



54th Annual Rural Energy Conference

PRESENTATION

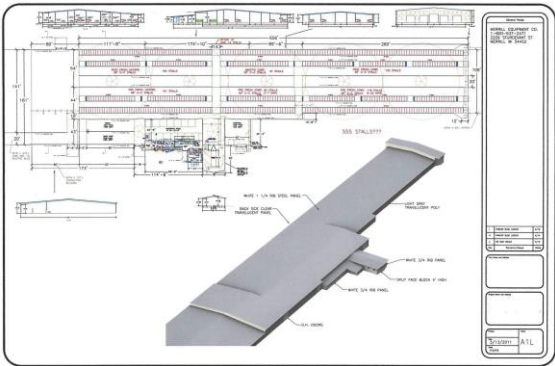
On
 Large Electrical System Design for Farms
 and/or
 Agricultural Occupancies
 By:

BADGER STATE CONSULTING, LLC
 Electrical Consulting, Design & Inspection Services
RON L. JANUSCHKE
 P.E. (Electrical) Licensed Designer #P-000000000
 Badger State Consulting, LLC
 8750 Hwy. 101
 Wausau, WI 54981-0203
 Phone: (715) 212-1888
 Fax: (715) 448-0245
 E-Mail: ron@badgerstate.com
 Web: badgerstateconsulting.com

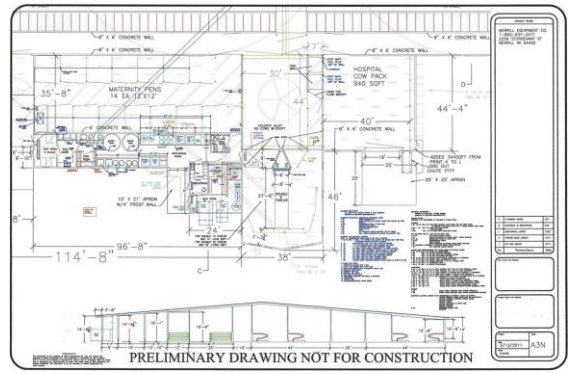
Electrical Design starts prior to construction

- Obtain preliminary drawings
- Review project overview
- Meet with customer
- Visit site
- Review proposed project with local Utility Co.
- Obtain electrical loads from mechanical contractor
 - Listing of all electrical loads
 - Ventilation loads
 - Design lighting loads for energy & long day lighting
- Prepare load calculations for electric service sizing

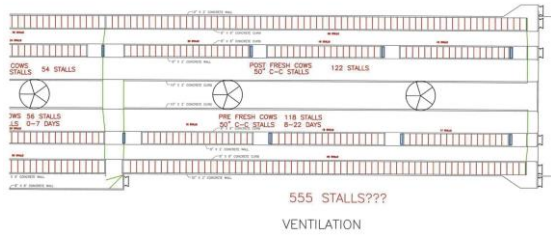
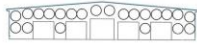
BUILDING DETAILS



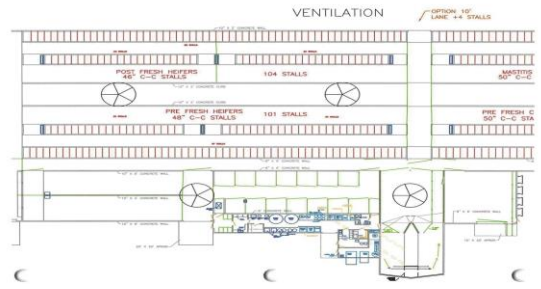
BUILDING DETAILS



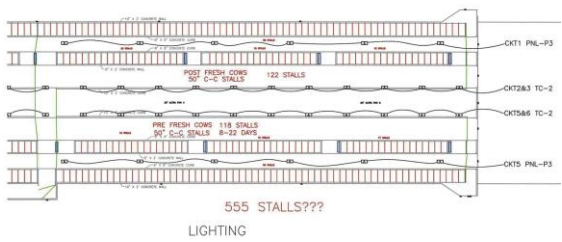
VENTILATION DETAILS



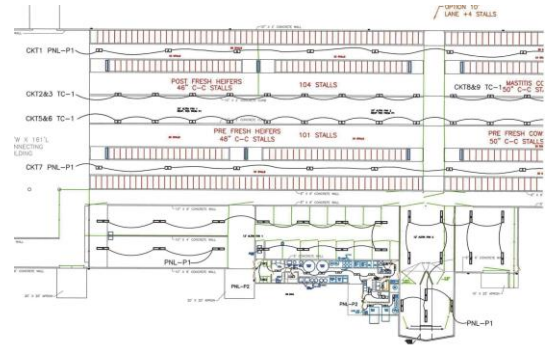
VENTILATION DETAILS



LIGHTING DETAILS



LIGHTING DETAILS



LOAD CALCULATIONS

SERVICE SELECTION BASED ON VOLTAGE

120/208-volt service 3PH 4W	1231 AMPS
480/277-volt service 3PH 4W	534 AMPS

NOTE: WE WILL REQUESTING A 800-AMP 480/277-VOLT SERVICE

EXAMPLES OF LARGE SERVICES



3-SECTION MAIN SWITCHBOARD



MAIN SERVICE
DISCONNECT AND
UTILITY CT SECTION



AUTOMATIC
TRANSFER SWITCH
SECTION

ANOTHER EXAMPLE OF 2-SECTION SWITCHBOARD





OTHER THAN DAIRY AG FACILITIES

- Agricultural facilities not only include dairy farms but in North Central Wisconsin include the fruits and vegetable growers.
- Central Wisconsin has potato growers who supply most of the Frito Lay chip market.
- Central Wisconsin growers also supply Del Monte Foods with peas, corn, and many other vegetables for the canned food market.
- Antigo area is the potato growers who supply the seed potatoes for the Plover growers

