臺灣中部風場海域環境及施工碼頭規劃概況

An Environment Study Of The Offshore Wind Farm in The Central Taiwan and The Planning of Fabrication Yard

中興工程顧問股份有限公司

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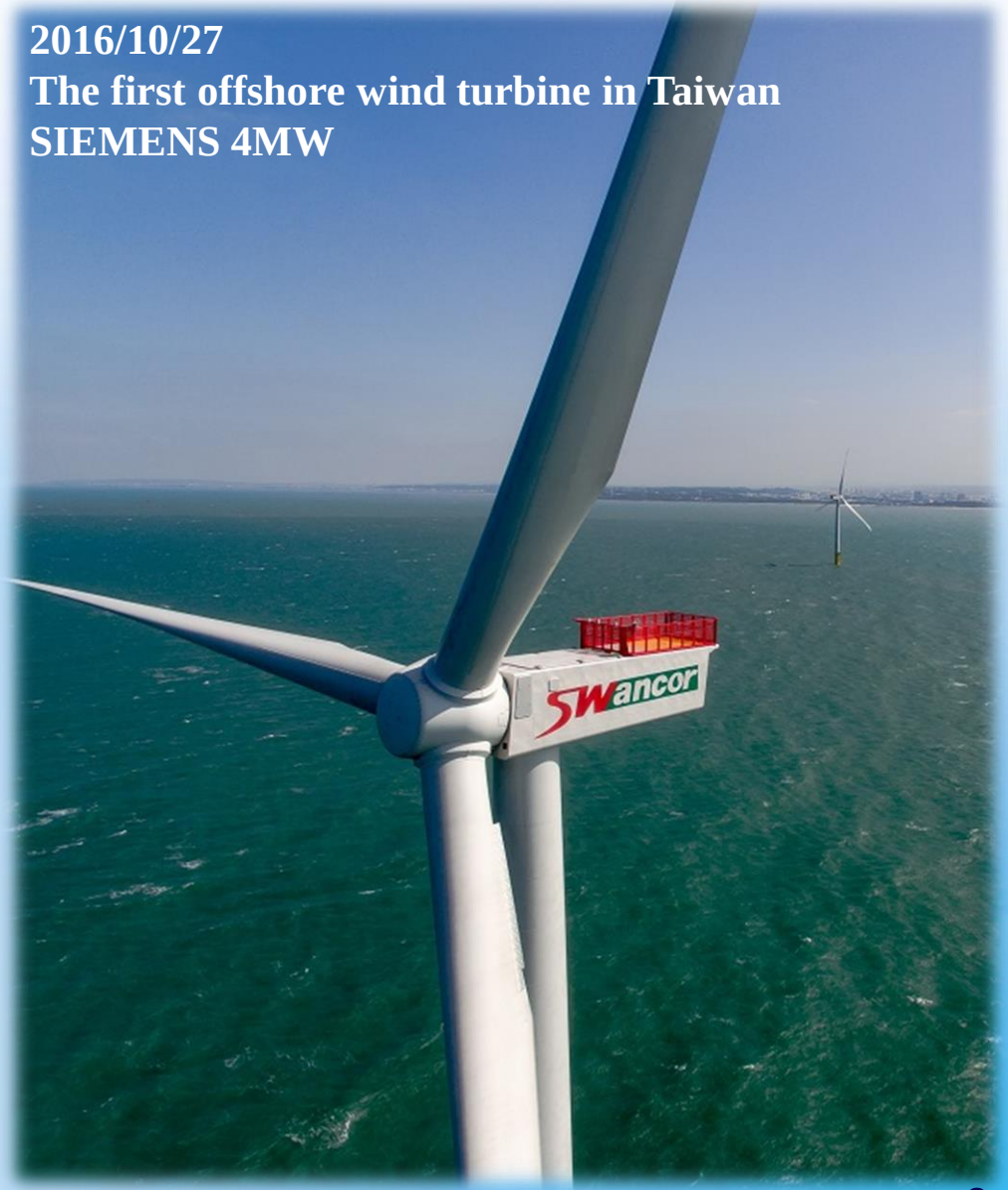
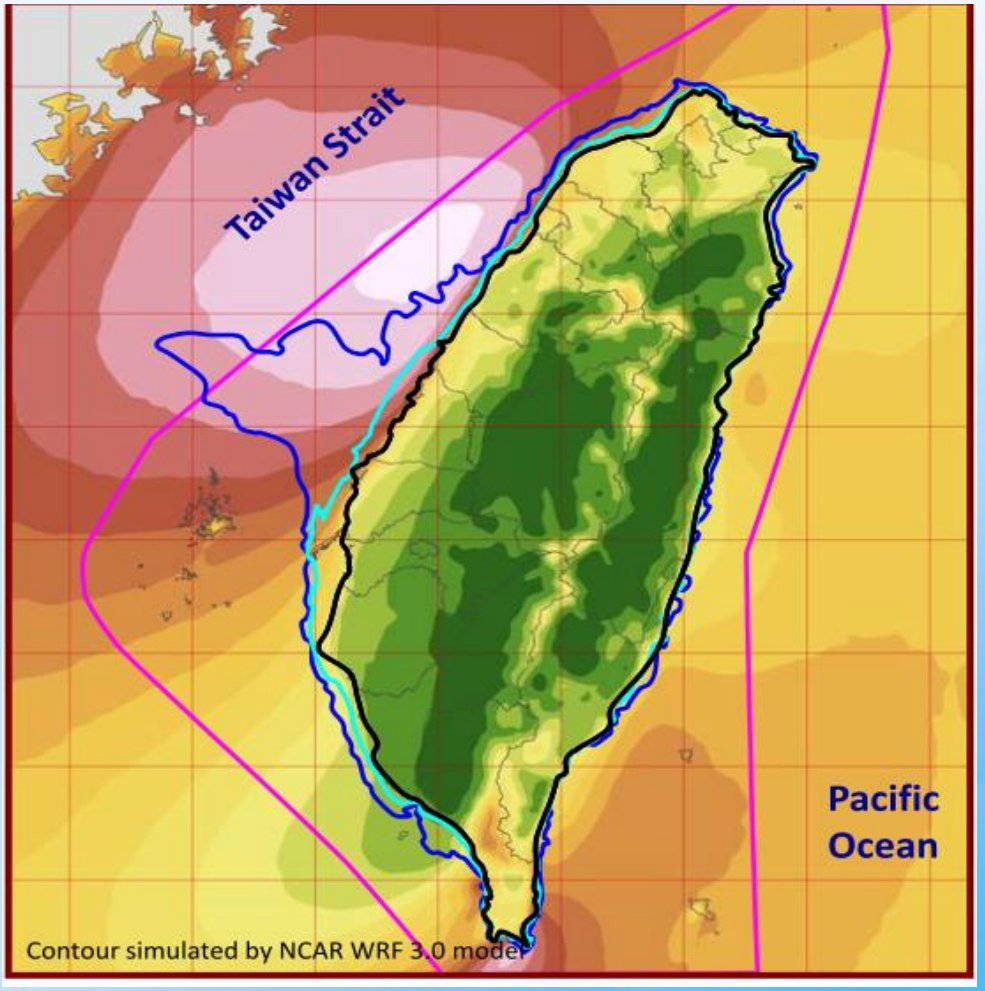


The Situation of Offshore Wind farm in Taiwan

Potential Wind Energy in Taiwan

- **Water depth:5~20m**
  - Area：1,779.2 km^2
  - Total Potential：9 GW
  - Exploitation：1.2 GW
- **Water depth:20~50m**
  - Area：6,547 km^2
  - Total Potential：48 GW
  - Exploitation ：5 GW
- **Water depth>50m**
  - Total Potential ：90 GW
  - Exploitation ：9 GW



Density of Wind Energy(W/m^2)

< 100	400 - 500	800 - 900	1,200 - 1,300
100 - 200	500 - 600	900 - 1,000	1,300 - 1,400
200 - 300	600 - 700	1,000 - 1,100	1,400 - 1,500
300 - 400	700 - 800	1,100 - 1,200	> 1,500

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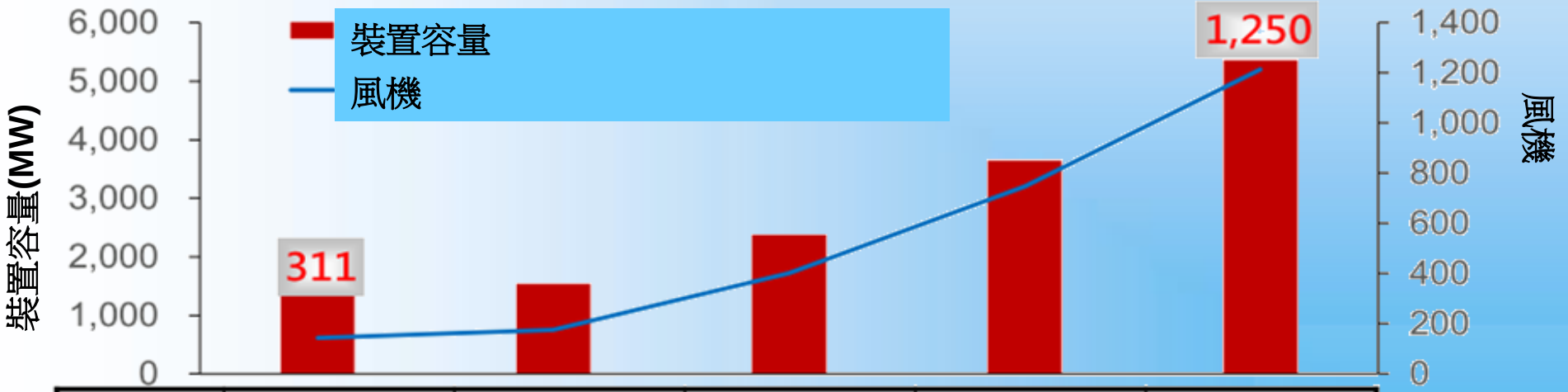
The Project of Thousand Wind Turbines in Taiwan

- **Targets**
  - **Recently ： 4 demonstration offshore wind turbines by 2016**
  - **Medium ： Offshore 520 MW by 2020**
  - **Future： Offshore 3,000 MW by 2025, 4,000 MW by 2030**



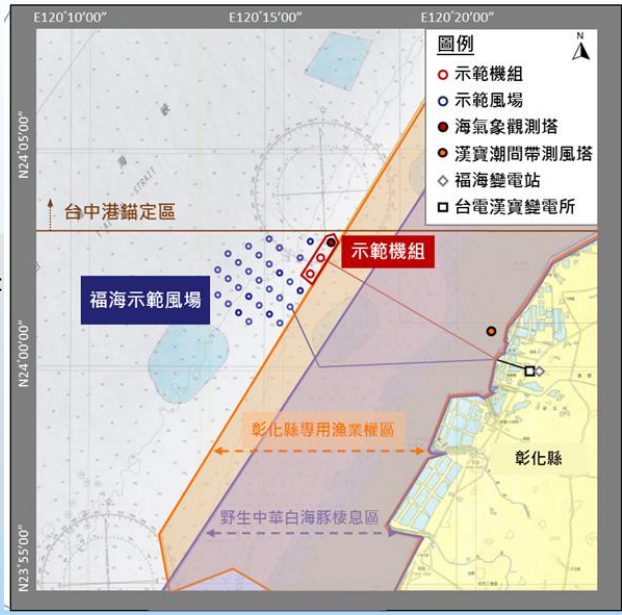
Year	2013		2015	2020	2025	2030	
	MW	WTs	MW	MW	MW	MW	WTs
岸上	614	311	737	1,200	1,200	1,200	450
離岸	0	0	0	520	2,000	4,000	800
總風力發電裝置容量	614	311	737	1,720	3,200	5,200	1,250

