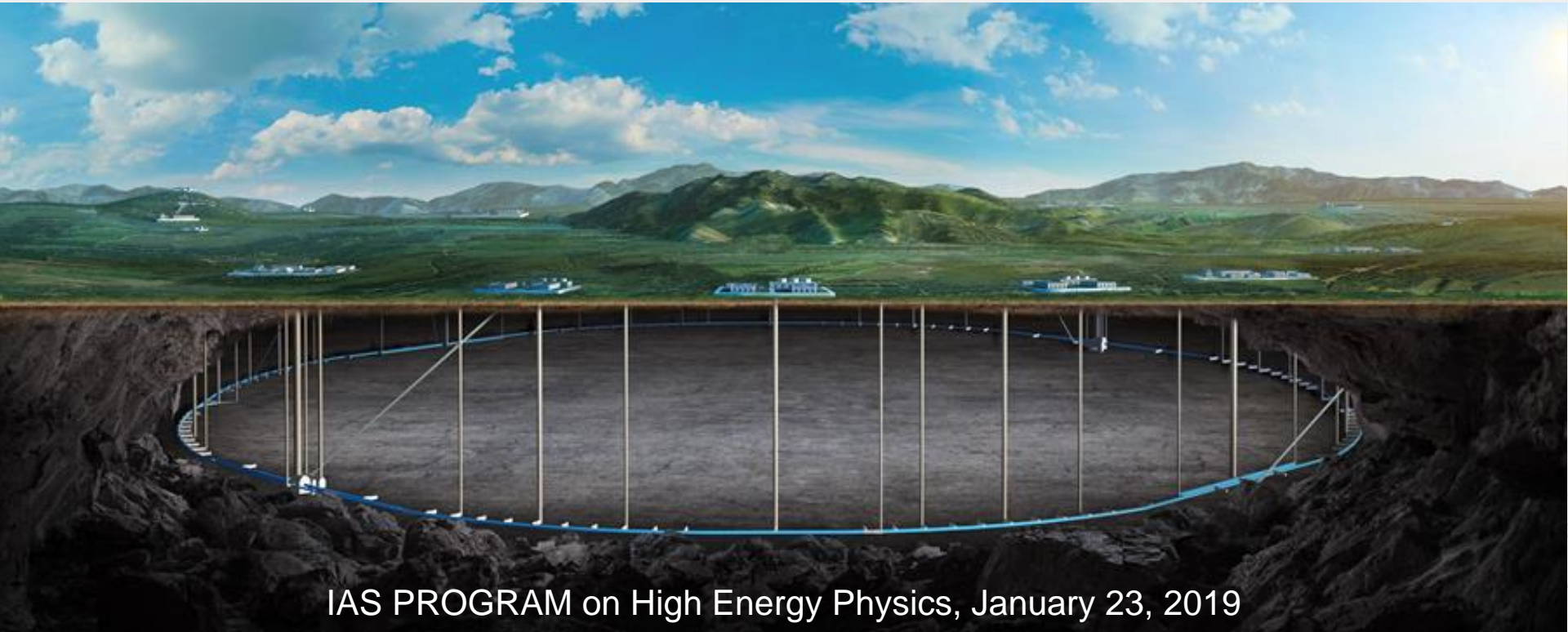


CEPC Civil Engineering Design and Implementation

Yu Xiao

Yellow River Engineering Consulting Co., Ltd.



IAS PROGRAM on High Energy Physics, January 23, 2019



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01 Introduction

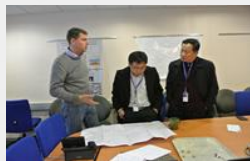
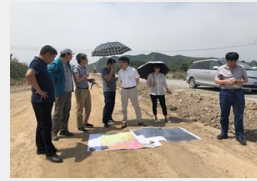
02 Site Investigation

