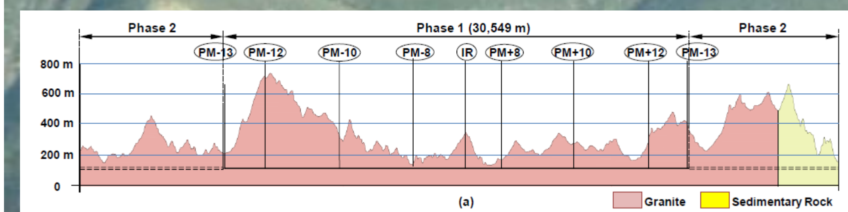
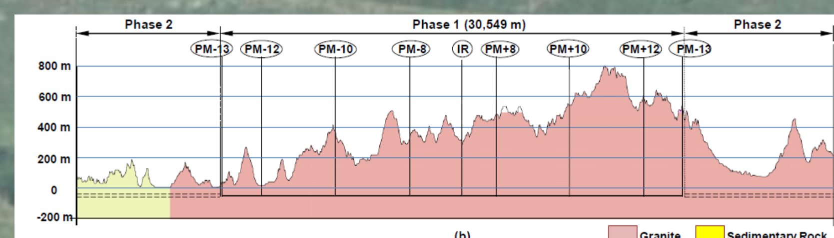
Civil Design – Asian Region (1)

- Two Candidate Sites (Kitakami and Sefuri)
  - Mountainous, not far from big towns, accessible with paved roads
  - Horizontal underground access with slopes less than 10%, access tunnel length assumed to be 1 km in average
  - Underground accelerator structures and full associate facilities.
  - Geological survey is ongoing in both sites. →ex) Aerial Laser Survey

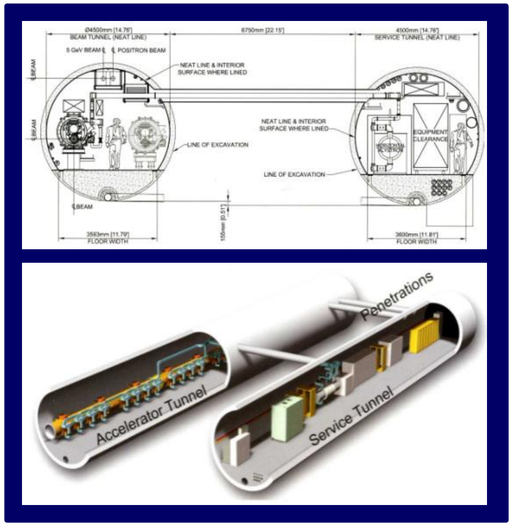


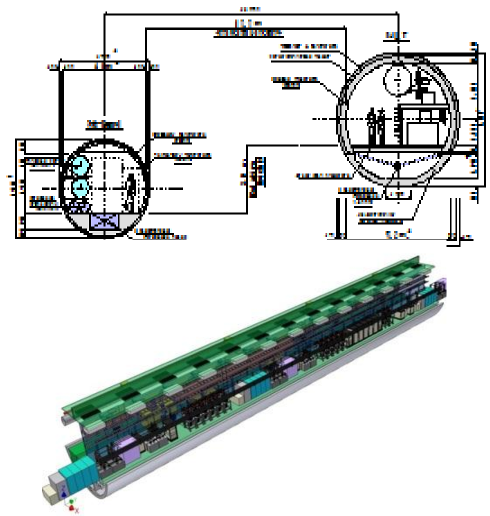


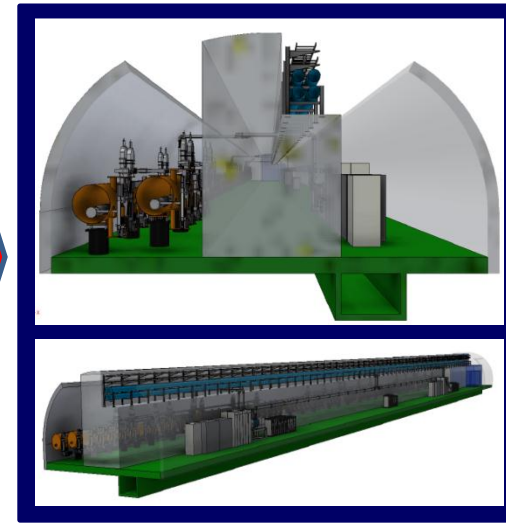
Civil Design – Asian Region (2)

Design Change of the ML Tunneling Method

■RDR (TBM) ■SB09 (TBM) ■TDR (NATM)





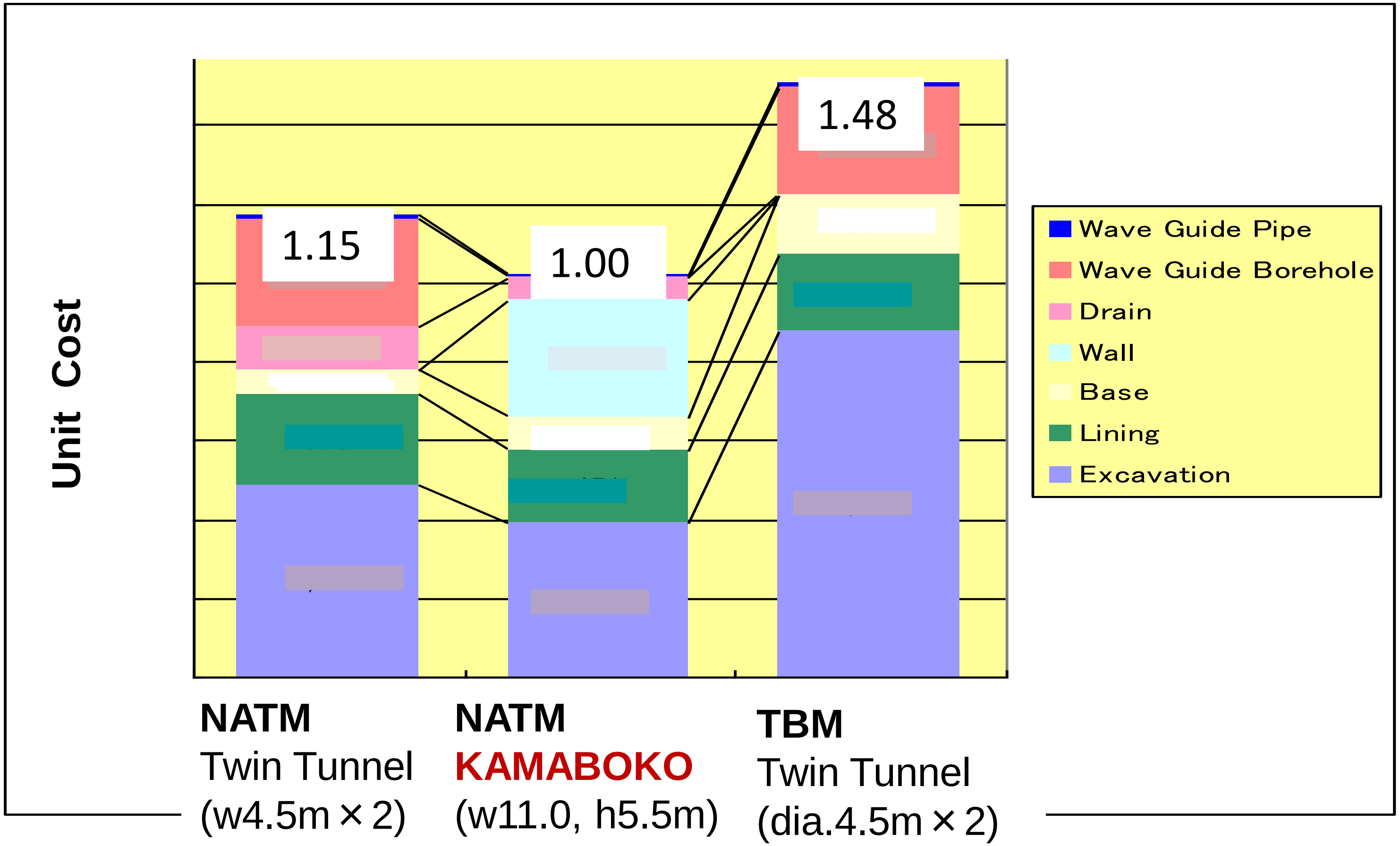


Why did we choose the KAMABOKO-Tunnel in TDR?

- Construction **COST**?
- Construction **Schedule** ?
- **Topography** Condition ?
- **Geological Feature** ?
- Any Other Factor?

