# PILLAR MOUNTAIN WIND PROJECT
KODIAK ISLAND, ALASKA

PHASE II
SUMMER, 2012

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WIND TURBINE TOWER FOUNDATION PLAN

ABBREVIATIONS:
- C.C.  CONCRETE COVER
- O.D.  OUTSIDE DIAMETER
- I.D.  INSIDE DIAMETER
- E.W.  EACH WAY
- TYP  TYPICAL
- T.O.C.  TOP OF CONCRETE
- O.C.  ON CENTER
- T&B  TOP AND BOTTOM
- NTS  NOT TO SCALE
- C.J.  CONSTRUCTION JOINT
- H.B.  HUB HEIGHT
- MW  MEGA WATT
- WTG  WIND TURBINE GENERATOR
- BFS  BELOW FINISHED SURFACE

BUILDING AND DESIGN CODES:
- INTERNATIONAL BUILDING CODE 2006, INTERNATIONAL CODE COUNCIL
- BUILDING CODE REQUIREMENTS FOR STRUCTURAL CONCRETE, ACI 318, 2008, AMERICAN CONCRETE INSTITUTE
- AISC MANUAL OF STEEL CONSTRUCTION, ASD, 13TH EDITION

WIND TURBINE AND TOWER:
- MANUFACTURER: GE ENERGY
- MODEL: G.E. 1.5-77, rNAMTS
- POWER OUTPUT: 1.5 MW
- TOWER HEIGHT: 79.7 m HH

DESIGN DATA:
- CRITICAL FOUNDATION LOADS (UN-FACTORED)@ 0.83 FT ABOVE GROUND LEVEL (LOAD DLC6.2-4)
  - OVERTURNING MOMENT, M0 = 35,455.93 FT-KIPS
  - HORIZONTAL BASE SHEAR, Fr = 163.07 KIPS
  - VERTICAL TOWER REACTION, Fv = -499.80 KIPS (DOWNWARD)
- MIN. 28-DAY CONCRETE COMPRESSIVE STRENGTH FOR SPREAD FOOTING: 4000 PSI
- MIN. 28-DAY CONCRETE COMPRESSIVE STRENGTH FOR PEDESTAL: 4000 PSI
- MIN. COMPRESSIVE STRENGTH OF GROUT: 3 DAYS = 6500 PSI  28 DAYS = 8000 PSI
- MIN. YIELD STRENGTH OF REINFORCING BAR: 60 KSI
- MIN. YIELD STRENGTH OF BOTTOM ANCHOR RING PLATE: 36 KSI
- DESIGN ALLOWABLE SOIL BEARING PRESSURE = 10,000 PSF
- GROUNDWATER ELEVATION MATCHES EXISTING GRADE
- MIN. ROTATIONAL STIFFNESS OF FOUNDATION = 62.1 E+7 FT-KIPS/RAD
- MIN. HORIZONTAL STIFFNESS OF FOUNDATION = 1.03 E+6 K/FT
- MIN. COMPACTED UNIT WEIGHT OF FOUNDATION FILL = 115 PCF (MOIST)
- MIN. FOUNDATION BEARING DEPTH = 10.83 FT BFS
- ANCHOR BOLTS:
  - TENSION FORCE = 76 KIPS
  - MIN. YIELD STRENGTH = 75 KSI
  - MIN. TENSILE STRENGTH = 100 KSI
- ANCHOR BOLT DIAMETER (THREAD MAJOR DIAMETER) = 1 1/2 INCHES

GENERAL NOTES:
1. THE FOUNDATION SUPPORT AND SOIL PROPERTIES FOR THIS DESIGN ARE BASED ON RECOMMENDATIONS FOR ALL WIND TURBINES INCLUDED IN THE GEOTECHNICAL ENGINEERING REPORT FOR KEA WIND FARM PREPARED BY TETRA TECH ON MARCH 2008. THIS DESIGN IS APPLICABLE ONLY TO FOUNDATIONS AT TURBINE SITES 1, 2 AND 3.
2. ALL CONCRETE WORK SHALL CONFORM TO ACI-318.
3. FOR TECHNICAL SPECIFICATIONS, SEE DRAWING S-104
4. SEE ELECTRICAL DRAWINGS FOR GROUNDING SYSTEM AND ELECTRICAL CONDUIT LAYOUT.
5. THE CONSTRUCTION JOINT SHALL BE SEALED TO PREVENT WATER INTRUSION. SEAL THE JOINT WITH SILICON RATED FOR OUTDOOR USE. AFTER THE SILICON HAS SET, APPLY A LIQUID ROOFING TAR OR LIQUID RUBBER PRODUCT ALONG THE JOINT AND UP TO 6" ON EACH SIDE OF THE JOINT. ONCE THE TAR OR RUBBER PRODUCT HAS SET, INSTALL THE DRAIN SYSTEM.
6. BACKFILL AROUND THE DRAINS SHALL BE FREE DRAINING MATERIAL AND SHALL BE PLACED AROUND THE DRAIN WITHOUT ANY COMPACTION EFFORT.

