CEPC Siting and Civil Construction Preparation

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Contents

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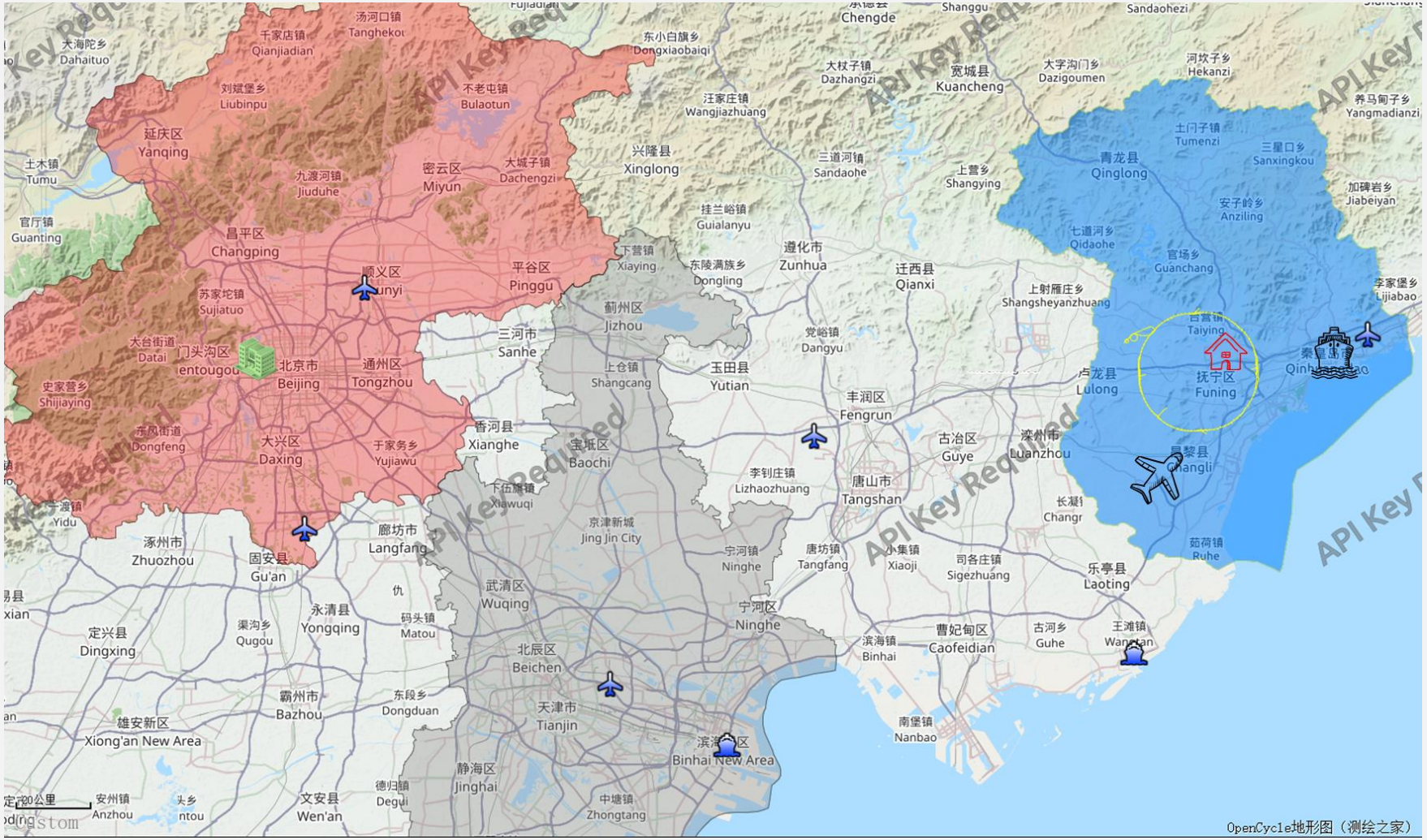
Introduction of Qinhuangdao

1.1 Location

Hebei Province

Qinhuangdao is in the northeast of Hebei Province, bordering on Bohai Sea in the south, Yanshan Mountain in the north, Liaoning Province in the East and Beijing and Tianjin in the West. It is in the junction of north and northeast economic zones of China, center of Bohai economic circle.