Civil Design – Asian Region (3)

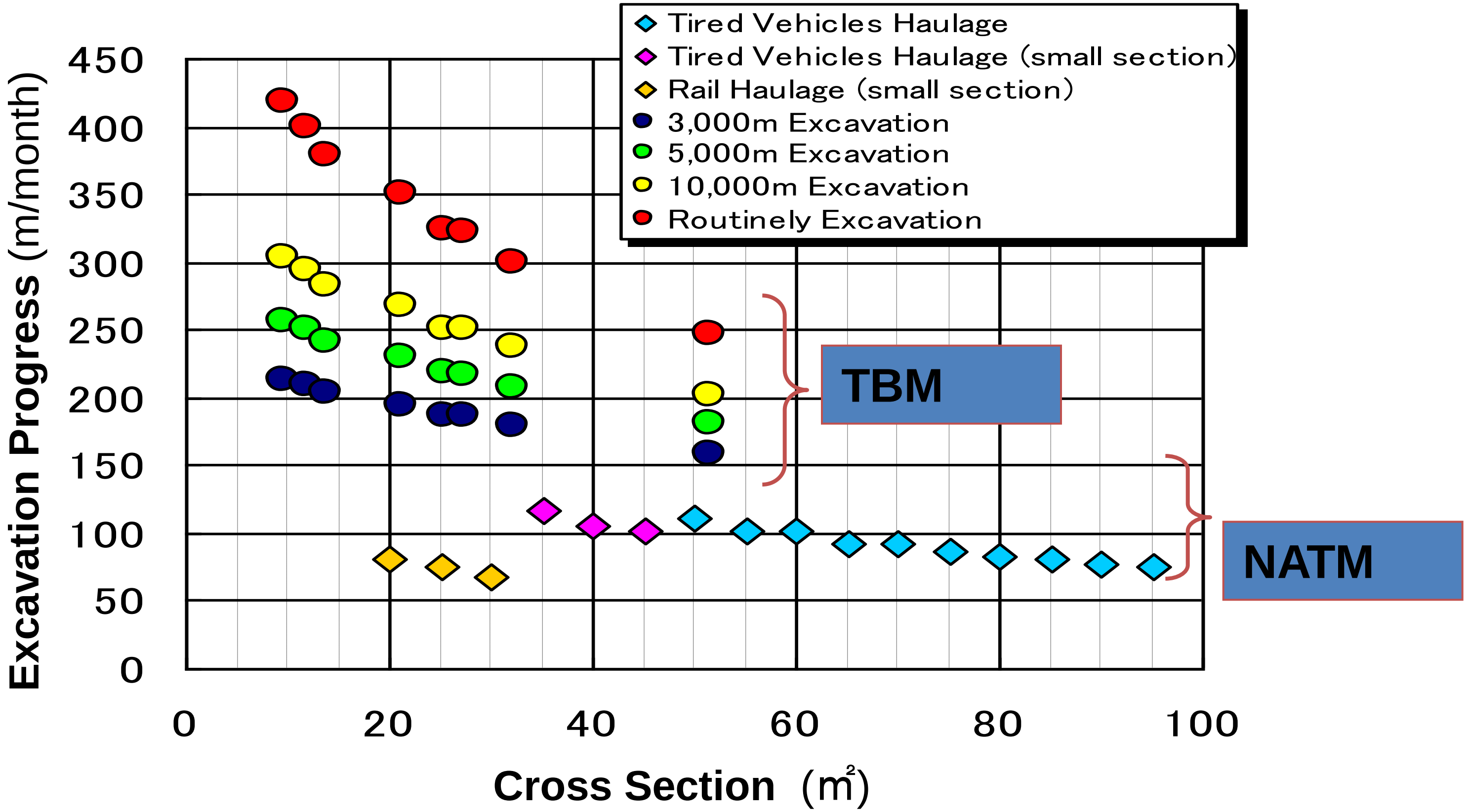
Cost Comparison of Tunnel Type



Civil Design – Asian Region (4)

Excavation Progress by NATM & TBM

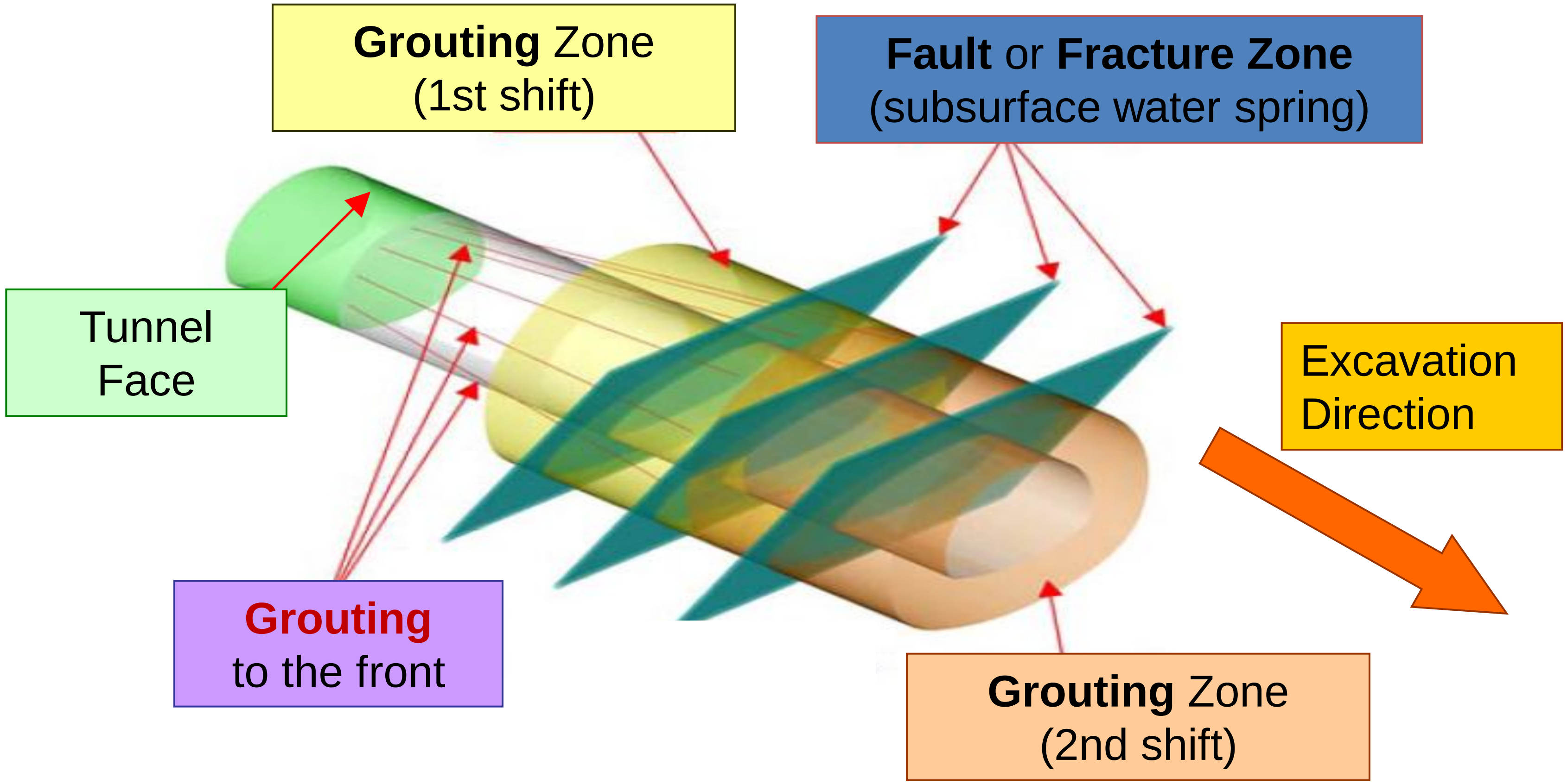
◇ NATM-excavation speed is slower than TBM, but Multiple Work Zones is possible.



Civil Design – Asian Region (5)

Grouting (Inflow Water measure)