Offshore Demonstration Incentive Program

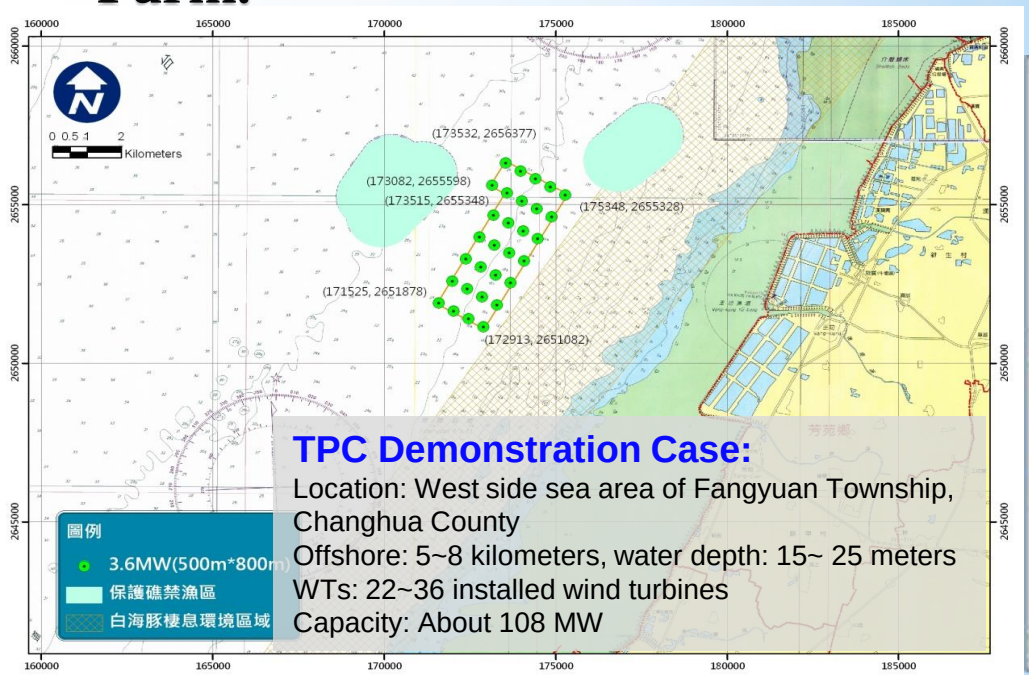
In 2013.1.25

Energy of Bureau announced：

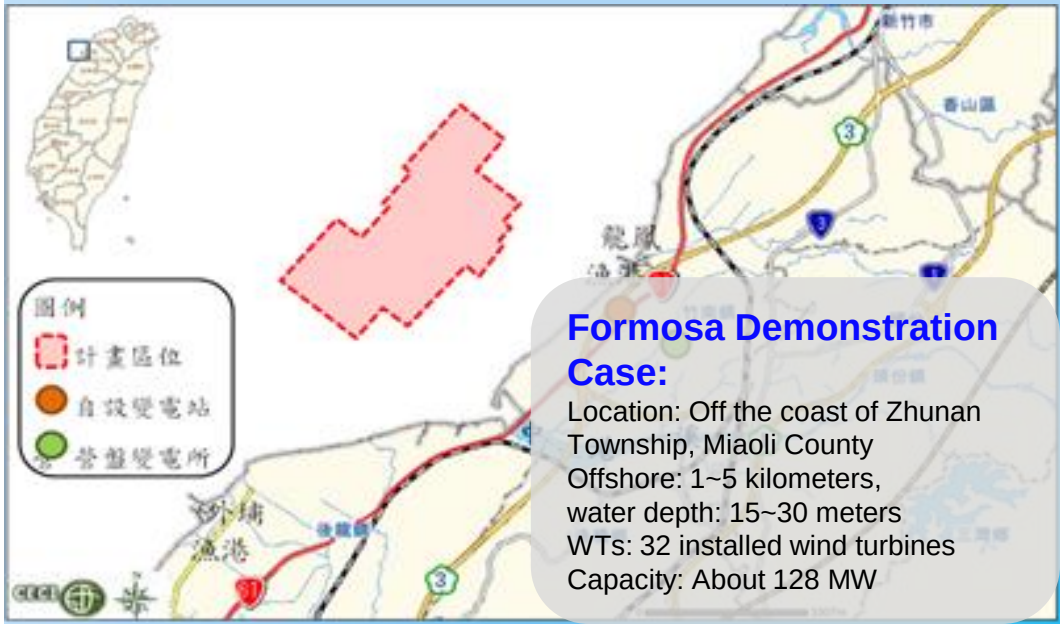
Swancor(Formosa), Taiwan Generation (Fuhai)and Taipower got the license to exploit the demonstration wind Farm.



Fuhai Demonstration Case:
Location: Off the coast of Fangyuan Township, Changhua County
Offshore: 8~12 kilometers,
water depth: 20~45 meters
WTs: 30 installed wind turbines
Capacity: About 120 MW



TPC Demonstration Case:
Location: West side sea area of Fangyuan Township, Changhua County
Offshore: 5~8 kilometers, water depth: 15~ 25 meters
WTs: 22~36 installed wind turbines
Capacity: About 108 MW

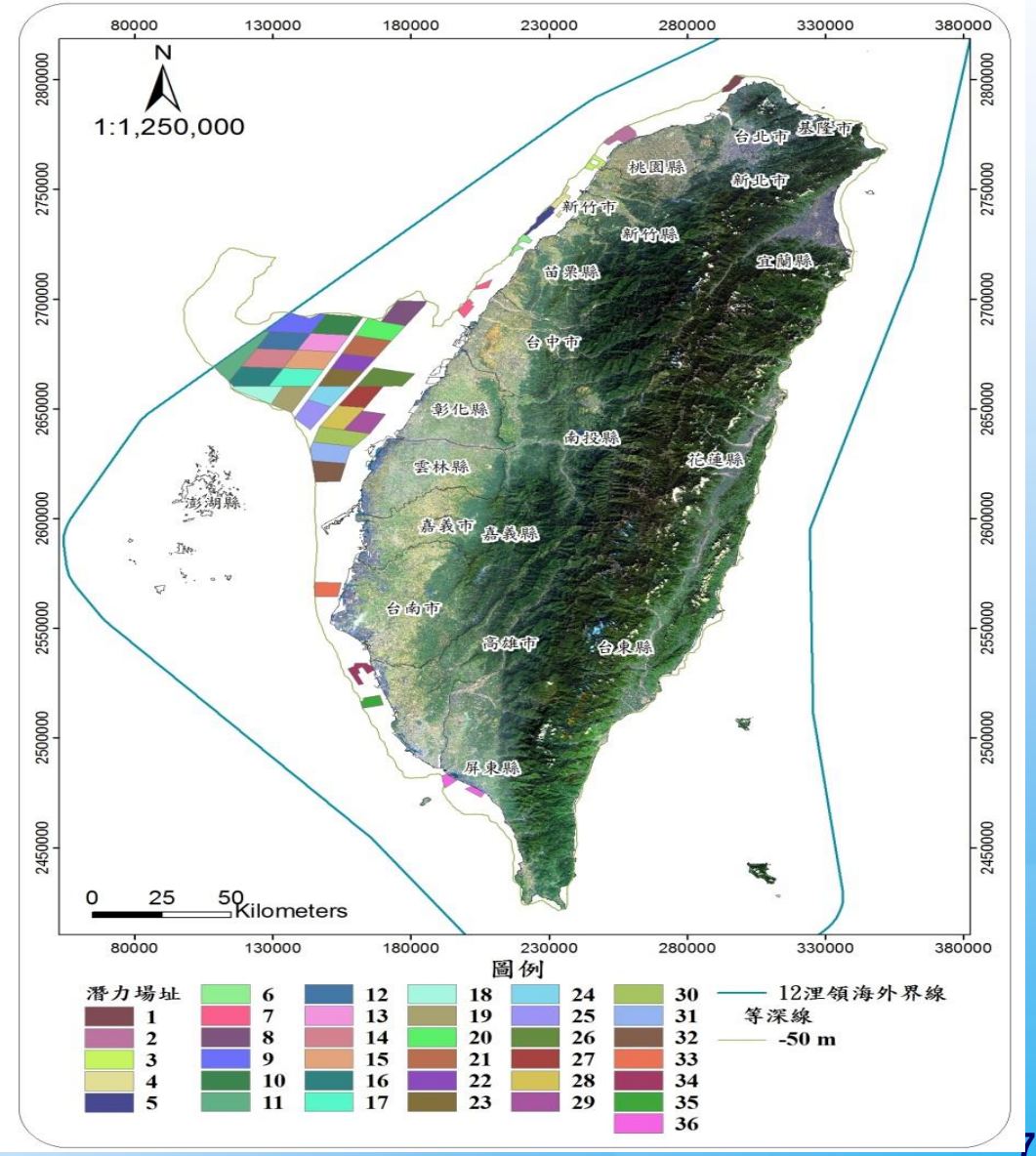


Formosa Demonstration Case:
Location: Off the coast of Zhunan Township, Miaoli County
Offshore: 1~5 kilometers,
water depth: 15~30 meters
WTs: 32 installed wind turbines
Capacity: About 128 MW