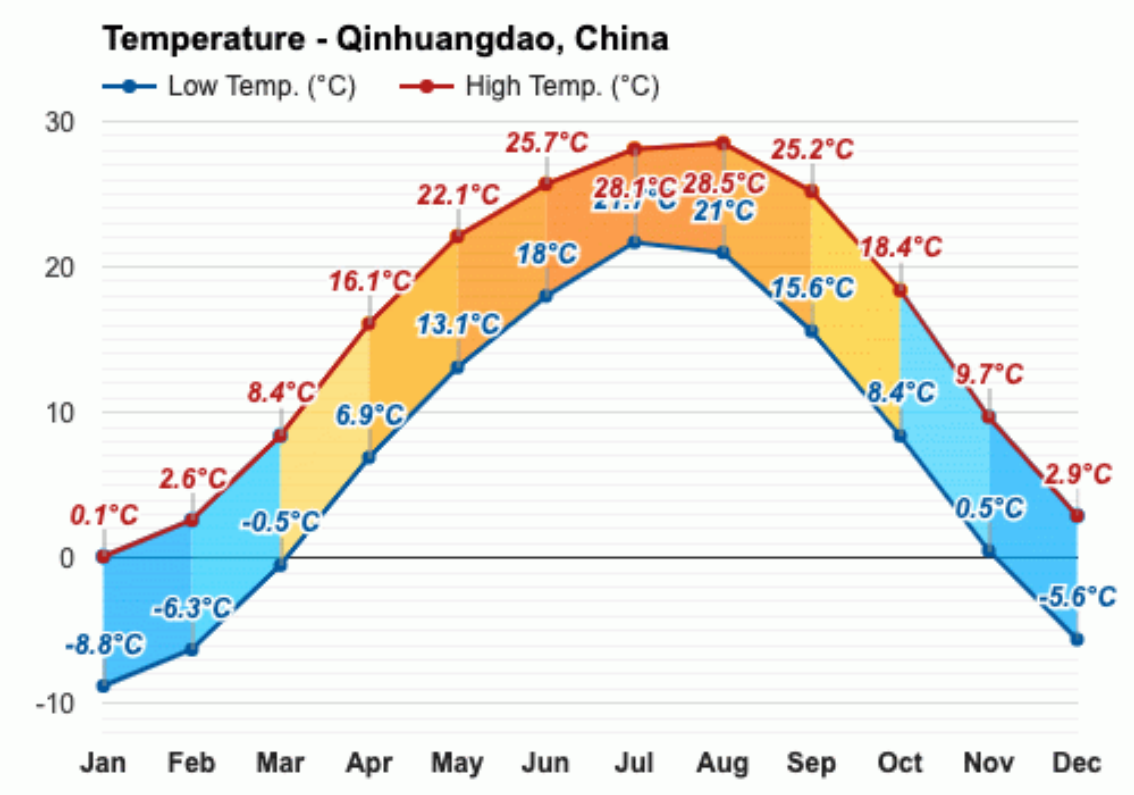
1.2 Traffic Conditions

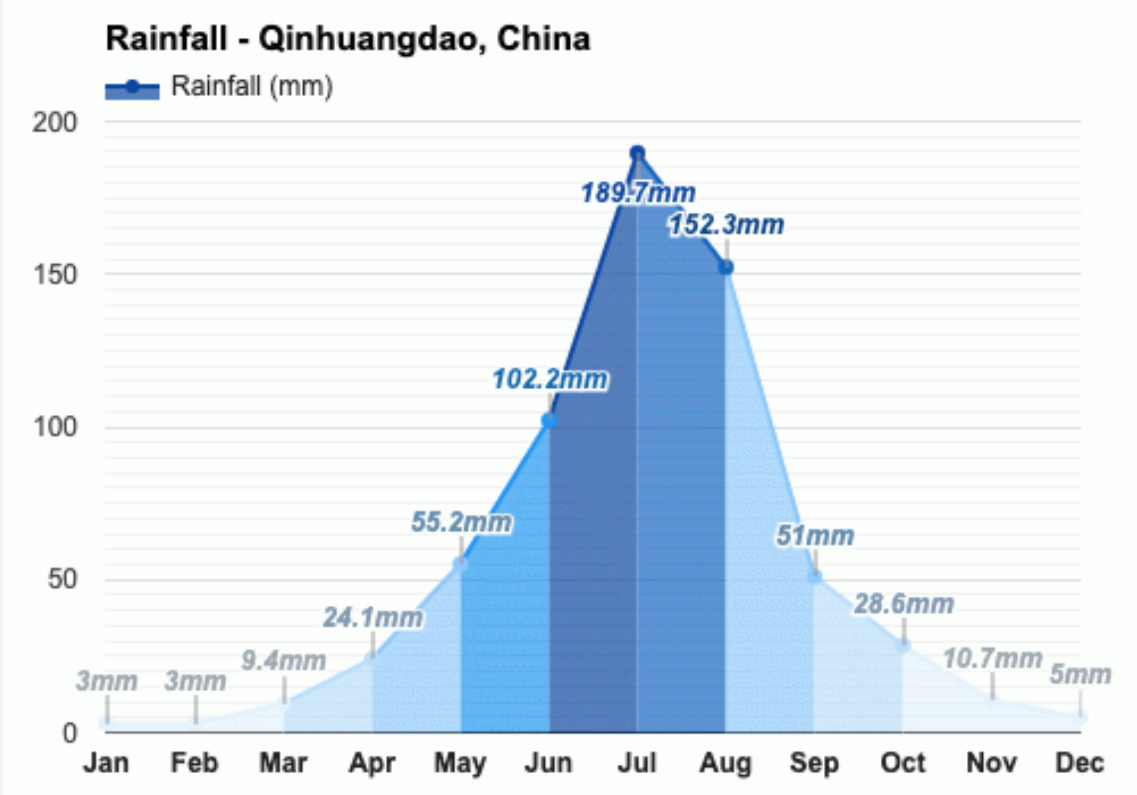


It’s 280km away from Beijing and 220km away from Tianjin. It has the confluence of 6 national railways including Tianjing-Qinhuangdao, Beijing-Shanhaiguan, Beijing-Qinhuangdao, Dalian-Qinhuangdao, Shenyang-Shanhaiguan railways and that of 3 highways including Beijing-Harbin, coastal and Chengde-Qinhuangdao highways.

The marine transport business of Qinhuangdao Port covers more than 130 countries and regions. Beidaihe airport has opened a number of domestic and international routes.

1.3 Climatic Conditions





Free from severe cold and intense heat, Qinhuangdao has a pleasant climate with a forest coverage rate of more than 46.75%, which is not only suitable for tourism but also for living.

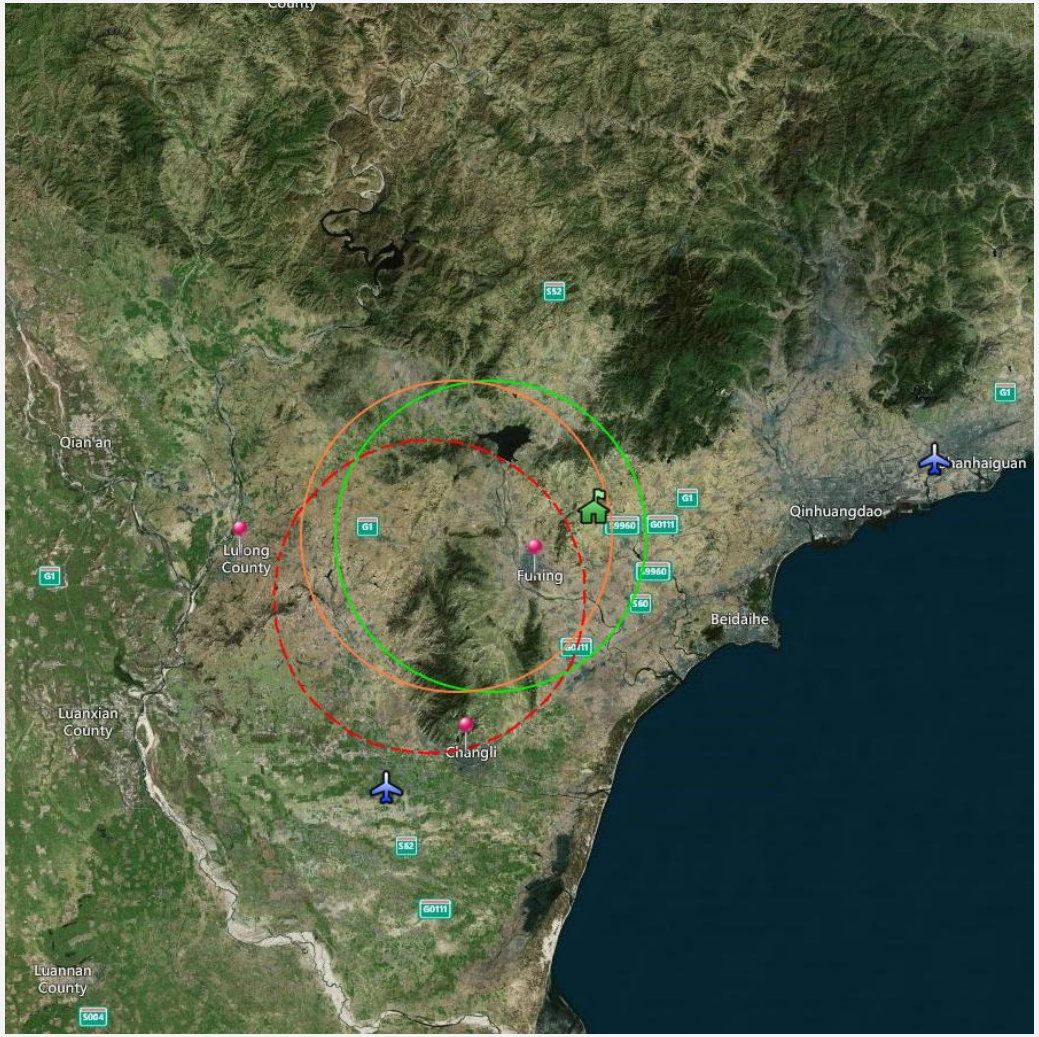
1.4 Economic Development

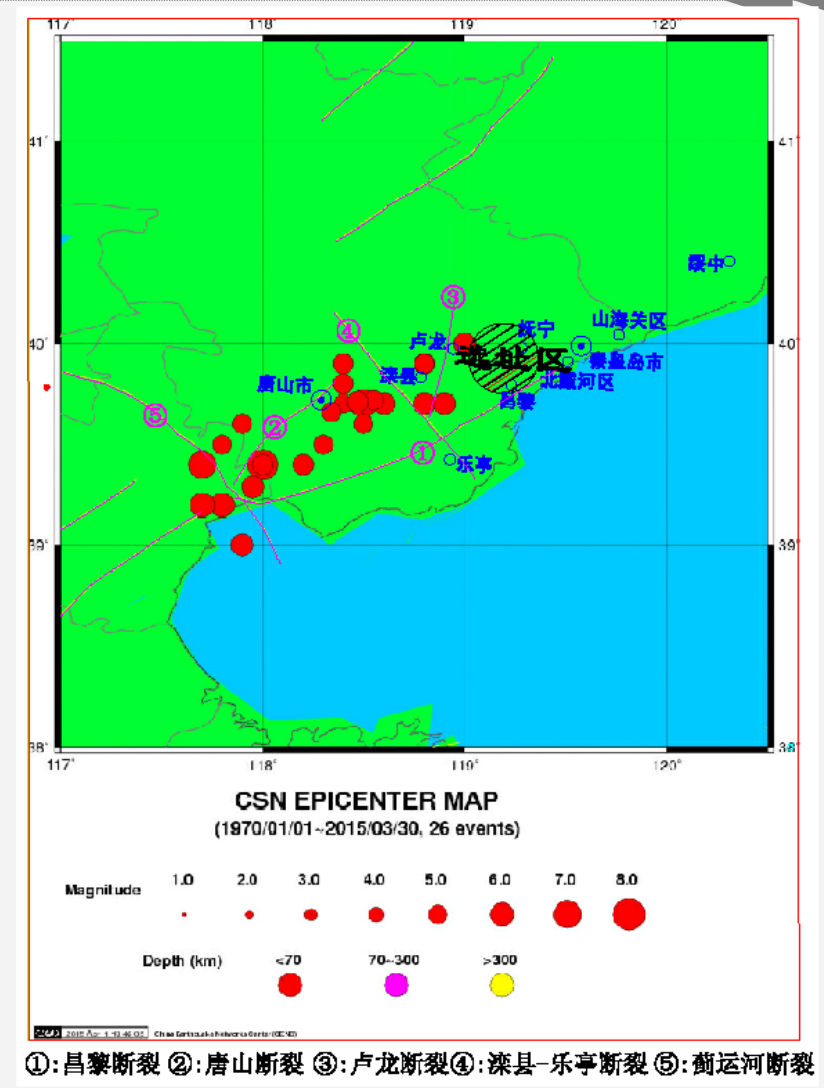
In 2022, the gross domestic product of Qinhuangdao was 190.952 billion yuan, an increase of 3.5% compared to the previous year.

