History of Rural Electrification and Farm Wiring Issues

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On-Farm Population

- 1862: 50% or 15 million
- 1962: 8% or 14 million
- 2012: ≥2% or 4.5 million

Number of Farms

- 1934: 6,821,350
- 1959: 4,782,961 (2.02 Million Loss)
- 1988: 2,158,800 (2.62 Million Loss)
- 2012: Less than 2 Million

Electrification of Farms

- 1923: 150,000 farms
- 1934: 11 %, or 744,000 farms
- 1959: 96 % or 4,593,000 farms
- 2012: 99.9 %

Farm Wiring Chronology

1891: Irrigation Pump Motor in CA
1918-19: Farm Generator Plans for Small Streams
Home Wiring Plans (Knob & Tube)
1921: Ventilation of Barns (Omer G. Kelley Stanford Res. Ctr.)

Poultry Ventilation
Early Wiring and Fusing (After Knob & Tube)

1923 CREA’s Committee on Relationship of Electricity to Agriculture
- Purpose to Create National Research and develop Bulletins on use of Electricity in Agriculture
  - NELA National Electric Lighting Assoc.
  - AFBF, American Farm Bureau Federation
  - ASAE (Now ASABE)
  - Equipment Manufacturers (GE, etc.)

MINNESOTA
- 1923 CREA
- Red Wing MN Project
  - Rural line for research, NSP
  - 8 farms-- Selected, Wired, and Monitored
  - Switch between kitchen stove and 5 hp motor
  - Location of service
  - Demand Factors

California and Alabama CREA’s
- Strong program in CA, funding at UC Davis, Stanford, and others
- Alabama Power built research rural lines. Cooperative Project at Univ. of Alabama involved many engineers and University Staff.
1926- Ventilation and Control of Potato Storage
1927- Evenings peaks a problem. More even power use would reduce cost!!
1928- Remodeled Cotton Gins used more electric Power
1933- NELA changed to EEI

1934- Surveys in 25 States by AG Engr’s on Availability and Use of Electric Power on Farms
1935- REA Rural Electric Administration Established
1939- EEI left CREA’s and formed Rural Division of EEI (Still active in 1973).

1939- First USDA Farm Electrification Research Projects
- Electric Pig Brooders
- Heaters for Hog & Cattle Waterers
- Egg Cooling
- Portable Electric Wood Saw

Electric Pig Brooder

Research on Heated Pig Waterers
Bulk Milk Cooling Research

Unique Early Research Projects

• Electric heating of wood seats in Outhouses
• Electrically heated Septic Tanks for Disposing of Dead Poultry. (Heat would enhance the decomposition)

Changes in Farm Labor because of Electric Automation

• 1962
  – 1 man milks 16 cows by hand
  – Milks 23 cows with limited automation
  – Milks 31 cows with maximum automation.
• 2012 milks 100 + cows

CHRONOLOGY (Cont.)

• In 1950’s Many Farm Electrification Councils were formed. One reason was to reduce confusion between REA and CREA’S
• It also brought Rural Electric Cooperatives into the Councils to Augment support from the Investor Owned Utilities

1954, Inter-Industry or Farm Electrification Councils

Electric Cooperatives
Investor Owned Utilities
Electrical Equipment Manufacturers

23 State FEC’s Organized in the mid-to-late 50’s
TEXAS

- TCREA 1926-1947
- TFEC 1947-1973
- TABEC 1973-2002
- Disbanded because of Deregulation and combining of Utilities

New York Farm Electric Council

- No CREA in NY. Had Farm Electric Council
- 1926-1941- Closed for WWII
- 1943-1983
- 1983-1996 Cornell AEP (Ludington)
- 1998-2000 EPRI-NE Center (Ludington)

A National Electrical Council

1962 Farm Electrification Council (FEC) Hugh Hansen, John Turrel
1976 Food & Energy Council (FEC) Ken McFate
1981 National Food & Energy Council (NFEC) Ken McFate, Richard Hiatt
2008 Rural Electricity Resource Council (RERC) Richard Hiatt

Magazine:
Electricity on the Farm

Farm Wiring Handbook:
Agricultural Wiring Handbook

Voltage Drop

- Total should be less than 5% from service to load
- Design for 2% for each segment
- Use tables in Ag Wiring Handbook
Agricultural Wiring Materials and Electrical Code update

Why is Proper Equipment Important?

