

1. I'm running a new 200-ampere, four wire feeder to an existing barn. The phase and neutral conductors are 4/0 XHHW aluminum and I'm using a 6 AWG copper equipment grounding conductor. The water supply at the barn is plastic but there still is metal piping in the milk house and barn. Do I have to bond the water?

Answer: Yes: NEC 250.32 and Exception. Yes, NEC 250.104(A)

250.104(A) requires "interior metal water piping systems" to be bonded. Bonding conductor sized per 250.66. Bonding permitted to water line at any point. Use 10-foot of metal piping as minimum length required to bond.

A no. 6 to the water pipe is the minimum required size of the bonding conductor. NEC 250.32 requires all electrodes at the building served to be bonded together and used as the electrode. If there are no existing electrodes, adding two ground rods at the barn and bonding them to the enclosure of the building disconnect is required.

2. We're building a fan control panel with combination motor starters. Each starter has a "short-circuit protector", a contactor, and an overload block. Each starter supplies only one motor. The sales "engineer" from the manufacturer of the starters told me we don't need a fuse block ahead of each starter if we order a "line side adaptor" with each one. Is this OK? Last time I did a control panel, the inspector made me add fuses I had to upcharge the farmer.

Answer: Several issues to examine. SBS 316.012-(1), NEC 409.110, 430.109(A)(5)

SPS 316.012-(1) Are the starters marked "CE"? This is not a listing mark. Listing by NRTL such as UL, ETL, CSA indicates suitability for use in Wisconsin.

409.110 requires control panels be marked with information including the short-circuit-current rating. What is the short-circuit current? Are the products listed for that available short-circuit current without upstream current limiting fuses?

430.109(A)(5) gives permission to accept some starters as the short-circuit and ground-fault protector if it is listed as a "self-protected combination controller" Check to see if an additional part such as a line side adaptor must be ordered in order to meet the listing requirements?

3. The farm has a diesel fuel tank. The gas tank and pump are gone. The pump motor sits on top of the tank and is wired with a blue extension cord. Do I need to wire the pump with IMC and seal-offs? Do I need to located a disconnect within sight of the pump?

A: No. NEC 501.1. Yes. NEC 430.102(A) and NEC 514.11(B)

501.1 Scope indicates the rules apply to flammable liquids, vapors and gases. Diesel fuel is a combustible liquid.

430.102(B) requires a disconnecting means within sight of a motor. NEC 514.11(B) applies to fuel dispensing equipment. The requirements are similar to NFPA 30. The disconnecting means must be at least 20-feet from the dispensing equipment.

4. I'm installing a new service and motor controller for a well pump. The service is at the road. The pump is in the middle of the field. A 200-amp fused switch is the service disconnect. My helper went to the Alliant 18 hour class. He said I need to order "rejection clips" with fused switches. What are "rejection clips" and do I really need to use them? My helper also wants to know if he still needs to get his license by April Fools day next year.

Answer: Yes. NEC 110.9, SPS 316.110-(1). Yes. 2007 WI Act 63.

Service equipment is intended to operate under fault conditions. It must have the proper interrupting rating. The minimum available fault current for agricultural services is usually 22,000-amperes. Current-limiting-type fuses are required for this application. The rejection clips are an accessory kit for the fused switch. When installed, they prevent non-current limiting fuses from being installed in the switch.

The 2011 NEC will require that service equipment be field marked with available fault current values.

WI Act 63 will require all electricians to be licensed if they intend to do construction work after 4/1/13. Your helper needs to take and pass that test soon or he/she will have to apply for their beginner's card.

5. We are working on a new dairy facility. We do not install the service equipment yet. The shop drawings shown the enclosure is 73-inches high with the main disconnect near the top. I would really like to bring our pipes in from the bottom but I'm worried about it getting too high by the time we install expansion joints. Can I build a platform if we exceed the 6' 6" height to the disconnect?

Answer: Yes. NEC 110.26

The permanent platform to meet the reach range requirement is OK. The minimum size would be the minimum required by Table 110.26(A). Presumably this would be 30-in by 36-inches.

6. The new dairy we are working on has an employee locker and lunch room and several rooms used for offices. The branch circuits will be run from the equipment room off the adjoining the milking parlor. Would we still have to use UF cable in the walls of these areas?

Answer: Type NM Cable OK. NEC 334.10, 334.12, NEC 547.1(A) &(B).

The Scope of Article 547 applies to parts of buildings or adjacent areas that have either excessive dust, corrosive atmosphere, or both normally present. We hope the lunch room and office environment is much cleaner and dryer than the parlor or barn.

NM is probably OK. The type of construction is probably II, IV or V. And presumably the offices, lunch and locker rooms are separated from the parlor area by doors. We also assume the rooms have some type of heating and ventilation system. If the attic space above such rooms is insulated and mice may inhabit the area, you will have to protect the cables from physical damage.

7. I hear the new code requires me to mark "Available Fault Current" on service equipment. How do I determine this value?

Answer: Contact Utility. NEC 110.9 & 110.10. NEC 2011 110.24

The utility can give you the value based upon their system parameters. This number, such as 22,000-amperes will be higher than the actual value at the customer's equipment. So you can use this value to specify your equipment and mark this value on the equipment. Or you can use this value as the starting point and calculate the approximate value at the customer's equipment. The actual fault current will go down as the impedance increases due to line length and conductor size and material.

Example from engineering handbook:

8. The free stall barn I'm wiring has a vet office in the barn. I'm locating a small transformer to get power for the 120-volts loads in the area. The transformer is several hundred feet away from where the service is located and grounded. If I over size the equipment ground for the transformer, can I also use it as the grounding electrode for the secondary?