02

Civil Engineering Design

2.1 Engineering Geology





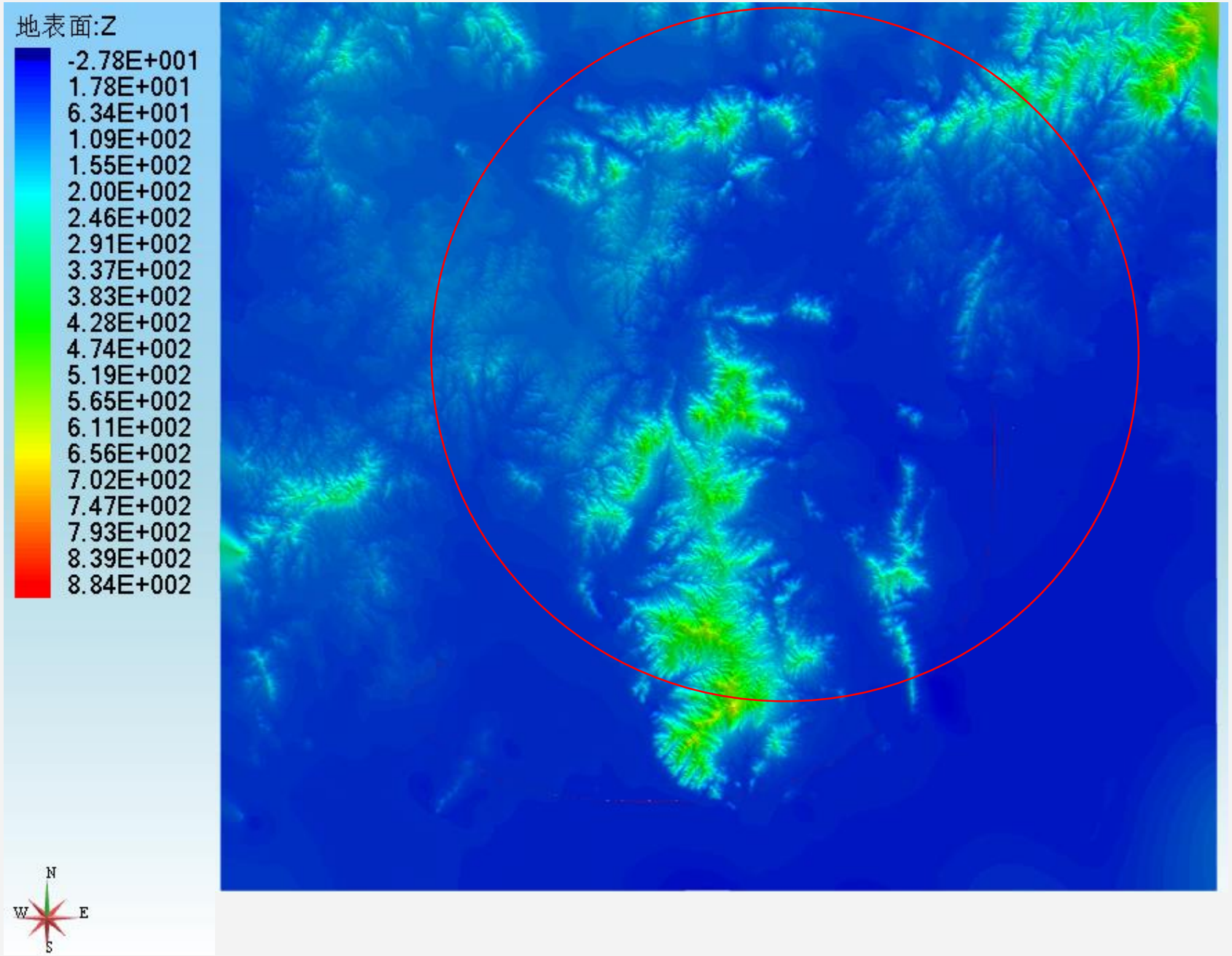
①:昌黎断裂 ②:唐山断裂 ③:卢龙断裂④:滦县-乐亭断裂 ⑤:蓟运河断裂

Qinhuangdao has a mountainous area in its north and borders on the sea in its southeast. It has Lulong fracture in its west and Changli fracture in its south. The seismic activities are relatively active in its southwest. The straight distance from the proposed project site to the epicenter of Tangshan Earthquake is about 80km.

2.1 Engineering Geology

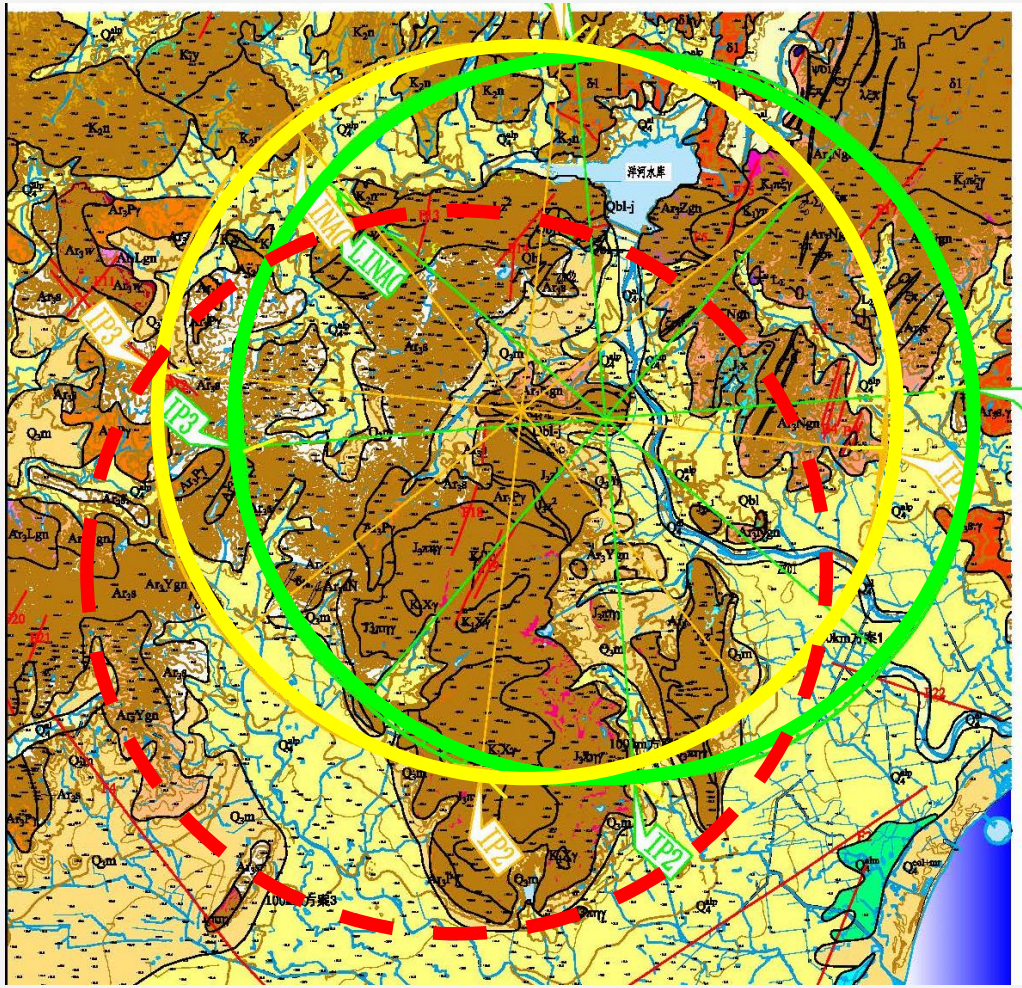
According to the Seismic Ground Motion Parameters Zonation Map of China (GB 18306-2015), the seismic peak ground acceleration to the east of Funing - Changli is 0.10g, while that to the west is 0.15g. The characteristic period of the seismic response spectrum is 0.40s.

