Site-specific CF design from TDR

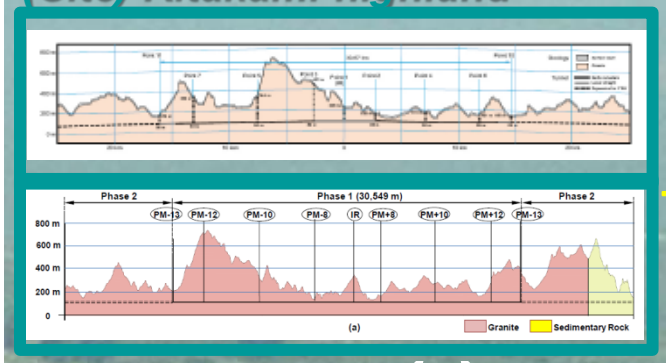
LCWS13, 12 November 2013

Atsushi ENOMOTO (KEK)

BACK

Overall Site Layout

(Site) Kitakami-highland



RDR

TDR

Overall Machine Layout
* Energy
* e+Source
* timing
* angle?

Site layout
(1) IR, Orientation
→(2) Access Points
→(3) ML length

Local Government ←→
* close connection
* iterated

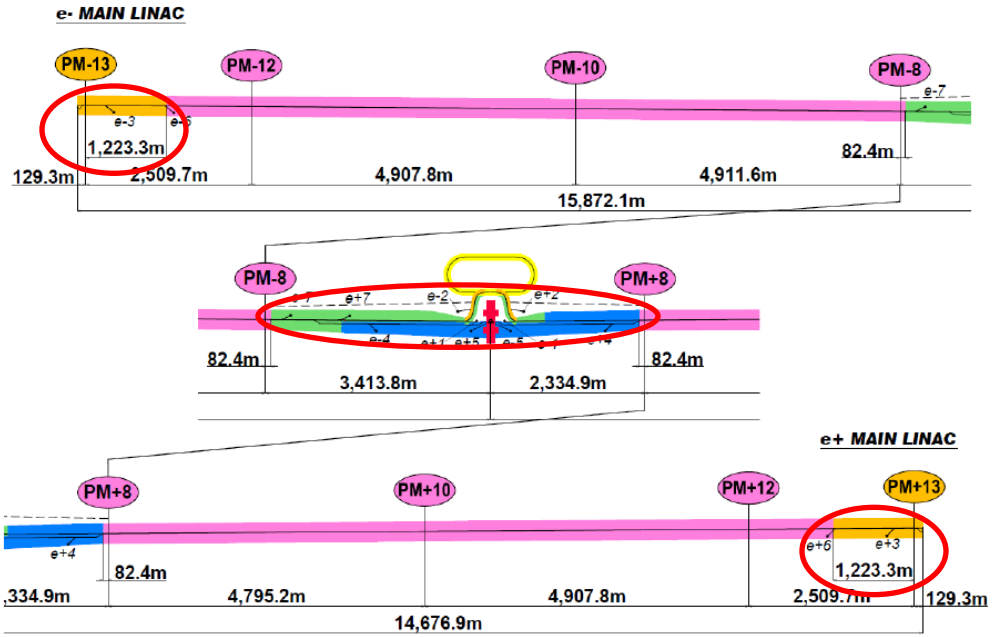
Damping Ring
Ring To Main Linac (RTML)
Detector Hall
PM-ab
PM+8
PM+10
PM+12
PM+13
(2)
(1)
e+ ML
e- Source
Surface Structures
Existing surface road
PM-8
PM-10
PM-12
PM-13
(Slope <7%)
e+ Source
PX
(Center Campus)
Access Tunnel
(Slope <10%)
Access Hall
e- Main Linac (ML)
Existing road
(3)
RTML turn-around

Staging Site Investigation & Survey
(1) Worse Geology, Water, Variation
→ (2) Wide-range survey (1/1000)
→ (3) Topology Survey
→ (4) Evironmental (Water, …)
→ (5) Land Precise Survey to purchase

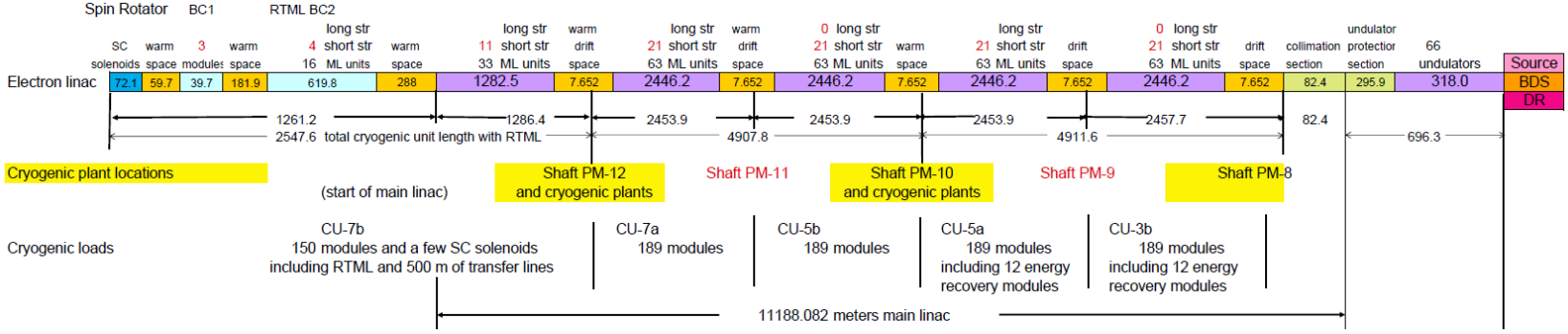
(The background photo shows a similar site image but does not show the real site.)

Remaining Tunnel Designs for Major Technical Area (In Asian Region)

* Central region (BDS, DH)
* RTML



Main Linac Length



General Technical Issues
after bedrock geological feature confirmed

Optimization of structure cross section concerning necessary rock support vs. costs.

(1) Chose rock support system: sprayed concrete, rock balts, PS anchor
(2) Optimize sizes and cross sections for various caverns
(3) Evacuation of inflow waters

Tunnel Design (Typical cross section)

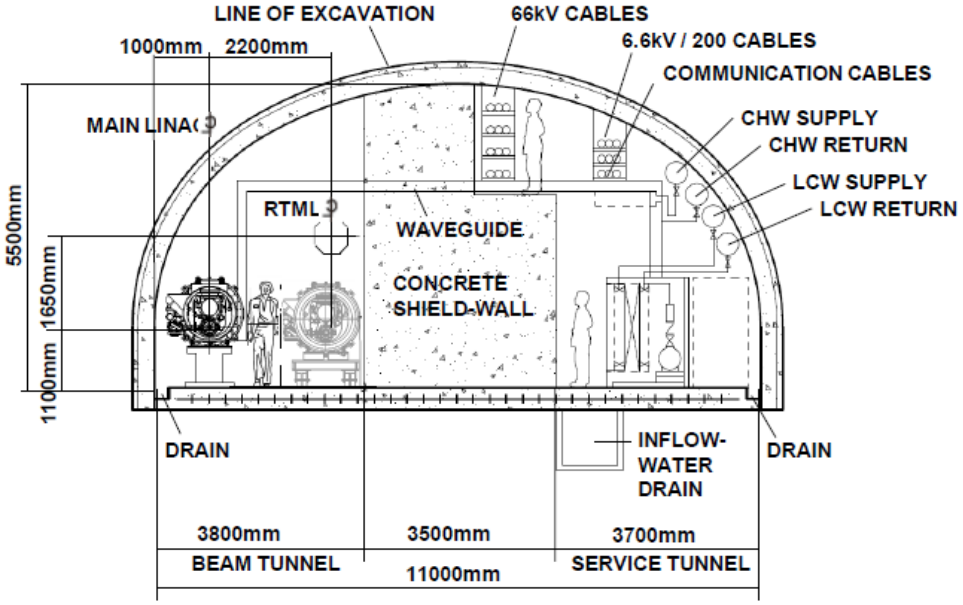
- *Distributed Klystron System (DKS)*
  - *RDR-like Main Linac (ML) Tunnel Design*
    - *with "beam" and "service" tunnels and*
    - *<5 km access intervals due to limited 2K-He transfer length.*

