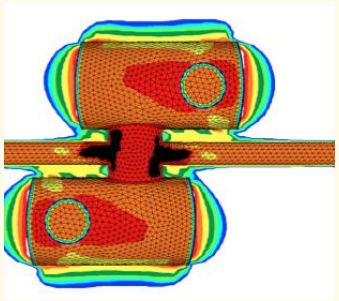
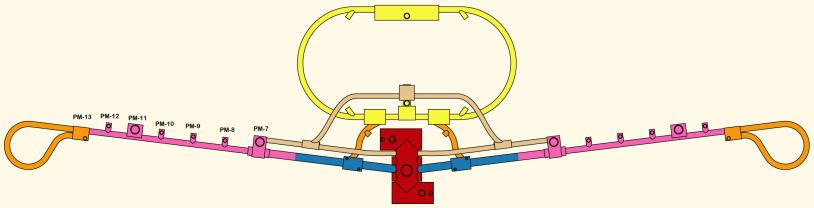
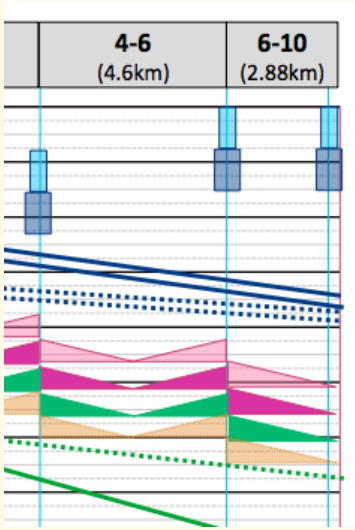
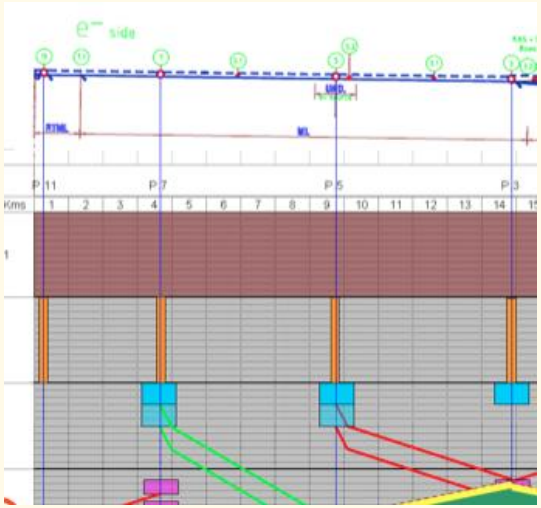




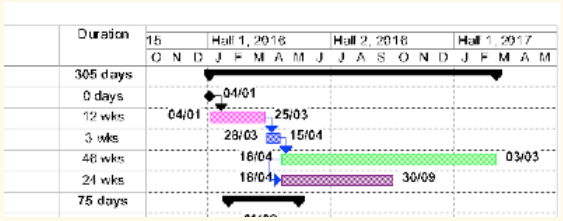


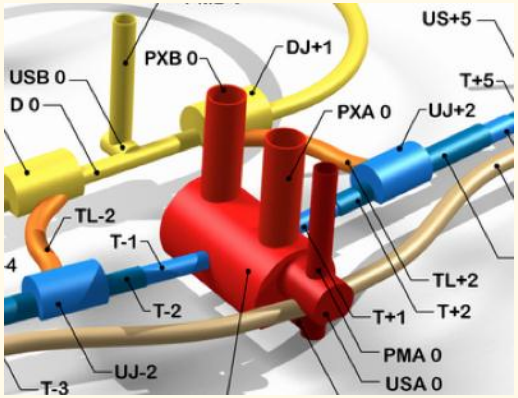
ILC Draft Project Schedule

Klycluster 500GeV



K Foraz & M Gastal





Many thanks to J Osborne, A Kosmicki, H Mainaud Durand, J Paterson for their help

Objectives and scope

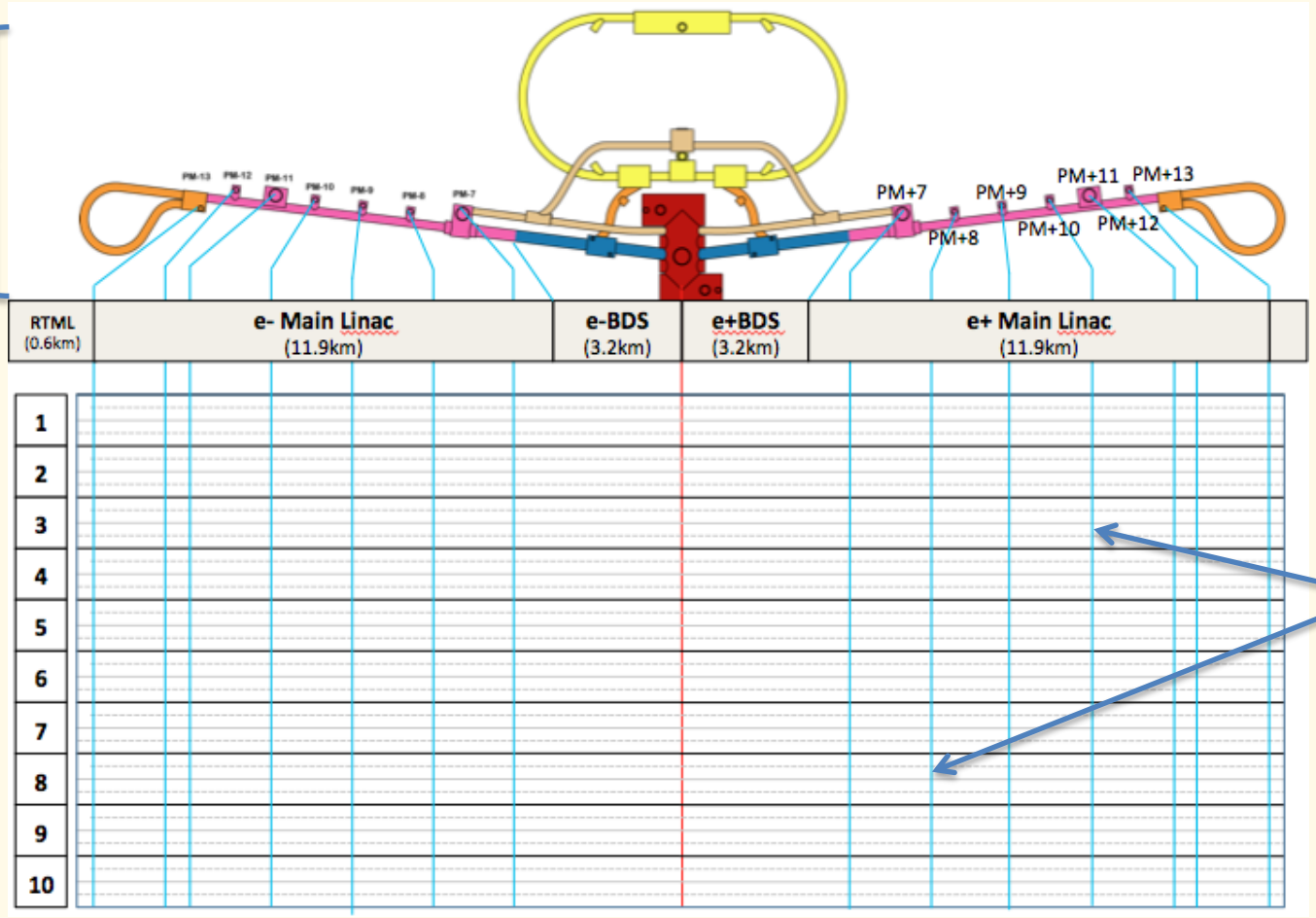
- To provide an update of the project schedule
  - Last revision, construction only, done in 2009 - Tsukuba meeting
  - Focus on the critical path
  - From excavation to commissioning of the facility
  - For European site primarily
  - Using LHC project construction data
  - Many parameters can be tuned and affect this draft scenario

- To integrate new data
  - Latest accelerator layout (March 14th 2012 – under approval)
  - ARUP studies for IR
  - Granada 2011 workshop
  - Draft ILC PIP (Project Implementation Planning)
  - Commissioning priorities

Schedule Format

→To follow work progress in time and space

ILC layout
(not to scale)



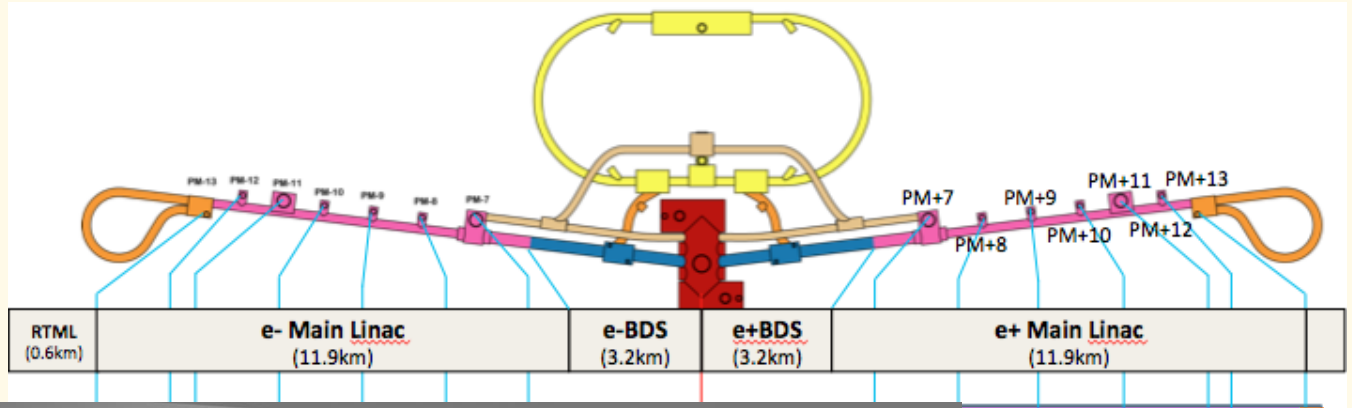
Shafts position

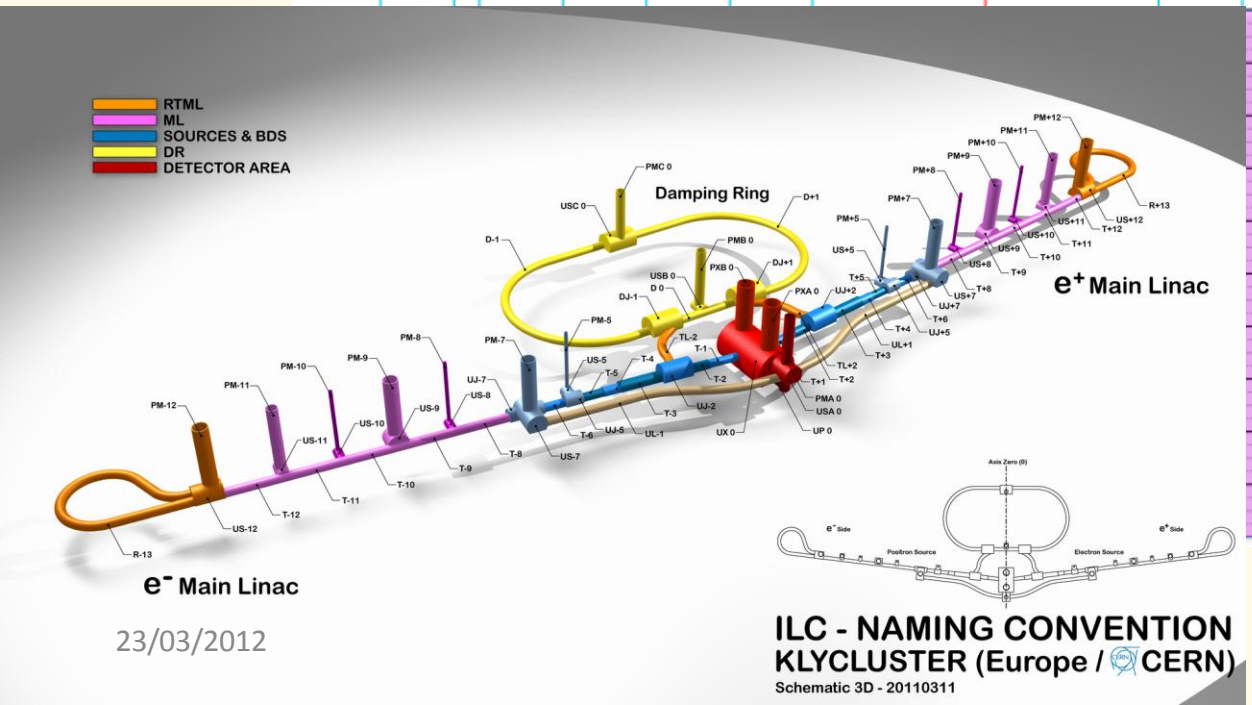
Distances (to scale)

