = 112.5$ Note 1 to the Table allows you to go to the next standard size overcurrent device. 240.6 indicates a 125 ampere device. So you would not need to comply with Note 2.

22. When we are replacing ballasts in fluorescent fixtures are we required to install a disconnect as required by 410.130(G)?

Answer: No SPS 316.003(4)

SPS 316.003(4) allows repairs made to existing installations to conform to the code that applied when installed. 2011 NEC 410.130(G)(1) will require disconnects to be installed when replacing a ballast.

23. The kitchens in an apartment complex have an area for the table that is separated by a cabinet peninsula. Am I required to AFCI protect the receptacles in this dinette area?

Answer: No 210.12(B)

All branch circuits supplying outlets in the rooms listed in 210.12(B) require AFCI protection. While dining rooms are listed, dinettes or breakfast nooks are not. To me a dining room is a separate room and what you are describing is part of the kitchen and they are not listed as requiring AFCI protection. If the plan shows that the dinette is off of the kitchen, then AFCI protection is required. If you are the EC, make sure you discuss this with the AHJ before rough-in.

24. We are installing a 600' conduit run using PVC and I am concerned about burning through a PVC elbow which will be located near the end of the run. Can I install a metal elbow in the run and is there anything special I should be concerned with?

Answer: Yes 250.86

250.86 requires metal enclosures and raceways to be connected to an equipment grounding conductor. Exc. 3 indicates a metal elbow is not required to be connected to an equipment grounding conductor where it is installed in a nonmetallic raceway and is isolated from contact by a minimum 18" of cover or encased in not less than 2" of concrete.

25. I am installing multiple disconnects on the secondary of a transformer and am confused on how to size the equipment grounding conductors. I have a 112.5 KVA 3 phase transformer with a 120/208 volt secondary. I will be using two, 200 ampere circuit breaker panels with main breakers. Each panel will be supplied with 3/0 THWN copper conductors for the ungrounded and grounded conductors but I am not sure about the equipment ground. Can you help me?

Answer: Yes 250.30(A)(2), 250.102(C)

Where an equipment grounding or bonding conductor is run with the derived phase conductors 250.30(A)(2) indicates that it is sized using 250.102(C). This section gives us direction on sizing the equipment bonding conductors or a service however in this case we will be using for a separately derived system. It

indicates we use Table 250.66 to size the bonding jumper based on the size of the phase conductors. It also tells us that where service conductors are installed paralleled in 2 or more raceways the bonding jumper for each raceway is based on the size of the conductors in each raceway. The 2011 NEC 250.30(A)(2) now calls the equipment bonding jumper the supply side bonding jumper however it still refers us to 250.102(C) for sizing.

26. I installed 16-#12 AWG THWN conductors in a 1" EMT conduit the receptacle circuits on our project. The inspector has indicated I need to change out the 20 ampere circuit breakers to 15 ampere. I know we have not overfilled the conduit and the spec calls for 20 ampere protection for all receptacle circuits so this isn't going to work. Is there any thing else I can do?

Answer: Yes 310.15(B)(2), Table 310.15(B)(2)(a), Table 310.16, Annex C Table C.1

The inspector is referring to the fact that you did not derate your conductors for the number of conductors in a raceway. 310.15(B)(2) indicates when you have more than 3 current carrying conductors in a raceway the allowable of each conductor is reduced per Table 310.15(B)(2)(a). The Table indicates that for 10-20 conductors you need to reduce the ampacity by 50%. Table 310.16 indicates a #12 THWN conductor is rated for 30 amperes using the 90 deg. Column. This would limit them to 15 amperes. You could add a conduit and divide the conductors in each conduit which would then require derating by 70% and you would be ok at 20 amperes. Or replace the conductors with #10 AWG and you would also be ok. You can check my math later but I think 16, 10 AWG THWN-2 insulated conductors will just fit in 1-inch EMT.

27. We installed a 30 HP motor for a pump at an update to our local water treatment plant. The branch circuit came from a controller in an existing Motor Control Center in the control room. The plan did not indicate the need for a disconnect at the motor. The motor is located in a lower level pump room. Because the disconnecting means at the controller is lockable I felt this would be OK however the inspector red tagged us for not having the disconnect within sight of the motor. What do you think?

Answer: The inspector is correct. 430.102

430.102(A) indicates a disconnecting means is required within sight of a motor controller. 430.102(B)(1) requires a disconnect within sight of a motor and (2) allows the disconnect for the controller to act as the motor disconnect when it is within sight of the motor. There is an exception that allows the controller disconnecting means to act as the motor disconnect if (a) it is impracticable or increases hazards to people or property. An example of it being impracticable

would be if this were a submersible pump. Your question seems to indicate they are not within sight of each other and it is not a submersible pump so you would need 2 disconnecting means.

28. We are remodeling several patient rooms at a hospital. The new rooms will have a sink in the room for the staff to use for washing without needing to use the bathroom sink. Some of the receptacles that 517.18 and 19 require will be less than 6' from this sink. I don't feel it is wise to GFCI protect them because of them possibly tripping when monitors or equipment are plugged in. Is there something else we could do?

Answer: Yes 210.8(5) Exc. 2

You are referring to 2008 NEC 210.8(B)(5) which requires GFCI protection for all 15 and 20 ampere 125 volt receptacles within 6' of a sink. Exc. 2 allows for receptacles located in patient care areas of a health care facility to not be GFCI protected unless required by 210.8(B)(1) which would be the bathroom. NEC 2011 210.8(B)(5) Exc. 2 is more restrictive as it will allow the elimination of this GFCI protection only in patient bed locations of general or critical care areas.

29. The AC output from the inverters of a PV system is connected to the customer's 200 ampere service panel. My interpretation is that the Point of Connection between the output of a PV inverter and the AC system can not exceed 120% of the overcurrent protection ratings. The sum of the inverter outputs is 50A. The inverters supply a 70-ampere circuit breaker in the panel. Is this OK?

Answer: No. 2008 NEC 690.64(B)(2) and 2011 NEC 705.12(D)(2) & (D)(7)"

The back-fed PV breaker in the main service panel could not be more than 40 amperes if the panel bus is rated at 200 ampere and the main breaker is 200 ampere. 690.64(B) allows the breakers feeding the panel to add up to not more than 120% of the panel rating. You can check my Math later if you want. (Calculation: $200 \times 1.20 = 240$, $70 + 200 = 270 > 240$ therefore would not comply.)

If the calculated load on the main panel would be 150 amperes or less they could change the main breaker to 150 ampere and they would comply.

(Math: $150 + 70 = 220 < 240$.)

Or a 225 ampere panel with a 200 ampere main breaker would also comply.

Also 690.64(B)(7) requires the back fed PV breaker to be installed at the bottom of the panel in order to use the 120% allowance.

Alternative method would be to add an additional disconnect for just the PV system on the side of the main service disconnect.

30. The DC output from the array of a PV system supplies a fused switch. Each of the four PV source circuit currents is rated 12.5 amperes. What is the minimum size of the fuses in the interconnected disconnect?

Answer: 70.-amperes. 2008 NEC 690.8(B)(1).

The minimum fuse size is 70.amperes. Total Inverter is 50-Amps. Increase this by 125% for overcurrent protection sizing give 70 amp minimum. You can check my math later if you wish. [Inverter output = $12.5A \times 4 = 50A$. $50A \times 1.25$ (for overcurrent protection sizing) = 62.5-amperes.Round up to 70-amps] The rating is allowed to be the next larger standard size since 240.4(B) is permitted to apply. So an overcurrent device rating of 70A would be the minimum permitted rating. The circuit conductors would have to be sized in the same manner.