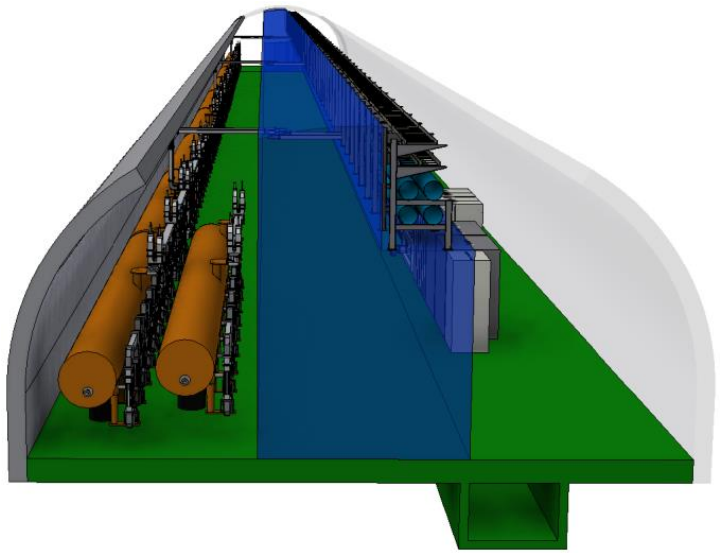
ML tunnel

*** Shield wall**

- thickness, material density, construction methods (precast, in-situ, prepacked)

*** Precise shape of "Kamaboko" and other structures**

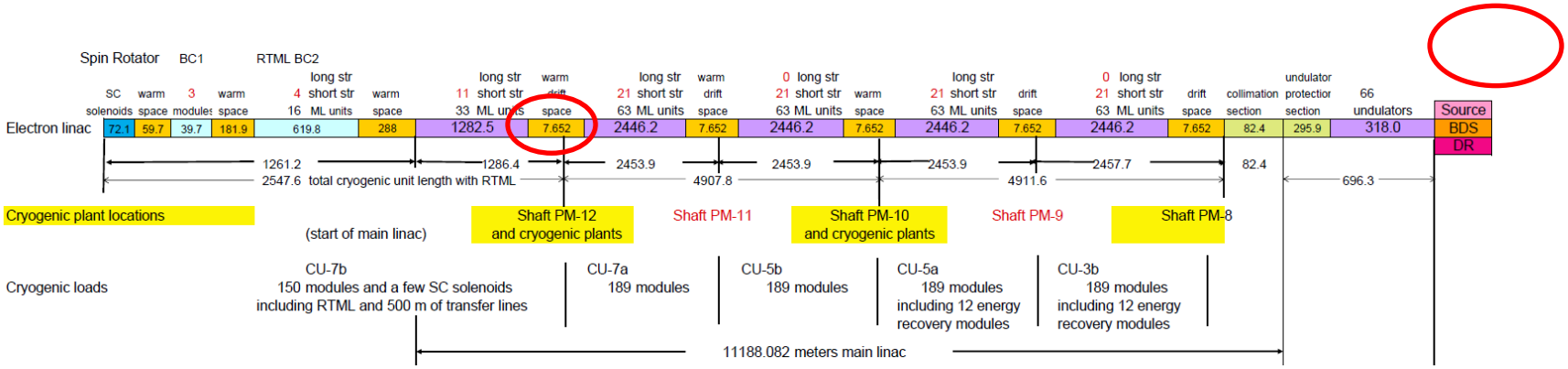




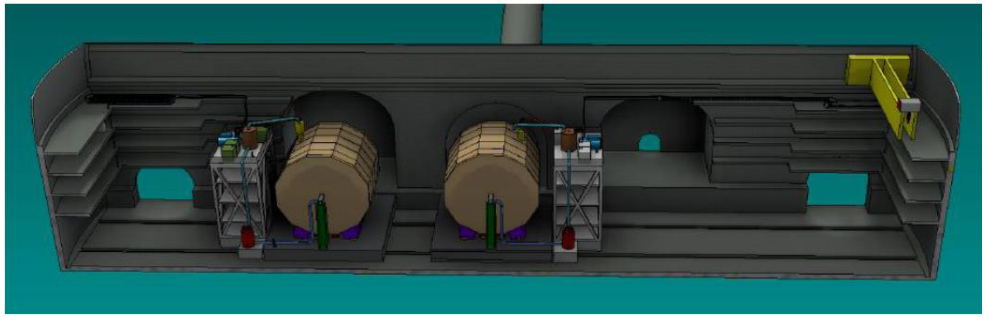
Remaining Tunnel Designs for Major Technical Area (In Asian Region)

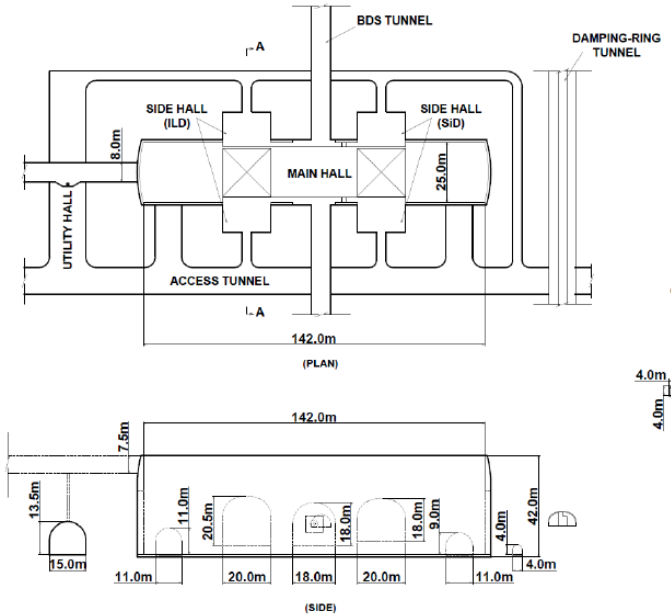
- Longitudinal (along the beam line) variation of tunnel cross section and machine layout

