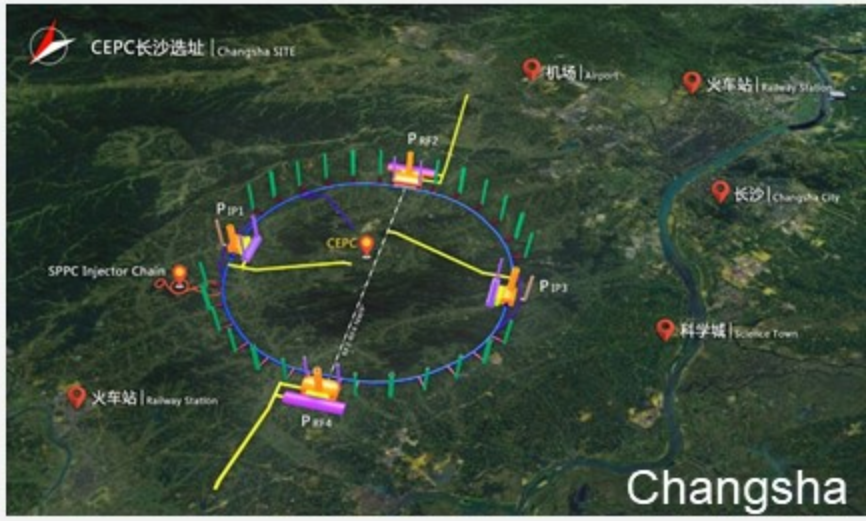
CEPC Infrastructure and Auxiliary Facility



Yu XIAO

Yellow River Engineering Consulting Co., Ltd.

September 14, 2022

Contents

01

Design Progress of Sites

YREC

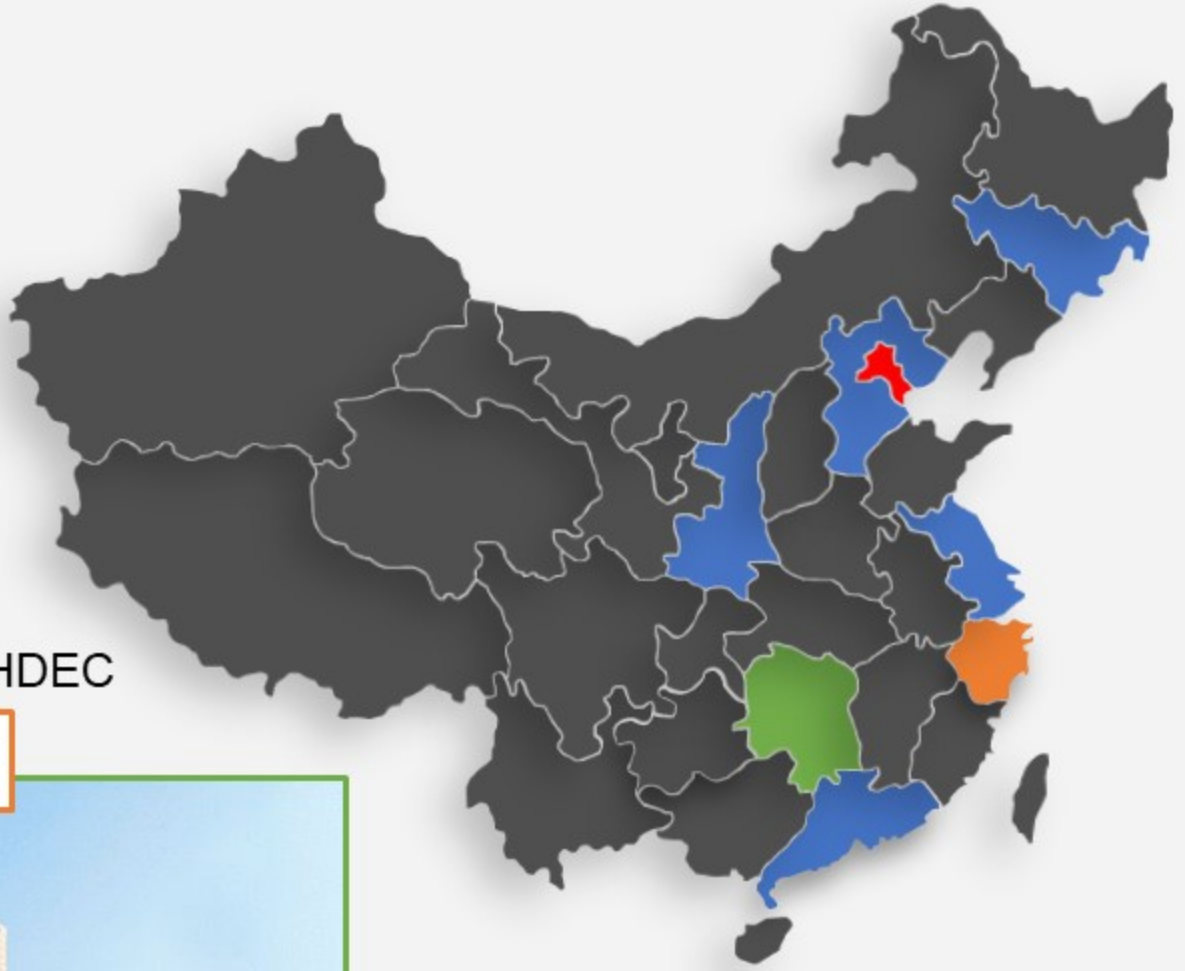
黄河勘测规划设计研究院有限公司
Yellow River Engineering Consulting Co., Ltd.

HDEC

中国电建 POWERCHINA 中国电建集团华东勘测设计研究院有限公司 HUADONG ENGINEERING CORPORATION LIMITED

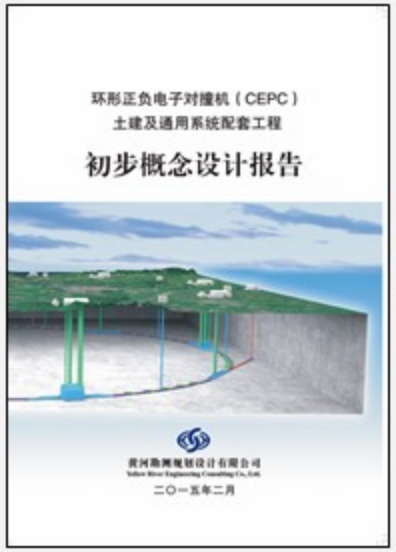
ZNEC

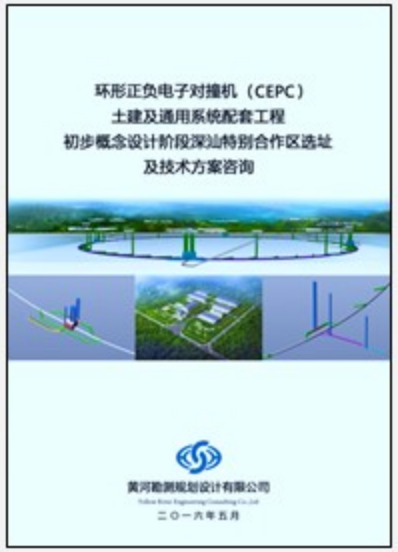
中国电建 POWERCHINA 中南勘测设计研究院有限公司 ZHONGNAN ENGINEERING CORPORATION LIMITED



黄河勘测规划设计研究院有限公司
Yellow River Engineering Consulting Co., Ltd.

Pre-CDR | CDR | TDR





2013.4 ~ 2015.3	2014.5 ~ 2016.8	2014.6 ~ 2017.7	2016.9	2017.7 ~ 2017.9	2017.9 ~ 2018.8	2018.9 ~ 2022
• Site selection in Hebei	• Site selection in Guangdong	• Site selection in Shaanxi	• Site selection in Jiangsu	• Site selection in Baoding, Hebei & Zhejiang	• 100km design of Qinhuangdao	• TDR design (Qinhuangdao, Changchun)

From March 25 to 29, 2018

The starting point of Huzhou site

the General Office of the Zhejiang Provincial People's Government invited CEPC-SPPC project experts from The High Energy Institute to visit the four sites preselected in Zhejiang province, and organized a CEPC-SPPC site evaluation meeting in Zhejiang. Huzhou site was preliminarily recommended as candidate site of Zhejiang Province after analysis and study.

By October 2021

the work that has been done is as follows

- **CEPC report on site selection (Zhejiang Huzhou)**

Answer the questions-Why did CEPC choose huzhou

- **CEPC report on socio-economic assessment**

Answer the questions-Why did huzhou choose CEPC

- **CEPC Technology Design Report on Civil engineering of the first stage**
- **CEPC report on science city concept plan**

Find a comfortable home for scientists

From December, 2018

The starting point of Changsha site

ZNEC continually carries out necessity demonstration and study on construction technology on CEPC Changsha Site.

- In July 2021, the government of Changsha City entrusted Hunan University to take the lead in the demonstration of the settlement of the CEPC Project in Changsha.
- In September 2021, Hunan University organized the site review meeting of the *Demonstration Report of China (Changsha) CEPC and New International Science City Project*.


长沙市科学技术局

关于调研国家重大科技基础设施相关事宜的函

中国电建集团中南勘测设计研究院有限公司：

根据长沙市委市政府的工作部署，我局拟启动环形正负电子对撞机（CEPC）国家重大科技基础设施建设前期调研，现委托湖南大学牵头开展CEPC项目落户长沙的论证工作，对CEPC项目落户长沙的必要性、可行性及重要意义进行论证，形成可行性论证报告报送市委市政府决策参考，现安排论证专家组成员前往贵单位调研相关事宜，请予接洽和协助。