31. I came across an installation for a sub meter. The electrician that did the install took some 12 AWG THHN wire and connected it under the line lugs of a 200 amp breaker. They did think to install some, in-line, 30 amp fuses on the No. 12's. My question; is the 6" of wire that is connected to the 200 amp breaker legal? Can you install the fuse in the panel like that?

Answer: No. No. 240.21(B)(1), 240.4(D) and 240.24(A)

The #12 AWG wire would be considered a tap and would have to comply with 240.21(B)(1) for a tap not over 10' long. It appears to meet these requirements including (4) which indicates the overcurrent device on the line side of the tap can not exceed 10 times the ampacity of the tap conductor. #12 AWG $20 \times 10 = 200$.

240.4(D) indicates #12 AWG wire is required to have overcurrent protection provided at not more than 20 amperes. The 30 ampere fuse is too large.

240.24(A) requires overcurrent devices to be readily accessible which would require the fuses to be reached quickly and not have to remove obstacles to obtain access. It appears this is installed in a power panel that would require the removal of the cover to access the fuses. This would not be considered readily accessible.

SPS 316.110-(1) requires equipment to be installed to meet the listing, and manufacturer's instructions. All wire connectors and lugs are marked on the lug itself or the packaging for the minimum and maximum wire size allowed. I doubt whether the lugs on the 200 ampere switch is rated for 12-AWG conductors.

32. I am one of the energy advisors for the Focus on Energy agriculture program. Our form states that all fixtures installed must be gasketed and listed for wet locations. The question I get from a lot of electricians and distributors is, will a "damp location" listed fixture be acceptable for these facilities (such as barns, parlors, etc)? If it needs to be "wet location" rated, can it be cord-and-plug connected?

Answer: Depends on the location. Not likely. 547.8

Art. 100 describes a wet location as one that is subject to saturation of water such as a vehicle washing area or located in unprotected areas exposed to the weather. A damp location is described as a location out of the weather and not subject to saturation with water but subject to moderate degrees of moisture. For instance I would not consider the ceiling of a barn or milk parlor to be a wet location however it could be a damp location. I would require a light fixture located in the pit area of a milk parlor to be rated for a wet location because of the wash down that occurs on a regular basis in this area. These may be able to be plugged in using a receptacle listed as a weather resistant type and an approved cover.

Most of the fixtures I see being installed may be rated for a wet location because we do look for the fixtures to be sealed, or gasketed, and constructed of a non-corrosive material, however one approved for a damp location may be acceptable if properly constructed. You are correct if the fixture would be required to be approved for a wet location you could not cord and plug connect them unless the attachment plug and receptacle were also approved for a wet location. You would not be allowed to hard wire a fixture using flexible cord unless the fixture, cord, and canopy, was listed as an assembly or the fixture required aiming or adjustment after installation. The fixture could be hard wired using a Chapter 3 wiring method that was approved for wet locations such as liquid-tight non-metallic conduit.

Most fixtures I see being installed are being cord and plug connected without using wet location receptacles because they are not being installed in a wet location.

[Here is a summary of the 2008 NEC regarding luminaires for Agricultural facilities, such as barns, parlors, and milk houses. This would not necessarily apply to shops, machinery storage sheds, etc.

547.8 Luminaires (Lighting Fixtures). Luminaires (lighting fixtures) shall comply with 547.8(A) through 547.8(C).

(A) Minimize the Entrance of Dust. Luminaires (lighting fixtures) shall be installed to minimize the entrance of dust, foreign matter, moisture, and corrosive material.

(B) Exposed to Physical Damage. Luminaires (lighting fixtures) exposed to physical damage shall be protected by a suitable guard. [ROP 19-23]

(C) Exposed to Water. Luminaires (lighting fixtures) exposed to water from condensation, building cleansing water, or solution shall be watertight. [ROP 19-24]

33. I inspected a lighting control system. The 24-volt, Class 2 conductors were installed with 277-volt lighting conductors in the same EMT raceway. The instructions with the listed lighting system indicated the installer should: "Re-

identify the Class 2 circuits at the lighting control panelboard to Class 1 by re-identifying the control transformer. The Class 1 conductors are then associated with the lighting system and code complying.” Can any Class 2 circuit be re-identified to Class 1 and installed with power conductors for any application as long as they are associated?

Answer: Yes. 725.130.

I think the way you are reading the code is correct. 725.130(A) allows you to install Class II or III circuits using a Class I wiring method meeting the requirements of 725.46, however it is still a Class II or III circuit and would have to meet all of the rest of the requirements in Part III. This would not allow the installation of just any Class II or III circuits in the same raceway or cable with the power conductors.

725.130 applies to Wiring Methods and Materials on Load Side of the Class 2 or Class 3 Power Source. It indicates “Class 2 and Class 3 circuits on the load side of the power source shall be permitted to be installed using wiring methods and materials in accordance with either 725.130(A) or (B).”

(A) Class 1 Wiring Methods and Materials. Installation shall be in accordance with 725.46.”

An example of a Class 1 within method is THHN insulated conductors in an EMT raceway.

725.130 (B) permits Class 2 and Class 3 wiring methods such as listed CL-2 and CL3 cables.

So you could not pull a Class 2 cable in the same raceway as power conductors. Your proposed installation could use 725.130 Exception No. 2: This exception permits Class 2 and Class 3 circuits to be reclassified and installed as Class 1 circuits if the Class 2 and Class 3 markings required in 725.124 are eliminated and the entire circuit is installed using the wiring methods and materials in accordance with Part II, Class 1 circuits.

The Fine Print Note gives some additional guidance: “FPN: Class 2 and Class 3 circuits reclassified and installed as Class 1 circuits are no longer Class 2 or Class 3 circuits, regardless of the continued connection to a Class 2 or Class 3 power source.”

I think your installation would be code compliant if the power supply was re-identified as a Class I and a Class 1 wiring method such as THHN insulation in EMT or Type MC cable is used for the entire circuit.

34. I have a church project with a 400 amp 1 phase service. The service feeds 2 different main breaker panels. One panel is in the basement, and the other is on the first floor. Can I leave this “as-is”?

Also, there is a school building about 120 feet away with a new 1200 amp 120/208 3 phase 4 wire service. Can I run a 200 amp 3phase feeder from the school for the A/C on the church?

Answer: Yes. 230.2 and 225.30.

230.2(D) allows 2 services for different characteristics such as voltage or phases. 225.30 has similar language for feeders or branch circuits.

There is no language prohibiting a service and a feeder to the same building so what you are proposing would be allowed.

There is another issue that the owner must resolve. NEC 230.71 does permit up to six service disconnecting means for each service allowed by NEC 230.2.

However, the two service disconnects for the church must be grouped at the same location. SPS 316.003(3) indicates existing installations shall conform to the code that applied at the time of the installation. The earliest code I have access to is 1947 and while it allowed up to 6 disconnects for each service it also required them to be grouped at the same location.

A single main disconnect could be installed to supply both existing service disconnects, or this may be an opportunity to correct this violation by installing a new service large enough to supply the entire load and not have to install the feeder from the school.

The same grounding electrode system must be used in the church for all permitted supplies.

The feeder disconnecting means does not have to be grouped with the two service disconnecting means. So the feeder could go to a different location as you propose.