Answer: No. Interpretation of NEC 250.4(A)(3). 2011 250.121

Two separate conductors are required. This practice is not permitted currently by state interpretation. 2011 NEC clarifies the intent. The equipment grounding conductor normally does not carry current. A grounding electrode conductor often will carry some current as electrically it is in parallel with grounded (neutral) conductors for the system.

9. The new barn has a manure pit with electric motor driven pump at one end. The pit and pump are in a "shed" type addition to the barn. The owner wants the pump panel and disconnect in the shed. Are 3R enclosures OK?

Answer: No. SPS 316.110 (1). 2011 NEC 110.28

A 3R disconnecting means and panel enclosure are permitted outside. They are not permitted in the barn, or in the shed containing the pit. Both locations are a corrosive environment. The enclosure types 4X or 6P are permitted in the shed.

10. When we 4-wire a farm, we often have to do some additional work on the house. We bring a 4-wire supply to the house and then we have to change out the electric dryer and range circuits. Or else, the bonded connection shows up on the stray voltage investigation and we look like we don't know what we are doing! We'd like to use 4-wire service entrance cable for these circuits. But we not sure how to size it any more. Do we use 60, 75, or 90 C ?

Answer: Currently 90 C for derating. Final ampacity not to exceed 60 C. NEC 338.10(B)(4). 2011 NEC 338.10(B)(4)(a)

Brief history on this subject. In the 2005 and previous editions, Type SE and SER cable was permitted to be sized based upon the 75 C column in Table 310.16. The 90 C rating of the insulation was permitted to be used for derating purposes.

The 2008 restricted the final ampacity to 60 C conductors, the same as Type NM cable. The 90 C rating of the insulation is permitted to be used for derating purposes.

The 2011 NEC allows the 75 C rating to be used where the cable is not run in thermal insulation. If the cable is run in insulation, the 60 C insulation Temperature Rating must be used. The 90 C rating of the insulation is permitted to be used for derating purposes. However, the final ampacity cannot be higher than that of 60 C conductors if this is the case.

The ampacity Table number has changed to Table 310.15(B) (16). There are a few changes in the allowable ampacity for some sizes of conductor. For example, the 90 C rating of 6 AWG aluminum SE, USE-2, or XHHW-2 was 60-amperes. It is now 55-amperes.

11. The electrician installed 3-4/0 AL conductors from the pole top disconnect to a 200A fused disconnect mounted on the same pole and continued with 4/0- 4/0- 2/0 AL USE to the house panelboard. There is no parallel grounding path from the house and all the water piping is plastic. The state inspector stopped for a farm inspection and ordered the house service corrected. What did I miss?

Answer: Equipment Grounding Conductor to House. NEC 250.32. NEC 547.9(A) & (B)

The equipment ground from the pole top (site isolation device) to the service disconnect on the same pole is sized based upon 250.66. And the feeder equipment grounding conductor to the house is sized based upon 250.122. Needs to be 4-wire since 2008 NEC took effect in 3-1-09.

12. Is the inspector correct ordering the installation of an intersystem bonding kit at a detached building supplied by a feeder? What if the garage was supplied from a multi-wire branch circuit?

Answer: It depends on the conditions. NEC 250.94

Are there other systems at the building? If so, the intersystem bonding terminal is required. An exception in the 2011 NEC omits the requirement for branch circuits.

13. 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, with a 350-amp 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.

14. I installed a new service on the side of the barn. When the inspector drove up, he saw the farmer plowing snow in the yard. The snow pile was in front of the service equipment. Now he wants me to put some concrete filled posts in front of the gear. Where's the Code requirement?

Answer: NEC 110.27(B)

Physical protection is required in locations where electrical equipment is likely to be exposed to physical damage. The enclosure or guards shall be arranged and of such strength to prevent such damage. This same situation could occur in other locations around the farm. For example, consider a grain bin set-up. Tractors and trucks will be pulling in during all hours of the day or night. Perhaps the necessary electrical equipment can be located in a small building or tucked in between the bins. If not, this is certainly another area where damage is likely to occur.

Remember to position the posts or guards such that the working space around the equipment is maintained.

15. A 320-amp at-grade service in the yard supplies the house and the barn. It has a 100-amp breaker for the barn. A house is supplied with 200 ampere feeder. The panel is in the basement and has a main circuit breaker. The water

supply to the house is plastic but the interior piping is copper. The ground rods are at the service pedestal. Can I bond the interior piping from the interior panelboard? If so, what size conductor is required a #6 CU or a #4 CU? Do I really need another two rods at the house?

Answer: Yes. 4- AWG. NEC 250.104(A) & 250.66. Yes. NEC 250.32 & SPS 316.250 (1)

Need OCP at the distribution point.

Both the feeder equipment grounding conductor and the interior water pipe bonding conductor must be a minimum #4 cu. Sized based upon feeder conductor size and Table 250.66.

A grounding electrode system is required at separate buildings and structure.

16. We build our own control panels for lights and fans. 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?

Answer: No. SPS 316.012-(1) NEC 409.110

Article 409 does not require listing. The panel must still be approved. Under the provisions of SPS 316.012, listing is an 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 requires the builder to assign a short-circuit current rating. This marking works hand-in-hand with requirements such as 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.

Remember NEC 110.16 always will apply to a control panel. An Arc Flash Warning label is required.

17. I'm bidding a free stall barn with 24 fans located throughout the barn. A two stage thermostat turns the fans on and off through two contactors. I would like to put a manual motor starter at each fan location as the required disconnect. Is this OK?