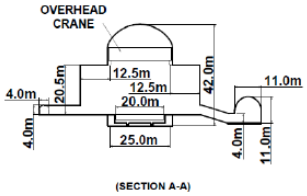
Main Linac Length

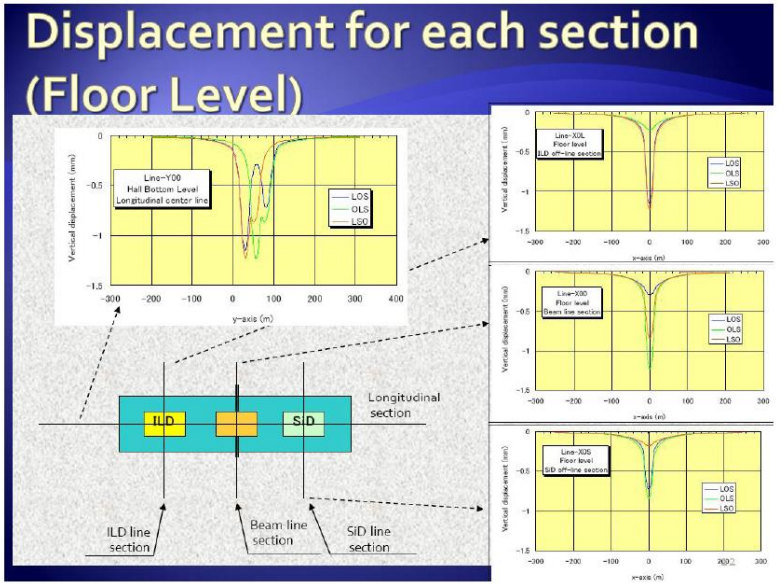


Detector Hall







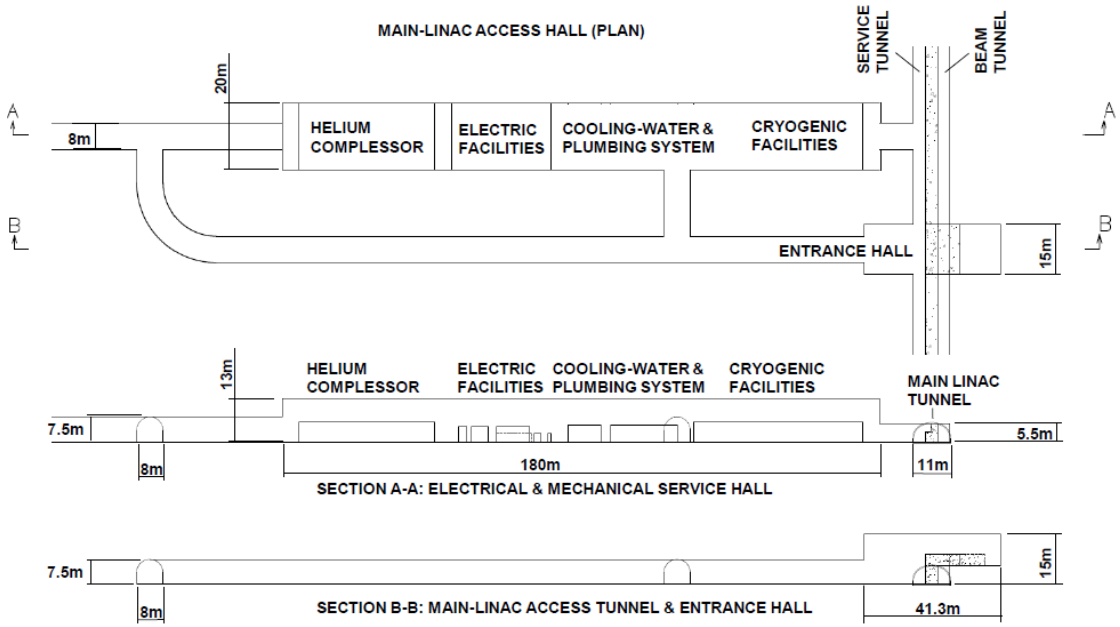


Detector Hall tunnel

- **Section and support**
- **Inner structure – Crane support**
- **Construction procedure including associated small caverns and tunnels**
- **Transportation during construction**

Access Hall

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

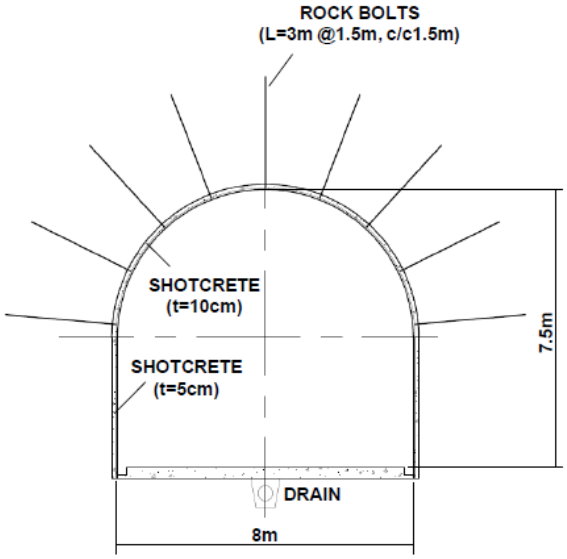


Detector Hall tunnel

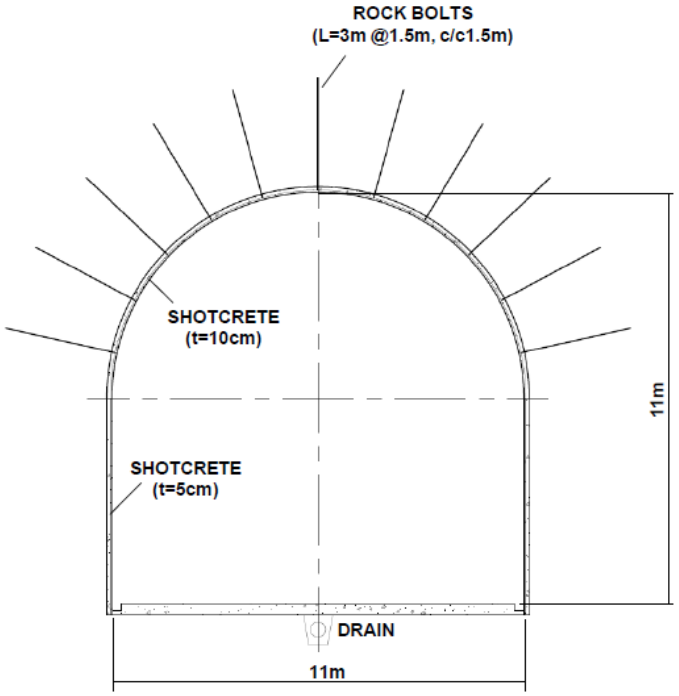
*** Layout and Structures for service equipment**
*** Access and transport for Machine**
*** Shielding**
*** Doors**
*** Crane**
*** Inflow water**
*** Section shape and Rock support**

Access Tunnel

- slope of <10% (ML & DR), <7% (DH)



UNDERGROUND ACCSESS TUNNEL
(MAIN LINAC, DAMPING RING)



UNDERGROUND ACCSESS TUNNEL
(DETECTOR HALL)

Access tunnel
*** Slope angle**
*** Section**
*** Safety**
*** Inflow water**

BACK

Surface Structures

ILC Surface Buildings (TDR)

Number of buildings	104
Floor Area (m2)	91,275

PM-13	PM-12	PM-10	PM-8	DR	PM0	DR	PM+8	PM+10	PM+12	PM+13
0	3,450	4,250	4,300	0	68,900	0	3,475	3,450	3,450	0

PM0

	BDS	Exp.	Gen.	(total)
Number of buildings	10.0	14.0	14.0	38
Area (floor)	3,650	19,750	45,500	68,900
Main Building (Office)			1	1
			10,000	10,000
Detector Assembly		2		2
		12,000		12,000
Service Building			1	1
			14,000	14,000
Office for technical Staff		1		1
		3,800		3,800
Office for technical Staff	1			1
	200			200
Electric Building		1	1	2
		300	100	400
Electrical Transformer			1	1
			10,000	10,000
Cooling Tower & Pump Station	1	1		2
	650	650		1,300
Cooling Ventilation Building	1	1		2
	400	400		800
Beam Dump Cooling Building	1	1		2
	300	300		600
Main Heat Plant			0	0
			0	0
Computer center			1	1
			1,200	1,200
Garage for Vehicules Maintenance			1	1
			1,000	1,000
Cryo- Warm Compressor				0
				0
Cryo- Surface Cold Box				0
				0
Control Room			1	1
			1,000	1,000
Control Rooms	1	1		2
	100	100		200
Workshop	1	1		2
	450	450		900
Site Access Building	1	1		2
	100	100		200
Shaft Access	1	1		2
	300	300		600
Survey Gallery			1	1
			800	800
Survey Calibration (piles)			1	1
			0	0
Underground Galleries Services	1	1		2
	150	150		300
Safety Buildings			1	1
			1,400	1,400
Gaz Buildings		1		1
		400		400
He Tank Platform	1	1		2
	1,000	1,000		2,000
Reception			1	1
			1,400	1,400
Wharehouse / Goods reception			1	1
			1,200	1,200
Restaurant & Cafeteria			1	1
			1,200	1,200
Hostels			1	1
			2,200	2,200