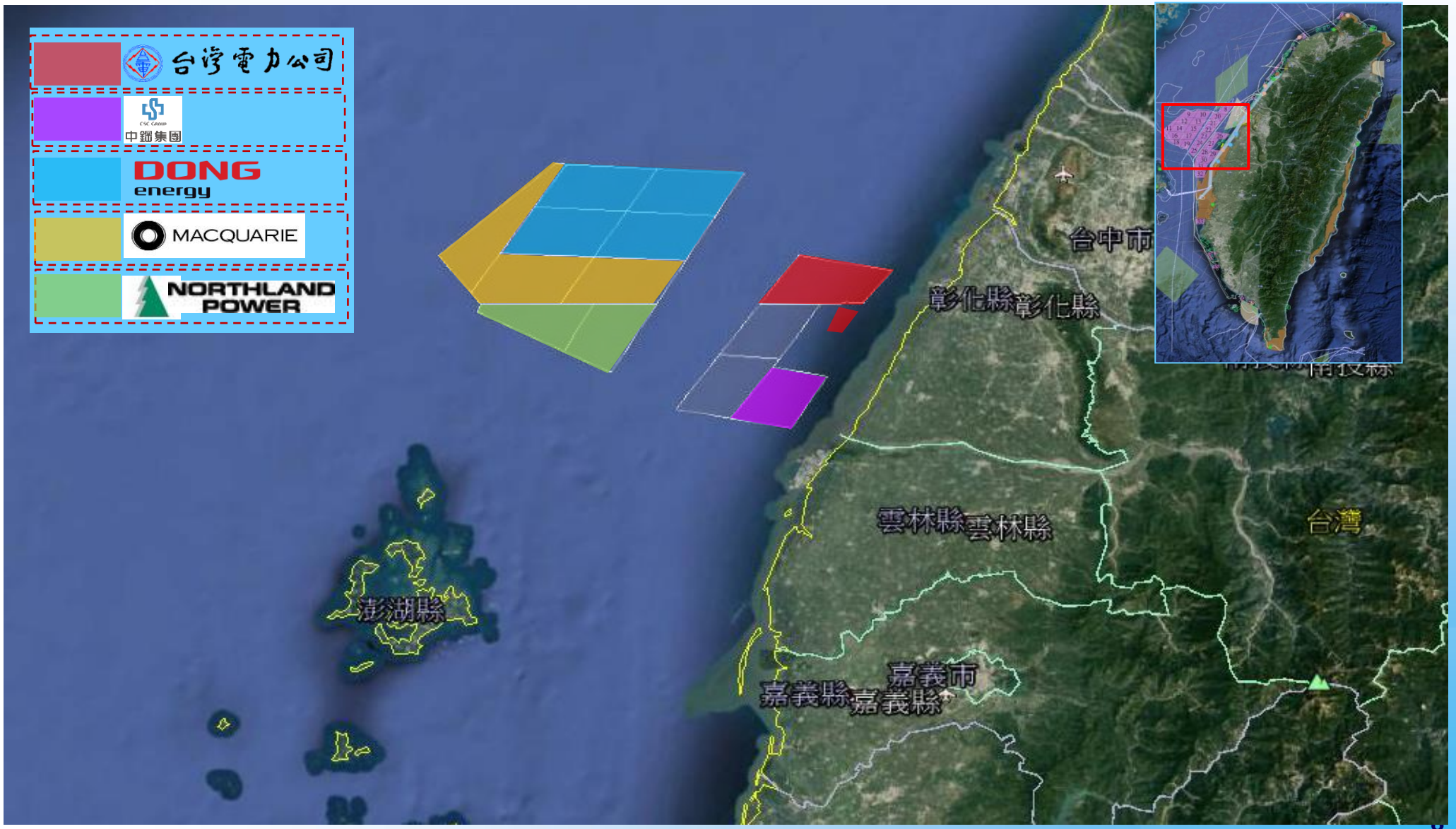
Offshore Wind farm Development

In 2015.7.2 BoE Announced:
36 Potential Site's Data

編號	縣市	名稱	面積 (km^2)	水深(m)			10m高平均風速 (m/sec)	離岸最近距離 (km)
				Max	Min	Mean		
1	新北市	新北市	26.2	50.3	18.0	40.9	7.9	1.1
2	桃園市	桃園市	50.2	49.8	1.0	29.3	8.0	0.2
3	新竹縣	新竹縣	22.2	49.9	1.0	24.5	8.0	0.4
4	新竹市	新竹市	31.6	50.3	24.2	38.7	8.3	2.2
5	苗栗縣	苗栗縣 1	34.7	51.5	37.2	44.7	8.4	4.7
6		苗栗縣 2	20.8	52.8	13.5	39.0	8.3	1.6
7	台中市	台中市 1	36.8	49.9	29.3	43.4	8.2	3.8
8		台中市 2	112.5	49.9	41.0	45.5	8.7	15.7
9	彰化縣	彰化縣 1_1	120.7	49.9	35.6	45.3	8.9	49.9
10		彰化縣 1_2	122.0	49.9	37.5	44.6	8.8	35.1
11		彰化縣 1_3	128.6	50.7	21.9	32.6	8.8	62.1
12		彰化縣 1_4	117.4	44.1	31.7	36.8	8.8	48.5
13		彰化縣 1_5	111.8	43.9	34.0	40.6	8.8	34.7
14		彰化縣 1_6	126.3	42.2	23.8	32.4	8.8	50.1
15		彰化縣 1_7	120.4	44.1	34.4	40.9	8.7	35.7
16		彰化縣 1_8	131.1	48.8	19.1	28.9	8.7	50.3
17		彰化縣 1_9	122.5	44.9	34.0	39.3	8.6	36.8
18		彰化縣 2_1	85.2	49.7	32.0	40.1	8.6	34.8
19		彰化縣 2_2	100.5	51.0	37.4	45.1	8.5	37.0
20	彰化縣	彰化縣 3_1	109.7	49.9	35.0	41.5	8.7	19.3
21		彰化縣 3_2	112.6	41.6	31.4	34.4	8.6	20.3
22		彰化縣 3_3	86.7	39.4	27.9	34.0	8.6	21.5
23		彰化縣 3_4	88.6	45.8	24.7	35.1	8.5	23.3
24		彰化縣 4_1	86.2	46.0	24.8	38.3	8.4	24.8
25		彰化縣 4_2	93.3	48.1	28.8	42.3	8.3	21.8
26		彰化縣 5	118.6	46.8	15.3	38.7	8.3	5.7
27		彰化縣 6_1	92.7	43.4	23.2	35.4	8.2	14.1
28		彰化縣 6_2	98.3	37.5	22.2	30.0	8.1	14.2
29		彰化縣 6_3	89.9	36.2	20.1	30.7	7.9	7.5
30	雲林縣	雲林縣 1_1	117.8	39.2	20.1	30.5	8.0	3.7
31		雲林縣 1_2	114.3	49.5	25.0	33.0	7.9	4.3
32		雲林縣 1_3	93.2	49.4	25.2	33.0	7.7	8.2
33	台南市	台南市	57.3	40.4	1.0	18.6	6.6	0.7
34	高雄市	高雄市 1	38.8	30.9	1.0	19.7	5.5	0.2
35		高雄市 2	32.5	41.5	4.8	21.4	5.3	1.8
36	屏東縣	屏東縣	32.5	31.7	1.0	13.0	4.0	0.5



Sinotech's Performance in OWF Development



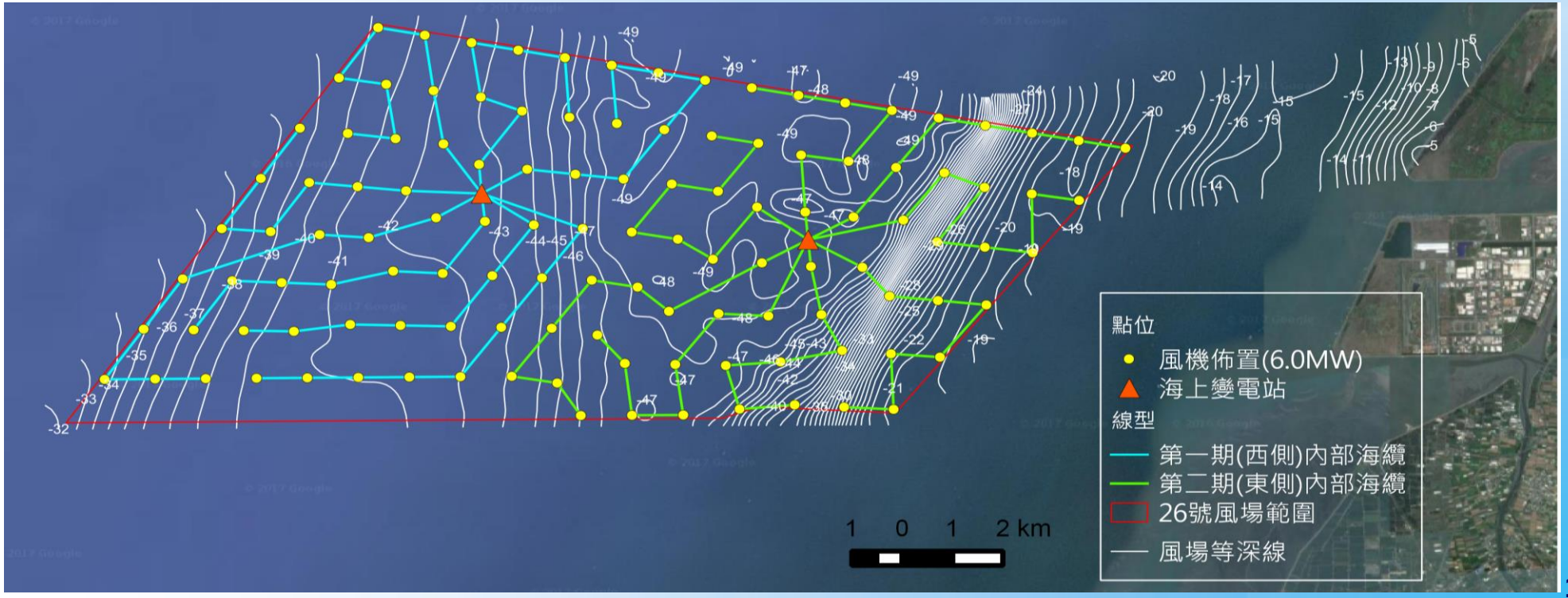
Summary of TPC OWF Project (Phase I)

- **Location： West side sea area of Fangyuan Township, Changhua County**
- **Water Depth：18~28m**
- **Turbine Capacity：3.6~6.0MW**
- **Total Capacity：108~110MW**

Turbine Capacity	Number	Total Capacity
3.6 MW	30	108 MW
4 MW	27	108 MW
5 MW	22	110 MW
6 MW	18	108 MW

Summary of TPC OWF Project (Phase II)

- **Location： West side sea area of Lukang Town, Changhua County**
- **Water Depth：18~50m**
- **Turbine Capacity：6.0~8.0MW**
- **Total Capacity：900MW**



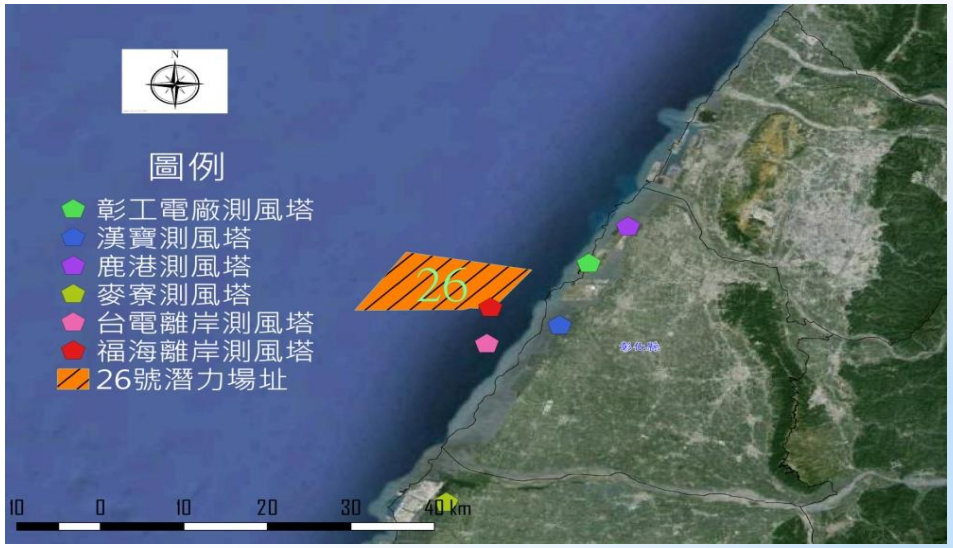
Summary of CSC's OWF Project

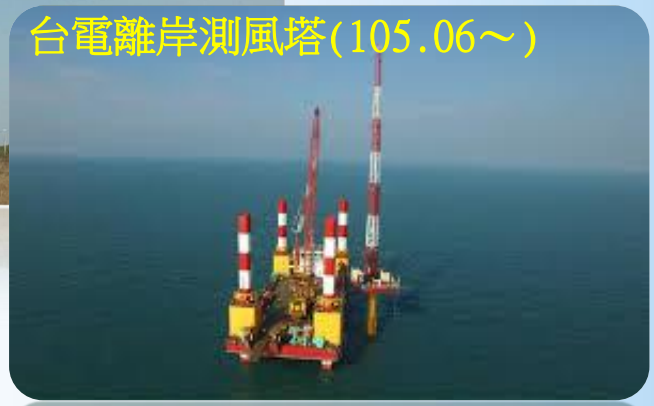
- **Location： West side sea area of Dacheng Township, Changhua County**
- **Water Depth：20~45m**
- **Turbine Capacity：5.0~7.0MW**
- **Total Capacity：500~700MW**