03 Project Layout and Design

04 Implementation

1

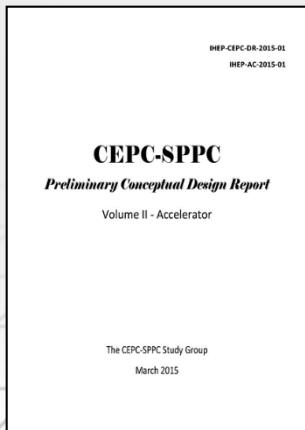
Introduction





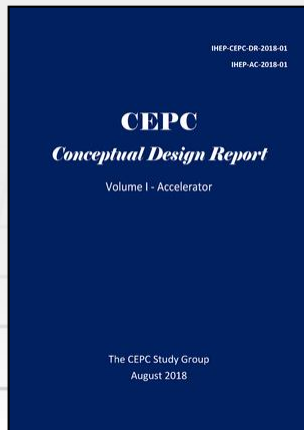
Pre-CDR

2015.03



CDR

2018.11



TDR

Ongoing~2022

2

Site Investigation

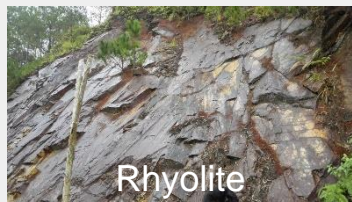




Gneiss



Granite



Rhyolite



Granite



Sandstone



Tuff



Sandstone



Glutenite



Stratum Lithology



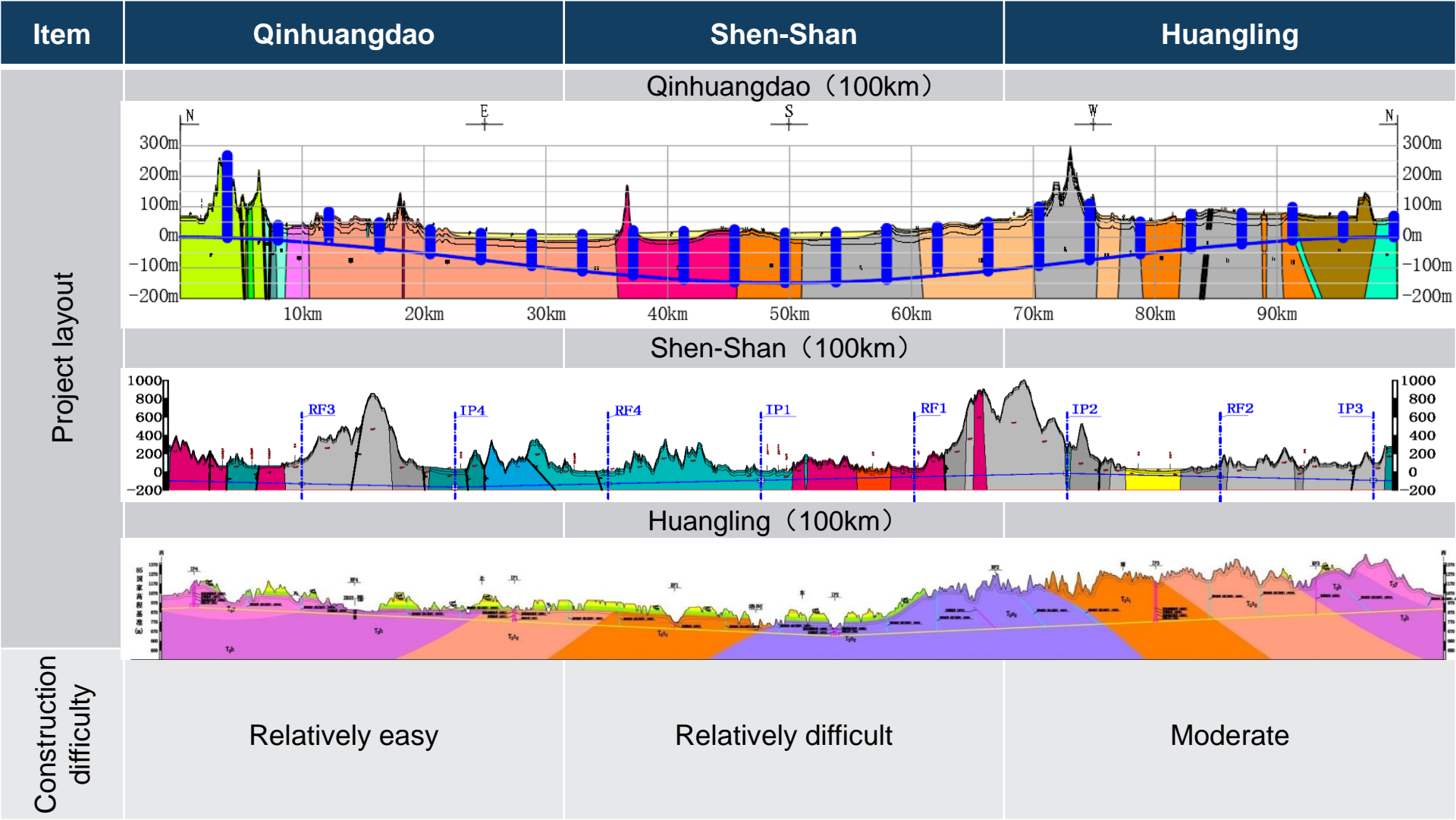
Qinhuangdao



Shen-Shan



Huangling



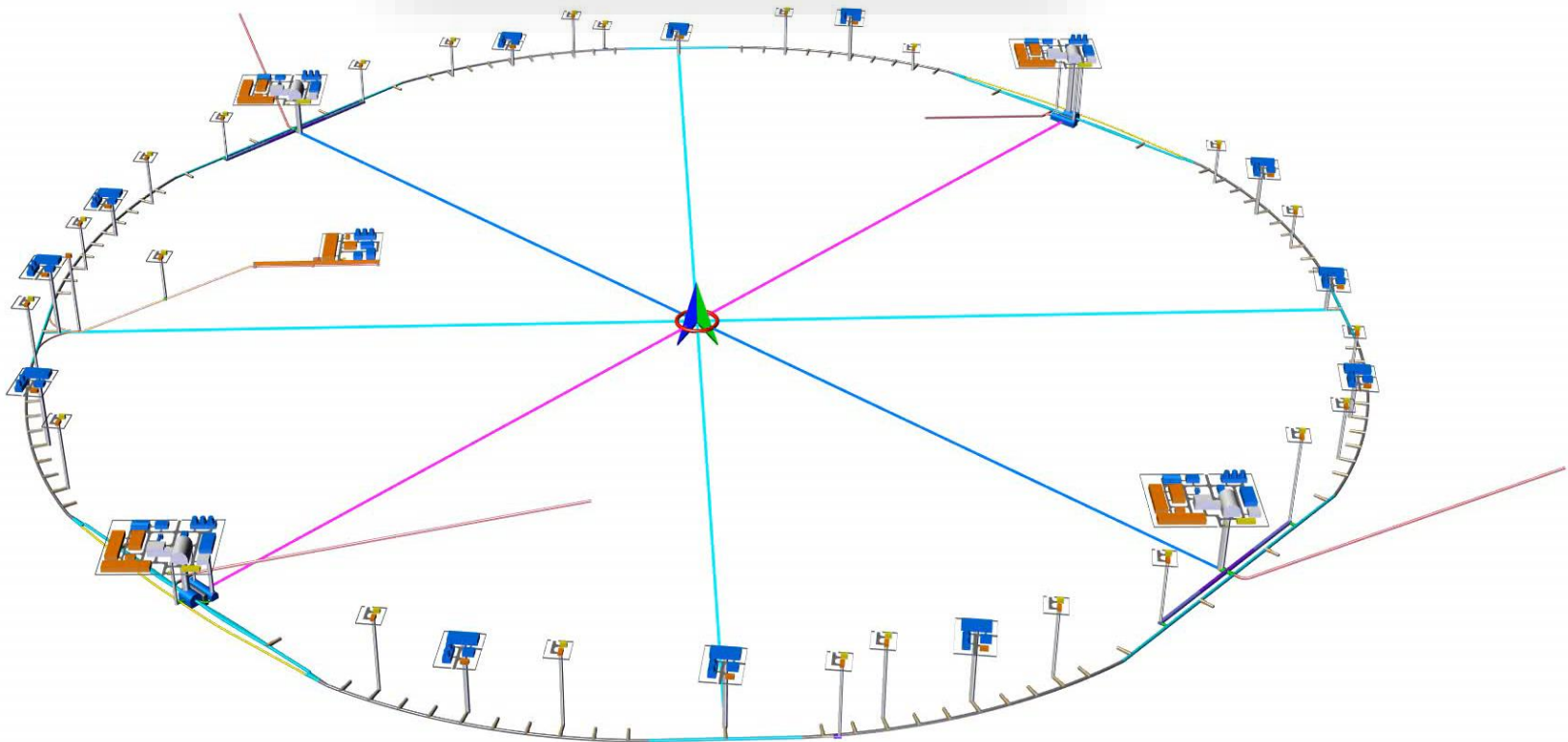
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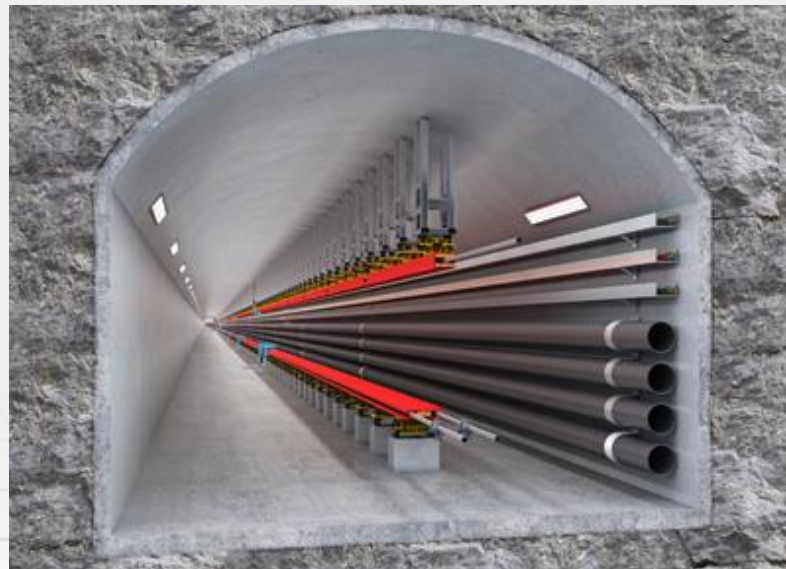
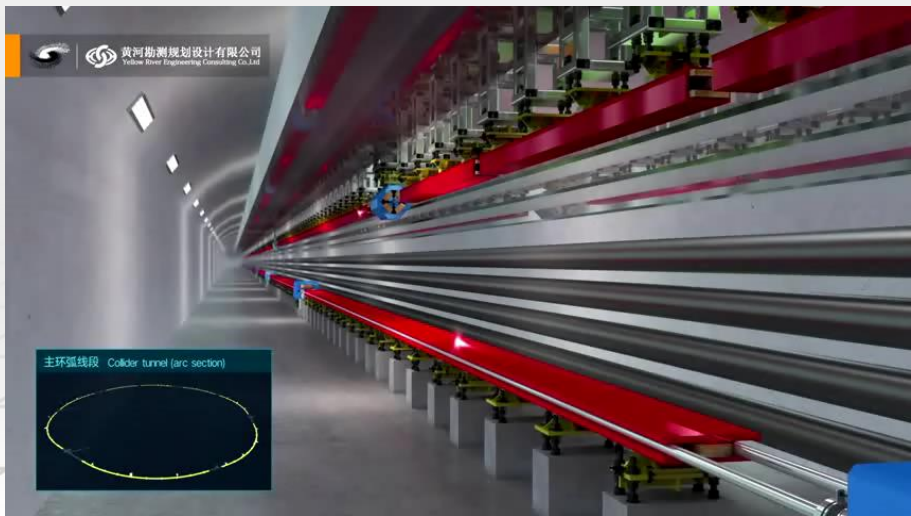
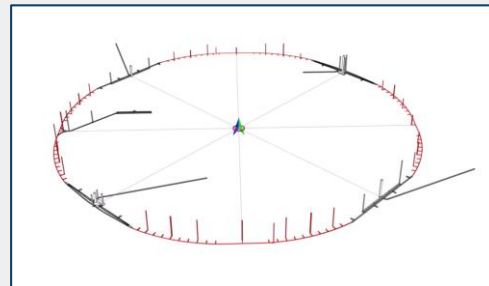
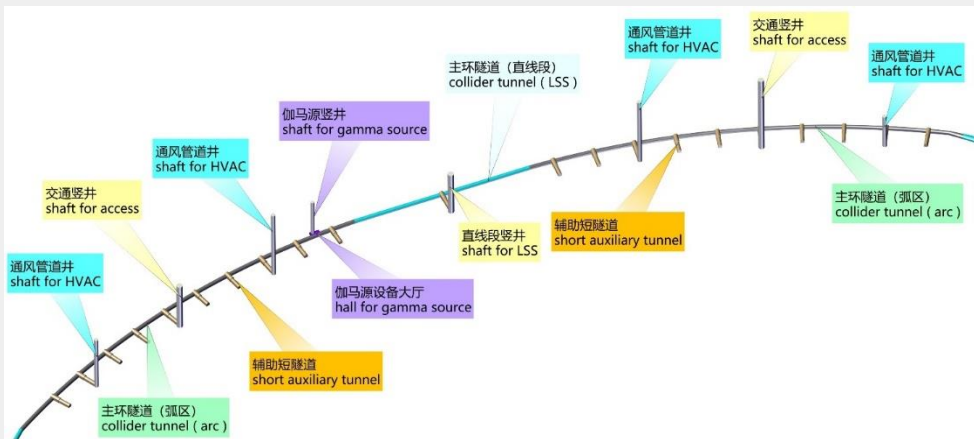
Project Layout and Design