One last requirement, NEC 225.37 Identification may apply. The requirement indicates that where a building is supplied by a combination of branch circuit, feeders, or services, a permanent plaque or directory shall be installed at each disconnect location denoting all other services, feeders or branch circuits supplying the building.

35 I want to replace a sub-panel with fuses with a new panelboard with circuit breakers. The sub-panel is in a separate building about 120 feet from the service panel. I understand that it must be grounded with 2 rods at least 6 ft. apart using #6 wire and teardrop connectors. However, I'm getting different opinions as to whether the neutral bar must be bonded to the ground. Some say yes it must be bonded and some say no it should not be. Which is correct? FYI, I am the home owner. It is in Douglas County.

Answer: Typically neutral cannot be bonded in sub-panel. NEC 250.32.

NEC 250.32 gives us the requirements for the installation of feeders and panels at a separate building. It indicates a separate equipment grounding conductor is required to be installed with the feeder to the building. An exception applies only to an existing feeder to an existing building. This exception permits the grounded, or "neutral", conductor to be bonded to the building disconnecting means if there is no equipment grounding conductor installed and there are no continuous metallic paths, such as a metal conduit or pipe, between the 2 buildings.

So you may bond the neutral in your replacement panel only if both conditions are met:

A separate equipment grounding conductor is required to be installed for any new feeders. NEC 250.24(A)(5) indicates the grounded (neutral) conductor shall not be connected to the normally non-current carrying metal parts of equipment, to equipment grounding conductors, or be reconnected to ground on the load side of the service disconnecting means.

You are correct about the ground rods. NEC 250.32 requires the installation of a grounding electrode at the separate building. The rods would be connected to the equipment grounding bar in your new panel. The grounding electrodes could be connected to the same terminal bar that the grounded conductor is connected to only if you meet the exception to 250.32.

36. A multi-occupancy building has 2 services with different characteristics being installed. The first service has the service disconnects inside the building in each occupancy. The second service is being installed on the exterior with the main disconnect located outside. Is this allowed?

Answer: Yes, this is allowed. NEC 230.2(D) Services of a Different Characteristic

You are correct in that 230.2(D) allows the installation of a second service on the same building as long as it has different characteristics. Examples would be a single-phase service and a three-phase service. Or a three-phase service of one voltage such as 480/277-volts and a three-phase service of a different voltage such as 240-volt, grounded B-phase or 208Y/120-volts.

When you meet one of the conditions in 230.2 that allows a second service supplying the same building, each service is treated separately. Each service would have to meet all of the applicable requirements of Article 230 and could utilize any of the applicable exceptions. The owner could use 230.40 Exception No 1 for one service and locate the service equipment in each tenant's space. They could also use 230.40 Exception No 2 for the second service and group all disconnects for the other new service. However the disconnecting means for one permitted service never are required to be grouped with the disconnecting means of another service.

Remember, 230.2(E) applies where multiple services supply the same building. At each service location, a permanent plaque or directory must denote presence of multiple services, the location of them, and the area served by each.

37. An industrial control panel contains a 1-kva control transformer. The primary is 480-volts, the secondary 120-volts. The secondary loads are control circuits as well as a receptacle and fluorescent light within the cabinet.

Would this installation require a grounding electrode conductor to be installed to the nearest grounding electrode? I've seen this same type of situation in roof top units.

Answer: Grounding Electrode is required. 250.30(A)

The secondary of a 120-volt separately derived system supplying feeders or branch circuits is required to be grounded and connect to an electrode system with a min. 8 AWG copper grounding electrode conductor per 250.20(B)(1), 250.20(D), and 250.30(A). Remember that 210.3 also applies so a transformer with a minimum rating of 1800VA transformer is required to supply a 120-volt, 15-amp branch circuit. A transformer supplying an individual branch circuit could be rated less. The Code does not permit supplying a 15-ampere, duplex receptacle and a fluorescent light from a transformer with a secondary rating of 8-amperes. NEC 210.23(A) (2) would further limit the lighting load to 7.5 amperes since a receptacle outlet is also on the same circuit.

This may be why many contractors remove the transformer tap to the receptacle and install their own branch circuit for the receptacle outlet. If the transformer only supplies control circuits and is rated 1-kva or less, the secondary system can be bonded 14 AWG copper Cu equipment grounding conductor per 250.30(A)(1) Exception No. 3. Then a grounding electrode conductor to one of the electrode types in 250.52 is not required at all per 250.30(A)(3) Exception No. 3.

Realizing the Class 1 control circuit transformer sized 1000 VA or less is not required to be grounded at all means that a control transformer can operate at 120V line to line per 250.21(A)(3). However, when supplying a branch circuit the transformer is required to be grounded

38. I have processing room where flammable liquids are used. Our insurance company has it rated "Class 1 Div 2". The 2008 NEC Section 500.5 states the classified spaces are defined by room, section or area. The room we are classifying has two overhead doors which remain open in normal operation. They are fire-rated coil doors that will close on a fire. We want to treat the adjacent room as unclassified. Can we do so if the fire doors are set to close automatically in a case of fire or explosion? What if we made the overhead doors operational so they are closed at all times?

Answer. The adjacent room must be classified. NEC 500.4(A), 500.7(K)

You indicated the hazard is created by a flammable liquid or gas in the processing room. In the event of a discharge, what would keep the gas from migrating to the adjacent room? Adjacent areas are typically classified unless vapor migration is addressed. Positive pressure differentials or gas detection with shutdown are examples of means employed in order to treat adjacent areas as nonhazardous. NEC 500.7(K) Protection Techniques may give you some useful information on how to proceed.

39. I installed a 150 kva transformer for a repair garage. Don't worry, it's not sitting on the floor! I need 208Y/120-volt power for lights and plugs. I plan to supply 2- 200-amp panels in different locations. The building has plastic water piping so the only electrode is the rebar. I know I need a No. 4 to run from X0 to the rebar connection. Is a No 4 OK from X0 to the transformer case? And what about from the case to the each of the two- 200-ampere panels?

Answer: No: 2 minimum. No. 4 is OK. NEC 250.32

I assume you're using 3/0 copper to supply the 200-amp panels. The system bonding jumper connects the X0 of the secondary to the enclosure. It is sized based upon the equivalent area of the secondary supply conductors. A 3/0 conductor is 167,000 cm. $2 \times 167,000 = 334,000$. Using Table 250.66, this gives a No 2 system bonding jumper. Supply sized bonding jumpers are sized based upon the same process. Each ungrounded supply conductor is 3/0. So you would need a No. 4 in each raceway from the transformer enclosure to each disconnect enclosure.

Grounding electrode conductors sized based on 250.66. However, a No 4 is always the largest size required for concrete-encased electrodes.

40. Just a couple of "DAH" questions to start your day.

What section of the code do I find "whole house" generator sizing ?

What section do I find over current protection for underground feeders ?

Answer: 702.5(B), Article 225-II

By "whole house" I assume you intend to transfer the entire house load automatically. So both the generator and the transfer would have to have adequate capacity to pick up the entire load. The code section would be 702.5(B)(2) The Code gives you two options for Automatic Transfer Equipment (a) The standby source is capable of supplying the full load that is being transferred. This would be the calculated or measured demand load of the entire house.