Answer: Yes, Comply with NEC 430.102(A), 430.102(B) and 430.109(A)(6)

Definition of Within-sight: You must be able to see the disconnect from the motor location and be with 50-feet. It must be of a type listed on 430.109. Manual motor controllers OK as the required disconnect only if listed and marked " Suitable as a Motor Disconnect"

Remember you also need a disconnect within sight of the contactors. 430.102(A) requires a disconnect within sight of each motor controller. The contactors are the controllers not the thermostat. When the controller disconnect is opened, the control circuit to the thermostats must be disconnect a the same time or you need to add a third disconnect for the control circuit per 430.75(A).

Summary of Requirements:

430.102(A) Must have a disconnecting means within sight of the contactor.
430.102(B) Must have a disconnecting means within sight of each motor.
430.75(A) Motor Control disconnect opens control circuit or additional disconnect required. If separate devices used, must be located adjacent to each other.
430.109(A)(6) Manual Motor controllers only permitted as the required disconnect if marked " Suitable as a Motor Disconnect" and located downstream of the branch circuit fuses of circuit breaker.

18. I installed 2-200 ampere, panelboards from a 400 ampere service. We installed a 4 AWG copper grounding electrode conductor from the intersystem bonding terminal strip to our ground rods. We also installed a 4 AWG conductor from each panel to the terminal strip. The inspector failed us indicating we needed a continuous grounding electrode conductor from the rods to each panel. I think we can do it the way we did but can't find a code section to allow it. Can you help me?

Answer. Yes. NEC 250.64(D)

The grounding electrode can be terminated at a grounding bar for the installation you are referring to.

When installing a service with multiple disconnects as allowed by 230.71(A), which is what your installation is, I would look at 250.64(D).

This section tells us we can use a common grounding electrode conductor with taps from each switch. Size the main grounding electrode using Table 250.66. A tap is then installed to the grounded terminal in each switch sized to the largest conductor supplying the switch. Finally the common grounding electrode conductor must not have a splice. I would accept the intersystem terminal required by 250.94 if the required 3 terminations are still available for the other systems.

This would seem to be the installation you have. The tap conductors to each panel and the ground rods could be a 4 AWG copper. The conductor to a water

pipe however would have to be a minimum 2 AWG copper. You can check my math later.

[A 2/0 conductor is 133100 kcmil. So assuming a set of 2/0 cu to each panel, $133100 \times 2 = 266200$ kcmil. Table 250.66 requires a 2 AWG for service conductors over 3/0 through 350 copper.]

If using aluminum service conductors add the largest to each panel and the same would apply. This would apply whether the water pipe is a grounding electrode 250.52, or if we are just bonding the metal water pipe as required by 250.104. 250.64(D)(2) allows an individual conductor from each panel to the grounding electrode or bonding of water piping sized to the service conductor to each panel. 250.64(D)(3) allows the grounding electrode to be connected to the grounded conductor at a common location such metering equipment or a wireway. Many utilities do not allow a connection in the metering equipment so check with them first if using this provision.

Installing the grounding electrode continuous between the 2 panels, while perhaps meeting the letter of the code, is not allowed because of being disconnected in the event of maintenance or replacement of the first panel which would disconnect the grounding electrode to the second panel.

19. I installed 16-12 AWG THWN conductors in a 1" PVC conduit for lighting circuits in a new freestall barn. The inspector has indicated the 20 ampere circuit breakers are too large for the No. 12's. With the number of lights on each circuit I am afraid a 15 ampere breaker may trip on hot days. I know 12-AWG wire is rated for 20 amperes and I have not overfilled the conduit so what is his problem?

Answer. Derating of the conductors is required. NEC 310.15(B)(2) & Table 310.15(B)(2)(a). NEC Table 310.16. NEC 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 ampereage 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.

20. At a new grain facility we are wiring the controller for the motor at the top of the leg is located in the control 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 a disconnect within sight of the motor. What do you think?

Answer. The inspector is correct. NEC 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 exc. 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.

21. On a farm rewire project the existing feeder to the barn is a 3 conductor. The tri-plex is in good condition and properly sized so I would like to add an equipment grounding conductor to it. Will this be OK and is there anything special I should be looking at?

Ans. Concept OK. Talk to AHJ. Other considerations apply. NEC 310.2, 338.10(B)(2), 250.32, 220.61

The conductor you add will be required to be insulated and used as the grounded conductor not the equipment grounding conductor. Use wet location conductor and properly support or wrap around tri-plex.

NEC 310.2 requires all conductors to be insulated. The exception allows covered or bare conductors where allowed elsewhere in the code.

For SE Cable, NEC 338.10(B)(2) allows the use of an un-insulated conductor to be used only as the equipment grounding conductor. The exception allows the grounded conductor to be un-insulated in accordance with 250.32. An example of the proper use of the exception is an existing 3-wire feeder to an existing building. The conditions of the exception indicate no equipment grounds or parallel metallic paths are present and it applies to existing circuits only. In any case, the neutral size is calculated 220.61.

22. I installed liquid-tight flexible conduit to a compressor in a shop. The state 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. NEC 350.6

350.6 requires LFMC and it's fittings to be listed. Similar requirements are found in all of the raceway articles. Non-listed product can only be used if overall assembly is listed as a unit.

23. I am worried about GFCI protecting some receptacles for tractor tank heaters. The farmer plugs in a Bobcat he uses to scrape alleyways and the cows will not be happy if their alleys aren't clean. Can I install a single receptacle and call it good?

