

Great Lakes Expo Presentation

30 minutes (including Q&A)

Slide 1: It is a pleasure to be with you today for the 2022 Great Lakes EXPO at the Devos Place in beautiful downtown Grand Rapids, Michigan. Unfortunately, AI cannot be here today, but my name is Danella Gong and we prepared this presentation entitled “Electrical Grounding Safety and Energy Efficiency Potential for Irrigation.

Slide 2: Irrigation systems have rapidly spread across Michigan. Changing rainfall patterns, risk mitigation and expansion of seed corn production in Michigan with the establishment of two of the largest US seed corn facilities in the southern area have accelerated this growth.

An irrigation unit, such as this center pivot system, is an electrical challenge in that the electrical current must be transported over a long distance. Some units can be up to a half-mile long. Because the wires have resistance, voltage drop will occur as the current travels the long distance from the source panel to the individual segment motors or other loads.

Slide 3: As a result, there has been a rapid increase in the number and size of agricultural irrigation systems, sometimes stressing the local energy supply. We can now boast that St. Joseph County, Michigan – included in the red area - is the most irrigated county with the most center pivot systems east of the Mississippi River. This growth has necessitated the need for stressing electrical safety to prevent accidents that can sometimes be fatal.

This red area is under electrical supply stress, partly due to the growth in irrigation systems.

The yellow circle shows areas that are starting to feel this electrical supply stress as well, mostly due to the growth of MI's fruit & processing industry: winery, apples, cherries, & the like.

Slide 4 & 5: Be it a high-pressure or low-pressure sprinkler, large electrically driven irrigation systems generally require 3-phase power at 480 volts, although the control and drive components generally operate at a much lower voltage. At that voltage level the effect of electrical accidents can be significant and, in some cases, fatal. Three-phase power is not always available to most farms or irrigation locations, so there are challenges in those situations since utilities do not allow electric motors greater than 20hp on single-phase lines.

[ON SLIDE 4] Pictured are some less efficient variations of center pivot – they shoot water upwards instead of downwards, so the wind blows a lot of it away from the target area.

Drive component = synchronized motors on each of the tires

In MI, single phase is dominant (AI did an informal survey, & 80-85% of rural MI farmers do single phase)

Slide 6:

Lost voltage is lost energy. If the voltage is lower than optimum, a motor must draw additional current to develop the power required to move the irrigation machine and water. Excessive current not only increases the voltage drop, but it can result in motor overheating which can lead to premature motor failure.

To minimize the current flow, the motors must be operated at the highest voltage practical. Therefore, irrigation machines normally operate at 480 volts rather than 240 volts or 208 volts. Also, loads powered from a 3-phase source rather than a single-phase source draw 40% less current to develop the same power.

Slide 7: Time to talk about safety! Safety for irrigation systems is primarily about proper grounding and having your system installed by a certified installer and electrician experienced in irrigation systems. This is not a DIY project! Our focus for this presentation will be on often the most neglected aspect, grounding.

Slide 8: Read "Safety at the Water Pumping Station"

There are 3 components of an irrigation system:

- The electrical supply
- The water pumping station: a large motor (pictured) that provides water for distribution
- And lastly the central pivot system itself

Slide 9: Read "Irrigation motors or systems not connected to the service panel ground rods can result in a shocking experience. Be sure that the service panel is adequately grounded."

Service panel = where utilities connect for use & maintenance

Ground rods = allows excess electricity to flow into the ground rather than through you when you touch it

How to tell if safe? If you don't have the tools, just a quick touch

Slide 10: Read "Irrigation motors or systems connected to the service panel ground rods prevents a person from receiving a shock."

Now you can see the motor is connected to the service panel.

Slide 11: Read "Safety at the Center Pivot."

“When a pivot is powered-up, always check to make sure it is safe to touch.”

“The grounding rods must be connected to the irrigation system’s electrical panel.”

“It’s recommended 3-4 connected ground rods 8 feet long and spaced 10 feet apart from each other to effectively ground your irrigation system.”

Slide 12: Read “Equipment grounding wire must be run with circuit wires to all electrical loads.”

“The equipment grounding wire must be either bare or with green insulation or green covering”

Read the diagram images too

Slide 13: Lightning Protection is important because these irrigation systems are often exposed in open fields – making them the tallest metal object around.

Slide 14: In addition to adequate grounding, installing a surge protective device (SPD) type 1 as close to the irrigation system ground as practical is recommended.

The diagram shows an example of an irrigation system with an SPD type 1 component.

Slide 15: Energy Efficiency in Irrigation.

First we talked about safety, now we’ll talk about efficiency.

Slide 16: These charts are breakdowns of energy use for audited irrigation systems - shown in both kilowatt hours & the equivalent MMBtu value.

The Michigan Farm Energy Program conducted 20 audits of MI irrigation systems – this is where the data comes from.

Slide 17: As a result of these energy audits, we found that upgrading to more efficient low-pressure center pivot irrigation systems can save you on average \$21,000 a year! This is assuming a 15-year operational year – most operate for 20, so this is even a conservative estimate.

Slide 18: We hope your irrigation system is working properly without any major issues. For an Energy Audit, contact Aluel S. Go (goaluel@msu.edu)

Slide 19: Thank you all for your time & attention!

Questions & Answers:

Q: What are some energy recommendations?

A: 1. Convert to a low pressure system. 2. Adopt variable frequency drives on water pumping motor & wheel motors. A VFD is like the gear on your car – imagine if you only had 1 gear! Your engine would have to work so hard & travelling wouldn't be very efficient. 3. Install an end gun system. It covers the corners of the circular center pivot – doesn't reduce energy use, but increases coverage & lessens wasting space.