(b) This option would allow the use of a Load Management System as means to limit the load to some predetermined level. Then the source would only have to have the capacity sufficient to supply this predetermined "worst case" load. Some manufactures do build a panel that automatically limits the circuits supplied for residential applications. This is a link for a Square D product on the last page of your handout. (<http://products.schneider-electric.us/products-services/products/load-centers/residential/intelligent-load-centers/>)

The rules for outside feeders are found in Art. 225. As you know the feeder would have to be calculated for the load to be served, 225.3.

41. Hello, we have a new building being fed from an existing building. The feeder is protected in our main building by a 40-ampere breaker. The wire size is 8 AWG THWN-2. We remembered from last year's seminar that we needed to bring an equipment grounding conductor along and connect it to two ground rods. The new building's loads are less than 40 amps. Our inspector says we need a 60-ampere disconnect at the new building but said to check with you to see if the wire size needed to be increased. He's OK with our load calculations. What's the deal?

Answer: Applies to the rating of the disconnecting means only. 225.39(D)

I agree 225.39 requires the disconnecting means to be not less the calculated load and in no case less than (A) thru (D). We agree that the disconnecting means at the second building has to have a minimum rating of 60-amperes. This rule does not affect conductors sizing.

NEC 225.5 indicates the size of the conductors shall be based on loads as determined by 220.10 and Part III of Art. 220. While 230.42(B) requires service conductors to be not less than the service disconnecting means, there is no similar requirement in Art. 225.

The outside feeder conductors can be sized and protected to meet 310.15 for the load to be served and the disconnecting means would need to meet 225.39. I see your installation as being code compliant.

42. We are doing a build out in an existing building. The existing fluorescent light fixtures are equipped with a 20' cord and twist lock plug. In most cases the outlets are directly above the fixtures or within a few feet. There are some that might be as far as 5-8' away, in this situation we tie wrapped the cord to the structure to get to the receptacle. The inspector has a problem with this. Even if the Code has changed and the inspector is correct, aren't we "grandfathered in"?

Answer: No, the inspector is correct. No, you are not "grandfathered in". NEC 410.62(C)

The permission to use a cord and plug connection for such fixtures has been around since the 1980's. The permission has always been conditional on the fixture being located directly below the outlet that supplies it. Five to eight feet is clearly out of reach from the fixture. Locating the receptacle 3-feet from the fixture is reasonable.

The grandfather clause is now numbered as SPS 316.003-(3). It grandfathers in installations that complied with the Code in effect at the time of original installation. This cannot be the case as prior to the permission to located a receptacle "directly" above the fixture and connect it to a attachment plug and cord, the code did not allow fixtures to be wired with Cord at all. One option has not changed and is still permitted. You could use a Chapter wiring method such

as Type MC cable or flexible metallic conduit to connect the fixture to a remote outlet box. The wiring method would have to be secured and supported.

43. If you have multiple isolated grounding conductors going back to a panel; Can you just run one green wire back to the panel and splice them in a junction box or do you have to run a separate isolated ground wire back for each circuit and /or isolated ground receptacle?

Answer: Either option acceptable. 250.146(D)

You're correct in that NEC 250.146(D) leaves it up to you to determine the connection point between the isolated equipment grounding conductor(s) and the enclosure(s). In other words, you could splice the isolated equipment grounding conductors out and bond them to the enclosure at any point between the receptacle enclosure and the source of power. The Code does not require you to run individual isolated equipment grounding conductors. One adequately sized isolated equipment grounding conductor would be permitted as long as it is run with the circuit conductors. This permission is given in 250.122(C).

44. SPS 316.334 states that "Romex" is permitted to be used in other structures as long as the building is of Types III, IV, and V construction. I am not sure Types II, IV, and V are. Can I use it in a 3-story, wood-frame apartment building? Also, can I run PVC in the underground parking garage?

Answer: Yes. SPS 316.334

Yes, you are correct. The type of construction is determined by the building Code. The general contractor, architect, or building official should be able to help you determine the type of construction for the above ground portion as well as the parking garage.

Wood frame buildings are typically Type V construction. Nonmetallic cables, such as Type NM cable or SE are permitted. The garages used for parking only are nonhazardous locations. PVC conduit is a permitted wiring method. Don't forget about expansion fittings if the structure is unheated. Remember to compensate for building movement at each expansion joint.

45. I'm installing a switchboard in an electrical room. I would like you to verify we meet the working space requirements in 110.26(C). The electrical equipment is rated at 1600-ampres at 480/Y277-volts. The main switchboard is 13'-0" wide. We plan to have only one exit out of the room, but it is a double door. And the doors are located directly opposite the front face of the switchboard. Would this installation be code correct?

Answer: Acceptable with one door as located directly opposite and no obstructions between. NEC 110.26(C)(2)(a)

If the door was centered on the opposite wall it would closely reflect Exhibit 110.18 in the 2008 NEC Handbook. I would approve the layout on that basis.

46. I do have a quick question for you. I'm sizing the riser conductors for a 400-ampere service. The service supplies 4 units and a public panel. All panels are rated at 100-amperes. It seems to me I would have to do a load calculation if the riser conductors are smaller than 500-kcm copper. Do I size the meter packs the same way?

Answer: Correct. 230.42(A), Table 310.16, Table 310.15(6)

The service conductors that supply all of the dwelling units and the public panel must be calculated and sized per the load. Same answer for the meter socket. For example, say the result of the load calc was 250-amperes after all applicable demand factors were applied. The service conductors would have to have an allowable ampacity of 250-amperes. So 250 kcm THWN or 350-kcm XHHW conductors would be the minimum size in the riser or mast. The common power buss of the socket would also have to have a minimum 250-ampere rating. Each meter position could be rated 100-amperes.

Since the voltage is 240/120-volt, single phase, you could use Table 310.15(B)(6) for the supply conductors to each individual dwelling unit. You could not use this Table for sizing the conductors in the riser or mast and for the public panel.

47. It is the intent of articles 110.9 and 110.10 to require a short-circuit, arc flash and coordination study be performed for a feeder and panel installation from an existing panel board?

Answer: Short-circuit study Yes. Coordination study- Maybe. Arch flash study-No.

One intent of 110.10 and 110.9 is to ensure the equipment will safely perform under fault conditions. So a short-circuit study or calculation may be necessary in order to ensure the equipment is properly rated. In some cases, a coordination study may be required by the same section. This would be the case if a series rated overcurrent protective devices were used with a distribution where the available short-circuit current was higher than the lowest rated fuse or circuit breaker. Or if equipment was used that had a short-circuit-current-rating lower than the available short-circuit current. In both cases, the choice of the correct type of protective device is critical and substitute devices of the same rating may violate this section. Sections such as 240.12 and 240.86 reinforce the general requirements in 110.9 and 110.10.

Requirements such as NEC sections 517.26, 700.27, 701.11 and 708.52(D) prompt a coordination study.

And NEC 110.16 requires that certain types of equipment be marked in the field as an arc-flash hazard. However, determining the severity of the potential exposure and selecting the PPE for the task are not part of the requirement. You may want to contact OSHA on the applicability of standards such as NFPA 70E.

(Note: OSHA referral info on last page of handout.)

48. I have a job where we need to install a 200 amp subpanel. The subpanel would be fed from existing ITE switchgear. The problem I have is that these ITE, Type FJ frame breakers are no longer available. My inspector told me that we could only use a secondhand breaker if "approved". When asked how to go about getting a breaker "approved" I was given this reply " Approvals are granted by a NRTL certified third party testing agency" Does this mean "UL"? Is this my only option?