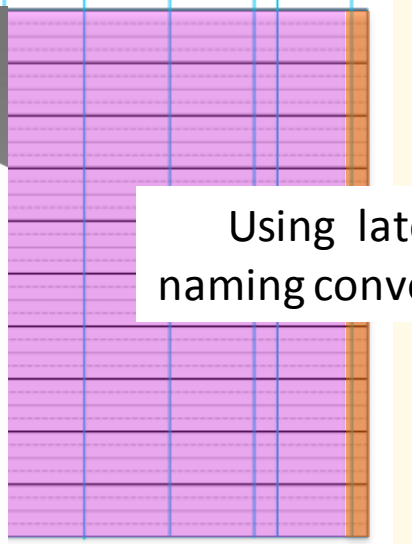
30,978m

Schedule Format

→To follow work progress in time and space



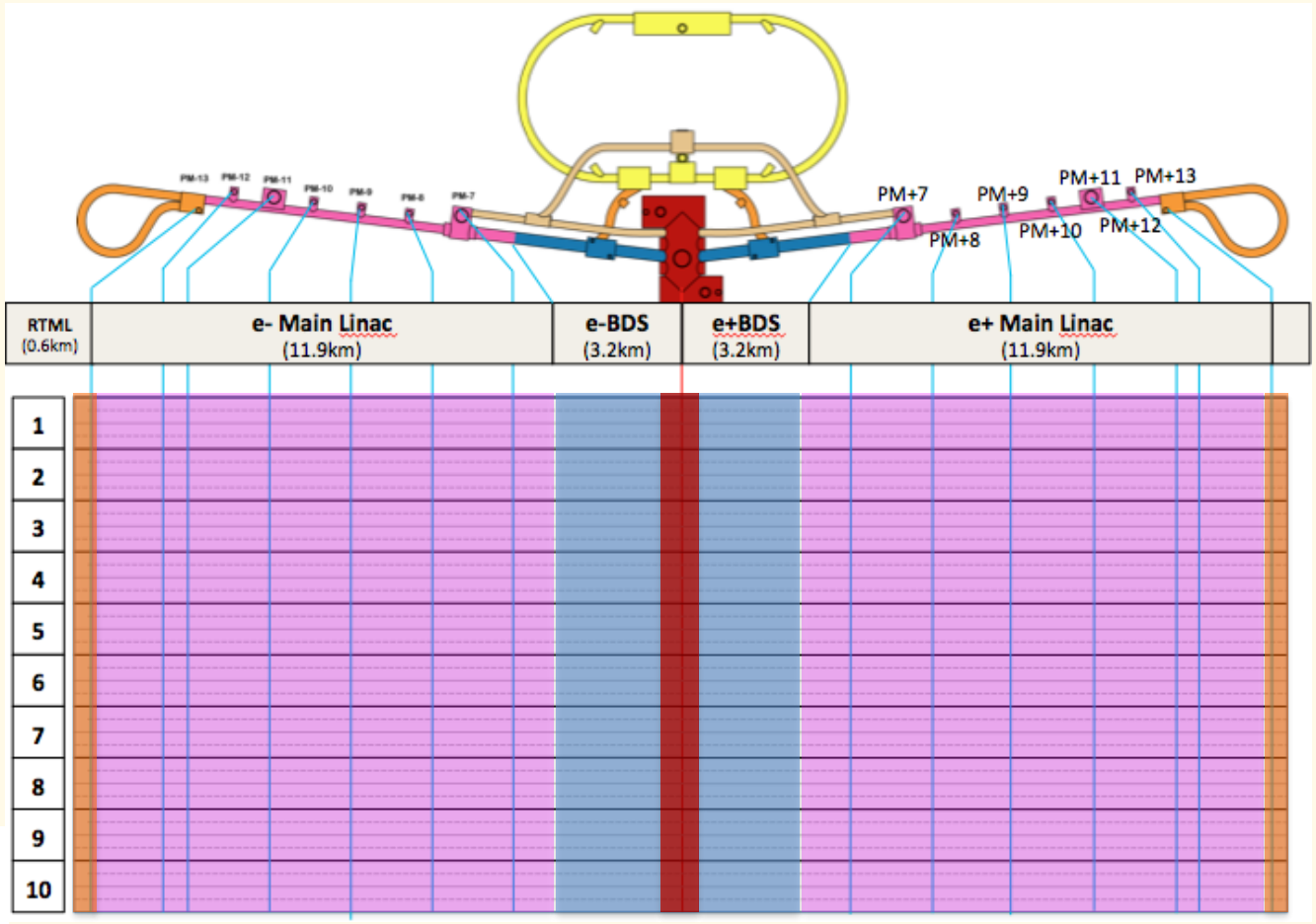




Using latest naming convention

Schedule Format

→To follow work progress in time and space

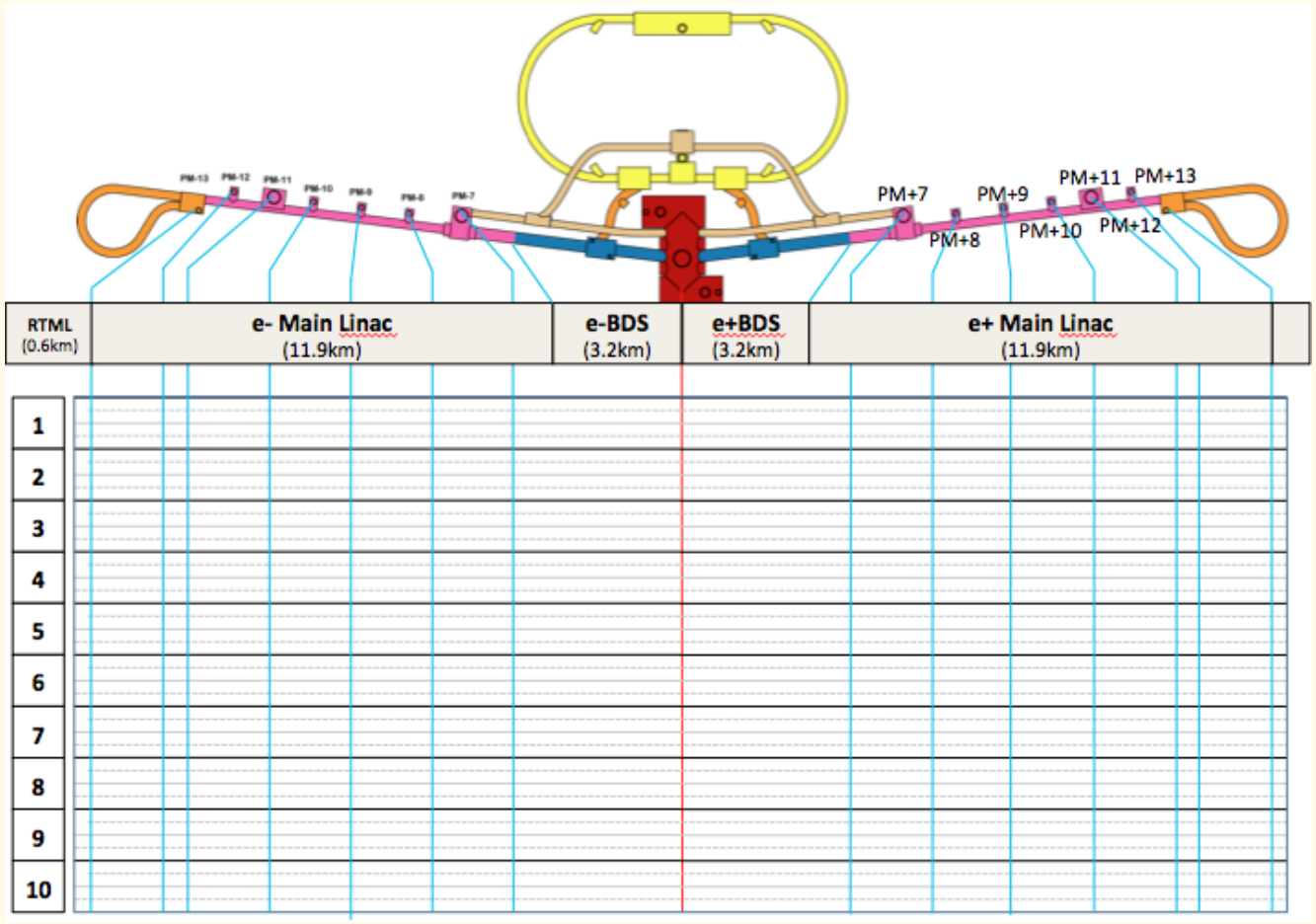


Only for
IR, BDS,
ML & RTML

Schedule Format

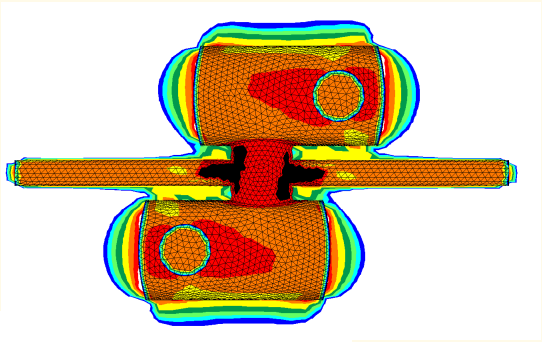
→To follow work progress in time and space

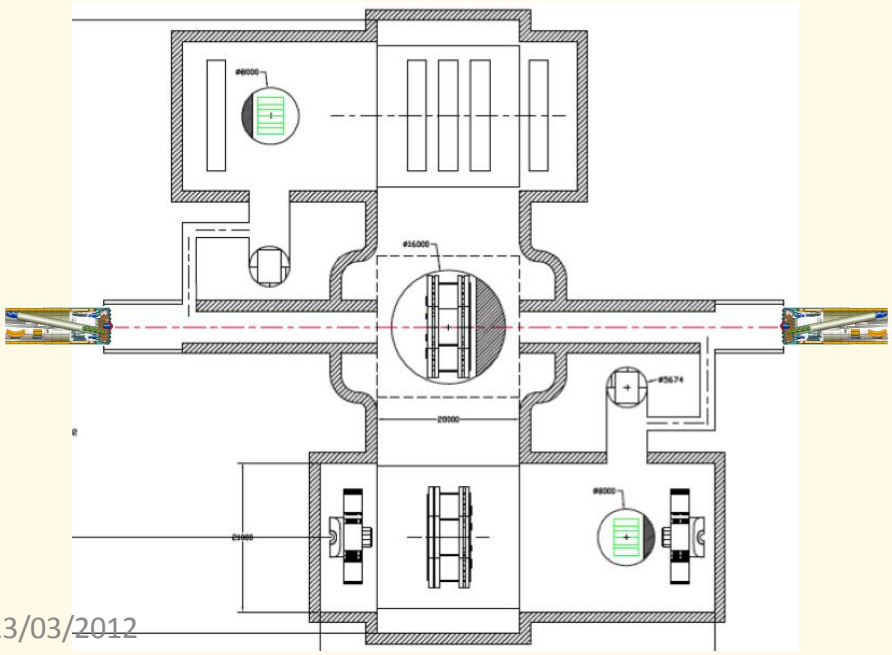
Time line
In years

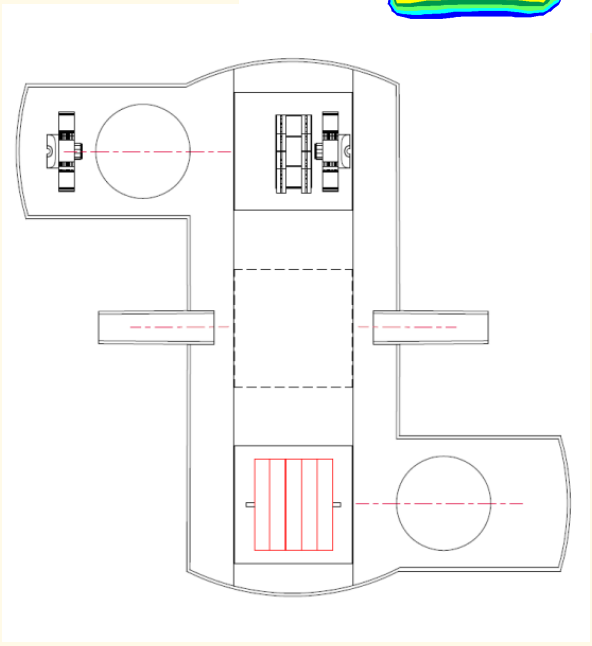


Strategic aspects

- → Result of the ARUP/J Osborne studies recommends minimising stress concentration on the IP by excavating and finishing the interaction cavern before tackling the tunnels and service caverns
- → TBMs launched from adjacent shafts (PM7) and extracted from an IR shaft
  - → Allows time for finishing of IR cavern
- → Recommendations were made for CLIC IR
- → Compatible with both the 2 and 3 shaft IR layouts