2.1 Engineering Geology



The site is located in a low hilly land higher in west and lower in east on the whole. There is a low mountain in the middle of the site. The highest elevation is 695m, while the lowest located in the coastal areas in the east at an elevation of 0m.

2.1 Engineering Geology



Stratum Lithology

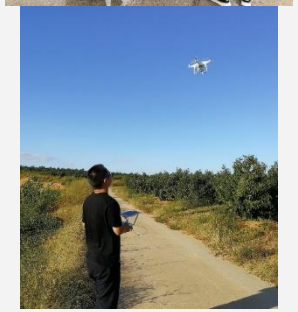
In the project site, strata are dominated by gneiss, granite, sandstone and tuff. About 90% of the surrounding rock along the tunnel is Class II and III. Overburdens on site are in a medium thickness of about 10~23m, but there is a rapid growth in thickness from Liushouying to southeast of Changli County.

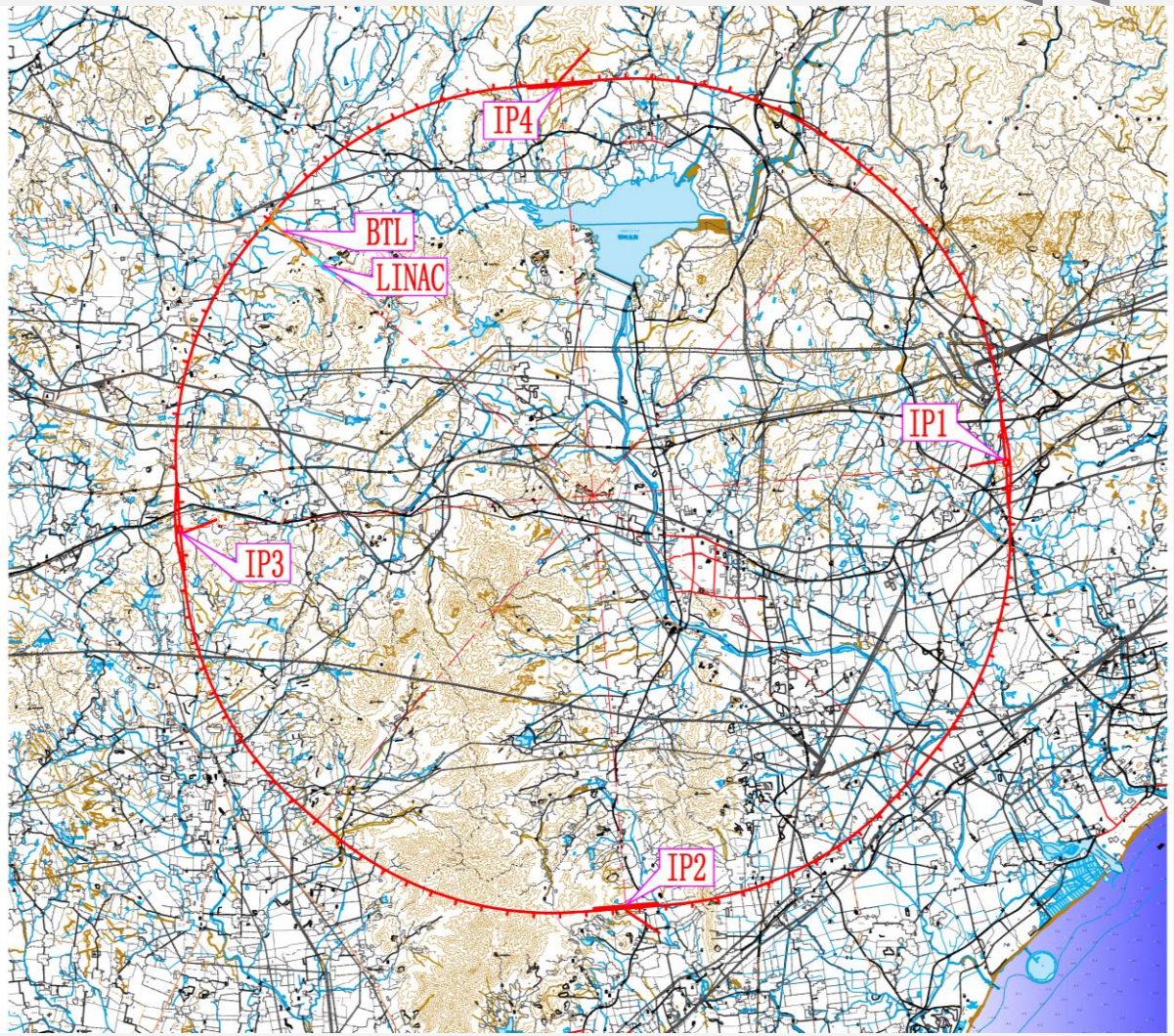
2.2 Site Choice and project layout

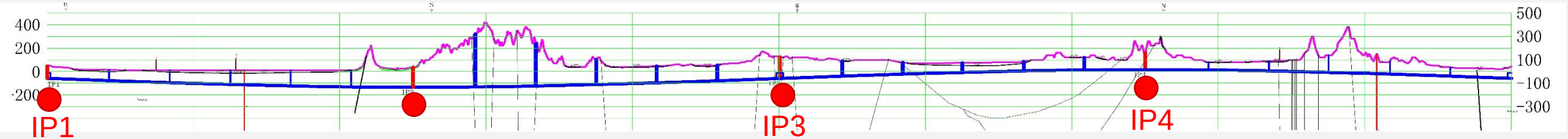
We compared various tunnel routes, and conducted field investigation of the proposed site in Qinhuangdao.

Based on the investigation and our analysis of the topographic and geological conditions, project layout and construction arrangement of the options, a preliminary representative plan has been selected.

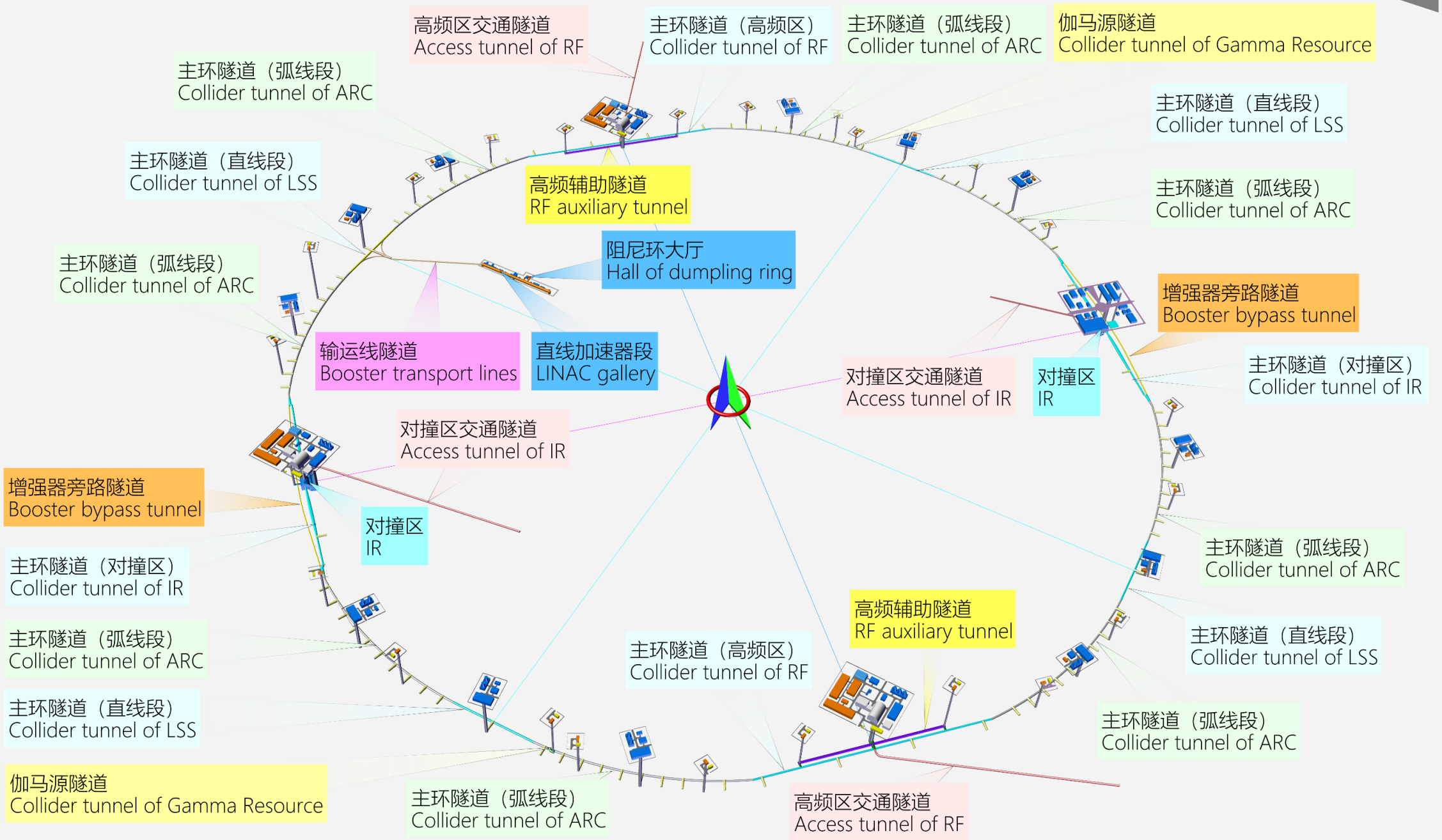
The tunnel route will be further refined as the work progresses in the future.