Environmental Conditions in Changhua Offshore

Environmental Conditions in Changhua Offshore

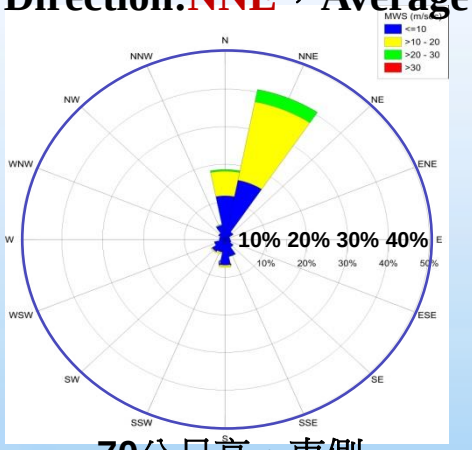
➢ Wind Speed&Direction



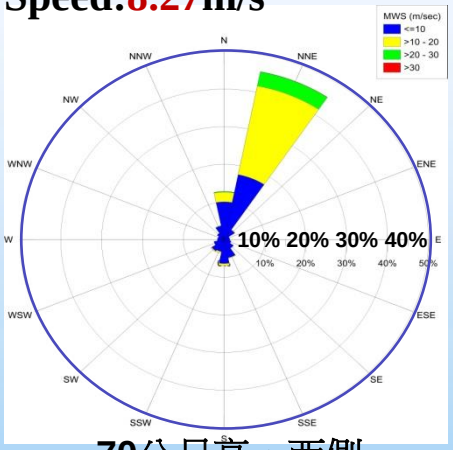


➢ Rose Map in Changjiang Power Plant Wind Tower Data

Direction:NNE，Average Speed:8.27m/s

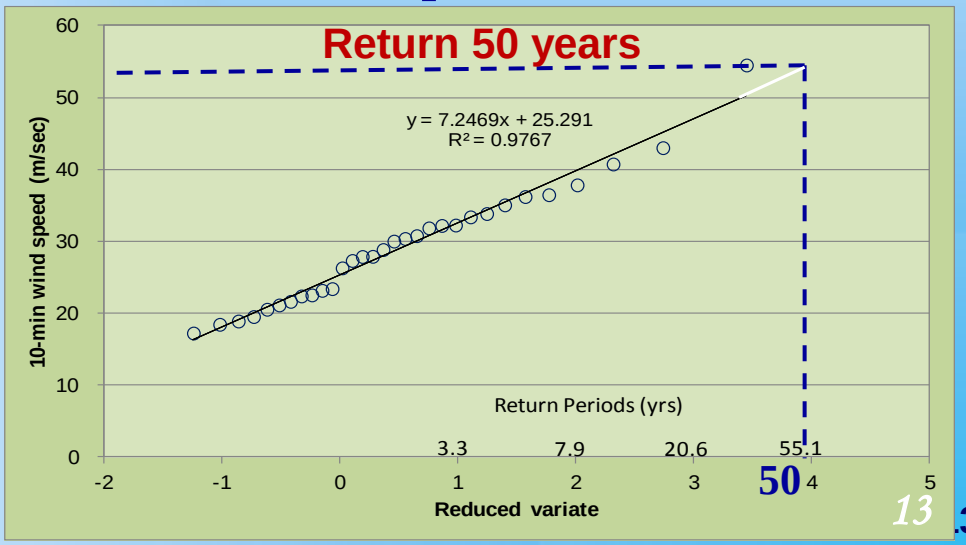


70公尺高，東側



70公尺高，西側

➢ Extreme wind speed:53.57m/s



Environmental Conditions in Changhua Offshore

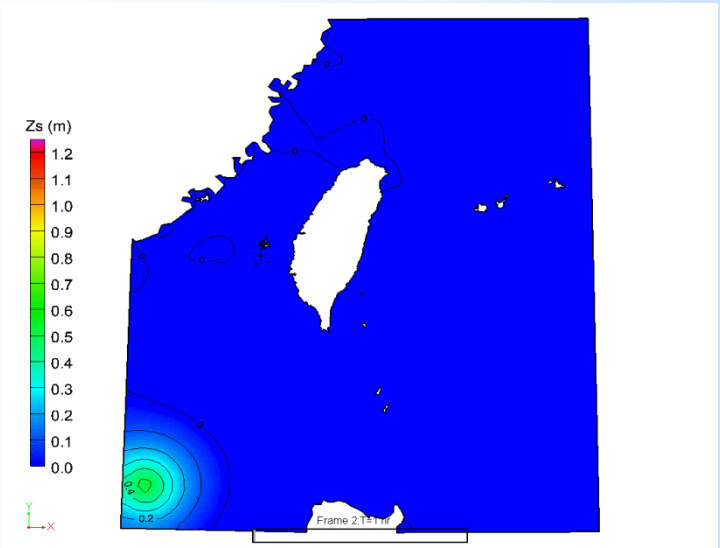
Tidal Level Statistics

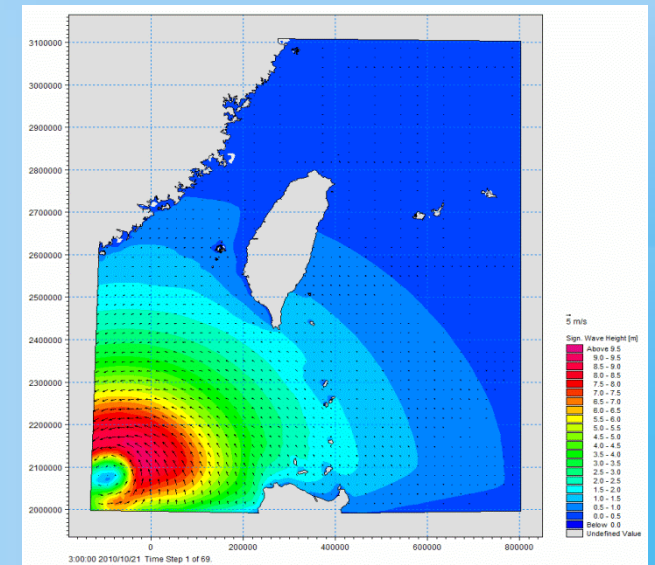
Tidal level	Elevation (m) (TWVD 2001)
Highest High water level (HHWL)	+3.48
Mean High Water Spring (MHWS)	+2.56
Mean high Water (MHW)	+2.15
Mean Water Level (MWL)	+0.31
Mean Low Water (MLW)	-1.47
Mean Low Water Spring (MLWS)	-2.02
Lowest Low Water Level (LLWL)	-2.81

Environmental Conditions in Changhua Offshore

Storm Surge Heights

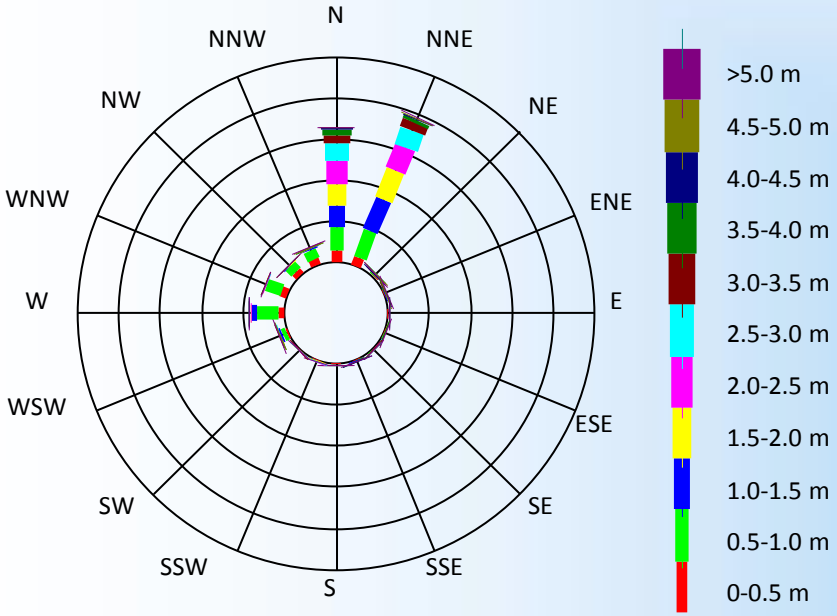
Return period (year)	Storm surge height (m)
5	0.636
10	0.837
20	1.030
25	1.091
50	1.276
100	1.456



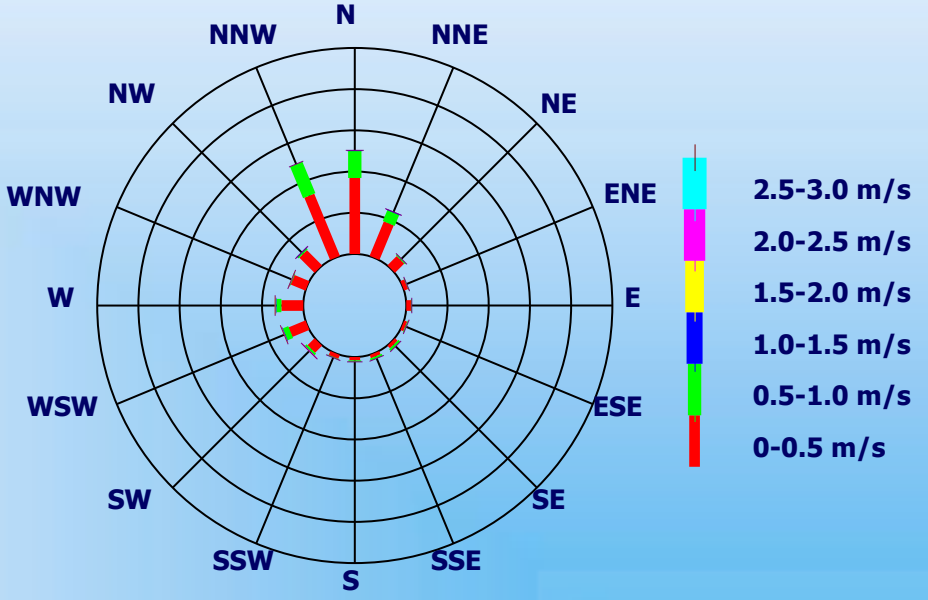


Environmental Conditions in Changhua Offshore

The wave height of 0~ 1.5 meters of the year is about 44.86% with wave period between 5~7 seconds, and the wave height of 1.5~ 2.5 meters of the year is about 25.94% with wave period between 6~8 seconds. For the wave direction, it is mostly between NNE~ NNW.



