New Transport Line for PF-AR

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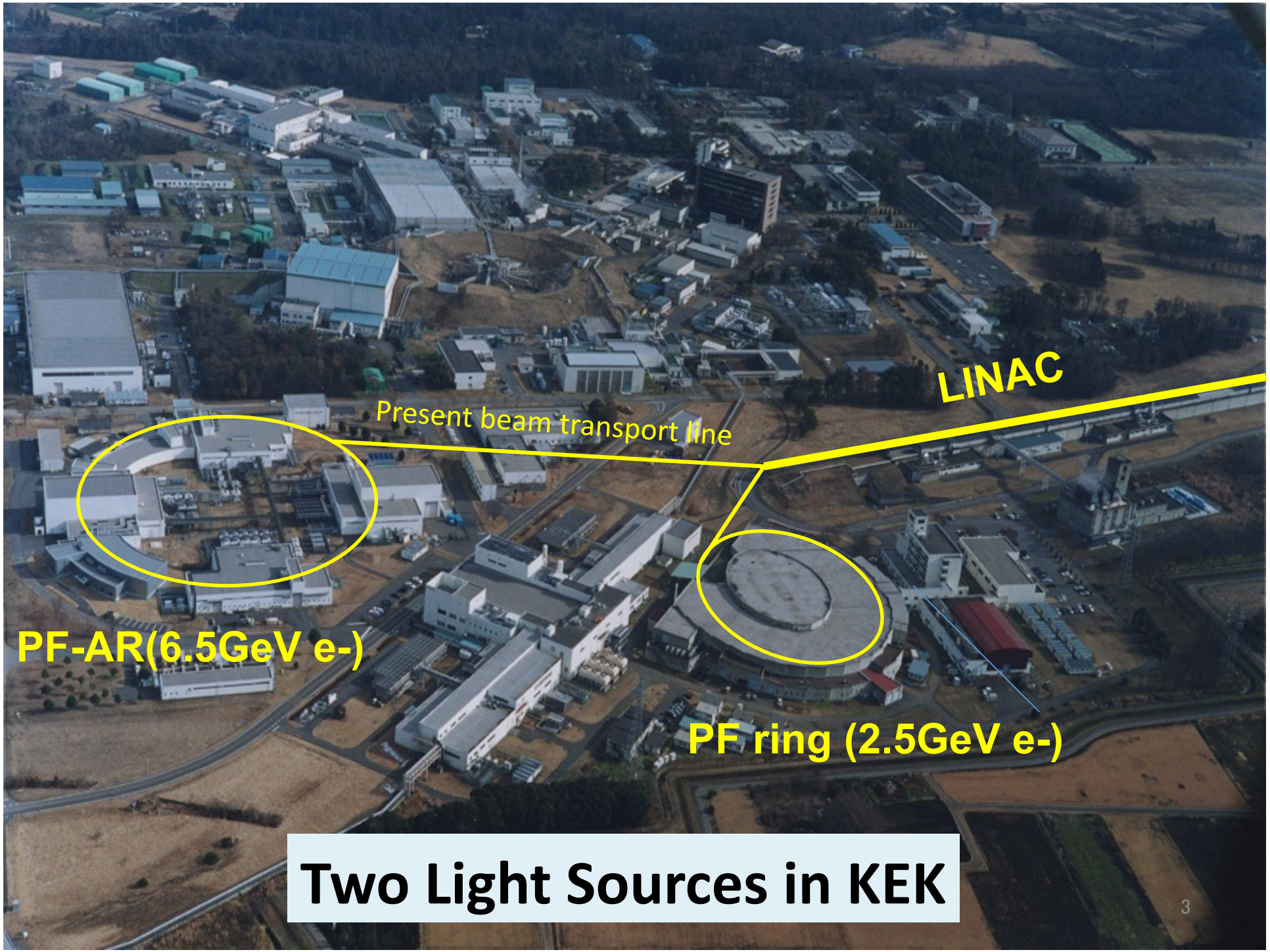
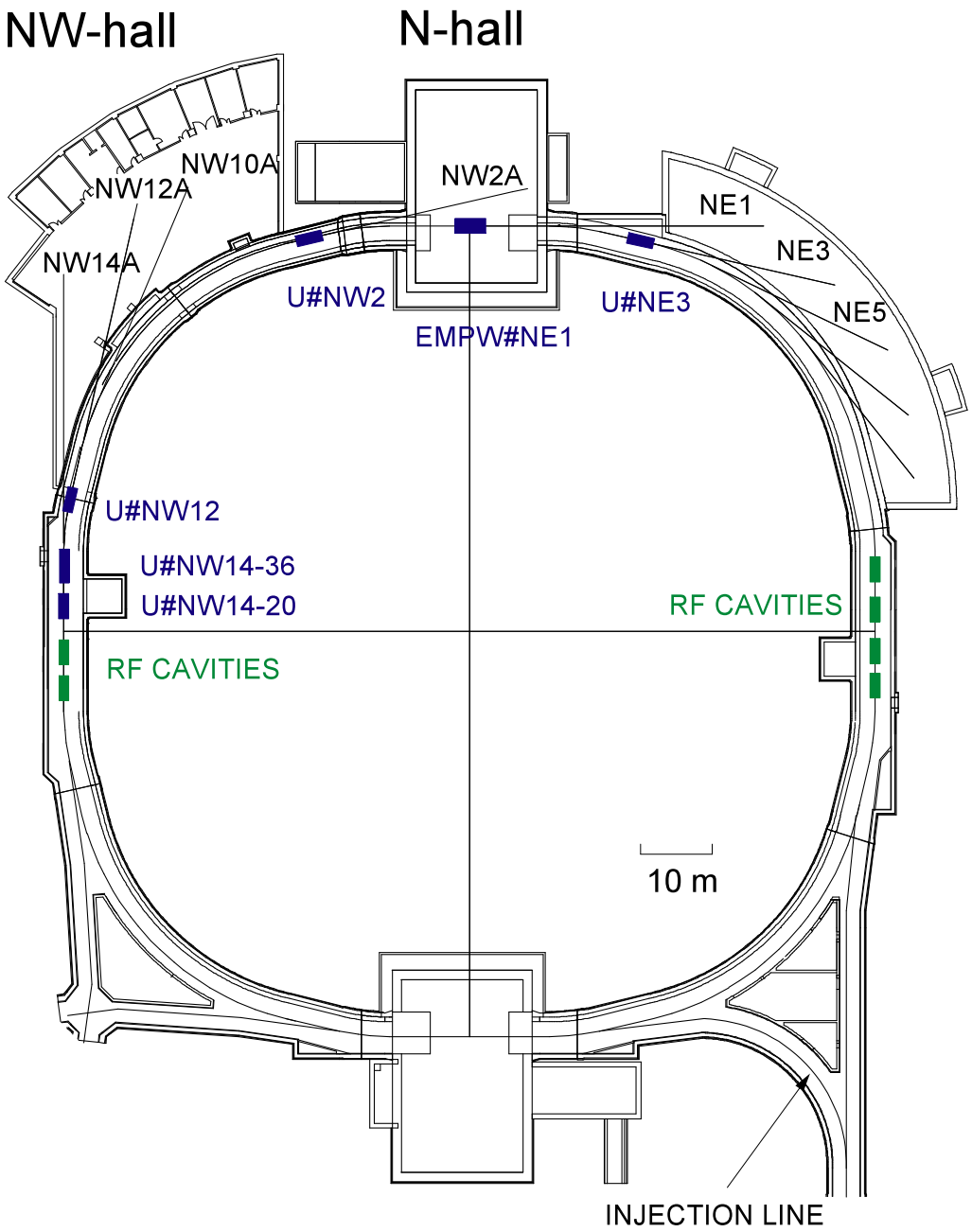
Outline

