MINGYANG SMART ENERGY
明阳智能
地蕴天成·能动无限



Logistics and Installation Practices in China

Mark Lou, MINGYANG

MINGYANG SMART ENERGY™
明阳智能



1 A Quick Glance of MINGYANG

2 Wind Power Forecasting & Target in China

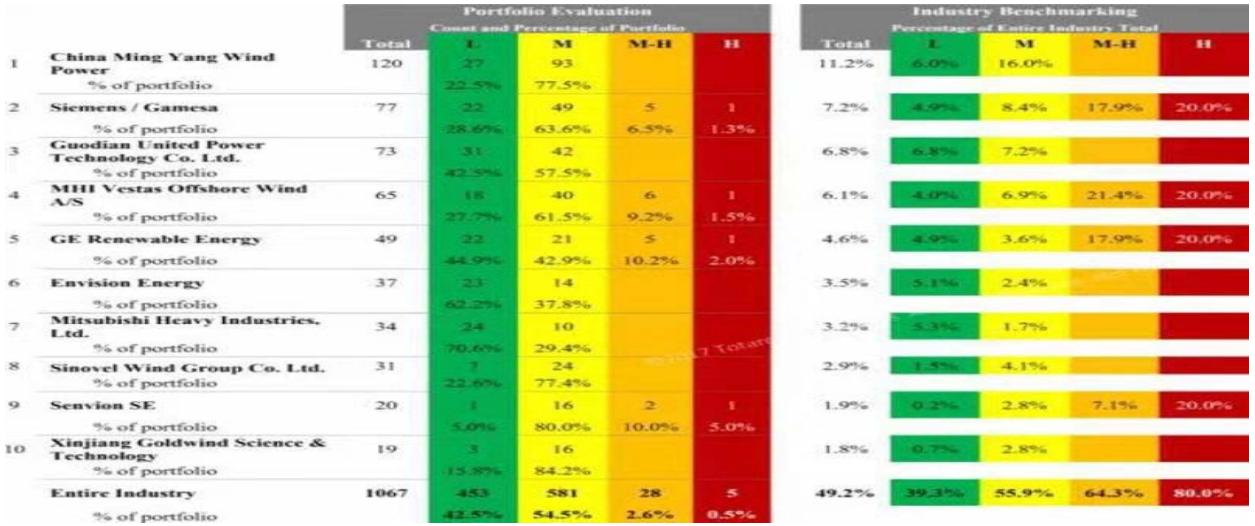
3 Logistics and Installation Full package Solutions

4 Innovative Practices

ABOUT MINGYANG

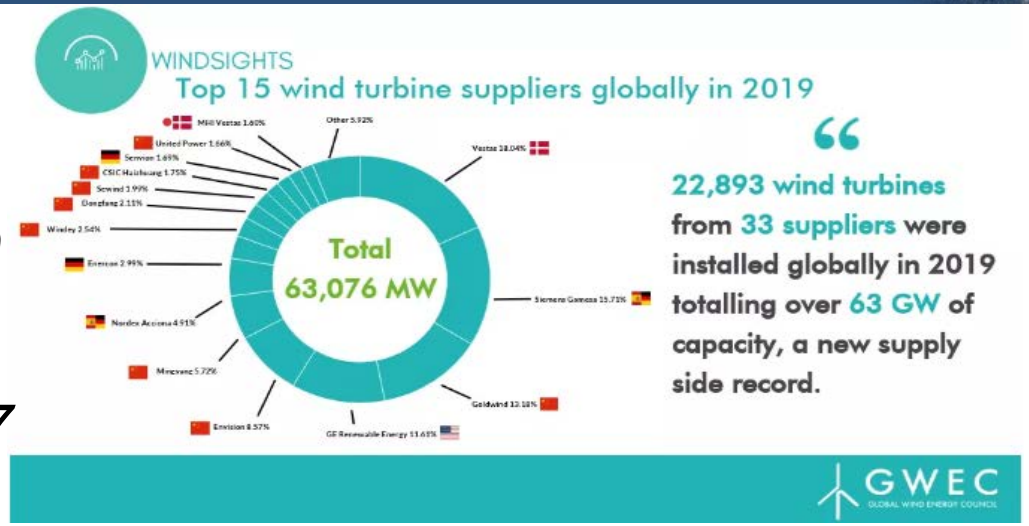
- *Rank No.6 wind turbine supplier globally in 2019*
- *Rank No.6 offshore wind turbine supplier globally in 2019*
- *Rank No.3 wind turbine supplier in China in 2019*

- *Best innovative offshore wind turbine globally in 2017 By Totaro & Associates(US)*



		Portfolio Evaluation					Industry Benchmarking				
		Count and Percentage of Portfolio					Percentage of Entire Industry Total				
		Total	L	M	M-H	H	Total	L	M	M-H	H
1	China Ming Yang Wind Power	120	27	93			11.2%	6.0%	16.0%		
	% of portfolio		22.5%	77.5%							
2	Siemens / Gamesa	77	22	49	5	1	7.2%	4.9%	8.4%	17.9%	20.0%
	% of portfolio		28.6%	63.6%	6.5%	1.3%					
3	Guodian United Power Technology Co. Ltd.	73	31	42			6.8%	6.8%	7.2%		
	% of portfolio		42.5%	57.5%							
4	MHI Vestas Offshore Wind A/S	65	18	40	6	1	6.1%	4.0%	6.9%	21.4%	20.0%
	% of portfolio		27.7%	61.5%	9.2%	1.5%					
5	GE Renewable Energy	49	22	21	5	1	4.6%	4.9%	3.6%	17.9%	20.0%
	% of portfolio		44.9%	42.9%	10.2%	2.0%					
6	Envision Energy	37	23	14			3.5%	5.1%	2.4%		
	% of portfolio		62.2%	37.8%							
7	Mitsubishi Heavy Industries, Ltd.	34	24	10			3.2%	5.3%	1.7%		
	% of portfolio		70.6%	29.4%							
8	Sinovel Wind Group Co. Ltd.	31	7	24			2.9%	1.5%	4.1%		
	% of portfolio		22.6%	77.4%							
9	Senvion SE	20	1	16	2	1	1.9%	0.2%	2.8%	7.1%	20.0%
	% of portfolio		5.0%	80.0%	10.0%	5.0%					
10	Xinjiang Goldwind Science & Technology	19	3	16			1.8%	0.7%	2.8%		
	% of portfolio		15.8%	84.2%							
	Entire Industry	1067	453	581	28	5	49.2%	39.3%	55.9%	64.3%	80.0%
	% of portfolio		42.5%	54.5%	2.6%	0.5%					

- *1.5GW offshore wind turbines were installed & 7.4GW+ Orders to be executed*
- *MySE 11-203: Single Largest wind turbine in China & The Largest hybrid-driven wind turbine Globally*



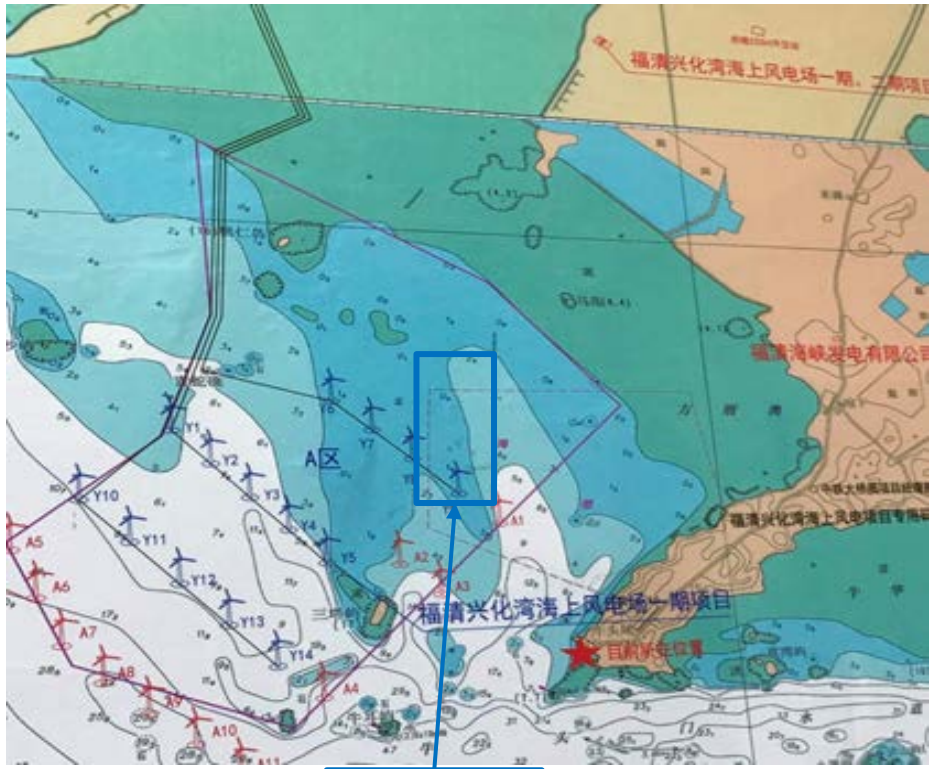
- *Best Turbine 2018 by WIND POWER MONTHLY*

No.	Ming Yang's	On the List of Best Turbine 2018
1	MYSE 5.5 - 155	Offshore
2	Ming Yang 76.6-metre blade for MySE 5.5 - 155	Blade

ABOUT MINGYANG

MySE Offshore WTGs – MySE5.5-155 Operation Performance

- China Three Gorges Corporation is one of the biggest IPP in China
- 8 OEM suppliers involved, including Mingyang, GE, Gold Wind, Shanghai Electric, XEMC, CSIC, DongFang Electric, and Taiyuan Heavy Industry.