POTATO GRADING FACILITY





EVERYTHING IS MOVABLE, ELECTRICAL
MUST ADAPT



NOTICE THE "MELTRIC" CORD
CONNECTORS



CORDS CAN BE UNPLUGGED EVEN
UNDER LOAD





NEMA 4X BOX WITH CONTACTORS TO CONTROL OTHER EQUIPMENT

TYPICAL ELEVATOR MOVED INTO PLACE AND FIELD CONNECTED



CONTROL PANEL FOR ALL THE VARIOUS CONVEYOR MOTORS



E-STOP AT EVERY WORK STATION



FLOOD LIGHTING FOR WORKING LATE HOURS DURING HARVEST



POTATO STORAGE

- Potato storage is big business in NC Wisconsin.
- The storage bins must be temperature and humidity controlled.
- Huge buildings with bins hold the potatoes.
- All winter long those stored potatoes are taken to the potato grading facilities then sent to potato processing where they are made into French fries, hash browns and many other foods along with bagging for grocery stores.

EXAMPLE OF BIN HOLDING POTATOES



EVERY STORAGE FACILITY MUST HAVE FAN ROOMS TO CONTROL HUMIDITY



**LARGE FAN MOTORS ARE
CONTROLLED BY VFD DRIVES**



FAN ROOMS ARE PLENUM AREAS



**TYPICAL POTATO STORAGE BUILDING
REQUIRE LARGE 3-PHASE SERVICES**



GRAIN DRYING BIG IN 2013 & 2014

- Many new grain drying facilities cropped up in 2013 and 2014.
- When LP gas was expensive and hard to get the facilities were charging a premium price.
- Multiple bins as well as single bin installations.
- Many of the larger farmers opted to install single bins for their own use to save money & offset costs by drying the neighbors product.
- Installations had special electrical requirements



LARGE MULTI-BIN
INSTALLATIONS
TAKE A LOT OF
POWER

MOTORS ARE ALSO ON TOP. THEY DO
REQUIRE A DISCONNECT WITHIN SITE



EACH BIN HAS MANY FAN MOTORS
ALONG WITH THE LP GAS FIRED UNITS





SOME INCLUDE STAIRS TO THE TOP



NEMA 3R LOAD CENTER POWER



NOTICE 120-VOLT RECEPTACLE. MUST BE RATED "WR", GFCI AND HAVE THE IN-USE "BUBBLE" COVER. NOTE NEW CODE WILL REQUIRE A HARD USE, IN-USE COVER.

BINS MUST POWER THE ELEVATORS TO
LOAD AND UNLOAD THE BINS



ROBOTIC MILKERS STARTING TO SHOW UP



NICE AREA FOR THE FARMER TO RELAX AND WATCH THE WORK BEING DONE



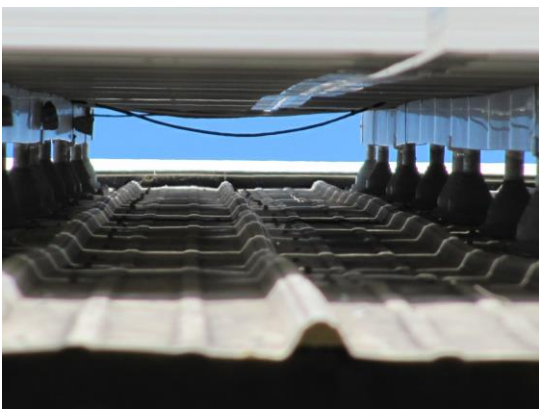
WINDOWS TO VIEW OPERATION



PHOTOVOLTAIC (SOLAR) INSTALLATIONS

- Large free-stall barns provide the perfect area for a solar collectors.
- Owners can off-set utility bills and if the Utility allows can sell back power.
- Rebates and grants are available.
- Data suggests solar gets a better return on the investment than wind power.

