

## Engineering Document

### Transportation, installation, commissioning, acceptance, running & operating of the wind turbines (farm)

#### Chapter I Transportation & Installation

##### Section I: The transportation method

According to the destination and the specific conditions along the way, the following transportation methods are currently used:

1) Sea: by bulk carriers for large size components, such as the tower, blades, arms, and generator. The electrical equipment, hydraulic systems, and standard components would be transported in containers.

2) Motor Vehicle: For transport from seaport to the installation site by flatbed truck of 15m-18m in length. The conditions of the destination should be taken into consideration when deciding upon any other motor vehicles that may be needed. The longest part is the support pole/Beam and track components, which is 20m length and light weight. The blade size is 11.5m length and 2.6m width.

3) On the low-grade roads, experienced technicians to carry necessary tools and materials, such as sleepers, triangle wood, wire rope, springboard, skid, wire, jack, shovel, crossbow, sledgehammer, brown rope, etc. Flat-panel counterparts to deal with emergency issues such as small bridge reinforcement, saddle-type pavement height, high-speed removal of the cabin cover and packaging in front of the tunnel.

4) In the instance where the road may be difficult to pass through, a crane with the appropriate tonnage should be considered, and the crane assisted shifting method is adopted to help the flatbed pass the curve.

In this method, the shifting operation method should be agreed with the driver and the crane driver of the carrier in advance, and safety operation should be paid attention to, especially when operating on the roads in the mountains.

##### Section II: The process of hoisting & installation

###### 1. Preparation before hoisting

a) Check and confirm that each foundation has been accepted and meets the installation requirements.

b) Confirm that the power transmission & transformation project of the wind farm has been accepted.

c) Confirm that the weather conditions on the day of installation are appropriate and the maximum wind speed on the ground does not exceed 8m/s.

d) The manufacturer engineers and the representative of the investor, to organize the installers to read and become familiar with the installation manual.

e) Focus on the manufacturer engineers, organize the installation team, and clearly identify the only commander on the installation site.

f) Develop a detailed installation plan. Clear job positions, responsibility to people, clear installation sequence, operation procedures, technical requirements, safety requirements, clear installation equipment, tools, measuring tools, auxiliary materials, oil materials, etc. used in each position of each process, and prepare separately according to needs.

g) Clean up the installation site, remove debris, and clear out large vehicle passages. The installation site must be enough space for the crane slewing around each foundation site.

h) Clean the foundation of the wind turbine, the upper and lower end faces of the flange and the bolt holes, clean the thread surface of the bolt, remove the rust-proof packaging, and apply anti-rust oil.

i) The heaviest component is around 5 tons & 20m height, so the crane needs 2\*20 ton/40m crane arm, and the climber vehicle have been implemented as required and reached the scene.

j) The person responsible for each installation process is responsible for checking the goods one by one according to the installation operation plan and the schedule.

## 2. Installation schedule

Based on experience, the installation period of one turbine is two days.

## 3. Installation process

### a) The control cabinet in place:

Before installing Super Turbine, the control cabinet and other electrical equipment must be installed in a room which is near by the grid point. The control cabinet and other electrical equipment are fixed on the foundation and installed as needed. If the control room consists of lightweight building materials, the walls and roof of the control room can be in place after installation.

### b) Steel structure assembly:

All the poles will be installed according to the foundation drawing at first. Hoisting each beam after finishing the installation of the poles. According to the connecting drawing of beam & poles to connect the poles & beam by the bolts. The torque wrench must be used in the steel structure assembly. The torque value of the torque wrench must be set to the specified torque value according to the design requirements of the connecting points.

c) Install the generators and position parts after the steel structure finished and then install the trailer. All trailers must install the wheels on the ground

according to the trailer assembly drawing and then inject hydraulic oil in the trailers.

d) Install the blades after the trailer installed. The blades installation requires the small crane (20 ton/40m arm).

e) Steel cables and chain installation after blades installed.

f) Control wiring:

Complete the connection of all control cables and power cables according to the instructions of the installation manual.

h) Cables connecting

When the structure, trailers and blades assembled, connecting all cables according to the electrical and cable connecting draw. All types of cables in place.