Turbines from 8 OEMs are tested under the:

- same wind
- same site
- same environment



Project name:	Fujian Xinghua Bay offshore wind farm
Location:	Fujian Province, China
Water depth:	average 4.1 meters

Mingyang	GE	Goldwind	SEC(Siemens)	XEMC	CSIC	DEC	TZ
5.5MW	6.0MW	6.7MW	6.0MW	5.0MW	5.0MW	5.0MW	5.0MW

ABOUT MINGYANG

MySE Offshore WTGs – MySE5.5-155 Operation Performance



MySE 5.5-155 has the best performance

No. 1

- Best average energy production and availability
- Yearly full power generation 4836h，99.97% for Y9 position

First LVRT

- Successfully passed the first offshore LVRT in China

Quickest 240

- The quickest to pass the 240-hour test run and successfully completed the PAC

Full power production during Maria

- The only one run under full power during Typhoon Maria in July 13, 2018!

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WIND POWER FORECASTING&TARGET IN CHINA



- According to the National electric power planning, the installation capacity of wind power will be up to 1100GW by the year of 2035, which accounts for 25% of total power installation; to 1970GW by 2050, which accounts for 33% of the total.
- This means the newly installed wind power capacity will exceed 59GW each year from 2021 to 2035 and 57GW yearly from 2036 to 2050.
  --It is really big potential market for onshore and offshore wind power!

- "We'll take strong measures and strive to realize the carbon dioxide emission to the peak by 2030 and the carbon neutralization by 2060."
  —President Xi Jinping of People Republic of China



TO MAKE IT,
WE NEED TRANSPORT AND INSTALL MORE OFFSHORE WIND TURBINES!

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3、Logistics and Installation Full package Solutions



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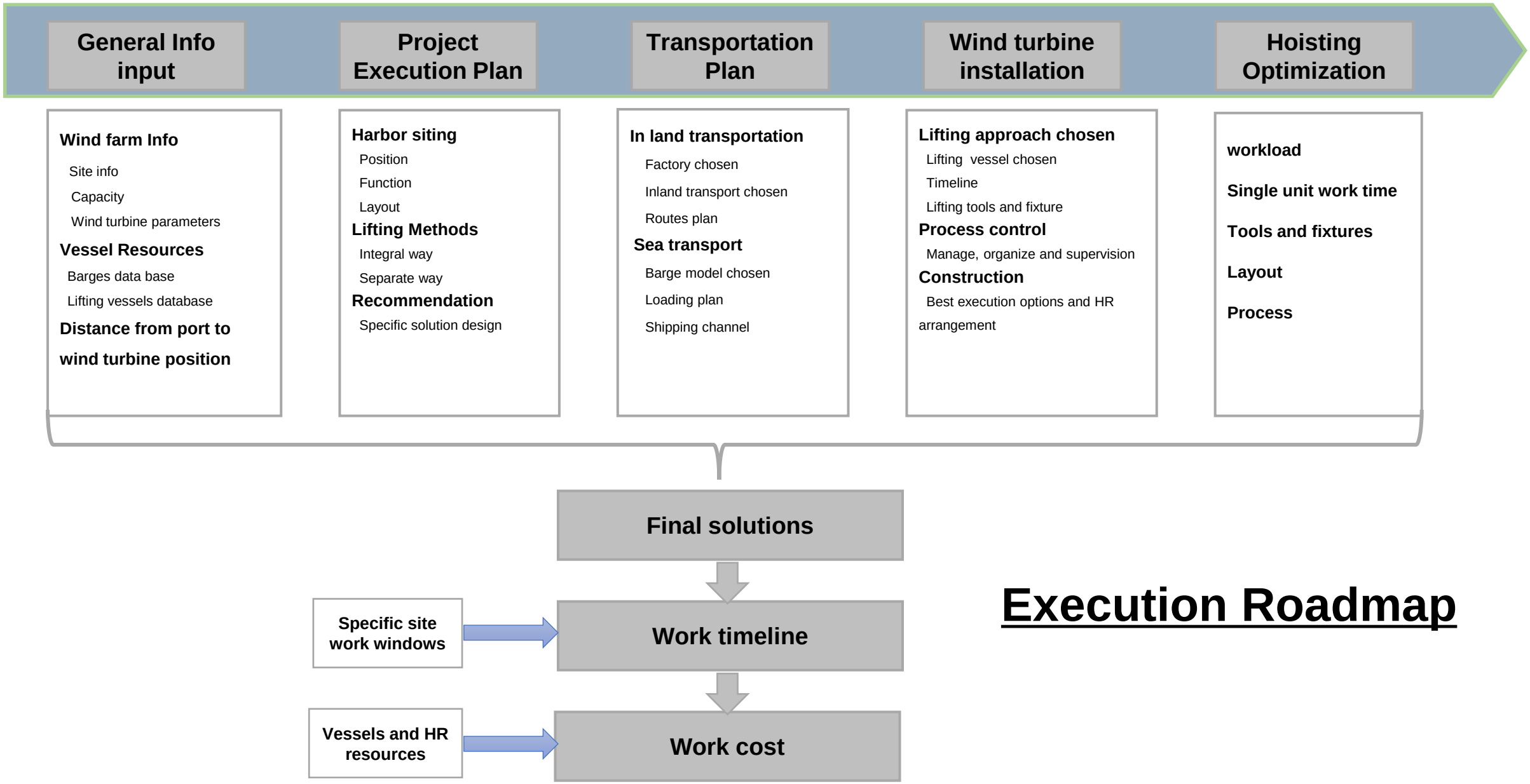
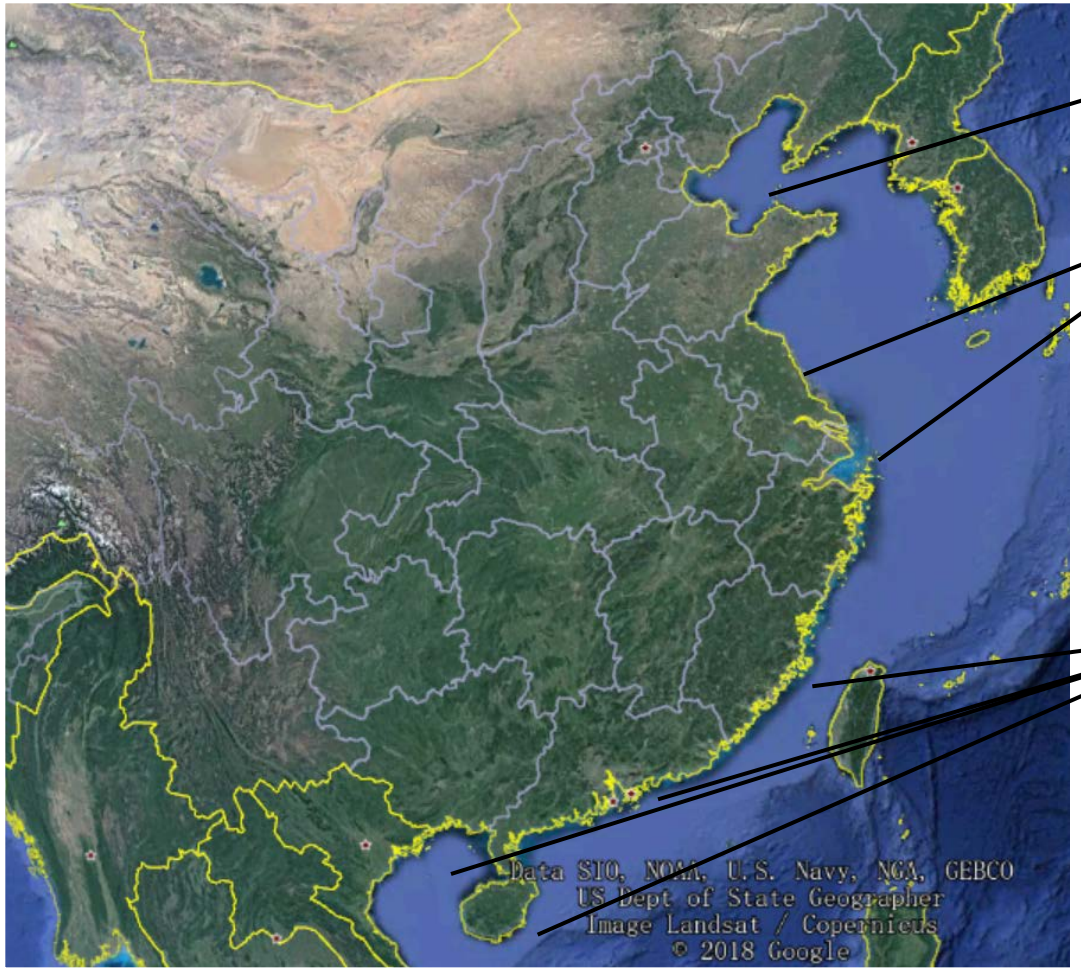
Execution Roadmap



General Info input



Bohai Sea：Wind speed: 6.5-8m/s; Foundation affected by ice load; Silty mud, sandy shore and rocky shore.

Jiangsu：Wind speed6.5-8.5m/s; Low Typhoon Probability; Silty silt.

Shanghai，Zhejiang：Wind speed 6.5-9.5m/s, Typhoon destructive climate; Sedimentary layers; Gentle continental shelf; Many channels and islands.

Fujian：8-10+m/s; Typhoon destructive climate; Rocky geology.

Guangdong：7-9m/s; Typhoon destructive climate; Rocky geology or silty mud.

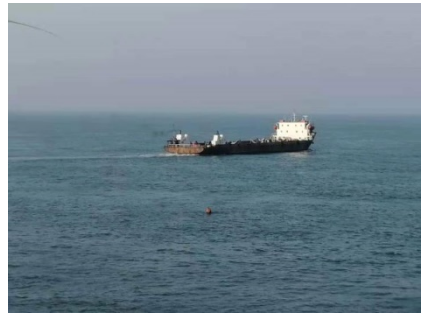
Guangxi：6.3-7.3m/s, fewer typhoons Compared with Guangdong; Silty mud.

Hainan：6.6-7.7m/s; Typhoon destructive climate; Reef or silt.

Vessel Resources

- Barges: 2000t、3000t、5000t、7000t、>10000t with different anchor positioning ability such as 2 anchors、4 anchors、6 anchors and 8 anchors.