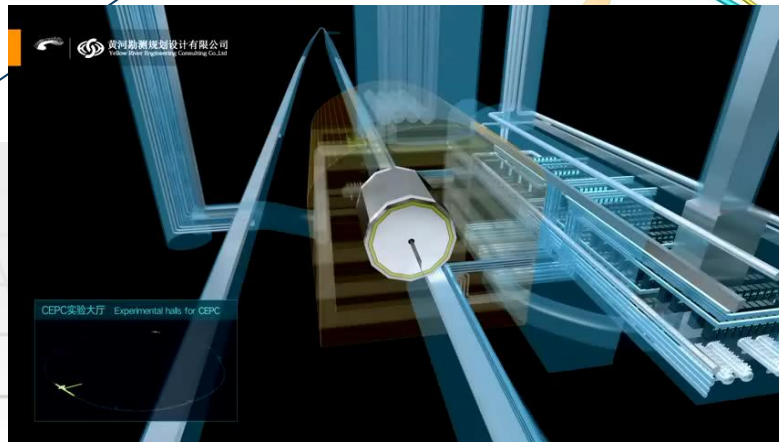
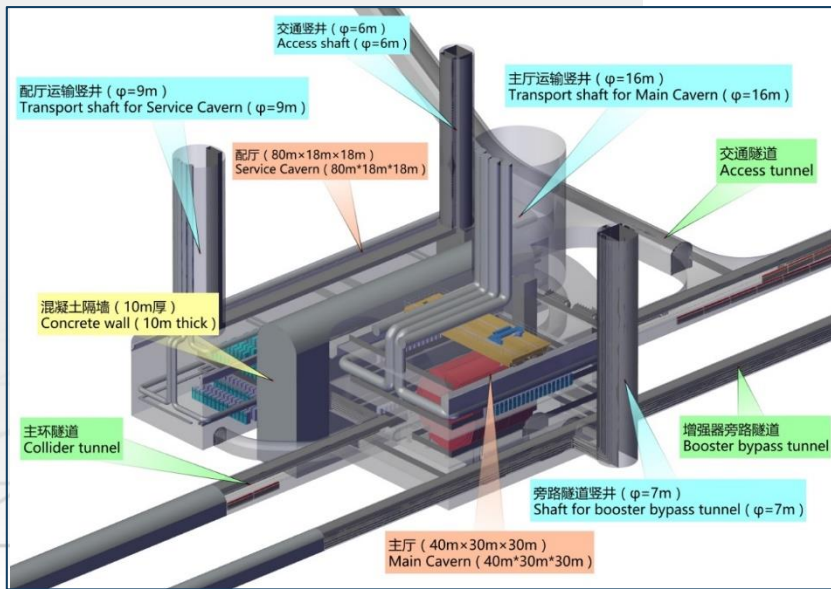
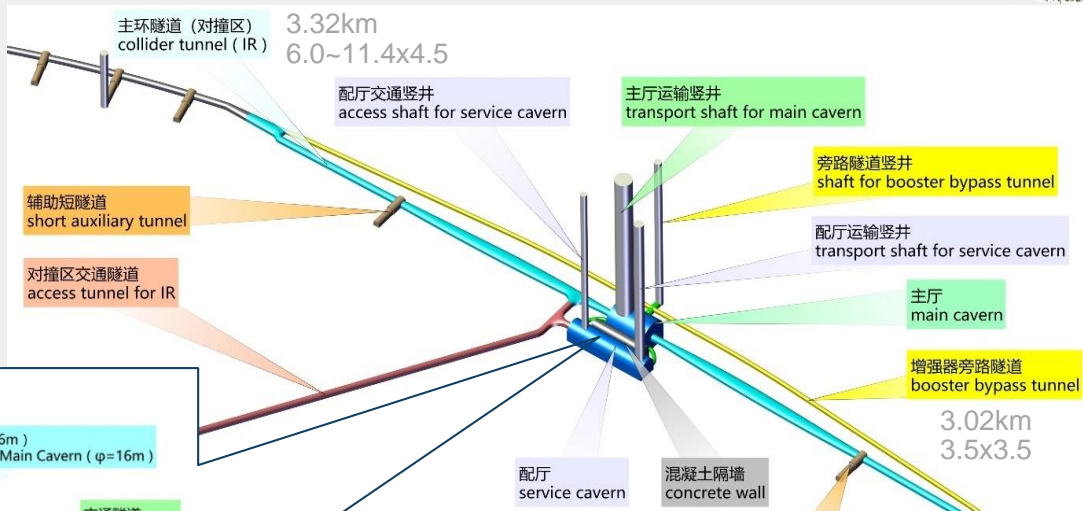
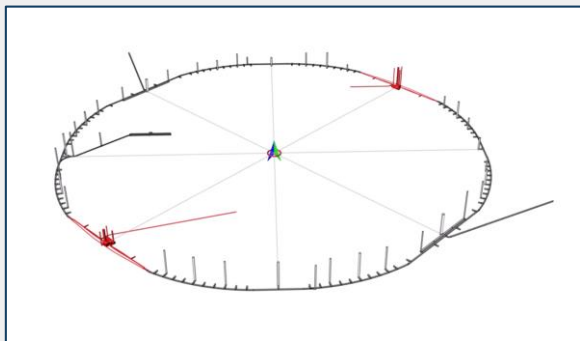