- Introduction
  - -Photon Factory Advanced Ring (PF-AR)
  - -Beam injection for PF-AR
  - -Requirement of Fast Switching Injection
- New transport line
  - - New tunnel
  - - Optics
  - - Construction schedule

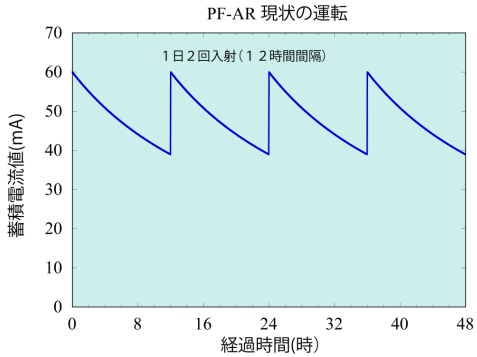


Two Light Sources in KEK

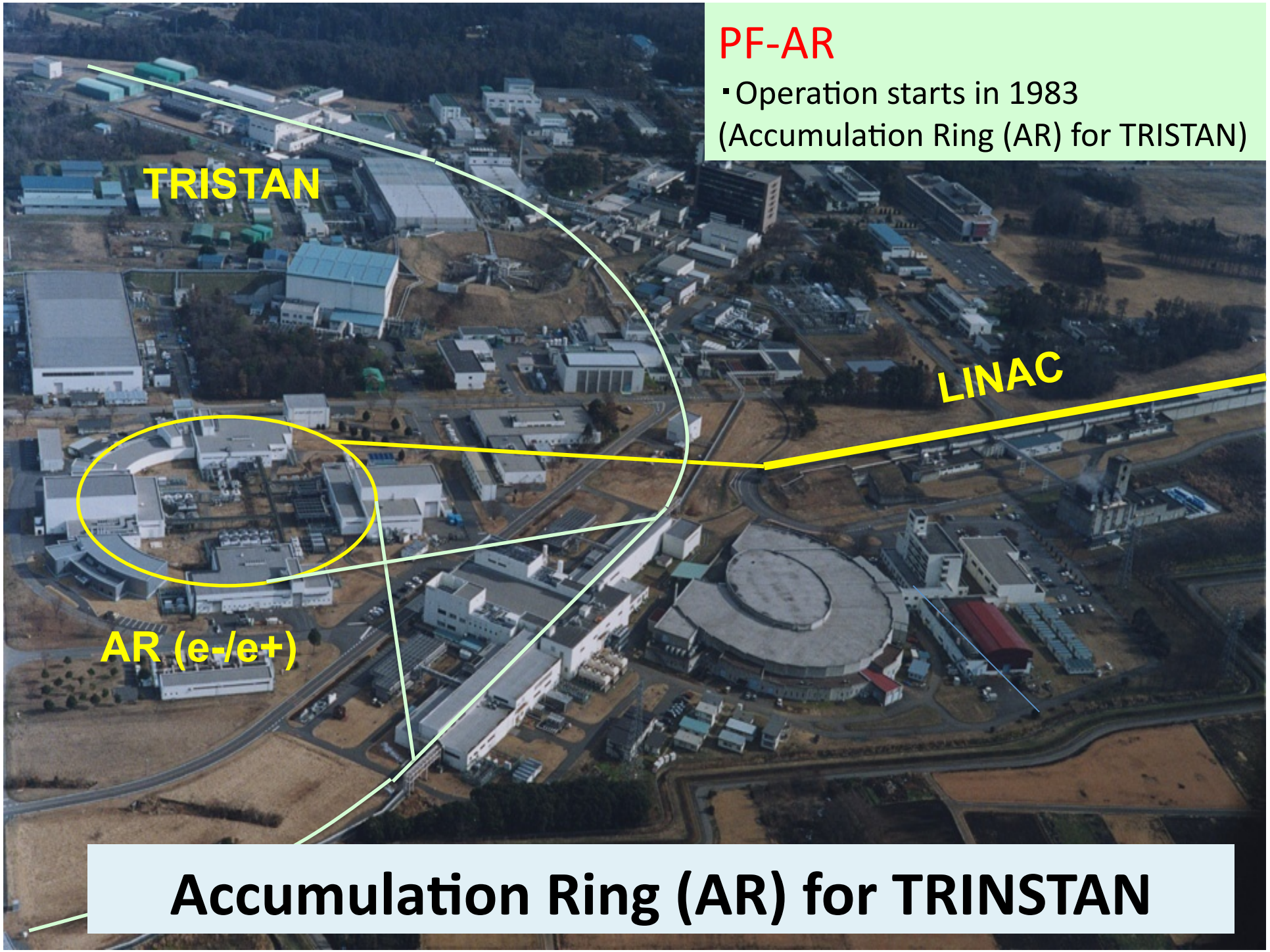
PF-AR

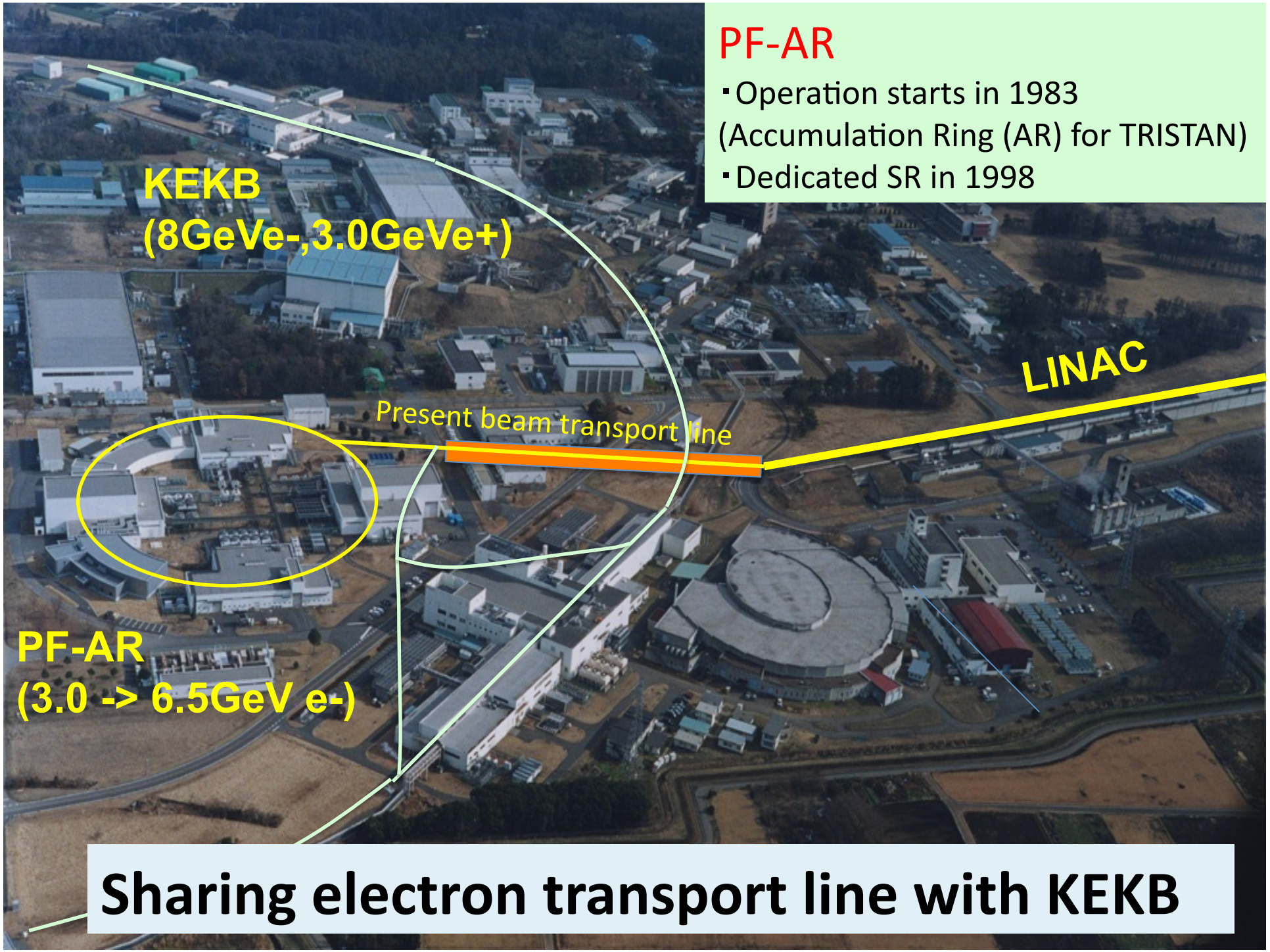


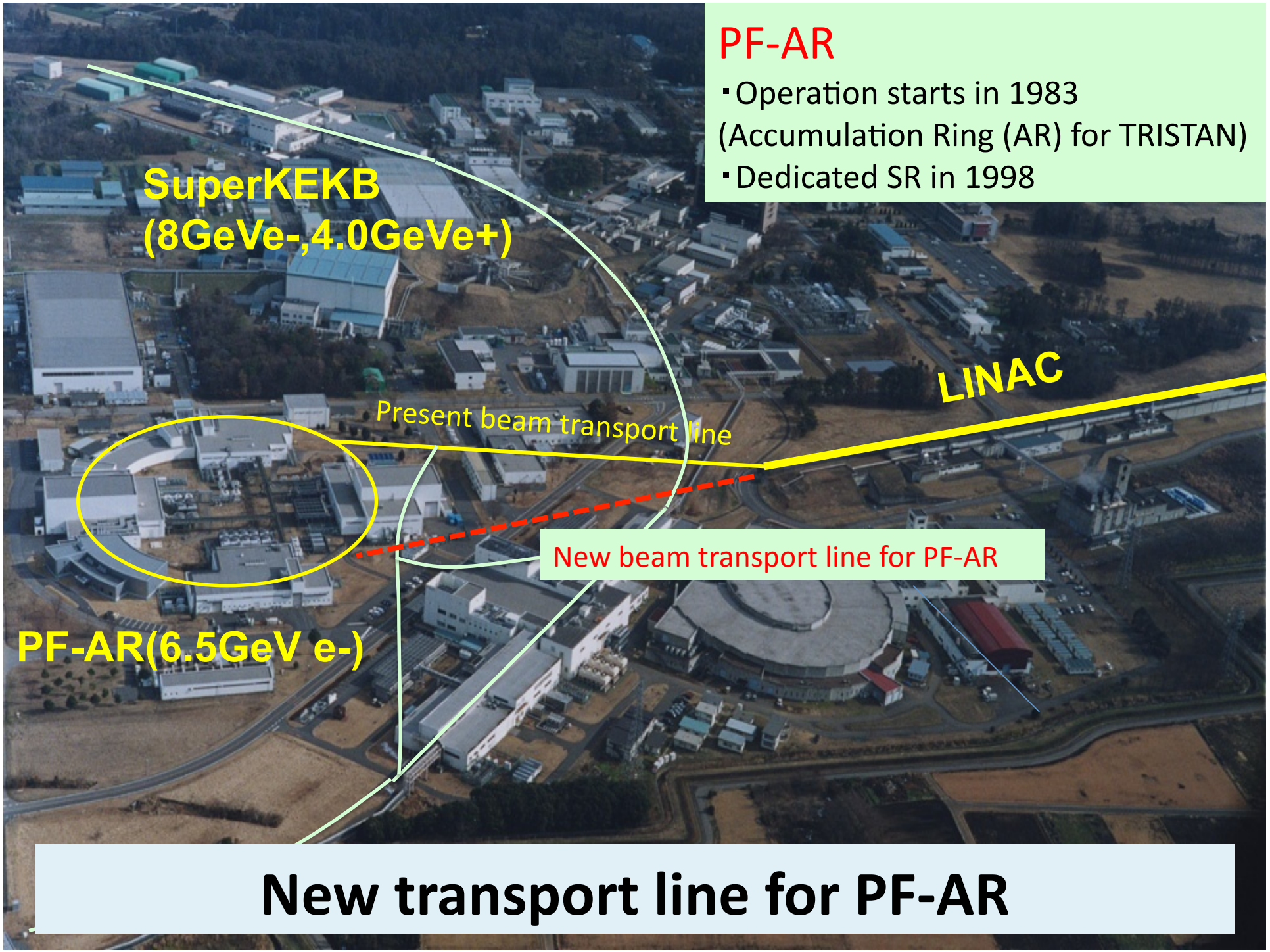