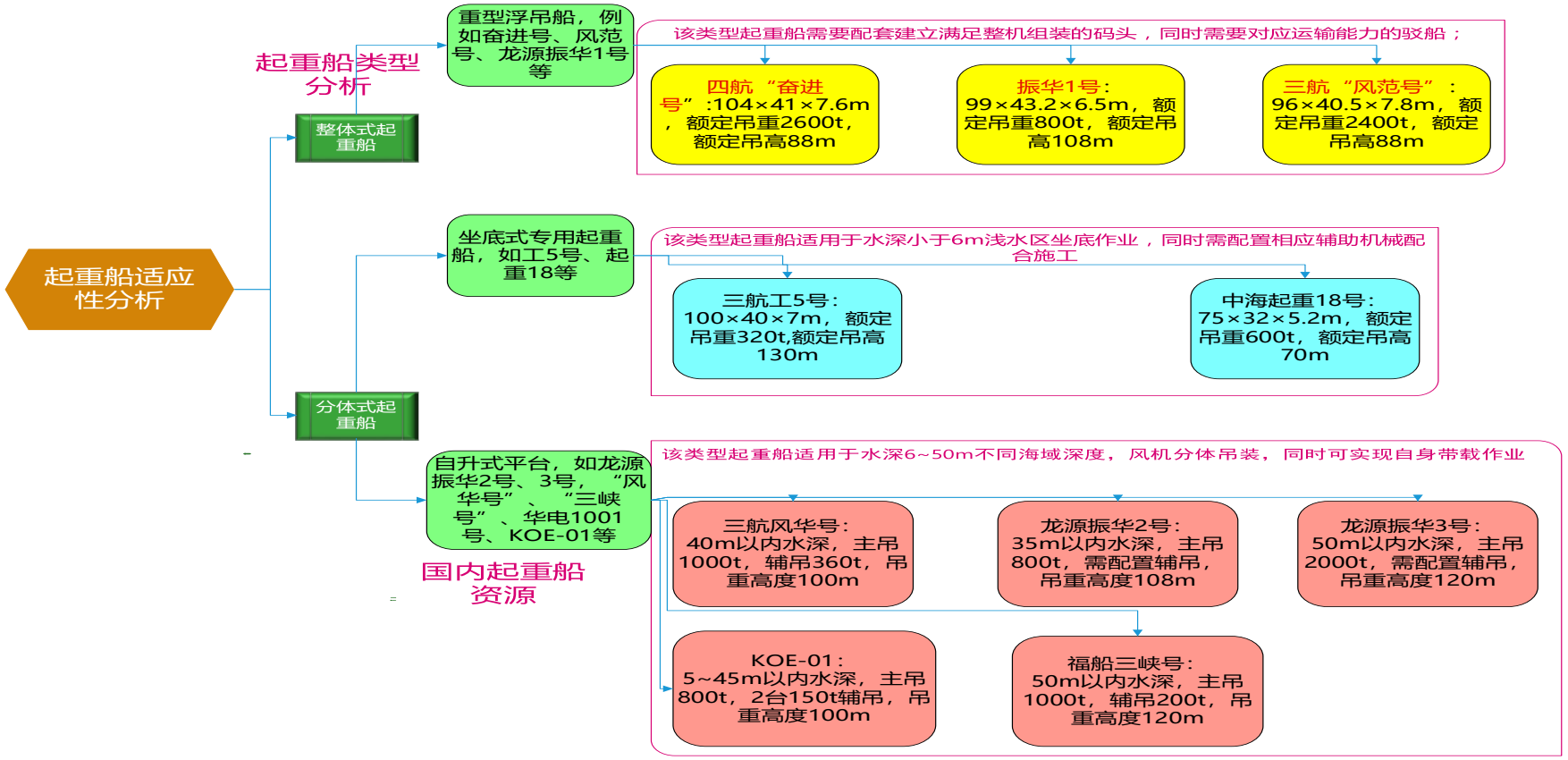





- All the barges will be evaluated according to the requirements and the most suitable barges will be chosen as the transport means based on their parameters, cost and performance.

Vessel Resources

- We analysis the crane performance based on the site info and feedback to the customer our suggestions.









- All the parameters of the jack up, floating crane and submersible crane are in our Vessel database.

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3、Logistics and Installation Full package Solutions



1. Execution roadmap and general input
2. **Harbor and lifting methods chosen**
3. Transportation plan
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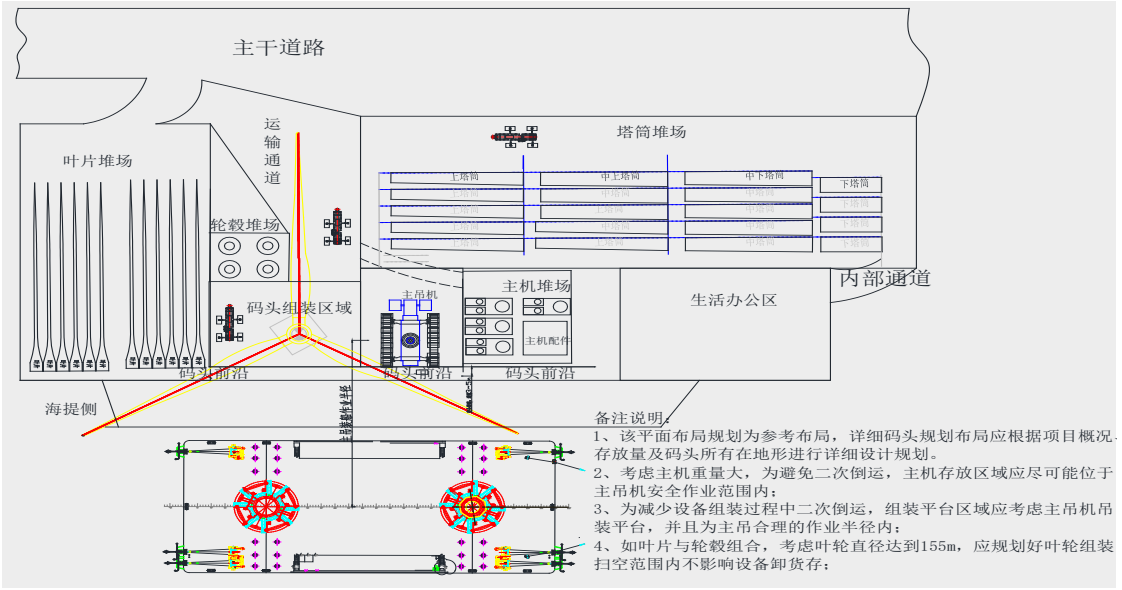
Harbor and Lifting methods chosen

Integral Lifting-Harbor Layout design

Ser.	Contents	Dimension（m）	Foundation	Remarks
1	Blade stockyard	78m×54m	Flat and compacted	**4 sets wind turbines stocked**
2	Hub stockyard	19m×5m		
3	Nacelle stockyard	20m×15m		
4	Tower stockyard	87m×30m		
5	Lifting platform	30m×16m	Standing area Bearing capacity 25t/m2，move path 18t/m2	900t crawling super crane
6	Assembling area	40m×40m	Flat and compacted	
7	Office	100m×100m	40 persons capacity	
8	Equipment area	20m×25m	Flat and compacted	
合计		**约19800m²**		

Ser.	Work content	Work hours	Remarks
1	Tower hoisting	10h	Including tower pre assemble
2	Tools hoisting	4h	Including beams and frame
3	Nacelle hoisting	3h	Including nacelle accessories mounting
4	Rotor assemble	6h	Including 3 blades assemble
5	Rotor hoisting	3h	**26 hours assemble per wind turbine**

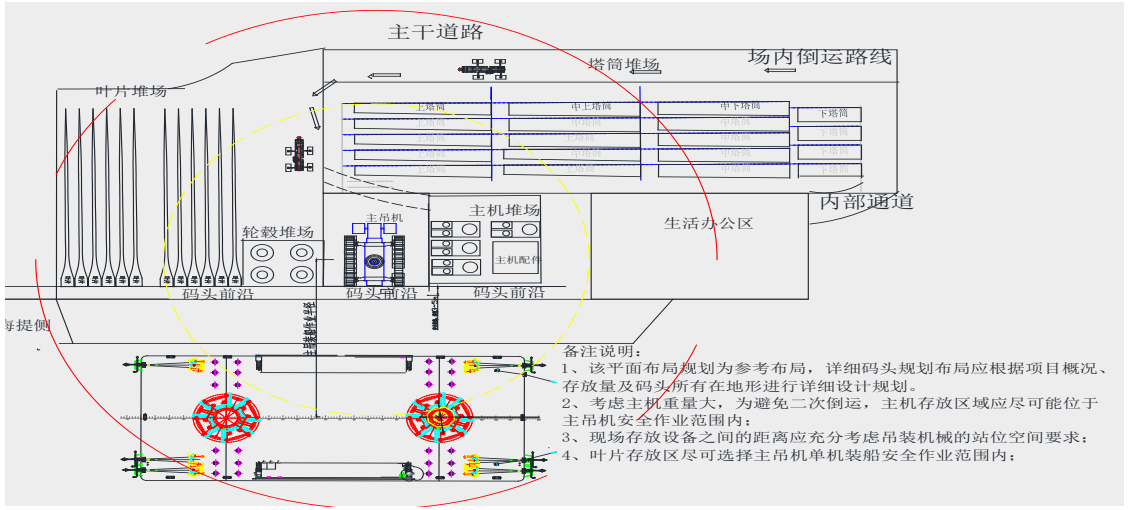


Harbor and Lifting methods chosen

Separate Lifting-Harbor Layout Design

Ser.	Contents	Dimension（m）	Foundation	Remarks
1	Blade stockyard	78m×54m	Flat and compacted	**4 sets wind turbines stocked**
2	Hub stockyard	19m×5m		
3	Nacelle stockyard	20m×15m		
4	Tower stockyard	87m×30m		
5	Lifting platform	20m×16m	Standing area Bearing capacity 20t/m^2，move path 15t/m^2	650t crawling crane
6	Assembling area	50m×50m	20 persons capacity	
7	Office	20m×25m	Flat and compacted	
Total		**10600m^2**		