Answer: Currently yes, if GFCI receptacle within 3. NEC 547.5(G).
No, based upon the 2011 NEC. Proposed SPS 316.547 will apply only to fencer receptacle outlets.

547.5(G) requires 15 and 20 ampere 125 volt receptacles installed in 4 different areas on a farm to be GFCI protected.

1. Areas with an equipotential plane.
2. Outdoors
3. Damp or wet locations.
4. Dirt animal confinement areas.

It does allow a receptacle in one of these locations not to have GFCI protection where a GFCI protected receptacle is located within 3-feet.
The 2011 NEC removes this provision. 2011 version of SPS 316.547 is proposed to add an Exception to 547.5(G). This Wisconsin exception for farms will allow a single receptacle to supply an electric fencer that is not GFCI protected if a GFCI protected receptacle is within 3'.

24. We installed a 200 ampere 120/240 volt feeder to a circuit breaker panel to supply fans and conveyors at a cluster of grain bins. The panel is mounted on a post next to one of the bins. Am I required to bond to the grain bins in addition to the equipment grounds run with the branch circuits to the equipment on the bins?

Answer: Yes. NEC 250.104(C)

250.104(C) requires structural building steel that is interconnected to form a structure's frame to be bonded to the service disconnect, the grounding electrode conductor or the grounding electrode. It is sized per 250.66 for the size of the feeder or service conductors supplying the structure. Although this was applied whether the structure was supplied by a service or a feeder the 2011 NEC will make it clear it is required whether a service or feeder is used.

25. 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.

26. 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

NEC 250.86 requires metal enclosures and raceways to be connected to an equipment grounding conductor. Exception No. 3 indicates a metal elbow is not required to be connected to an equipment grounding conductor where it is installed in a nonmetallic raceway system and is isolated from contact by a minimum 18" of cover. Burying the elbow such that the metal had at least 18-inches of cover is typical for underground installations. Another second option is to encase the elbow in not less than 2" of concrete. This would be an option for whether below grade or above grade installations.

The third option is to extend the elbow to a grounded enclosure via IMC or RMC.

27. We are supplying a shed with a 40 ampere feeder, 8-AWG, XHHW insulated copper, protected with a 40 ampere circuit breaker. The load is minimal, a couple of heaters, lights and two fans, and is less than 40 amperes. Because we will be supplying more than 2 branch circuits I believe 225.39(D) would apply. This requires a disconnecting means shall have a rating of at least 60 amperes. My question is does the feeder need to be 60 amperes or can the 40 ampere feeder supply the 60 ampere disconnect?

Answer: 40 ampere feeder is OK 225.31, 225.39(D), 225.5, 220.10. 408.36(D).

This is an outside feeder and 225.31 requires a disconnecting means for a feeder or branch circuit supplying a building. 225.39 indicates the rating of the disconnect and (D) indicates where more than 2 branch circuits are supplied it can not be rated for less than 60 amperes. 225.5 requires the conductors to be sized based on the loads as determined by 220.10 and Part III of Art. 220. While 230.42(B) requires service conductors to be sized not smaller than the service disconnecting means I see no similar language in Art. 225. If the feeder conductors are properly protected they can supply a larger panel. Don't forget the hold-down kit if you are backfeeding a circuit breaker.

28. I am installing multiple disconnects on the secondary of a transformer and am confused on how to size the equipment grounding conductor. The primary side is OK, right out of Table 250.122 and based on the breaker size. But what about the two equipment grounds on the secondary? They will connect the transformer enclosure with each disconnect enclosure. I will be using 2-200 ampere circuit breaker panels with main breakers. Each panel will be supplied with 3/0 THWN copper conductors for the ungrounded and grounded conductors. Can you help me?

Answer: Yes. NEC 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 on a service however in this case we will be using it 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.

29. We were asked to install a branch circuit for the vacuum pump at a new facility we are wiring. The milk equipment people then installed the VFD controller and compressor. The inspector "red-tagged" us when he saw that the controller is located directly above the vacuum pump. We put the branch circuit where we were told so I don't think it's our problem. What do you think?

Answer: I agree, but it is a problem. NEC 110.26

The NEC requires the installation of equipment that may require servicing while energized to meet the working space requirements found in 110.26(A)(1) thru (3). At some point while trouble shooting motor controllers they will typically be energized for testing of the control or motor circuits. Either the controller or the pump will need to be moved. If you put the circuit where you were told let the owner decide if he wants to pay you or have the installer correct his mistake.

30. We are installing a new 200 ampere 120/240 volt feeder to a new leachate system. Because of the length of the feeder I increased the size of the conductors to 2 paralleled 3/0 XHHW-2 copper per phase. I plan on installing a set of 2-3/0 ungrounded, 1-1/0 grounded, and a #6 AWG copper equipment grounding conductor in each of 2 raceways. Will this be code compliant?

Answer: No. NEC 250.122(B), Chapter 9 Table 8

Good job for taking voltage drop into consideration but there is a problem with your installation.

250.122(B) requires that where you increase the size of ungrounded conductors the equipment grounding conductor also must be increased proportionately. You increased the size of the phase conductors by 100% or twice the minimum size. You need to increase the equipment grounding conductor by 100%. A 6 AWG is the minimum based upon Table 250.122. I think you now need a 3 AWG in each raceway. You can check my math later if you want to.

[The Math: Chapter 9 Table 8 indicates $3/0=167800$ cir. mils. $167800 \times 2=335600$, $335600/167800=2$. Table 250.122 requires a #6 AWG equipment ground for a 200 ampere overcurrent device. Chapter 9 Table 8 indicates a #6 conductor is 26240 cir. mils. $26240 \times 2=52480$. Chapter 9 Table 8 requires a #3 which is 56620 cir. mils.]