2.2 Site Choice and project layout



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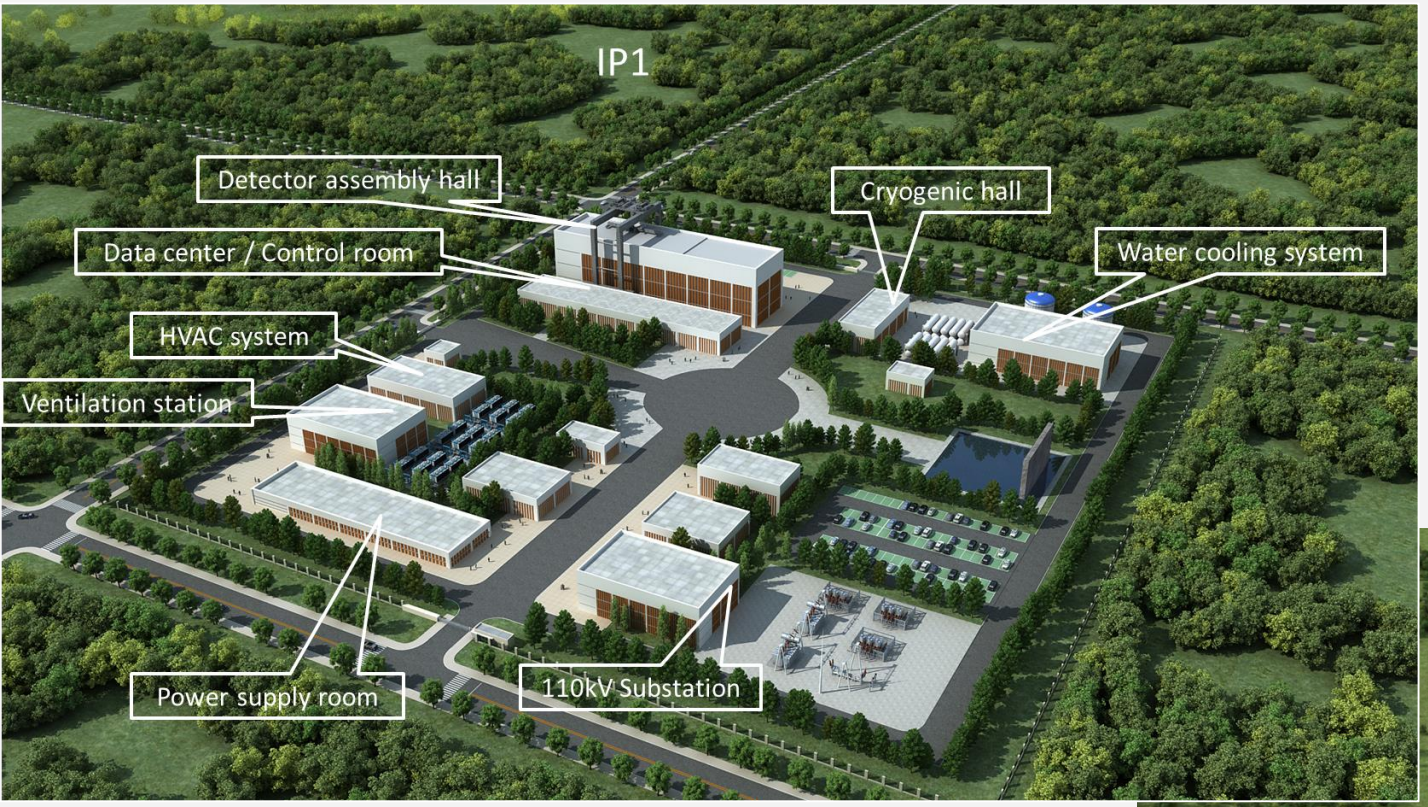
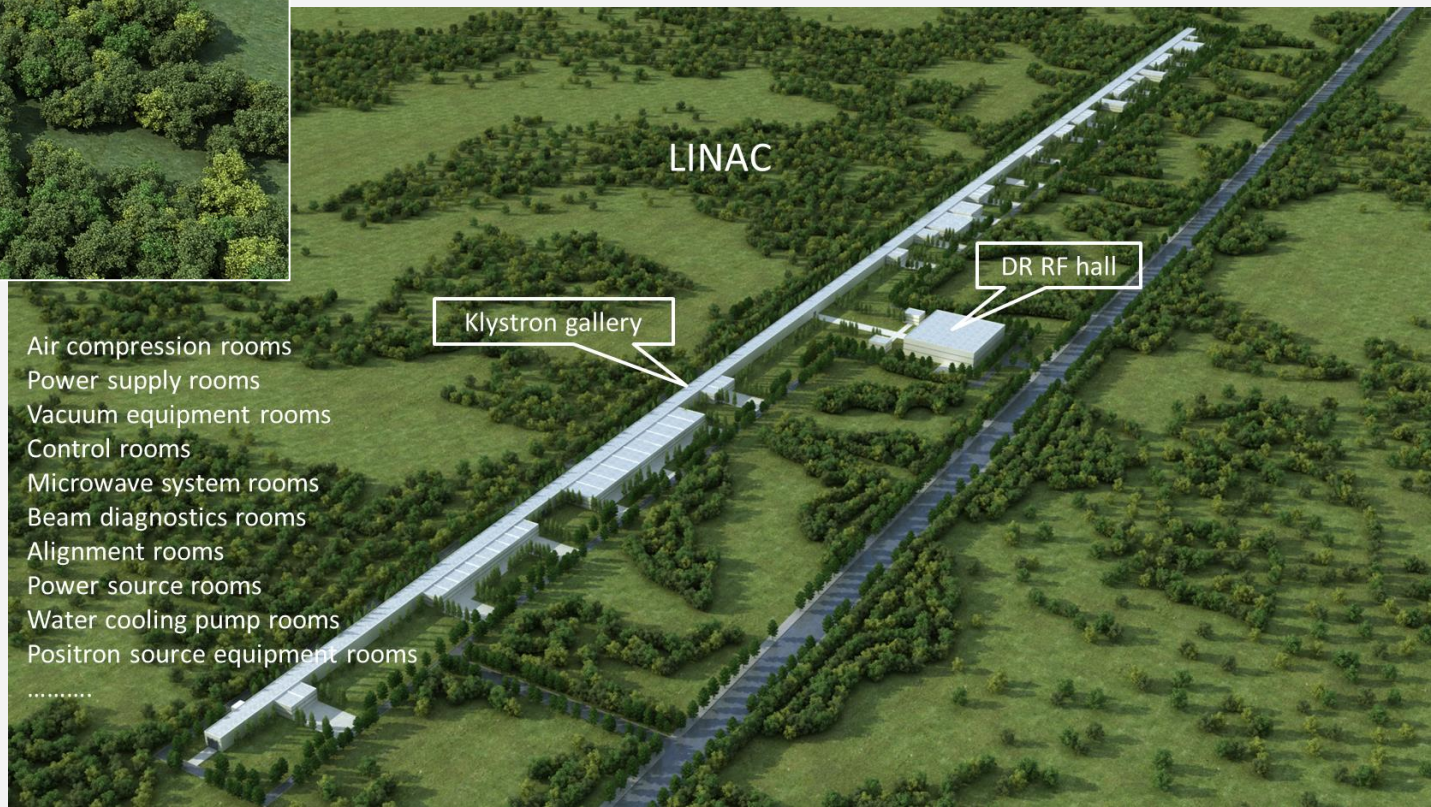