Ser.	Contents	Work hours	备注
1	Tower loading	5h	Including 4 tower section loading
2	Nacelle loading	3h	Including nacelle accessories mounting
3	Hub loading	2h	Including nacelle accessories mounting
4	Rotor loading	6h	Including 3 blades loading
Total			**16 hours loading per wind turbine**



Harbor and Lifting methods chosen

Separate lifting ships needed

Ser.	Model	Function	Quantity
1	Jack up（1000t +）	Lifting	1
3	Self-driven Crane	Pre assembly	1
5	Barge	Component transfer	1
7	Anchor-positioning ship	Anchor position	3
9	Transport ship	Transport	2
One construction site			

Integral lifting ships needed

Ser.	Model	Function	Quantity
1	2400t floating crane	Lifting	1
3	350t jack up	Assist assemble and unload	1
5	Barge	Transfer fixture and tools	1
7	Communication ship	HR transfer	2
9	Alerting ship	Guide and alert	2
One construction site			

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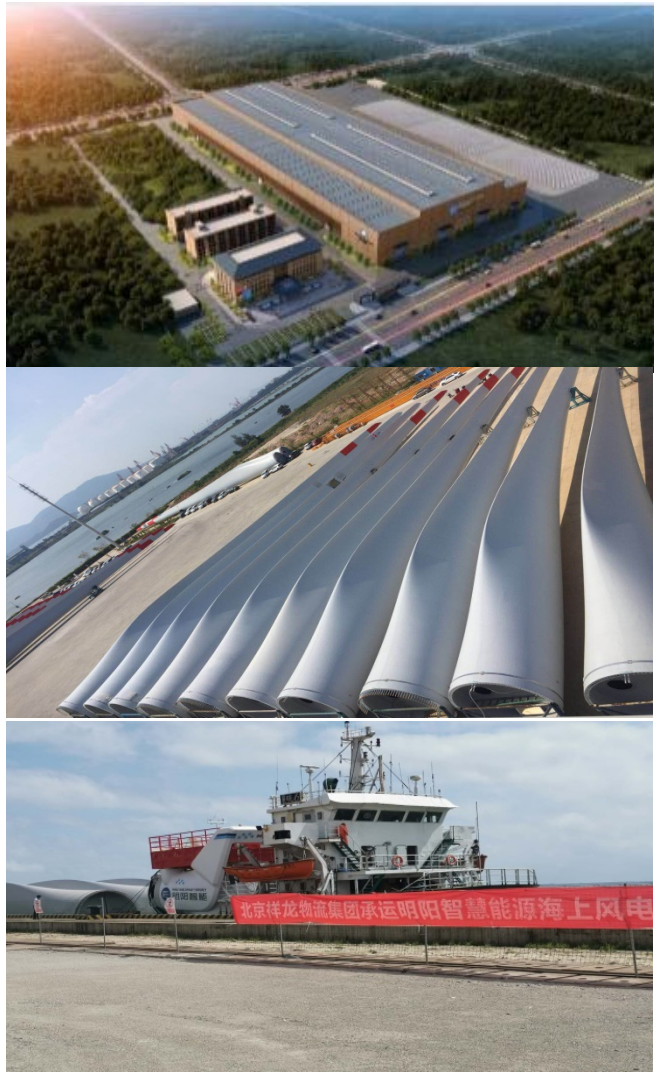
Transportation plan

- Plan different factories according to the wind farm position and different harbors based on the factories.



Zhuhai Factory



Yang Jiang Factory



Shanwei Factory

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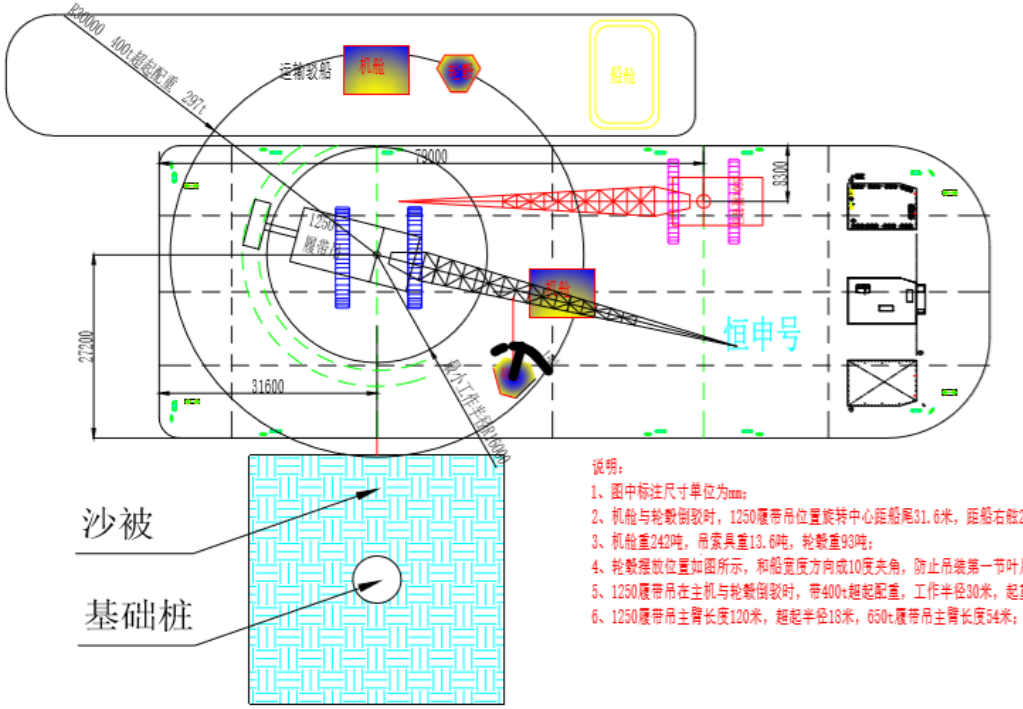
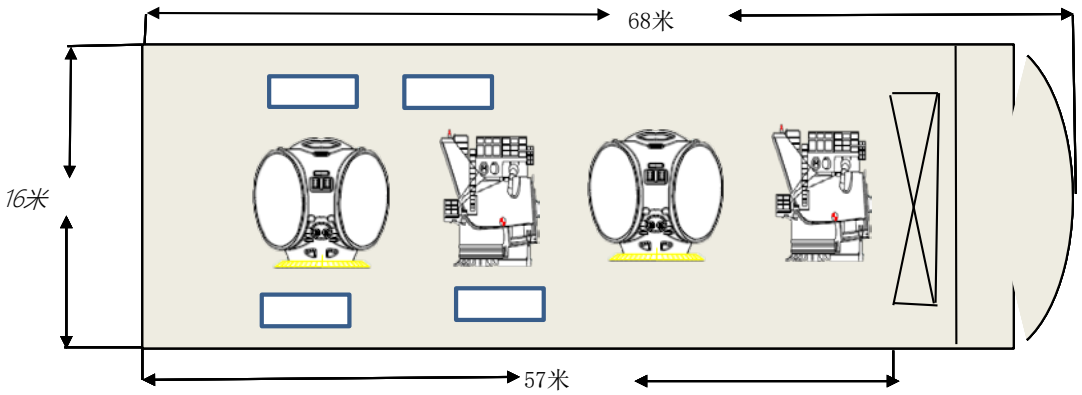


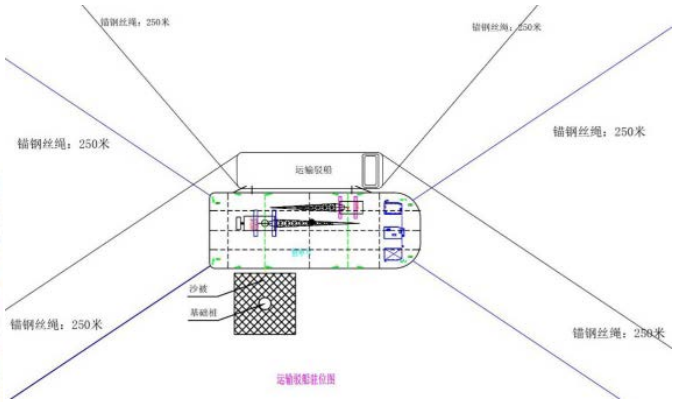






运输船进场路线示意图







Transportation Plan

deck arrangement and approach route

7.1.1Calculation sheet of forces acting on each cargo (各货物无限制工况综合受力分析计算表)

sheet 3	Calculation forces of cargo			
	Nacelle	Hub	Blade	
M	260	98	42	t
L	6	6.35	77.5	m
B	10.084	5.72	5	m
H	9.78	6.08	4.5	m
g	9.81	9.81		
Transverse force result				
z_o	4.90	4.30		
y_o	6.00	4.83		
Φ	30	30		
TΦ	10	10		
$F_{φy}$	267.85	91.88		
$F_{θz}$	326.88	102.6		
F_{qy}	58.68	38.61		
F_{wy}	12.00	12.70		
Longitudinal force result				
z_o	4.90	4.30		
x_o	25.40	26.33		
θ	15	15		
Tθ	10	10		
$F_{φx}$	131.47	43.49		
$F_{θz}$	681.51	266.2		
F_{qx}	98.62	34.78		
F_{wx}	20.17	11.44		
Vertical force result				
L_{vessel}	98.00	98.00		
a	1.96	1.96		
$F_{z(+)}$	3060.20	1153.4		
$F_{z(-)}$	2041.00	769.3		
F_{zy}	1020.50	384.6		
F_{zx}	528.25	199.1		
F_{zz}	1707.33	643.5		
COMBINA (综合惯性力计算) force result				
Fy	2634.33	1008.5		
F_x	1438.66	537.6		
Fz	-582.11	-208.2		