31. A new facility we are wiring will have a 1200 ampere, 277/480 volt service. The service disconnect has ground fault protection of equipment installed. The inspector is telling me he won't approve the service until I have it performance tested. I told him it has a test button on the breaker and if that trips it we should be good. What do you think?

Answer: Not good enough. NEC 230.95

Services of more than 150 volts to ground, less than 600 volts phase to phase, and 1000 ampere or more are required to have ground fault protection of equipment by 250.95. (C) indicates the system shall be performance tested when first installed in accordance with manufacturers instructions and a written record of the test made available. The test button is only a mechanical test. The manufacturers require the control circuitry be tested. A current injection test is one method of doing this.

32. The facility we are working on will have a 277/480 volt and 120/208 volt system. Is there a specific color coding required for the conductors of these 2 systems?

Answer: Color coding, No. Unique Identification, Yes. SPS 316.210 Note. NEC 210.5

While SPS 316.210 has an informational Note to 210.5(C), such Notes are not enforceable. The Note recommends 277/480 volt systems use brown, orange, yellow and 120/208 systems use black, red, blue. Also remember when you have multiple systems in the same premises 210.5(C) requires the identification of each ungrounded conductor by phase or line and system at each termination point. The identification means used is required to be made available or permanently post at each panelboard.

33. On a large farm project free stall barn, milking parlor and calf shed building the owner has a 1000 ampere 480/277 volt service with an adjacent on site generator. The generator is sized to supply all three buildings. Each building has its own transfer switch. Outside of the building is the 1500 KVA utility transformer. Since this is a farming operation and since the buildings are wood post and beam structure with metal skin, I think the 20 foot of transformer to generator separation rule does not apply.

Answer: Electrical Contractor is Correct! SPS316.700 and 316.701

I believe that you are referring to the requirements in SPS 316.700 and 16.701 pg. 6. The generator supplies a optional standby system only. The requirements for emergency systems and legally required systems do not apply in this case. The rules would apply to a generator supplying an emergency or legally required system regardless of the type of occupancy involved.

34. I wired a large machine shed with a 600 ampere single phase 120.240 volt service. The shed is for the two new JD combines. I wired the shed with Romex since it had a metal skin on the inside for protection. The shed is also used for repair work on all kinds of diesel- and gas-powered equipment. He has installed a Class A chimney and plans to have a wood burning heater moved from the old machine shop. Can he put that heater in there?

Answer: See requirements for Major Repair Garages. NEC Article 511

The classified location extends up to 18 inches above the floor. Wiring above must meet 511.7(A)(1) and the wiring methods listed do not include Type NM cable.

Adjacent areas may be unclassified if suitable cut off from the repair area. Some shops would fall under the category of "Minor Repair Garages". If this is the case, there are no classified locations.

35. I am working on a new 3000 cow dairy farm and it has a large concrete manure/sludge pond with under ground waste piping system. They want a 200 ampere, single phase feeder panel by the pond. It will supply the manure pump motor and other uses. Is this considered as a 2008 NEC 682, Artificially Made Body of Water? If so, it sure is brown in color? Does the disconnect by the pond need an EQ plane around it?

Answer: Yes. NEC 680.1. Yes, if close to the pond. NEC 682.33(A).

The Scope of Article 682 indicates that bodies of water such as "aeration ponds, fish farm ponds, storm retention basins, treatment ponds, and irrigation channels are covered. A manure retention basin is similar and covered by this Article. Typically, 682.33(A) requires an equipotential plane installed adjacent to all outdoor service equipment or disconnecting means that control electrical equipment in or on the water if the equipment is accessible to personnel. The EQ plane must extend out for a distance of at least 36-iches from the electrical equipment and in all directions that a person could use to approach the equipment.

36. I was told that I had to put an Equipotential Plane in the new free stall barn that has metal post and beams set in concrete. The posts have metal fan brackets attached to them. I'm concerned that the connections to the plane will be cut after I leave the site. Who would carry the liability for the future problems is that happened?

Answer: The Owner. NEC 547.10. Ss 101.02 (13)(a)

The NEC 547.10(A)(1) requires an equipotential plane to be installed in confinement areas with concrete floors that have metallic equipment located such that the metallic parts may be come energized and the metal is accessible to livestock.

The electrical equipment could intentionally be isolated for the cow contact area. No requirement for a EQ plane if this is done.

The state will ultimately hold the owner responsible for the Code compliance of the installation.

37. I have a lady who recently built a new 25 cow milking parlor and cow barn, with a free stall area for her prized Jersey and Swiss Chalet herd. She questioned my use of PVC conduit. Can I use UF?

Answer: Yes. NEC 547.5(A)

Type UF is permitted in dry, damp, and wet locations. The installation must follow the general requirements of Part II of both Article 340 and 334. Requirements of bending radius, physical protection, and derating apply to all types of occupancies, including farms. The securing requirements are similar, every 4 and ½ feet but Type UF must be secured within 8-inches of enclosures for a farm application. And since the enclosures must be sealed against the dust and water in many locations, UF fittings must be used. Sealing the knock-out of a nail on box with silicon caulk is not acceptable. UF must be sleeved in conduit or otherwise protected in concealed spaces where subject to rodent damage.

Typical areas are the milk house attic, the top side of beams, and storage areas in the hay mow.