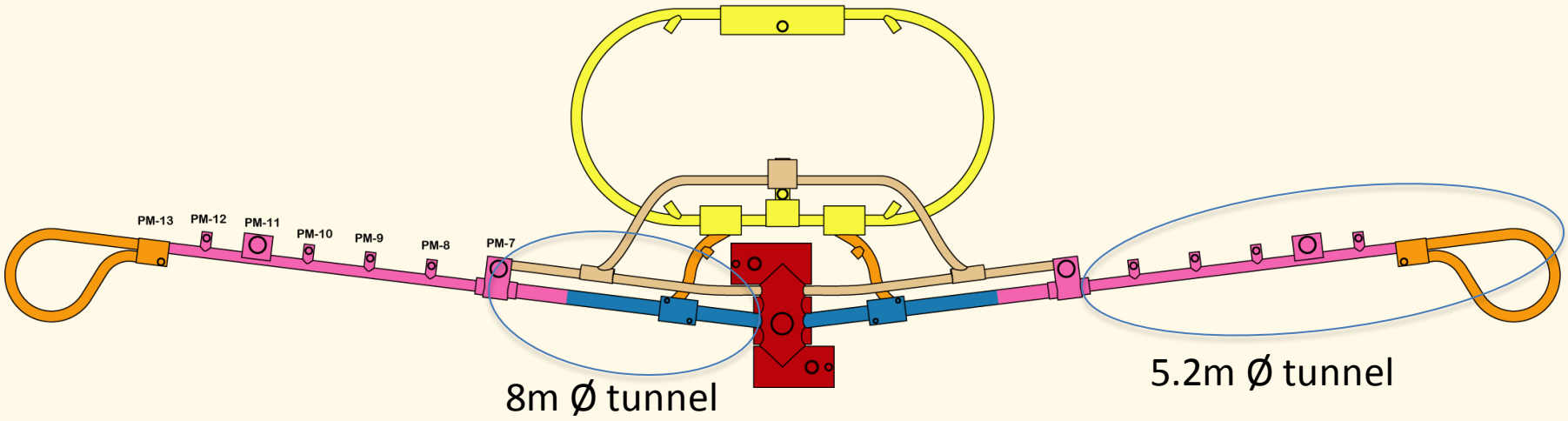


Strategic aspects

→ The BDS tunnel and part of the main linac have a diameter of 8m

→ To minimise cost and speed up excavation

→ The rest of the main linac consists of 5.2m diameter tunnel



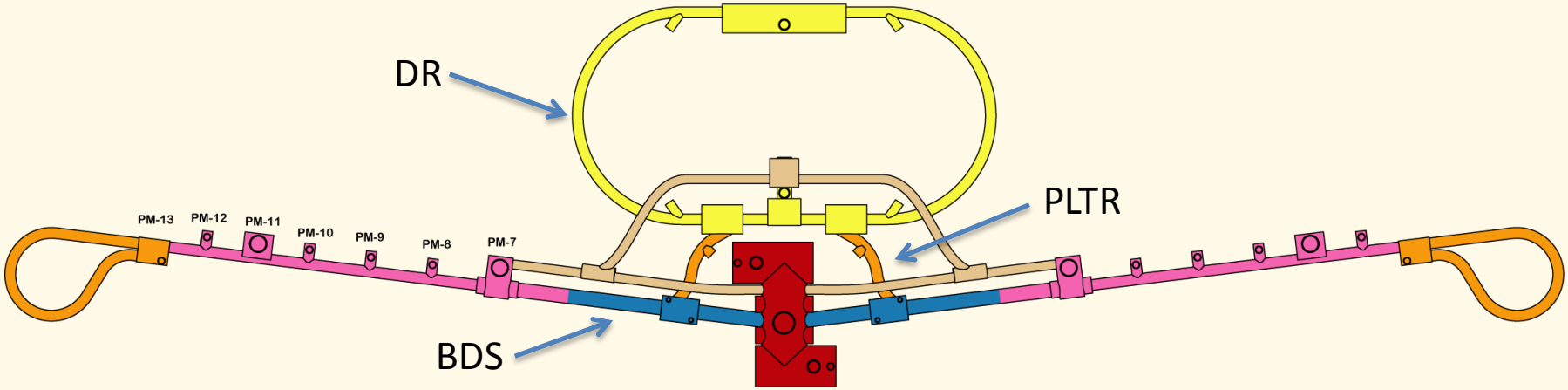
→ TBMs cannot be refurbished to accommodate both tunnel sizes

→ 2 different machines have to be used

→ We are now looking at a 4 TBM scenario in DBS, ML, RTML (2x5.2 + 2x8)

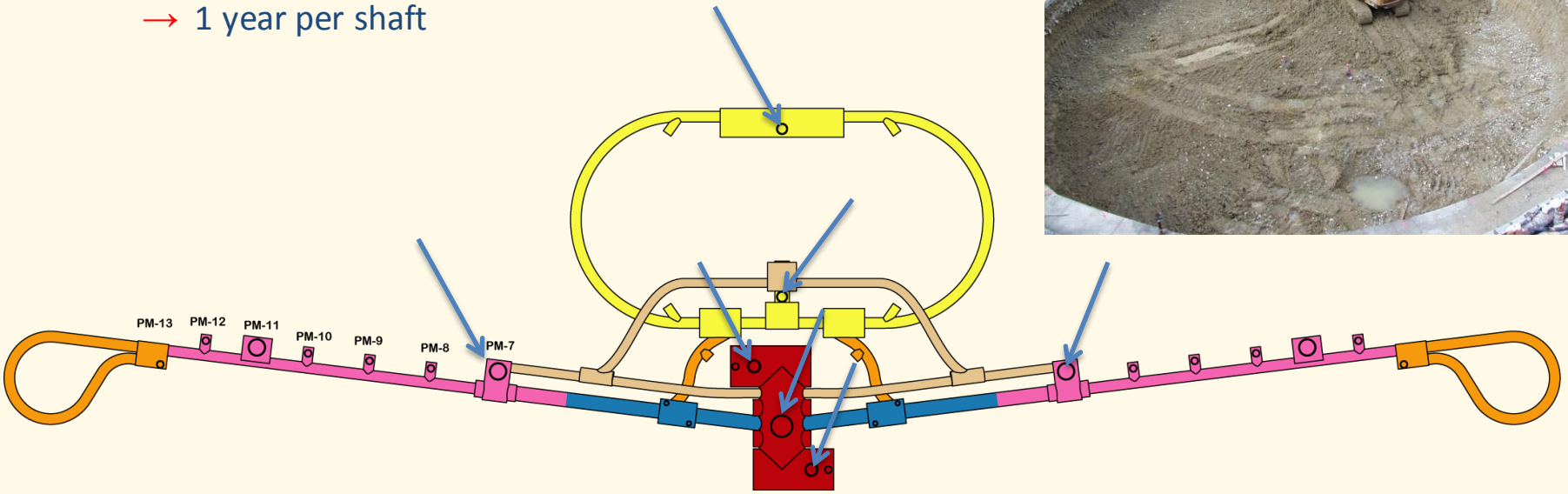
Strategic aspects

- → Requests for early commissioning will set priorities for the delivery of parts of the ILC complex
- → When designing the construction schedule, an attempt was made to deliver some components as early as possible:
  - → Damping Rings
  - → PLTR
  - → BDS & ML up to PM7
- → An attempt to design a detailed schedule of the commissioning period will be shown



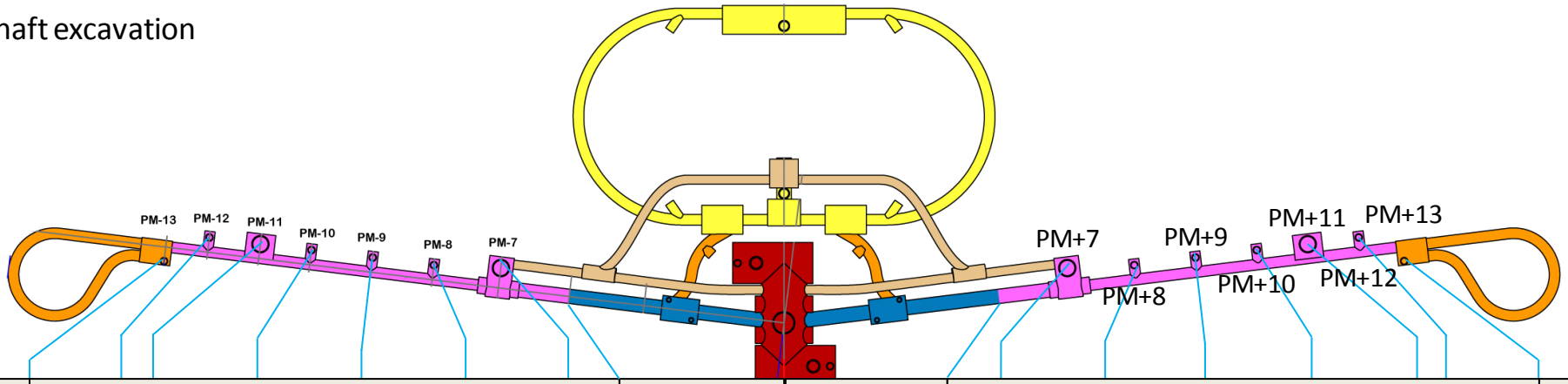
Year 1 – Construction kick-off

- → Excavation of shafts in parallel
  - → IR: PX0, PXA0, PXB0
  - → ML: PM+7, PM-7
  - → DR: PMA0, PMB0
  - → 1 year per shaft



- → Launch construction of detector assembly halls on the surface
- → Launch construction of service buildings

Shaft excavation



RTML (0.6km)	e- Main Linac (11.9km)	e-BDS (3.2km)	e+BDS (3.2km)	e+ Main Linac (11.9km)