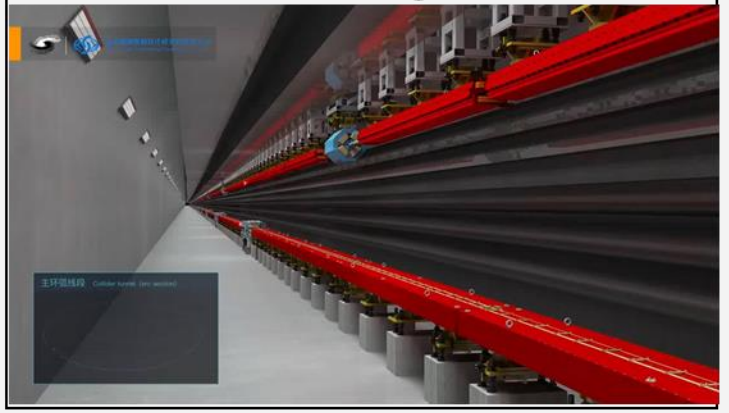


2.3 Equipment Layout

Klystron Gallery

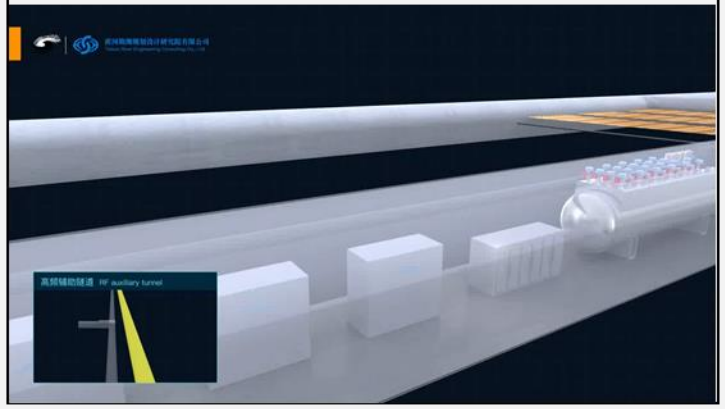
Linac & BTL Tunnel

Collider ring tunnel

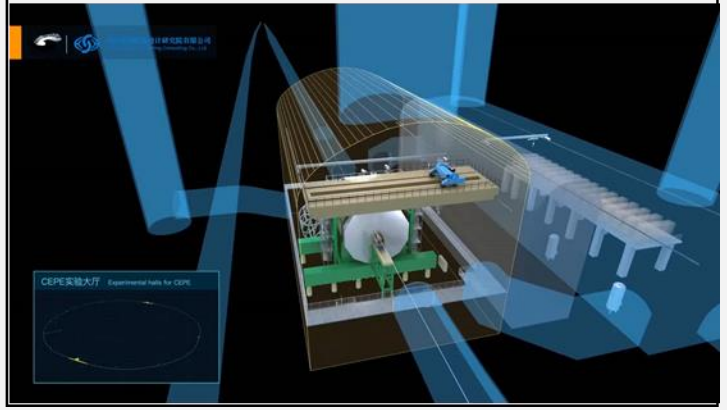


Collider ring tunnel (RF)

RF Auxiliary Tunnel



IP1 / IP3



2.4 Electric engineering

- **Power consumption of CEPC**
  - **Design electrical load： 339.7MW**

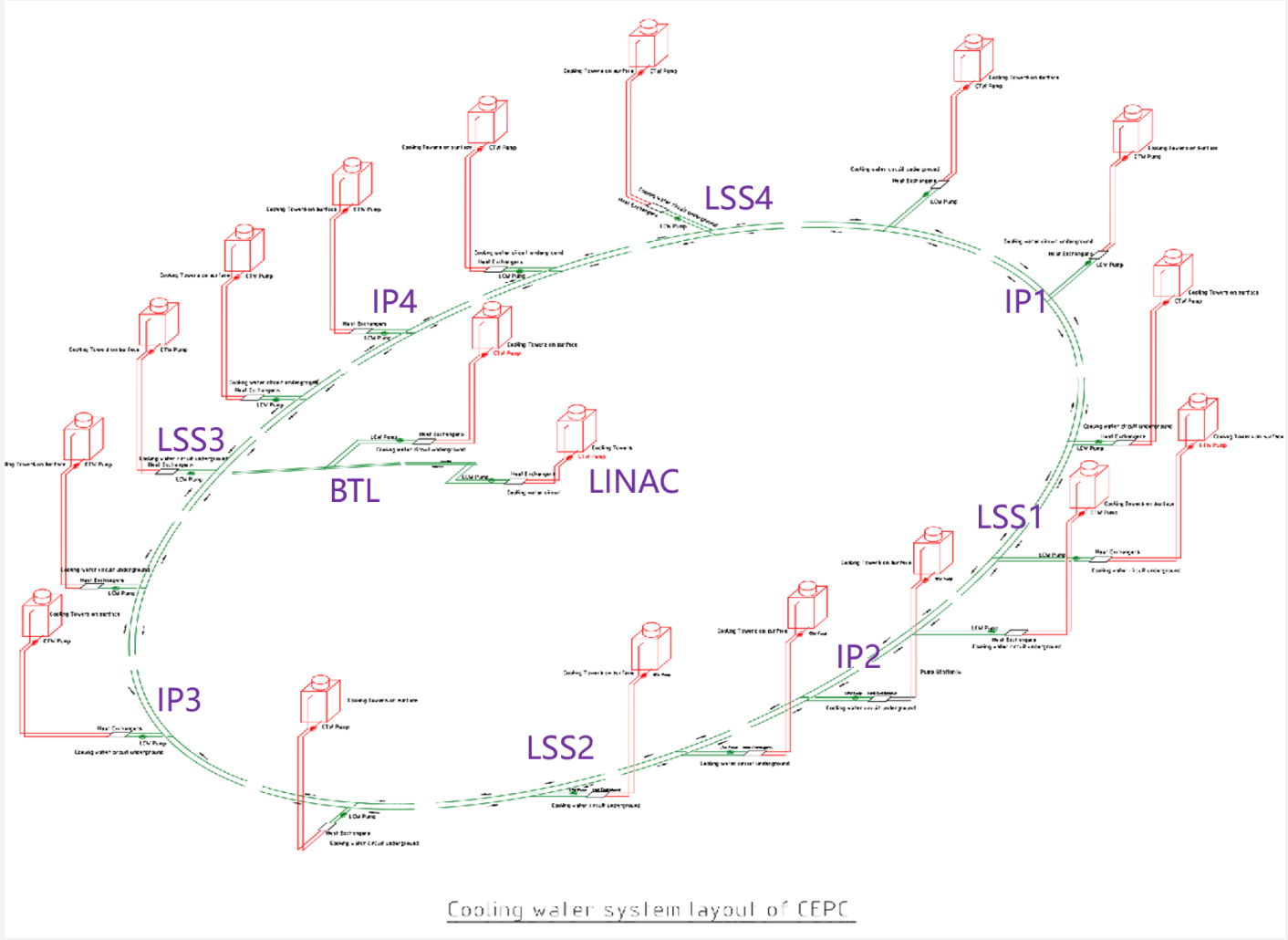
SN	System	TDR(Higgs50MW)						
		Collider	Booster	Linac	BTL	IR	Surface building	Total
1	RF Power Source	161.60	1.73	14.10				177.40
2	Crygenic system	9.17	1.77			0.14		11.08
3	Vacuum System	5.40	4.20	0.60				10.20
4	Magnet Power Supplies	44.50	9.80	2.50	1.10	0.30		58.20
5	Instrumentation	1.30	0.70	0.20				2.20
6	Radiation Protection	0.30		0.10				0.40
7	Control System	1.00	0.60	0.20				1.00
8	Experimental devices					4.00		4.00
9	Utilities	46.40	3.80	2.50	0.60	1.20		54.50
10	General services	7.20		0.30	0.20	0.20	12.00	19.90
	Total	276.87	22.60	20.50	1.90	5.84	12.00	339.71