38. My sister-in-law has purchased a 40 acre parcel of land for a future homestead. She built a small barn with a portion of the building having a dirt confinement area. This area will be for beef cattle only. Does she have to install any receptacles in that part of the building and if so do they have to be GFCI protected.

Answer: Receptacles not required. If installed, must be GFCI protected. NEC 547.5(G)

GFCI protection is required for all 125-volt, 15- or 20-ampere receptacles general purpose receptacles installed in outdoors, damp or wet locations, areas having an EQ plane, or dirt confinement areas. There will be a new exception for single receptacles supply fencers outlets in SPS 316.547. It modifies the general requirement in NEC 547.5(G).

“GFCI protection is not required for a single receptacle providing power for an electric fence controller used for livestock containment where an accessible GFCI protected receptacle is located within 3-feet of the non-GFCI protected receptacle.

Recommend at least on GFCI receptacle to supply a radio for steer contentment purposes.

39. I wired a new goat milking parlor and milk house. They also have a couple of small stainless steel coolers. There is a sink in the milk house. The lady is very concerned about electrical faults endangering her animals and operation; so she wants me to install AFCI protection for all of the circuits. Is that OK to do?

Answer: Yes, the Code is a minimum. NEC 210.12. Not a substitute for GFCI Protection. NEC 210.8(B)((5) and 547.5(G)

The NEC does not restrict AFCI protection for any application. It merely requires is for certain areas in dwelling units. Going beyond the minimum is always permitted.

However do not forget that per NEC 210.8 (B) (5) THAT ALL RECEPTACLES WITHIN 6' FT. OF A SINK must also have GFCI protection. GFCI protection is also required for 125-volt, 15- and 20-ampere receptacles in damp and wet locations. This would apply to receptacles in the milking parlor and the milk house. There are no incompatibility between GFCI and AFCI protection. They look for different hazards and operate in a different way.

40. In a barn and dairy operation I know that NEC 210.11 (B) requires that load be evenly proportioned among branch circuits. But with all of the varying loads and motors cycling on and off how this is possible and what tolerance can I realistically be allowed.

Answer: NEC 210.11 (B) pg. 48 provides the guidance.

The Code requires loads that are calculated on the basis of VA per square foot be evenly proportioned. On a typical farm, this would only apply to lighting loads. The real issue is how the owner or operator uses the various loads. You may initially set up with a near perfect balance but disproportionate loading will increase the current in that phase and may affect the neutral current. Connecting

loads line to line will help. Examples of such loads are lights, heaters, and most motors.

41. What do I do to measure excessive dust? Dust and moisture? I know the definition in 547.1 (A) but is the amount 1/16= inch, 1/8-inch or more? Some one told me if you can write your name in the dust, it is too much. Some say you can clean it periodically and then it is OK. Like that's going to happen on a farm.

Answer: Judgment call. NEC 547.1(A).

The definition uses examples to indicate the areas of concern. Mentioned are all areas of poultry, or livestock confinement systems may accumulate. Feed mixing or loading/unloading areas of bulk feed are also areas where excessive dust will accumulate. There is no practical way in these areas to keep the dust from accumulating. Enclosures types 4, 4X, 6, 6P, 12, 12K are all rated for use in indoor areas where excessive dust is present must be rated.

NEC 2011, Table 110.28 gives the enclosure ratings for various types of locations. This table can be used now as it essentially parallels the UL listing and testing for enclosure types.

42. Can pole top disconnect still be used; some one told me that they must have an over-current protection, no matter if it is overhead or underground? Can you sum this issue up?

Answer: Check the available short-circuit current prior to replacement. NEC 110.9, 110.10, and SPS 316.110-(1).

The NEC term for a pole-top switch is "site isolation device". One issue is the available short-circuit rating. The Utility can supply this information. A typical pole-top switch has a maximum short-circuit rating of 10,000-amperes. A new or replacement switch could not be installed where the available short-circuit current is greater than 10kA if this is the case. For example, the available fault current is less than 10,000-amperes at the load end of a 20-foot or longer overhead drop with 2/0 aluminum conductors where supplied by a 50-kva oil-filled transformer.

The installation requirements of pole-top switches are found in Article 547.9(A) and (B).

43. In 547.5 (D), it talks about flexible cord being able to be used provided that the cord , connectors and fittings used shall be listed and identified for the purpose. Does that mean if have to say for farm use or just that it is ok for wet or damp locations?

Answer: Identified for the location. 547.5(D)

NEC 547.5(D) Indicated that “where necessary to employ flexible connections, dusttight flexible connectors, liquidtight flexible metallic conduit, liquidtight flexible nonmetallic conduit, or flexible cord listed and identified for hard usage shall be used. All connectors and fittings shall be listed and identified for the purpose.” Examples of hard usage cord types are SO, and SE. If used outside, the marking must also have a “W”. For example a type SEOW or SOW cord could be used to make the flexible connection to a barn cleaner or manure pump motor. The fitting would also have to be approved for the environment. Cord connectors and strain relief in both examples would have to be rated for a wet, corrosive location.

44. I was written up for not having my operating handle from the site isolating device (pole top disconnect), grounded. The metal box above is grounded at the neutral point and that is all interconnected so what the problem.

Answer: Must be bonded. SPS 316.110-(1) NEC 250.110-(1)

It may or not be interconnected to the pole-top switch due to insulated connection at the switch and the pins or connectors making up the assembly. The Code requires a positive electrical ground connection.

Also per Wis. SPS 316, 110 for listed and labeled equipment, all that I have seen have a grounding lug on the bottom bracket and a label to ground it.