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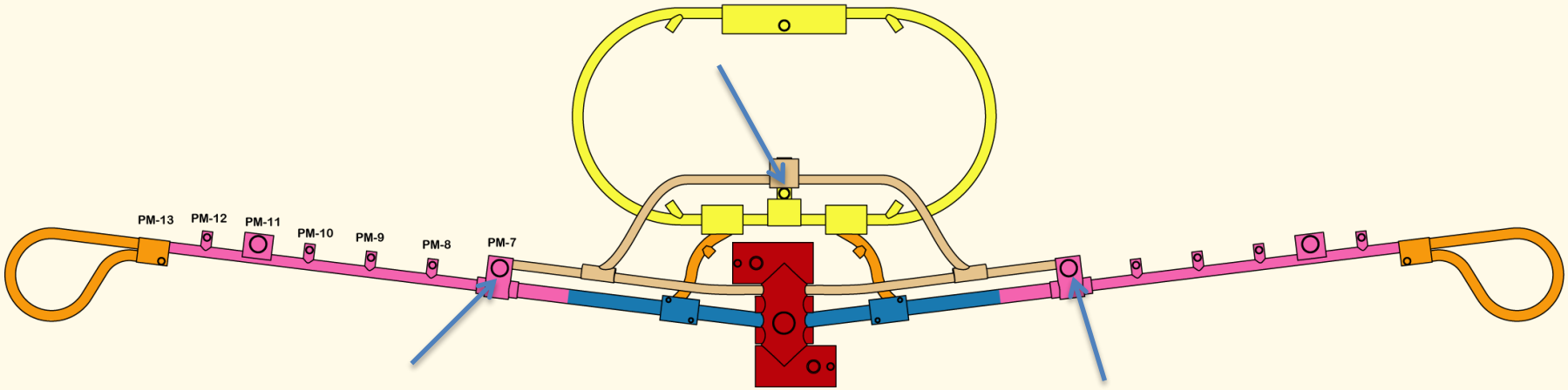
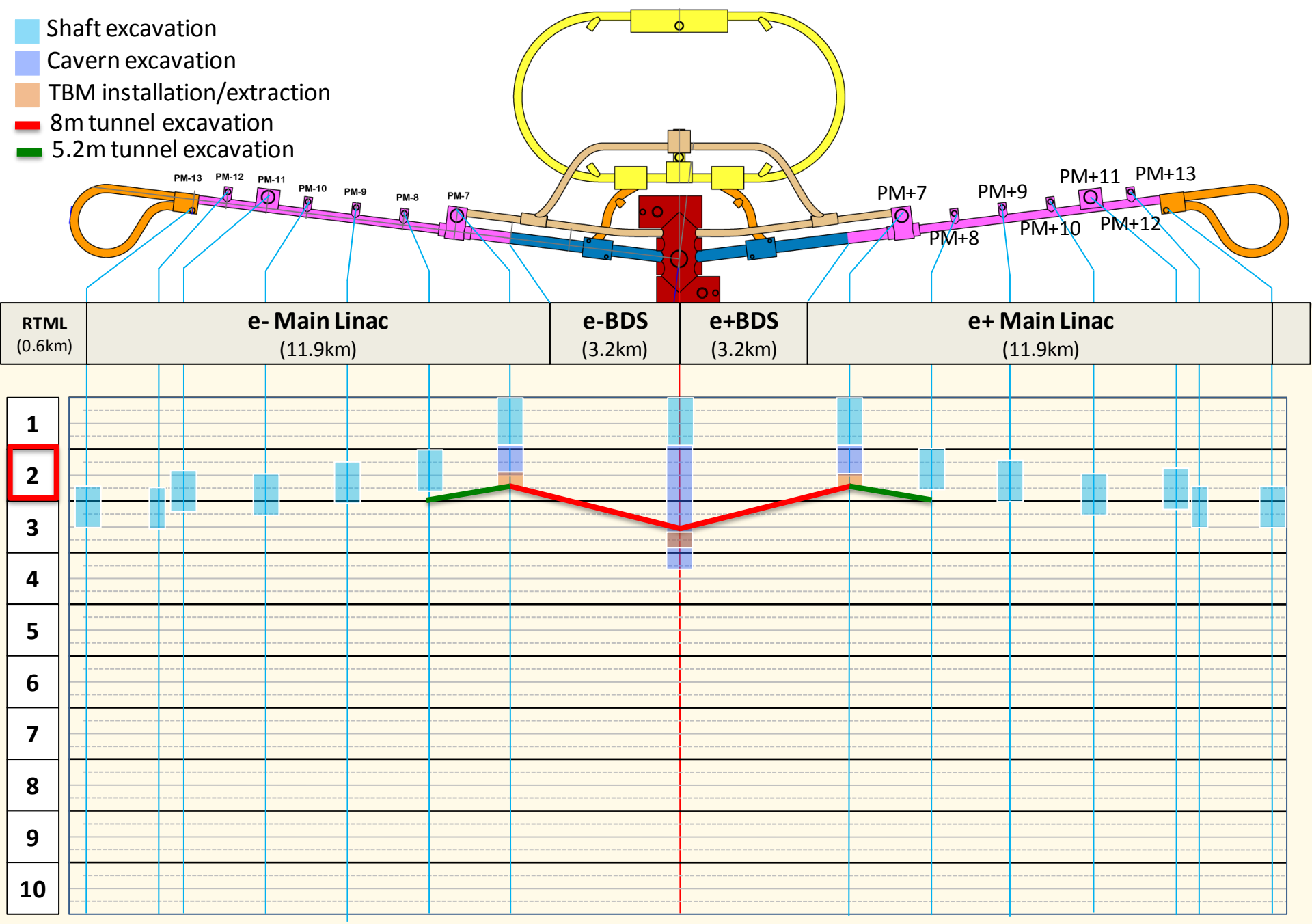
Year 2 – Tunneling

- Tunneling has to start in various parts of the facility
  - Shafts excavation of PM8,9,10,11,12,13
  - Shaft based caverns have to be excavated (IR cavern, US-7, US+7, USB0)
  - Two 8m diameter TBMs: ML + BDS
  - Two 5.2m diameter TBMs: ML
  - One 5.2m diameter TBM: DR



- Progress rates for European site:
  - 8m: 100m/w (3 shifts)
  - 5.2m: 150m/w (3 shifts)


Shaft excavation
Cavern excavation
TBM installation/extraction
8m tunnel excavation
5.2m tunnel excavation
PM-13
PM-12
PM-11
PM-10
PM-9
PM-8
PM-7
PM+7
PM+8
PM+9
PM+10
PM+11
PM+12
PM+13
RTML
(0.6km)
e- Main Linac
(11.9km)
e-BDS
(3.2km)
e+BDS
(3.2km)
e+ Main Linac
(11.9km)
1
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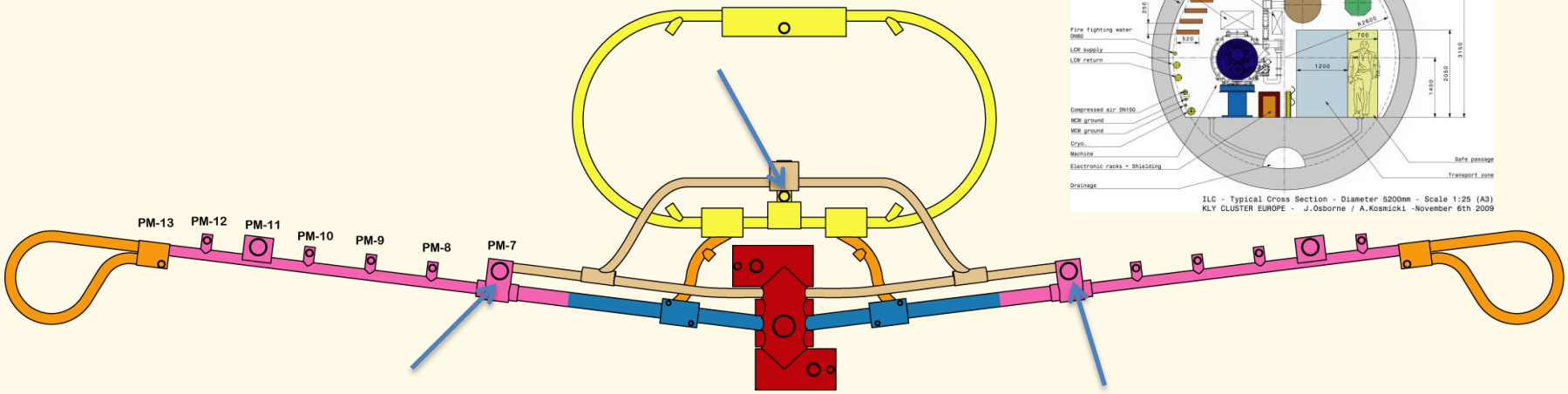
Year 3 – Tunneling, finishing, ceiling ducts

→ Tunneling will proceed in BDS, ML and DR

→ Spoil to be evacuated through PM8

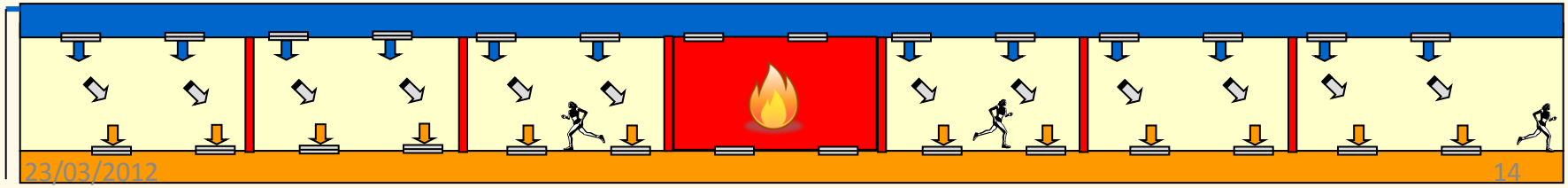
→ Invert concreting and tunnel finishing will start as soon as spoil management allows

→ Progress rate: 50m/d for 3 shifts



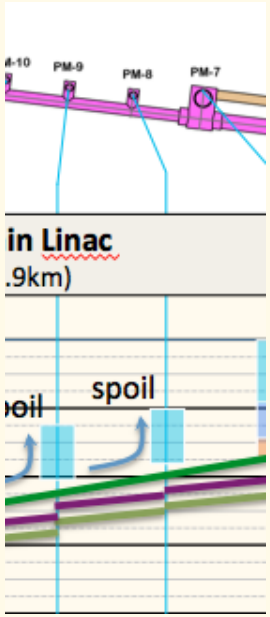
→ Ceiling ducts for fire safety purposes

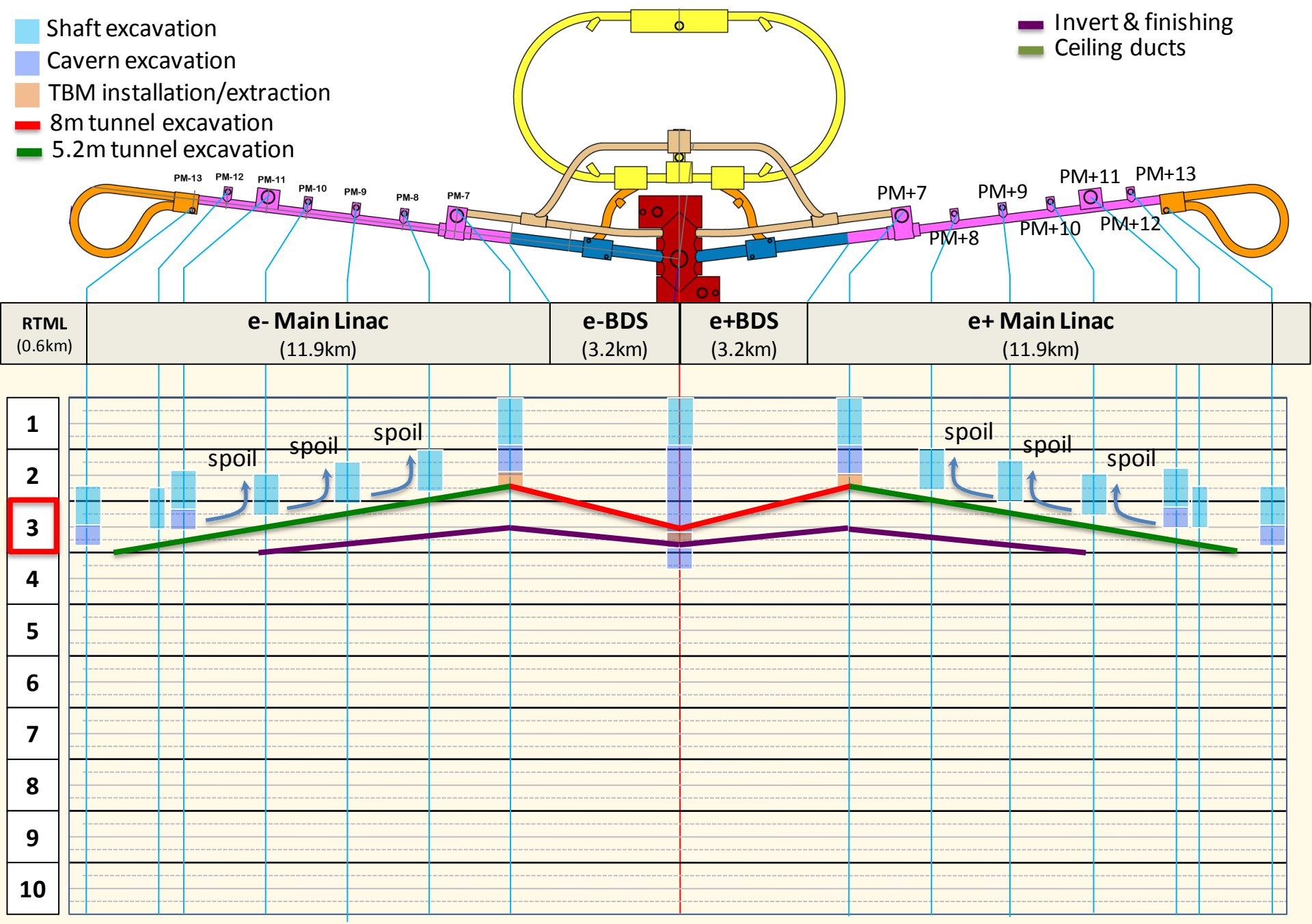
→ Progress rate: 50m/d for 3 shifts



Spoil Management

→Work in a tunnel section, e.g. T-8, can only start once the conveyor belt evacuating the spoil produced by the TBM is redirected to the nearest shaft




