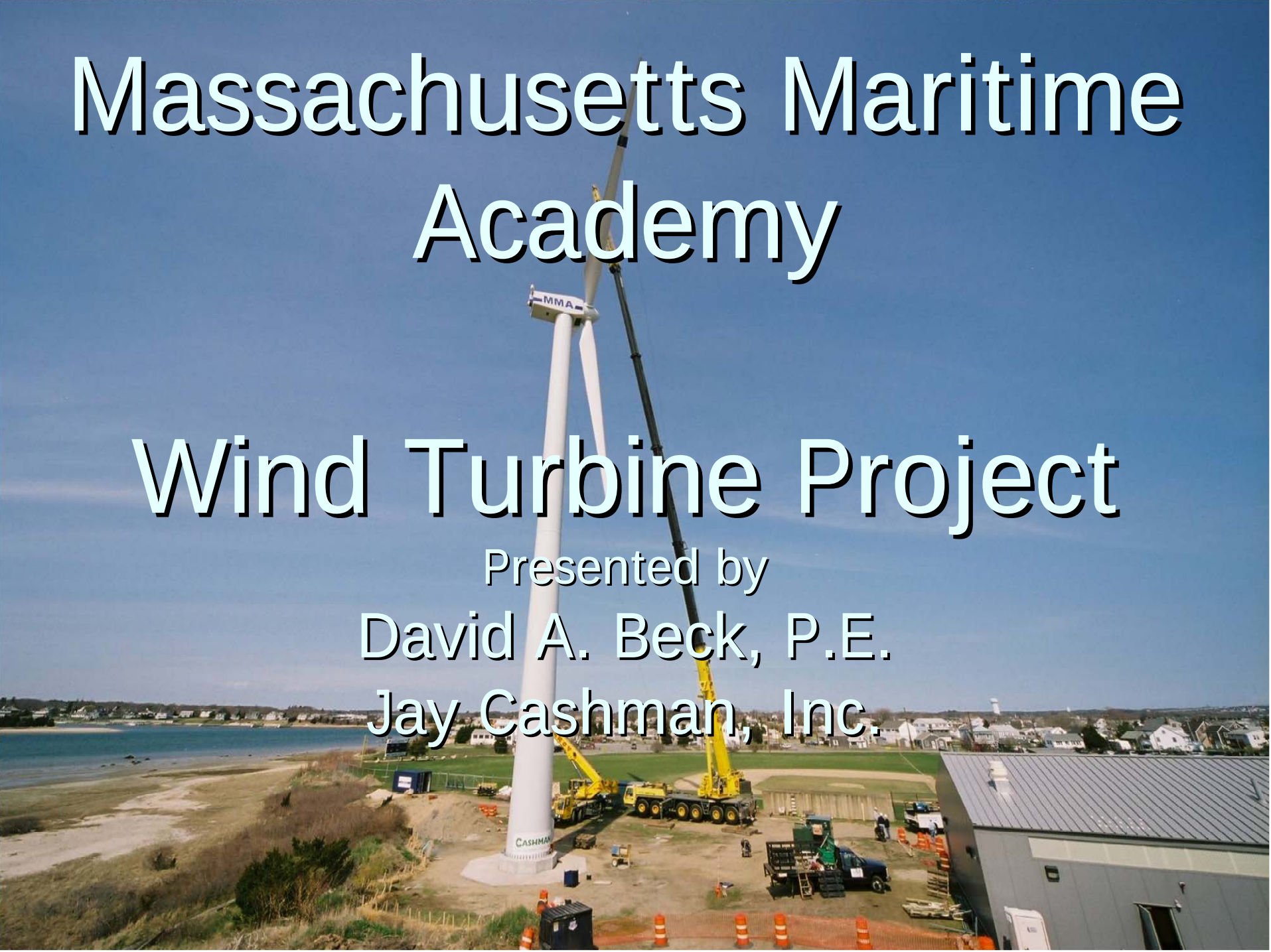
Massachusetts Maritime Academy

Wind Turbine Project

Presented by
David A. Beck, P.E.
Jay Cashman, Inc.