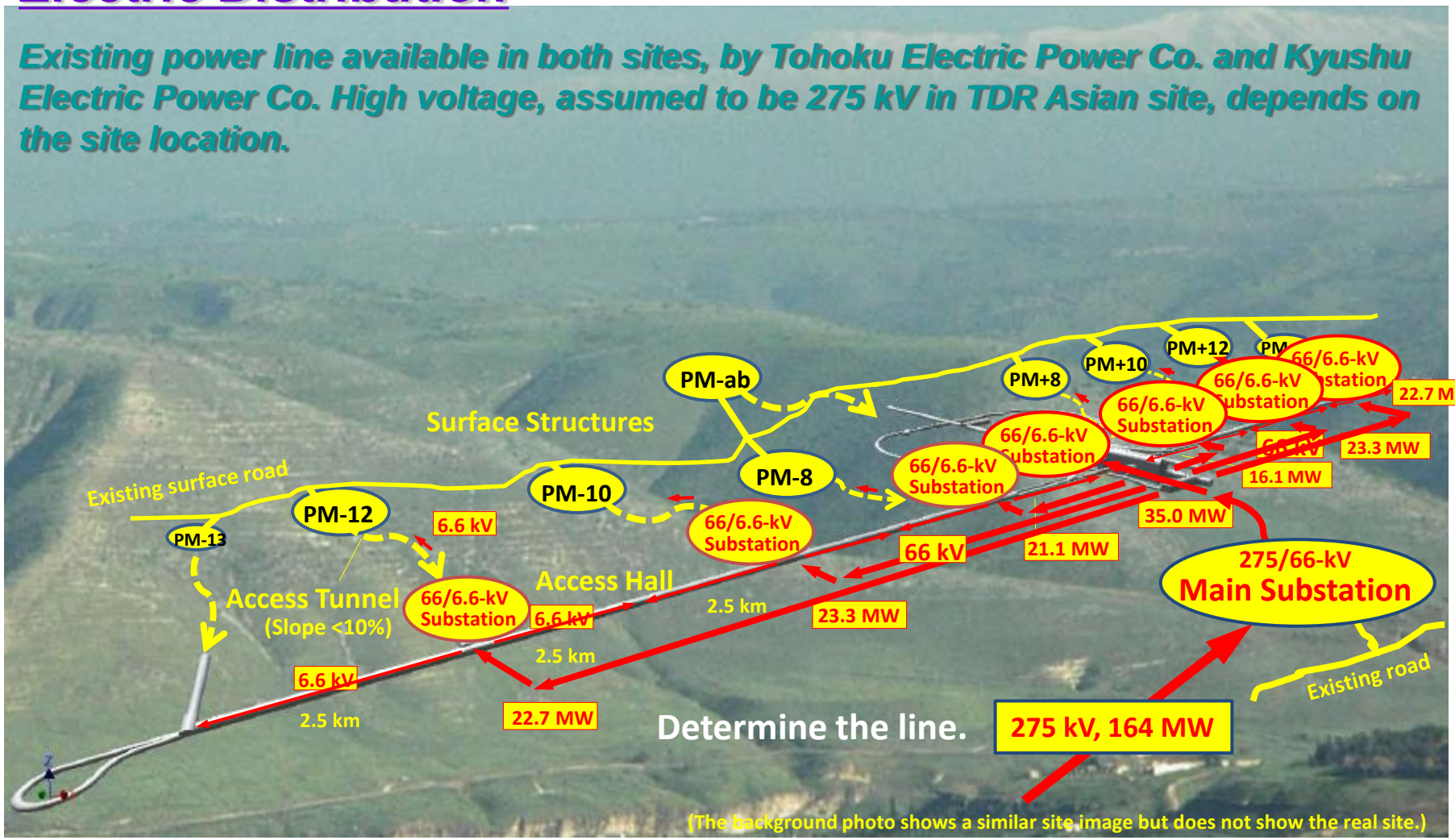
- *Surface Facilities:*
  - *Full facilities for green field construction*
  - *Scope and quantities (floors) based on RDR (CERN estimates)*
  - *Some facilities moved to underground*
  - *Site development costs are based on areas*

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%

BACK

Electric Distribution

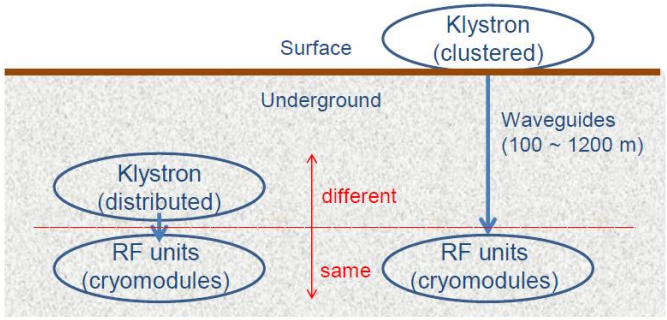
Existing power line available in both sites, by Tohoku Electric Power Co. and Kyushu Electric Power Co. High voltage, assumed to be 275 kV in TDR Asian site, depends on the site location.



Power Loads

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

Confirm power loads
*** Response for machine design developments**
*** Site-specific conventional power**
- Temp, humid, access length, …



	DKS	KCS
Klystron	378	403
RF units	567	567

~6%

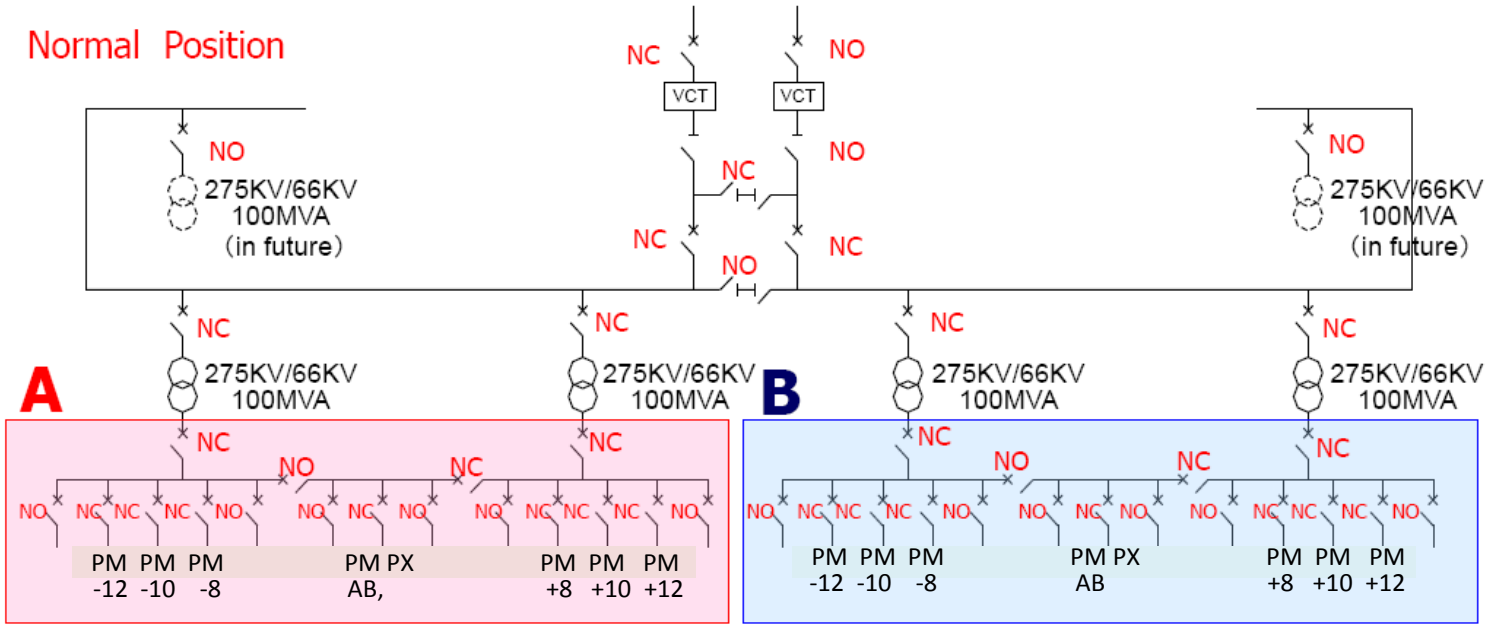
DKS Power Load in MW (TDR baseline - Low Power)