Answer: No. SPS 316.012-(1)

There are actually many NRTLs that are approved to list electrical equipment. You may use OSHA's recognition of a NRTL as proof of acceptability in Wisconsin. You may also contract with a Registered Professional Engineer to perform the same task.

Circuit breakers are listed under a program authorized by a NRTL. Listing can only occur at the time of manufacture and only in the factory. Once a breaker is "reconditioned", it is no longer considered "listed". The applicable Code section is SPS 316.110-(1).

"SPS 16.012 Use of approved materials and construction methods. (1)

MATERIALS. Materials, equipment and products which do not comply with the requirements of this chapter shall not be used unless approved in writing by the department. Approval of materials, equipment and products shall be based on sufficient data, tests and other evidence that prove the material, equipment or product meets the intent of the requirements of this chapter. Data, tests and other evidence shall be provided by a qualified independent third party.

Note: Examples of a qualified independent third party include a nationally recognized testing laboratory and a professional engineer."

49. A foreign built press was installed in our community. The press is made up of parts, some of which are listed. The manufacturer says the press was wired to "national and international electrical standards". Does the entire press have to be UL listed?

<http://www.osha.gov/dts/otpca/nrtl/index.html>

Answer: The owner has another option. The press can be evaluated in the field by a qualified independent third party. Manufacturer self-certification is not permitted by the rules as a basis for approval.

The evaluation should take into account data, testing, and the wiring methods and equipment used by the manufacturer(s). The conclusion that the press is acceptable should be based on comparable national standards such as NFPA 79 and UL 508.

Examples of qualified independent third parties are Nationally Recognized Testing Laboratories and Professionally Registered Engineers. The list is not exclusive. A Registered Electrical Designer could perform the evaluation and provide the evidence that the press meets the intent of SPS 16 and the NEC.

(Note: OSHA referral info on last page of handout.)

50. Are recreational vehicle pedestals required to connect to electrodes at each pedestals? What about an intersystem bonding kit?

Answer: Yes. Maybe. NEC 250.32(A), 551.75, 250.94

A recreational vehicle pedestal is considered a "separate structure". At a minimum, each pedestal would have to be connected to two driven ground rods. If other systems such as cable TV, phone, satellite TV, are intended to be installed, the intersystem bonding kit must be installed.

51. I heard we have to submit plans for fire pumps. Attached are the one-line diagram and calculations for the wire sizing. The local inspector will not approve the fire pump service. We tapped ahead of the main to supply the fire and jockey pumps. The issue seems to be the tap box for the jockey pump. Isn't this permitted?

Answer: Plans not required at this time. Tap may be Ok. NEC 695.6(F)

The tap to supply the jockey pump is permitted ahead of but not within the Fire Pump Controller that is also the service disconnect. This is still considered a "direct connection" in that there is no disconnecting means between the utility source and the Fire Pump Controller. Another section that is applicable is 695.6(l)(6) in the 2011 NEC

52. I currently have a Diesel Generator dedicated to feeding a Data center for backup power. I would like to locate the Life Safety Generator next to this existing generator. It will supply egress lighting. I would observe the manufactures recommendations for ventilation around the units. Please advise if there is a distance requirement that I am overlooking.

Answer: None. SPS 316.700

You are reading the code correctly. Nothing in 16.700 says anything about separation from another generator. The creation of 16.700 was to address

building fire, Utility transformer fire, or failure of the normal service equipment to which you just came up with an entirely different possible hazard. Comm 16.700 was created as prescriptive language when complying with NEC 700.9(C) for the items identified in 16.700. In your case you have a possible optional standby generator fire hazard or failure that may or may not disrupt the emergency standby power. There is no prescriptive requirement to address your situation so you are left with complying with 700.9(C) "minimizing the hazards". How you decide to minimize the hazard to assure continued function of the standby emergency system is up to you. Consider the issues in 700.9(C) , the optional generator catching fire or the engine throwing a connecting rod. If each generator is within their own housing and there is some space between them possibly there is no hazard. It is up to the designer to justify that they have taken precautions to comply with 700.9(C). I would suggest involving the generator manufacturer who may have reports of generator failures including the extent of associated damage and hopefully suggestions to avoid such adjacent damage.

53. How high does a light pole need to be for an HID lamp or mercury vapor lamp fed by a 480 volt single phase branch circuit? I have looked through Luminaires, high and low, voltage electric discharge lighting, etc. but can't find it anywhere.

Answer: Depends upon the voltage to ground. NEC 210.6(D)

You are probably thinking of 210.6(D). This section applies to a 480-volt system where the voltage to ground is also 480-volts or assumed to be 480-volts to ground. An example of the latter is a 480-volt ungrounded system. If this is the case, 22-feet is the minimum mounting height on poles. 210.6(C) applies to a system where the phase-to phase voltage is 480-volts and the phase to ground voltage is 277-volts. In this case, there is no minimum mounting height.

54. Our inspector recently came out for a preview of an aerial feeder installation that we will be working on. The work involves two - 600A, 480V aerial feeders that will originate in existing substation #10 and extend to Shop 3, which is one of many buildings on the campus. He had no concerns with the aerial plan, but did ask me to write you a short note regarding the location and number of disconnects for Shop 3. We would end up with 4 total disconnects at two different locations.

The campus is fed with a 13.2kV primary line, and the main 13.2kV disconnect for the facility is accessible and well marked. In the event of an emergency, personnel on site are directed by training and signage to the location of the main disconnect.

From there, individual buildings are served by approximately (17) 13.2kV/480V substations of various sizes that may serve multiple buildings or a single large load. Is this OK?

Answer: Yes. NEC 225.32 Exception No. 1

The issue involves the use of multiple disconnecting means for the same building. The disconnecting means are not grouped, however, the building is part of the Corporation "Campus". Such an arrangement is permissible under 225.32 Exception No 1. You indicated "In Shop 3, Substation #10 provides the power using (2) existing 600A, 480V aerial lines, which we are now expanding to (4). As a result, there will now be a total of 4 disconnects that must be opened to turn off power within Shop 3. All are located indoors within the building, but they are not grouped; instead they are strategically placed to serve machinery. Signage is placed next to each disconnect indicating where it is fed from and that there is more than one disconnect. Additionally, power can be turned off at Substation #10, which will kill all of the power in Shop 3 with a single switch.

This arrangement (main disconnect at substation, signage at individual downstream disconnection devices, and no more than six mains in a building) is common throughout the plant."

All of the conditions of the exception seem to apply. Please provide the inspector with a copy of the documentation you employ to ensure the qualified individuals know the location of and switching procedures for isolation of the building should the need occur.

55. Are there different requirements for emergency power for egress lighting in existing buildings that are altered existing buildings verses new buildings? I do not see anything mentioned about exceptions for alterations in IBC1006.3. However, Section 705.7 in the IEBC does not directly address emergency power though it does reference back to IBC. The building I am working on is a Level 2 alteration.

Answer. Yes, different requirements based upon the Level of Alteration. International Existing Building Code (IEBC)

You've done your homework. The difference is not in the specific requirements of IBC 1006 but in what areas IBC 1006 are applicable. The first step is to define the scope of the alteration using IEBC 705.1. The second step is to apply IBC 1006 to the work area as required by IEBC 705.7.1. Or if the work area on any floor exceeds 50% of the floor area, then the requirements in IBC 1006 apply to the work area plus the means of egress from the work area per 705.7.2

56. I am a State of Wisconsin Certified Master Electrician. I am currently working in a clinic. I'm being told by the engineer that there is redundant grounding of the receptacles. But there are no ground tails in any of the device boxes as required by NEC article 517.13(B). The equipment grounding conductor is terminated in the box and "self-grounding" receptacles are used. The journeymen say that they

are told to “do the work the way they your told, and don’t worry about it”. Please advise.