E=6.5 GeV (Injection Energy: 3GeV)
C=377 m
εx=290 nmrad
I= 60-40 mA



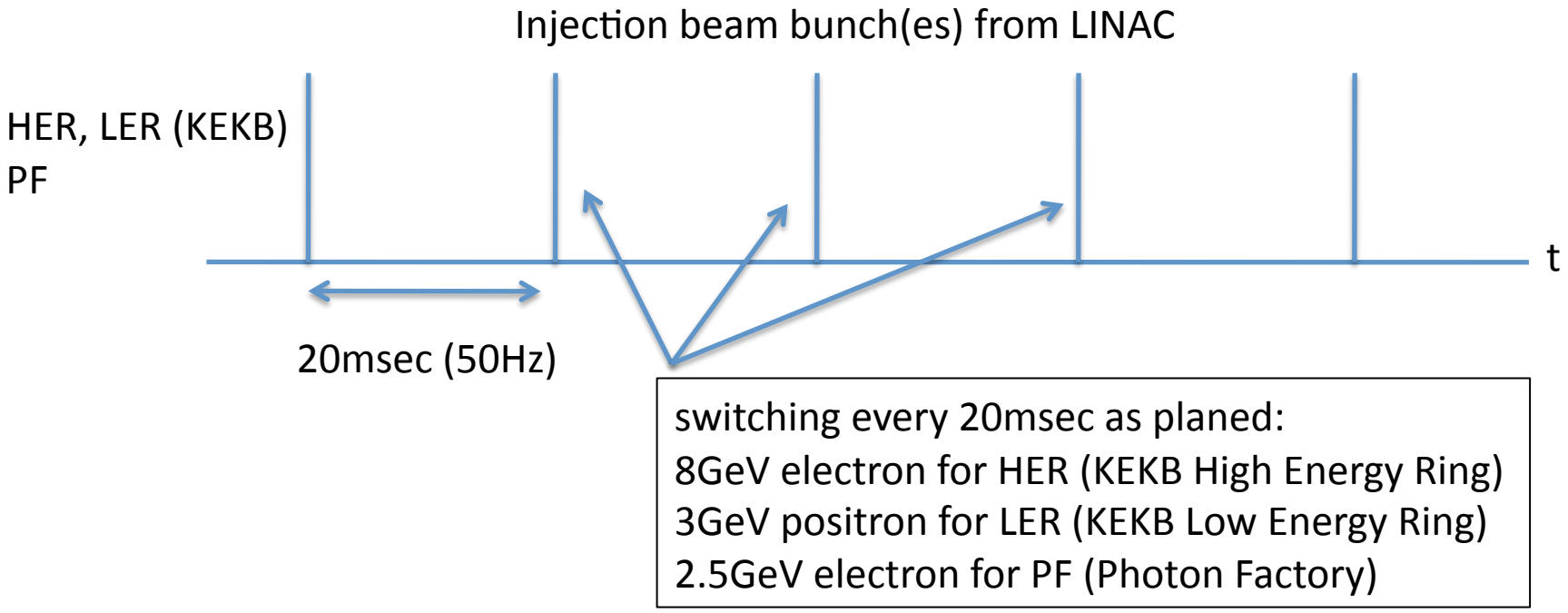
Always operating with single-bunch mode for the pulsed x-ray experiment


PF-AR
・Operation starts in 1983
(Accumulation Ring (AR) for TRISTAN)
TRISTAN
LINAC
AR (e-/e+)
Accumulation Ring (AR) for TRINSTAN


PF-AR
・Operation starts in 1983
(Accumulation Ring (AR) for TRISTAN)
・Dedicated SR in 1998
KEKB
(8GeVe-,3.0GeVe+)
LINAC
Present beam transport line
PF-AR
(3.0 -> 6.5GeV e-)
Sharing electron transport line with KEKB


PF-AR
・Operation starts in 1983
(Accumulation Ring (AR) for TRISTAN)
・Dedicated SR in 1998
SuperKEKB
(8GeVe-,4.0GeVe+)
LINAC
Present beam transport line
New beam transport line for PF-AR
PF-AR(6.5GeV e-)
New transport line for PF-AR

Fast switching of injection beam from LINAC (so far)



PF-AR uses LINAC exclusively in beam injection.