◇ **NATM (KAMABOKO Tunnel) is easy to perform the Inflow Water countermeasure**

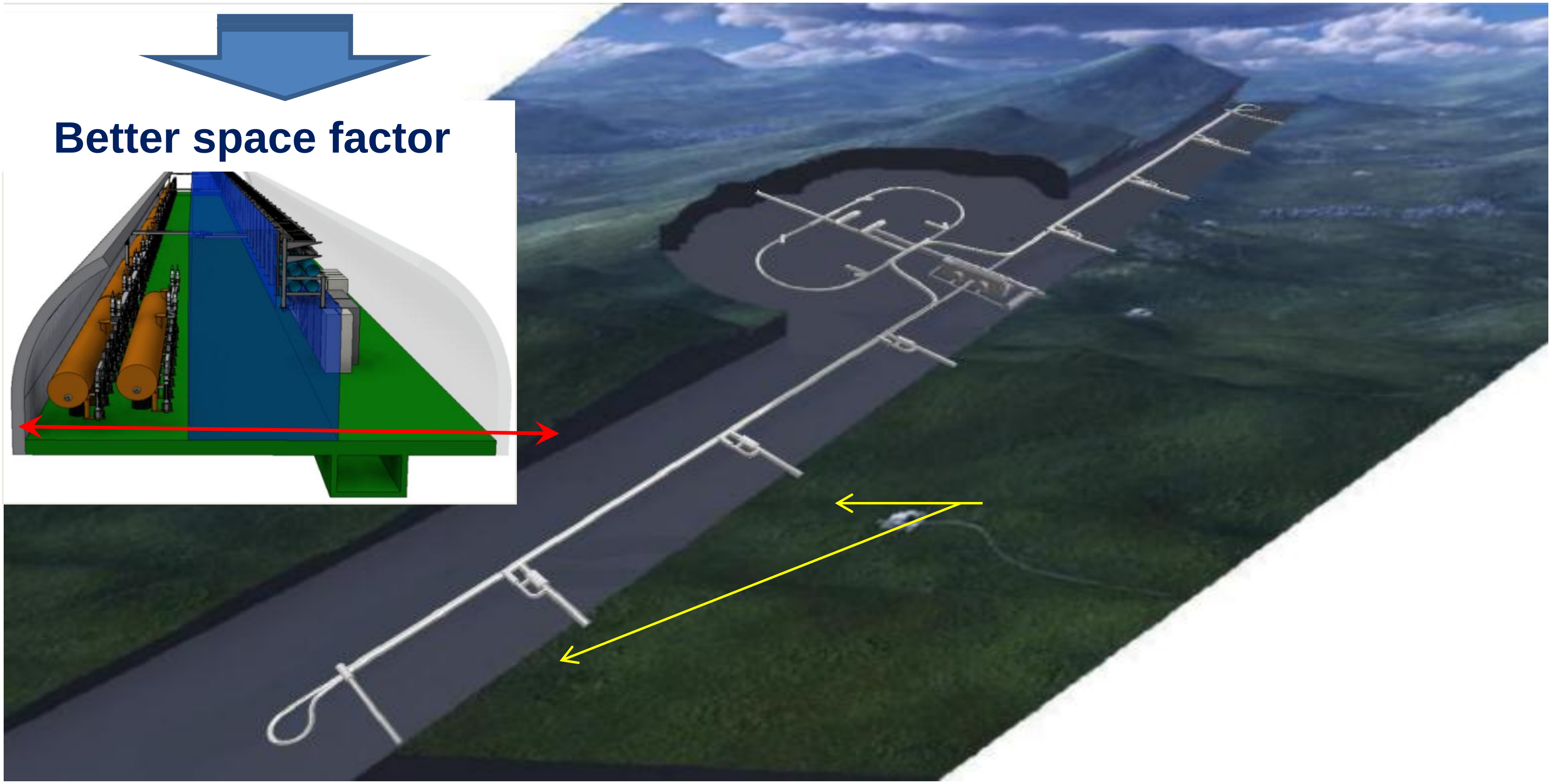


Civil Design – Asian Region (6)

Merit on the Functionality

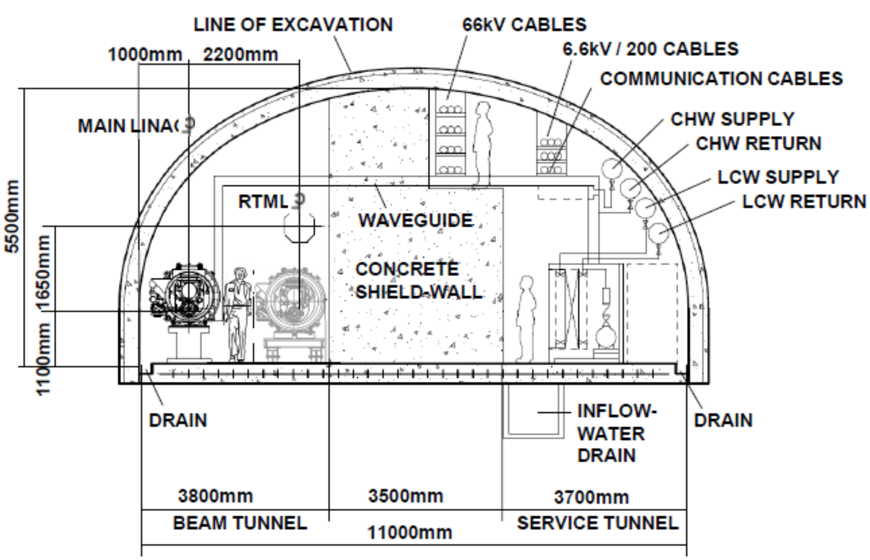
◇ Flat floor of the KAMABOKO tunnel

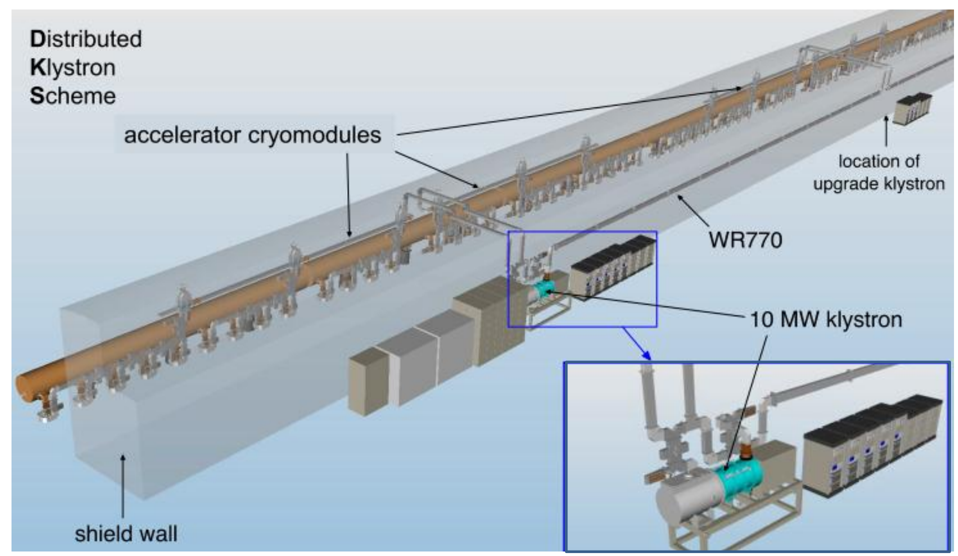
Better space factor



Civil Design – Asian Region (7)

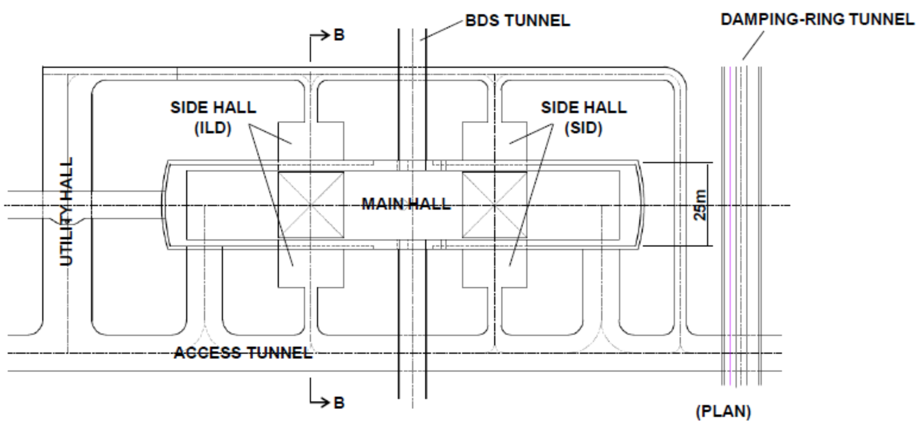
- **Distributed Klystron System (DKS) Requires**
  - **an RDR-like Main Linac (ML) Tunnel Design**
    - **with "beam" and "service" tunnels and**
    - **<5 km access intervals due to limited 2K-He transfer length.**
  - **ML lengths slightly(%) longer than KCS, by taking into account the cryo-strings to match the DKS RF distribution system.**

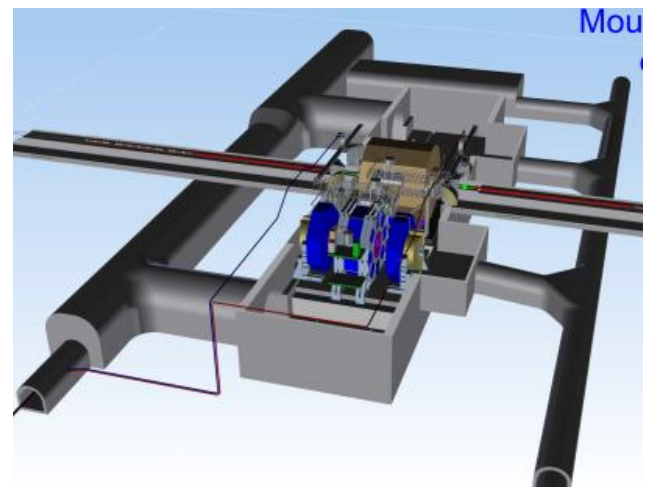


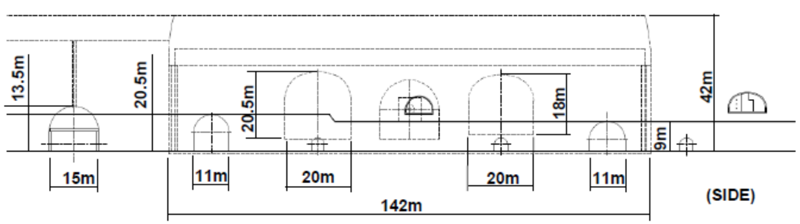


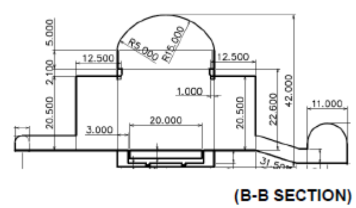
Civil Design – Asian Region (8)