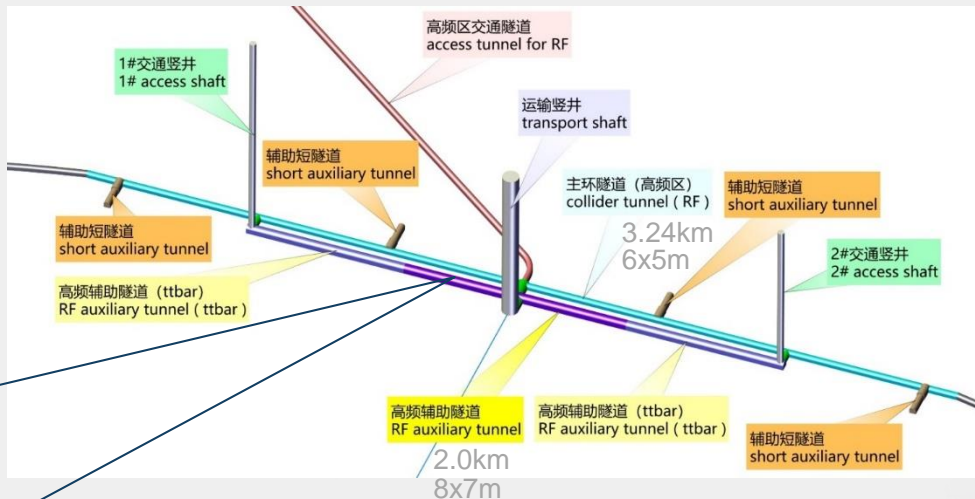
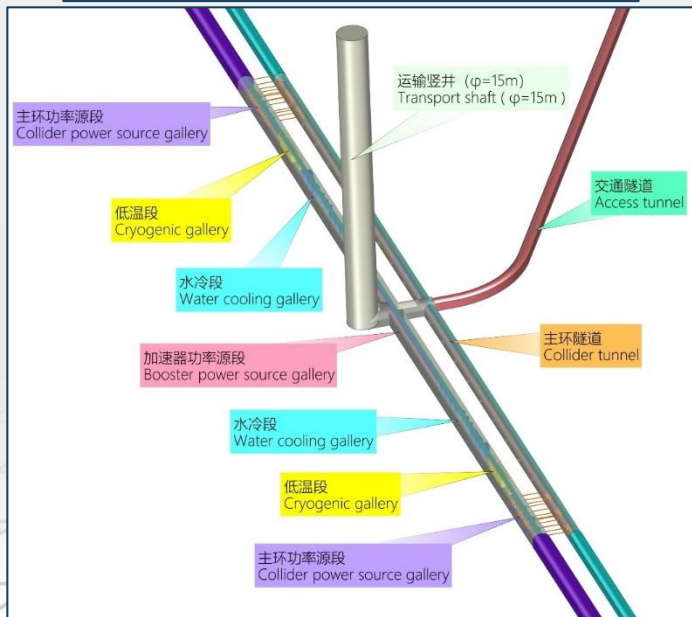
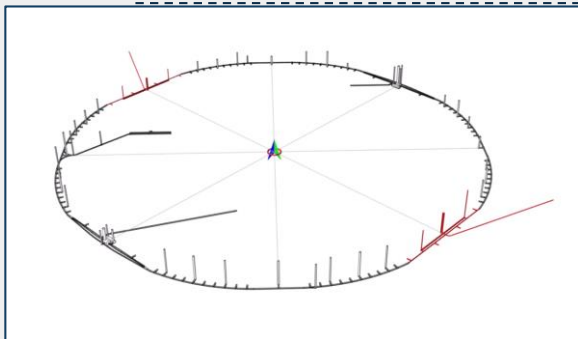
01 General Layout