Answer: Pigtails required in patient care areas. NEC 517.13(B)

As to the issue, NEC 51713(B) clearly states that the grounding terminals of all receptacles shall be connected to an insulated copper equipment grounding conductor. None of the exceptions are applicable.

57. I heard that there are some changes to the CSST bonding issue. Would you share them with us so we can get it right the first time?

Answer: Check the product approval. Not an Electrical Code issue.

The special bonding requirements for Corrugated Stainless Steel Tubing is a building Code issue. The NEC bonding requirement in NEC 250.102(B) is met as long as the equipment likely to energize the tubing is provided with an equipment grounding conductor. For example, if CSST tubing is used as part of the natural gas piping to a furnace, you meet the NEC the moment you connect the equipment grounding conductor that is run with the branch circuit conductors to the furnace enclosure.

The special bonding may be part of the CSST manufacturers’ installation requirements. The individual installing the CSST is the individual obligated by the building Code to install it per the installation requirements. Normally this is not the electrician.

There are some links, including one for Gastite's Flashshield, that has an ICC approval for use without additional bonding at the end of your handout. . We would recognize that for Commercial Building Code installations, as well as the UDC since it uses the same standard.

Both IFGC and NFPA 54 now require bonding of the of the CSST with a 6 AWG conductor. However if the CSST has an ICC or Wisconsin approval without bonding, it is acceptable in WI.

58. Under the new licensing law, will the plumber be able to run the wiring from the well into the house? This is a major concern to us. Now our plumber runs the wiring to the house in the same trench as the plastic water tubing. If we need a licensed electrician, it will really complicate things.

Answer: License not required for typical installation. 2007 WI Act 63.
State Statues 101.862.-(4) OK to bring into house and up to first junction box, disconnect or controller.

59. I am currently working on the remodel of an existing restaurant. I have relocated some of the existing fixtures. Are these fixtures required to be UL listed?

I also installed some antique fixtures which were rewired by a professional lighting company. What is the listing requirement for these?

There is one fixture that is an antique work light on a twisted cloth covered cord. The cord is new. It has an external grounding wire and is installed as a pendant fixture. What are the approval requirements for this one?

Answer: Complicated. SPS 316.003-(3)

Where you are using existing fixtures SPS 316.003-(3) states that existing electrical installations shall conform to the electrical code that applied when the installations were installed. This should take care of existing fixtures at the existing location.

Removing the fixture and installing it elsewhere in the building is treated as a new installation.

Since the code and Section 410.6 applies to new installations, antique fixtures that have a Label could be used anywhere. Once an item is labeled or listed it does not go away. If the antique fixtures do not have a label they would require evaluation which could be accomplished following SPS 316.012 (1). A professional engineer could evaluate the fixtures.

It sounds like you have constructed a fixture from the antique work light. This would require approval also.

You may wish to discuss these fixtures with the inspector to find out what he/she will accept.

60. What type of marking would indicate suitability for using a 3-phase panelboard as the service equipment for a 240-volt, corner-grounded delta.

Answer: SPS 316.110-(1), NEC 240.85

See the panelboard marking guide in the back of the UL White Book on page 9, 20 and 21 of the guide.

NEC 240.85 addresses the suitability of circuit breakers for given application. The breaker with a "straight" voltage rating such as 240-volts or 480-volts is permitted to be used on any system which the nominal voltage between any two conductors does not exceed the breakers voltage rating.

Two pole breakers could also be used on a 3-phase, corner grounded delta if marked with the proper voltage rating as well as "1-phase and 3-phase" indicating suitability.

Proper application of circuit breakers with slash markings considers both the phase to phase as well as the phase to ground voltage. For example, a 3-phase circuit breaker marked 120/240-volts could not be used on a 240-volt corner-

grounded delta system as the voltage to ground on the system is 240-volts and the breaker is only rated 120-volts to ground.

61. Is it your opinion that a pavilion type building that is open on all four sides would require means of egress illumination based on IBC 1006.1? Would you define the places for picnic tables in this type of building as "fixed type seating"?

Answer: No. No. IBC 1006

Typically, many of the open shelters found in parks are not required to have emergency lighting because they do not require two exits, which is a prerequisite for application of IBC 1006.3. Closer review of IBC 1006.3 will find that the various egress elements listed will not be part of a "open" structure, thus emergency illumination would not be required. So in simplicity, open buildings are not required to have emergency lighting.

Picnic tables are not considered fixed seating since they can be moved in different orientations, and densities.

Enclosed areas in the building may require exit signs and emergency egress lighting. Examples are an enclosed kitchen or community area. If the enclosed area is large enough such that the Code requires two or more exits, all requirements of the code for emergency lighting would be applicable. Such egress illumination would have to illuminate the path to the point that the people are outside the building, not just under it's roof. There also must be multiple paths for exit discharge.

62. I have a new medical clinic which has a generator. There are two transfer switches, 1 for the emergency system(NEC 700) and a much larger transfer switch for providing power for the remainder of the building (NEC 702). I noticed the elevator car lights are on the emergency system. Same for the "wand" doors. Is this permitted?

Answer: Permitted for Health Care Facilities.517.45.

NEC 517.45 indicates an essential electrical system complying with 517.30 through 35 would be allowed in a clinic.

You indicate the generator, as installed, supplies an emergency system and an optional system. As such the life safety branch of the emergency system is supplying the egress lighting permitted by 517.32(A). Section 517.32 (G) and (H) allow the elevator lights and automatic doors to be supplied from the life safety branch. If the facility indicates there are no critical care areas, a critical branch would be not be required to be installed. If the facility wanted a receptacle installed in each exam room and supplied with standby power, it would either need to installed from a critical branch, or if they didn't designate it a critical circuit, it could be installed from the optional system.

Typically, supplying the elevator lighting or automatic doors is not allowed from the required emergency system.

63. We installed a 150 kva, 3-phase, transformer. Copper is expensive so we would like to use paralleled 4/0 Aluminum to supply the secondary panel. The calculated load is 289-amperes and we plan to use a panel with a 400-amp aluminum buss. Is this OK?

Answer: Yes, but only with a 350-amp maximum size main. 240.21(C)

The “round-up rule” or 240.4(B) does not apply to taps or transformer secondary conductors. The secondary conductors must be protected at or below their ampacity. Based upon Table 310.16 or new Table 310.15(B)(16), the allowable ampacity of 4/0 XHHW conductors is 180-amperes at 75 C. That gives a combined ampacity of 360 for parallel conductors. The conductors are more than adequate for the load. The 400-amp bus is OK, but you will have to install a 350-ampere main or increase the size of the conductors.

64. It is the intent of Article 409 to require all control panels be listed? How do we assign a short-circuit-current rating to a control panel if we wire it ourselves?

Answer: No. SPS 316.012-(1)

Article 409 does not require listing. The panel must still be approved by the AHJ. Under the provisions of SPS 316.012, listing is one option.

The construction requirements of control panels are found in Part III of Article 409. One requirement that is often missed is the marking requirements of 409.110. Multiple supplies to a control panel are permitted so a new marking requirement will make it clear to users that multiple disconnecting means must be opened to disconnect power to the panel.