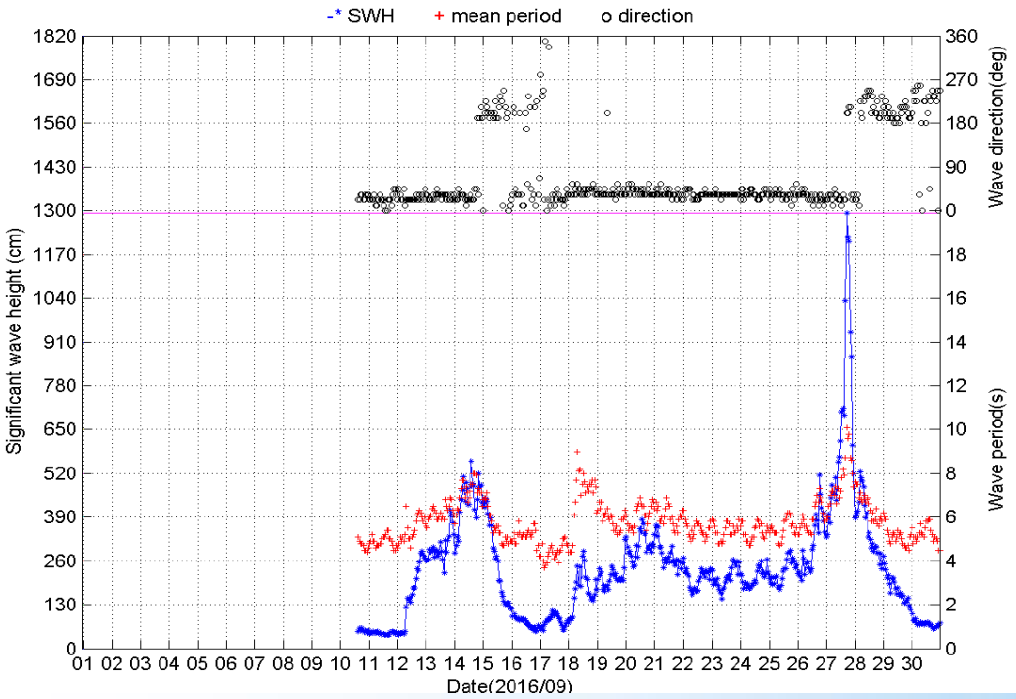
波高-波向玫瑰圖



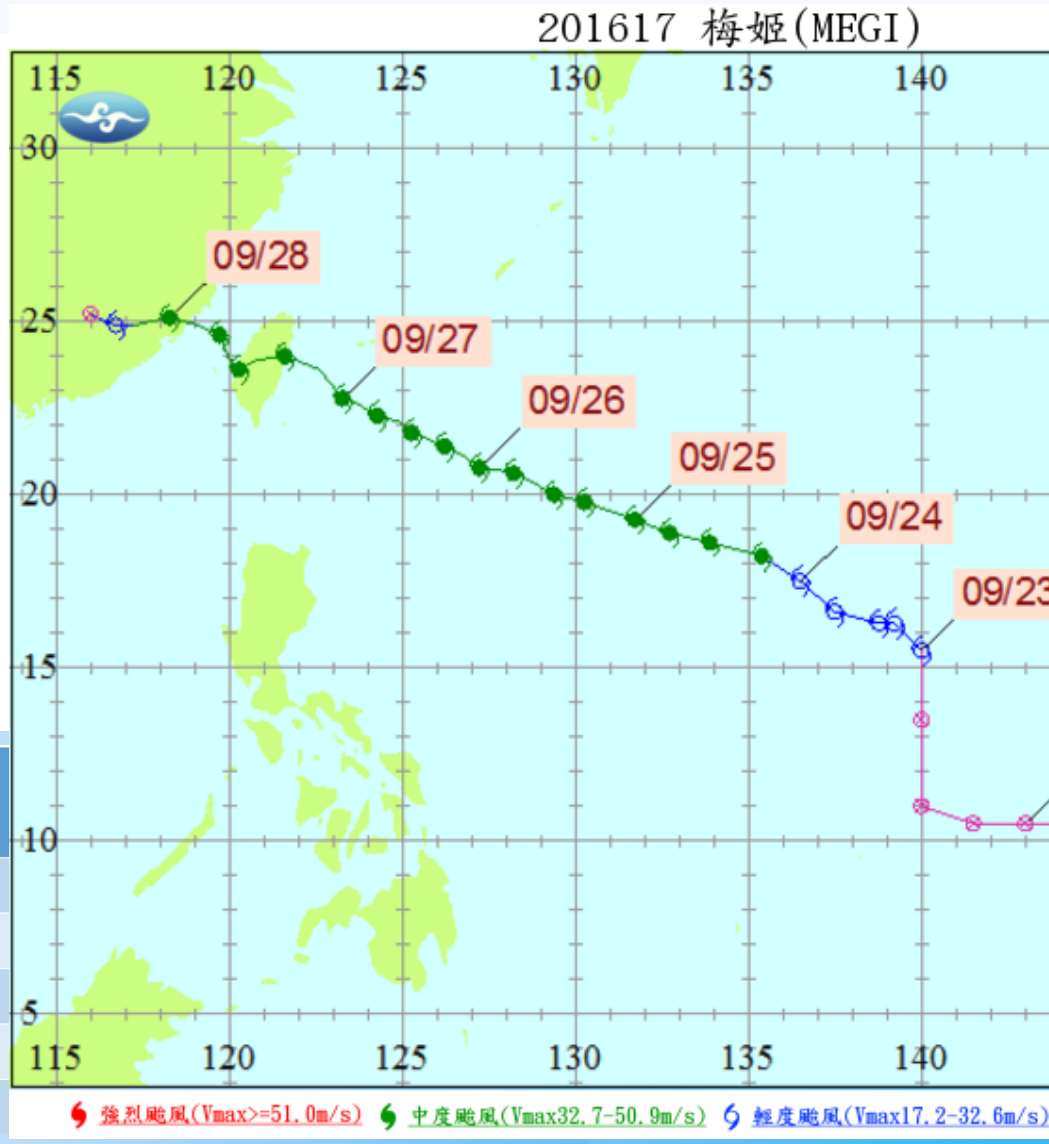
流速-流向玫瑰圖

Environmental Conditions in Changhua Offshore

Wave Observation in Site



Statistical parameter \ Month	September	October	Statistics
Maximum significant wave height (m)	12.94	6.25	12.94
Maximum mean period (sec)	10.1	8.3	10.1
Average significant wave height (m)	2.30	2.08	2.17
Average mean period (sec)	5.7	5.9	5.8
Dominant wave direction	NNE	NNE	NNE

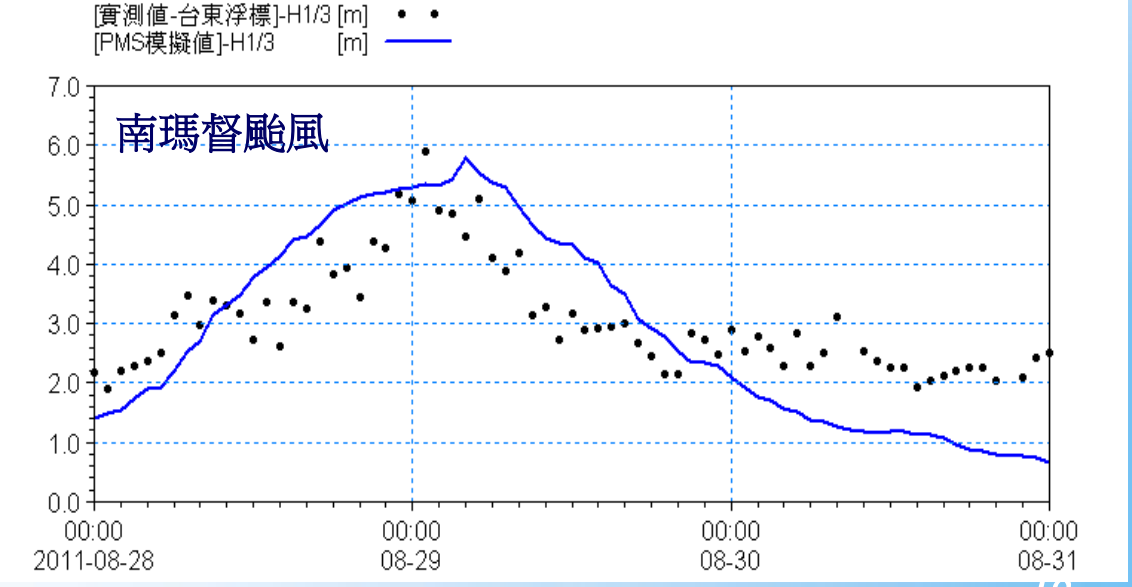


Environmental Conditions in Changhua Offshore

Typhoon Wave Simulation

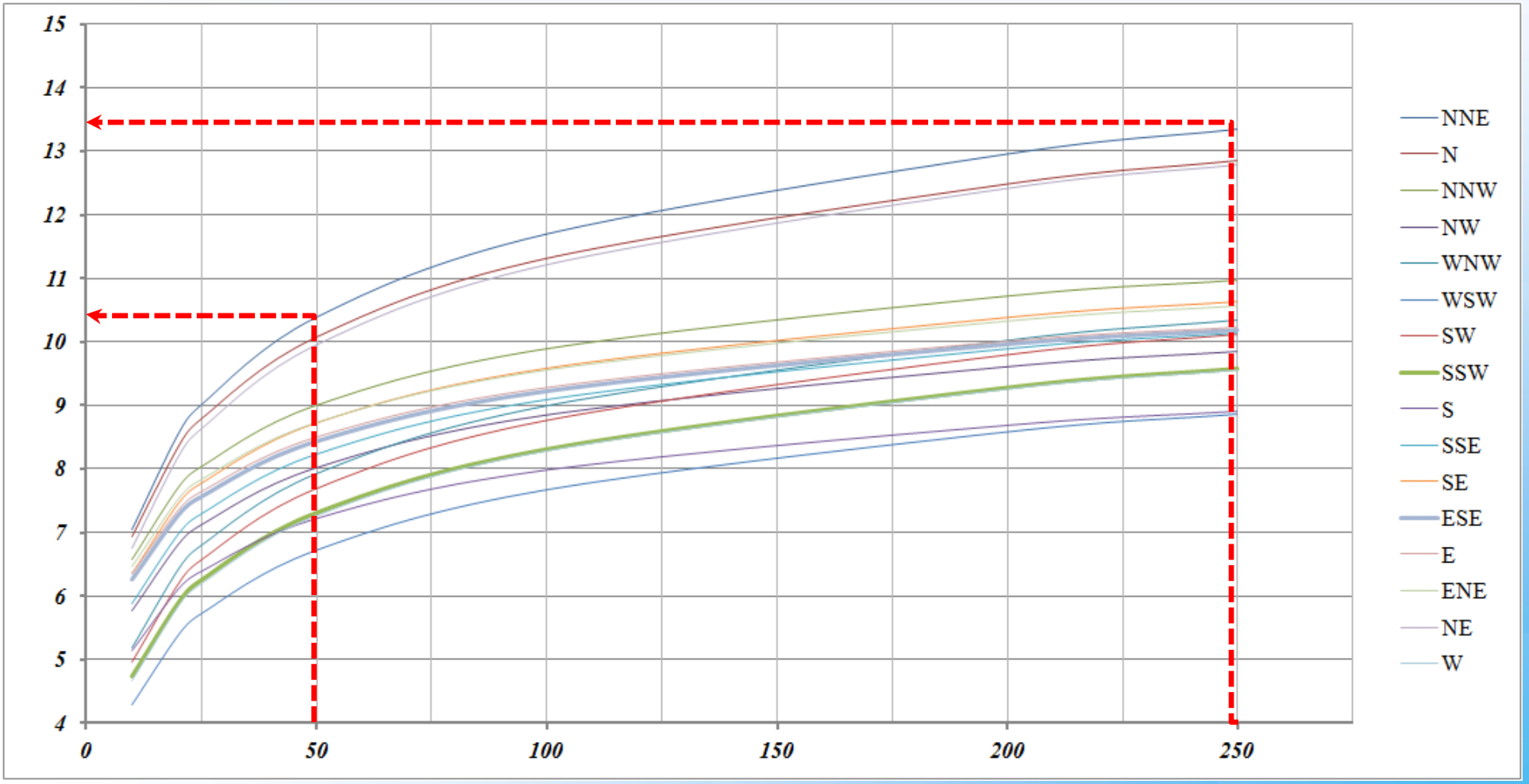
To simulate the extreme wave condition during the typhoon in project site, a wave numerical model (DHI SW model)with historical typhoon data between years of 1977 to 2016, are applied to module the wind-generated waves.