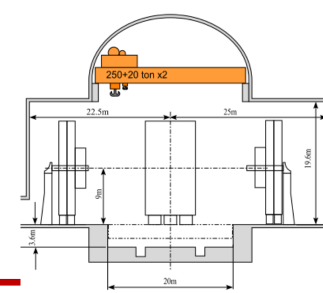
- **Site-specific Detector Hall Design for Sloped Access**
  - **Large access tunnel with a slope of <6%**
  - **Cavern design for site-specific detector assembly**





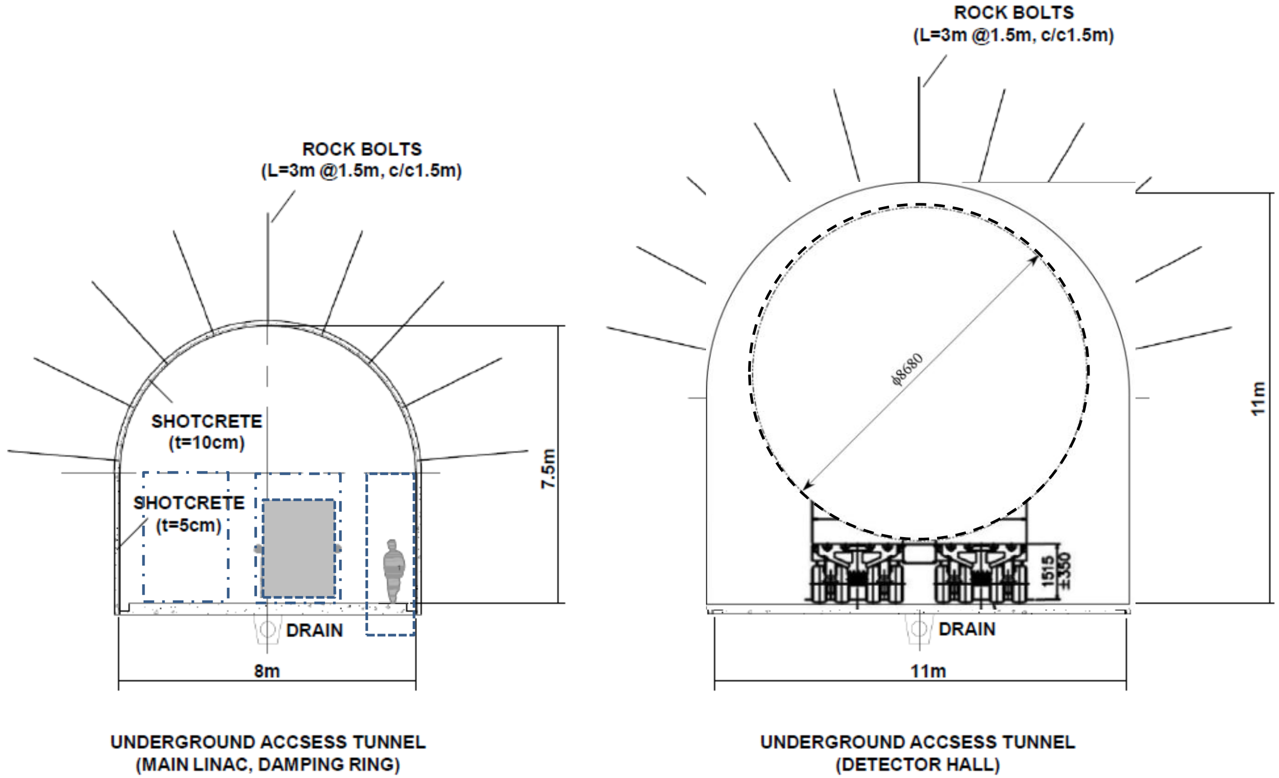






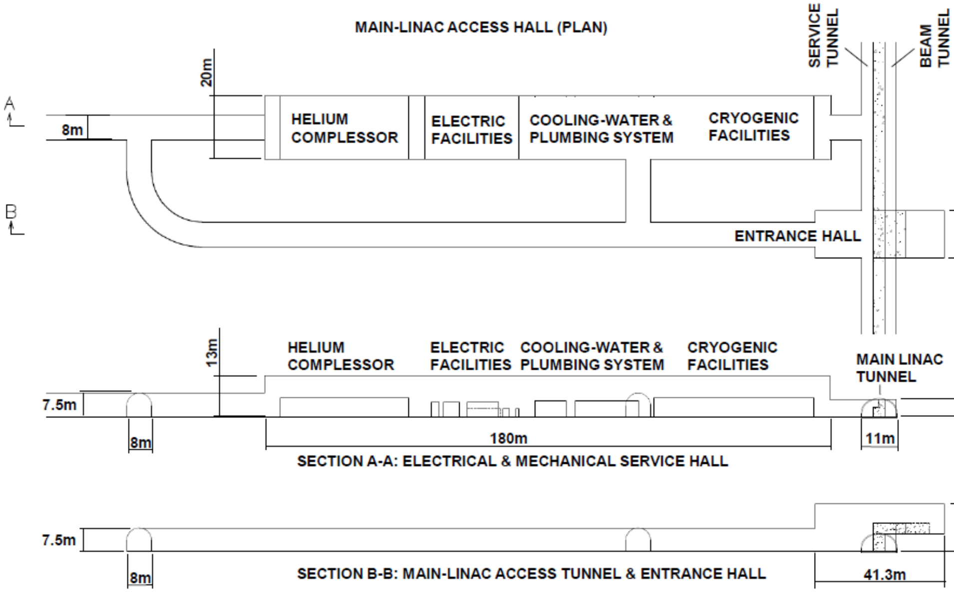
Civil Design – Asian Region (9)

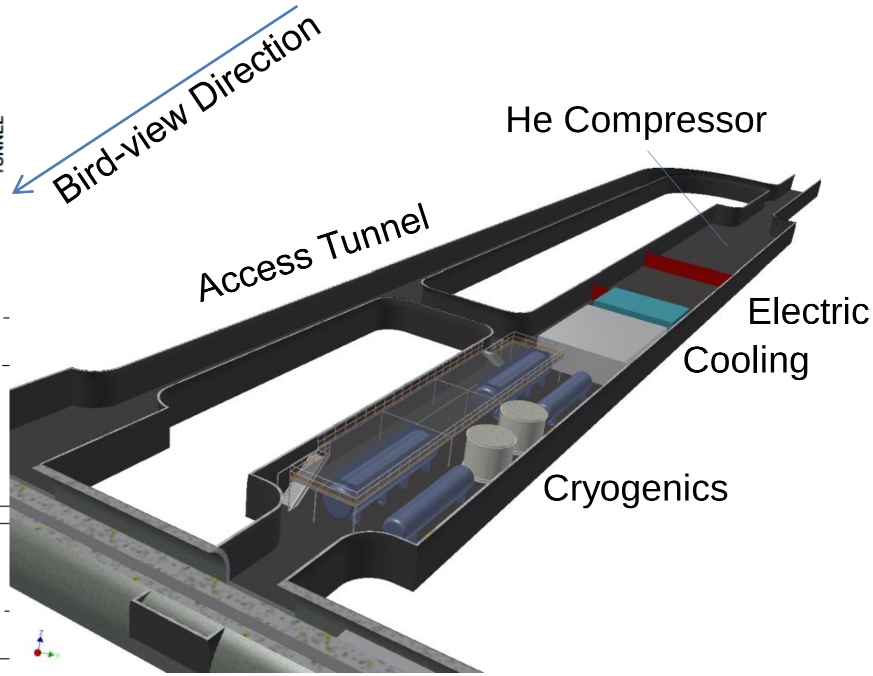
- **Access Tunnel**
  - **slope of <10% (ML & DR), <6% (DH)**



Civil Design – Asian Region (10)

- **Access Hall**
  - ***He Compressor, Cryogenic Facilities, Electrical Substation, Cooling-Water System, Plumbing System***



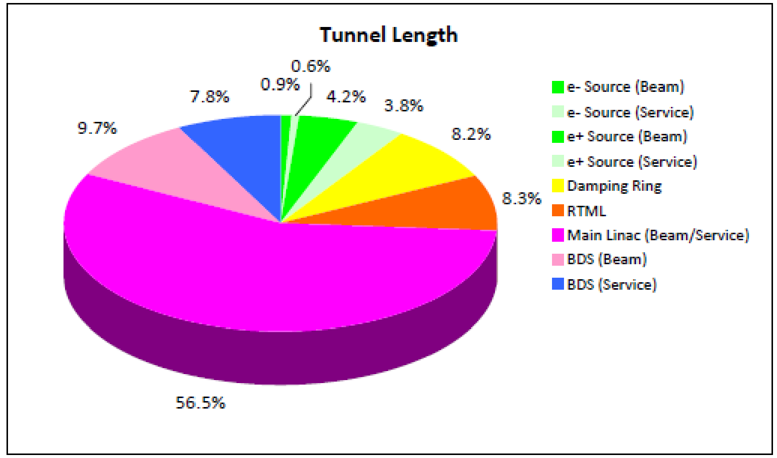


Civil Design – Asian Region (11)

•Total Volume of Underground Structures:

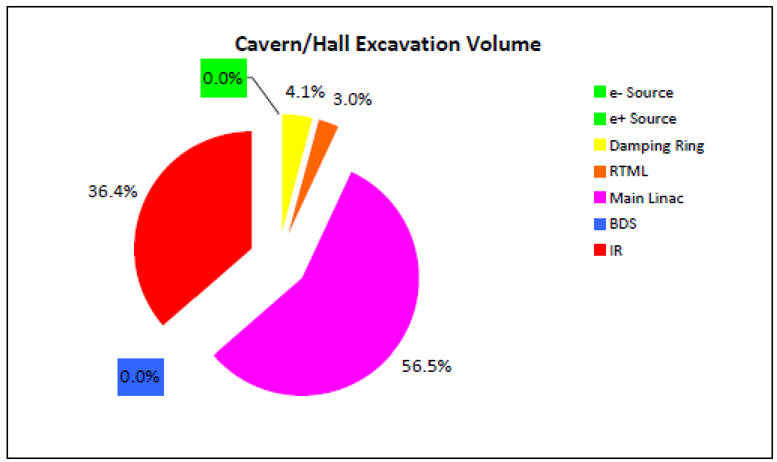
TUNNEL LENGTHS AND VOLUMES

AREA SYSTEM	LENGTH (m)	VOL. QTY (m3)	% LENGTH	% VOLUME
e- Source (Beam)	368	17,757	0.9%	0.8%
e- Source (Service)	223	4,881	0.6%	0.2%
e+ Source (Beam)	1,678	67,364	4.2%	3.2%
e+ Source (Service)	1,523	33,351	3.8%	1.6%
Damping Ring	3,239	120,352	8.2%	5.8%
RTML	3,305	200,237	8.3%	9.6%
Main Linac (Beam/Service)	22,425	1,395,754	56.5%	66.7%
BDS (Beam)	3,847	184,019	9.7%	8.8%
BDS (Service)	3,102	67,915	7.8%	3.2%
TOTAL	39,710	2,091,630	100.0%	100.0%



CAVERN SUMMARY AND VOLUMES

AREA SYSTEM	QTY	VOL. QTY (m3)	% VOLUME
e- Source	0	0	0.0%
e+ Source	0	0	0.0%
Damping Ring	4	21,151	4.1%
RTML	2	15,522	3.0%
Main Linac	6	293,687	56.5%
BDS	0	0	0.0%
IR	1	189,381	36.4%
TOTAL	13	519,741	100.0%



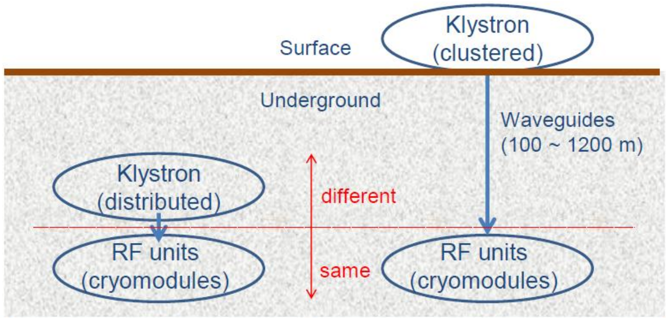
Civil Design – Asian Region (12)

- **Surface Facilities:**
  - **Full facilities for green field construction**
  - **Scope and quantities (floors) based on RDR (CERN estimates)**
  - **Some facilities moved to underground**
  - **Site development costs are based on areas**

SOURCE AREA	QTY	AREA (m2)	% AREA
e− Source	0	0	0.0%
e+ Source	0	0	0.0%
Damping Ring	0	0	0.0%
RTML	0	0	0.0%
Main Linac	65	22,375	24.5%
BDS	10	3,650	4.0%
IR	28	65,250	71.5%
TOTAL	103	91,275	100.0%

Electrical Design – Asian Region (1)

- **Power loads for DKS MLs and CFs**
- **TDR baseline (half beam power operation)**



	DKS	KCS
Klystron	378	403
RF units	567	567

~6%

DKS Power Load in MW (TDR baseline - Low Power)

Area System	RF Power	Racks	NC magnets	Cryo	Conventional		Total
					Normal	Emerg	
e- sources	1.28	0.09	0.73	0.80	1.47	0.50	4.87
e+ sources	1.39	0.09	4.94	0.59	1.83	0.48	9.32
DR	8.67		2.97	1.45	1.93	0.70	15.72
RTML	4.76	0.32	1.26	part of ML cryo	1.19	0.87	8.40
Main Linac	52.13	4.66	0.91	32.00	12.10	4.30	106.10
BDS			10.43	0.41	1.34	0.20	12.38
Dumps					0.00	1.21	1.21
IR			1.16	2.65	0.90	0.96	5.67
TOTALS	68.2	5.2	22.4	37.9	20.8	9.2	164
(Americas)	74.2 MW				14.6 MW	6.4 MW	161 MW

Electrical Design – Asian Region (2)

- ***Site-specific high-voltage distribution***

This schematic drawing is for 500 GeV full power (240 MW).

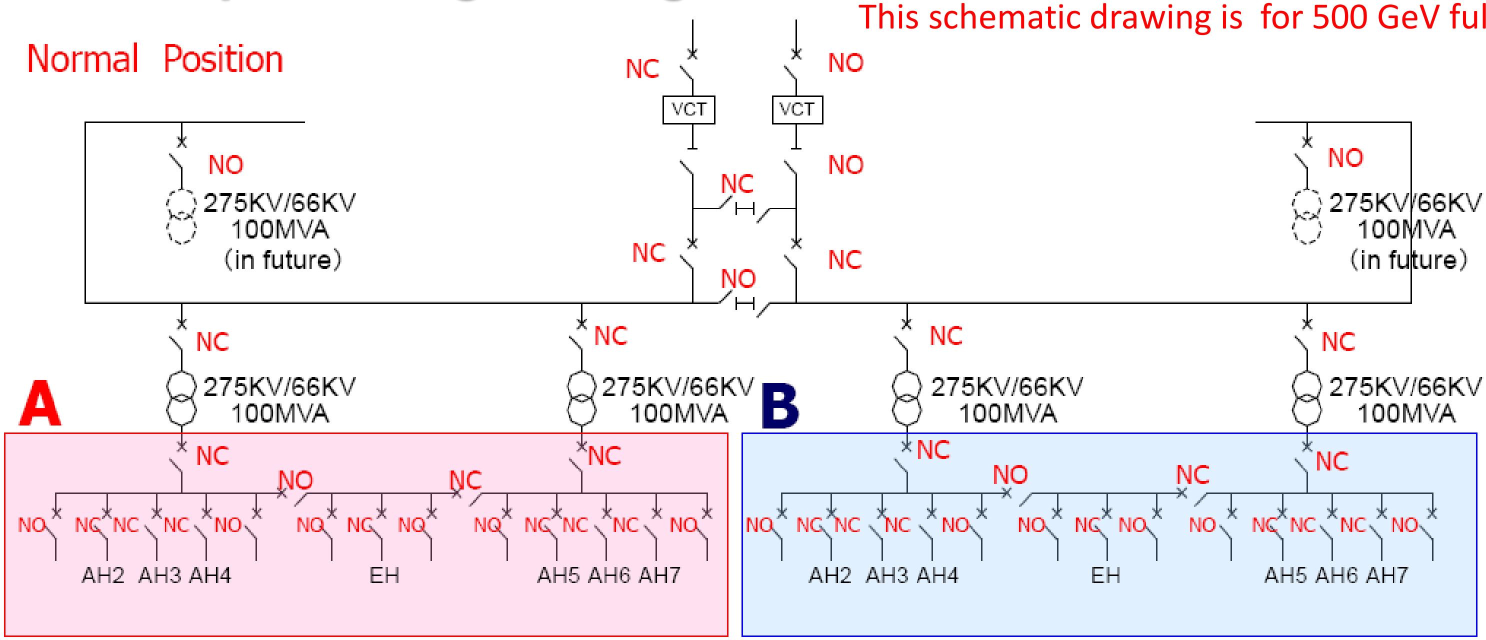


table : overall electrical load summary

	distribution	Power(MVA)	AH1	AH2	AH3	AH4	EH	AH5	AH6	AH7	AH8	TOTAL	
TOTAL	A	135.54		22.34	18.31	21.43	16.97	15.85	18.31	22.34		62.08	73.47
	B	103.54		15.89	13.98	19.85	11.56	12.40	13.98	15.89		49.72	53.83