Shaft excavation
Cavern excavation
TBM installation/extraction
8m tunnel excavation
5.2m tunnel excavation
Invert & finishing
Ceiling ducts
PM-13
PM-12
PM-11
PM-10
PM-9
PM-8
PM-7
PM+7
PM+8
PM+9
PM+10
PM+11
PM+12
PM+13
RTML (0.6km)
e- Main Linac (11.9km)
e-BDS (3.2km)
e+BDS (3.2km)
e+ Main Linac (11.9km)
spoil
spoil
spoil
spoil
spoil
spoil
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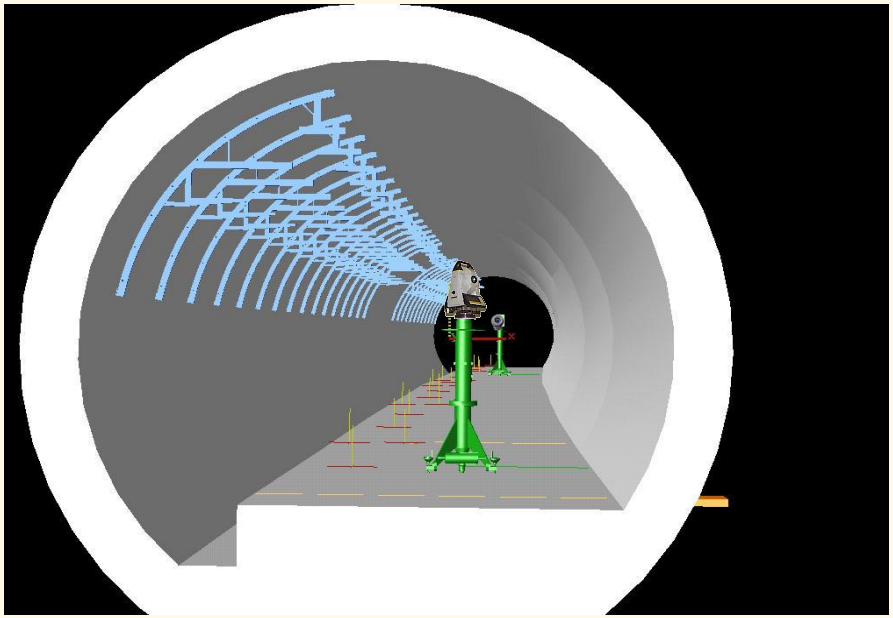
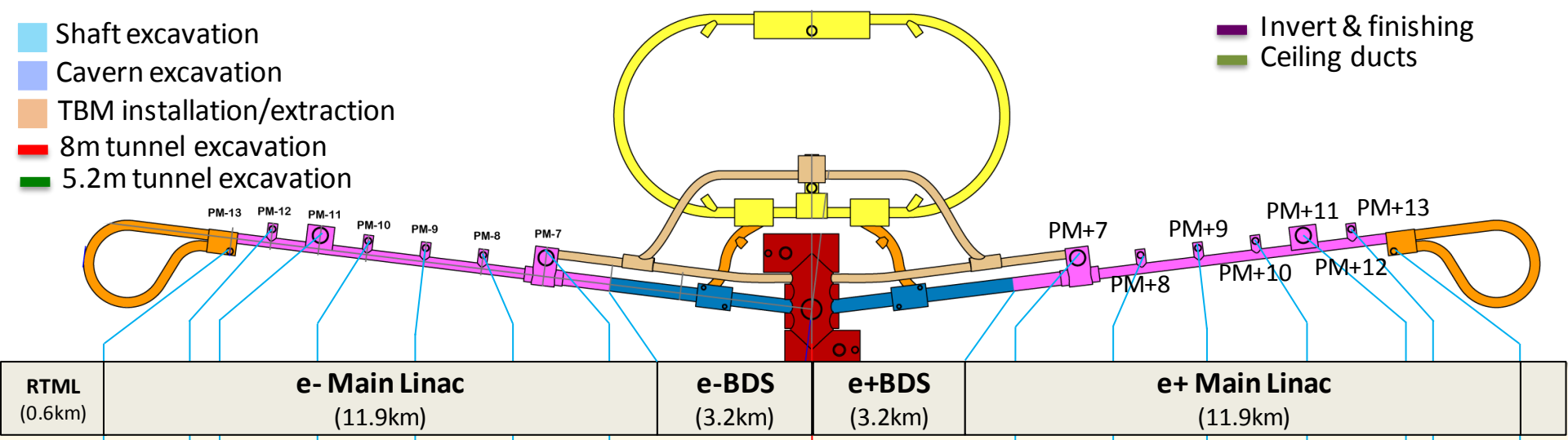
Year 4 – End of CE, start of infrastructure installation

- → End of CE phase
  - → BDS: Q2 ; ML: Q4 ; RTML: Q4
- → Start of infrastructure installation
  - → **Survey and set out of components supports**
  - → Electrics General Services
  - → Piping and ventilation
  - → Cabling

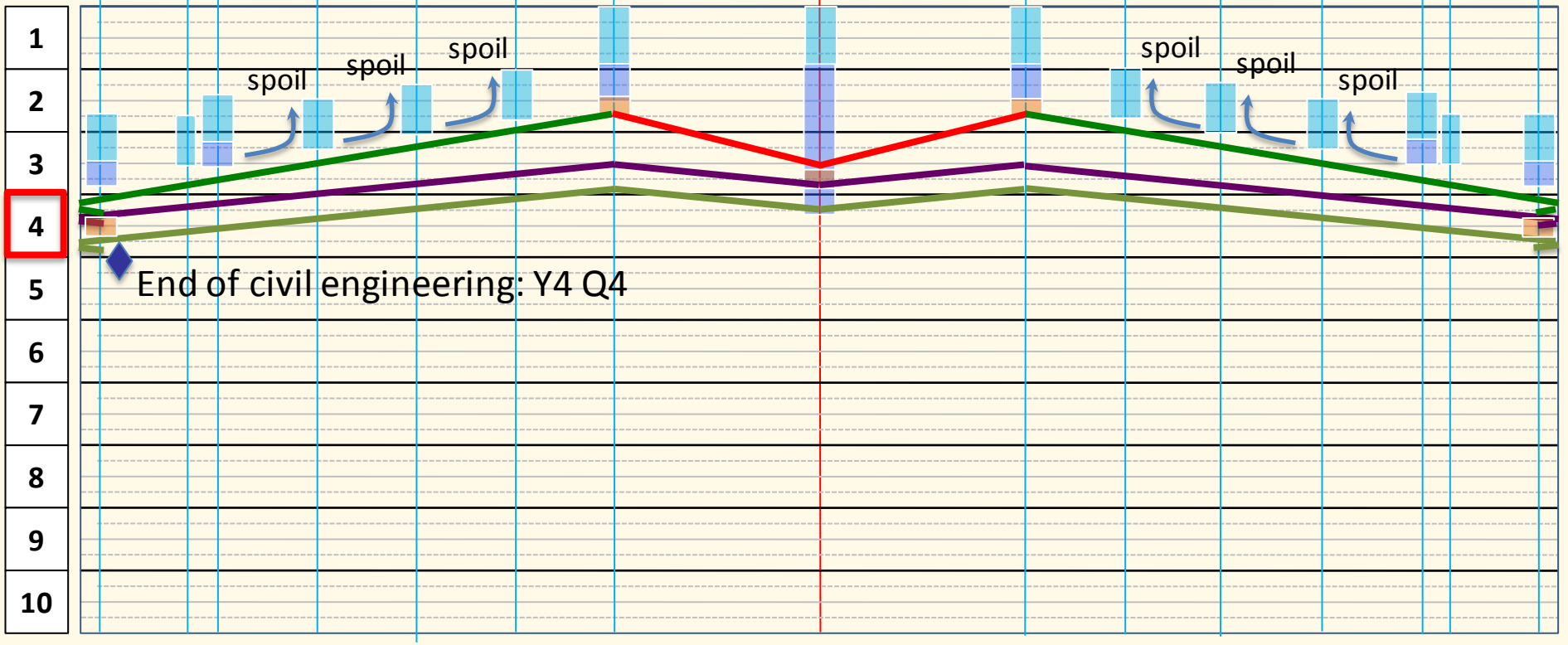
Progress rate 120m/w for 1 shift

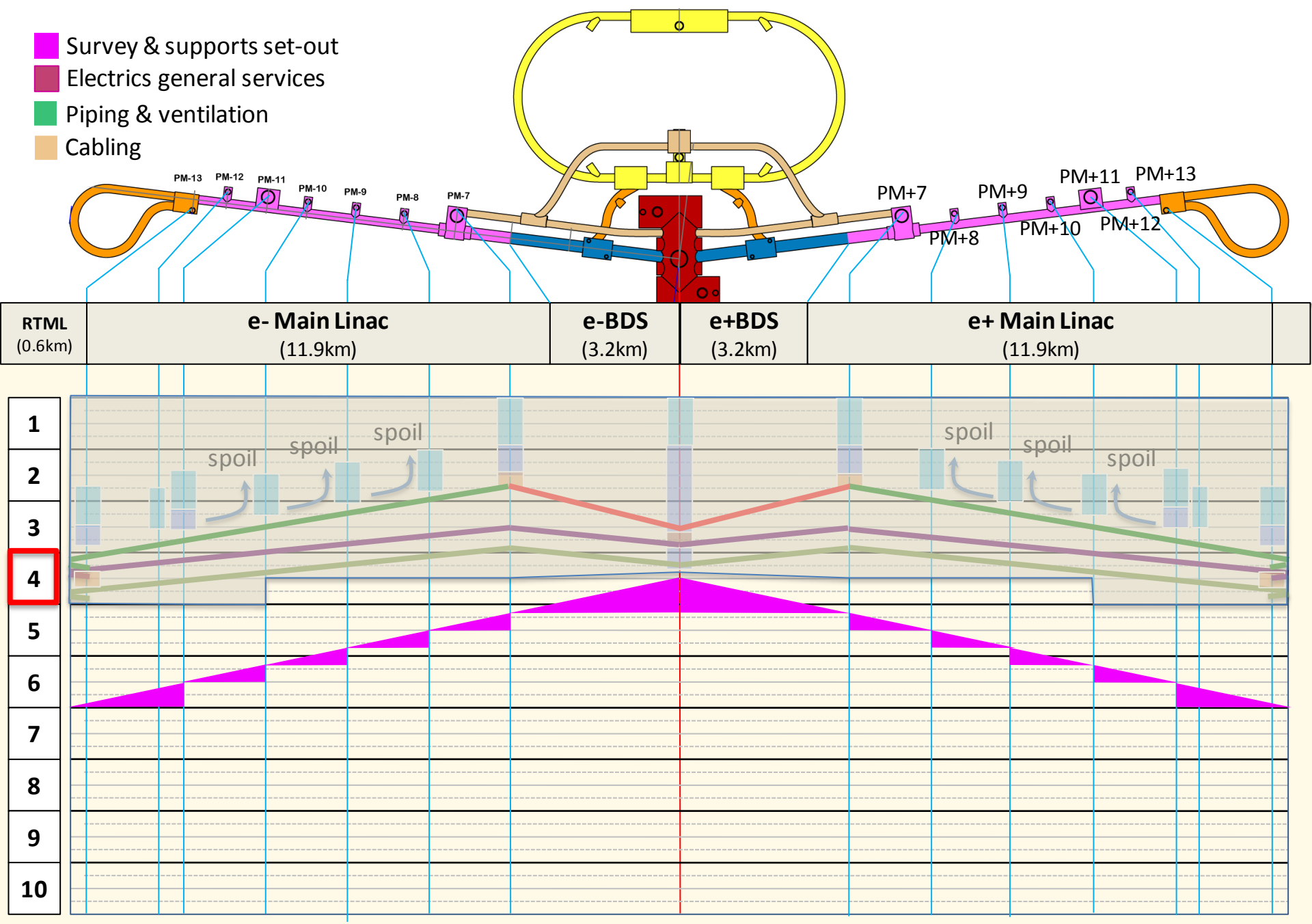


Courtesy of BE-ABP-SU



RTML (0.6km)	e- Main Linac (11.9km)	e-BDS (3.2km)	e+BDS (3.2km)	e+ Main Linac (11.9km)