MICHAEL J. SHANNON
DATE: MARCH 9, 2012
No. CE 11940
03-09-2012
1. FOR GENERAL NOTES, SEE DRAWING S-102.
2. MINIMUM EMBEDMENT LENGTH FOR ANCHOR BOLT SHALL BE 50 INCHES, MEASURED FROM T.O.C. OF SPREAD FOOTING @ CENTER (SEE DRAWING S-102).
3. FOR LOCATION OF VERTICAL BARS, SEE DETAIL 4 ON DRAWING S-102.
4. PROVIDE SHIM PACKS AT A MINIMUM OF FOUR PLACES EVENLY SPACED.
5. FOR CONDUITS AND GROUNDING SEE ELECTRICAL DRAWINGS.

ANCHOR BOLT ASSEMBLY DETAIL

NOTE
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SECTION 03300 EXCAVATION, BACKFILL AND COMPACTION
PART 1 GENERAL
1.1 THIS SECTION SPECIFIES THE TECHNICAL AND CONSTRUCTION REQUIREMENTS FOR THE EXCAVATION, BACKFILL AND COMPACTION FOR WIND TURBINE GENERATORS (WTG) FOUNDATIONS.

1.2 SUBMITTALS
A. DRAWINGS: PER SPECIFICATION.
- SUBMIT 3 FOR PLACEMENT OF WTG FOUNDATIONS.
- DRAWINGS: SHALL BE IN COORDINATION WITH THE PROJECT GENERAL CONTRACTOR.

B. SUBMITTALS: WHEN IMPOSSIBLE, SUBMITTALS SHALL BE IN COORDINATION WITH THE PROJECT GENERAL CONTRACTOR.
- SUBMITTALS: SHALL CONFORM TO THE REQUIREMENTS OF THE PROJECT SPECIFICATIONS AND THE PROJECT DRAWINGS.

1.3 DESCRIPTION
A. WORK: THE WORK CONSISTS OF THE FOLLOWING:
- EXCAVATION OF MATERIALS TO ENSURE THAT THE FOUNDATION IS Laided TO THE SPECIFIED DESIGN.
- BACKFILL AND COMPACTION OF MATERIALS TO ENSURE THAT THE FOUNDATION MEETS THE SPECIFIED DESIGN.

1.4 QUALITY ASSURANCE
A. PROVIDE BARS, WIRE FABRIC, WIRE TIES, SUPPORTS, AND OTHER DEVICES NECESSARY TO INSTALL AND SECURE REINFORCEMENT. CONCRETE OR OTHER NON-CORRODIBLE MATERIAL, HAVING A COMPRESSIVE STRENGTH OF NOT LESS THAN 5000 PSI (28 DAYS) OR 6000 PSI (90 DAYS), IS REQUIRED.

1.5 WARNING: FINE AGGREGATE SHALL COMPLY WITH ASTM C33.
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1.6 WARNING: COARSE AGGREGATE SHALL COMPLY WITH ASTM C33.
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2.0 EXECUTION
2.1 LEAN CONCRETE
A. DO NOT BACKFILL OVER POROUS, WET, FROZEN, OR SPONGY SUBGRADE SURFACES.
B. BACKFILL: WHEN IMPORTED STRUCTURAL FILL IS USED FOR FOUNDATIONS, SUBMIT LABORATORY SOIL TEST RESULTS DOCUMENTING FILL PROPERTIES. THIS TEST DATA SHALL CONFIRM THE IMPORTED FILL SUFFICIENT TO ATTAIN THE REQUIRED DENSITY.