SOLAR INSTALLATION ON FREE STALL



**SOLAR COMBINERS AND INVERTERS.
MANY LABELING REQUIREMENTS**





VENTILATION WIRING OFF SOLAR PWR



EACH FAN HAS ITS OWN O/C PROTECTION AND DISCONNECT





WIND INSTALLATIONS



**THIS FACILITY HAD
TWO 100KW
WIND MILLS**

**GROUNDING FOR LIGHTNING
PROTECTION**



SERVICE RATED DISCONNECT AT EACH
WIND MILL TOWER



SEPARATELY DERIVED
SYSTEM REQUIRES
O/C PROTECTION





METERED OUTPUT KWH FROM TOWER



SECOND TOWER INPUT TO BREAKER



IRRIGATION HUGE IN NC WISCONSIN

- All fruits and vegetable growers require irrigation for their fields.
- Even buyers like Frito Lay require irrigation in the contracts with farmers.
- WPS started a program back in 1990 to upgrade 480-volt 3-wire well setting services to upgrade to grounded 5-wire services including a service disconnect at the pole.
- A typical pump will require a 50, 75 or even 100HP 3PH 480-volt motor.

IRRIGATION

- Most of the wells did not have a service disconnect installed at the point of service.
- The service disconnect was at the center pivot point out in the field next to the pump panel.
- When lighting took out the wire to the service disconnect the utility company had to come out and pull the cut outs for the service.
- Most of the old 480-volt services were 3-wire 3PH 480-volt ungrounded settings.

IRRIGATION

- A lot of well settings in the North area were diesel engine settings.
- When diesel fuel was high cost it was a big expense.
- Many farmers paid to have three-phase brought to the field so they could go electric
- Another option was a 480-volt 2-wire service with a VFD drive to convert 480 to 3-phase.

SHOWS NEW ELECTRIC SERVICE TO REPLACE OLD DIESEL TANK & ENGINE



NEW WELL, PUMP AND 3PH PUMP PANEL



AT THE POINT OF SERVICE THE METER AND DISCONNECT



VFD DRIVE ALONG WITH ROTO PHASE FOR THE SMALLER 3PH LOADS



SERVICE RATED DISCONNECT ALSO SHOW LIGHTNING ARRESTOR



FUSIBLE SERVICE DISCONNECT WITH CURRENT
LIMITING FUSES TO CLEAR AVILABLE FAULT
CURRENT



WELL CASING IS THE BEST GROUND



MAJOR GROWERS USE TELEMETRY TO CONTROL
EACH FIELD. SMART PHONE, IPAD FROM THE
TRUCK.



TYPICAL 50, 75 OR 100HP PUMP



480V 1PH TO 3PH USING VFD



INTERIOR OF VFD



TYPICAL STANDARD SETUP



MORE DIESEL ENGINES TO GO



PUMP OUT OF LAKE NOT DRILLED WELL ALSO COMMON



FARMING GINSENG

- Ginseng is a perennial herb used by the Chinese as medicine.
- North Central Wisconsin is one of the prime areas for growing the plants and harvesting the roots.
- Ginseng farmers grow the root 3-5 years in the ground before harvest.
- Roots have to be dried before marketing.
- Very lucrative crop.

LARGE BUILDINGS FOR DRYING AND STORAGE OF THE ROOTS



THE DOORS ON EACH SIDE EACH HAVE SEPARATE CONTROLS FOR DRYING ROOTS



ABOVE EACH SPACE IS A/C AS WELL AS THE GAS FIRED HEATERS



THERMOSTATS & HUMIDISTATS CONTROL EACH SPACE. VFD'S CONTROL MOTORS



SEVERAL LARGE GAS BOILERS SERVE PROCESS



TYPICAL A/C UNITS ABOVE EACH SPACE



ROOTS READY FOR MARKET



\$\$\$\$\$\$\$\$\$\$\$\$\$\$\$\$



ROOTS ARE SOLD BY WEIGHT.
CENTRAL WISCONSIN IS PRIME CROPS



CHRISTMAS TREE GROWERS

- Very common to see the fabric “cover-all” buildings for many agricultural applications.
- If constructed for an agricultural facility the electrical code rules of NEC Art 547 apply.
- North Central Wisconsin also has large Christmas tree farms.
- From harvest to market may be several weeks
- Cut and bundled trees require temperature and humidity to remain fresh.

FARM USING A “COVERALL” BUILDING
FOR CHRISTMAS TREE SALES



LIGHTING AND VENTILATION A MUST



CRANBERRY GROWERS

- Wisconsin is a major supplier of the cranberry industry.
- Large cranberry fields are located in Wisconsin.
- Cranberry growers rely on water either from drilled wells or more common from rivers and lakes to quickly flood the fields when temperatures low to protect the plants.

CRANBERRY FIELDS



**LAKE PROVIDES WATER – PERMITS
REQUIRED**



LARGE PUMPS PUMPING FROM LAKE



LARGE PUMPS PUMPING FROM LAKE



DRILLED WELL SERVICE SERVING PUMPS WHEN NEEDED



WATER CANALS FOR FLOODING FIELDS



CRANBERRY FESTIVAL AFTER HARVEST



GOAT MILK FARMERS



TYPICAL GOAT FREE STALL BARN



MODERN PARLOR FOR HARVESTING GOAT MILK



LARGE ROTORY GOAT MILK FACILITY



LARGE DAIRY FARMS USING ROTARY PARLORS



HOLDING AREA PRIOR TO LOADING



www.alamy.com - DGGWNJ

NEW INSTALLATION



THANK YOU

ANY QUESTIONS?