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

BACK

High-Voltage Distribution

- 275-kV Main Substation and 66-kV distribution



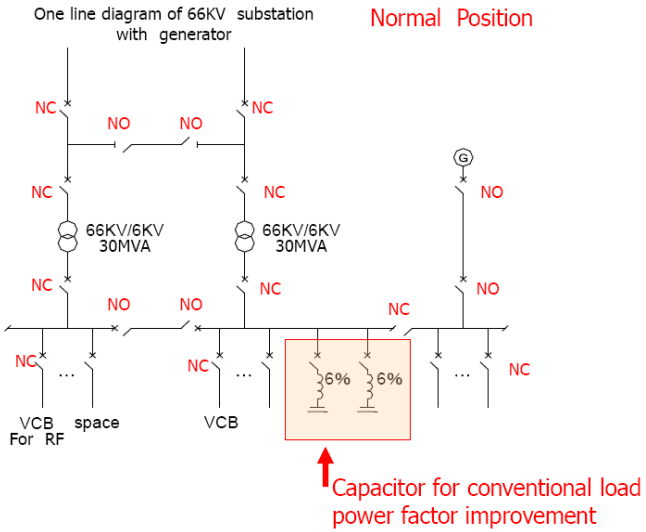
BACK

High-Voltage Distribution (2)

• Access-Hall 66-kV Substations and 6.6-kV distribution

table : overall electrical load summary

	distribution	Power(MVA)	PM-13	PM-12	PM-10	PM-8	PM-AB, PX	PM+8	PM+10	PM+12	PM+13	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			



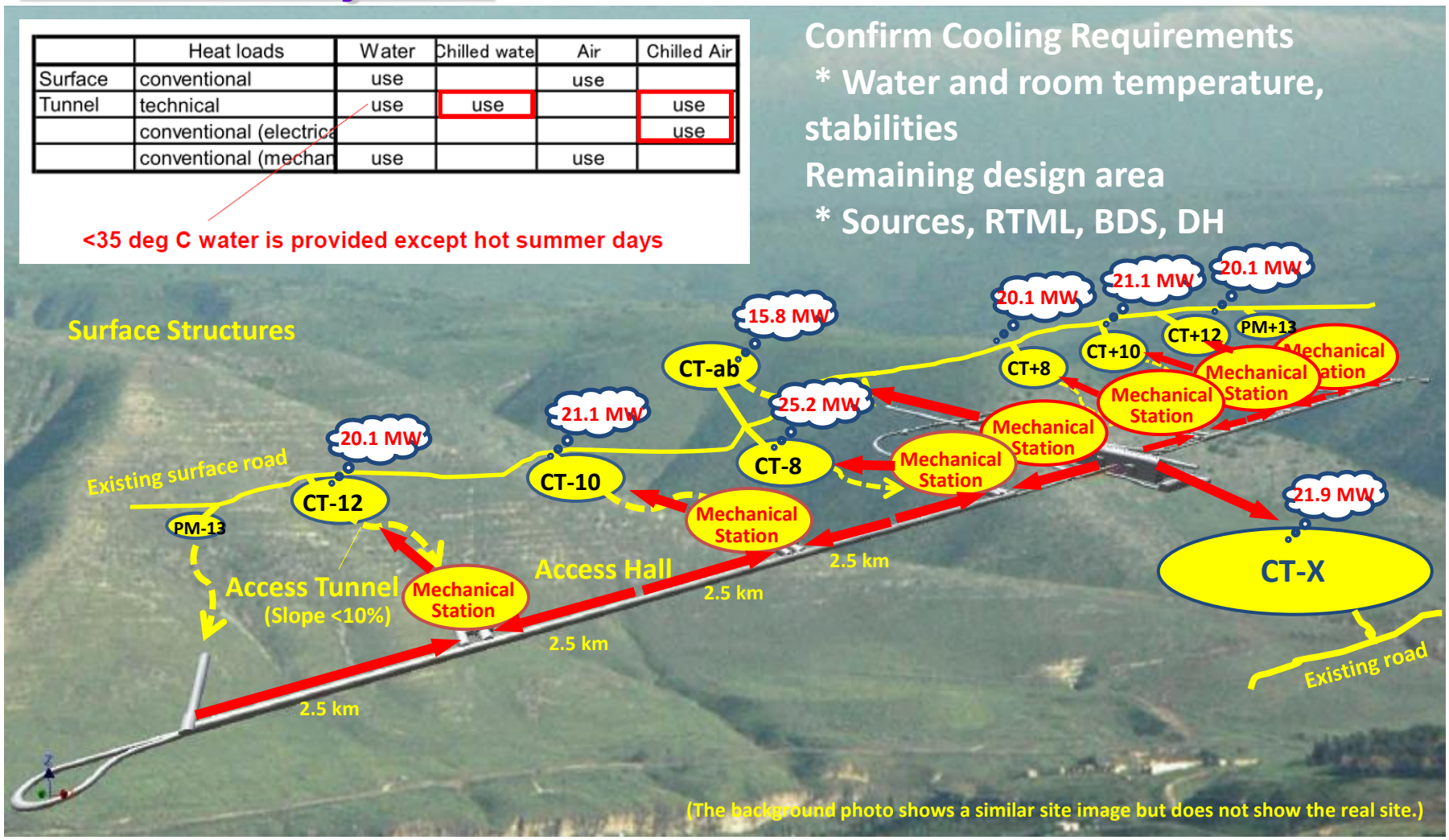
BACK

Mechanical System

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

<35 deg C water is provided except hot summer days

Confirm Cooling Requirements
* Water and room temperature, stabilities
Remaining design area
* Sources, RTML, BDS, DH



Heat Loads

- Heat loads for DKS MLs and CF s

Confirm heat loads
*** Response for machine design developments**
*** Site-specific conventional power**
- Temp, humid, access length, …

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

Area System	load to LCW	load to Air	Conventional	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