### Section III. Equipment acceptance & preservation management

1. Equipment acceptance. Super Turbine was divided into the following parts:

- Each (8) Blades put in a steel framer without package.
- Generator in wood box, one generator with one package.
- Steel structure without package, 40 units of poles, 40 units of beams.
- Trailers in wood box, one trailer with one box.
- Steel cables and chains in different wood box with mark.
- Center controller with wood box package and mark.
- Each AC/DC controller and inverter in different wood box, one inverter and AC/DC controller in wood box, one controller with one box and mark.
- Sensors & monitoring system and anemometer in a wood box with mark.
- Control wires in different wood boxes with mark.
- Power cables wrapped around a wheel with mark.
- Bolts, nuts in two steel boxes with mark.
- Installation tools in a big steel box with mark (one wind farm/one set of tools)
- Hydraulic oil with oil drums accordingly.
- Technical documents.

2. Acceptance process of the components in the wind farm.

The wind farm needs to set up a Temporary warehouse. The warehouse storekeeper of investor in cooperation with the technical staff, performs equipment acceptance according to the following procedures:

a) Count all types of boxes, box numbers and records

b) Fill in the warehouse receipt, in addition to the number of boxes and the box number, please indicate whether there is any damage.

c) When found that there is loss or some components was damaged, the warehouse storekeeper should fill out the report and report to his manager or boss and notify the carrier and supplier of the vacancy. Claims can be made to the responsible party when it affects the progress of the installation.

### 3. Warehouse management

#### a) Warehousing

All equipment with wood package needs rainproof. All components without wood package doesn't needs rainproof. All components, accessories, tools, oils, etc. shall be stored in the warehouse according to the regulations. For the packaging is intact, it will be installed in the short future.

#### b) Storage

Investors should establish and improve the rules and regulations of warehouse management to ensure that the materials in the warehouse are not damaged, and meet the requirements of safety, fire prevention, anti-theft, anti-deterioration, anti-corrosion and dust prevention.

#### c) Out of warehouse

The collection procedure should be completed. If it is stored on site, it shall be handled and taken by the responsible person.

## Section IV: Commissioning the Super Turbines

### 1. Commissioning item

- a) Checking all the connecting bolts of the steel structure.
- b) Checking all the tracks
- c) Checking each trailer and all the wheels of the trailers.
- d) Checking all the blades connecting on the trailer.
- e) Adjust each oil on the specified value of the hydraulic motor and test each hydraulic motor in the trailer with a testing tool.
- f) Checking main circuit、 switch and ground states
- g) Checking center controller function of pitch angle, checking each sensor including oil liquid level sensors, oil press sensor, bearing temperature sensor, encoder, wind meter, cables, lubricating and start status.
- h) Checking lubricating
- j) Set control parameters
- k) Review safe chain and monitoring.

2. Commissioning report

The commissioning report use  $\checkmark$  and  $\times$  mark recording the commissioning states. Pass use  $\checkmark$  and failed use  $\times$ . Status data such as temperature need to record the tested data.

If one item commissioning failed, must stop the system, and start again after analyzing and judging the cause, until commissioning was passed.

Below is the format of on-site commissioning report.

On-site tested report

Turbine number : 1----N

Pass sign:  $\checkmark$                 failed sign: X

1. Tested condition

10 minutes average wind speed ( ) m/s, Temperature ( ) $^{\circ}$ C

2. Equipment states

a) Positioning system

b) Pitch angle system

c) Generator

Temperature of bearing, temperature of generator rotor

d) Hydraulic system

Press of oil

e) Switch rated data ( according to the manufacturer’s data ) . Current & voltage of each pitch motor. Each hydraulic oil press of pitch system. Pitch software test

f) Data set up

Max rotation speed

$N_{max}$  ( ) r/min

Max RPM of generator

$N_{gmax(5\%)}$  ( ) /min

$N_{gmax(10\%)}$  ( )/min

The highest temperature of generator rotor.      $T=( )^{\circ}$ C

The highest temperature of hydraulic motor oil      $T=( )^{\circ}$ C

Average maxi power at 10min                          $P_{max}=( )$ kW

Instantaneous max power                              $P_{max}=( )$ kW

Max voltage of grid                                      $U_{max}=( )$ V

High voltage of grid (50ms)                          $U_{max}=( )$ V

Low voltage of grid (50s)                              $U_{min}=( )$ V

High frequency(200ms)                              $f_{max}=( )$ Hz

Low frequency (200ms)                              $f_{max}=( )$ Hz

Cut out wind speed(10min average wind speed)  $V_{out}=( )$ m/s

Max wind speed                                          $V=( )$ m/s

## h) Emergency brake

The time of blade feathering,

1 ~ 2s

System brake time.