Project Key Dates

- **Preliminary Technical Feasibility Study** by Sally Wright, PE - 21 May 2004
- DCAM Issues RFP in February 2005
- JCI Submitted Proposal March 9, 2005
- DCAM Awarded Contract July 2005
- Submitted Interconnect Application –Aug. 2005
- Order of Conditions Obtained Fall 2005
- Construction March and April 2006

Technical Feasibility Study

- UMASS RERL, Sally Wright
- Average wind speeds 6-6.5 m/s
- Fall Zone 1.5 x the blade tip height
- Setback from residences 3.0 x the hub height (492 ft. for V-47)
- Selected Site behind WWTP and Power Plant Building and next to Ball Field

Turbine Sitting

Vestas V47-660 kW Wind Generator Turbine

	meters	feet
Hub Height	50	164
Blade Sweep	47	154
Blade Tip Height	73.5	241

Post Cost and Saving

- Proposal Submitted at $1.3M, Final $1.4M
- Estimated CF = 25%; 1,461,746 kWh/year
- 82% used on Campus; 18% to grid @ $.05
- Simple Payback without RECs = 7.5 years

- Assuming RECs at $.05 per kWh, Simple Payback = 5.5 years

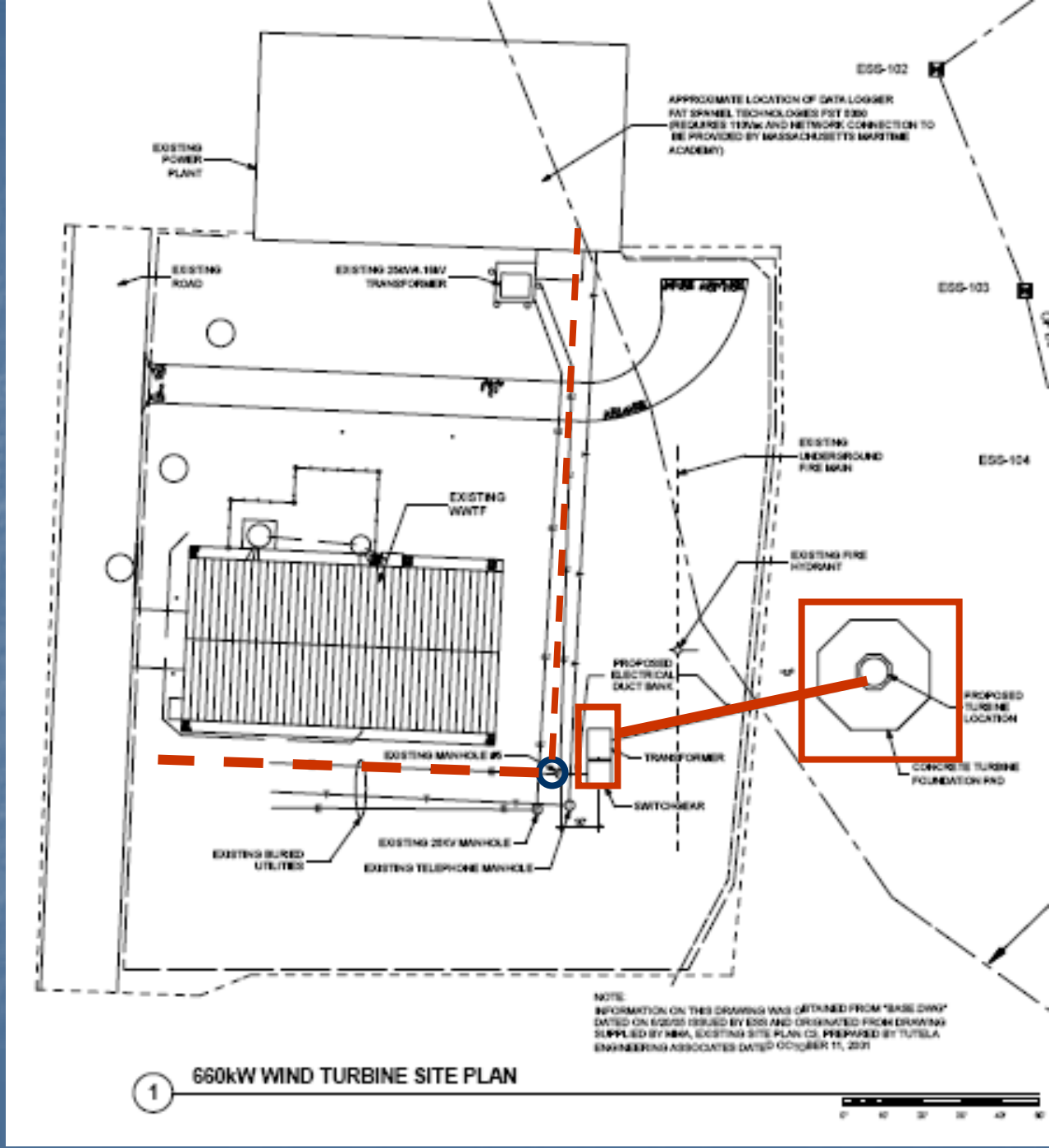
Project Design Team

- Jay Cashman, Inc. – General Contractor
- Energy Management, Inc. – Management Support
- ESS Group – Permitting (NOI and FAA)
- Solar Design – BOP Electrical Design
- LeMessurier Consultants – Foundation Design