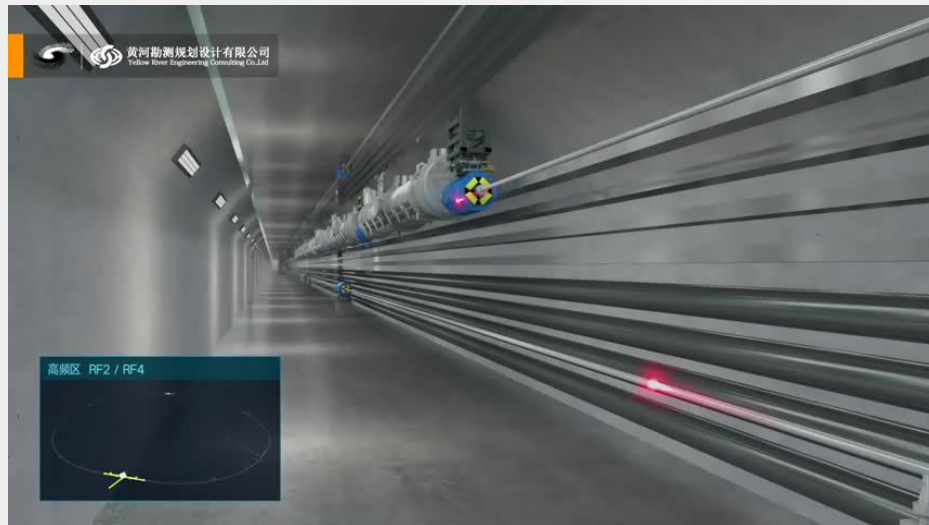
Typical cross section of collider tunnel



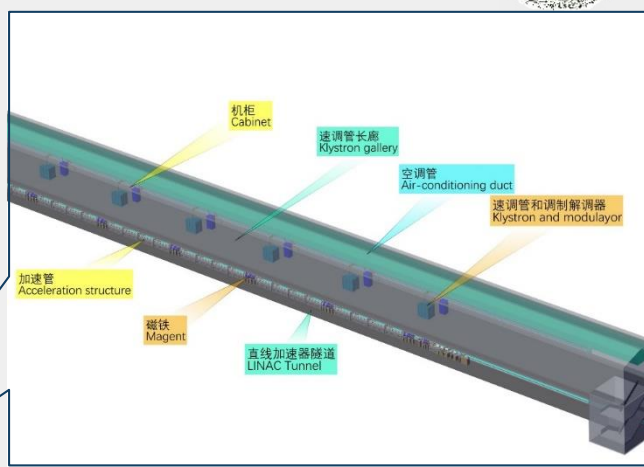
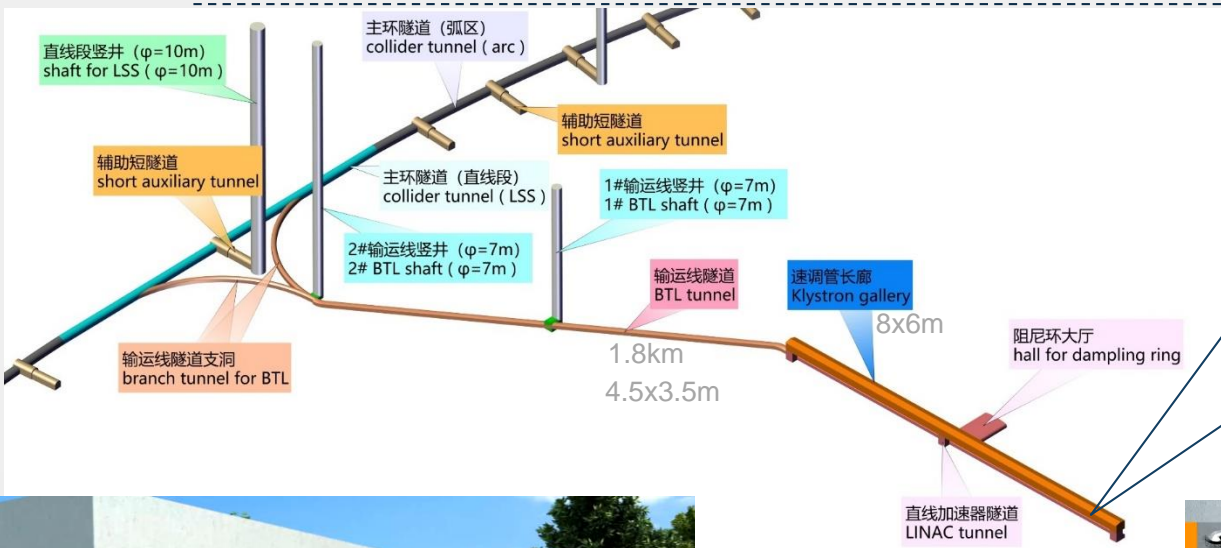




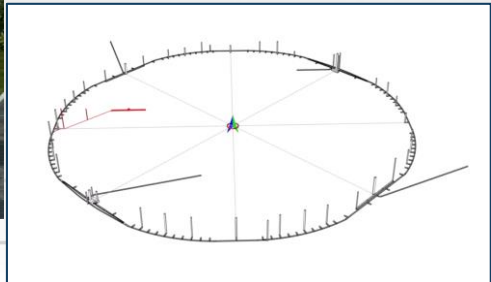
RF Auxiliary Tunnel



Collider Tunnel (RF)