- **Power supplies and schemes**
  - **The voltage levels on the site**
    - 220kV incomer of CEPC master substation.
    - 110kV power distribution system.
    - 10kV power distribution system for HV power equipment and step-down substation incomer.
    - 0.4kV power distribution system for dedicated and general services.
  - **Back up diesel generator sets are required for personnel safety: lifts, smoke extraction etc.**
  - **Instrumentation and power converter control systems require uninterrupted power supplies (UPS).**

2.5 Cooling water system

- **Function**
  - Absorb heat, cooling process equipment.
  - Provide a constant temperature environment.
  - Adjusting resonant frequency by water temperature.
- **Composition**

  Dual circuit cooling mechanism.
  - **LCW** (Low-conductivity water)— Cooling process equipment directly.
  - **CTW** (Cooling tower water)— Provide cold source for LCW.
  - **DW** (Deionized water)— Supply low-conductivity water for makeup.
  - Waste water collection and discharge system
  - Cooling water control system

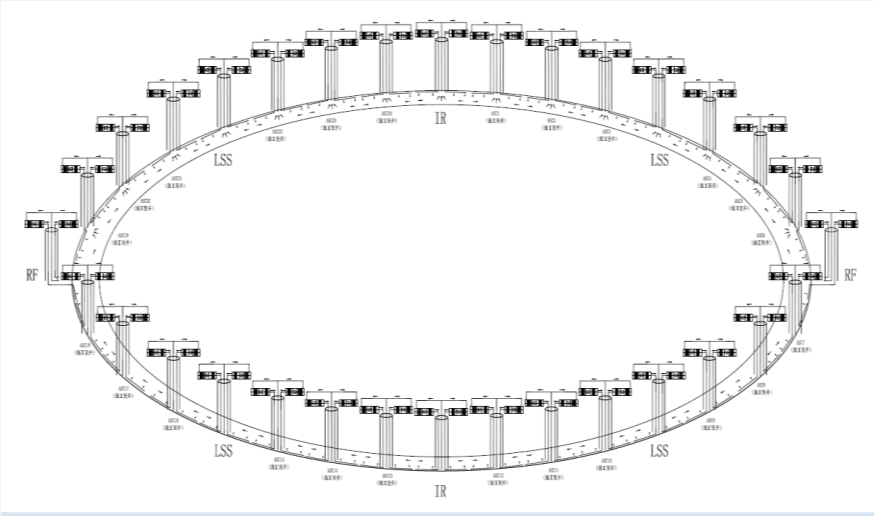


Cooling water system layout of CFPC

2.6 Heating Ventilation and Air Conditioning

- **Estimated cooling loads of HVAC**
  - Ring tunnel: 14MW
  - Service buildings: (200W/m^2) 28MW

  Total: **42MW**
- **Coolant for air conditioning: chilled water**
- **Heat source for heating system in winter**
  - Heat pump -- heat recover from cooling system.
  - Backup boiler



- **Air-conditioning system in tunnel**
  - **Layout**
    - The ring tunnel is divided into **32** independent sections.
    - Each shaft serves as a ventilation and exhaust channel for the underground main ring tunnel, and a ventilation pipe and a smoke exhaust pipe are arranged therein.
  - **Operation scenario**
    - **Machine operation mode**

      -- Temperature and humidity in tunnel are maintained by inlet air.
    - **Transitional mode**

      -- To purge air in the tunnel before access.
    - **Accessible mode**

      -- The air flow rate could be cut down.
    - **Emergency mode**

      -- In case of smoke and gas extraction.

2.7 Compressed air system

Compressed air is considered a safe and reliable source of power for pneumatic equipment. Vacuum valves, cryogenic valves, and other pneumatic equipment used in CEPC extensively rely on compressed air to function.

- **Key requirements and parameters**
  - **Centralized compressed air station: 18**

-- Operating Pressure： 0.6~0.8MPa

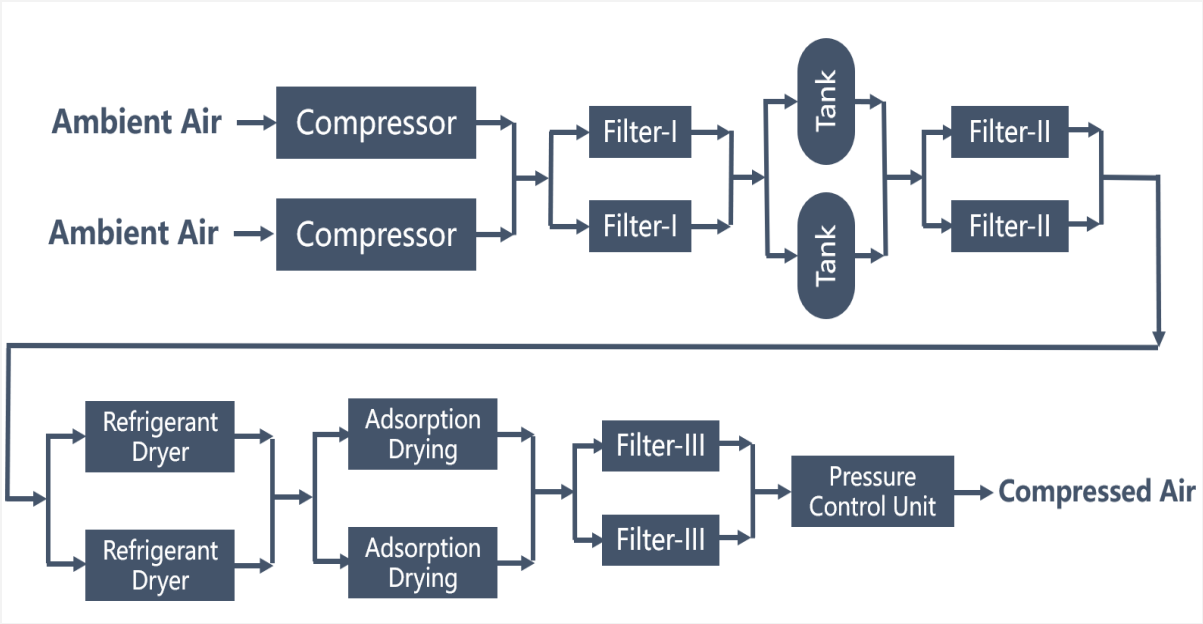
-- Single Plant Capacity：10Nm3/h

-- Particle Removal Efficiency: ≥99.97%

-- Pressure Dewpoint Temp.: -40℃

-- Oil Content: ≤0.01ppm

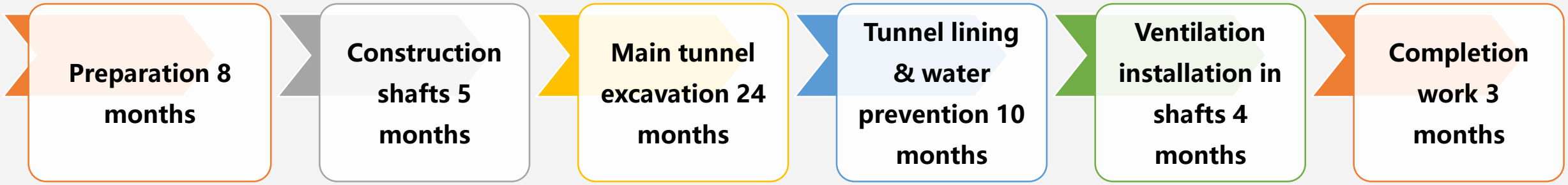
  - **Centralized air cooling station: 2**



2.8 General Construction Schedule

The total construction period is 54 months, including preparatory work of 8 months, main works of 43 months and completion work of 3 months.