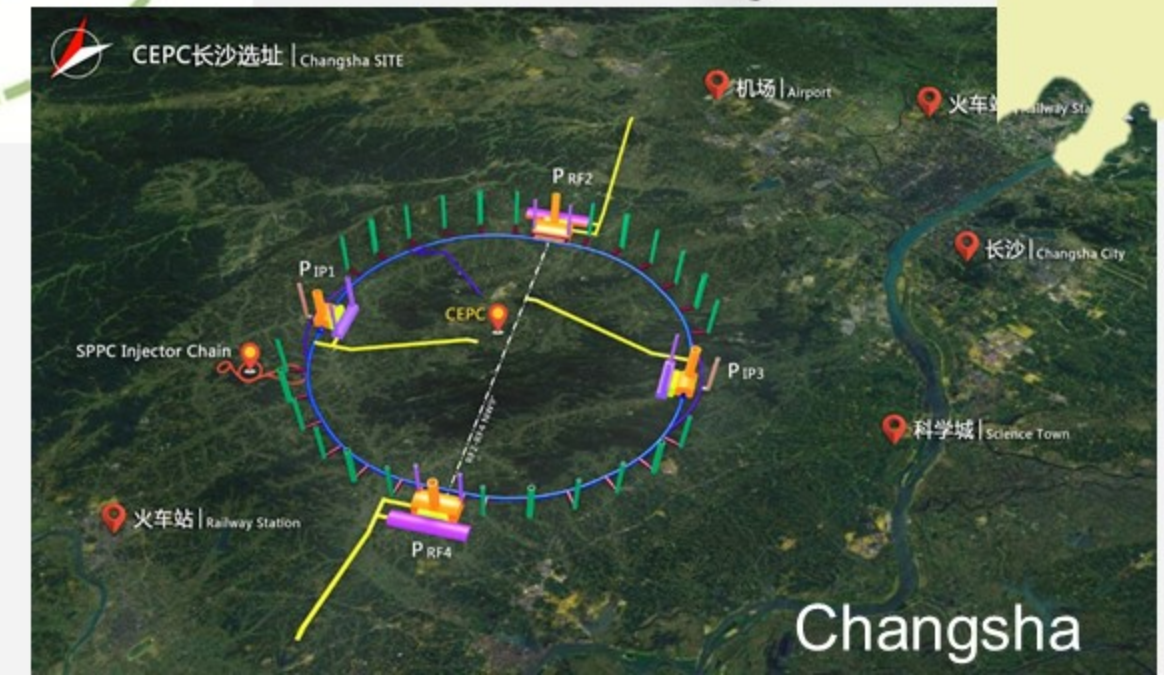
02

Civil Engineering

Qinhuangdao
Huzhou
Changsha

2.1 Location

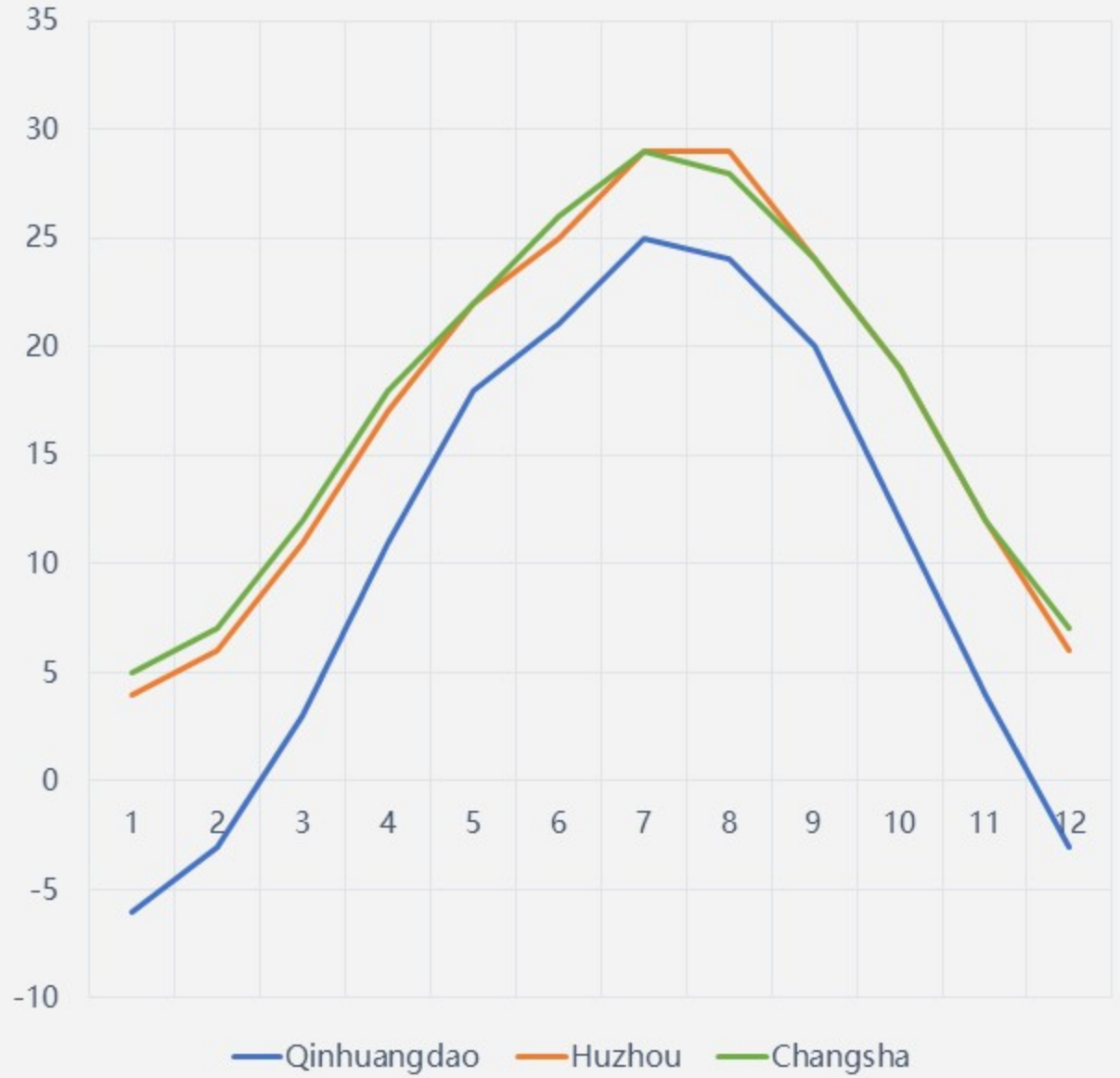
Qinhuangdao

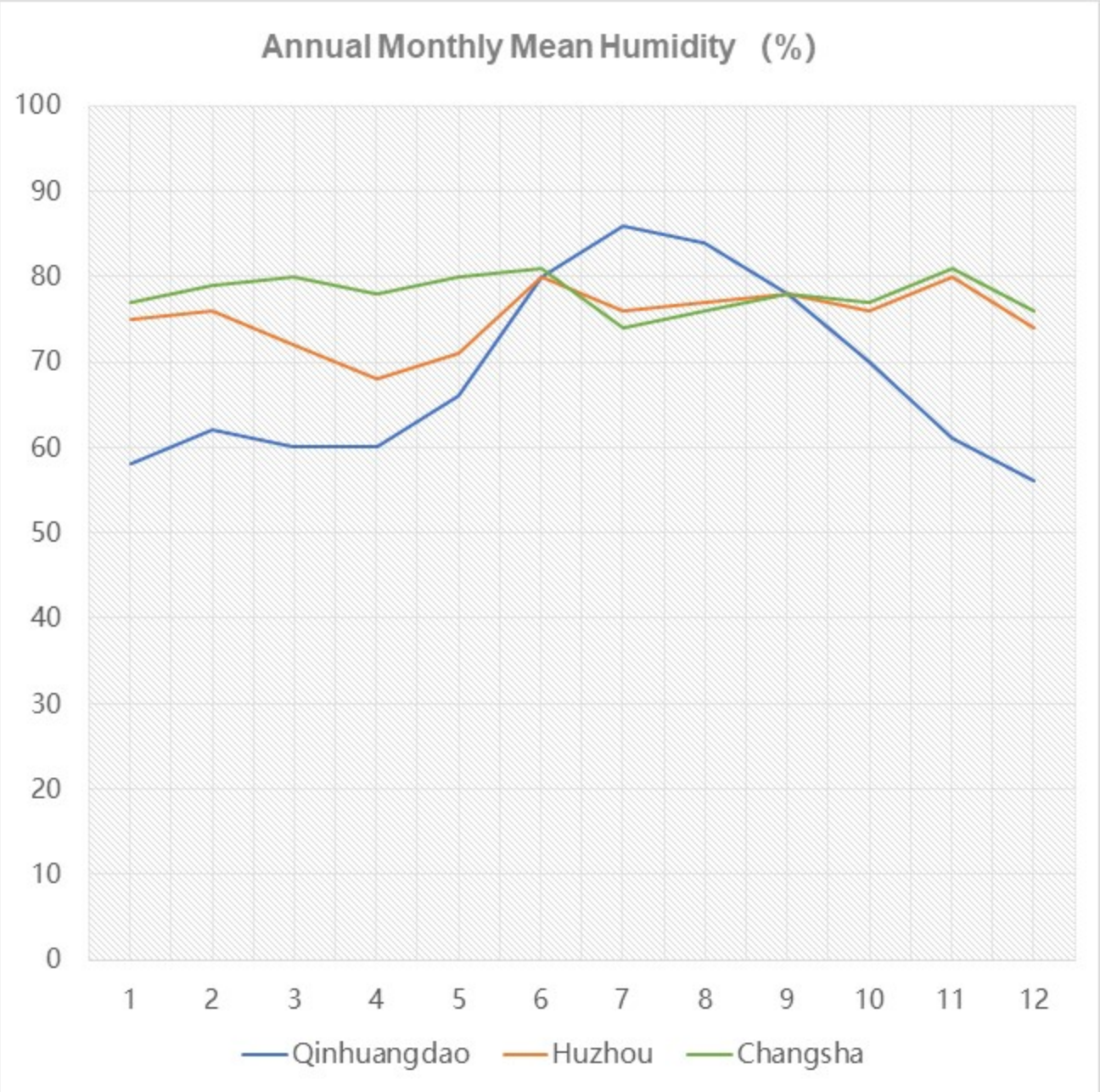


Changsha

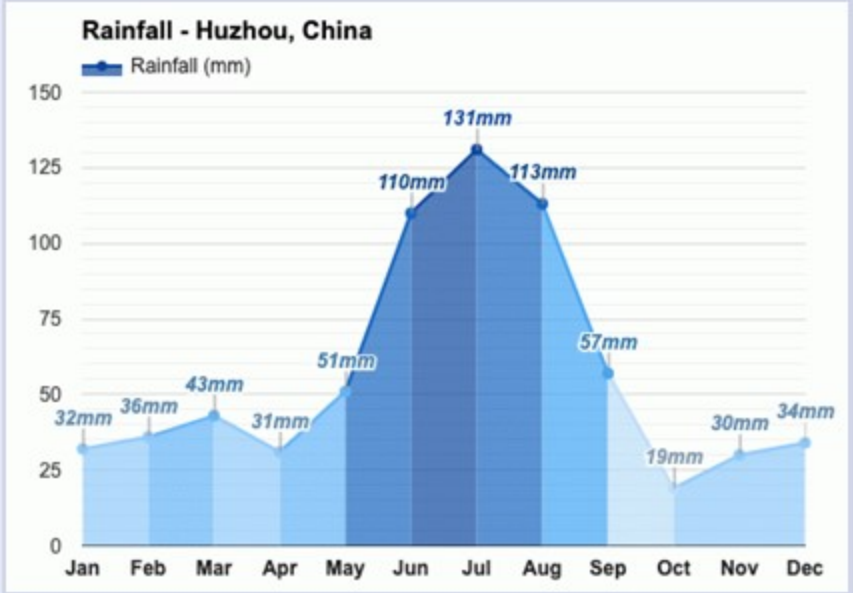
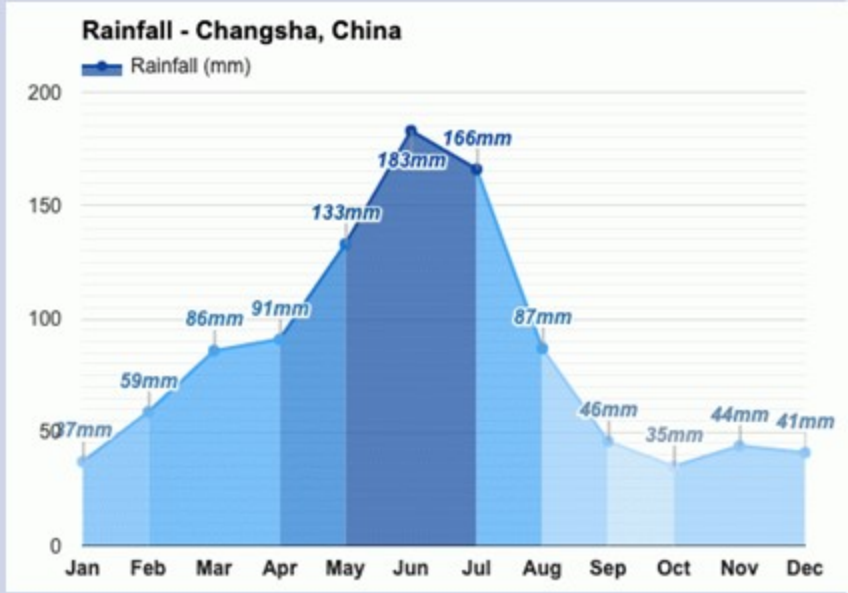
Huzhou