Another marking require the builder to assign a short-circuit current rating. This marking works hand-in-hand with requirements such a 110.9, 110.10 and new 409.22. In other words, once the short-circuit rating is determined, the Code requires the available short-circuit current to be equal to or less than the rating. If the control panel is marked “5000-amperes” and the available is “25,000-amperes”, a serious safety hazard is created.

An informational note in Section 409.110 give some guidance on determining the short-circuit rating. It indicates that UL 508A is an example of an approved method. The method in UL 508A essentially establishes the rating based upon the “weakest-link-in-the-chain” theory.

65. It is my understanding that emergency lighting that is installed "over and above code" is not required to meet IBC code minimums? Same answer for fire alarm systems?

Answer: Correct. Incorrect. IBC 1006. NEC 700

IBC 901.2 has a pretty specific requirement that indicates non-required fire systems shall meet all applicable Code requirements. A partial fire alarm system gives a false impression that the building is safer than it really is.

There is no similar requirement for emergency lighting. Emergency lighting that does not meet the minimum illumination levels is permissible. The acceptability defaults to not creating a hazard that is prohibited by the code. The electrical wiring for the non-required egress illumination would have to meet the applicable requirements of NEC Article 700 if connected to a required emergency system.

66. We were discussing angle pulls. Installation is MC Cable that contains 4- 4/0 conductors. The cable uses with 2-inch connectors. I maintain a standard 2-inch LB, LR or LL is not code legal because it is only 10-inches long. As I read further I see there is an exception for shorter conduit bodies that are listed and marked. If I find a fitting listed for 4 – 4/0 conductors, I can use it regardless of length?

Answer: Correct. NEC 314.28(A)(3)

The length does not have to be measured or comply with the general rules for straight or angle conduit bodies if the fitting is listed and marked. The general rule for a 2-inch LL or LR would give minimum length of 12-inches. 314.28(A) (3) would permit a fitting is listed to accept 4- 4/0 wires that is less than 12-inches long.

Combinations of conductors are permitted as long as the maximum conduit fill permitted by Table 1 of Chapter 9 is followed. For example a listed, 2-inch fitting marked 3 – 300 kcm conductors could be used. The conduit fill tables permit either 3- 300 or 4-4/0 fit in a 2-inch EMT or RMC”

67. We are wiring a fire alarm system with Simplex and have to install some transformers. The Class 2 transformers will provide 24-volt power to damper motors. What size fuse do I need on the load side to protect the transformer?

Answer: 20-ampere maximum. 725.127.

NEC 725.127 indicates that a Class 2 transformer may be protected by an overcurrent protective device rated 20-amperes or less.

68. We have had an issue come up, as to whether electric sterilizers are required to be on emergency power for a surgical center. This is a day surgery only facility. There is no overnight patient stay. Emergency power is provided via a 100 KW diesel generator. The inspector approved it back when it was built in 1997. However, they can't renew their accreditation unless the issue is resolved.

Answer: Standby Power required. 517.2, 517.45, 517.34(B)

I reviewed the 1996 NEC and then compared it to the 2008 and 2011 NEC. The applicable requirements are essentially the same with respect to this issue. So the facility is not "grandfathered in" as the requirement should have been met back in 1996.

The starting point in the 1996 NEC is the definition of Ambulatory Health Care Center. Under 517-2, part (2) of the definition, "those facilities that provide, on an outpatient basis, surgical treatment requiring general anesthesia".

517-45 covers Essential Electrical System for Ambulatory Care Centers. 517-45(c)(1) Exception indicates: "if critical care areas are present in the facility, the essential system shall be as required in Section 517-30 through 517-35."

Back to the definition for critical care area. Critical Care Areas include "operating rooms and similar areas in which patients are intended to be subjected to invasive procedures and connected to line-operated medical devices.

I then looked at the paragraph under 517-34. The last sentence is germane. "It's arrangement shall also provide for the subsequent connection of equipment described in Section 517-34(b). This is where the requirement enters the picture.

My conclusion is:

- 1) The permissive requirement in 517.34(b)(7) applies only to the choice of delayed automatic or manual connection.
- 2) The requirement is only for "Minimal electrically heated autoclaving equipment" to be connected to the Equipment System. This means not all of the autoclaves have to be connected to standby power. Perhaps one smaller "back-up unit" could be used to meet the requirement.

69. We installed a 800-ampere service on the outside of an existing building. The underground water pipe is plastic so we installed two ground rods. The inspector says that since the water piping in the building is copper, we have to bond it. The piping is over 100 feet from the service, do you have any idea what that's going to cost?

Answer: Yes. 250.104(A)

Using two rods as the required grounding electrode is fine as long as there are no other electrodes present. That does not relieve you of the responsibility of bonding the interior water piping. The bonding jumper must be sized using Table 250.66. We would expect to see a 2/0 copper or 4/0 aluminum bonding conductor. It may be attached to the water piping at the closest accessible point.

70. I received a selective coordination study for a hospital addition. First question is how far up the one line do they have to go? Second question is do the new circuit breakers on the normal side of the transfer switch have to be coordinated?

Last question, they say with circuit breakers they are only required to coordinated to 0.1 second. Is this true?

Answer: Up to first existing breaker. SPS 316.003-(3) Yes. No. NEC 517.26 and 700.27

Selective coordination will essentially ensure that only the first protective device upstream of the fault will open. It has been a Code requirement for emergency systems since the 2005 NEC became effective in Wisconsin. The requirement is not retroactive to portions of the existing essential system built earlier.

The requirement applies to all overcurrent devices. For example, a 20-ampere breaker supplies emergency lighting in the new operating room. The 200-ampere critical branch panel is fed from a new 2000-ampere switchboard on both normal and emergency side. The 20-ampere circuit breaker must be selective coordinated with the 200-ampere and 2000-ampere devices on both sides of the transfer switch.

The engineer may be referring to a new published version of NFPA 99 that does set a 0.1 second limit for selective coordination for hospitals. The version of NFPA 99 is not effective in Wisconsin. The current Wisconsin Code requirements do not set a lower limit for selective coordination. A practical limit is coordination to 0.01 seconds as most published overcurrent data does not give time-current characteristics below this value.

71. My company does a lot of energy retrofits in existing buildings. We take out an existing metal halide or HPS fixture and hang a T-8 or T-5 florescent fixture in its place. Even if the receptacle outlet for the old fixture was directly above the fixture, it may not be exactly above the new fixture. The old fixture might be 24-inches in diameter and the new only 8 or 12-inches wide. How much leeway do we have?

Answer: Maximum offset from centerline of fixture of 3-feet. 410.62(C)(1)

The permission to supply an electric discharge fixture with flexible cord originally appeared as an exception to the general rule. The general rule is 410.24 and requires a raceway or cable assembly to supply the fixture.

The intent of 410.62 is to facilitate replacement or repair of the entire fixture. If you can't reach the receptacle from the fixture location, you certainly haven't met the requirement. Remember that you'll likely be on a ladder or lift and the safe replacement of the fixture is what the inspector will take into account when evaluating the installation.

72. I'd like to use a wireway above a power panel. It will be easier to get conductors into the panel in the future as we won't have to drill into a live panel. Do we have to apply the requirements for pullboxes?