Hub 98T LASHING CAL

XZ Non Standarized Cargo Seafastening & Lashing Calc

Date:	2018/11/8		From:	玉柴
Voy. No.:	18001		To:	海上
Job. No.:	SEAFASTENING		Name:	Howard
Cargo item :	Hub			
Weight :	98	M. Tons		
Length :	6.35	M		
Width:	5.72	M		
Hight	6.08	M		
Dist. a(vertical-COG)	2.7	M		
DISt. b(tipping axis)	2.25	M		
F_y	1008.53	KN	from sheet 03	
F_x	537.64	KN	from sheet 03	
$F_{z(-)}$	-208.21	KN	from sheet 03	

Welding Capacity[kN / kNm] (SEE WELDING CALCULATION SHEET)

Transv. capacity:	PS [kN]	911.2	227.8KN/EACH
	SB [kN]	911.2	227.8KN/EACH
Long. capacity	Fwd [kN]	455.6	227.8KN/EACH
	Aft [kN]	455.6	227.8KN/EACH
Tipping capacity:	PS [kNm]	630	105KN/EACH
	SB [kNm]	630	105KN/EACH

Lashings Capacity[kN / kNm] (SEE LASHING CHAINS CALCUL

Transv. capacity:	PS [kN]	201.1745	Lashing ch
	SB [kN]	201.1745	
Long. capacity	Fwd [kN]	148.033	
	Aft [kN]	148.033	
Tipping capacity:	PS [kNm]	1886.011	
	SB [kNm]	1886.011	

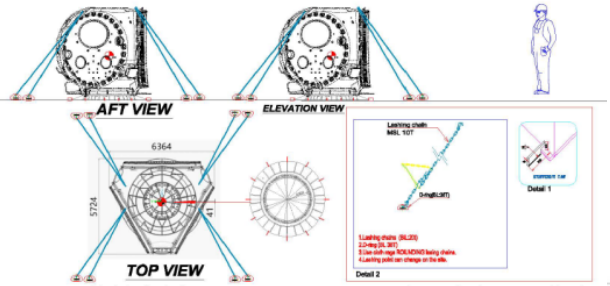
RESULTS:

Actual forces		Securing capacity
Transverse sliding force [kN]:	1008.5	Transv. capacity:
Longitudinal sliding force [kN]:	537.6	Long. capacity
Cargo tipping moment [kNm]	2723.0	Tipping capacity:

单边共计6只

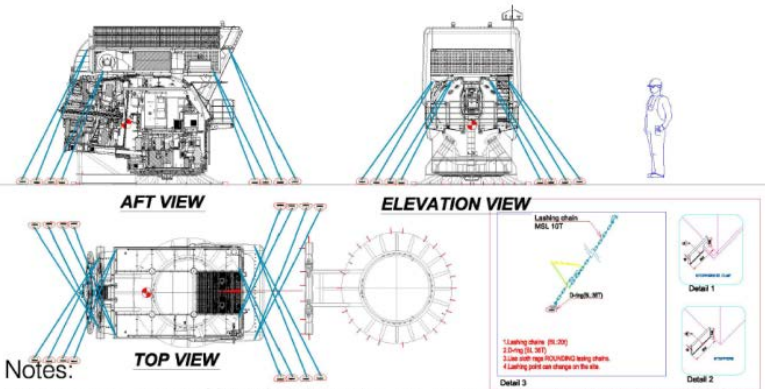
鞍座与本体之间用橡皮(纵向防滑)

Hub 6.35x5.72x6.08M/98T



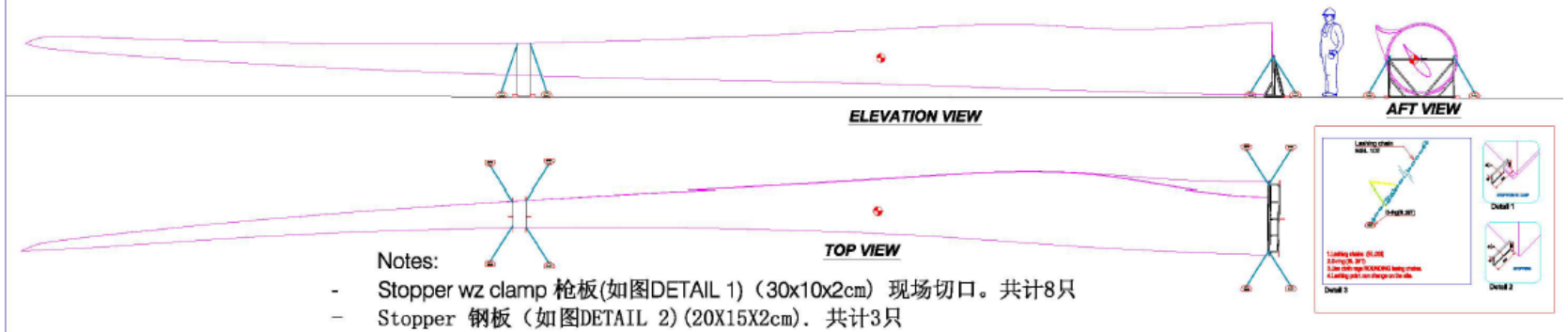
Notes:
Stopper wz clamp 枪板(如图DETAIL 1)（30x15x2cm）现场切口。共计12
Lashing chains wz tensioners (BL:20t)绑扎链条 （如图DETAIL 2）
D-RING (BL:36t) 地令（如图DETAIL 2）共计8只
绑扎点现场确定.

NACELLE 10.084X6X9.78M/260T



Notes:
Stopper wz clamp 枪板(如图DETAIL 1)（30x15x2cm）现场切口。共计24只
Stopper 钢板（如图DETAIL 2)(30X15X2cm). 共计8只
Lashing chains wz tensioners (BL:20t)绑扎链条 （如图DETAIL 3）共计16套
D-RING (BL:36t) 地令（如图DETAIL 3）共计16只
绑扎点现场确定.

风叶（BLADE）77.5X6.2X6M/42T



Notes:
- Stopper wz clamp 枪板(如图DETAIL 1)（30x10x2cm）现场切口。共计8只
- Stopper 钢板（如图DETAIL 2)(20X15X2cm). 共计3只
- Lashing chains wz tensioners (BL:20t)绑扎链条 （如图DETAIL 3）共计8套
- D-RING (BL:36t) 地令（如图DETAIL 3）共计8只

Ship fixing Safety calculation

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3、Logistics and Installation Full package Solutions



1. Execution roadmap and general input
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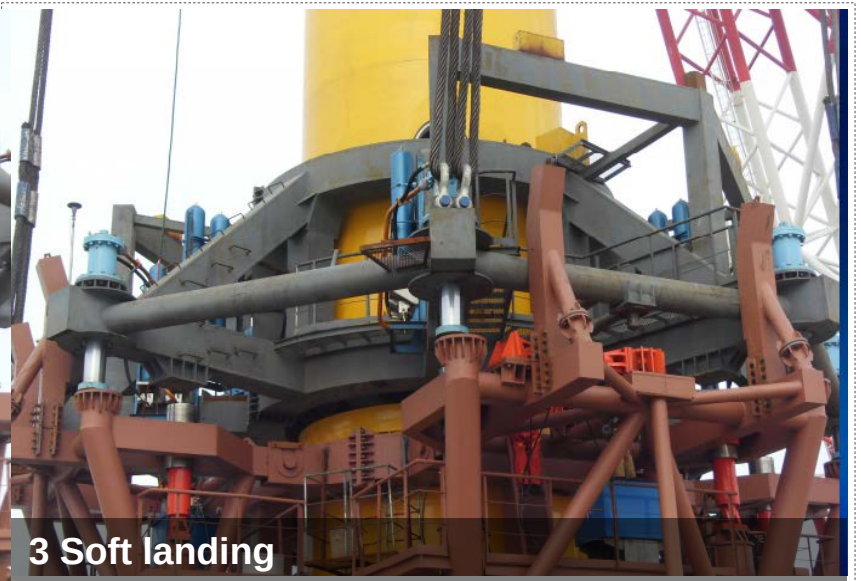
Integral lifting