Annual maximum method is used to analyze the extreme wave parameters, Hs and Tp, for different return periods.



Environmental Conditions in Changhua Offshore

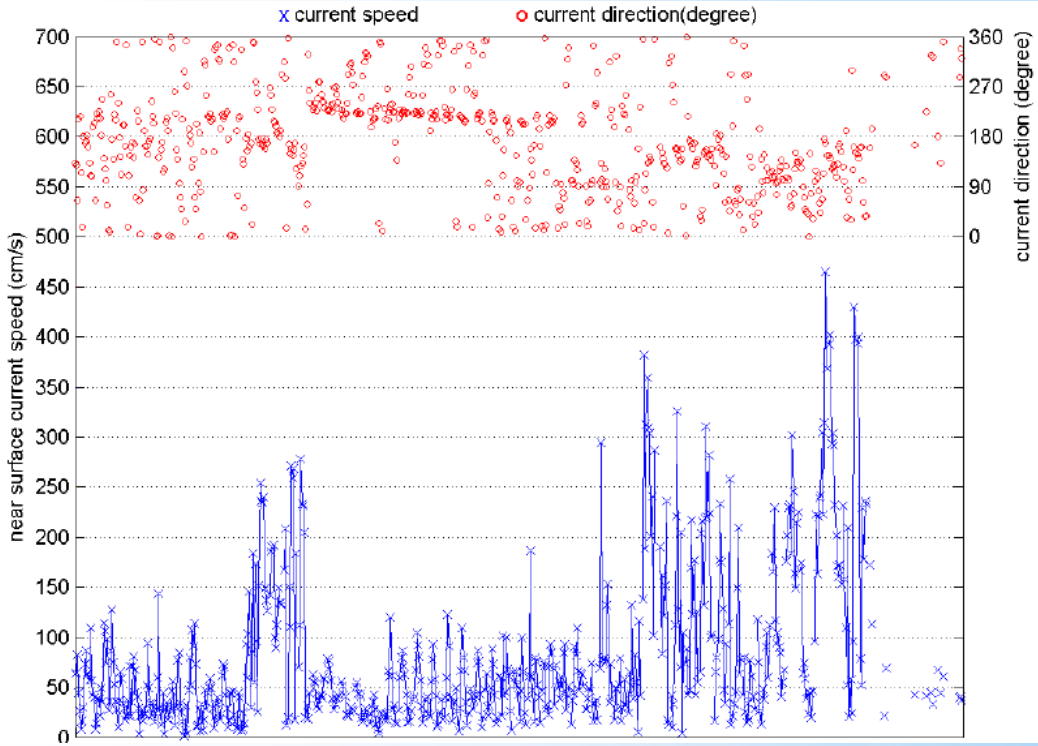
Extreme Wave Parameters of Site($H_{1/3}$)

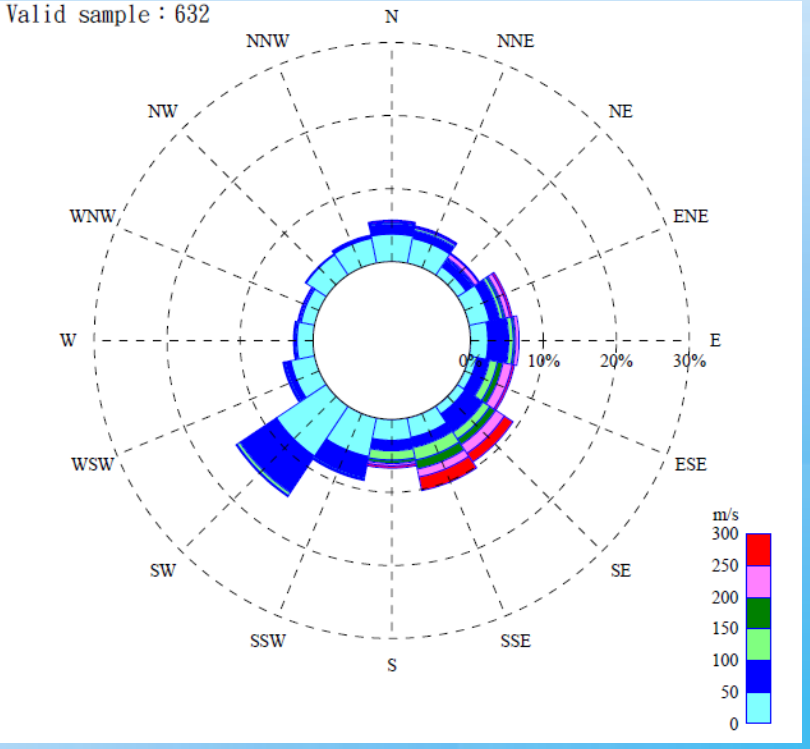


Environmental Conditions in Changhua Offshore

Current Observation in Site

Current statistics of site show that the largest constituent is the "principal lunar semi-diurnal", also known as the M2 tidal constituent. The mostly current directions is NE - SW. The maximum current speed is over 2 knots.



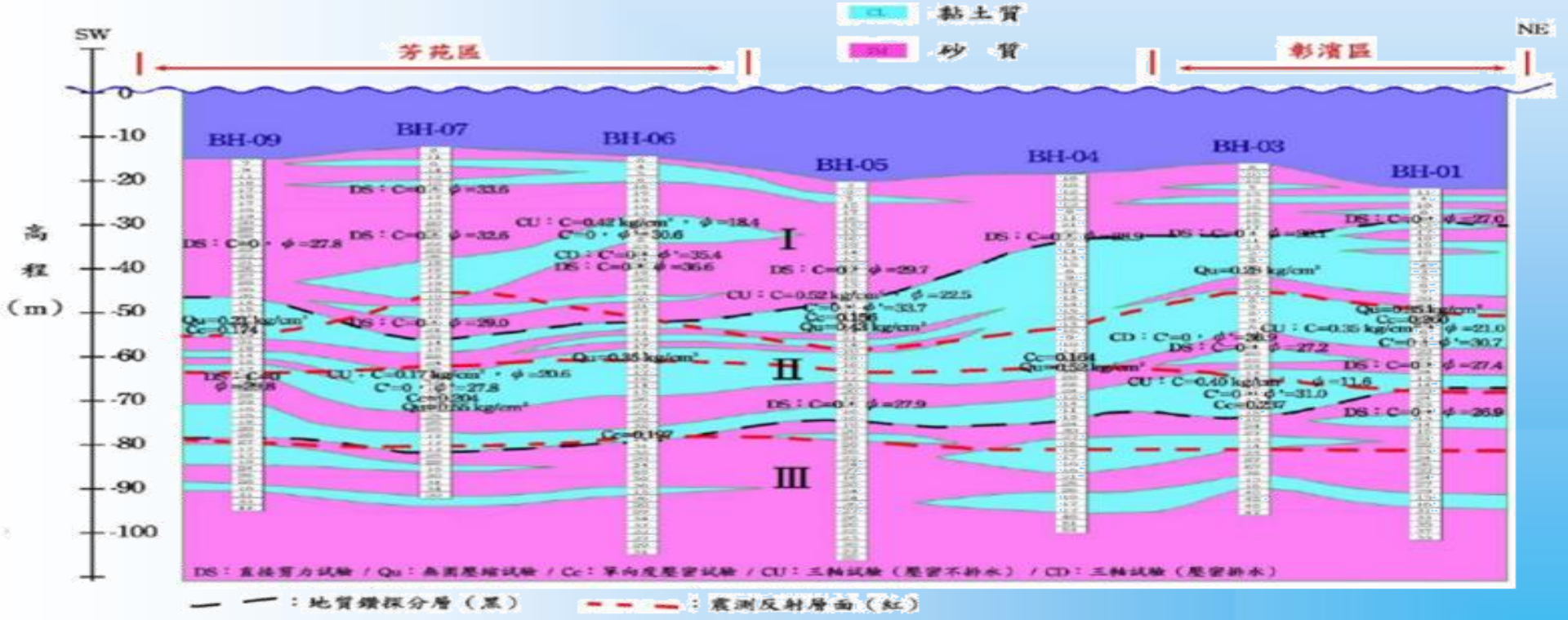


Environmental Conditions in Changhua Offshore

- **Borehole**
  - **Onshore**

    Sandy Silt & Clayey Silt
  - **Offshore**

    Sandy Silt & Clayey Silt



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The planning of fabrication yard in Taichung Port