Answer: No. Same formula but different application. 376.23(A)

If you carefully read the requirement you will see that the sizing requirements for wireways used a pull boxes are different from pullboxes. Both requirements kick in for insulated conductors that are 4 AWG or larger in size and are deflected within the enclosure. With pull boxes, the calculation is used to determine dimensions between where the conduit enters the wall of the box and the wall opposite. With wireways, the same calculation determines the dimension between where the conductor enters the wireway and where it leaves. For example, the conduit containing the conductor is 2-inch. A conductor that enters a pull box, is deflected 90 degrees, then leaves the pull box results in a pull box of at least 12 –inches by 12-inches. If you are pulling into a wireway, the 2-inch conduits must be at least 12-inches apart. How big is the wireway? The cross sectional area is determined by 376.22(A). The conductor fill at any cross section is limited to 20 % of the cross sectional area. For example, if you pulled 3-3/0 THHN conductors through the wireway, the minimum cross sectional area is 4 square inches. You can check my math later.

One last requirement, remember that derating is generally not a factor as long as you limit the number of current-carrying conductors in any cross section area to 30. Add, the 31st conductor and the adjustment factor is 40%.

73. I'm installing the lighting for a new "swim spa" in the community room of a high-end condo project. The depth of the water is 48-inches. You essentially are swimming in place and the length of the spa is only 8-feet. I told them the low voltage lighting is an issue. They said it a "spa" not a pool. What do you think?

Answer: Pool. 680.2, 680.22, 680.43.

Definition of a pool is "manufactured or field constructed equipment designed to contain water on a permanent or semi-permanent basis and used for swimming, wading, immersion, or therapeutic purposes. Based upon the construction and the depth of the water, this is a permanent pool. The requirements of 680.22(B)(2). The minimum height of totally enclosed luminaires is 7-foot, 6-inches above the maximum water level. Other fixtures must be at least 12-feet above the water. There are additional restrictions on luminaires mounted between 5 foot and 10-feet horizontally from the inside wall of the pool. These requirements and exceptions are more stringent than the requirements for lighting fixtures above and around spas and hot tubs in 680.43(B).

74. My crew wired a new service. The conductors were parallel 400kcm aluminum with XHHW insulation. Some of the conductors are compacted stranded conductors, some have normal stranding. All are the same size. The inspector says "No Way, the diameters are different". What's your opinion?

Answer: Installation complies with 310.4(H).

Conductors in parallel must meet the requirements in 2011 NEC 310.4(H)(2). The requirement is the same in the 2008 NEC. 310.4(H)(2)(3) indicates the conductors must "Be the same size in circular mil area." The size in circular mil area is 400.

One possible issue is the terminations.

75. I'm working in a RCIC. The facility will operate like an "assisted living" center in that no patients that require life support can be accepted. Do we need to install hospital grade receptacles in the sleeping rooms? What about using hospital grade MC or AC cable as the wiring method?

Answer: No. No. 517.13, 517.18(B), 517.10

RCIC are licensed health care facilities. However, the type of "patient care" that can be provided is limited to general assistance in basic daily activities such as eating, bathing and dressing. 517.10 indicates that Part II wiring and protection apply to all health care facilities. Both the requirements for redundant grounding in 517.13 and hospital grade receptacles in 517.18 and .19 are found in Part II. However, there are two exceptions to 517.10. 517.10(B)(2) exempts areas of nursing homes and limited care facilities wired in accordance with Chapters 1 through 4 of the NEC and used exclusively for patient sleeping areas.

76. I'm wiring a building with a lot of ventilation fans. The fans have 1HP motors. The motors draw 2.0 amperes at 480-volts. We would like to put 8 motors on a circuit and protect them with is 20-ampere circuit breaker. Is this OK?

Answer: No. 430.52(C), 430.32.

The requirements for protecting motors are split into two parts. Protection against ground-faults and short-circuits are covered by 430.52(C). The maximum rating of a circuit breaker is limited to 250% of the motors full load current rating, rounded up to the next standard size. The Code requires Table 430.250 to be used. This Table indicates the current is 2.1 amperes. Multiplying this by 250% and rounding up gives a 15-ampere breaker maximum.

Overload protection requirements are different. The requirements for motors 1 HP and less are found in 430.32(B). While there are several options, none would permit a 15-ampere breaker to protect a motor drawing 2.0 amperes from overloads. Either a separate overload device is used or the motor must be equipped with integral overload protection. If a separate device is used, the maximum rating or setting would be limited to about 125% of the motors current or about 2.5 amperes.

77. These new fixtures look like high-bay type electric discharge fixtures. They are intended to work with self ballasted lamps. We want to install them in a new

warehouse. Do we treat as them as electric discharge fixtures and allow a cord-and-plug connection? Or do we need to file for a petition?

Answer. OK to hook-cord-and-plug connect them. NEC 410.62(C)

It looks like a cord-connected luminaire to me. NEC could actually remove "Electric-Discharge from 410.62(C) and the requirements wouldn't change. This is an incandescent mogul base luminaire that is intended to be used with self-contained fluorescent lamps. There are similar LED luminaires coming out to replace low bay HID luminaires, we should be able to apply 410.62(C) to them as well.

Another thought, when we retrofit a cord & cap supplied fluorescent with LED tubes & line voltage sockets do we violate 410.62(C) because it is no longer an electric-discharge luminaire? No, so it should be OK to treat similar fixtures in the same manner.

Websites and other resources:

Department of Safety and Professional Services Codes:

<http://dsps.wi.gov/sb/SB-DivCodes.html>

Lighting plan submittal info: <http://commerce.wi.gov/SB/SB-CommBldgsLight0209.html>

UL Product Marking Guides:

<http://www.ul.com/global/eng/pages/offerings/perspectives/regulator/electrical/newsletters/>

Residential Load centers for use with generators: <http://products.schneider-electric.us/products-services/products/load-centers/residential/intelligent-load-centers/>

OSHA: <http://www.osha.gov>

OSHA _ Nationally Recognized Test Laboratories:

<http://www.osha.gov/dts/otpca/nrtl/index.html> From this web site you can click on the NRTL to find out what they are recognized for.

Organizations Currently Recognized by OSHA as NRTLs

Canadian Standards Association (CSA)

(also known as CSA International)

Communication Certification Laboratory, Inc. (CCL)

Curtis-Straus LLC (CSL)

FM Approvals LLC (FM)

(formerly Factory Mutual Research Corporation)

Intertek Testing Services NA, Inc. (ITSNA)

(formerly ETL)

MET Laboratories, Inc. (MET)

NSF International (NSF)

National Technical Systems, Inc. (NTS)

QPS Evaluation Services Inc. (QPS)

SGS U.S. Testing Company, Inc. (SGSUS)

(formerly UST-CA)

Southwest Research Institute (SWRI)

TUV Rheinland PTL, LLC (TUVPTL)

TÜV SÜD America, Inc. (TUVAM)

TÜV SÜD Product Services GmbH (TUVPSG)

TUV Rheinland of North America, Inc. (TUV)

Underwriters Laboratories Inc. (UL)

Click on the NRTL name shown above to view its scope of recognition (the list of standards, sites, and programs that OSHA has recognized for the NRTL). See March 9, 1995, Federal Register notice for more detailed information about the programs that a NRTL may use. Also see the FAQs.

CSST Info:

<http://dsps.wi.gov/sb/docs/SB-CommercialBuildingsXProductEvaluations201107-H.pdf>

<http://www.csstfacts.org/>

http://www.icc-es.org/reports/pdf_files/ICC-ES/ESR-1194.pdf

<http://www.tracpipe.com/>

http://www.icc-es-pmg.org/Listing_Directory/pdf/PMG-1066.pdf