Klystron gallery

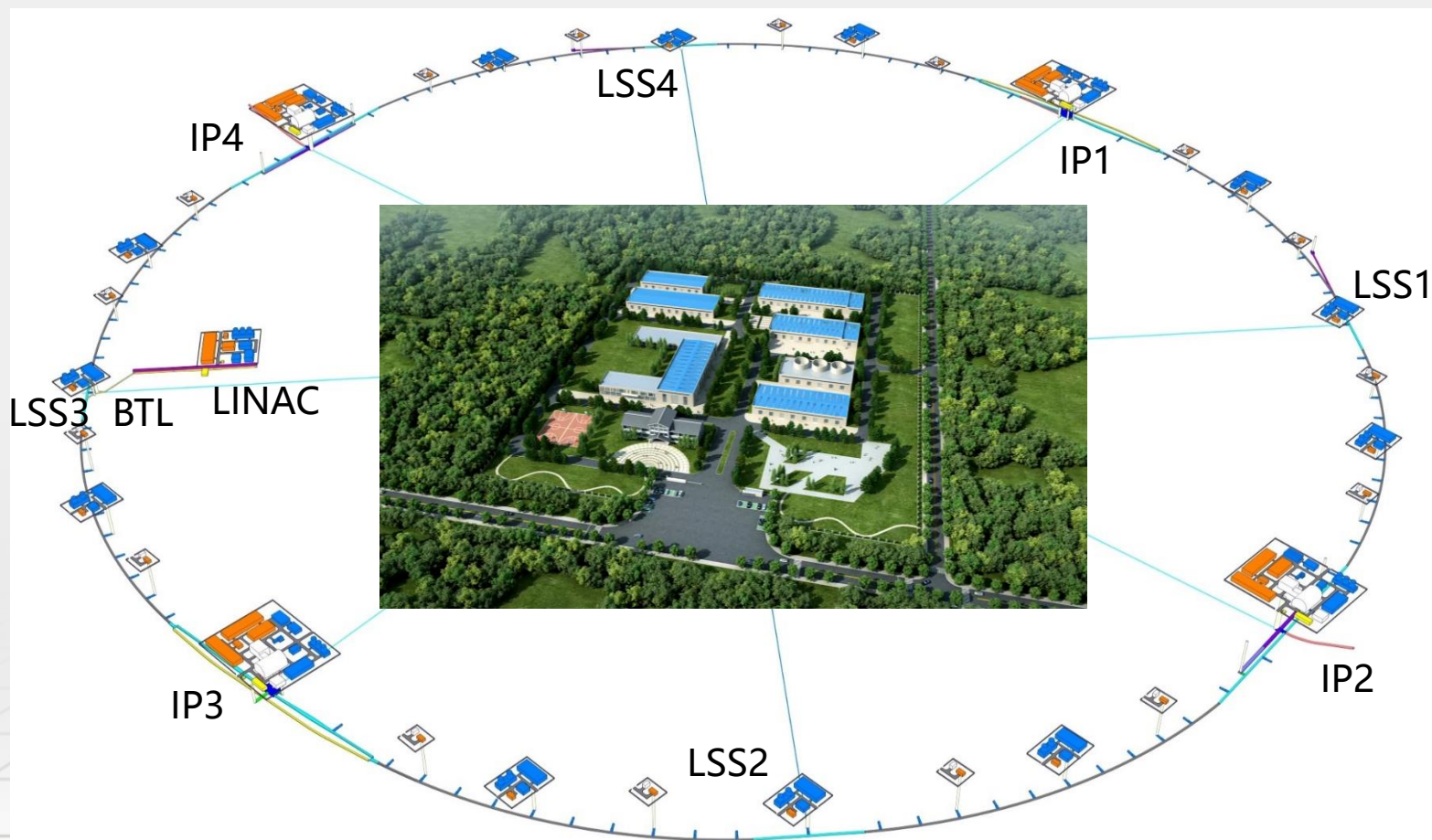


Linac Tunnel & BTL Tunnel



Region	Item	Qty	Diameter (m)
IR	Transport shaft	2	16.00
	Bypass tunnel access shaft	2	7.00
	Auxiliary shaft	2	9.00
	Auxiliary access shaft	2	6.00
RF	Transport shaft	2	15.00
	Transport shaft	4	6.00
LSS	Access & pipe shaft	4	10.00
Arc sections	Access & pipe shaft	8	10.00
	Ventilation shaft	16	7.00
BTL	Access & pipe shaft	2	7.00

Surface Buildings





02 Electrical Engineering

(1) Power loads

The total electrical load for physical experiments and general facilities is about 270MW.

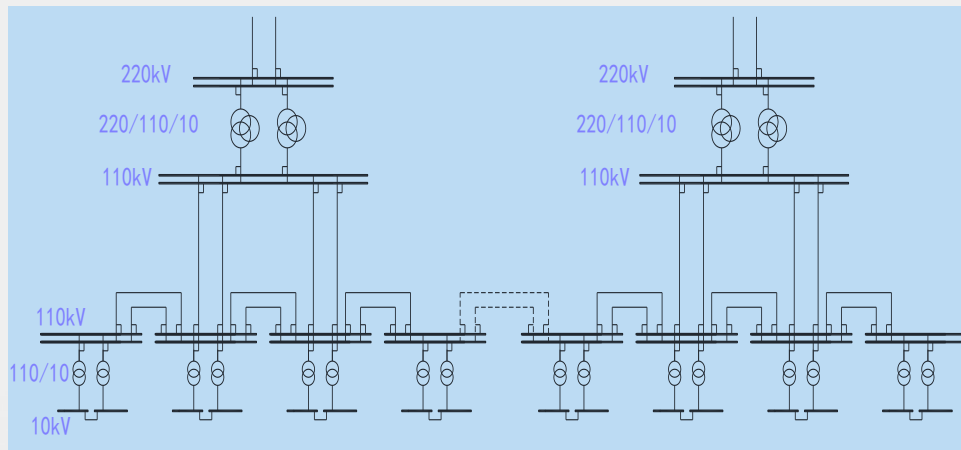
	System for Higgs (30MW)	Location and electrical demand(MW)						Total (MW)
		Ring	Booster	LINAC	BTL	IR	Surface building	
1	RF Power Source	103.8	0.15	5.8				109.75
2	Cryogenic System	15.67	0.89			1.8		18.36
3	Vacuum System	9.784	3.792	0.646				14.22
4	Magnet Power Supplies	47.21	11.62	1.75	1.06	0.26		61.9
5	Instrumentation	0.9	0.6	0.2				1.7
6	Radiation Protection	0.25		0.1				0.35
7	Control System	1	0.6	0.2	0.005	0.005		1.81
8	Experimental devices					4		4
9	Utilities	31.79	3.53	1.38	0.63	1.2		38.53
10	General services	7.2		0.2	0.15	0.2	12	19.75
	Total	217.604	21.182	10.276	1.845	7.465	12	270.37



(2) Power supplies and schemes

It is proposed to adopt 220kV power supply for the project, and to set two 220kV central substations in the project area.

110kV substation will be set respectively near the shaft ground exits of IR and RF (IP1-IP4) and linear sections (LSS1-LSS4), with 8 step-down substations in total.



For critical loads where a power failure could cause damage, diesel generators, EPS power supplies, or UPS will be installed.