2.2 Climate

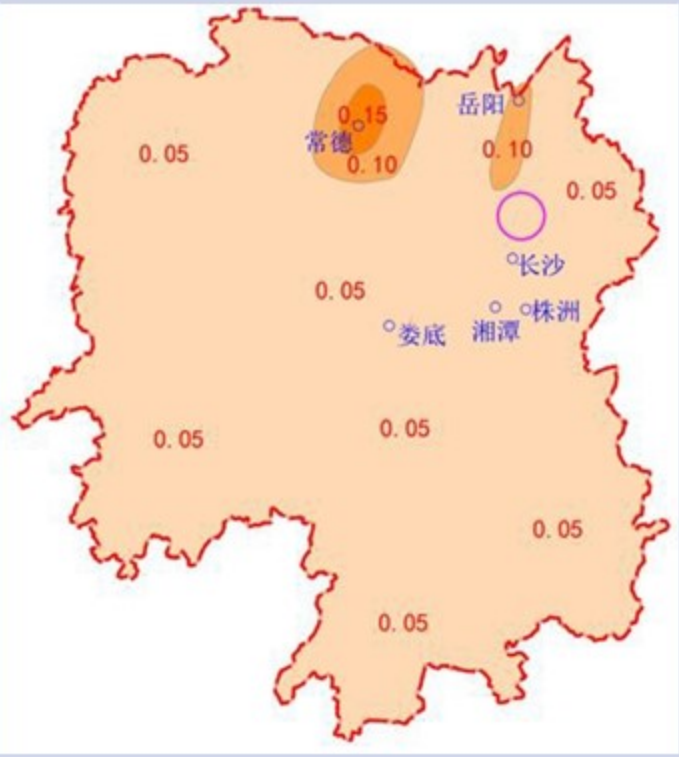

Annual Monthly Mean Temperature （℃）
35
30
25
20
15
10
5
0
-5
-10
1
2
3
4
5
6
7
8
9
10
11
12
Qinhuangdao
Huzhou
Changsha


Annual Monthly Mean Humidity （%）
100
90
80
70
60
50
40
30
20
10
0
1
2
3
4
5
6
7
8
9
10
11
12
Qinhuangdao
Huzhou
Changsha

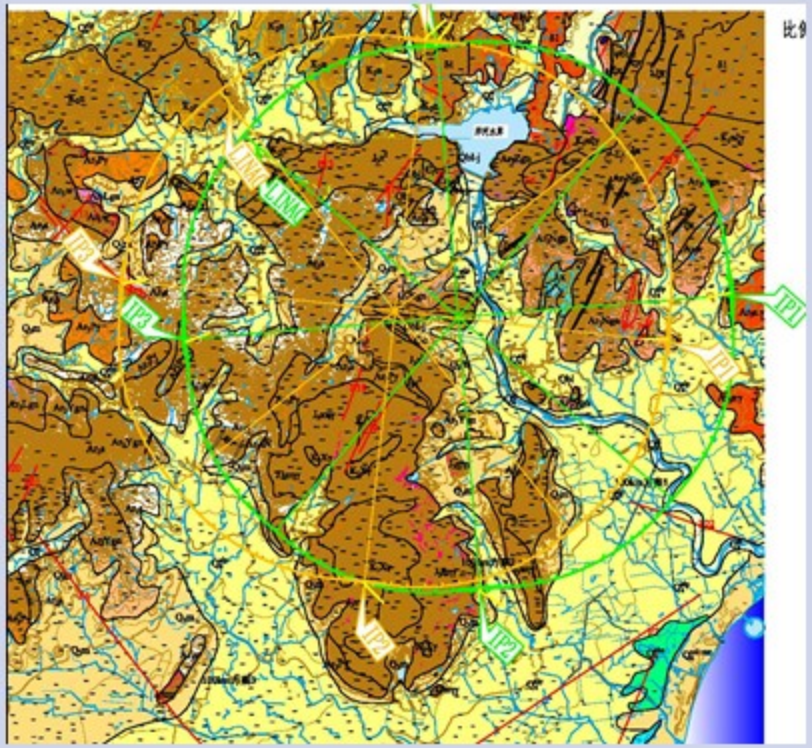
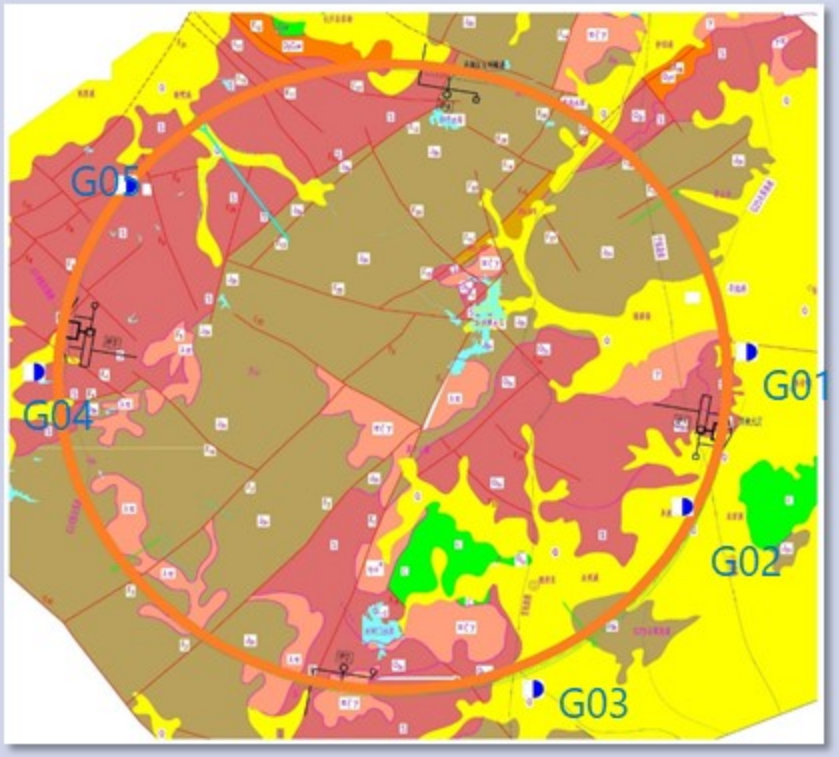
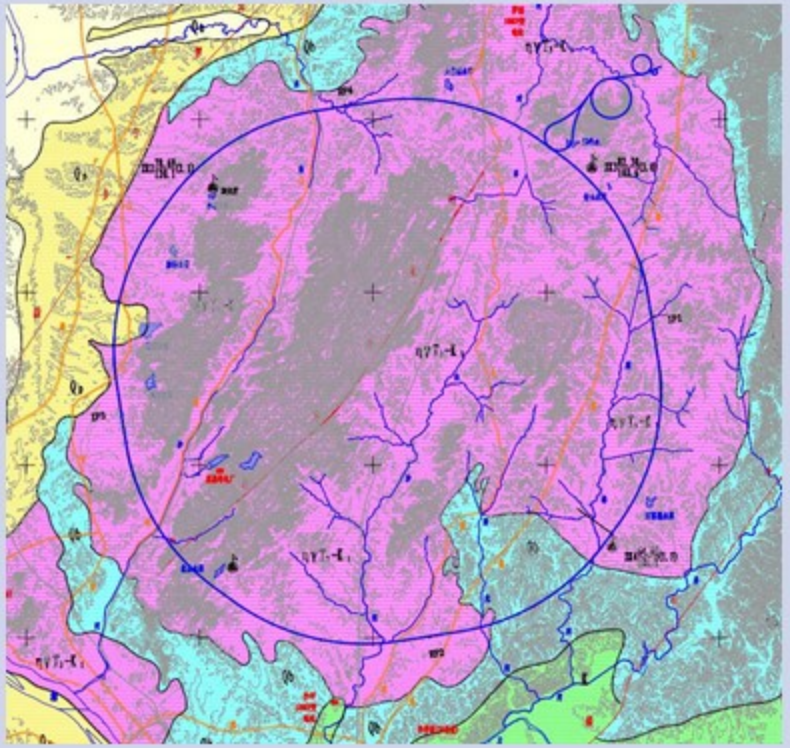
2.2 Climate

Qinhuangdao	Huzhou	Changsha
		
Annual mean precipitation		
630mm	1023mm	1362mm

2.3 Engineering Geology

Qinhuangdao	Huzhou	Changsha
		
	Seismic peak acceleration	
0.10g~0.15g	0.05g	0.05g
	Basic seismic intensity	
VII	VI	VI