1 Hoisting rigging


2 Positioning


3 Soft landing

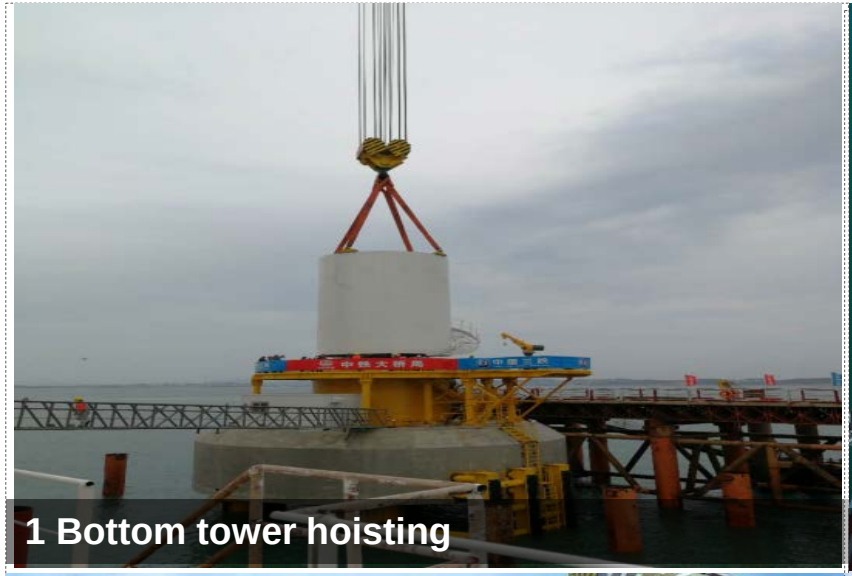

4 Accurate positioning


5 Remove the balance beam


6 Electrical container hoisting

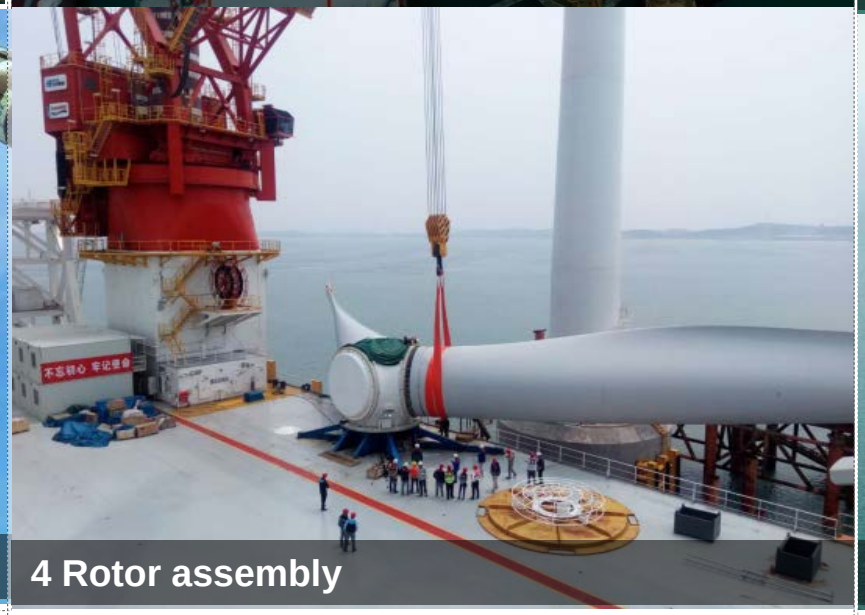
Separate lifting

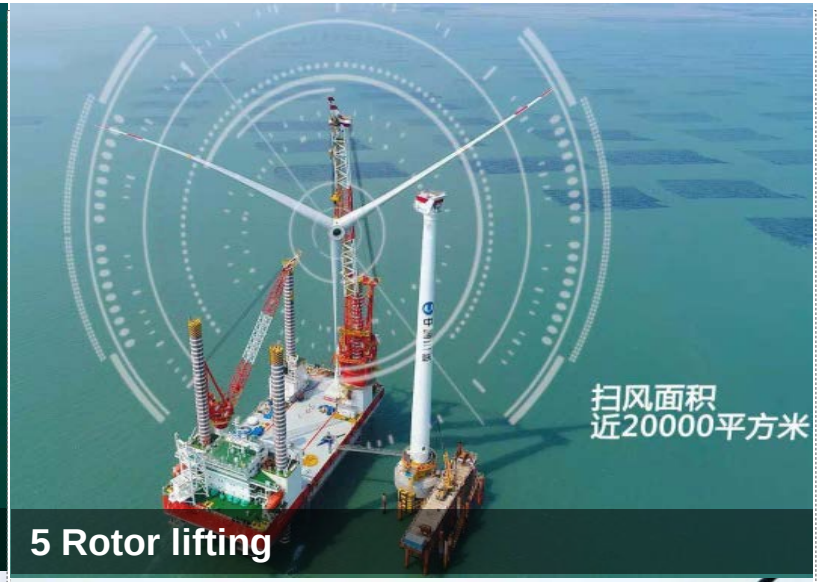
”Daqiao Fuchuan”, 1000t, 100m hoisting height


1 Bottom tower hoisting


2 Tower lifting


3 The nacelle hoisting


4 Rotor assembly



5 Rotor lifting


6 Rotor final assembling

Single blade lifting

Transport nacelle and hub together

↓

Hoist nacelle with hub

↓

+30°postion installation for the 1st blade

↓

Adjust the 1st blade from +30° to -60° using the special hoisting tool

↓

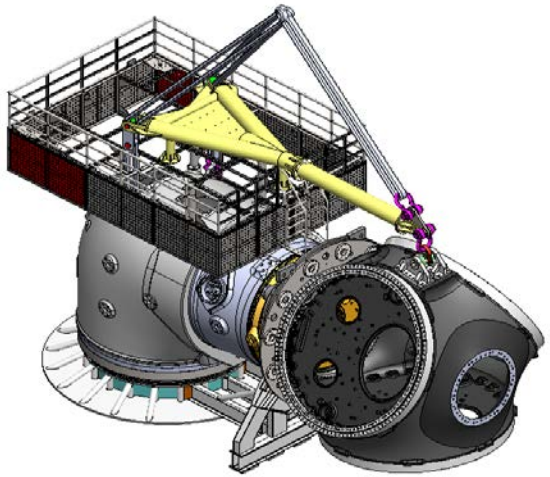
Install the 2nd blade in 0° position

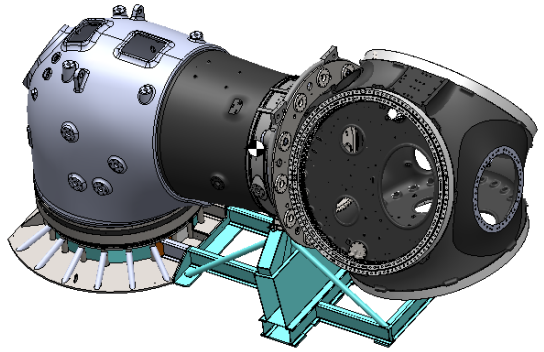
↓

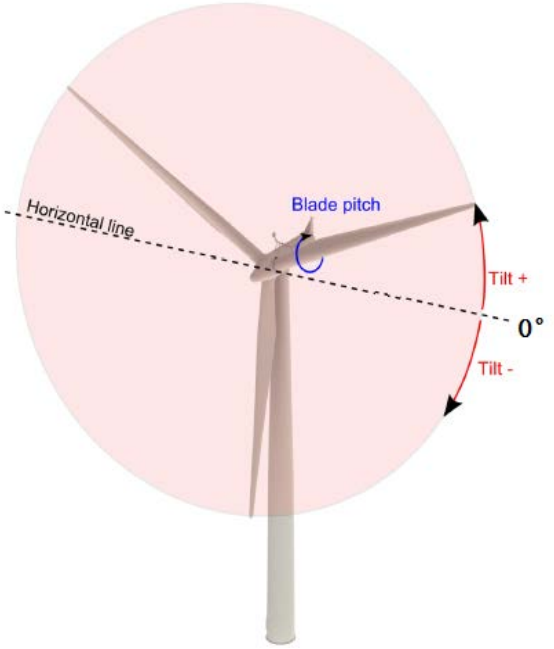
Adjust the 2nd blade from 0° to +30° using the special hoisting tool

↓

Install the 3rd blade in +30° position









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3、Logistics and Installation Full package Solutions



1. Execution roadmap and general input
2. Harbor and lifting methods chosen
3. Transportation plan
4. Installation solution
5. Solution optimization and finalization

Solution optimization and Finalization

$$\zeta(t)=\sum_{n=1}^{\infty}\zeta_n=\sum_{n=1}^{\infty}a_n(\omega_n t+\varepsilon_n)$$

H1/10 wave height cycle grade frequency Analysis
Wave-front Equation

$$f(H)=\frac{\pi}{2}\frac{H}{\bar{H}^2}\exp[-\frac{\pi}{4}\left(\frac{H}{\bar{H}}\right)^2]$$

Probability Density Function

1月										
周期（s）	0-2.9	2.9-3.9	3.9-4.9	4.9-5.9	5.9-6.9	6.9-7.9	7.9-8.9	8.9-9.9	9.9-10.9	10.9以上
个数	0	0	23	186	275	241	19	0	0	0
H≤0.6	-	-	0.13	0.13	0.67	-		-	-	-
0.6≤H≤0.8	-	-	0.81	0.54	3.36	0.4		-	-	-
0.8≤H≤1.0	-	-	1.34	4.3	7.53	8.06	0.4	-	-	-
1.0≤H≤1.2	-	-	0.4	9.01	8.87	7.39	1.48	-	-	-
1.2≤H≤1.5	-	-	0.27	8.6	8.47	8.87	0.13	-	-	-
1.5≤H≤2.0	-	-	0.13	2.42	7.93	7.39	0.54	-	-	-
2.0≤H≤2.5	-	-	-	-	0.13	0.27	-	-	-	-
2.5≤H≤3.0	-	-	-	-	-	-	-	-	-	-
3.0≤H≤3.5	-	-	-	-	-	-	-	-	-	-
3.5<H	-	-	-	-	-	-	-	-	-	-
总个数（个）	744									
6月										
周期（s）	0-2.9	2.9-3.9	3.9-4.9	4.9-5.9	5.9-6.9	6.9-7.9	7.9-8.9	8.9-9.9	9.9-10.9	10.9以上
个数	0	82	502	117	19	0	0	0	0	0
H≤0.6	-	5.14	14.86	4.03	-	-	-	-	-	-
0.6≤H≤0.8	-	3.33	31.94	5.56	-	-	-	-	-	-
0.8≤H≤1.0	-	2.22	9.31	1.94	-	-	-	-	-	-
1.0≤H≤1.2	-	0.69	8.61	2.78	0.42	-	-	-	-	-
1.2≤H≤1.5	-	-	5	1.81	1.25	-	-	-	-	-
1.5≤H≤2.0	-	-	-	0.14	0.97	-	-	-	-	-
2.0≤H≤2.5	-	-	-	-	-	-	-	-	-	-
2.5≤H≤3.0	-	-	-	-	-	-	-	-	-	-
3.0≤H≤3.5	-	-	-	-	-	-	-	-	-	-
3.5<H	-	-	-	-	-	-	-	-	-	-
总个数（个）	720									

MONTH	Installation window period (days)
1	1
2	4
3	6
4	14
5	19
6	25
7	18
8	10
9	12
10	11
11	3
12	0.4
合计	123

Working windows for each wind farm will be calculated and be shown as above.