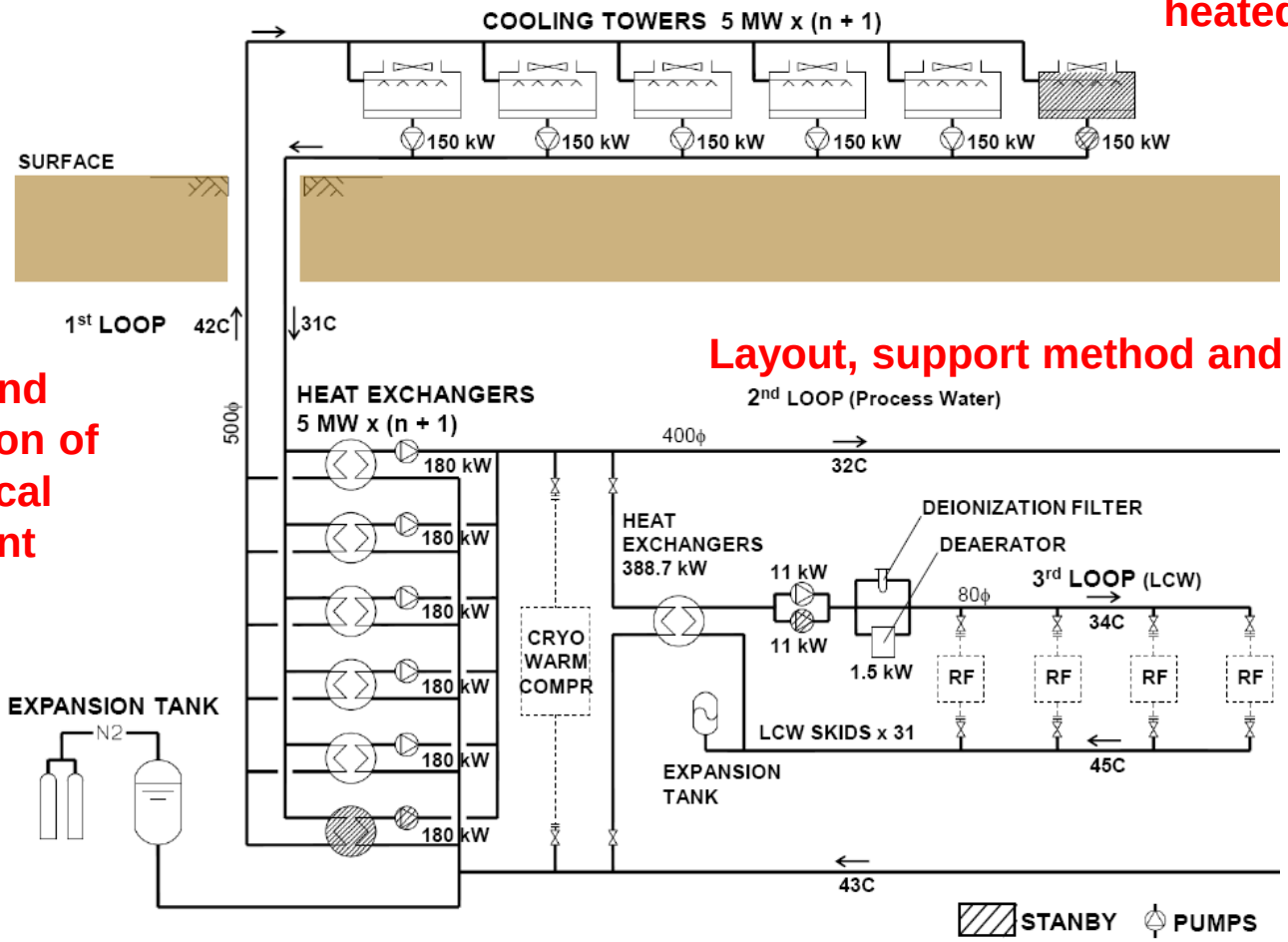
(Americas) 13.5 MW 154 MW

Process Cooling Water

Surface layout

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

Utilizing heated water



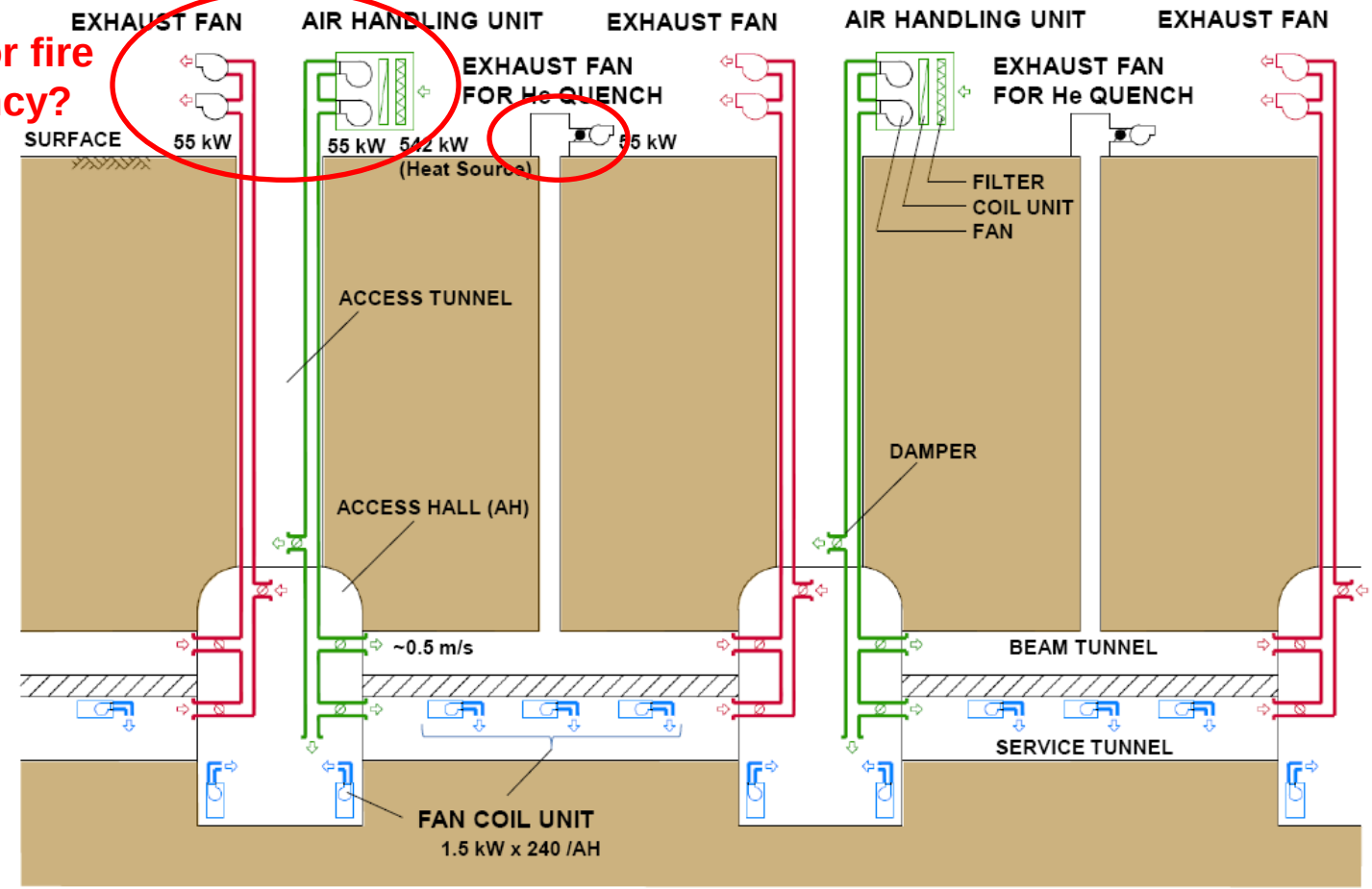
Layout, support method and schedule

Layout and installation of mechanical equipment

Air Treatment

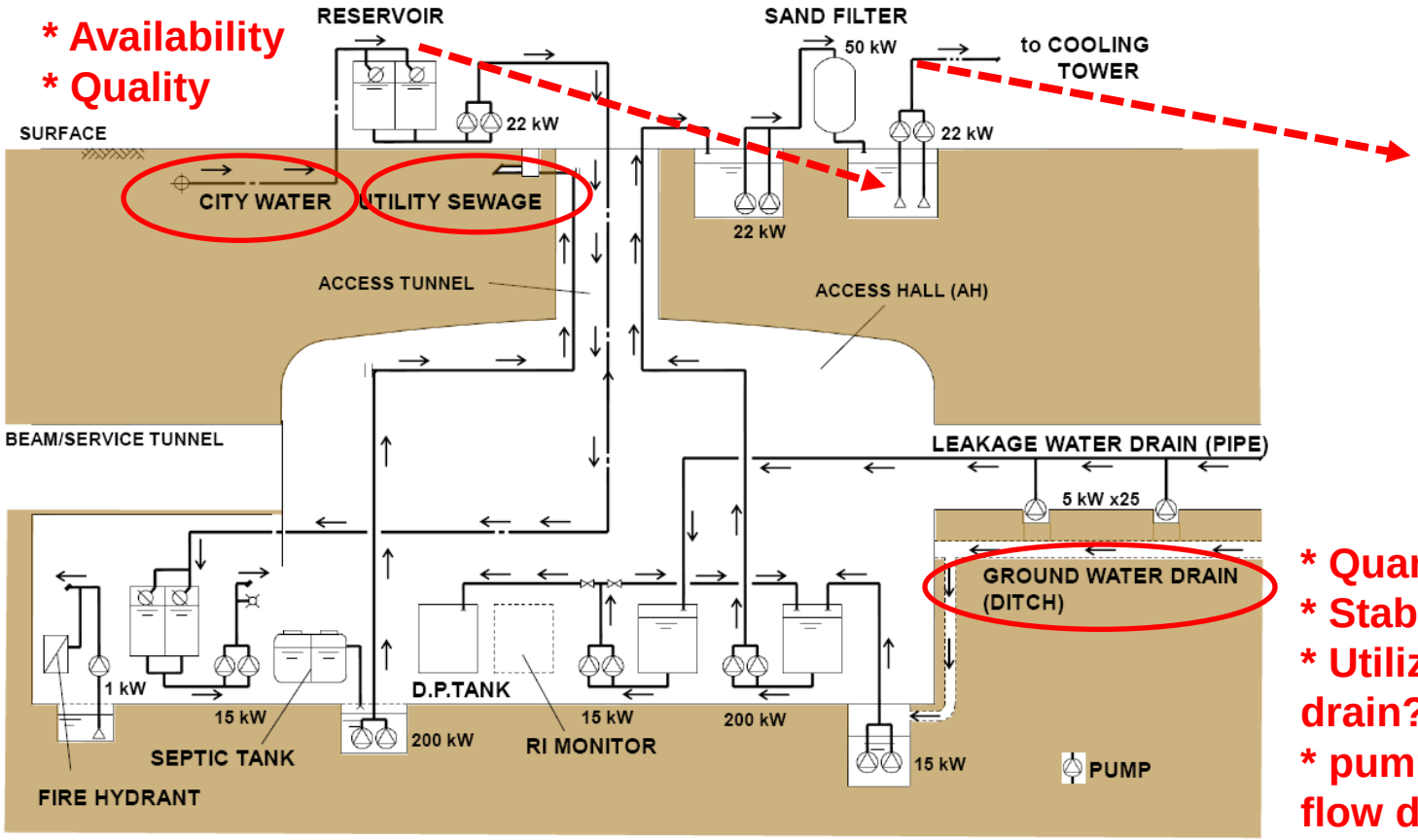
- *RDR-like Design for MLs (air flow rate ~0.5 m/s)*