Construction Port

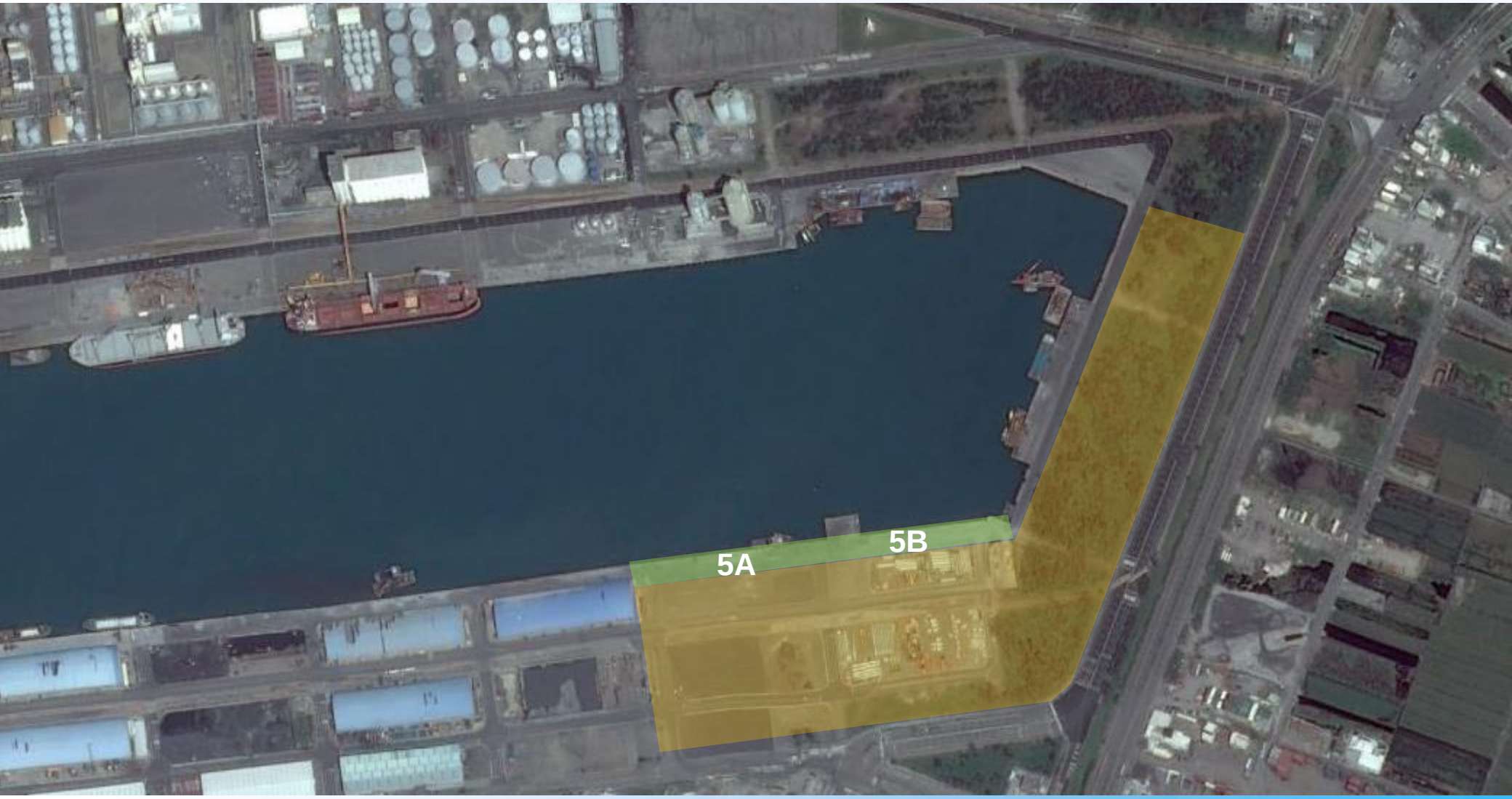
- The Export Ports in TAIWAN

Construction Port

➢ Bird View of Taichung Port

Construction Port

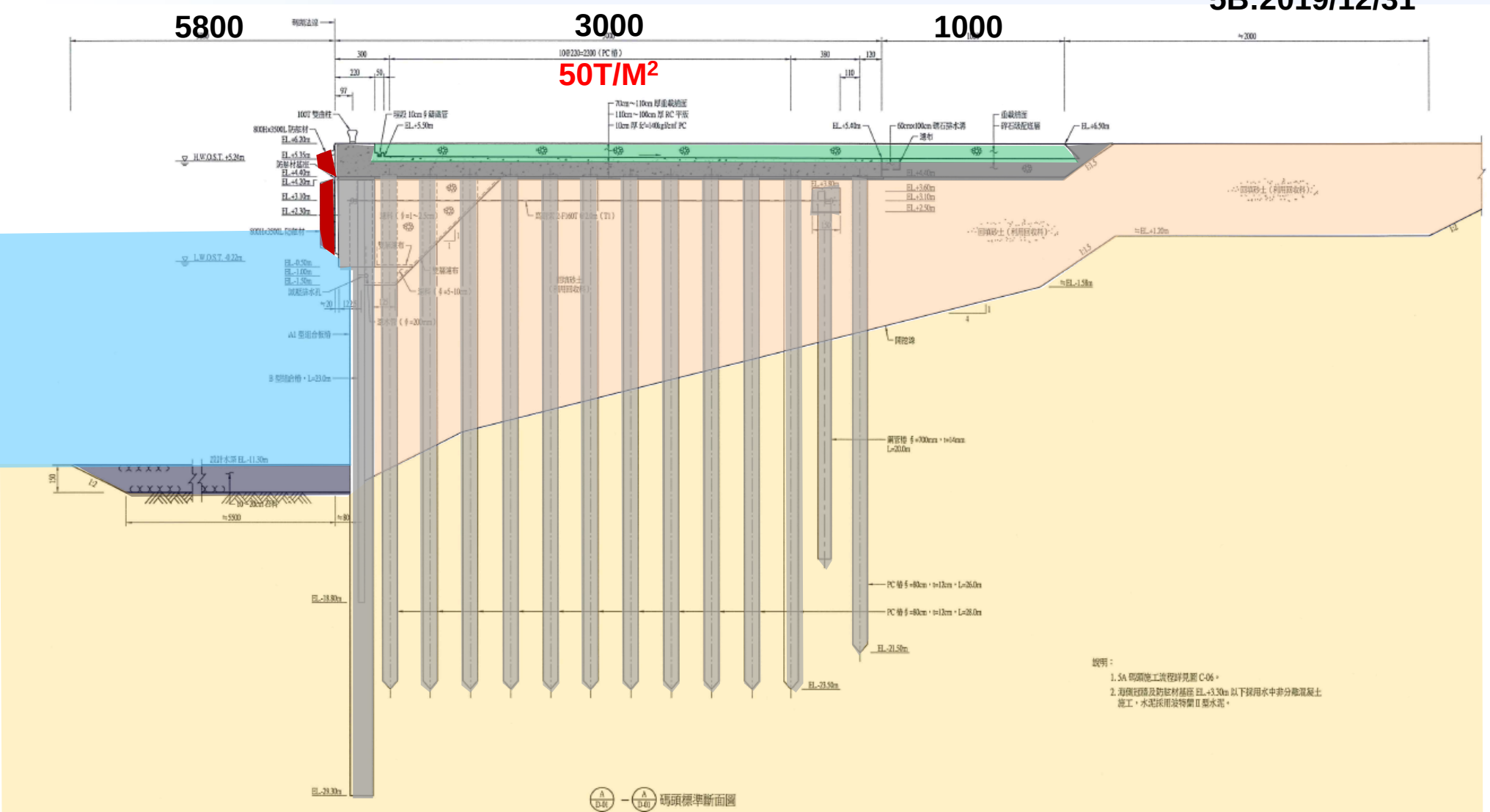
- Location :#5A、5B in Taichung



Construction Port

➢ Design Drawing of 5A、5B Berth

Completion date:
5A:2018/12/31
5B:2019/12/31



Onshore Terminal

From :Offshore Wind Port Feasibility Study of Taichung Port, Taiwan

➢ The layout of development plan:STEP 1 (5A、5B&4C)

Onshore Terminal

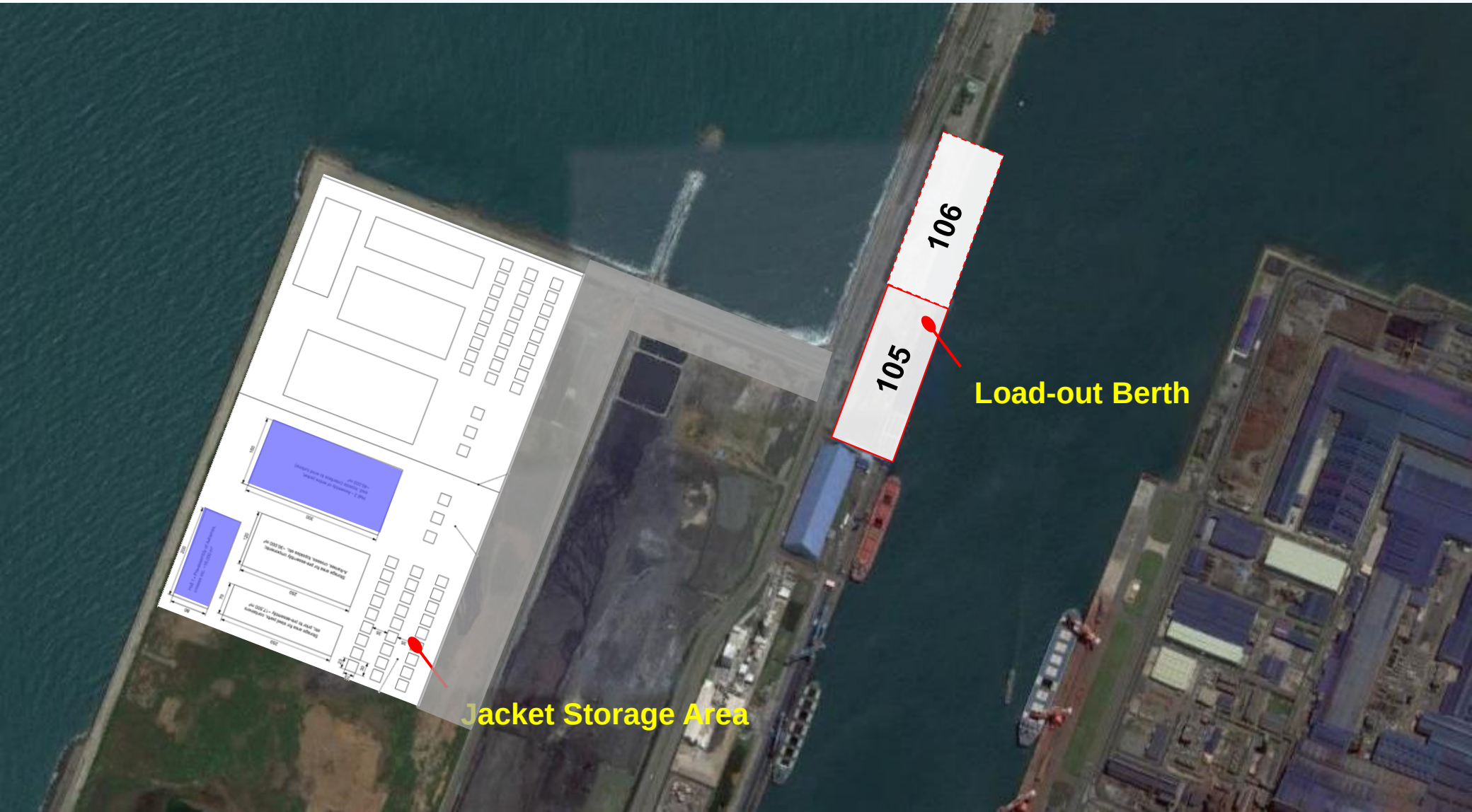
From :Offshore Wind Port Feasibility Study of Taichung Port, Taiwan

➢ The layout of development plan:Final (8、7、6、5、5A、5B&4C)