The critical activities are:

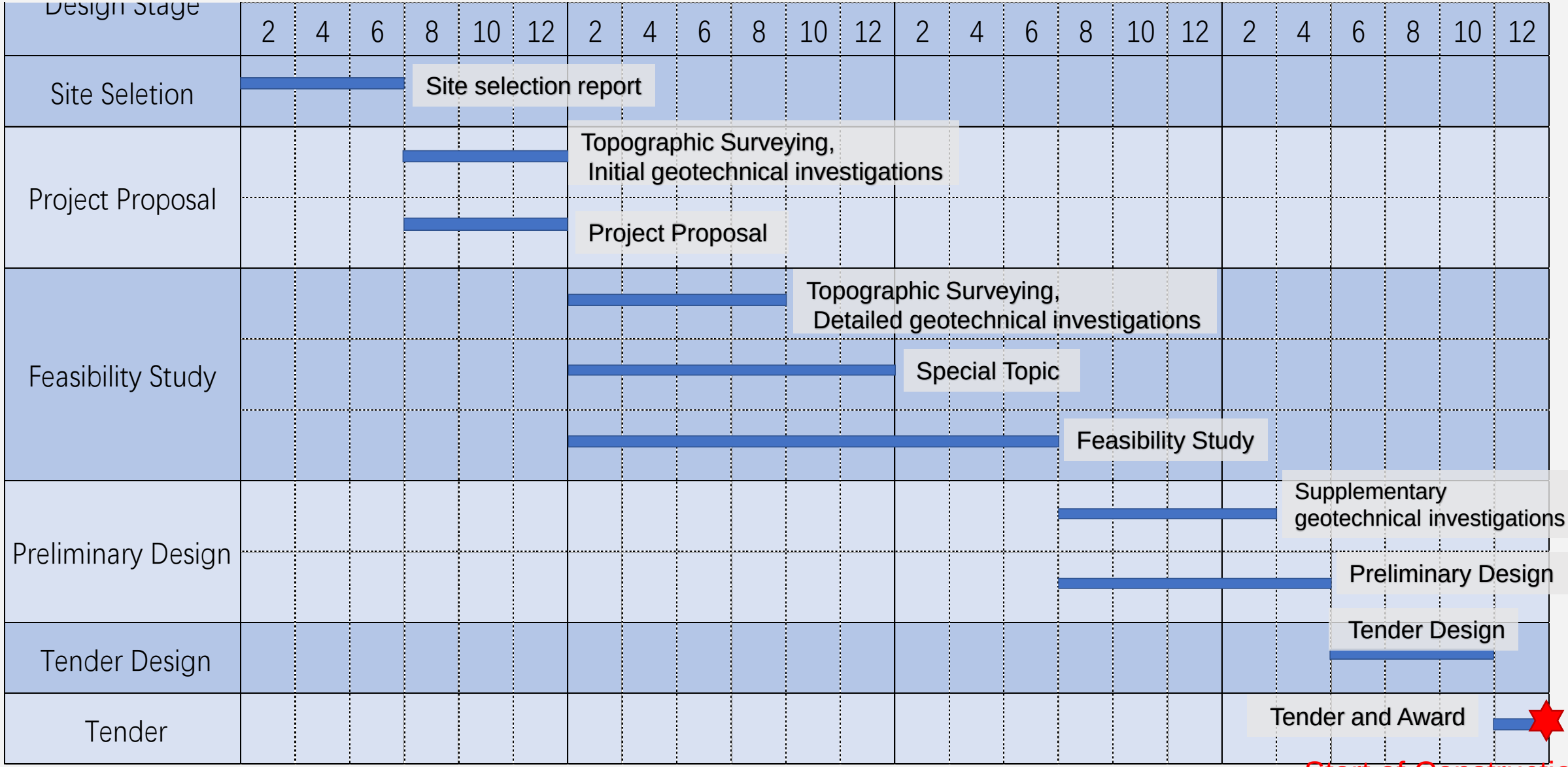


The surface buildings and electrical installation are carried out in parallel and not on the main path.

03

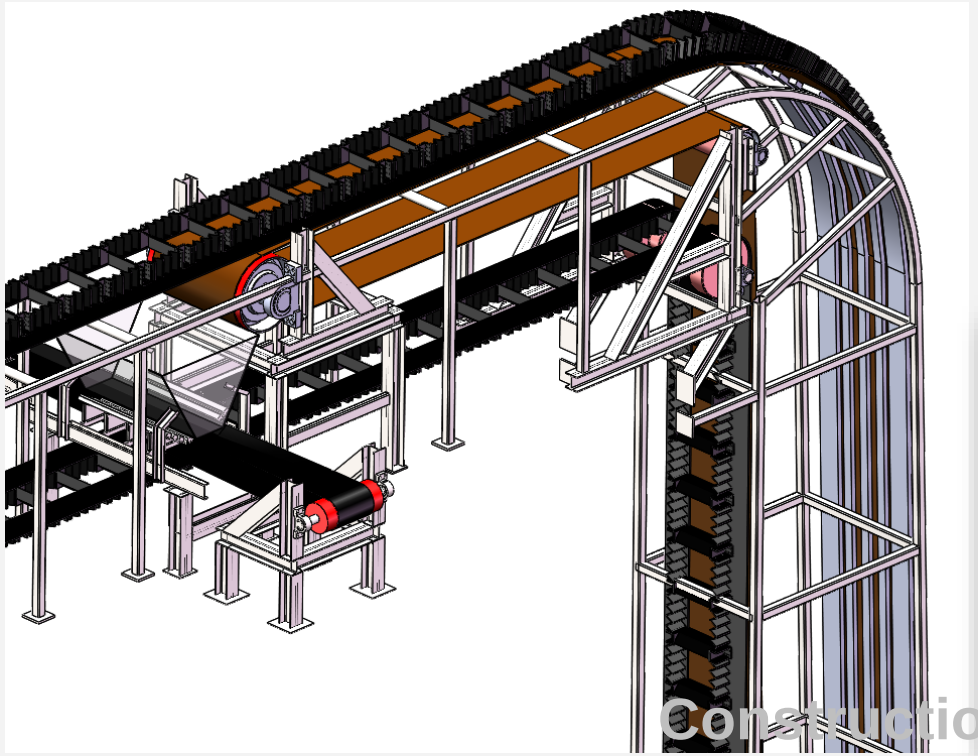
Main Tasks for the Next Stage

Implementation Planning before Construction



Critical Technical Problems in EDR

- Site selection
- Alignment optimization
- Refine designs for all structures
- Construction methods and equipment
- Design and optimization of ventilation and air-conditioning system
- Design and optimization of fire control system
- BIM design
- Green design
- Cost & schedule estimate
- ……



Construction equipment and construction methods

Energy saving consideration

- Power reduction measures
  - Auxiliary facility should be built near to the heat load center.
  - Minimize the operating pressure.
  - Using high efficiency motor and variable frequency motor will help to reduce energy consumption.
  - Adopting high temperature chiller, the cooling efficiency will increase by 2~3% for every 1℃ increase of water outlet temperature.

- Thermal energy recover

Through heat recovery chiller, heat exchanger maximizes the heat absorbed by LCW as several heat sources.

- Air conditioning heat source.
- Heating source in winter.(If possible, the heat supply could radiate to surrounding residential areas)

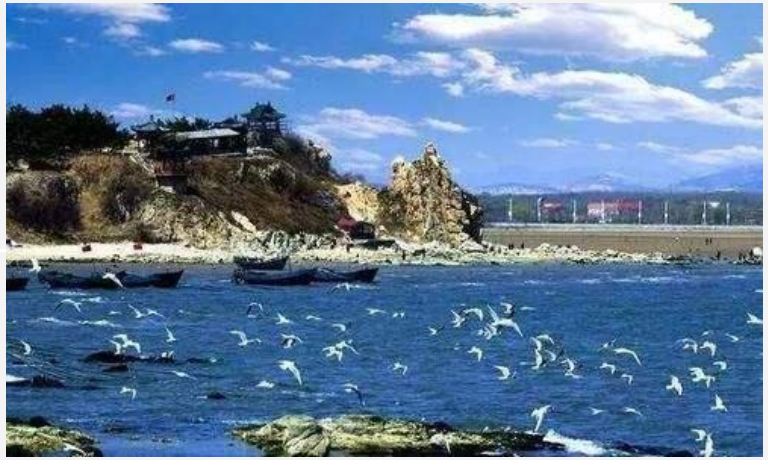
Heat recovery and utilization of low temperature hot water is a very complicated and difficult problem.

04

Summary

Qinhuangdao site is suitable for CEPC construction.

There is still a lot of work to be done before construction.
Advance the preliminary civil engineering design as soon as possible.



THANK YOU FOR YOUR ATTENTION

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