- *Design not done for the central region, roughly cost-estimated .*

Loads for fire emergency?



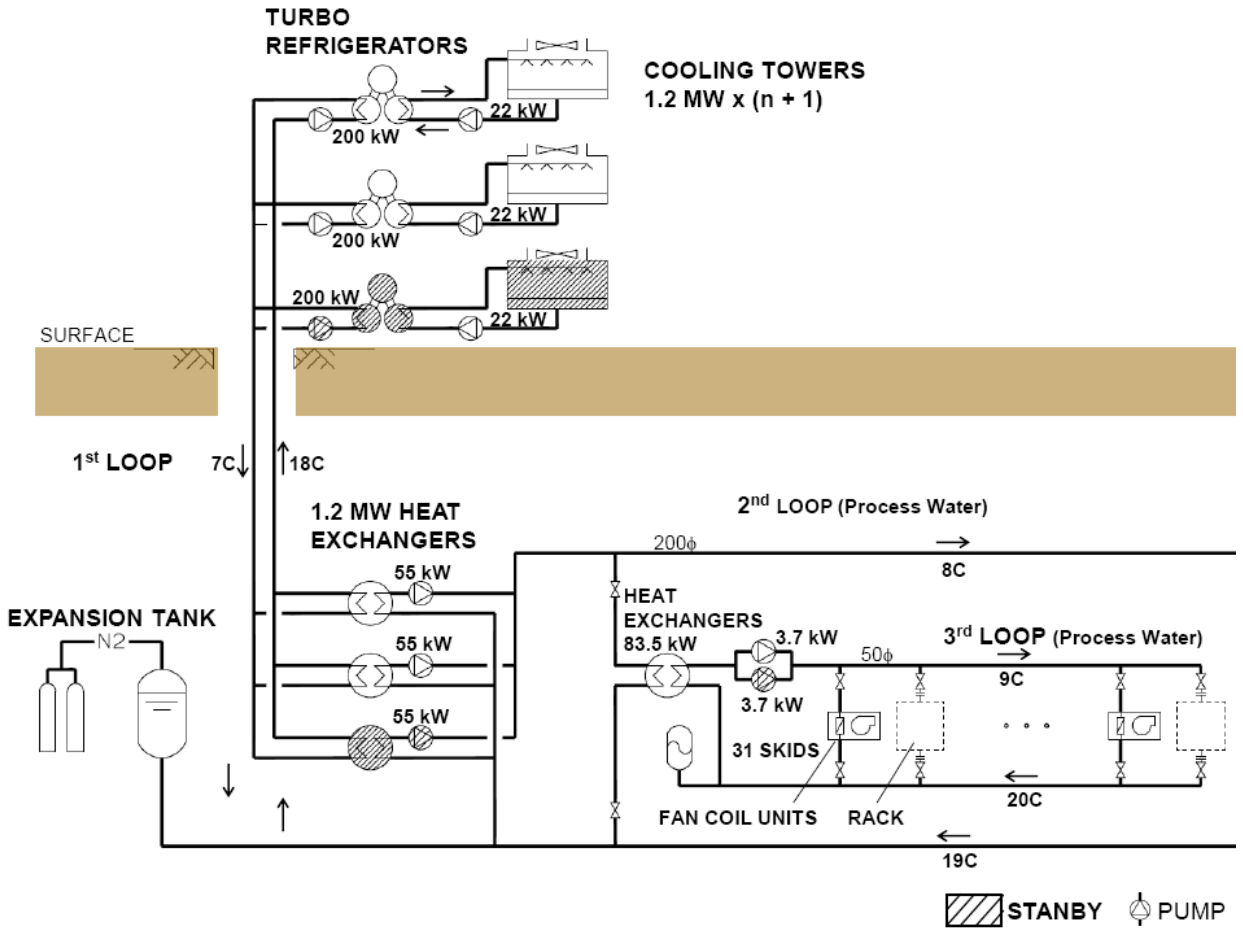
Piped Utilities

- *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 .*



Chilled Water

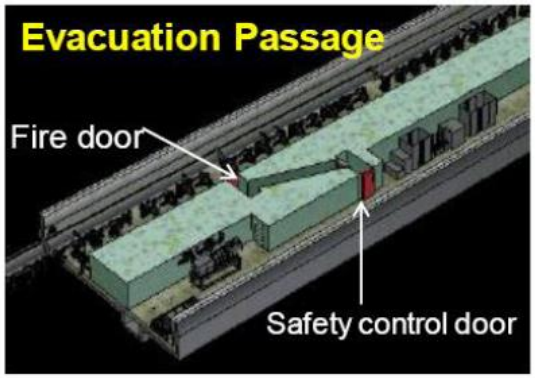
- *Heat loads for DKS-MLs and Site-specific Conventional system*
- *Design not done for the central region, roughly cost-estimated*