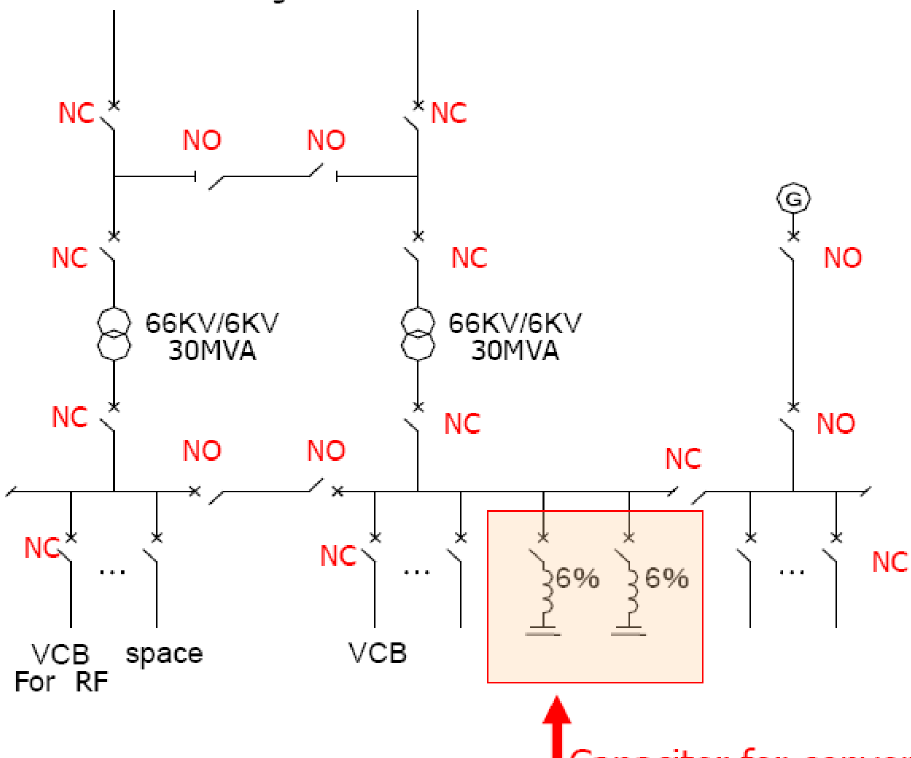
66kV/6.6kV transformer		30MVA 30MVA	30MVA 30MVA	30MVA 30MVA	30MVA,30MVA (30MVA)	30MVA 30MVA	30MVA 30MVA	30MVA 30MVA	

Electrical Design – Asian Region (3)

- **Access-Hall 66/6.6 kV Substations**

One line diagram of 66KV substation with generator

Normal Position



Capacitor for conventional load power factor improvement

Mechanical Design – Asian Region (1)

- **Heat loads for DKS MLs and CF s**

DKS Thermal Loads in MW (TDR baseline - Low Power)

Area System	load to LCW	load to Air	Conven tional	Cryo (Water load)	Total
e- sources	1.40	0.70	1.87	0.80	4.77
e+ sources	5.82	0.64	2.27	0.59	9.32
DR	10.92	0.73	2.69	1.45	15.79
RTML	4.16	0.76	2.02	part of ML cryo	6.94
Main Linac	42.17	5.57	16.89	32.00	96.63
BDS	9.20	1.23	1.68	0.41	12.52
Dumps	14.00		1.12		15.12
IR	0.40	0.76	1.79	2.65	5.60
TOTALS	88.1	10.4	30.3	37.9	167

(Americas) 13.5 MW 154 MW

Mechanical Design – Asian Region (2)

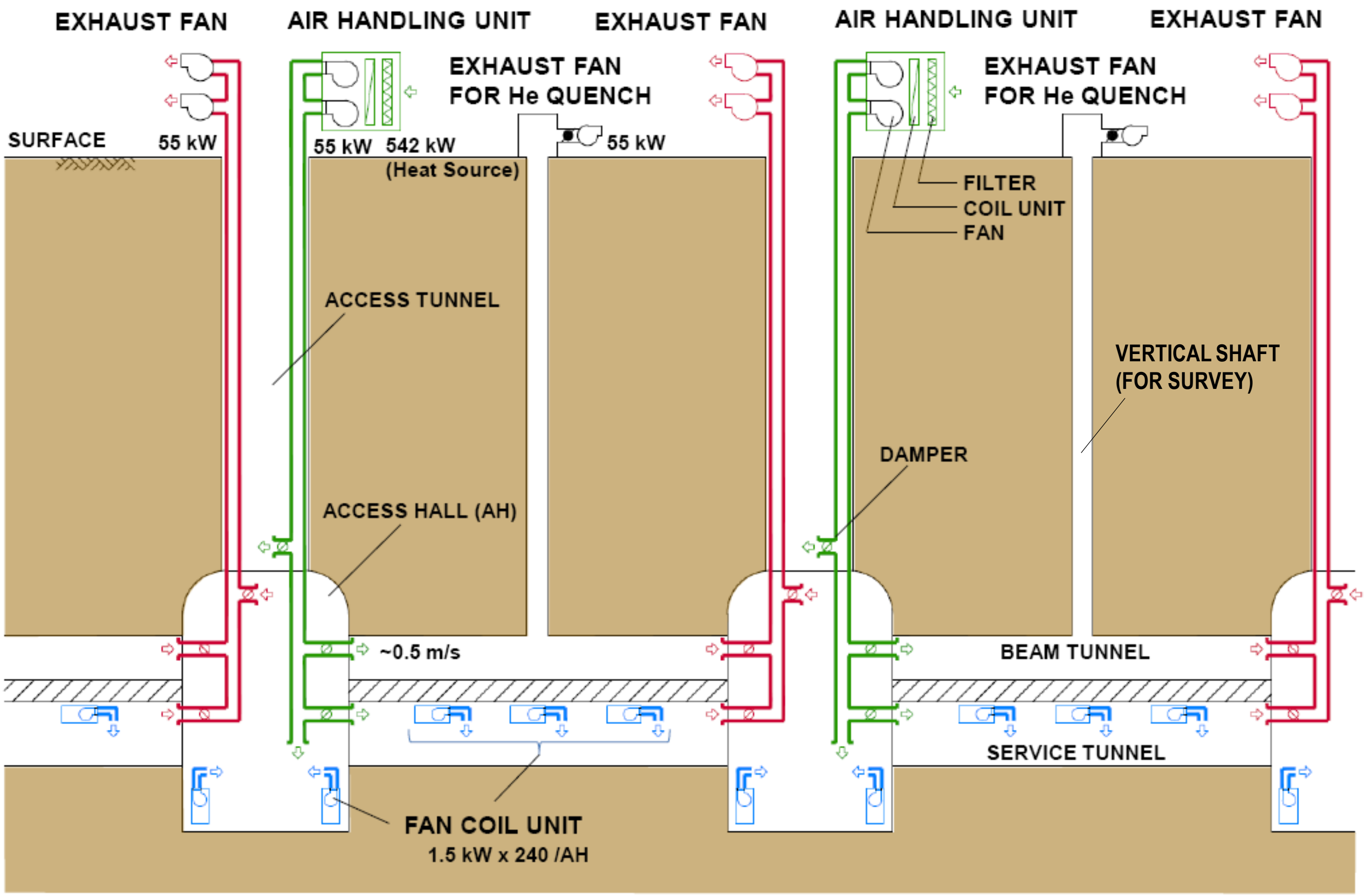
- Heat loads for DKS MLs and CF s

	Heat loads	Water	Chilled wate	Air	Chilled Air
Surface	conventional	use		use	
Tunnel	technical	use	use		use
	conventional (electrica				use
	conventional (mechan	use		use	

