Connecting Off-Shore Wind Farms to the Grid

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Today’s topics

- How do you connect the wind farms to the grid?
- What are submarine cables?
- How underwater cable systems are designed
- Permitting considerations
- How submarine cable systems are installed
How do you connect the wind farms to the grid?

- Underwater cables are run from each turbine to a shore located substation
- Underwater cables are called submarine cable systems
- Usually at either 34,500 volts or 115,000 volts
- Connection from turbines to shore is responsibility of developer
- Complexity of cable system depends on the number of turbines, and characteristics of the water environment

What is a submarine cable?

- An underground transmission cable designed to operate in a marine environment
- Contains additional layers which allow it to be operated for long term in harsh marine environment
- Wrapped with steel armor wires for mechanical protection
Typical submarine cable

XLPE- cross-link polyethylene cable

- Copper or aluminum conductor
- Conductor shield
- Extruded insulation
- Insulation shield
- Metallic sheath
- Jacket / oversheath
- Armor wires / layers
- Very small dielectric losses

Cross section of typical submarine cable
How underwater cable systems are designed

- Obtain soil samples from bottom of Lake Michigan
- Perform a marine survey
- Decide how to enter the water from the shore

Horizontal directional drilling

Beach Approach
How underwater cable systems are designed

- Decide if the cable will be buried or laid on the lake bottom
- Design the cable based on the above decisions
- Bid cable manufacture to qualified companies
- Prepare installation specifications and drawings
- Bid installation to qualified marine contractors

Permitting

- Submarine cable systems are designed and installed with close cooperation with permitting agencies
- State: Michigan DNR
- County / township
- Approvals can take one year
How submarine cable systems are installed

Barge
Traction engine

Tug
Back of barge

Diver
Main lay barge
Pre-lay grapnel run

Burial tools: 5m plow system
Typical (direct) landing float-in

Floatation system
Typical final landing

Questions / Discussion