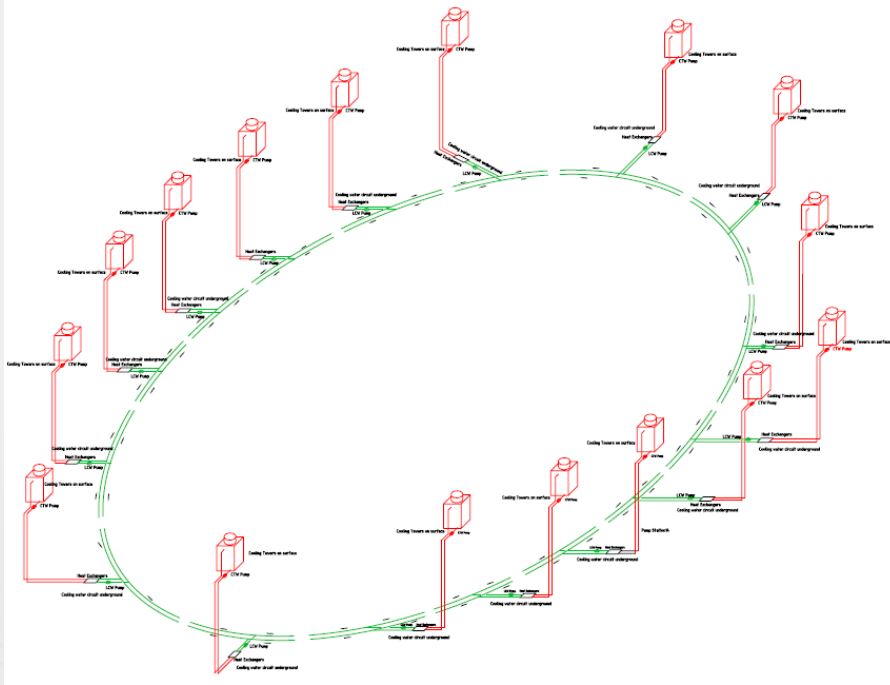
03 Cooling Water System

- The heat load dissipated by CEPC machine

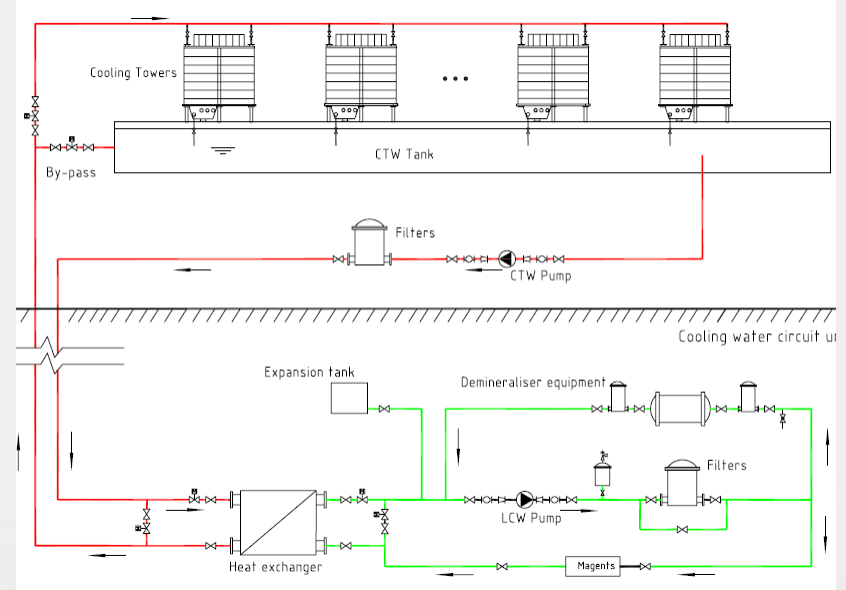
System	Location and heat loads(MW)					
	Ring	Booster	Linac	BTL	IR	Total
Accelerating tube / Waveguide			2.32			2.32
Power source	43.8	0.15	3.48			47.43
Cryogenics	11.62	0.68			1.8	14.1
Experimental devices					2.5	2.5
Magnets	33.763	7.604	1.367	0.838		43.572
Vacuum chamber of ring	60					60
Power convert for magnets	4.721	1.162	0.175	0.093	0.026	6.177
Condenser in stub tunnel	18.169					18.169
Pump	16.787		0.745	0.121	0.466	18.119
Total	188.86	9.596	8.087	1.052	4.792	212.387



Schematic layout of cooling circuits in the tunnel



- There are 16 circuits around ring tunnel.
- Primary loops on surface
- Secondary loops are underground.



Flow diagram of typical cooling water circuits



04 Ventilation and air-conditioning system

(1) Air-conditioning system in tunnel

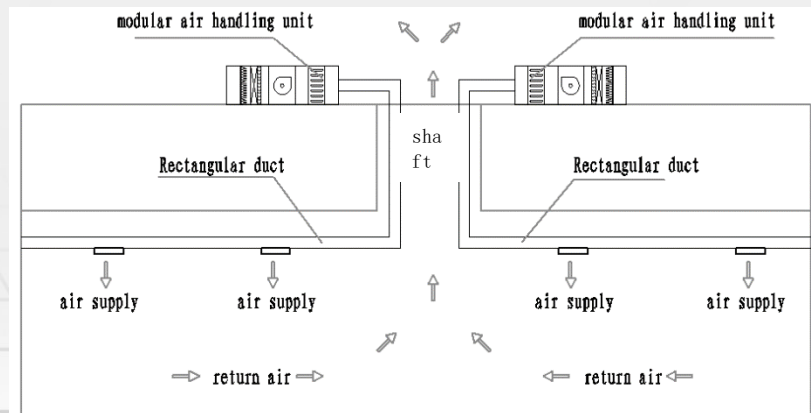
The air conditioning cold load of collider ring tunnel is about 6MW according to the existing design scheme.

The collider ring tunnel is generally divided into 32 sections, with about 3km interval, by shafts in experiment halls, vent shafts, access shafts and shafts in RF. Each section is considered as an independent section for the ventilation and air-conditioning system and shall be processed respectively. Each shaft is used for air supply and air exhaust.

(2) Ventilation and smoke exhaust 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.