Survey & supports set-out
Electrics general services
Piping & ventilation
Cabling
PM-13
PM-12
PM-11
PM-10
PM-9
PM-8
PM-7
PM+7
PM+8
PM+9
PM+10
PM+11
PM+12
PM+13
RTML
(0.6km)
e- Main Linac
(11.9km)
e-BDS
(3.2km)
e+BDS
(3.2km)
e+ Main Linac
(11.9km)
spoil
spoil
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spoil
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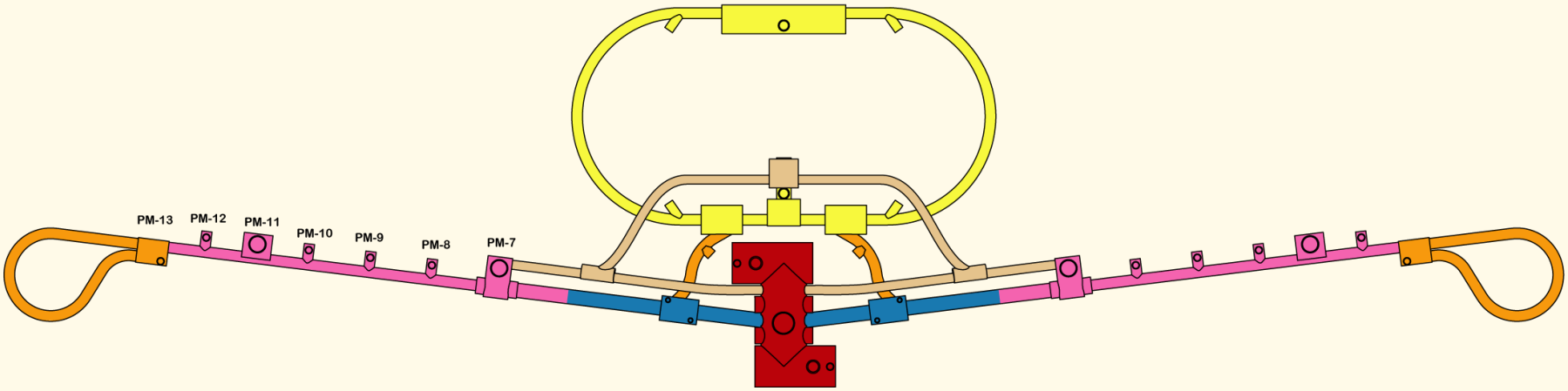
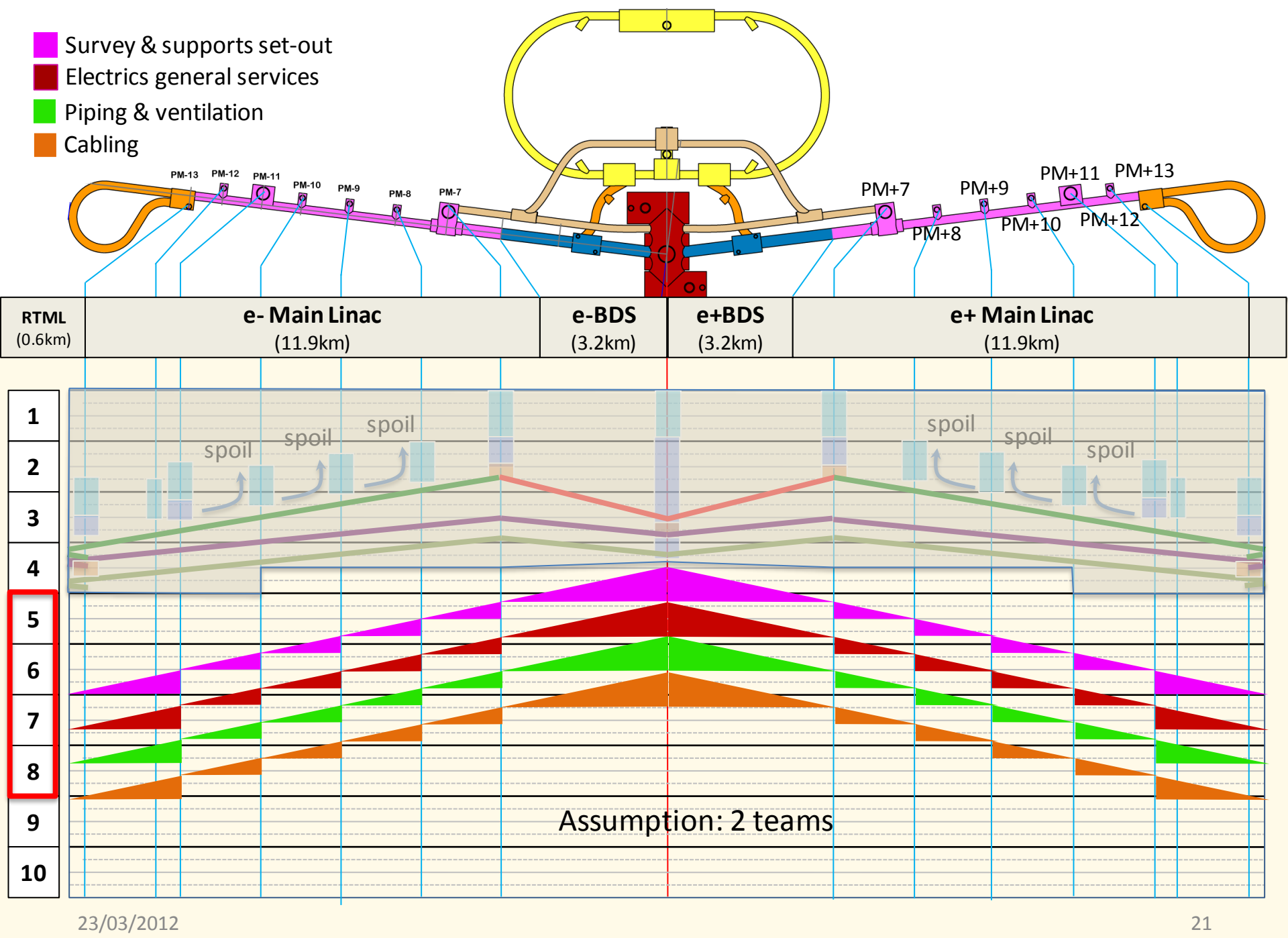
Year 5 6 7 8– Getting ready for machine components installation

→ Installation of infrastructure
- → Survey and set out of components supports
- → Electrics General services
- → Piping and ventilation
- → Cabling

Progress rate 120m/w for 1 shift



→ Impact of the number of teams deployed is significant
- → Baseline: 2 teams
- → Option: 4 teams


Survey & supports set-out
Electrics general services
Piping & ventilation
Cabling
PM-13
PM-12
PM-11
PM-10
PM-9
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PM-7
PM+7
PM+8
PM+9
PM+10
PM+11
PM+12
PM+13
RTML (0.6km)
e- Main Linac (11.9km)
e-BDS (3.2km)
e+BDS (3.2km)
e+ Main Linac (11.9km)
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spoil
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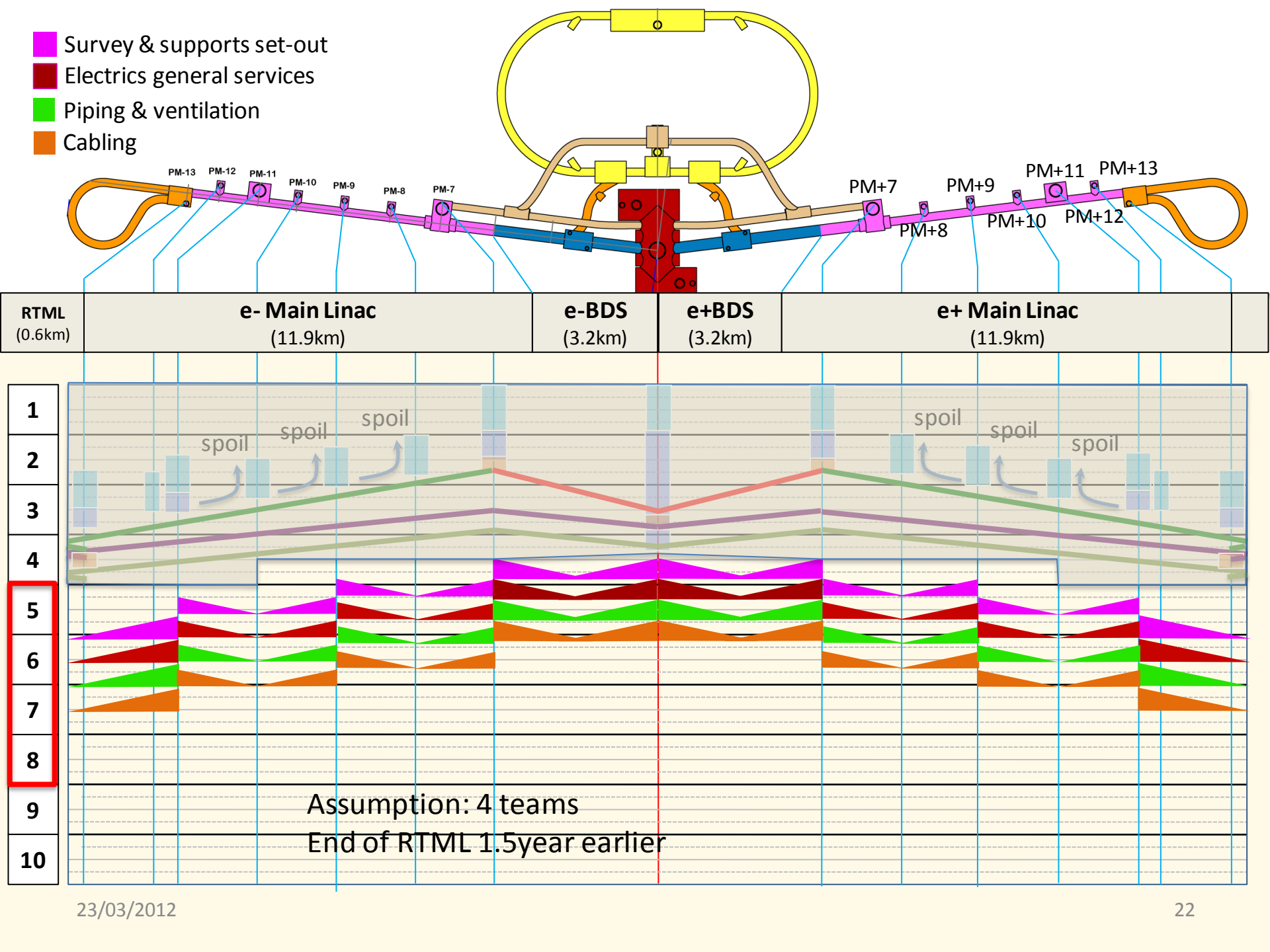
spoil
Assumption: 2 teams


Survey & supports set-out
Electrics general services
Piping & ventilation
Cabling
PM-13
PM-12
PM-11
PM-10
PM-9
PM-8
PM-7
PM+7
PM+8
PM+9
PM+10
PM+11
PM+12
PM+13
RTML (0.6km)
e- Main Linac (11.9km)
e-BDS (3.2km)
e+BDS (3.2km)
e+ Main Linac (11.9km)
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spoil
spoil
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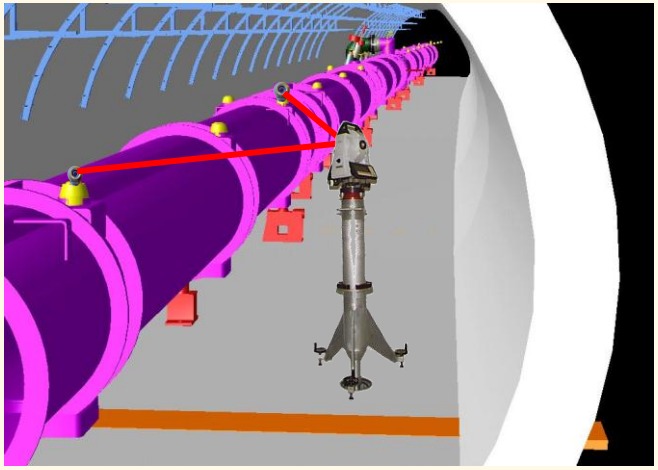
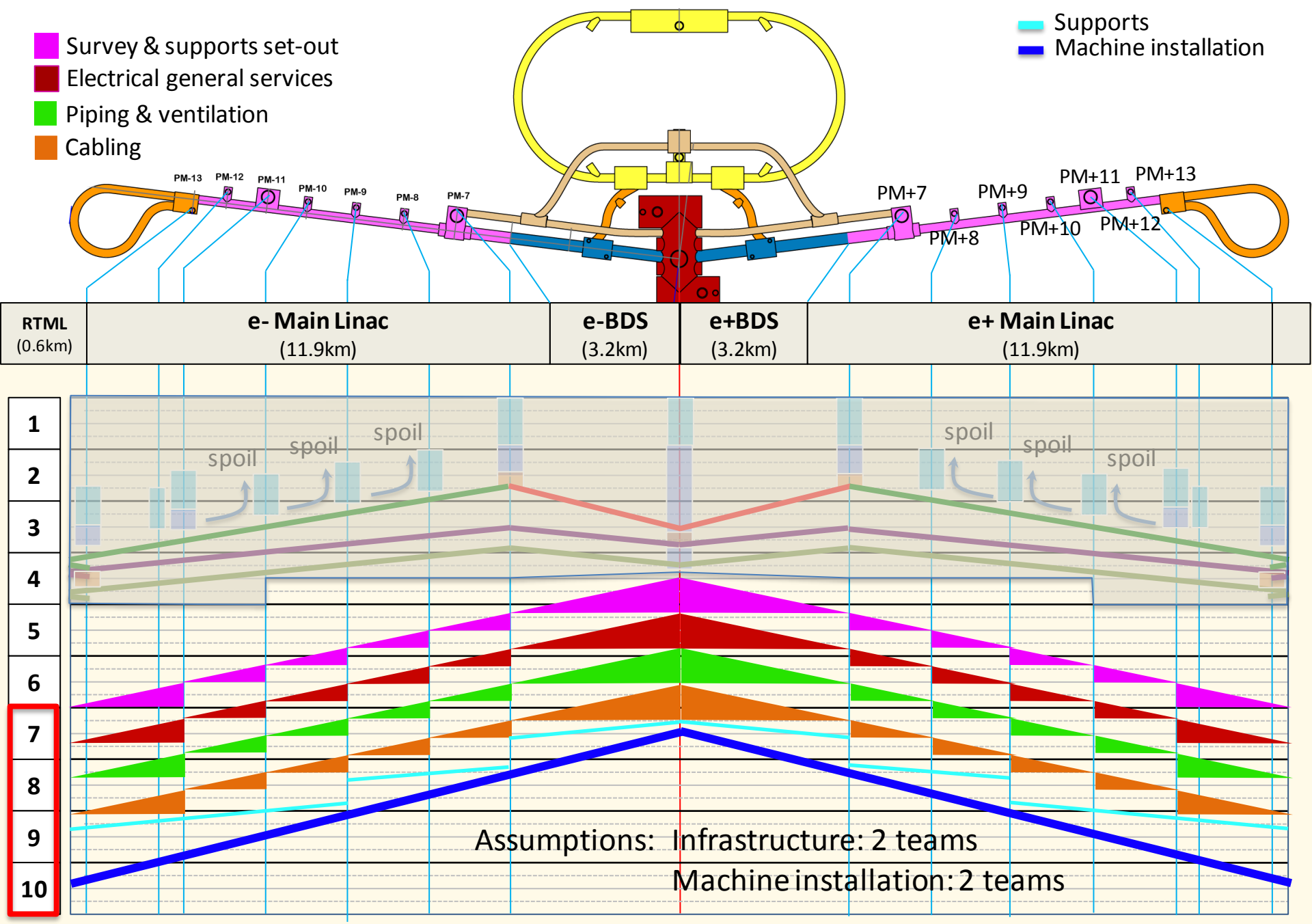
spoil
Assumption: 4 teams
End of RTML 1.5year earlier