<35 deg C water is provided except hot summer days

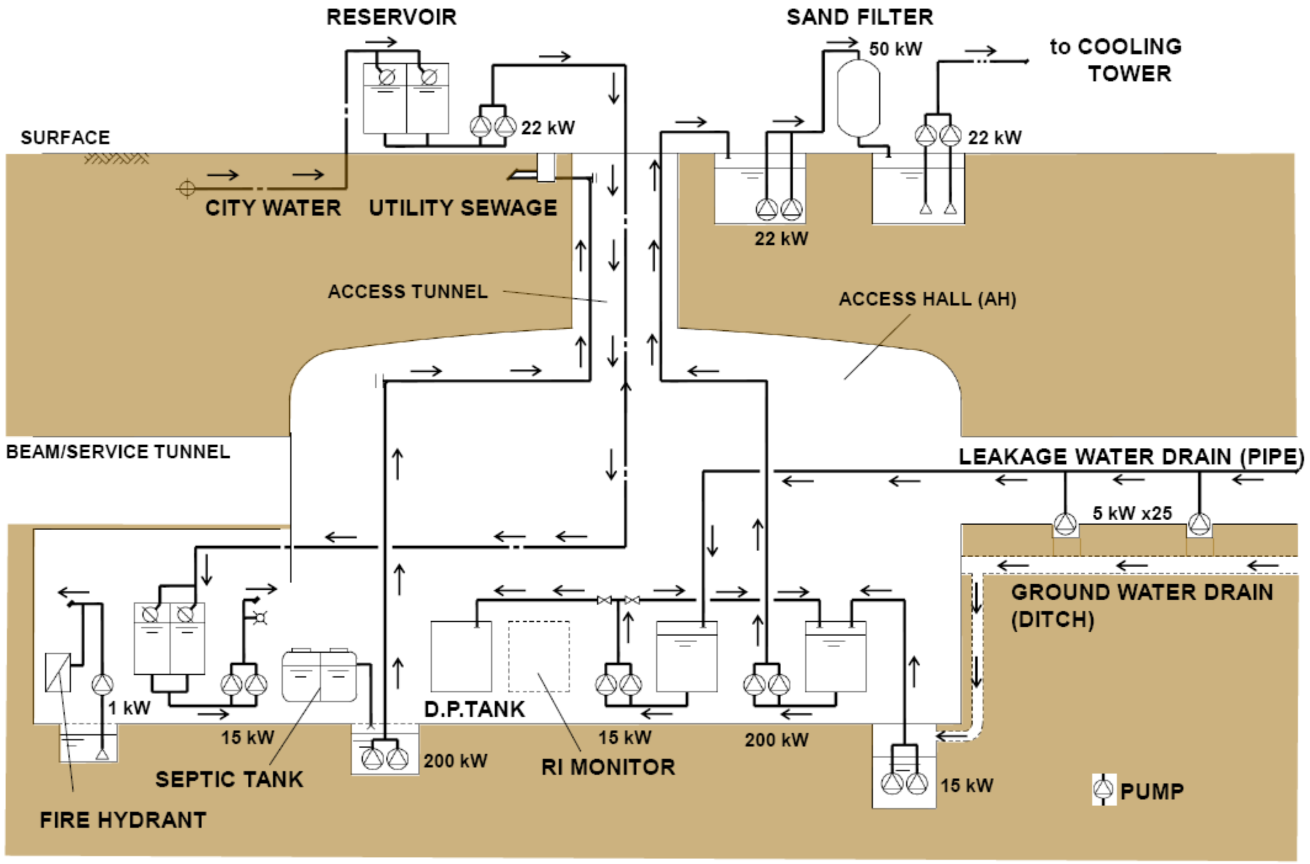
Air Treatment Design – Asian Region

- RDR-like Design for MLs (air flow rate ~0.5 m/s)
- Design not done for the central region, roughly cost-estimated .



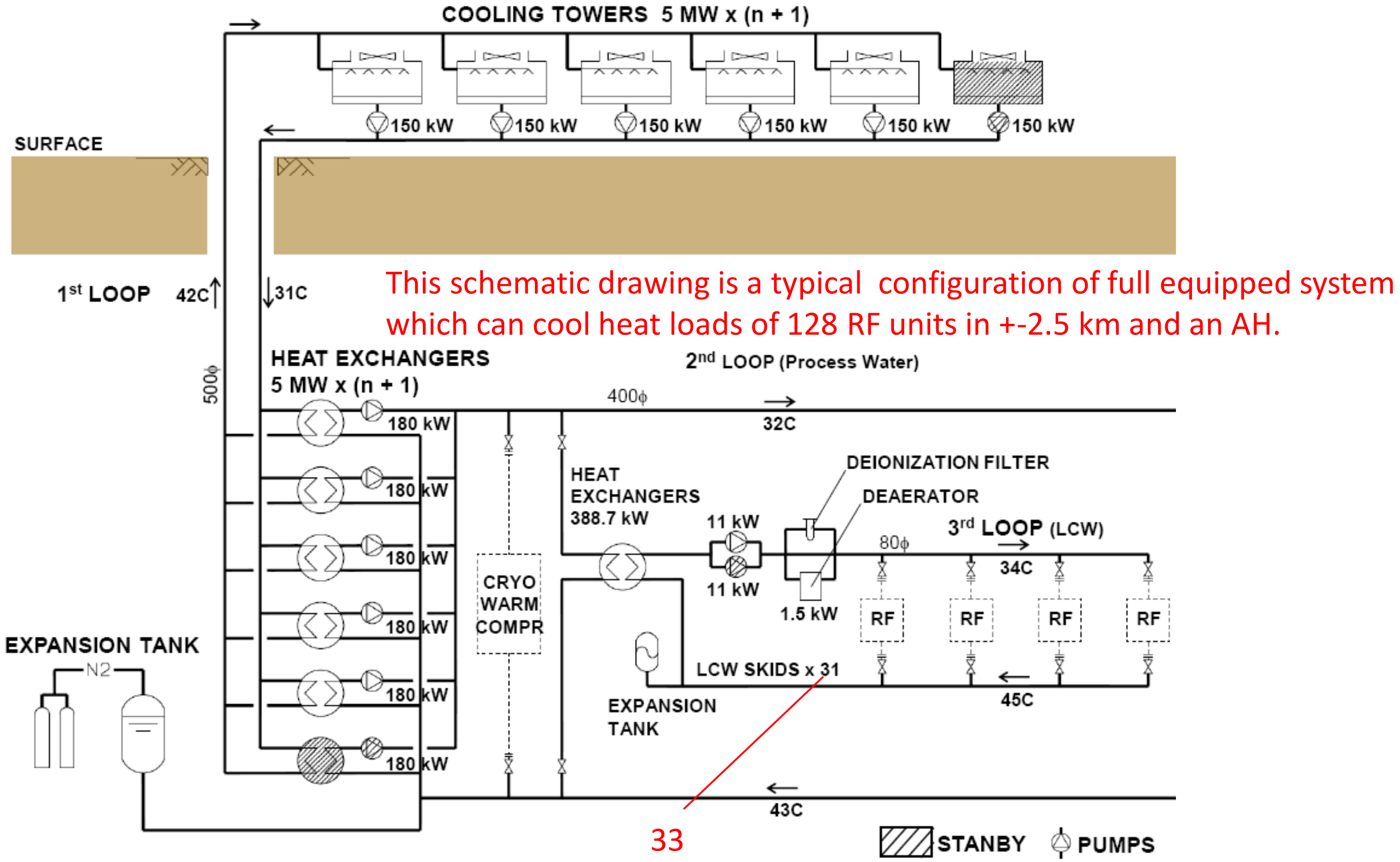
Piped Utilities Design – Asian Region

- *Inflow ground water assumed 1 ton/km/min., Utilization of inflow water for cooling*
- *Treatment of leakage water from accelerator, Underground access hall utilities*
- *Design not done for the central region, roughly cost-estimated .*



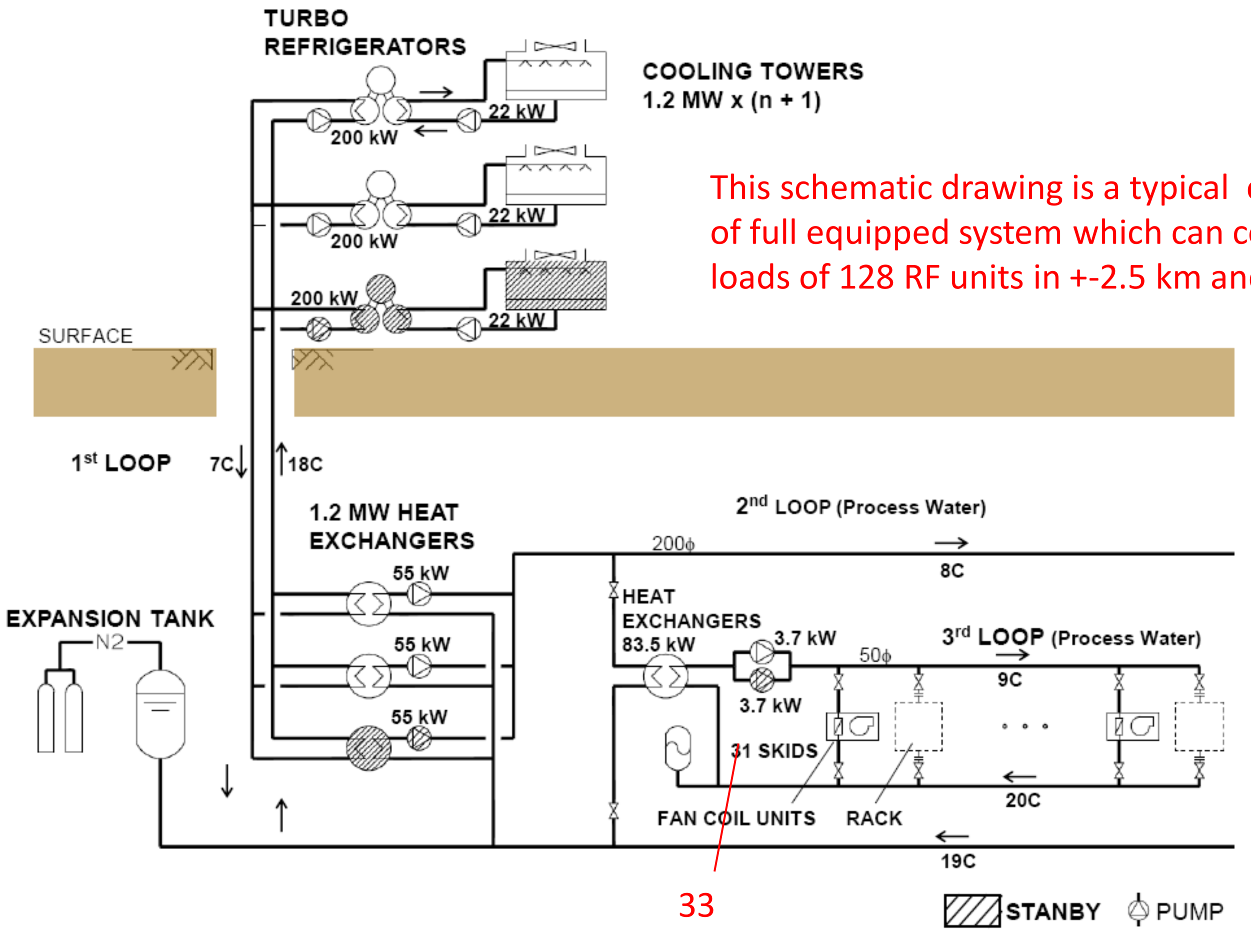
Process Cooling Water Design – Asian Region