- FAIL-SAFE
- When will electrical equipment fail?
- It Works-- will it fail safe????

Fuses and Circuit Breakers

Open for Overloads
Open for Faults

Bolts are NOT Safe Fuses!

Extension Cords

- Greatest Cause of fires
- Extension cords fail with small arcs that cause fire but carry small amounts of amperage (Much less than 15 A)
- Codes now require Arc Fault Circuit Interrupters (AFCI’S) throughout the house.

No Blo Fuses

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Turn the Receptacle Around!

NEVER Pull by the Cord!!

Overloaded!

Who Needs a Plug?

Works for 240 Volts Also!

Cut it Off, Then Fix it Right
Is It Safe to Use if it Faults?

Motors
TOTAIVLY ENCLOCED
FARM-DUTY

Disconnect
Over-current Protection
Within Sight
5-10ft.

Thermal Overload Protection
(Running Overload or Over-Current)
- Manual Reset Preferred
- Automatic Reset Not Recommended
Grounding

- Proper Grounding along with fuses or circuit breakers provide personnel protection
- Double Insulation provides additional safety from metal surfaces.
- The Receptacle Outlet must be grounded to make the grounded equipment fail safe.

Grounding

- A ground rod (electrode) provides lightning protection and limits the voltage to ground
- An equipment bonding conductor provides the low resistance path for fault current to open protective devices

Grounding Electrodes in the Same Building shall be Bonded Together

This includes electrodes for lightning protection systems

Lightning Protection
Caused by Electricity?

Lightning Arrestors
- Needed? ........ YES!!
- First Arrestor on Line Side
- Others on Line or Load Side

Main Service Surge/Lightning Arrestor

Lightning Protection
Agricultural Wiring
Materials and Electrical Code update

NEC
• Chapters 1-4 Basic Requirements
• Chapter 5-8 Special Requirements
• Chapter 9 References, Tables
547.5 Wiring Methods

A. Wiring Systems
B. Mounting
C. Equipment Enclosures etc
D. Flexible connections
E. Physical Protection
F. Separate Equipment Grounding conductor
G. Receptacles (GFCI’S)

Agricultural Buildings
Equipment Enclosures, Boxes, Etc.
Section 547.5(C)
Excessive Dust: Enclosures shall be designed to minimize the entrance of dust and shall have no openings (such as holes for attachment screws) through which dust could enter the enclosure.
Agricultural Buildings
Equipment Enclosures, Boxes, Etc.
Section 547.5(C)

Damp and Wet Locations: In damp or wet locations enclosures shall be placed or equipped so as to prevent moisture from entering the enclosure.

Hose down: Where surfaces are periodically washed or sprayed with water, boxes, conduit bodies, and fittings shall be listed for use in wet locations, and equipment enclosures shall be weatherproof.

Boxes & Fixtures
NON METALLIC
SURFACE MOUNT

Waterproof is not Watertight
Don’t Use Bakelite fixtures

547.9 Electrical Supply to Building(s) or Structure(s) from a Distribution Point.

Overhead electrical supply shall comply with 547.9(A) and 547.9(B), or with 547.9(C).

Under-ground electrical supply shall comply with 547.9(D).

Site-Isolating Device 547.9(A)

Description and requirements for a pole-top switch
547.9(A) 1-10)
547.9 Electrical Supply to Building or Structures from a Distribution Point.

A. Site Isolating Device
   Electrical supply (Special 4-wire?)
B. 3-wire?
C. 4-wire Feeder

Confused?
Just follow Article 225 and 250.32

547.10 Equipotential Planes and Bonding of Equipotential Planes

* Definition of Livestock
* Gradient requirement was removed
* EQ Plane required where metallic equipment may become energized
* Bonding not required for slotted floors
Thanks to
Midwest Plan Service
MREC members

Where are the Safety Shields?

Who Moved It?

I thought It would Clear!

Watch Where you Park Your Car!
Watch where you Park the State Vehicle