8-10s

Tested Results √ or X?

**Chapter II Super Turbines running & operating**

## Section I Completion acceptance

## 1. The purpose of acceptance.

- a) Inspection construction quality. Clarify contractual responsibility
- b) Transfer the project from the construction phase to the production phase

## 2. Acceptance conditions

- a) The Super turbine has passed the trial operation, analyzed and evaluated, and meets the design requirements. Both the manufacturer and the investor have signed the test operation record or memorandum.
- b) Reconfirm the quality of the basic construction of the Super Turbine
- c) Reconfirm the qualified manufacturing quality of the Super Turbine
- d) Reconfirm that the Super Turbine installation quality is qualified
- e) Reconfirm that Super Turbine commissioning basically meets the requirements.

## 3. Specific items and contents of acceptance

- a) The main components (positioning system, pitch angle system, chain and generator system, brake system) , on grid system, operate normally, without abnormal vibration and no leakage (oil).
  - b) Each grounding resistance meets the requirements, and the single ground resistance is not more than 4Ω.
  - c) Safety and function meet the design requirements.
  - d) Wind turbine and personnel safety in the engineering process
  - e) The control system is functioning normally, including pitch angle regulation, starting, braking, power generation stability, power generation, emergency braking etc.
  - f) Monitoring and sensor functions are normal, including: wind speed, wind direction, speed, electrical parameters, temperature, vibration, grid power loss, etc.
4. The power quality of the turbine meets the grid requirements, including voltage and current changes, voltage flicker, inrush current, harmonics, etc.
  5. Vibration and noise are within the normal range
  6. Electromagnetic interference is within the normal range
  7. The tightening torque of all bolts meets the design requirements.
  8. No abnormalities in coating

---

## 9. Acceptance conclusion

- a) Based on on-site observations and analysis of the above records, research, and comparison with contract terms, make conclusions on eligibility or not, and make suggestions and suggestions for improvement and occurrence.
- b) Acceptance opinions and reports should be archived and used as official information for the wind turbine technical file.

## Section II Commissioning of Super Turbine system

After the completion of the acceptance of the Super Turbine, it will enter the trial operation phase. As the owner of the wind farm, the investor must not only prepare the project for normal operation, but also investigate whether the technical indicators of the various functions of the unit have met the design requirements under the test operation conditions.

### 1. The conditions of commissioning

- a) The installation quality of Super Turbines meets the requirements of the manufacturer's standards.
- b) The on-site commissioning of the Super Turbine has been completed, the parameters meet the requirements, and the trial operation is normal.
- c) The wind farm power transmission and transformation facilities meet the normal operation requirements.
- d) Environmental and meteorological conditions meet the requirements for safe operation.
- e) Other requirements specified by the Super Turbine manufacturer have been met.
- f) The adaptability requirements of wind farms for wind turbines have been met, for example, for resisting strong typhoons, moisture, sandstorms etc.

### 2. Everything is ready of the commissioning

- a) Designated leadership for the commissioning
- b) Developed a commissioning plan
- c) Trained operators and with working conditions
- d) Established wind farm management rules and regulations
- e) Developed emergency measures for accident handling

### 3. The term of commissioning

The commissioning time of 7mw wind farm is 300h

### 4. Management of wind turbine commissioning

The operators of wind farm should standardize the monitoring of the operation, and collect, sort and analyze the operating status and data,

especially the monitoring and analysis of the adaptability of the wind turbine. Abnormal situations should be dealt with in a timely manner. When serious abnormal conditions (such as overheating, abnormal vibration and noise, etc.) occur, the equipment should be shut down decisively. All abnormal situations should be notified to the production plant in time, and information communication and communication with the production plant should be strengthened. After the trial run is completed, the test run records should be completed as required by the manufacturer's manual. Signed by the representative of investor and manufacturer and classified in the crew technical file.

Thank you!