KEKB transport line (sharing area) is optimized for 3GeV electron during PF-AR injection.

It takes ~15min, twice a day.

SuperKEKB requires Fast Switching Injection for PF-AR

- SuperKEKB is a high luminosity e+/e- collider for high energy physics .
- SuperKEKB needs continuous injection to compensate very short beam lifetime (~10 min).
- PF-AR can not use LINAC exclusively for 15 min.
- Fast switching is required for PF-AR beam injection.
- In addition, top-up operation is strongly required for much higher stability in PF-AR experiment.

New transport line for PF-AR

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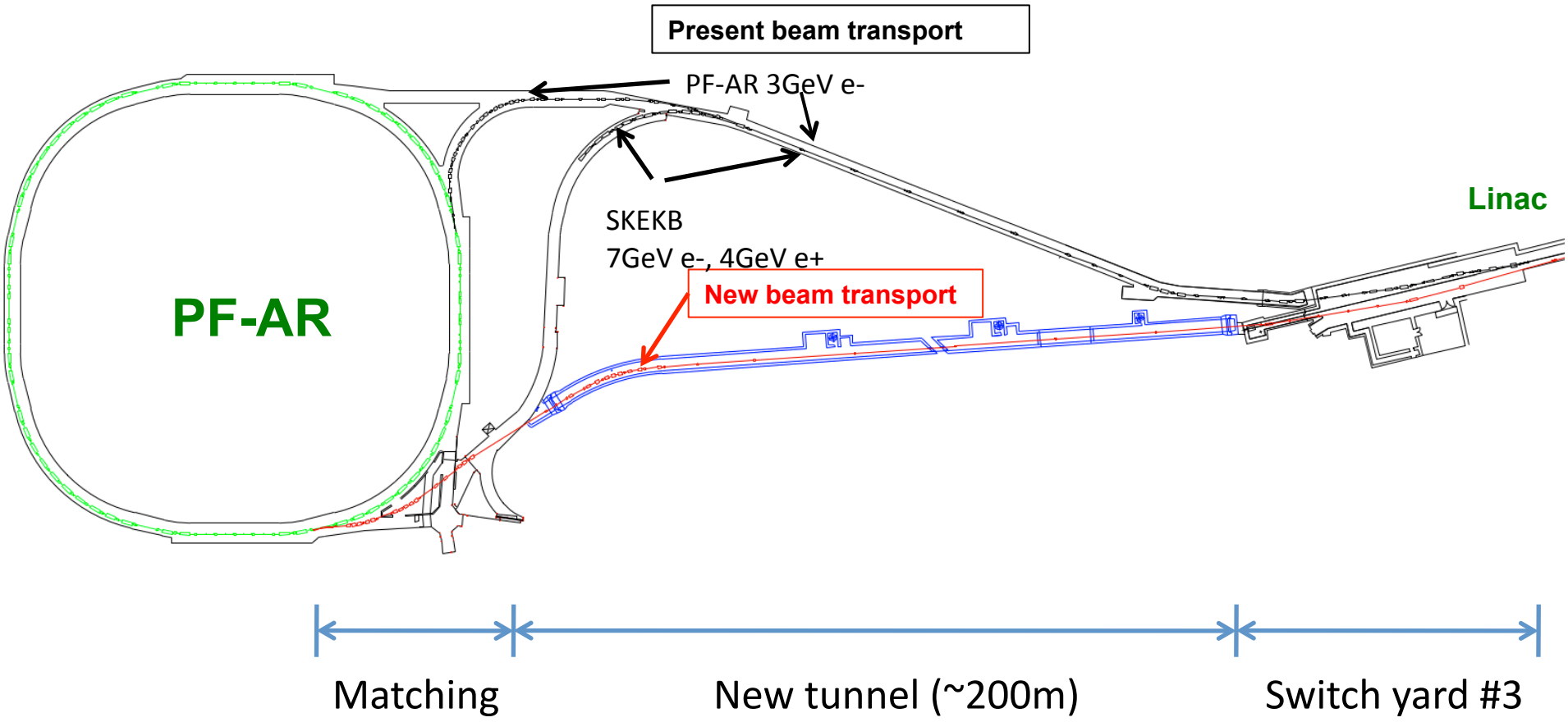
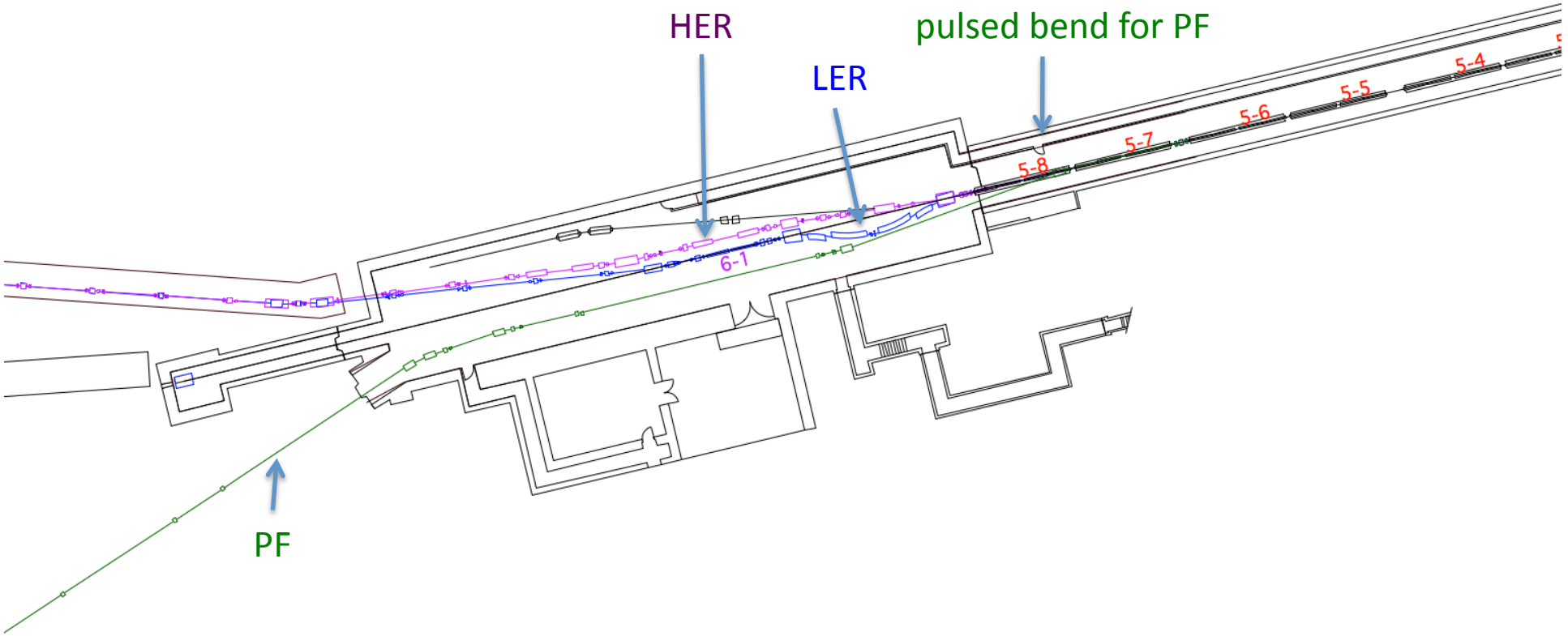
  - - New tunnel
  - - Optics
  - - construction schedule