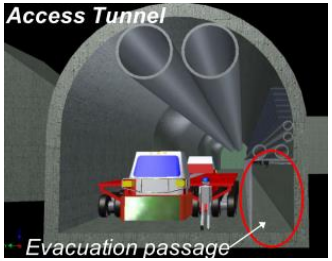


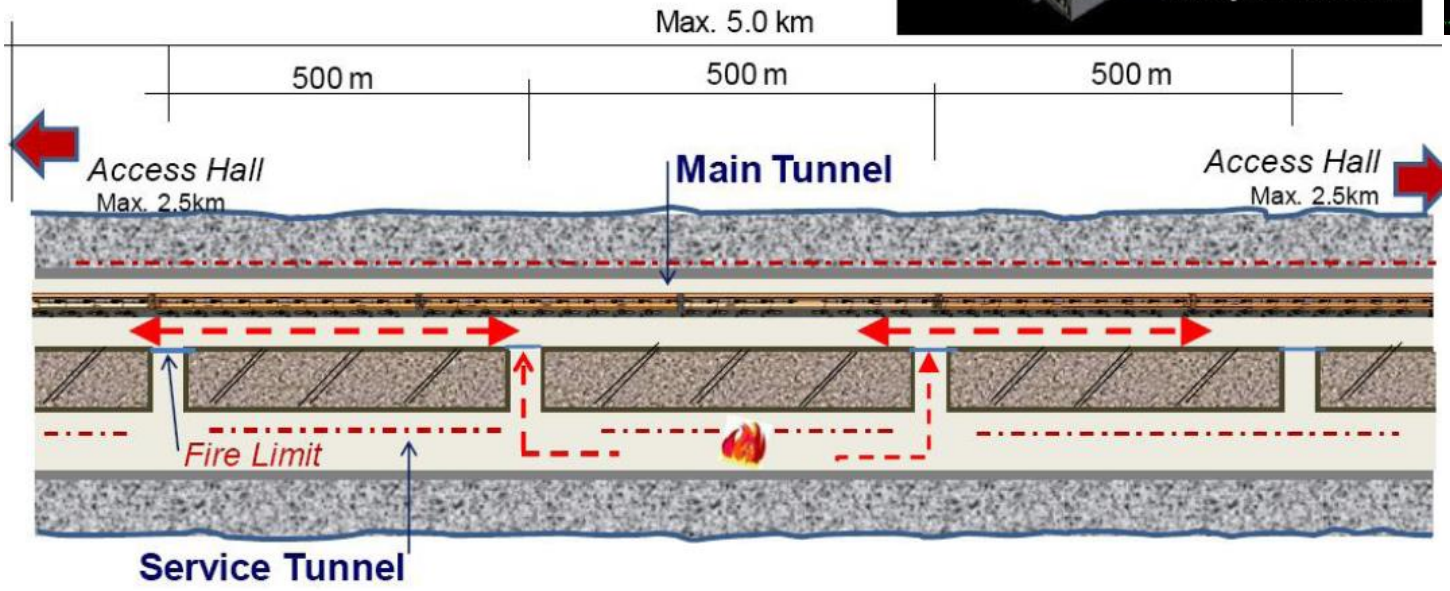
Safety

Evacuation Plan

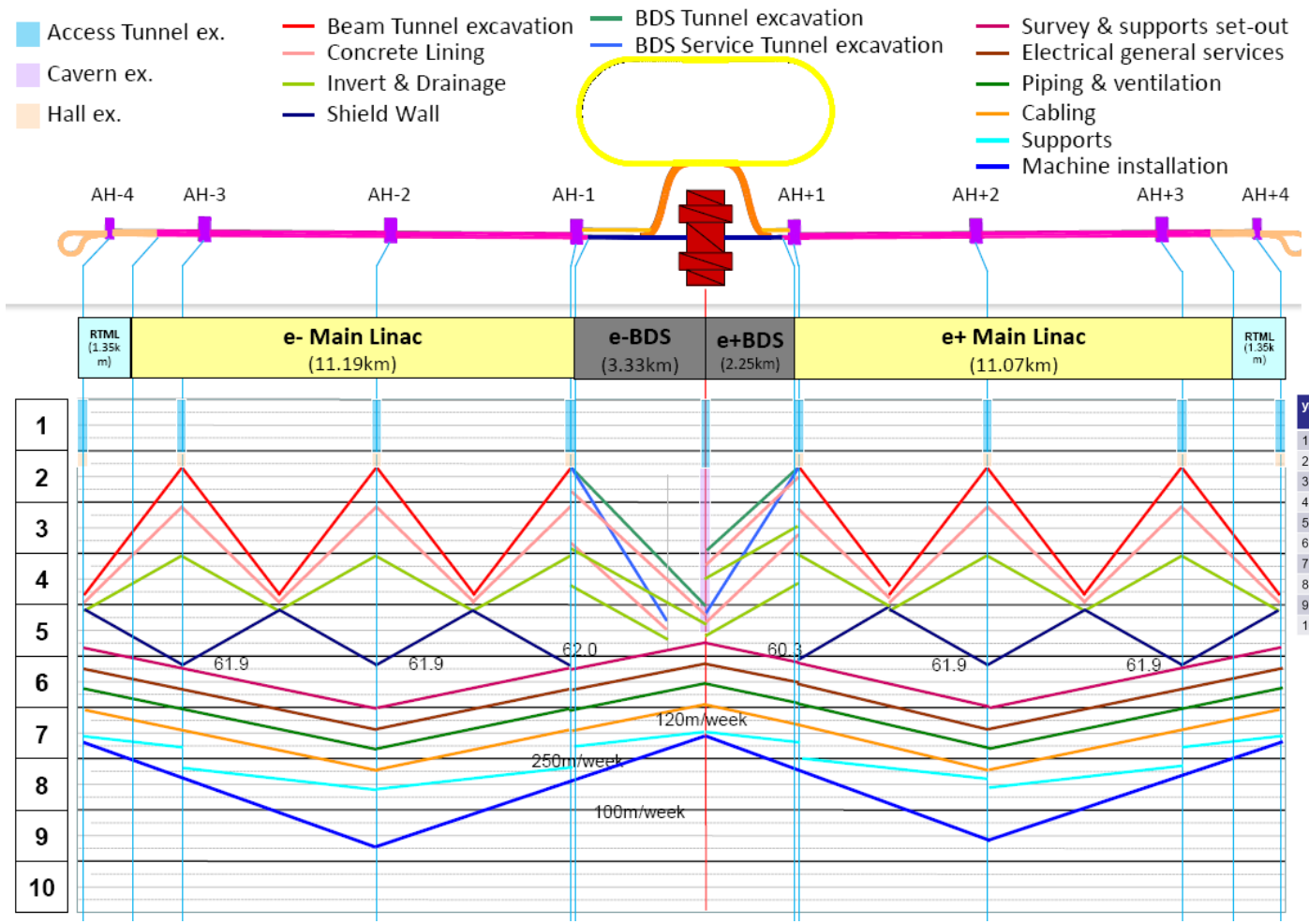
- In the case which the fire started in the service tunnel , we can take refuge in the Beam-tunnel.
- Evacuation in two directions is attained.



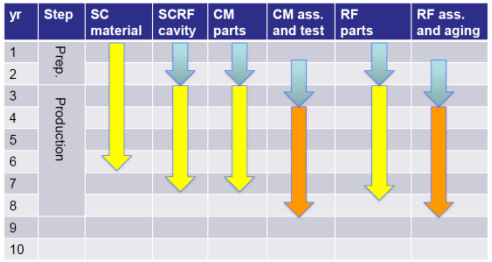




Construction Schedule



under discussion



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