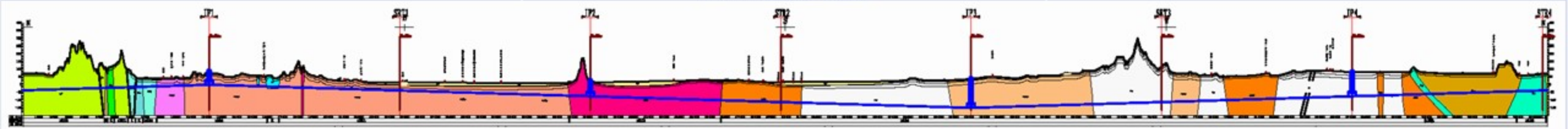
2.3 Engineering Geology

Qinhuangdao	Huzhou	Changsha
		
Stratum Lithology		
Gneiss Granite	Sandstone Tuff	Granite Sandstone, Slate

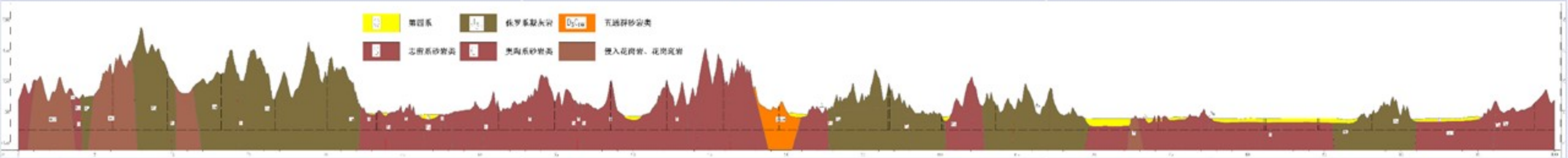
2.3 Engineering Geology

Qinhuangdao	Huzhou	Changsha

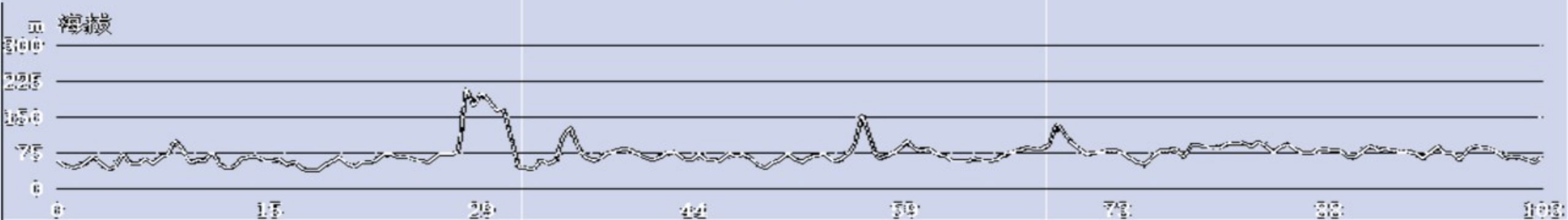
Qinhuangdao



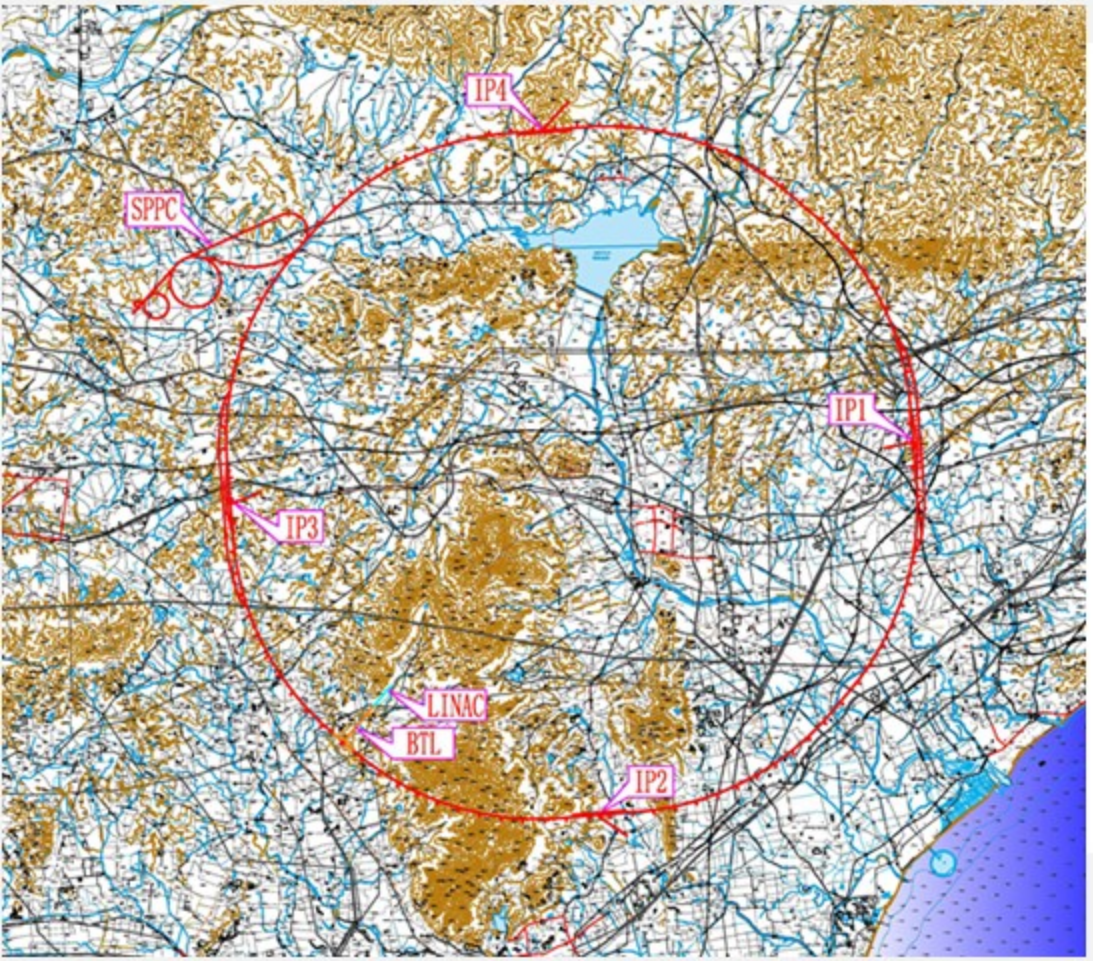
Huzhou

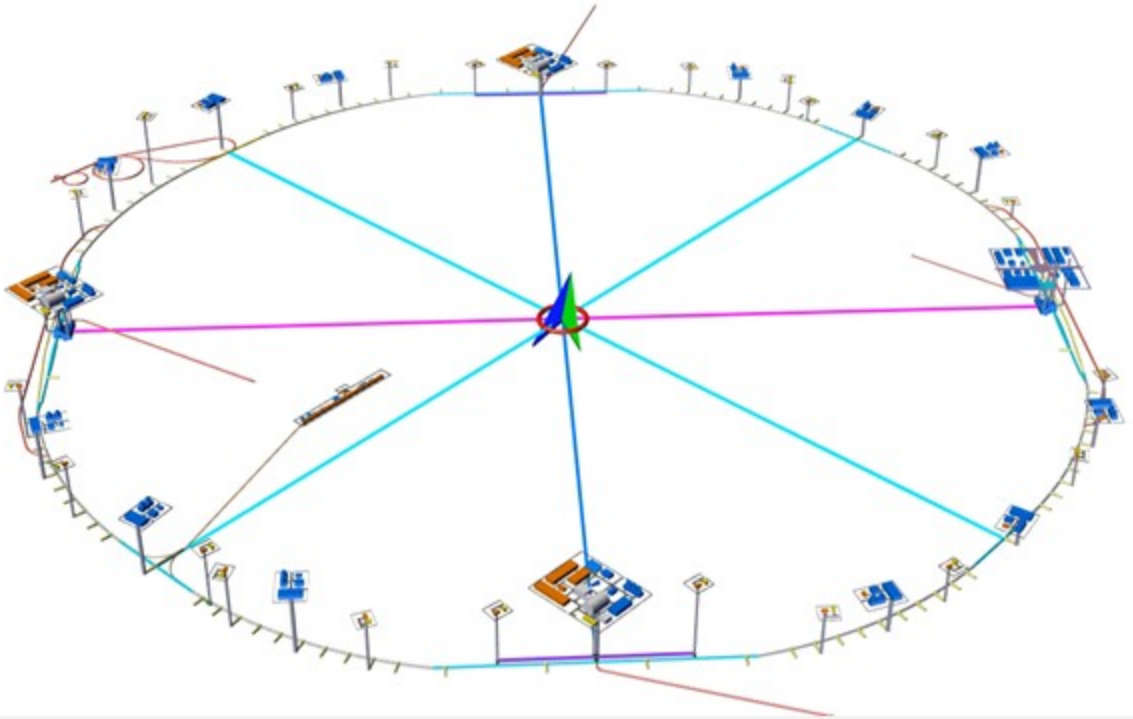


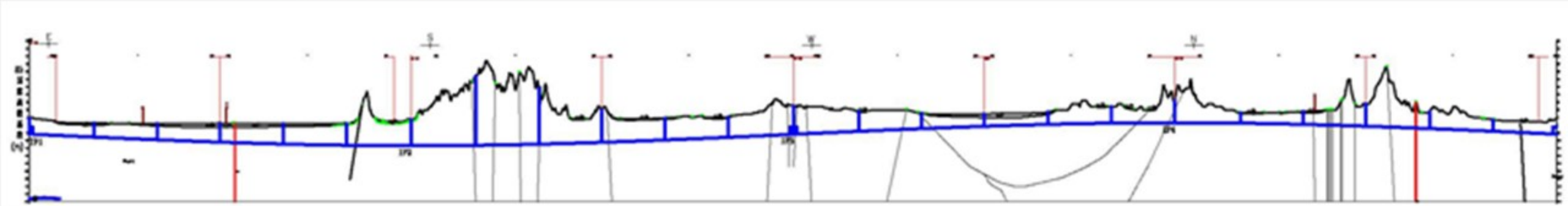
Changsha



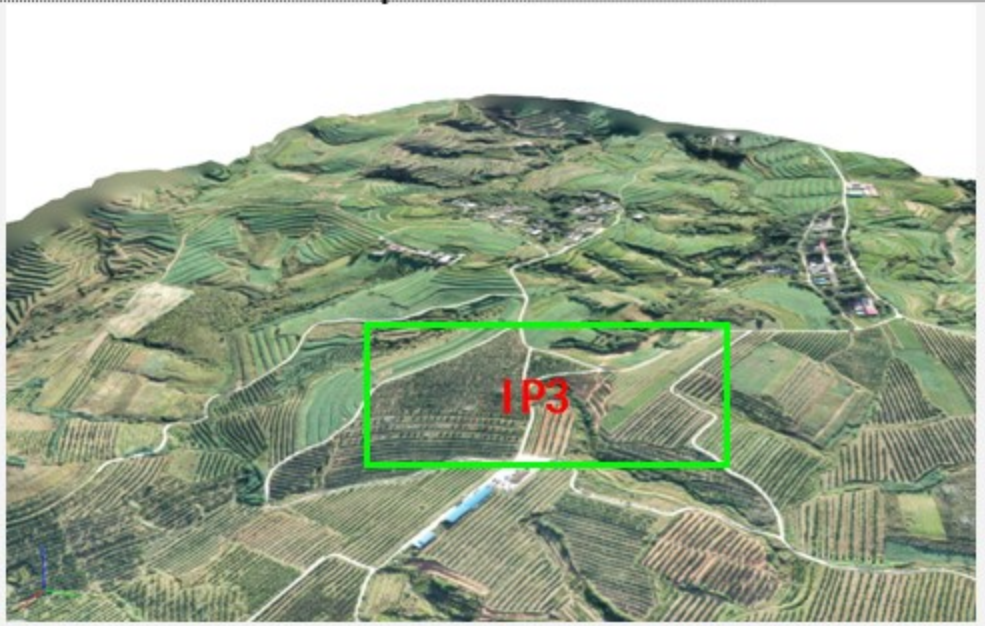
2.4 Project Layout

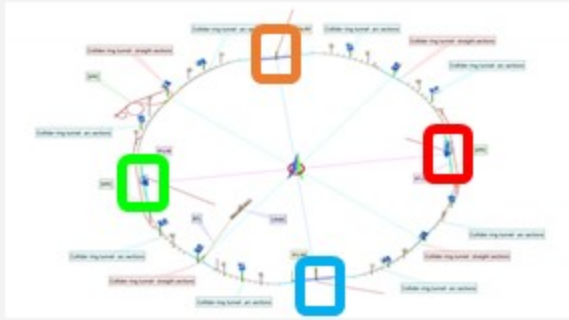


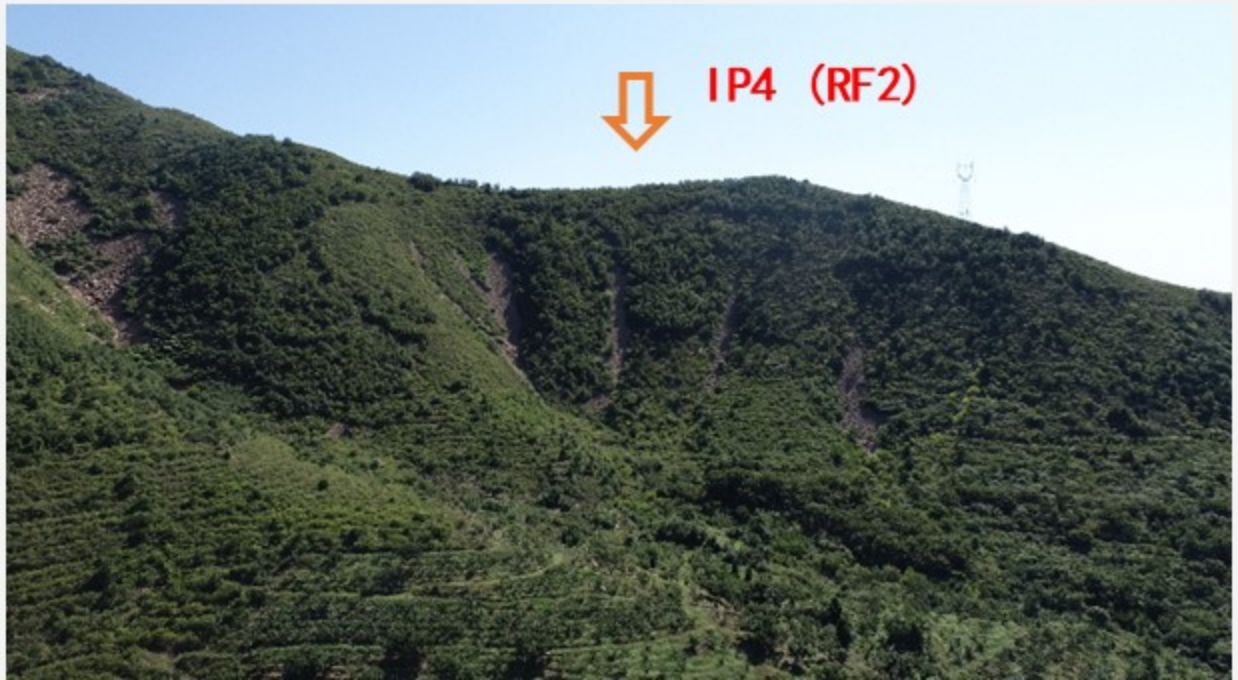




Preferred Option





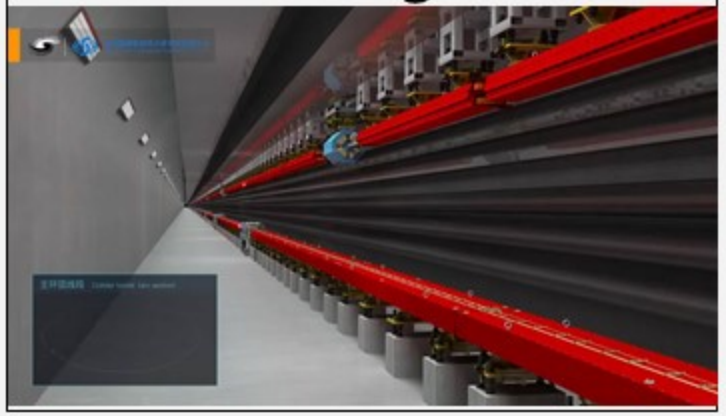


2.5 Equipment Layout

Klystron Gallery

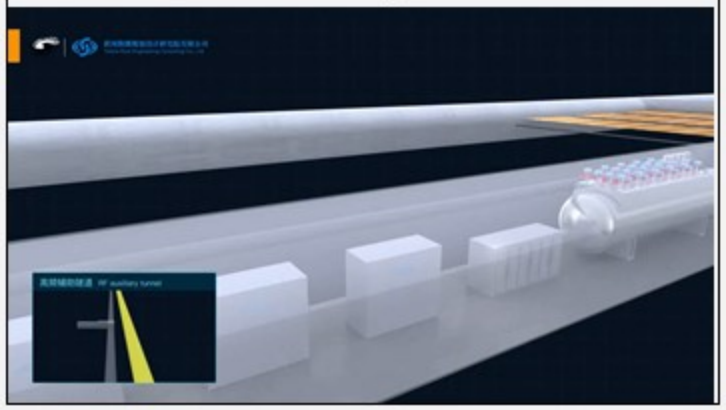
Linac & BTL Tunnel

Collider ring tunnel

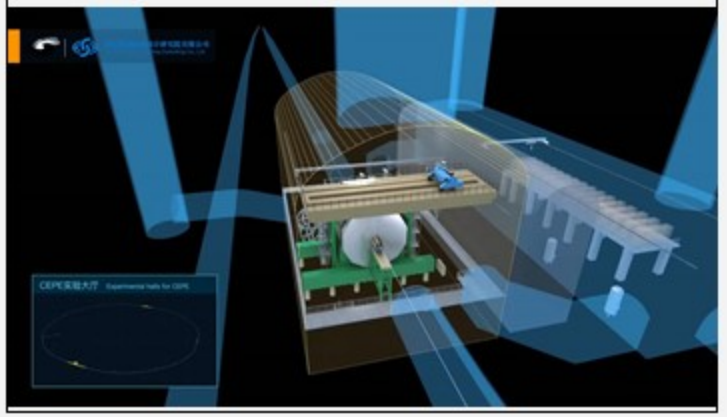


Collider ring tunnel (RF)

RF Auxiliary Tunnel



IP1 / IP3



2.6 Surface Buildings

IP1

LINAC

