Minnesota Power-Camp Ripley Solar Partnership
Minnesota Power

- Taconite Ridge Renewable Energy Center
- Rapids Energy Center
- Boswell Energy Center
- Laskin Energy Center
- Taconite Harbor Energy Center
- Camp Ripley Solar Project
- Bison Wind
- Oliver County I & II
- Hydroelectric Units

How we are moving EnergyForward:

<table>
<thead>
<tr>
<th>Year</th>
<th>Renewable</th>
<th>Coal</th>
<th>Natural gas</th>
</tr>
</thead>
<tbody>
<tr>
<td>2005</td>
<td>1/3</td>
<td>1/3</td>
<td>1/3</td>
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<tr>
<td>Current</td>
<td>1/3</td>
<td>1/3</td>
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<tr>
<td>Goal</td>
<td>1/3</td>
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Solar Energy Standard and MP’s solar strategy

**CUSTOMER**
- Solar Analysis Program
- SolarSense Rebates
- Made in Minnesota Incentives

**COMMUNITY**
- Community Solar Garden Pilot Program
- Awaiting Final MPUC Approval

**UTILITY**
- 10MW Camp Ripley Solar Project
- In-Service

SES compliance => 29 MW utility scale & 4 MW small scale by 2020
Camp Ripley Development Principles

• Customer Focused
  – Meet the needs of our customer(s)

• Innovative and Forward Looking
  – Include educational component
  – Platform for new technology including Microgrids

• Cost Competitiveness
  – Project must compete through an RFP process
  – Utility quality build
  – Designed to capture 30% ITC
Renewable Energy Partnership

- Leverages 80 acres of underutilized land at Camp Ripley to supply renewable energy to Camp Ripley and Minnesota Power’s customers
- Allows significant progress toward Department of Defense sustainable energy goals for Camp Ripley
- Aligns with Minnesota Power’s EnergyForward power supply strategy and secures 1/3 of its solar energy requirements for Minnesota solar mandate
- Solar array estimated to produce more than 17,000 MWh each year, enough to power enough to power 10% of the annual electricity requirements of Camp Ripley plus 1500 houses for an entire year

Project expected to be in service Fall of 2016
Project Location and Technology

- 10 MW-AC (13.07 MW DC)
- Located on 34.5 kV Distribution
- Fixed Tilt (35 degree)
- First Solar thin film panels-116,000
- Driven Pile ~5000
- (4) 2.5 MW Inverter/transformer Skids with full grid capabilities
- ~$25M project budget including interconnection
Minnesota Passes Solar Jobs Act
MP Begins to develop a solar strategy
MP and MN ANG storm
MP and MN ANG sign MOU
MP issues a site specific RFP
MP bid selected in RFP
EPC Contract signed
MPUC Filing
MPUC Approves Project
Project Design and Construction Phases

- Geotechnical & Pile Testing
- Design-Final to IFC
- Site Clearing
- Earthwork and Roads
- Pile Driving
- Racking Installation
- Module Installation
- Commissioning
Geotechnical & Pile Testing

• Geotechnical
  – Performed 8 penetration test borings
  – Depths were 20 – 40’
  – Geotherm, Inc. performed thermal characteristics testing

• Pile Testing
  – 13 locations & 2 piles at each location driven to 8’ & 10’
  – 5x6 Cee was tested for the pile
  – Testing performed for uplift and lateral capacity
Pile Testing...
Site Clearing

• 45 acres cleared
  – March 2016
  – Site was an old gravel pit
  – 20 year growth of mostly red pine

• Trees were chipped and used at a Biomass generation facility in Benson

• Three week total timeframe to clear
Site clearing cont’d...
Earthwork & Roads

• 14,200 yards of material moved
• Create Positive Drainage throughout the site
• Temporary seeding
• Roads:
  – Main access roads – geotextile fabric and graveled
  – Perimeter roads – compacted native material
• Site Stabilization and Final Seeding
  – Utilized a low growth native prairie mix
Earthwork cont’d...
Pile Driving

• April-May 2016

• Two pile driving machines

• Pile are driven to 10’ depth

• 4,690 total piles installed
Racking Installation

• Racking definition:
  – Support structure for the solar modules
    • Galvanized Steel
  – Installed over the course of two months
  – Gamechange was the manufacturer
DC Cable and Combiner Box Installation

• Start with N-S piles to support combiner box and DC cable installation
• Allows the electricians to get started on the electrical work and minimizes interference with pile driving activities.
DC Trenches and Combiner Box Installations
Racking installation cont’d...
Module Installation

• Work performed by Hunt Electric
• Suction cup rigging device
  – Eliminated majority of work from ladders
  – Increased employee safety and efficiency
  – Modules were bolted into position six at a time
  – ~750 modules installed per crew each day
  – 116,208 modules total
Module installation cont’d…
Commissioning

• Cold Commissioning
  – Meggering
  – Polarity checks

Hot Commissioning
• Voltage checks
• VLF tests
Tornado

• A Category F1 tornado struck Camp Ripley the night of September 7\textsuperscript{th}.

• Project damage:
  – Storage container overturned and blown into array
  – Roof from a Camp Ripley building deposited in the array
  – ~4,500 broken modules
  – 75 damaged posts
  – Significant racking damage in segments of the array
Tornado cont’d...
Event Timeline:

9/7/16: Tornado occurs
9/8/16: Damage assessments completed
9/12/16: Rebuild begins
9/26/16: New materials ordered
10/21/16: Rebuild complete
Tornado cont’d...
Tornado cont’d...
Contractors

HUNT Electric Corporation

LANDWEHR Construction Inc.

M+W GROUP

Frattalone Companies