- *Heat loads for DKS-MLs and Site-specific Conventional system*
- *Design not done for the central region, roughly cost-estimated*



Chilled Water Design – Asian Region

- *Heat loads for DKS-MLs and Site-specific Conventional system*
- *Design not done for the central region, roughly cost-estimated*

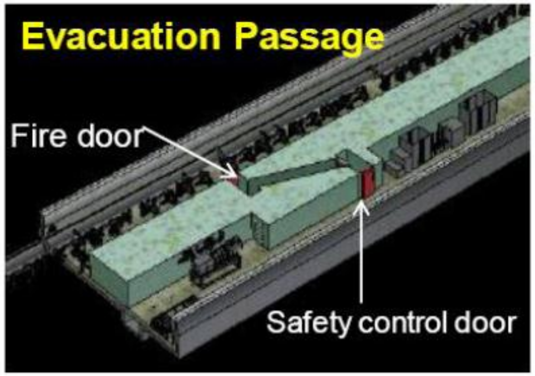


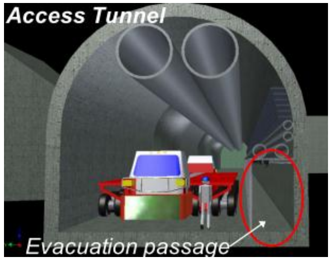
This schematic drawing is a typical configuration of full equipped system which can cool heat loads of 128 RF units in +-2.5 km and an AH.

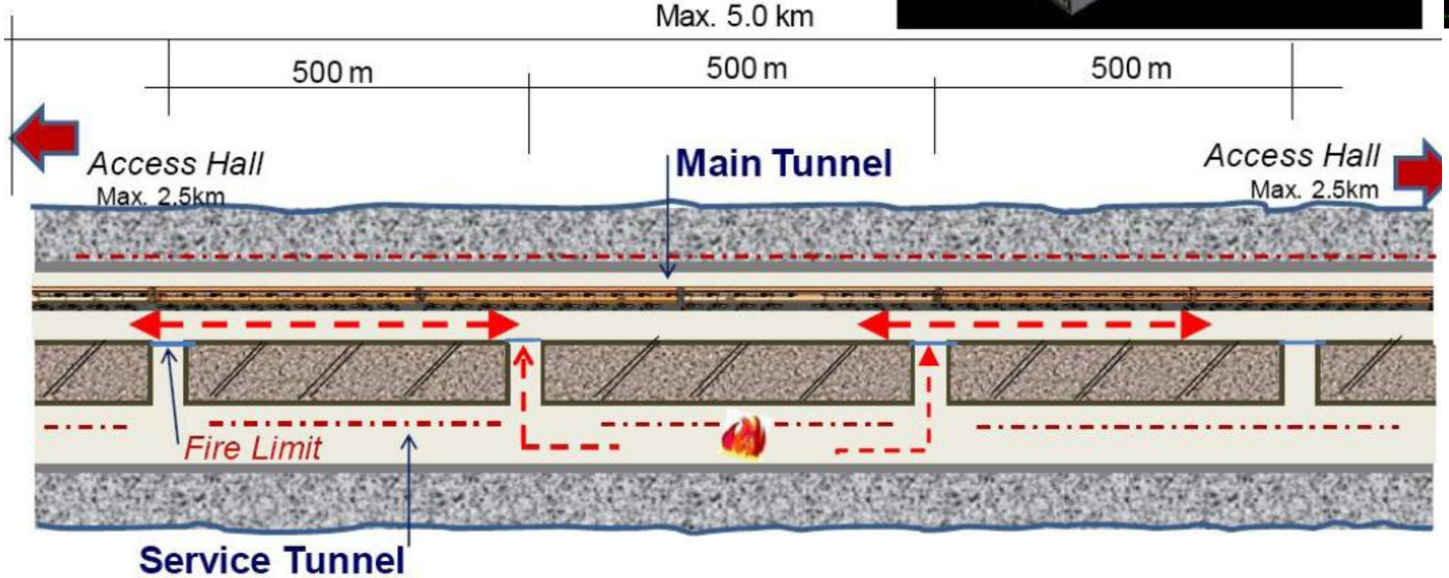
Safety Equipment Design Design – Asian Region

Evacuation Plan

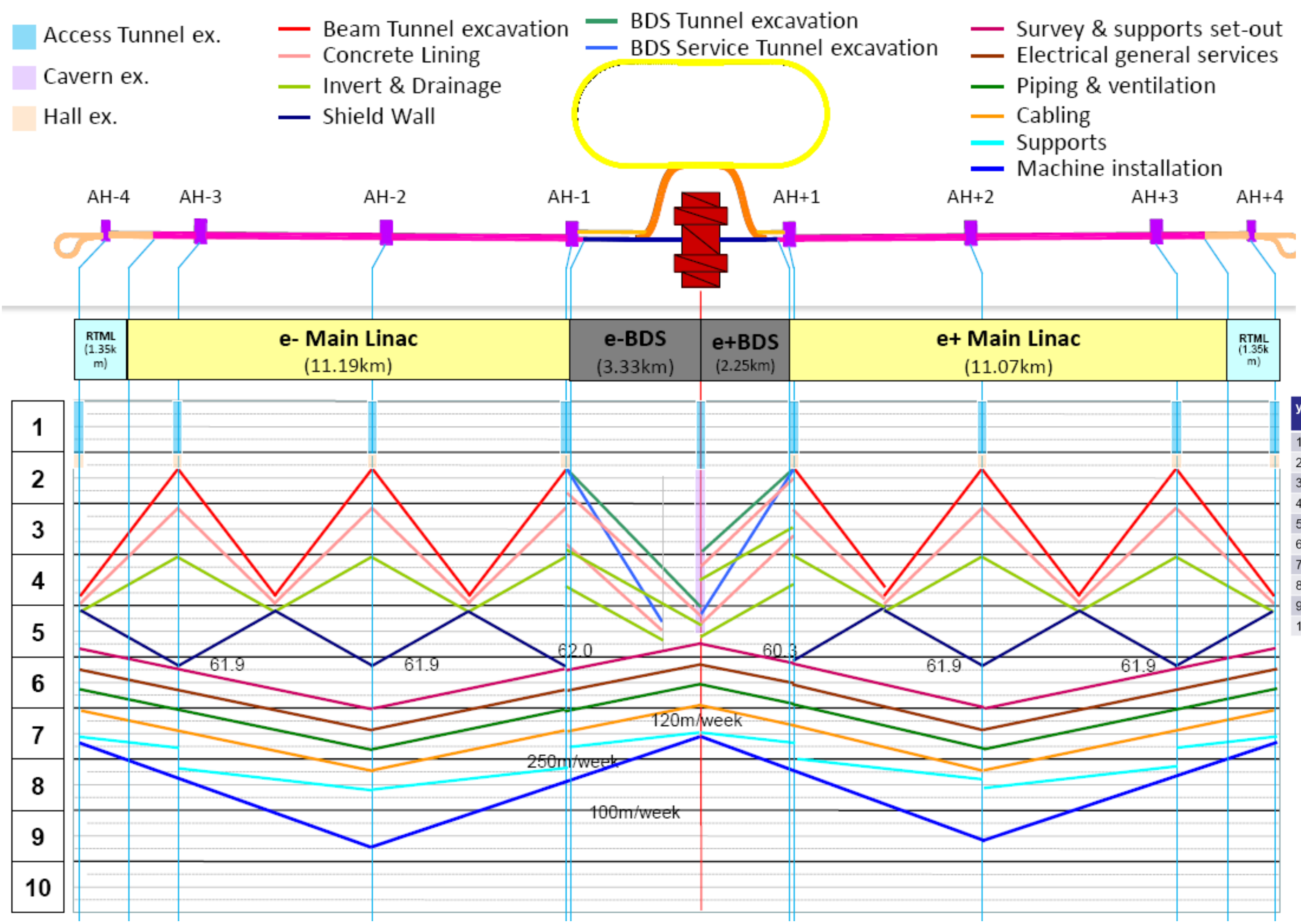
- In the case which the fire started in the service tunnel , we can take refuge in the Beam-tunnel.
- Evacuation in two directions is attained.

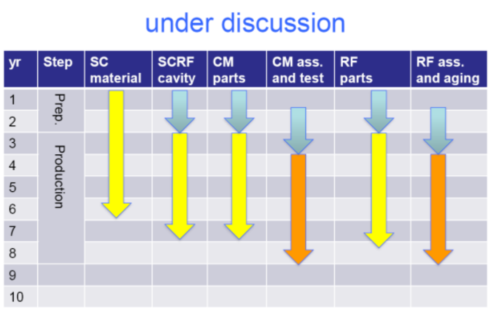






Construction Schedule - Asian Region





Asian region CFS Design Summary

- Site investigation is ongoing in two candidate sites
- Tunnel design was progressed using NATM
- Large cavern designs were made (DH, AH)
- Electrical and mechanical systems were developed for ML
- Construction schedule and costs were studied