2.7 International Science City

Huzhou

中国电建 POWERCHINA
中国电建集团华东勘测设计研究院有限公司
HUADONG ENGINEERING CORPORATION LIMITED

Changsha

中国电建 POWERCHINA
中南勘测设计研究院有限公司
ZHONGNAN ENGINEERING CORPORATION LIMITED

03

Auxiliary Facilities

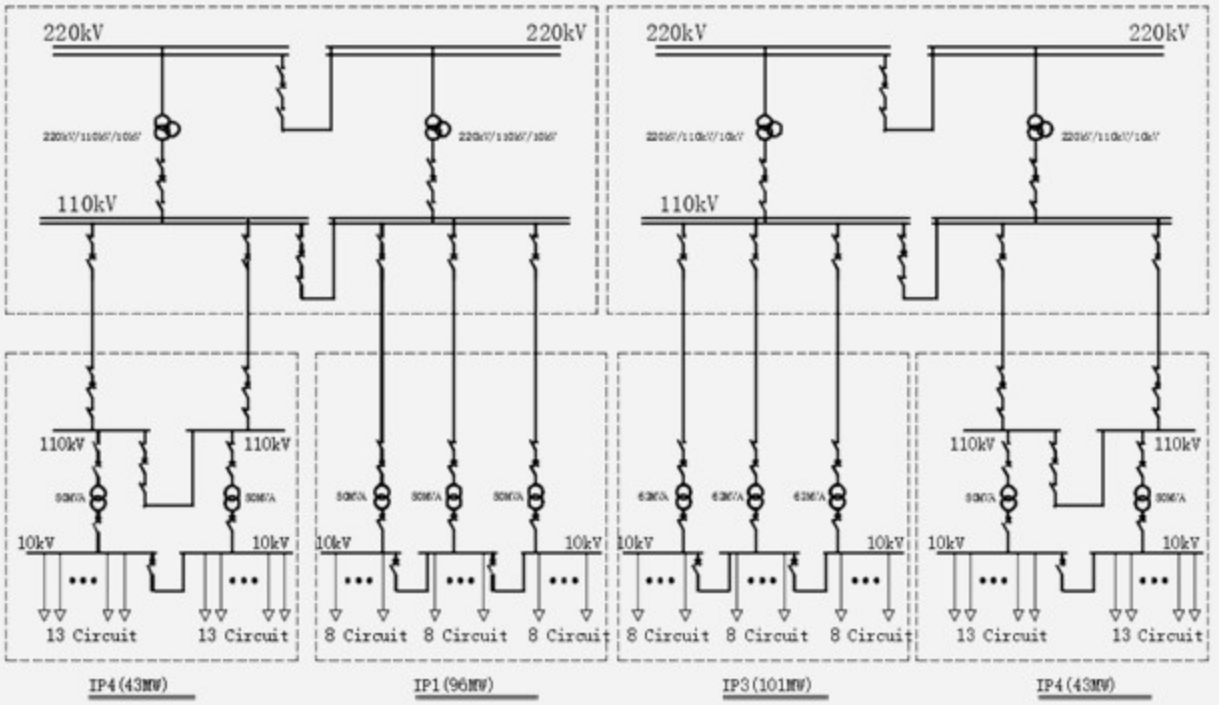
3.1 Electric engineering

- **Electric power demand**
  - Total: 340.7MW

	System for Higgs (50MW /beam)	Location and electrical demand(MW)						
		Ring	Booster	LINAC	BTL	IR	Surface building	TOTAL
1	RF Power Source	161.5	1.4	11.1				174.1
2	Cryogenic System	15.5	0.6	-		1.7		17.9
3	Vacuum System	1.0	3.8	1.8				6.5
4	Magnet Power Supplies	52.3	7.5	2.4	1.1	0.3		63.5
5	Instrumentation	1.3	0.7	0.2				2.2
6	Radiation Protection	0.3		0.1				0.4
7	Control System	1.0	0.6	0.2	0.0	0.0		1.8
8	Experimental devices					4.0		4.0
9	Utilities	42.4	3.5	2.0	0.6	1.2		49.7
10	General services	7.2		0.3	0.2	0.2	12.0	19.8
11	RF system			0.8				0.8
12	**TOTAL**	**282.4**	**18.2**	**18.9**	**1.8**	**7.4**	**12.0**	**340.7**