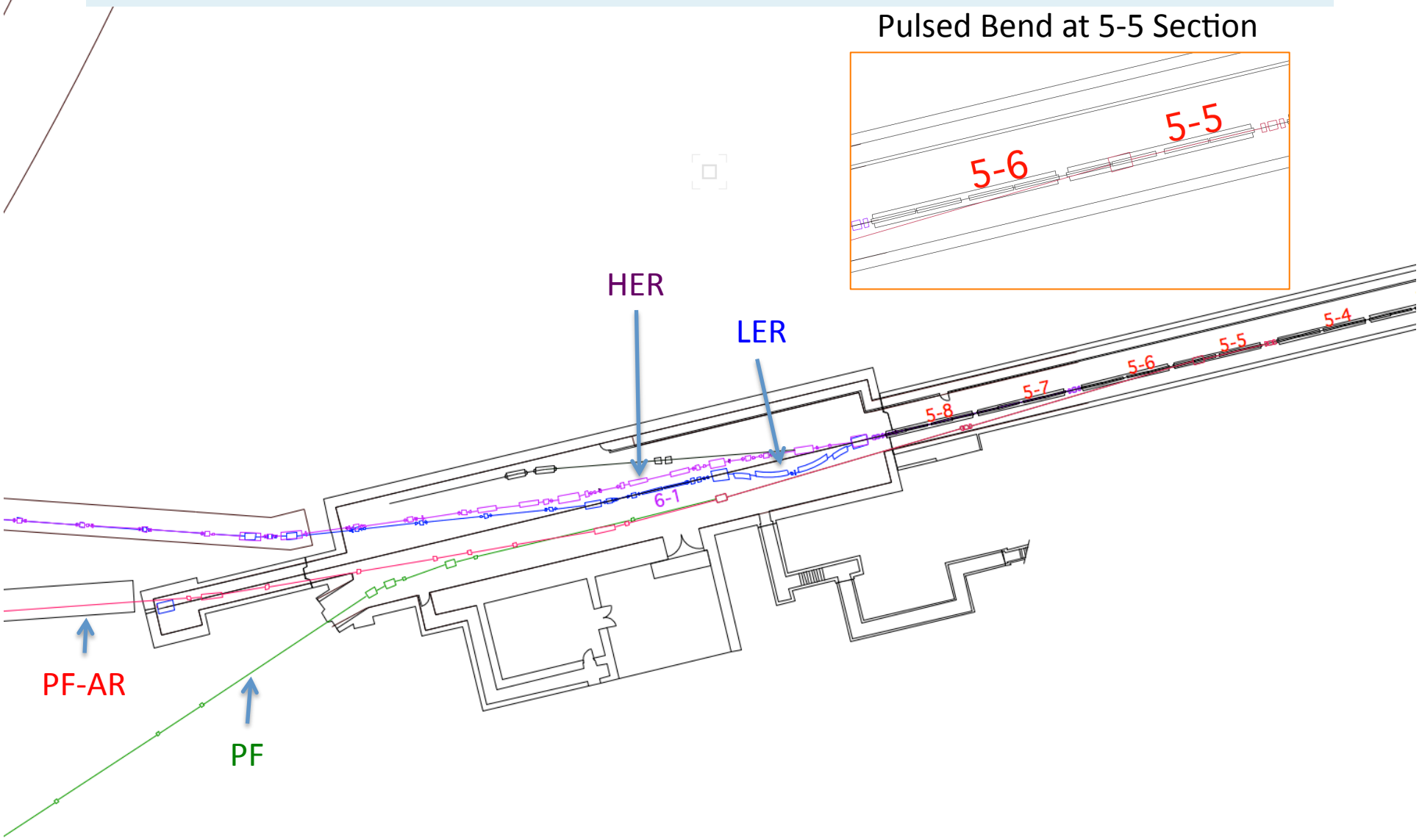
New beam transport for PF-AR



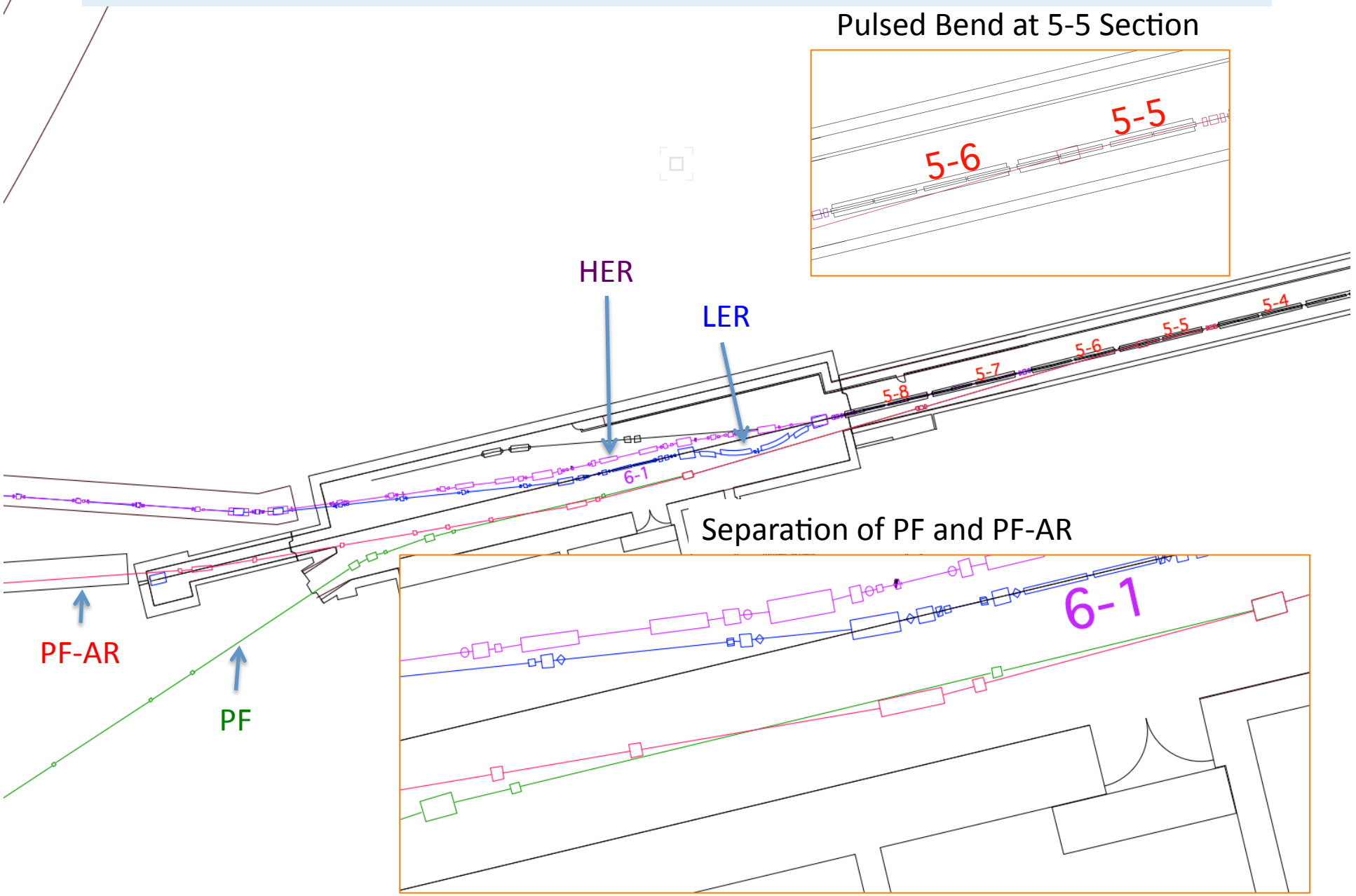
Switch yard #3 (present)



Switch yard #3 (upgrade)



Switch yard #3 (upgrade)