Solution optimization and Finalization

Smart Construction Assessment System – MY Offshore ™

海上风电总容量: 198 兆瓦

风机型号: MySE5.5-155 所有风机参数

风机额定功率: 5.5 兆瓦

码头至风场平均距离: 10 公里

风机间平均距离: 1.4 公里

平均水深: 8 米

最大水深: 15 米

选择施工方式: 分体式叶轮拼装 查看吊装参数

指定安装船只: 大桥福船号 查看船只参数

每日工作时间: 12小时

Installation Part

经纬度的输入有两种方式
1.如果需要精准输入，请手动输入经纬度坐标
2.地图输入，可以在地图上选择相对应的地点

经纬度输入方式: 手动输入 地图选点

经度: 110 ° 38 ′ 52.8 ″

纬度: 20 ° 31 ′ 55.2 ″

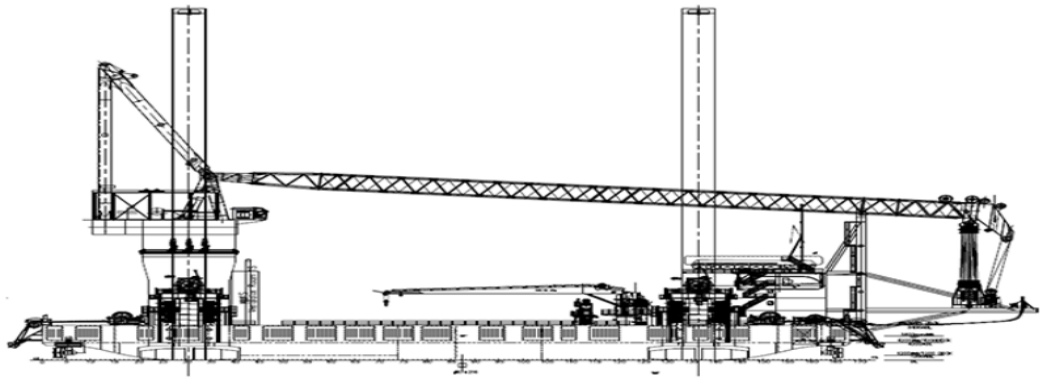
限制风速: 10 米/秒

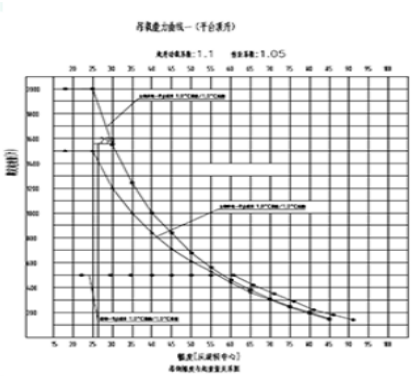
限制波高: 1.5 米

海上施工开始时间: 三月

Ship capacity and data

船名	总长（米）	型宽（米）	型深（米）	最大作业水深（米）	主钩（吨）	副钩（吨）	吊高（米）	空船航速（节）	满载航速（节）	升降速度（米/分钟）
大桥福船号	108.5	40.8	7.8	50	200	120	80	5	2	0.5

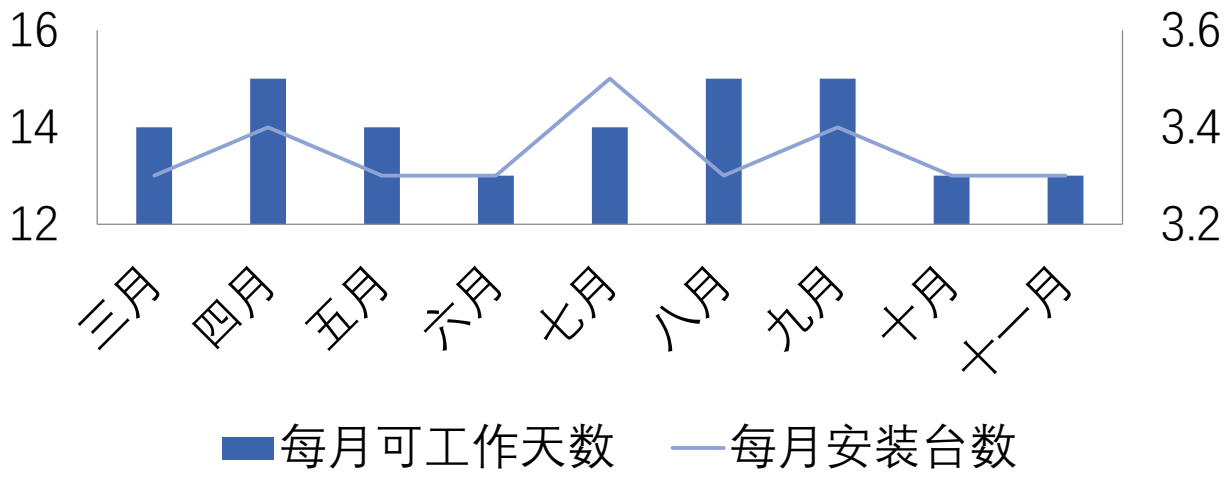




All the related info will be input into our “MY Offshore” system which can calculate、check and optimize the whole process of construction.

Solution optimization and Finalization

Weather allowed



Construction cost assessment

Ship	Hoistin ways	Duration/ WTG	Time limit Total	Average efficiency	Cost/wtg	Remark
***	Separate rotor assemble	3.5	267	4.1	377.3	1 work site

Installation fleet

Ser.	Model	Function	Quantity
1	JACT-UP（800t)	Separate hoisting	1
2	Barge with 10000t	Transit platform and temporary floating wharf	1
3	towboat	towing	1
4	Self-propelled rotary crane (350t)	transit or pre-assemble	1
5	Anchor boat	ships anchor	3
6	Transportation ship	worker commuting	2
7	Guard ship	emergency help and safety alert	2
8	Transport barge		2

Solution optimization and Finalization

Loading on board, transportation, installation, the average installation time spent is 30h per WTG, about 106 man-hour were input

Preparation		
Unloading	Jack up positioning	Foundation Re-inspection

Tower installation		
Tower unloading	Installation each part	Electric& accessories installation

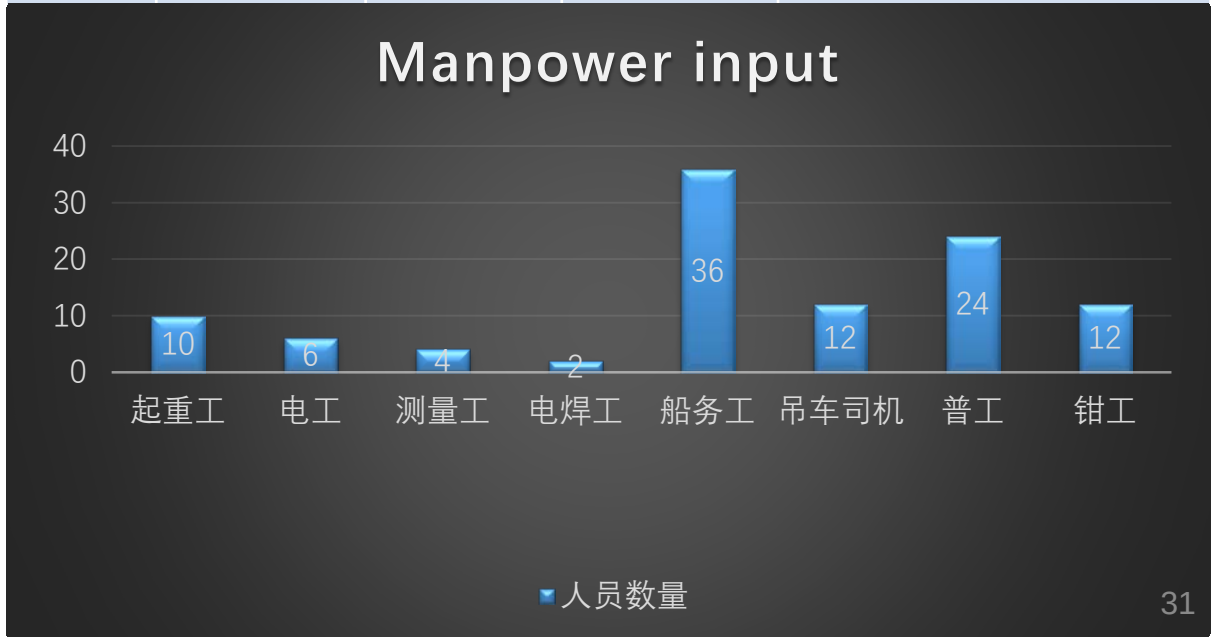
Nacelle hoisting		
Nacelle unloading	Accessories installation	Hoist the nacelle

Rotor assemble		
Blades unloading	Assemble blade and hub	Torque check

Rotor installation		
Erection tools linked	Rotor hoisting	Torque tightening

Wind turbine acceptance	
Install transformer and electric container	Electrical parts connection and acceptance

Ser.	Contents	Min man-hour	Max man-hour	Remarks
1	Positioning	3h	6h	Cargo ship and jack up
2	Tower hoisting	8h	12h	4 parts tower
3	Nacelle hoisting	2h	4h	
4	Rotor assemble	6h	9h	3 blades assemble on deck
5	Rotor hoisting	4h	6h	



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1 A Quick Glance of MINGYANG

2 Wind Power Forecasting & Target in China

3 Logistics and Installation Full package Solutions

4 Innovative Practices

Mingyang Offshore Wind Farms
Part of Records



Southern Grid Zhuhai Guishan
85MW,29 MySE3.0



CTG Fujian Xinghua Bay
11MW，2 MySE5.5



Datang Jiangsu Binhai
150MW,50 MySE3.0



Guangdong Energy Wailuo,
200MW, 36 MySE5.5-155



CGN Yangjiang Nanpeng Island
400MW,73 units, MySE5.5-155



CTG Yangjiang Shapa
300MW, 55 MySE5.5-155



Track Records



Guangdong Energy Jinwan
300MW, 55 units, 5.5MW



CGN Houhu Project
500MW, 91 units,5.5MW



CECEP Yangjiang
300MW, 55 units, 5.5MW



China Huadian Fujian
150MW, 22 units, 7.0MW



Mingyang Shapa
300MW, 44units, 6.45MW

- China Datang Binhai：9 wind turbines installation per month
- CGN Nanpeng：16 wind turbines installation per month
- “Huadian Wenqiang” Jack-up：27 hours installation finished

Practice 1: Integral Transportation and Lifting



- Mainly using the large crawling crane to install the wind turbine in the multi-functional harbor and transport it to the position with a 10000t class barge.
- Using floating crane to install the wind turbine on the foundation.