2.2 REINFORCING MATERIALS
A. LEAN CONCRETE MIX DESIGN: SUBMIT 14 DAYS PRIOR TO PLACEMENT OF LEAN CONCRETE.
B. BACKFILL: WHEN IMPORTED STRUCTURAL FILL IS USED FOR FOUNDATIONS, SUBMIT LABORATORY SOIL TEST RESULTS DOCUMENTING FILL PROPERTIES. THIS TEST DATA SHALL CONFIRM THE IMPORTED FILL SUFFICIENT TO ATTAIN THE REQUIRED DENSITY.

2.3 FOUNDATION FILL
A. FINE AGGREGATE SHALL COMPLY WITH ASTM C33 OR GRADATION APPROVED BY THE MASTEC REPRESENTATIVE.
B. COARSE AGGREGATE SHALL COMPLY WITH ASTM C33.

2.4 FILL MATERIALS
A. IMPORTED STRUCTURAL FILL MATERIAL SHALL BE CLEAN DENSE GRADED AGGREGATE FREE OF OXIDE AND FREE OF ALL CONTAMINANTS MEETING THE REQUIREMENTS OF ALASKA DEPARTMENT OF TRANSPORTATION STANDARD SPECIFICATIONS SECTION 703 FOR CLASS B MATERIAL.
B. BACKFILL: WHEN IMPORTED STRUCTURAL FILL IS USED FOR FOUNDATIONS, SUBMIT LABORATORY SOIL TEST RESULTS DOCUMENTING FILL PROPERTIES. THIS TEST DATA SHALL CONFIRM THE IMPORTED FILL SUFFICIENT TO ATTAIN THE REQUIRED DENSITY.

2.5 CLEANUP AND RESTORATION
A. CEMENT SHALL CONFORM TO ASTM C150, TYPE I.
B. IN-PLACE DENSITY TEST: ASTM D698, ASTM D2167, ASTM D6938
C. PLACE STRUCTURAL FILL IN LOOSE LIFTS TO ACHIEVE MAXIMUM 6 INCHES COMPACTED OR A COMBINATION THEREOF.

3.0 PARTIAL DETAILS
3.1 CONCRETE FORMWORK
A. CONCRETE VARIES: SUBMIT 14 DAYS PRIOR TO PLACEMENT OF THE CONCRETE.

3.2 MIXING AND TRANSPORTING CONCRETE
A. LEAN CONCRETE MIX DESIGN: SUBMIT 14 DAYS PRIOR TO PLACEMENT OF LEAN CONCRETE.
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3.3 QUALIFICATIONS
A. FINE AGGREGATE SUPPLIED TO MATCH PLANT TO ALLOW FOR CAPACITY OF MATCH PLANT TO PROVIDE CONCRETE QUALITY WITHIN 1%.
B. MIX DESIGNS WHENEVER SPECIAL ADMIXTURES ARE REQUIRED.
C. FINE AGGREGATE SHALL COMPLY WITH ASTM C33.

3.4 MIXING AND TRANSPORTING CONCRETE
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B. BACKFILL: WHEN IMPORTED STRUCTURAL FILL IS USED FOR FOUNDATIONS, SUBMIT LABORATORY SOIL TEST RESULTS DOCUMENTING FILL PROPERTIES. THIS TEST DATA SHALL CONFIRM THE IMPORTED FILL SUFFICIENT TO ATTAIN THE REQUIRED DENSITY.

4.0 PARTIAL DETAILS
4.1 CONCRETE FORMWORK
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4.4 MIXING AND TRANSPORTING CONCRETE
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EC, INC.

F. HOT WEATHER: THE CONCRETE SURFACES SHALL BE KEPT BELOW 85 DEGREES F FOR THE
MICHAEL J. SHANNON
BE INSPECTED AND RE-TESTED FOR TENSION VALUES. AN INSPECTION REPORT SHALL BE
EACH WTG FOUNDATION, A MINIMUM OF 15 RANDOMLY SELECTED ANCHOR BOLTS SHALL
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CURING PERIOD.