3.1 Electric engineering

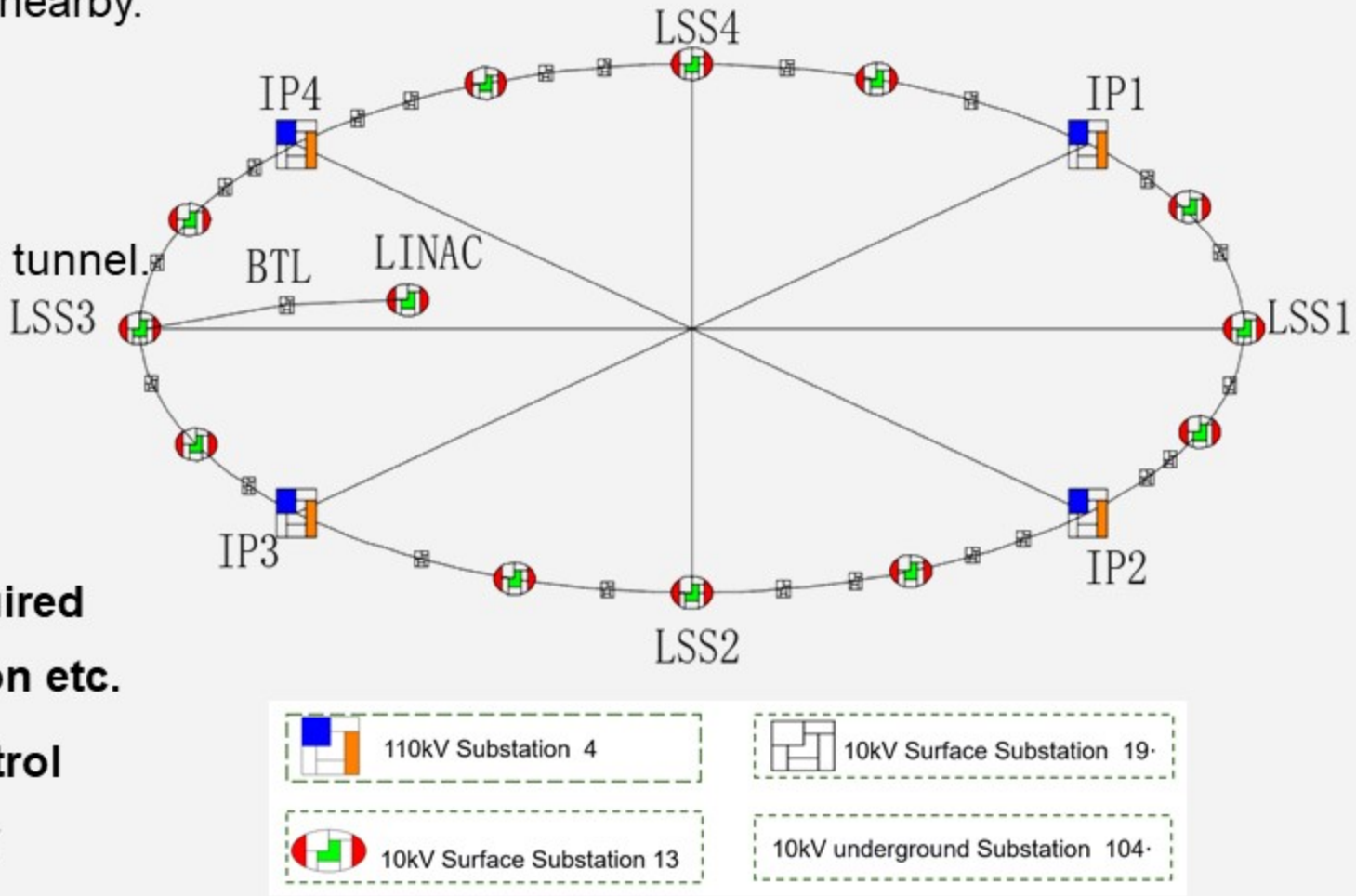
- **Power supplies and schemes**
  - **The voltage levels on the site**
    - 220kV incomer of CEPC master substation.
    - 110kV power distribution system.
    - 10kV power distribution system for HV power equipment and step-down substation incomer.
    - 0.4kV power distribution system for dedicated and general services.
  - **220kV/110kV Master substation**
    - 2 substations
    - Rated capacity of transformer: 2*210MW (220/110kV/10kV).
    - 220kV feeds connected to grid station nearby (State Grid Corporation of China).
    - Three-phase three-volume natural oil circulating air-cooled on-load regulating.



- **110kV/10kV step-down substations**
  - 4 substations(IP1~IP4)
  - Rated capacity of transformer: 6*63MW+4*80MW

3.1 Electric engineering

- **10kV step-down substations**
  - 10kV feeders from 110kV/10kV substation nearby.
  - Surface 10kV loop : 40
  - Underground 10kV loop
    -- 96 substations (10/0.4kV) along the ring tunnel.
    -- near the load points.
  - Dry-type transformers
  - Centralized reactive compensation
- **Back up diesel generator sets maybe required for personnel safety: lifts, smoke extraction etc.**
- **Instrumentation and power converter control systems may require uninterrupted power supplies (UPS).**

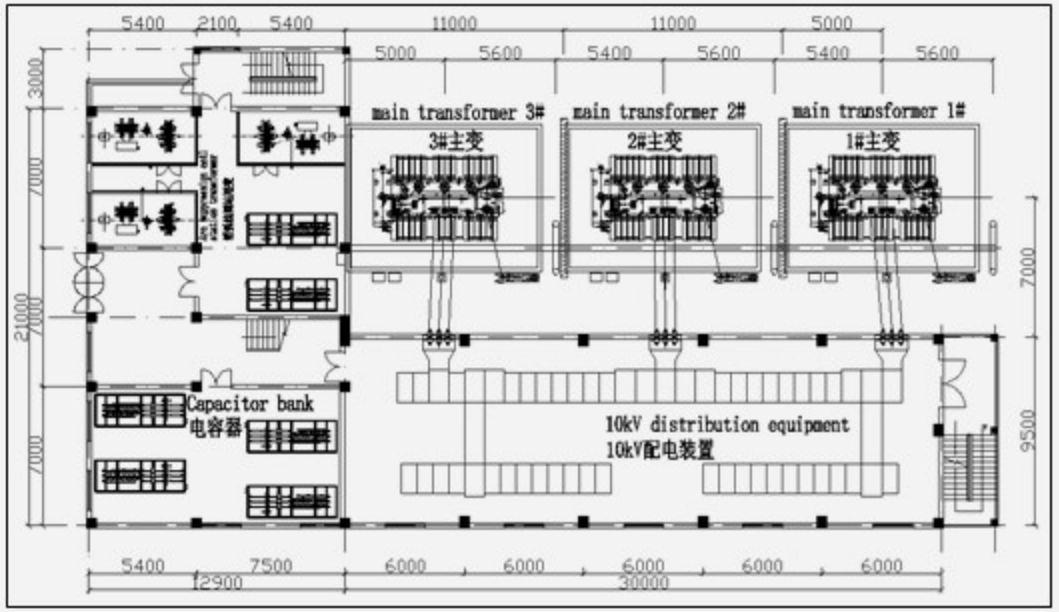


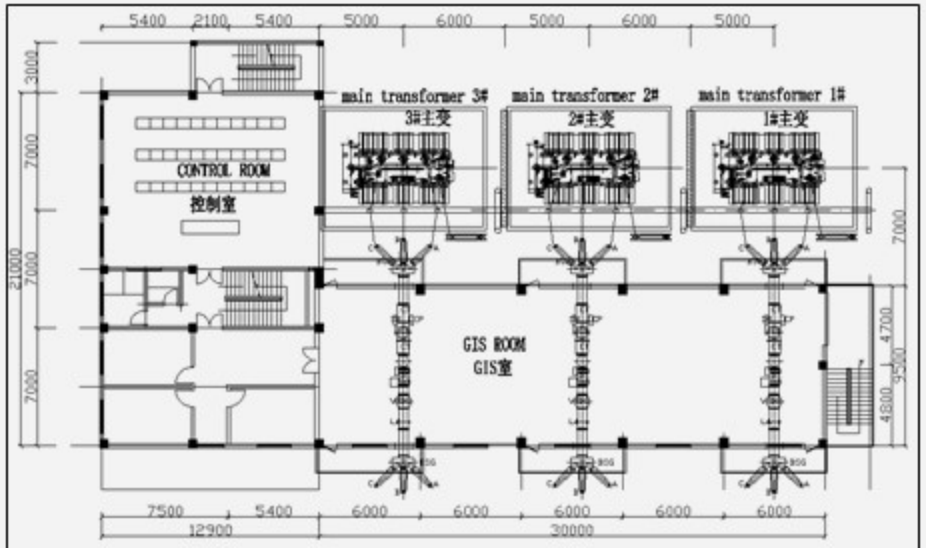
3.1 Electric engineering

- **110kV Substation layout**
  - **IP1/IP3**
    - Main electrical wiring of 110kV substation

    -- 110kV lines connected by the line transformer bank.

    -- 10 kV lines connected by sectionalized single busbar.
    - Main transformer Outdoor;
    - 10 kV Switchgear indoor
    - Double-row arrangement;
    - Outgoing line by cables.
    - 110 kV GIS equipment in single row.





3.2 HVAC

- **Estimated cooling loads of HVAC**
  - Ring tunnel: **6MW**
  - Service buildings: (200W/m^2) 28MW

  Total: **34MW**
- **Coolant for air conditioning: chilled water**
- **Heat source for heating system in winter**
  - Heat pump -- heat recover from cooling system.
  - Backup boiler

Design Parameter	Unit	Quantity
Total cooling load	MW	34
Total chilled water flow rate	m^3/h	5850
Total cooling tower water flow rate	m^3/h	7016
Total capacity of cooling towers	MW	41

- **Indoor Design Parameters**
  - **Tunnel**
    - Temperature: within 30-34℃ and shall be kept below 35℃
      -- Inlet: 18~20℃
      -- Outlet: less than 35℃
    - Relative humidity: 50% ~ 60%, and shall be lower than 65%
  - **Experimental halls**
    - Temperature: about 26℃(summer), 20℃(winter)
    - Relative humidity: 50% ~ 60%, and shall be lower than 65%.
  - **Control room (or electronics)**
    - Temperature: about 20-25℃
    - Relative humidity: 45% ~ 60%
  - **Other service building**
    - Temperature: about 28℃(summer), 18℃(winter),
    - Relative humidity: lower than 65%