Preconditions:

- Functional port is near the wind farm;
- Transport balance beam, upper and bottom lifting frame and accurate positioning fixtures are necessary;
- Floating crane with enough lifting height and weight.





Practice 1: Integral Transportation and Lifting

- Case1: For some projects with multi-functional harbor







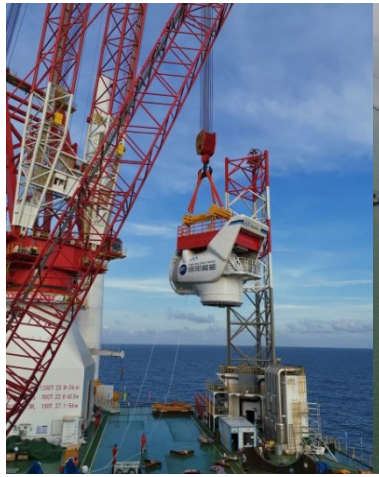
Practice 2: Separate transportation, assembling and Lifting

- Case2: For most of Chinese Projects













Practice 2: Separate transportation, assembling and Lifting

- Case 3: For some Projects with rough sea conditions



- Using big barge(over 10000t) to transport more wind turbines and towers
- It could partly solve the wave problem comparing with those small tons barge.

Preconditions:

- At least 6 positioning anchors with length≥ 100m、width≥ 22m、depth of immersion≥4.2m,single anchor hook ≥5t

Practice 3: Jack-up direct transport





- Using jack-up to pick up wind turbines and towers in the harbor and transport to the position, then install them.

Preconditions:

- Harbor can meet the legging requirements;
- Enough Space to lay the wind turbines, blades and towers;
- Distance from position to harbor is not far away.



Practice 3: Jack-up direct transport

- Case 4: for winter installation projects and the jack up with self-propelled

1 Berthing



3 Nacelle&hub loading



5 Check



2 Tower loading



4 Blades loading

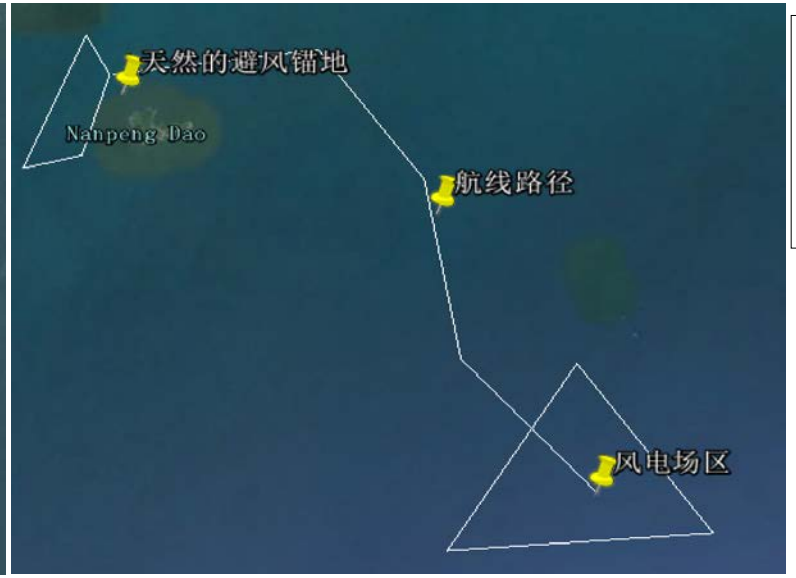


6 Departure



Practice 4: Anchorage transfer

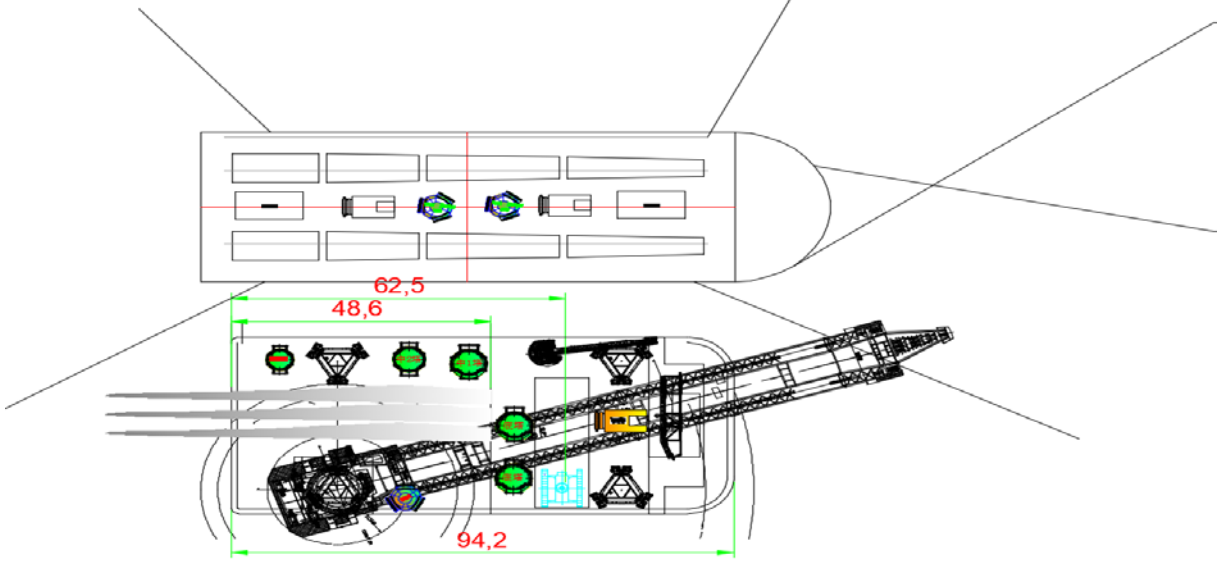


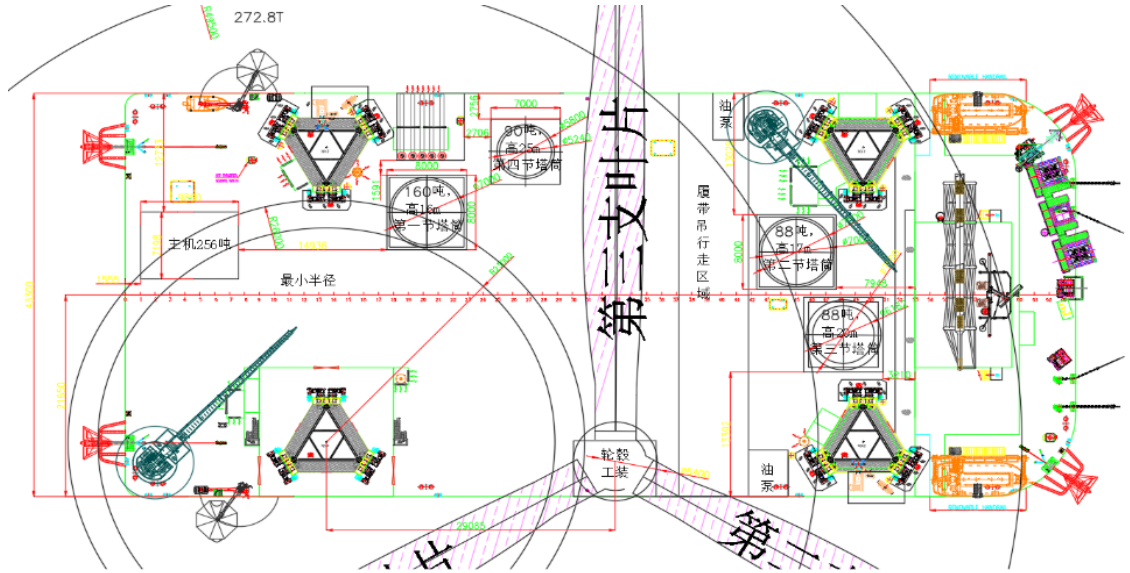


Taking advantage of the anchorage or the shelter bay near the wind farm to transfer the wind turbines from barge to Jack up, assembled, then transport to the position.

Preconditions:

- There are anchorages or shelter bays;
- The anchor place are suitable for legging;
- The barge with 4 position anchors





Practice 4: Anchorage transfer

- Case 5: for some projects in China





Rotor assemble













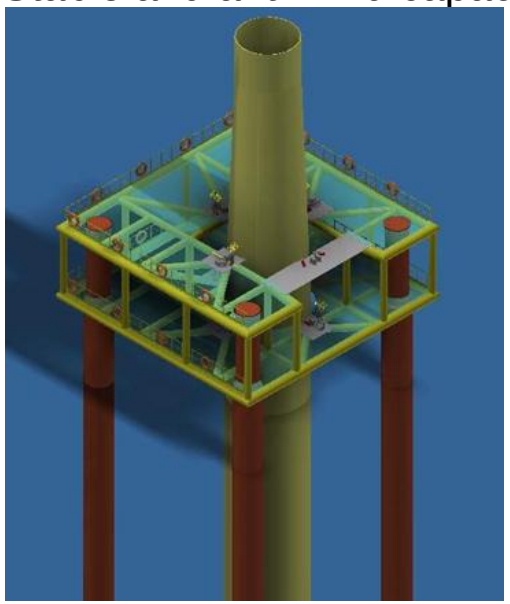
Practice 5: Temporary bearing platform

Case 7: undergoing

Build pile platform foundation near the wind turbine position, then put the crawling crane on it to lift the wind turbine.

Preconditions：

- Geological condition is suitable for the piling；
- Foundation and platform can bear the crane；
- Enough space for the rotor assembling；
- Stable and anti-wind capacity is ok for the lifting.



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