Year 7 8 9 10– Installing machine components

- → Installation of supports for machine components
  - → Progress rate: 250m/w for 1 shift
- → Installation of machine components
  - → Transport
  - → Interconnections
  - → Alignment
  - → Progress rate: 100m/w for 1 shift (Average value from LHC, to be further defined…)
- → 2 teams for each activity




Survey & supports set-out
Electrical general services
Piping & ventilation
Cabling
Supports
Machine installation
PM-13
PM-12
PM-11
PM-10
PM-9
PM-8
PM-7
PM+7
PM+8
PM+9
PM+10
PM+11
PM+12
PM+13
RTML
(0.6km)
e- Main Linac
(11.9km)
e-BDS
(3.2km)
e+BDS
(3.2km)
e+ Main Linac
(11.9km)
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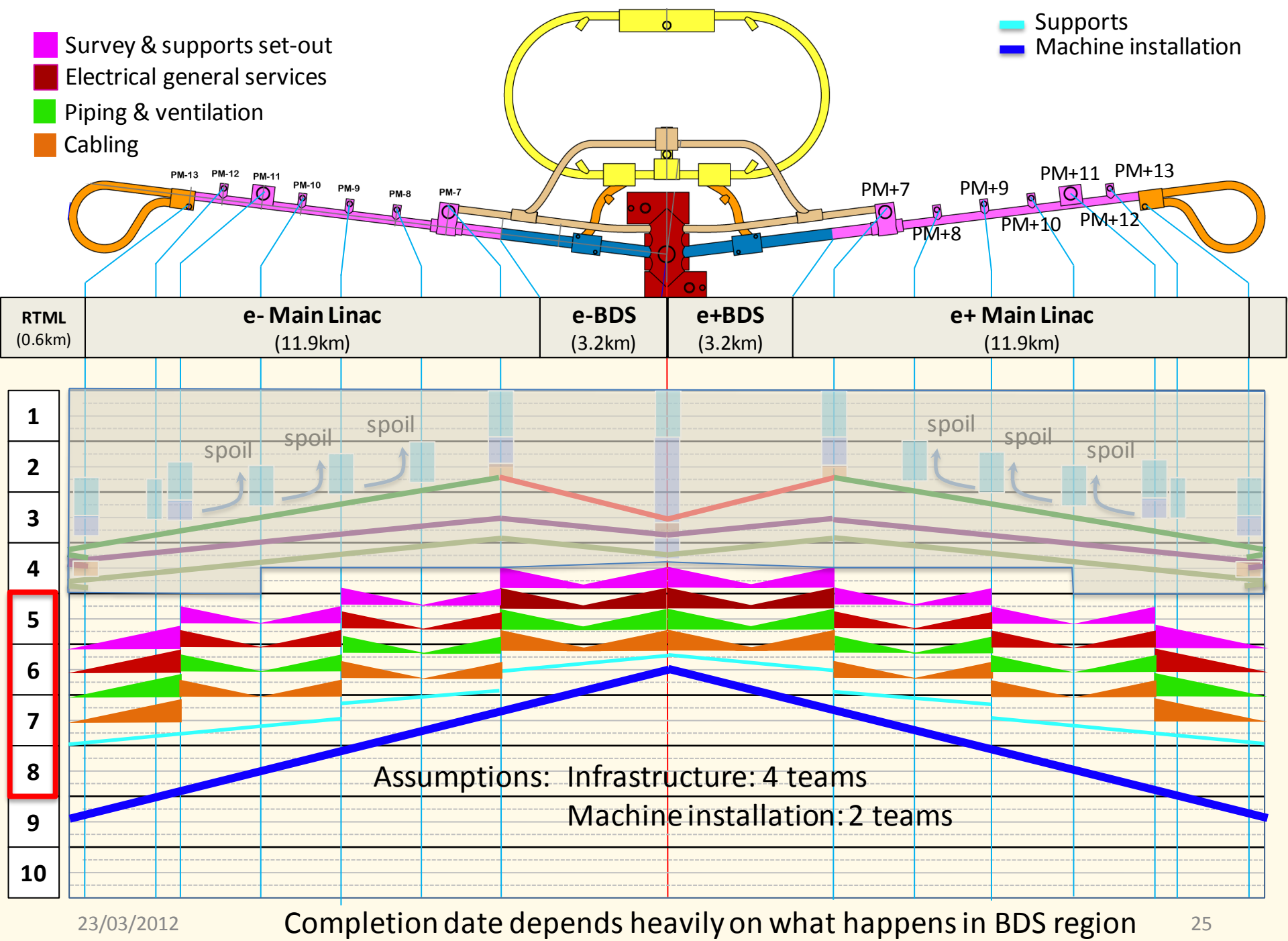
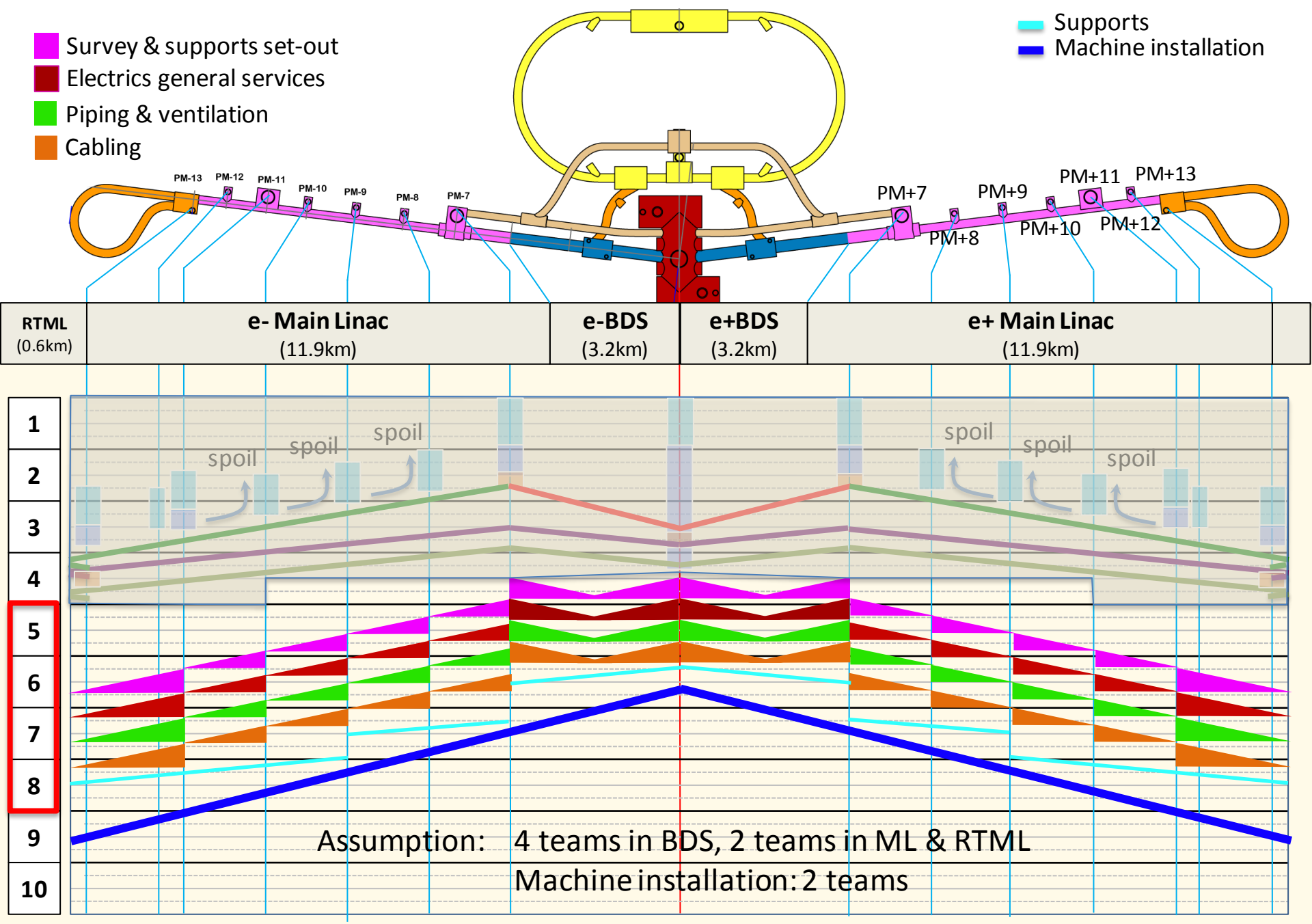
spoil
Assumptions: Infrastructure: 2 teams
Machine installation: 2 teams



Completion date depends heavily on what happens in BDS region


Survey & supports set-out
Electrics general services
Piping & ventilation
Cabling
Supports
Machine installation
PM-13
PM-12
PM-11
PM-10
PM-9
PM-8
PM-7
PM+7
PM+8
PM+9
PM+10
PM+11
PM+12
PM+13
RTML (0.6km)
e- Main Linac (11.9km)
e-BDS (3.2km)
e+BDS (3.2km)
e+ Main Linac (11.9km)
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spoil
spoil
spoil
spoil
spoil
spoil
Assumption: 4 teams in BDS, 2 teams in ML & RTML
Machine installation: 2 teams

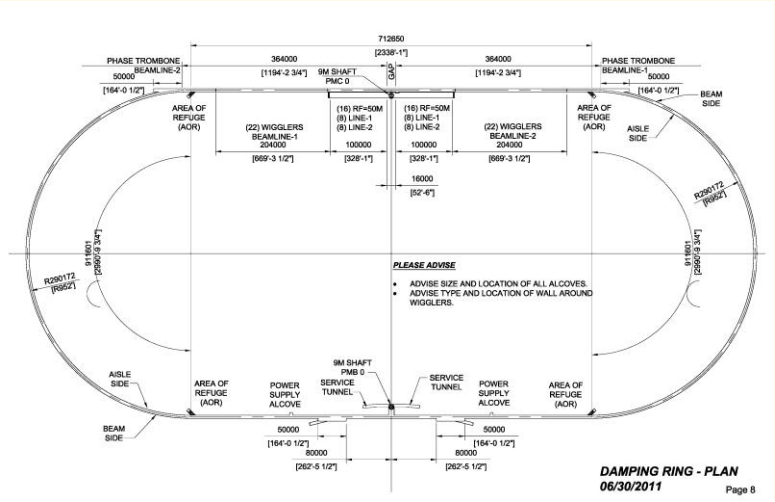
Commissioning

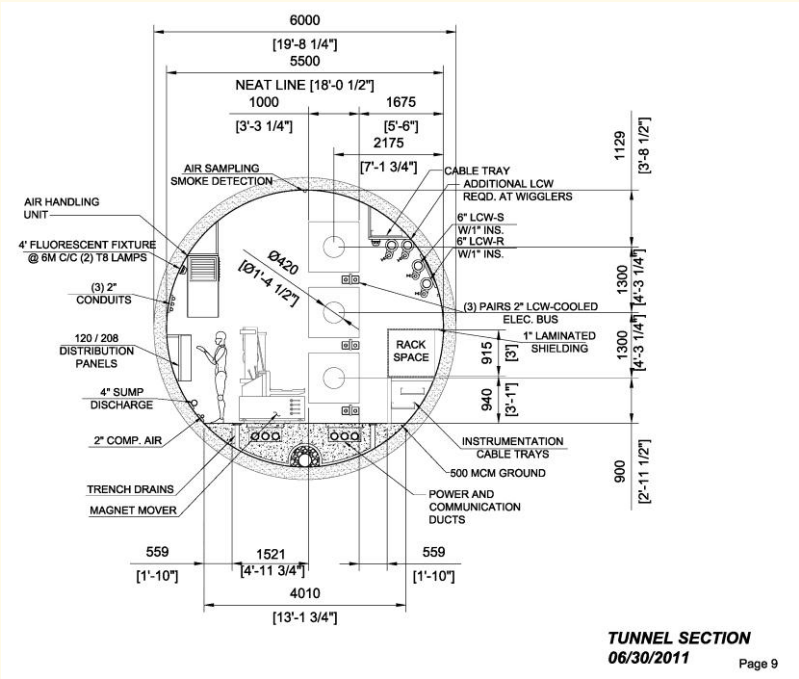
- Early Commissioning : Draft program (Ewan):
  - The e- injector system to 5 GeV and dump : 3 Months
  - The e+ source and systems to 5 GeV and dump utilizing the auxiliary low current e- source to produce e+ : 3 Months
  - Hardware commissioning of injection lines and both Damping rings : 3 months
  - Commission both rings with beams from injectors with extraction only into first dump in the PLTR (beam still in injection/extraction tunnels): 9 months