45. Can you explain why in 547.8 (D) pg. 465 why I have to use an insulated or covered copper conductor; when I normally just use an insulated aluminum conductor that is cheaper and save the farmer money?

Answer: Corrosion. 547.8(D)

Grounding is an issue on all electrical installations. In cases where the atmosphere is corrosive, copper conductors are required. Swimming pool installations and hospitals are two example of occupancies of the than farms where “extra” grounding is required and copper grounding and bonding conductors are specified.

46. I have a PTO driven generator and a Ronk hard wired transfer switch at grade level but what I want to know is what size, temporary cables and type to use. I seem to burn a lot of the ones up, that I had lying around the farm. Also the connectors do not seem to stand up very well either.

Answer: Size flexible cords using Table 400.5(A)

Take a typical 50KW PTO driven generator. At 210/240-volts, single phase the rated output is just over 200-amperes. A 3/0 type G portable power cable has an allowable ampacity of 201-ampere. So if the generator is really loaded up, a No 2

cord is not going to last very long as it is rated at just over 100-amperes. And motor loads will stress the cords and connectors ever further due to the high amount of starting current. The manufacturer of the 50 KW generator may tell you that it will be able to handle the starting current of a 25 HP motor. Even a 5-HP motor will draw over 150-amperes at start-up. Remember that cords used on farms must be listed and identified for hard usage.

47. A service is moved in a house and the existing service is now supplied as a new 4-wire feeder. What must be done with the electric range, electric dryer, or existing feeder panelboard wiring?

Answer: Separate neutral and equipment grounding conductors. NEC 250.24(5)

Since these items are now supplied from a 4-wire feeder rather than a service the grounded (neutral) conductor is no longer allowed to ground the appliances and feeders were never permitted to be grounded off the grounded conductor. They must be rewired 4-conductor and neutral bonding jumpers on the appliances shall be removed.

48. I have a customer that wants a generator and automatic transfer switch for their milking parlor. The service on the barn is rated at 800 amperes at 480-volts. The calculated load for the parlor and barns is 391-amps. I was thinking of using a 500kW generator with 600-amp transfer switch. Is this OK?

Answer: Yes. Size ATS per load. 702.5(B)

The first requirement is to ensure that the standby source is capable of supplying the full load intended to be automatically transferred. If the whole complex is being transferred, then either a load calculation, demand measurement, or other method acceptable to the AHJ must be used to determine the total load. You indicated the calculated demand load is 391-amperes. The generator can be loaded to about 600-amperes. Since the system supplies several large motors, you should contact the generator manufacturer. You will want to ensure either the generator is capable of handling the simultaneous starting current of these motors or manage the motors such that they cannot be started at the same time. Your proposed arrangement is acceptable and leaves some room for future loads.

Remember that 702.8(A) requires a sign be placed at the service equipment. The sign shall indicate the type and location of the stand-by source.

49. 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. 2/0 copper or 4/0 aluminum required. NEC 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.

50. 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. NEC 430.52(B), 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.

In your case it may not be possible to just replace the 20-ampere breakers with 15-amp breakers. A maximum of only 6 motors can be supplied by a 15-ampere circuit. And then will all be able to start simultaneously? Another Code requirement that has to be met.

51. What are the limitations on the length of feeder conductors entering a building?

Answer: Provide disconnect nearest point of entrance with maximum of 8-feet inside building. SPS 316.225-(4)

SPS 316.225 requires that building disconnects be installed in the same manner as service disconnects. In general, the rules for feeder that supply a building are very similar to the rules that apply when a utility service supplies the building. Requirements pertaining to the type of disconnecting means, location of disconnecting means and grounding all closely parallel the rules for service installations. Section 225.32 of the NEC requires the building disconnecting means to be installed at a readily accessible location either outside of a building

or structure or inside nearest the point of entrance of the service conductors. SPS 316.230 (3) adds: This is a department rule in addition to the requirements of NEC 230.70 (A). It states, "*Raceways containing service conductors or cables, or service entrance cable not contained within a raceway, may not extend longer than 8 feet into a building to the service disconnect or the first service disconnect of a group of disconnects as permitted by NEC 230.71. The raceway or conductors shall be considered to have entered the building at the point where they pass through the outer surface of the building exterior, except as permitted by NEC 230.6.*" The conductor length inside the enclosure is not counted as part of the 8 feet of permitted conductor length.

52. Manufacturers provide labels inside packages containing ground-fault circuit-interrupter receptacles and recommendations to place them on protected receptacles downstream from the device. Where are these labels required to be used?

Answer: Primarily upon receptacle replacement. NEC 403.3(D)
SPS 316.110 (1)

SPS 316.110 (1) says: "*Listed or labeled equipment shall be installed or used, or both, in accordance with any instructions included in the listing or labeling, provided the instructions, listing or labeling do not conflict with this chapter.*" Barring any specifics in the listing or labeling other than the manufacturer's recommendations the use of these labels is specified in NEC Section 406.3 (D) Replacements. It states that "Replacement of receptacles shall conform with 403.3 (D) (1), (D) (2), and (D) (3) as applicable." It is paren. (3) that has a requirement for the use of these labels. (3)(b) states: "A non-grounding-type receptacle(s) shall be permitted to be replaced with a ground-fault circuit interrupter type of receptacle(s). These receptacles shall be marked "No Equipment Ground." An equipment grounding conductor shall not be connected from the ground-fault circuit interrupter-type receptacle to any outlet supplied from the ground-fault circuit-interrupter receptacle." (3)(c) adds: "A non-grounding-type receptacle(s) shall be permitted to be replaced with a grounding-type receptacle(s) where supplied through a ground-fault circuit-interrupter. Grounding-type receptacles supplied through the ground-fault circuit interrupter shall be marked "GFCI Protected" and "No Equipment Ground." An equipment grounding conductor shall not be connected between the grounding-type receptacles." The labels are not intended to be used on new construction to identify GFCI protected receptacles although they may be; but not in my house.