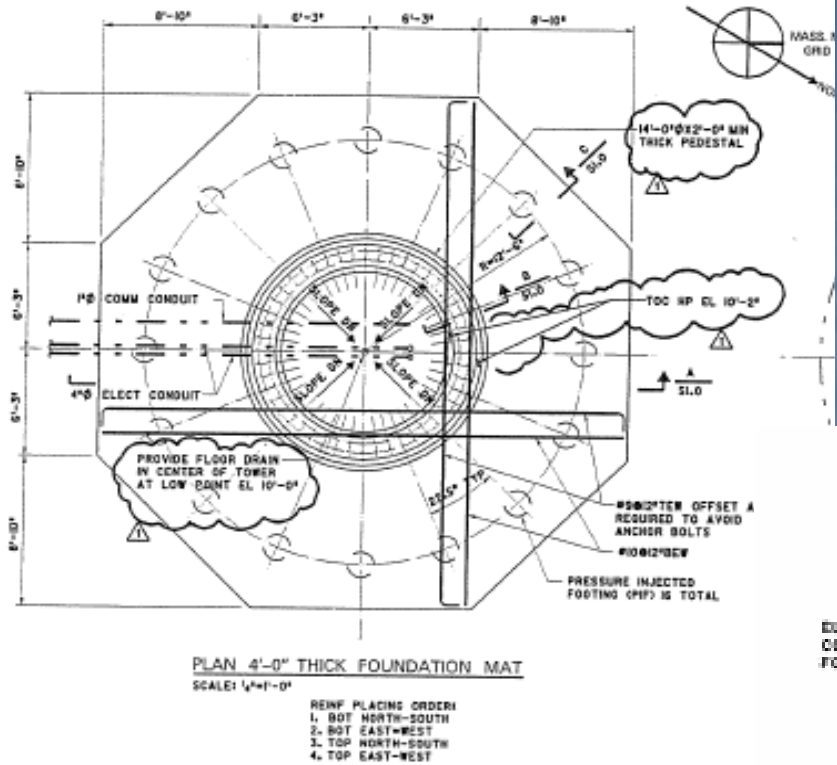
Permitting

- ESS reviewed potential environmental Impacts
- Notice of Intent Filling with Bourne Conservation Commission
- FAA Notice of Proposed Construction (>200')
- State facility not subject to local bylaws
- The Mass Building Code followed
- Avian Impact Analysis
- Post Construction Avian Study by MMA