Onshore Terminal

From :Offshore Wind Port Feasibility Study of Taichung Port, Taiwan

- Foundation Manufacture -2 Factories



Brief Introduction of Sinotech Engineering Consultants,Ltd

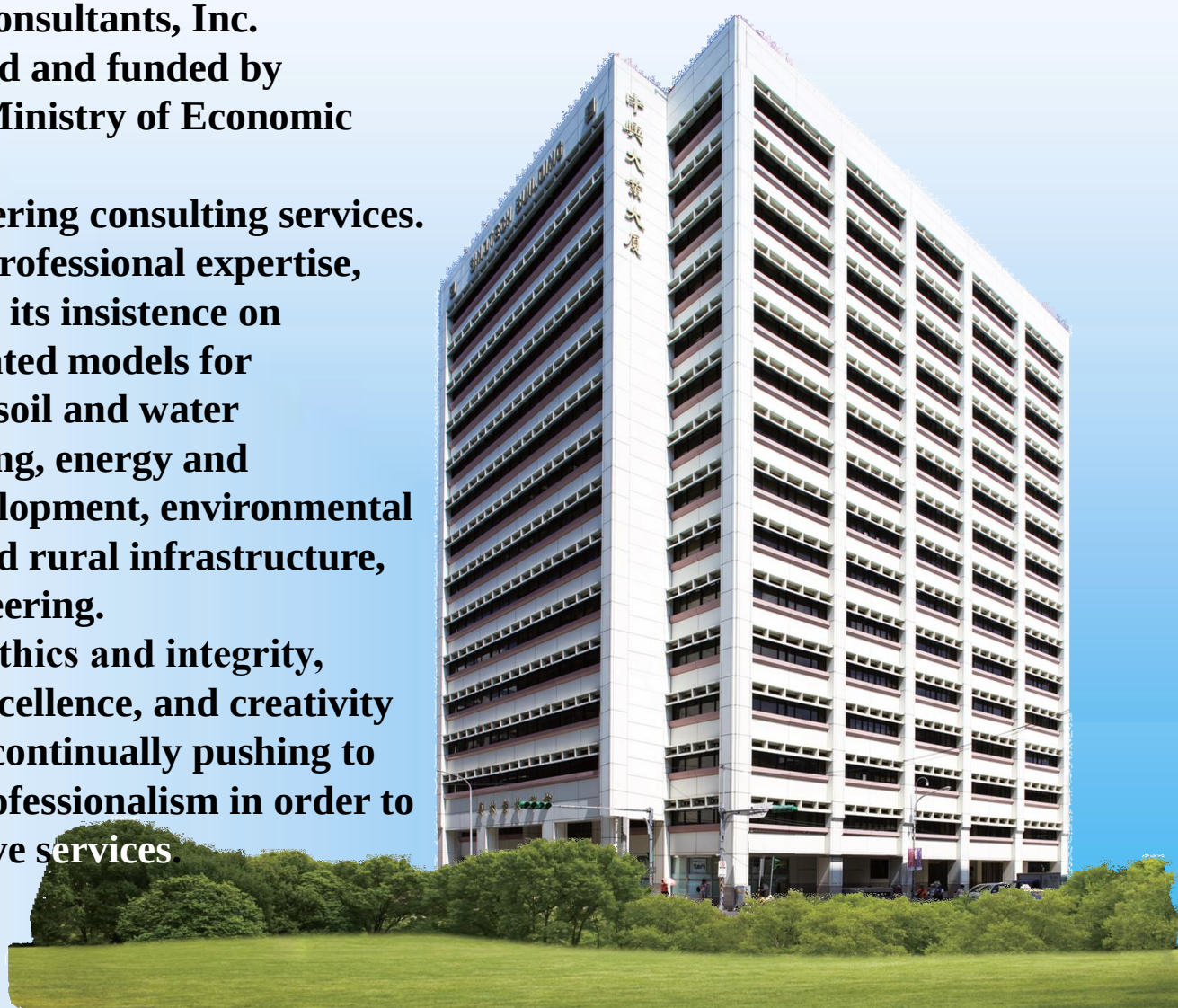
中興工程顧問股份有限公司
Sinotech Engineering Consultants, Ltd.

Sinotech: Steadfastness and Expert Guidance

Sinotech, one of the most reputable engineering consulting firms in Taiwan, was spun off from the non-profit corporation Sinotech Engineering Consultants, Inc. (Sinotech Inc.), which was established and funded by various state enterprises under the Ministry of Economic Affairs in the 1970s.

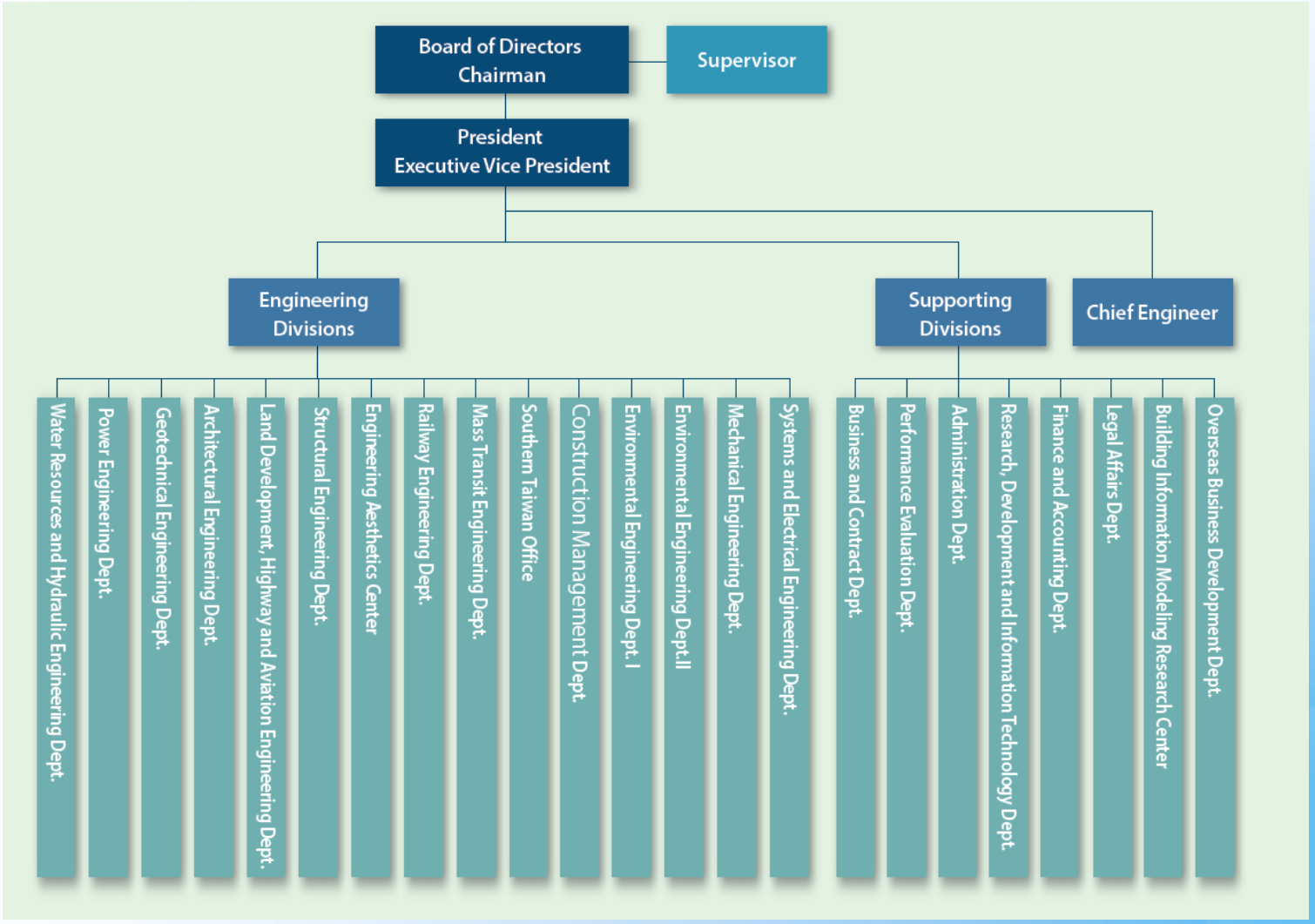
Sinotech offers all manner of engineering consulting services. Combining talented personnel and professional expertise, technology and wisdom, it has — via its insistence on meticulousness and precision — created models for engineering quality in such fields as soil and water conservation, geotechnical engineering, energy and electrical generation, industrial development, environmental protection, transportation, urban and rural infrastructure, and mechanical and electrical engineering.

Under its corporate philosophy of "ethics and integrity, commitment to quality, pursuit of excellence, and creativity and innovation," Sinotech has been continually pushing to raise the level of its expertise and professionalism in order to provide its clients with comprehensive services.



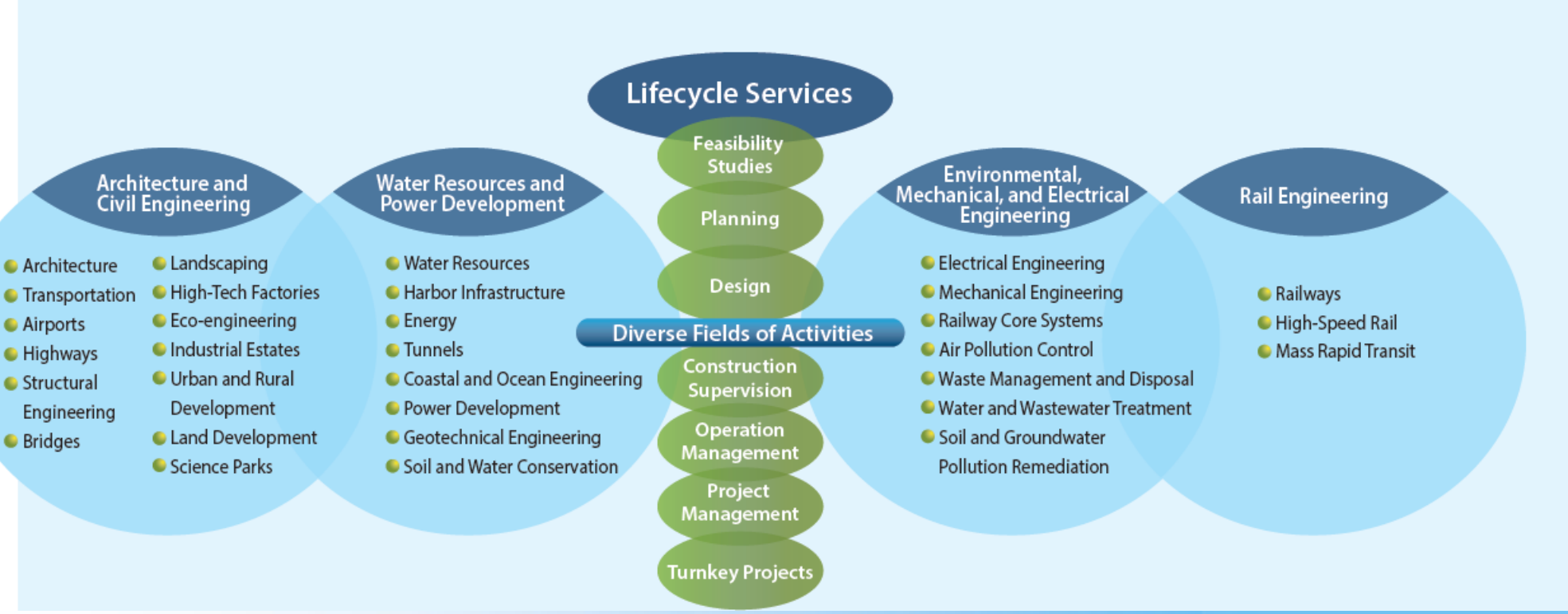
Division of Labor

Responsibility centers, concentrations of high-quality professionals



Scope of Services

Covering engineering lifecycle, providing full-spectrum services



Field of Activities

Responsibility Center for Water Resources and Power Development

Field of Activities

The Responsibility Center for Architecture and Civil Engineering

Field of Activities

Rail Engineering Responsibility Center

Field of Activities

Environmental, Mechanical and Electrical Engineering Responsibility Center

Thank you for your
attention.