3.2 HVAC

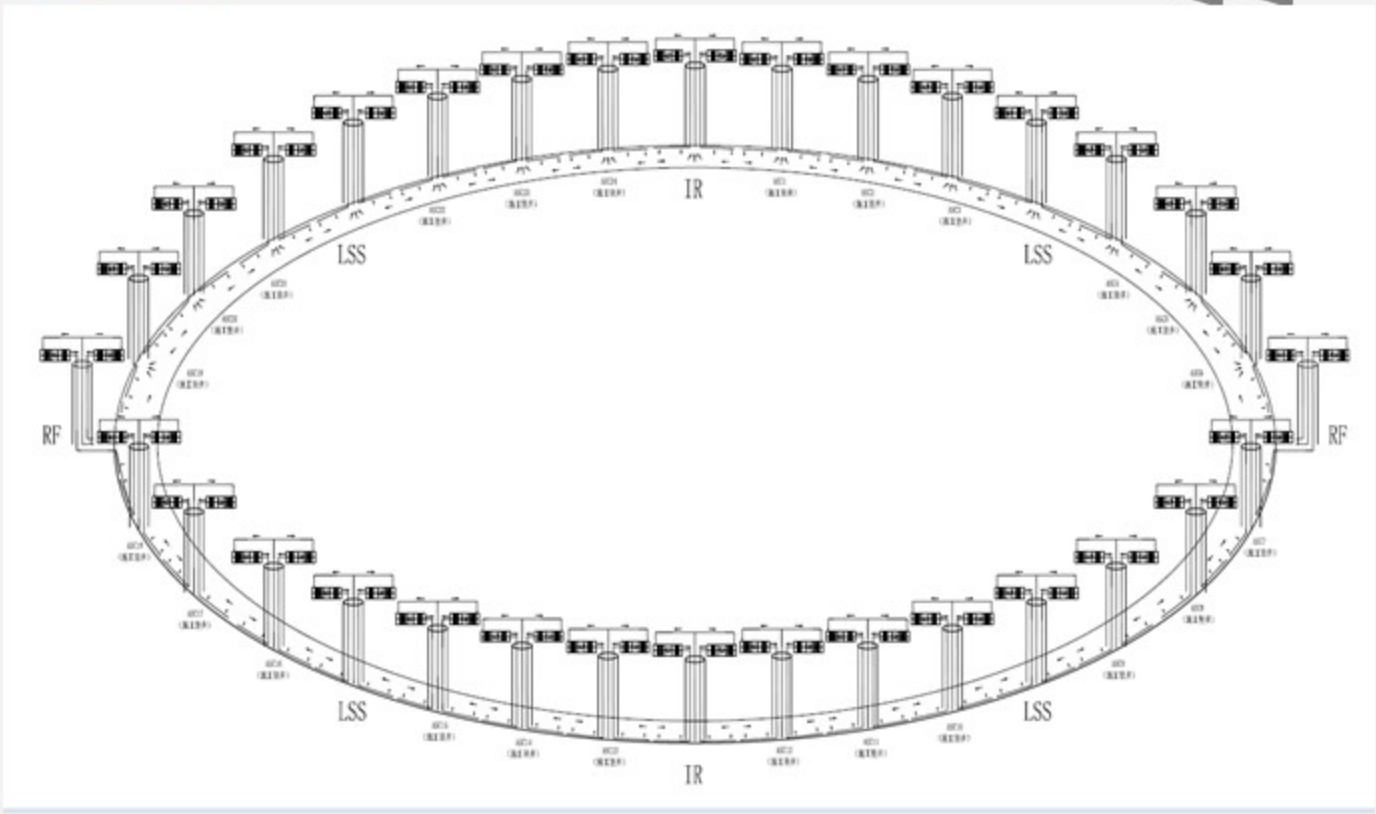
- **Air-conditioning system in tunnel**
  - Layout
    - The ring tunnel is divided into 32 independent sections.
    - Each shaft serves as a ventilation and exhaust passage for the collider ring tunnel, and a ventilation pipe and a smoke exhaust pipe are arranged therein.
  - Operation scenario
  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

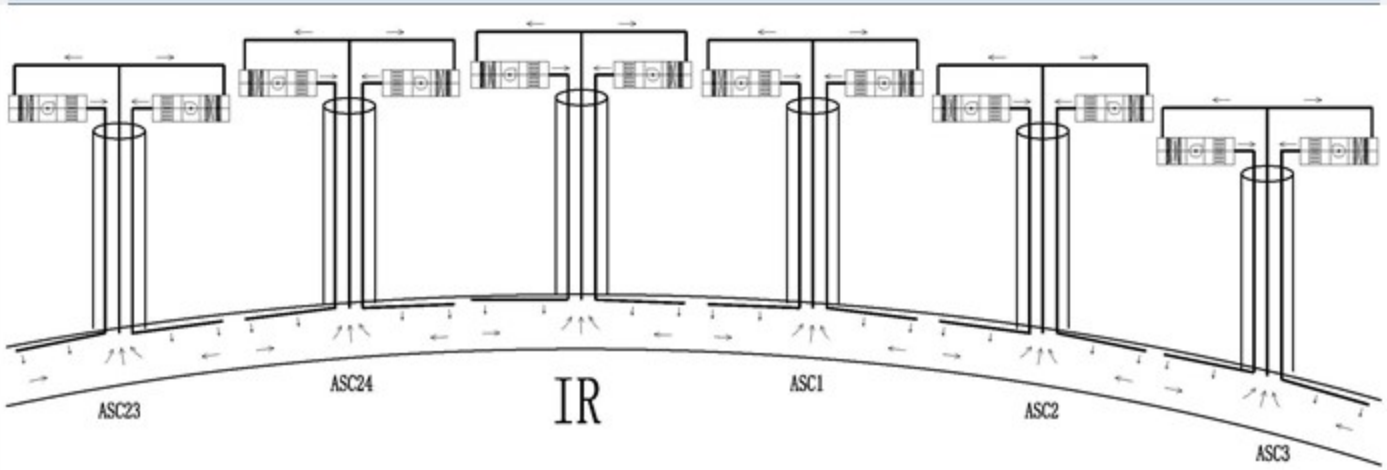
      -- Temperature and humidity in tunnel are maintained by inlet air.
    - **Transitional mode**

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

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

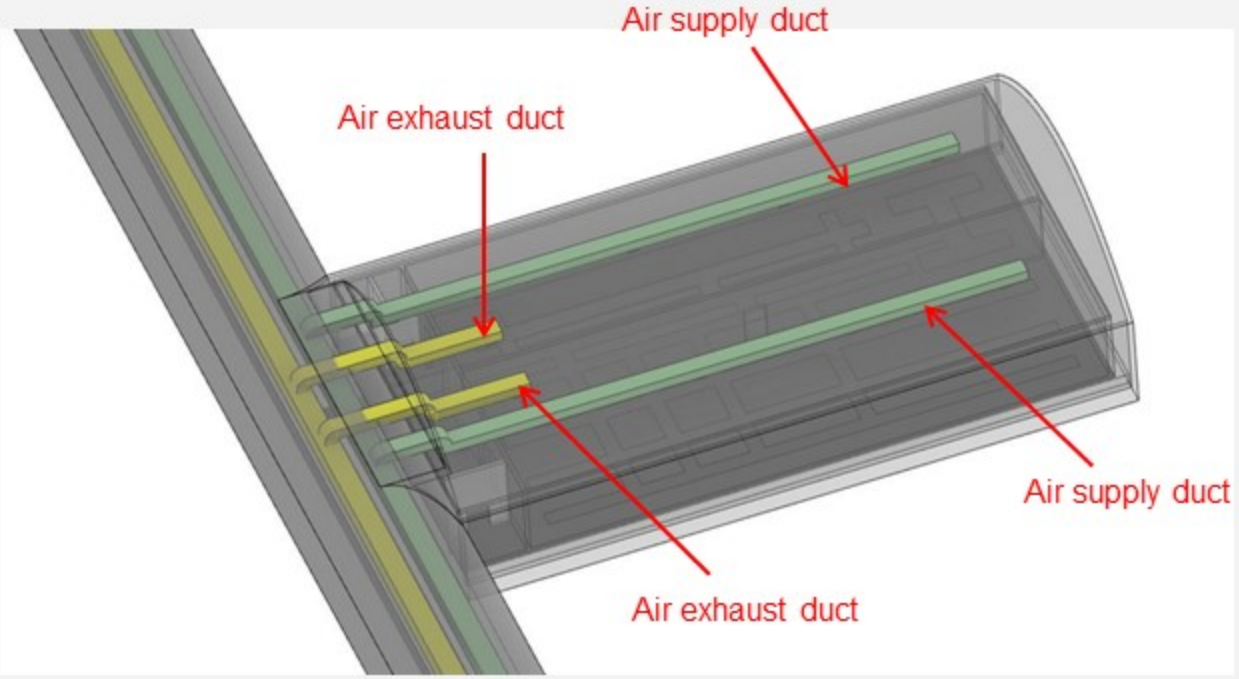
      -- In case of smoke and gas extraction.

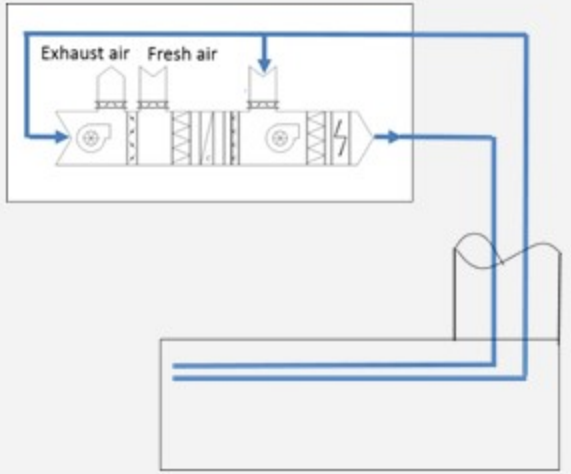




3.2 HVAC

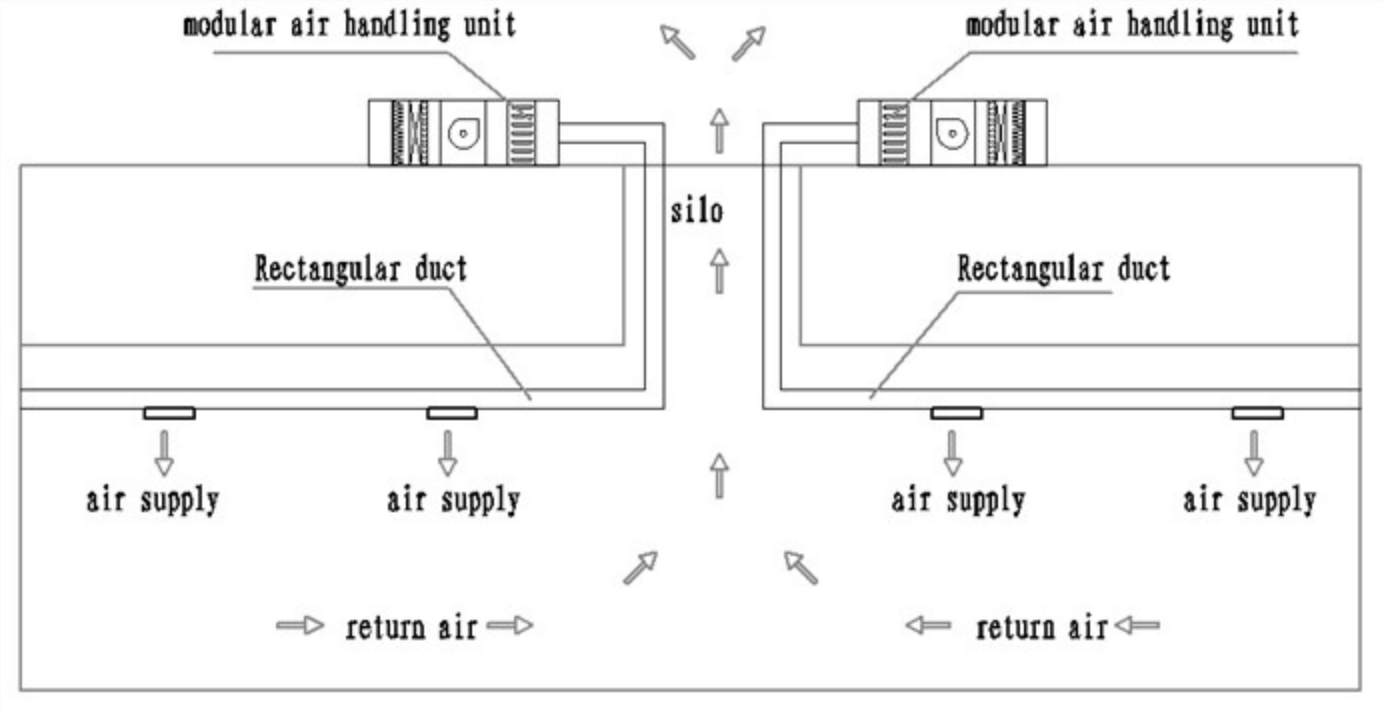
- **RF auxiliary tunnels and experiment halls**
  - Air conditioned and ventilated by mechanical supply and extraction of air via ducts in access shaft.
  - AHU is on ground level.
  - Dedicated smoke, gas extraction systems
- **Auxiliary stub tunnels**
  - Air supply ducts are led out from the air supply trunk duct in the collider ring tunnel to feed cold air into the auxiliary stub tunnel, and then air exhaust ducts are connected to the air exhaust trunk duct in the collider ring tunnel for exhausting hot air from the stub tunnel.
- **Other service buildings**
  - AHU
  - fan-coil + fresh air system





3.2 HVAC

- **Ventilation and smoke exhaustion system**
  - It is proposed to combine the smoke exhaust system with the mechanical air exhaust system based on the layout features of underground caverns. Emergency smoke exhaust is applied to both the collider ring tunnel and the experiment halls.