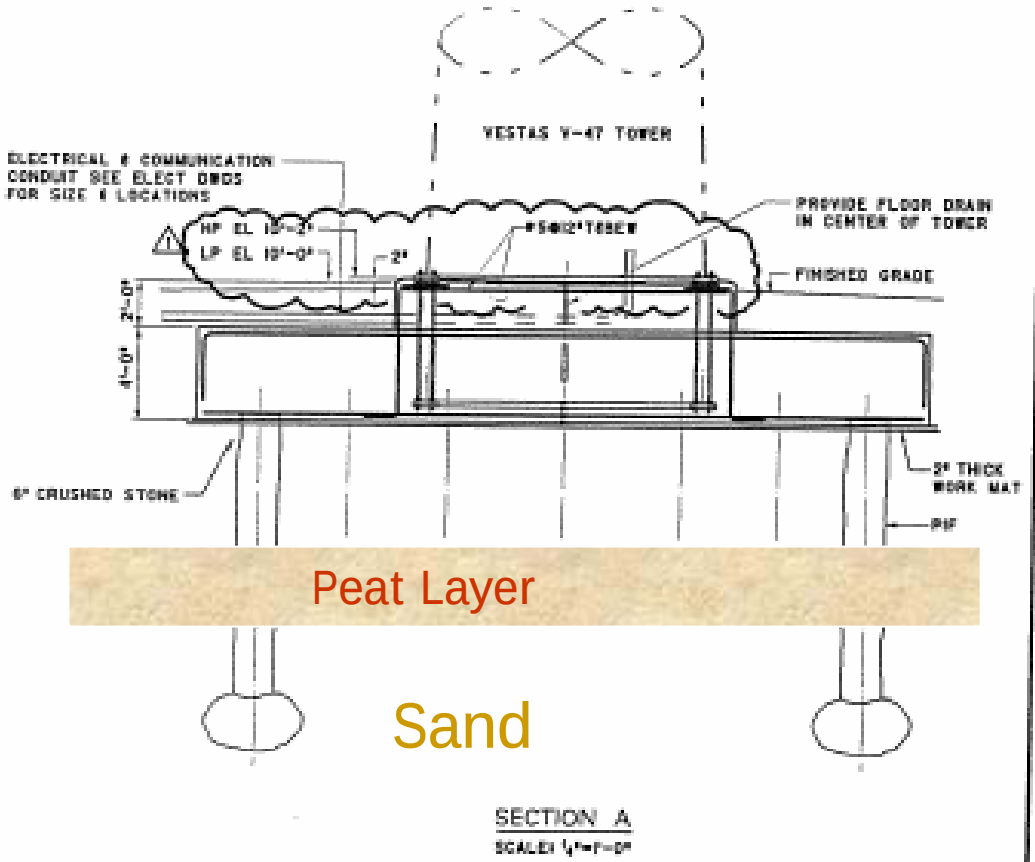
BOP Electrical Design



WTG Foundation Design



- 16 PIFs (50 tons/20 tons)
- 30'x30'x 4' Base Mat
- 14' Dia. X 2' Pedestal
- 96 Anchor Bolts



Construction Subcontractors

- G. Donaldson Construction – PIF Install
- Fiore Construction (MBE) - Site and Foundation Work
- R. Reid Electric (MBE) – BOP Electric Equipment
- Mass Electric Construction Company - Electrical BOP and WTG Work
- Keystone Engineering (WBE)– WTG Installation
- Lighthouse Electric Construction - DAS

Site Work and Foundation Installation

- Install Erosion Controls
- Install 16 Pressure Injected Footings (PIFs)
- Foundation Excavation
- Mud Mat and Remove PIF Concrete
- Install Base Mat Rebars, Anchors and Conduits
- Install Foundation Pedestal
- Install Buried Conduits
- Backfill Operations

Site Prior to Construction

Installation of 16 PIFs

Excavation Around PIFs

PIFs and Mud Mat

Bottom Steel and 96 Anchor Bolts

Rebars, Anchor Bolts and Conduits

Base Mat Concrete (110 CY)

Conduits at Manholes (EMH#5)

Conduits to Electric Equipment

Backfilling Foundation and Duct Bank

Pedestal Forms

V47 Components

Tower From North Dakota

- Bottom Tower Section
- Top Tower Section

Parts From Italy

- Nacelle
- Parts Container - Hub, Nose Cone, Controller
- Blades Container

Nacelle Arrives at Site

Unloading Parts Container

Tower Sections Arrive

Base Section Making Turn Into Site

Making Turn at Pump House

Base Tower Installation

- Offload from Transport
- Install Electrical Cables
- Power Wash
- Install Rigging
- Upright
- Place on Foundation over 96 Anchor Bolts
- Grout Base
- Pretension 96 Anchor Bolts

Inside of Base Section

Electrical Preparation Work

Lifting Base Section

Up Righting Base Section

Swinging Base Section

Tower Rigging

Setting Tower Base Section

Rotor Assembly on Ball Field

- Offload Blades from Shipping Container
- Set-up Elephants Foot on Ball Field
- Set Hub and Fiberglass Cone
- Install Three Blades