53. I installed a 150-kva transformer in a milking parlor. Don't worry, it's not sitting on the floor! I need 208Y/120-volt power for lights and plugs. 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: System Bonding Jumper is 2 AWG minimum. NEC 250.30(A)(1) GEC is 4 AWG minimum. NEC 250.30(A)(3)

First of all, how are you going to keep the transformer clean and dry if it actually in the parlor? A vented NEMA 1 or even 3R transformer is not intended to be installed in areas that have a corrosive atmosphere or subject to hose down.

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.

54. Wis. SPS 316.920 (1) states that only State Electrical Inspectors can inspect farming wiring and system. I am a certified commercial electrical inspector in a city that has accepted jurisdiction and we have farms in the City limits, so why can't I inspect them. The manure pits all look the same no where they are located at.

Answer: Enforcement-state only. Consultation-anyone. SPS 316.920

55. I would like to run 2-2-2-4 quad, Type USE-2, out to a loafing shed. I plan to direct bury it and protect at each end with PVC. Can I protect the feeder at 100-amperes?

Answer: No. 90-amperes maximum. NEC 310.16, 338.12(B).
Covered Copper Equipment Ground Required. NEC 547.9(D).

The allowable ampacity of 2 AWG aluminum is 90-amperes at 75 C.. The cable must be protected at 90-amperes or less.

USE cannot be brought into the building. Cables with additional markings such as RHW could be used within the building where run in a raceway.

The equipment grounding conductors for direct buried cables supplying a building with livestock must be insulated or covered copper.

The ampacity Table has a new number in the 2011 NEC. It will be 310.15(B)(16).

56. We are installing a new 800 ampere, 277/480 volt, service for a new dairy. We used 2-750kcm aluminum conductors per phase and neutral. There is no underground water so we ran a No 4 to where the rebar is brought out of the footing. Is a No 4 also OK for bonding the CT Cabinet?

Answer: No. NEC 250.92(A), 250.102(C), 250.66

Service conductor enclosures such as metering equipment, raceways, wireways, etc. are required to be bonded by 250.92(A). How to size them is found in 250.102(C). Supply side bonding jumpers are sized depending on the size of the service conductors using Table 250.66. Example; 2 paralleled 750kcmil aluminum conductors would require a minimum 2/0 copper or 4/0 aluminum bonding jumper.

57. We used PVC conduit to wire overhead lighting in a new freestall barn. The inspector indicated we need to install expansion joints in the straight conduit runs between the receptacle boxes. The lights are about 30-feet apart. What do you think?

Answer: Expansion fittings required inside. 352.44

352.44 indicates expansion joints are required where expansion more than 1/4" can occur. Table 352.44 gives expansion characteristics. You need to figure out what the expected change in temperature is. For example if the barn gets down to freezing in the winter and up to 90-in the summer, the change in temperature is 60 degrees. The change in length for a 60 degree change in temperature is 2.43-inches per 100-feet of PVC conduit. Over that 30-feet, the expansion will be about 3/4 inch. You would need at least one fitting in each straight run.
[Math: 2.43-inches /100-feet X 20-feet = 3/4 inch]

58. Am I required to GFCI protect a cattle waterer? They are 240-volt, drop in donut-type units. The farmer is worried about freezing because the barn is not full at this time of year.

Answer: Not in this case. 547.5(G)

GFCI protection is not required for just for cattle waterers. It is required for 15- or 20-ampere, 120 volt receptacle outlets in damp or wet locations on the farm. All such receptacles would require GFCI protection by 547.5(G). Some electricians are direct connecting the heaters is permitted as long as the heater either has a disconnect within sight or the breaker can be locked off. The instructions with the heater may indicate that they should be removed each summer so check first prior to direct wiring the drop in type unit.

59. I ran direct-buried conductors out to the new calf shed. The conductors are fed out of an at-grade distribution panel. The conductors were aluminum with USE-2/XLPE insulation. I know I need a covered copper equipment ground. Is THWN insulation OK or does it have to be USE? Does the equipment-grounding conductor have to be "full sized"?

Answer: Yes, covered EGC OK. NEC 547.9(B). No, EGC size based on breaker or fuse rating. NEC 250.32 and 250.122(B).

Insulated or covered copper equipment grounding conductor required for direct-buried underground conductors. The THWN is a covering in this case. The distribution equipment has overcurrent protection. Only overhead conductors can be run from the distribution point without overcurrent protection. Once you go down the pole, Overcurrent protection is required.

So NEC 547.9(C) refers you to NEC 250.32. The equipment grounding conductors is sized from Table 250.122. So if you ran a 100-amp feeder with No 1 aluminum conductors, the equipment grounding conductor would be No 8 copper.

60. 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.

Below is a summary of the 2008 NEC regarding luminaries 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]**

Electrical Program on the Internet:

<http://www.commerce.state.wi.us/SB/SBElectricalAndLightingSystemsProgram.html>

Sign-up for informational emails:

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

Check the status of your license:

http://apps2.commerce.wi.gov/SB_Credential/SB_CredentialApp/SearchById

Information on the New Licensing Law

<http://dsps.wi.gov/sb/SB-ElectricalCredChngApps0311.html>

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