- Requires the availability of:
  - BDS and ML up to PM7: Y7 Q2
  - PLTR
  - Damping Rings

- Draft schedule for the construction and installation of the DR+PLTR
  - DR: One 6m diameter, 3240m long tunnel – excavation using TBM at a rate of 150m/w for 3 shifts
  - PLTR: Two 6-8m diameter, 270m long tunnels – excavation using road headers at a rate of 30m/w for 3 shifts
  - When possible, the RD and PLTR are treated as one 3780m tunnel

Early Commissioning

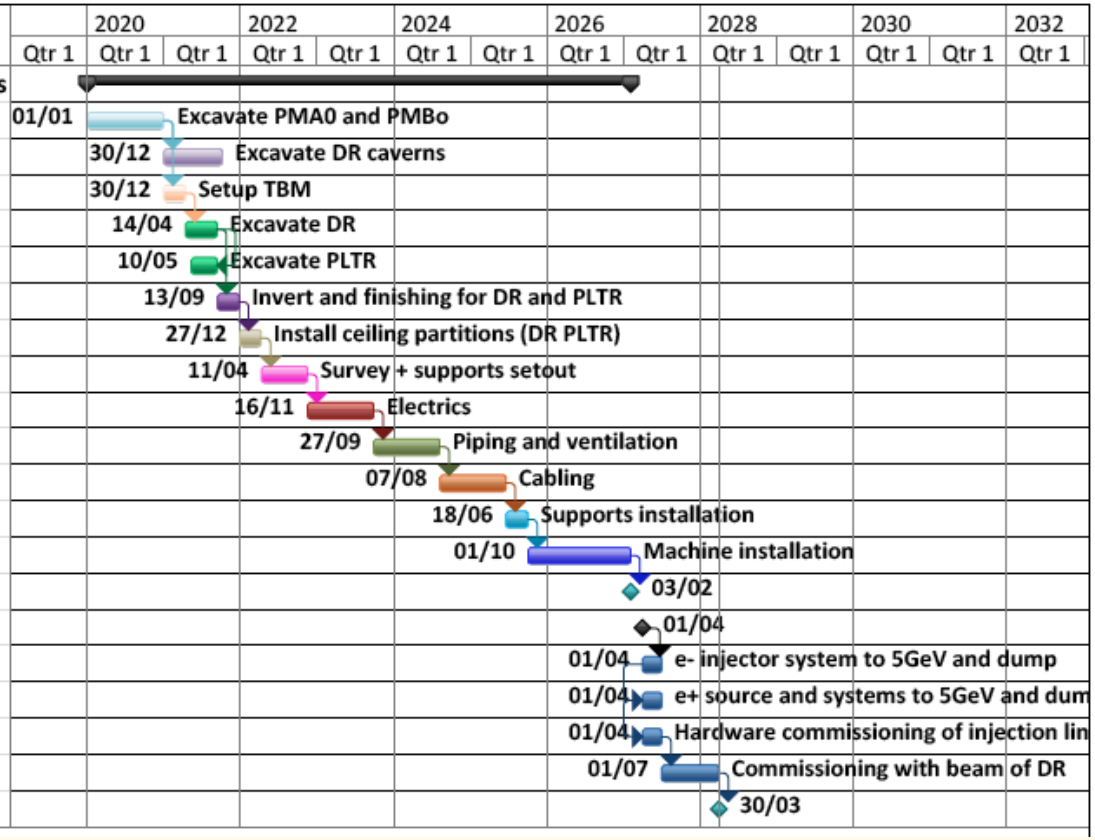




- → CE phase
  - → Invert and finishing: 250m/w
  - → Ceiling ducts: 250m/w
- → Installation of infrastructure in DR and PLTR
  - → Survey: 120m/w 120m/w
  - → Electrics: 80m/w 120m/w
  - → Piping & ventilation: 80m/w 120m/w
  - → Cabling: 80m/w 120m/w
- → Installation of machine components
  - → Supports: 250m/w
  - → Machine elements: DR: 50m/w ; PLTR: 100m/w
    - → Many more components per meter to install in DR

Delivery of DR and PLTR for commissioning

ID	Task Name	Duration
1	**DR and PLTR construction**	**1850.5 days**
2	Excavate PMA0 and PMBo	52 wks
3	Excavate DR caverns	40 wks
4	Setup TBM	15 wks
5	Excavate DR	21.6 wks
6	Excavate PLTR	18 wks
7	Invert and finishing for DR and PLTR	15 wks
8	Install ceiling partitions (DR PLTR)	15 wks
9	Survey + supports setout	31.5 wks
10	Electrics	45 wks
11	Piping and ventilation	45 wks
12	Cabling	45 wks
13	Supports installation	15 wks
14	Machine installation	70 wks
15	DR and PLTR ready for commissioning	0 days
16	BDS ready for commissioning	0 days
17	e- injector system to 5GeV and dump	13 wks
18	e+ source and systems to 5GeV and dump	13 wks
19	Hardware commissioning of injection lines and DR	13 wks
20	Commissioning with beam of DR	39 wks
21	Early commissioning complete	0 days

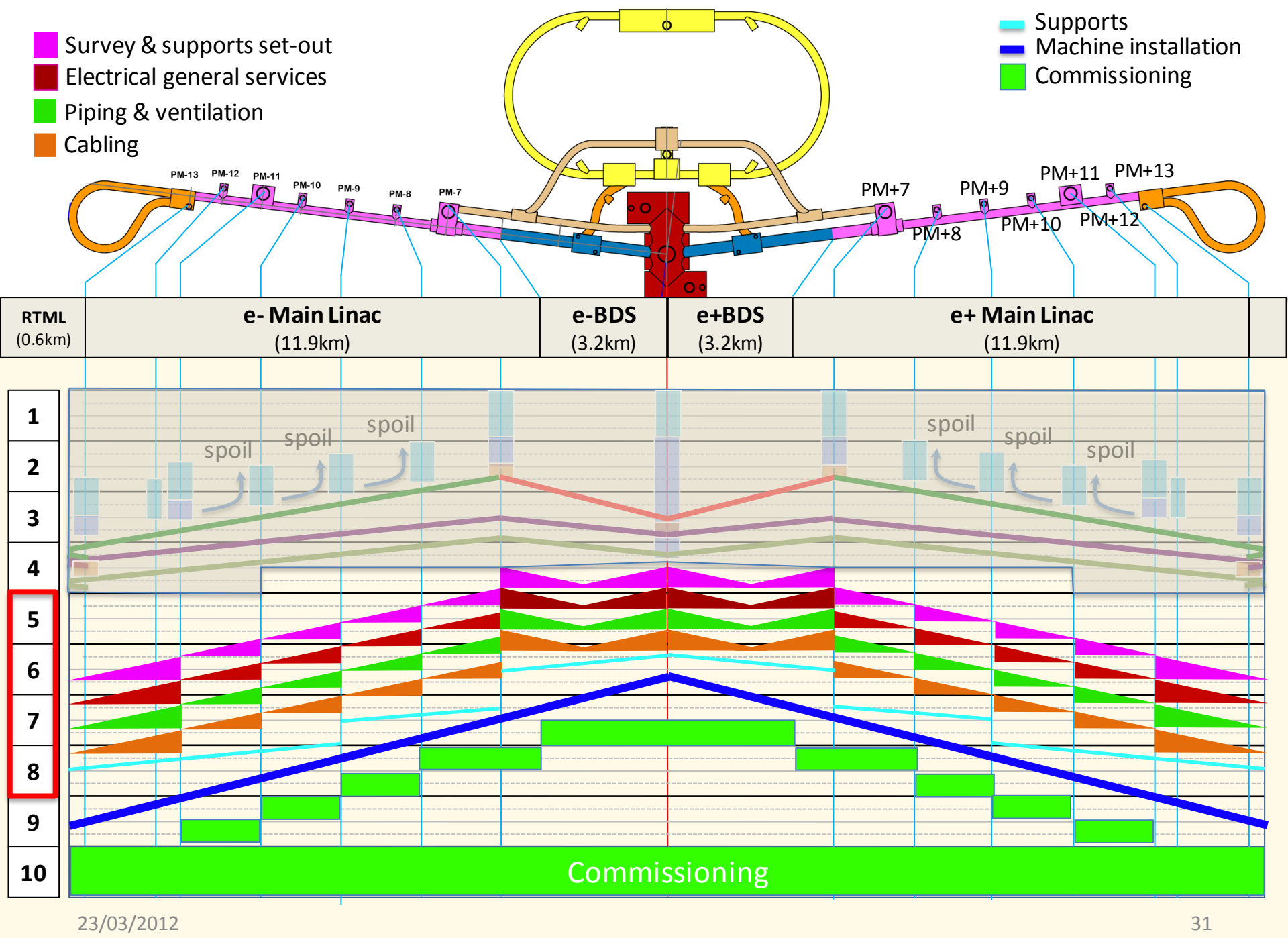


→ Under our set of assumptions, the DR and PLTR would be made available to commissioning before the BDS becomes available

→ The early commissioning would be over during Y8 Q3

Global Commissioning

- → Still quite early to come up with precise estimates
- → Based on LHC:
  - → 6 month of pre-commissioning per sector
  - → 12 months of global commissioning
- → Key dates
  - → BDS ready for commissioning: Y7 Q2
  - → ML ready for commissioning: Y9 Q3
- → Pre-requisite to launch commissioning with beam IF detectors not available
  - → Temporary vacuum pipe through IR area
  - → Temporary QD0
  - → Temporary shielding


Survey & supports set-out
Electrical general services
Piping & ventilation
Cabling
Supports
Machine installation
Commissioning
PM-13
PM-12
PM-11
PM-10
PM-9
PM-8
PM-7
PM+7
PM+8
PM+9
PM+10
PM+11
PM+12
PM+13
RTML (0.6km)
e- Main Linac (11.9km)
e-BDS (3.2km)
e+BDS (3.2km)
e+ Main Linac (11.9km)
spoil
spoil
spoil
spoil
spoil
spoil
1
2
3
4
5
6
7
8
9
10
Commissioning

Conclusion and next steps

→ This draft schedule shows how the ILC could be built and commissioned in 10 years

→ Many additional studies will be necessary to finalise the work plans

→ New iteration would be necessary when layout is modified

→ Next steps:

- → Include waveguide and RTML (input needed from installation studies)
- → Include Service Tunnel and its cavern
- → Include Surface buildings
- → Launch scheduling studies for the construction and installation of the detectors – synergies with CLIC

Example:
CLIC IR

	Task Name	Duration
1	Excavate 1st shaft	12 mons
2	Excavate 2nd shaft	12 mons
3	Construct of 2/3 of Surface Assembly Halls	12 mons
4	Excavate and finish Transfer Tunnel	12 mons
5	Extract 2 TBMs	3 mons
6	Excavate and finish Detector Caverns	24 mons
7	Assemble and commission Detectors	42 mons
8	Construct Surface Service Buildings	24 mons
9	Install Caverns Infrastructure	24 mons
10	Complete Surface Assembly Hall A	12 mons
11	Complete Surface Assembly Hall B	12 mons
12	Install Crane for Heavy Lowering	1 mon
13	Lower Detectors	6 mons
14	Connect detectors to their services	11 mons
15	Commission Detectors & Push-Pull	12 mons
16	Ready for 500GeV beam	0 days