Offloading Blades

Setting Hub on Elephant's Foot

Blade Pitch Linkage

Setting Nose Cone on Hub

Install First Blade

Bolting Blade to Hub

Tie-Down of Blades

Install Blades onto Hub

Completed Rotor

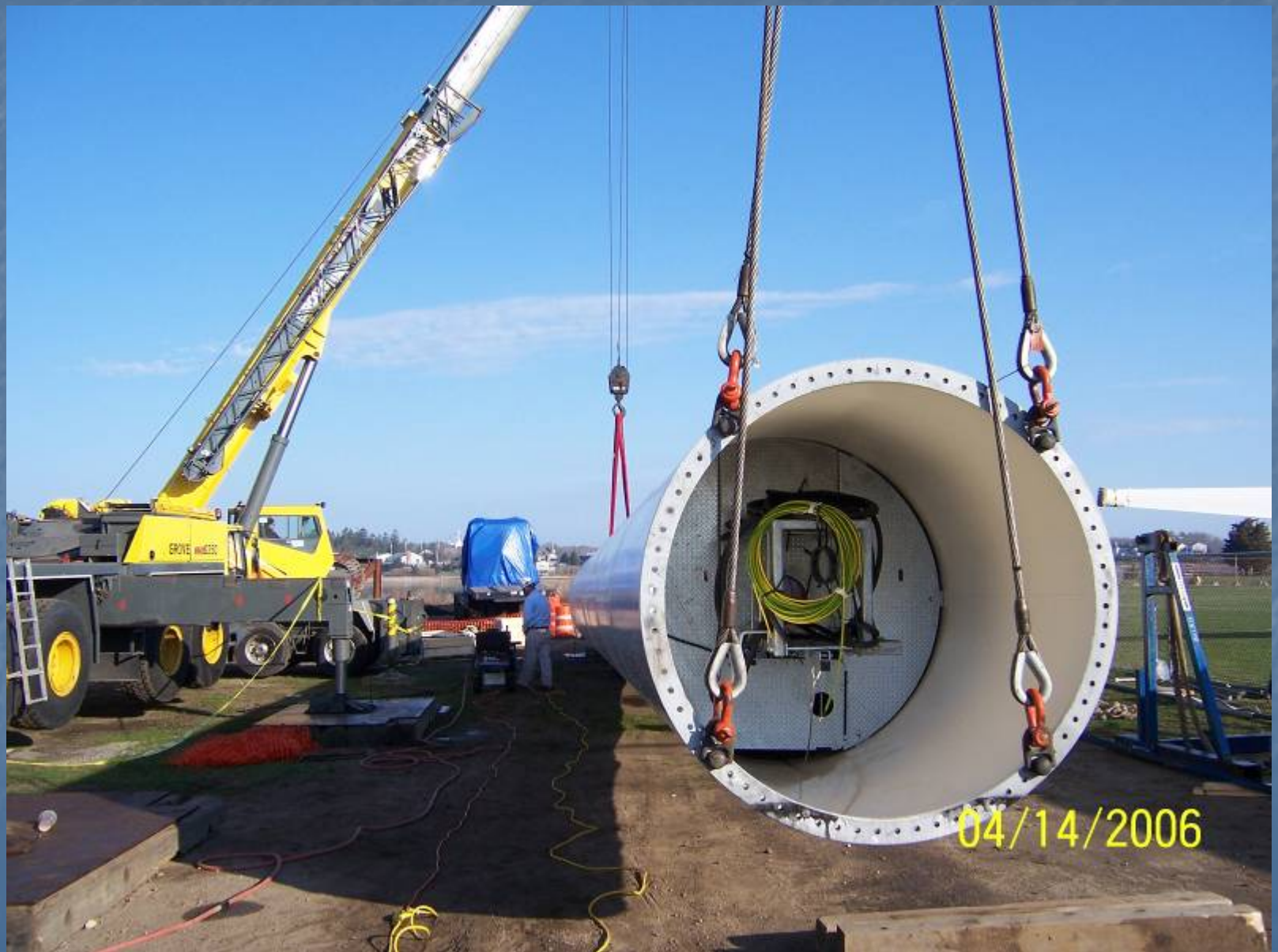
Rotor Tied Down and Ready for Lifting

Install Top Section, Nacelle and Rotor (Friday April 14th)

- Install Cables in Top Tower Section
- Install FFA Lights and Wind Instruments on Nacelle
- Lift, Set and Bolt Top Tower Section
- Lift, Set and Bolt Nacelle
- Lift and install Rotor onto Nacelle

Rigging Tower Top Section

Lifting Top Tower Section



Up Righting Top Section

Lifting Top Section

Installing Top Section onto Tower Base Section

Setting Top Section

Top Section Set

Derigging from Tower

Nacelle FAA Lights and Wind Vanes

Nacelle Preparation

Installing Nacelle Lift Chains

Nacelle Ready for Lifting

Lifting Nacelle from Transport

Lifting Nacelle From Transport

Lifting the Nacelle

Setting Nacelle on Tower

Bolting Nacelle to Tower

Rotor Lift Rigging

Lifting Rotor from the Horizontal

Rotor Raised to Vertical

Rotor Hub


04/14/2006

Rotor Being Lifted

Man on Top

Rotor Mated to Nacelle

Installation Completed

April 14th


MMA

Construction Schedule Summary

- March 15th – Start PIFs
- March 28th – Place Base Foundation
- April 10th – Nacelle Arrives at Site
- April 12th – Install Tower Base Section
- April 14th – Install Top, Nacelle and Rotor
- April 15th – WTG Electrical Hookup
- May 27th – Nstar Installs Recloser
- June – WTG Commissioning

Electrical Interconnection

- Application Submitted Aug. 2005
- Nstar Impact Study Completed Nov. 2005 (fee $7,250)
- Jan. 2006 Advises Cost to Change out 65T Fuses with Recloser
- Feb. 2006 MMA pays Nstar for Recloser (about $57,000 for additional protection)
- May 27, 2005 Nstar Installs Recloser

Questions?