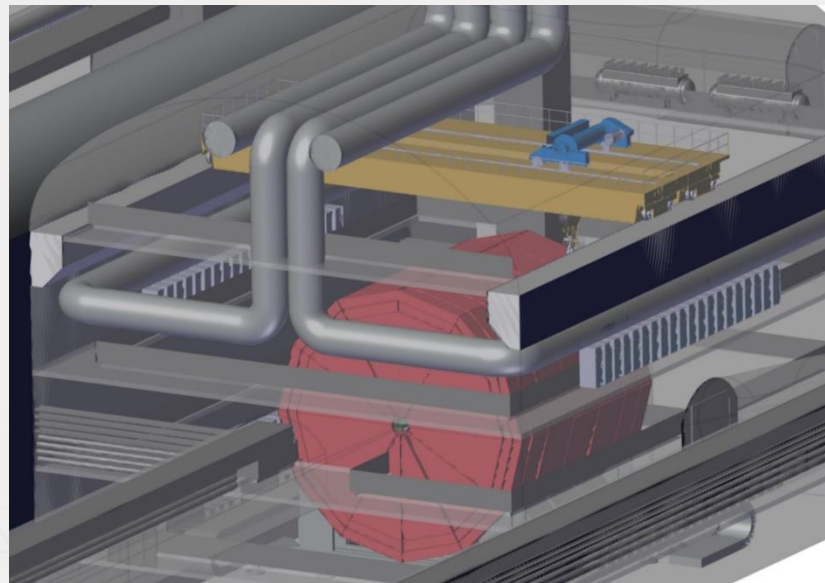




05 Permanent Transportation and Lifting Equipment

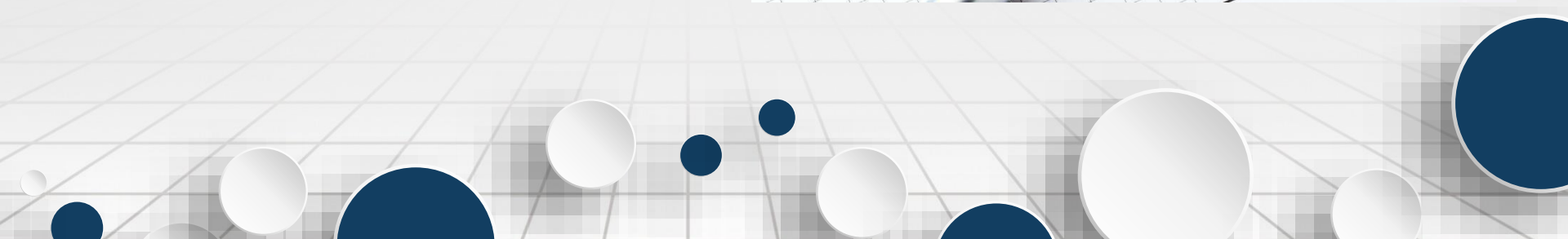


20 sets



4

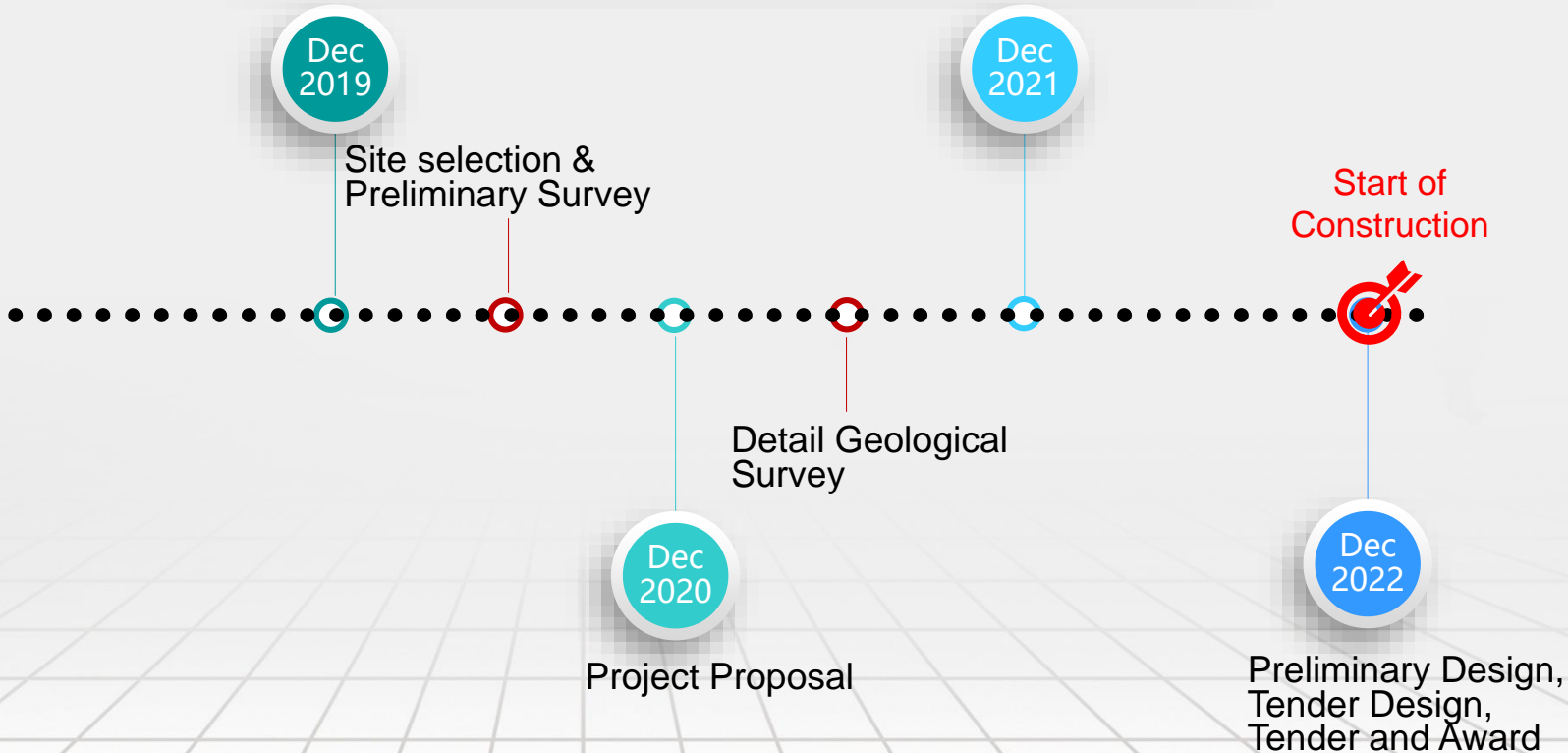
Implementation





Implementation Planning before Construction

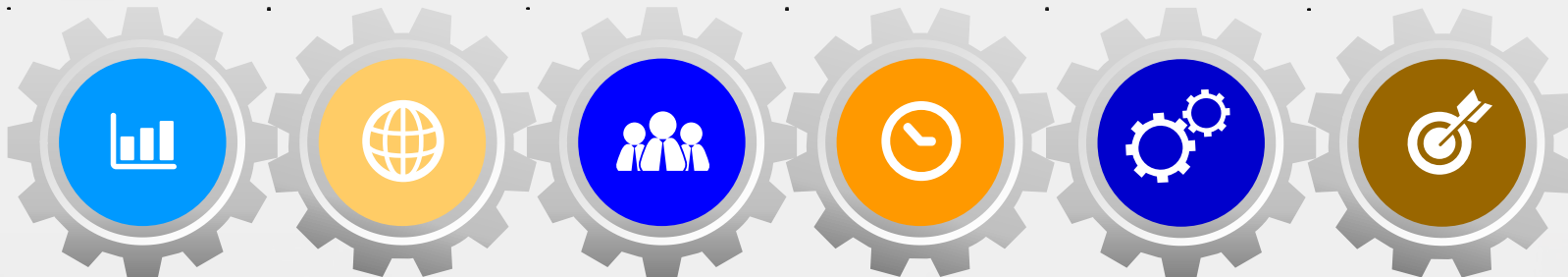
Feasibility Study





General Construction Schedule

Total construction period - 54 months



8 months

Preparation

5 months

Construction shafts

24 months

Main tunnel excavation

10 months

Tunnel lining & water prevention

4 months

Ventilation installation in shafts

3 months

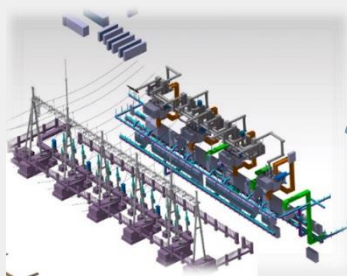
Completion work

Main works - 43 months



● Critical Technical Problems in TDR

- Site selection
- Project layout and optimization
- Structure, cross section shape, waterproof of tunnel and cavern
- Construction scheme of long distance tunnel
- Design and optimization of ventilation and air-conditioning system
- Design and optimization of fire control system
- BIM design
- Green design



THANKS