04

Construction Schedule

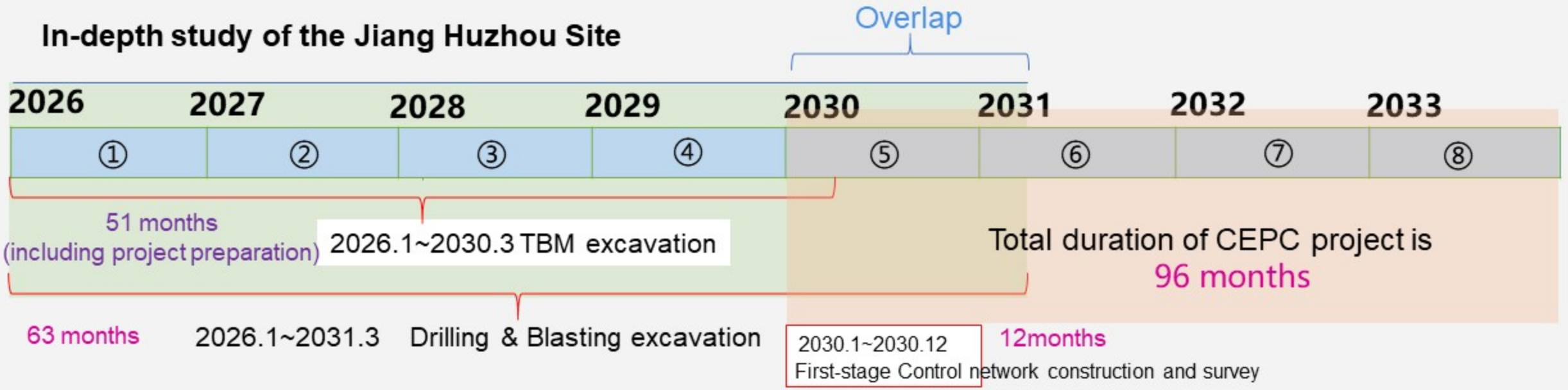
General Construction Schedule （DBM）

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.

In-depth study of the Jiang Huzhou Site



1.CEPC production Including civil works and installation of physical equipment. It will begin in 2026 and end in 2033, The total duration of CEPC project is 96 months.

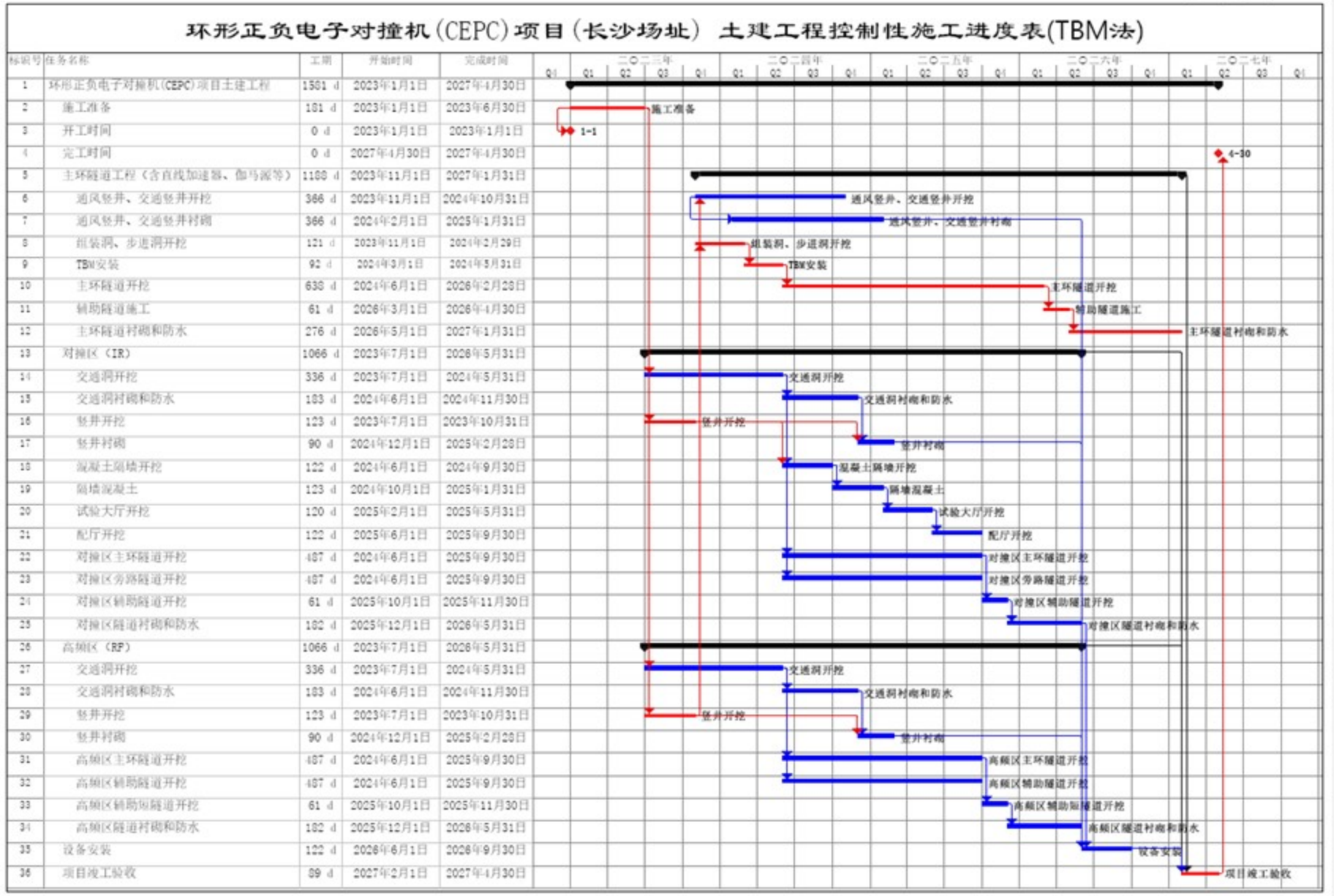
2.The total civil works period is 63 months.

3.The total installation period of physical equipment is 48 months.

4. The Overlapping period of civil works and equipment installation is 15 months.

■ Construction Organization Design

- Eight open-type TBMs will be adopted for construction, and the shafts of permanent structures can be used as launch shaft and receiving shaft of the TBMs.
- The total TBM construction period is 52 months, including 6 months for construction preparation, 43 months for construction of main works, and 3 months for completion.



标识号	任务名称	工期	开始时间	完成时间
1	环形正负电子对撞机(CEPC)项目土建工程	1561 d	2023年1月1日	2027年4月30日
2	施工准备	181 d	2023年1月1日	2023年6月30日
3	开工时间	0 d	2023年1月1日	2023年1月1日
4	完工时间	0 d	2027年4月30日	2027年4月30日
5	主环隧道工程（含直线加速器、伽马源等）	1189 d	2023年11月1日	2027年1月31日
6	通风竖井、交通竖井开挖	366 d	2023年11月1日	2024年10月31日
7	通风竖井、交通竖井衬砌	366 d	2024年2月1日	2025年1月31日
8	组装洞、步道洞开挖	121 d	2023年11月1日	2024年2月29日
9	TBM安装	92 d	2024年3月1日	2024年5月31日
10	主环隧道开挖	638 d	2024年6月1日	2026年2月28日
11	辅助隧道施工	61 d	2026年3月1日	2026年4月30日
12	主环隧道衬砌和防水	276 d	2026年5月1日	2027年1月31日
13	对撞区（IR）	1066 d	2023年7月1日	2028年5月31日
14	交通洞开挖	336 d	2023年7月1日	2024年5月31日
15	交通洞衬砌和防水	183 d	2024年6月1日	2024年11月30日
16	竖井开挖	123 d	2023年7月1日	2023年10月31日
17	竖井衬砌	90 d	2024年12月1日	2025年2月28日
18	混凝土隔墙开挖	122 d	2024年6月1日	2024年9月30日
19	隔墙混凝土	123 d	2024年10月1日	2025年1月31日
20	试验大厅开挖	120 d	2025年2月1日	2025年5月31日
21	配厅开挖	122 d	2025年6月1日	2025年9月30日
22	对撞区主环隧道开挖	487 d	2024年6月1日	2025年9月30日
23	对撞区旁路隧道开挖	487 d	2024年6月1日	2025年9月30日
24	对撞区辅助隧道开挖	61 d	2025年10月1日	2025年11月30日
25	对撞区隧道衬砌和防水	182 d	2025年12月1日	2026年5月31日
26	高频区（RF）	1066 d	2023年7月1日	2028年5月31日
27	交通洞开挖	336 d	2023年7月1日	2024年5月31日
28	交通洞衬砌和防水	183 d	2024年6月1日	2024年11月30日
29	竖井开挖	123 d	2023年7月1日	2023年10月31日
30	竖井衬砌	90 d	2024年12月1日	2025年2月28日
31	高频区主环隧道开挖	487 d	2024年6月1日	2025年9月30日
32	高频区辅助隧道开挖	487 d	2024年6月1日	2025年9月30日
33	高频区辅助短隧道开挖	61 d	2025年10月1日	2025年11月30日
34	高频区隧道衬砌和防水	182 d	2025年12月1日	2026年5月31日
35	设备安装	122 d	2026年6月1日	2026年9月30日
36	项目竣工验收	89 d	2027年2月1日	2027年4月30日

05

Summary

All sites can satisfy requirements for CEPC construction.

Advance the preliminary civil engineering design as soon as possible.

In the early stage, comprehensive demonstration on technology, economy, social and environmental impact, water and energy conservation will be carried out to determine basically the sites through comparison. The demonstration will focus on project scale, technical proposal, land acquisition and resettlement, environmental impact and investment, and special demonstration will be conducted for key technical issues.

Construction method

Both drilling & blasting and TBM are feasible. Construction periods of the two methods are similar, and overall cost of drilling & blasting is lower.

With the continuous advancement of TBM technology, the cost of TBM equipment and operation are gradually reduced, while the labor cost of drilling & blasting method increases year by year. The advantages of TBM will be increasingly prominent for implementation of the Project.

黄河勘测规划设计研究院有限公司
Yellow River Engineering Consulting Co., Ltd.

Market Distribution
市场分布

THANK YOU FOR LISTENING