CONSECUTIVE DAYS AFTER PLACEMENT IN ACCORDANCE WITH ACI 301. BEGIN CURING FORMED
CONCRETE SURFACE BY FINAL HAND TROWELING OPERATION, FREE OF TROWEL MARKS,
GRADE, AND ELEVATION BEFORE BLEEDWATER APPEARS. PERMIT CONCRETE TO ATTAIN A SET
D. PLACE, CONSOLIDATE, AND IMMEDIATELY STRIKE OFF CONCRETE TO OBTAIN PROPER CONTOUR,
SMOOTHED.

3.12 TOLERANCE

b. THE AVERAGE OF THE COMPRESSIVE TESTS EQUALS OR EXCEEDS THE 7-DAY OR 28-DAY
STRENGTH AS APPLICABLE.

VIBRATOR WHEN MORE THAN ONE LIFT IS REQUIRED. PLACE CONCRETE IN 18 INCHES MAXIMUM
VIBRATORY ELEMENT SUBMERGED IN THE CONCRETE, WITH A MINIMUM FREQUENCY OF NOT
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A. DEFECTIVE CONCRETE: CONCRETE NOT CONFORMING TO REQUIRED DETAILS,
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G. ANCHOR BOLTS IN AREAS DIRECTLY IN CONTACT WITH CONCRETE OR GROUT SHALL BE
ACCEPTABLE AND SATISFACTORILY COMPLETED WORK.

C. HORIZONTAL ANGULAR ALIGNMENT (ROTATION)

H. READY-MIX CONCRETE SHALL BE IN ACCORDANCE WITH ACI 301 AND ASTM C94.

A. DEFECTIVE CONCRETE: CONCRETE NOT CONFORMING TO REQUIRED DETAILS,
PART B SUBMISSIONS, 3/4 INCH TO 1 1/4 INCH, PLUS 1/4 INCH.

DEFINITIONS

PART G REQUIREMENTS APPLICABLE TO THE PROJECT.

PART 1 GENERAL

PART 2 PRODUCTS

PART 3 EXECUTION

1.1 PLACEMENT OF ANCHOR BOLTS

A. BOTTOM ANCHOR BASE PLATE SHALL CONFORM TO ASTM A490 PLAIN PLATE, HEADING
B. ASSEMBLED INSPECTION REPORT (IN 1 ORDER) OF ALL PRODUCTS (Steels, Anchors, Bolts, Plate) AND OTHER ASSOCIATED DOCUMENTATION.
C. SCREW ANCHORS: PEDIC DRAWINGS OF SCREW ANCHORS IN SHEET FORM FOR APPROVALS.
D. STEEL ANCHERS SHALL BE HARDENED MATERIAL BY VALING FORM ENGINEERING.

PART 4 SUBMITTAL REQUIREMENTS

SECTION 01300 SUBMITTAL REQUIREMENTS
A. THIS SECTION SPECIFIES THE REQUIREMENTS FOR SUBMITTALS LISTED IN SECTIONS
B. ANCHOR BOLT PLUMBNESS (VERTICAL): LESS THAN 1/16 INCH IN 1 FOOT
D. EMBEDMENT RING PLATE ELEVATION: 1/2 INCH

TOLERANCES
A. ANCHOR BOLT PROJECTIONS: SHALL BE CAPED WITH PLASTIC CAPS, CAPS TO BE
H. READY-MIX PROJECTIONS: SHALL BE CAPED WITH PLASTIC CAPS, CAPS TO BE

PART 1 GENERAL

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THIRD PARTY REPRESENTATIVE: REPRESENTATIVE OF THE CLIENT QUEMIS.
C. WRITTEN ACCEPTANCE: ACCEPTANCE OF THE WORK INVOLVING WRITTEN
W. HANDSPRINTING: APPLY HANDSPRINTING TO FORMS AND CONSTRUCTION DETAILS.
V. PAVEMENT MARKING: APPLY PAVEMENT MARKING TO CONCRETE AND ROADWAY.
X. PIPE: Apply pipe to pipe connection. This shall include Equipment supporting the conveyor belt. This shall also be applicable to pipe above and below ground. The pipe shall be supported on a concrete base.
Y. PILOT HOE: Apply Pilot Hoe to form. This shall be used to provide a smooth finish on concrete. This includes concrete, roadways, and sidewalks.
Z. PLACARDING: Apply placard to construction. This shall include equipment supporting the conveyor belt. This shall also be applicable to equipment above and below ground. The placard shall be supported on a concrete base.

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