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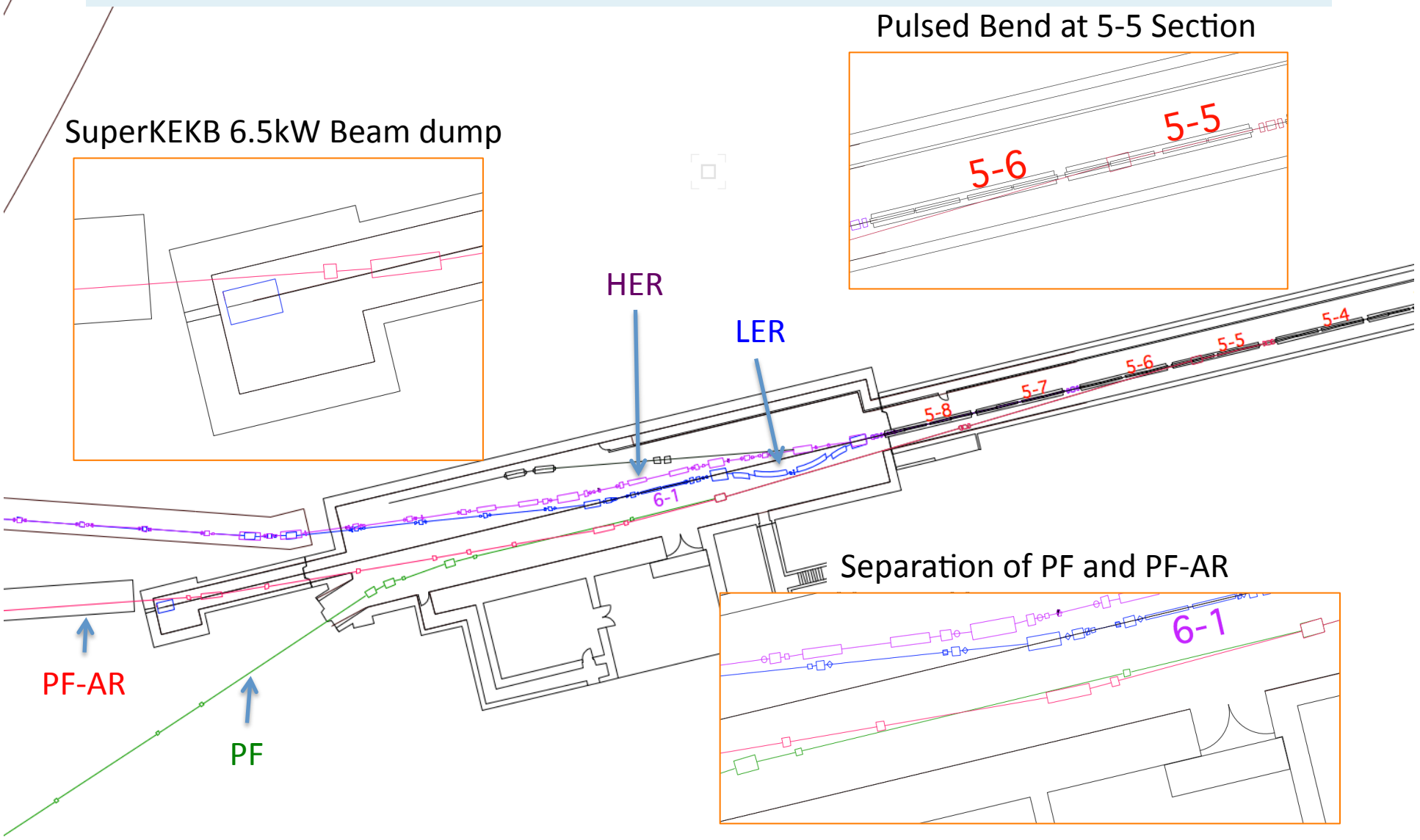
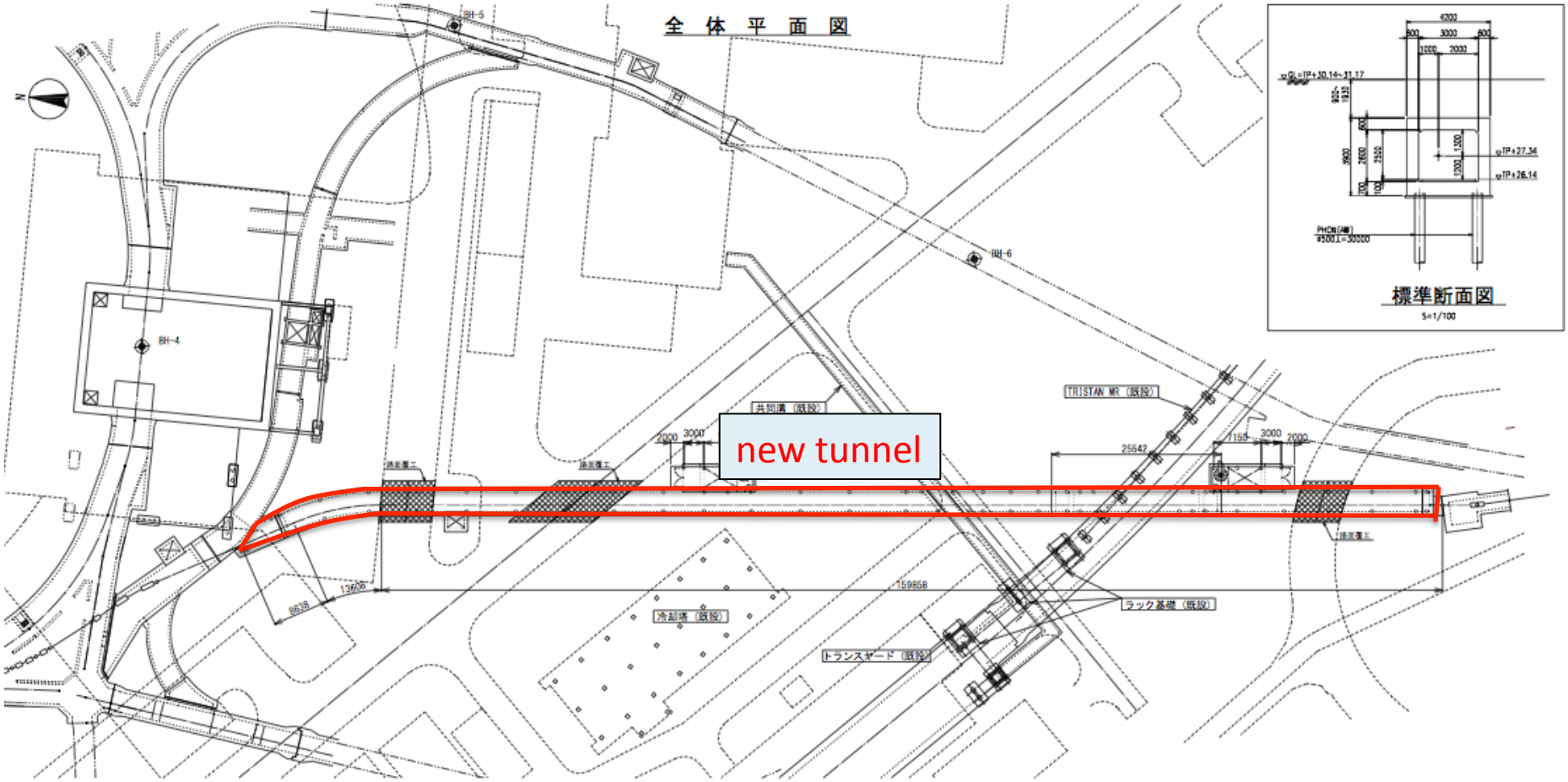
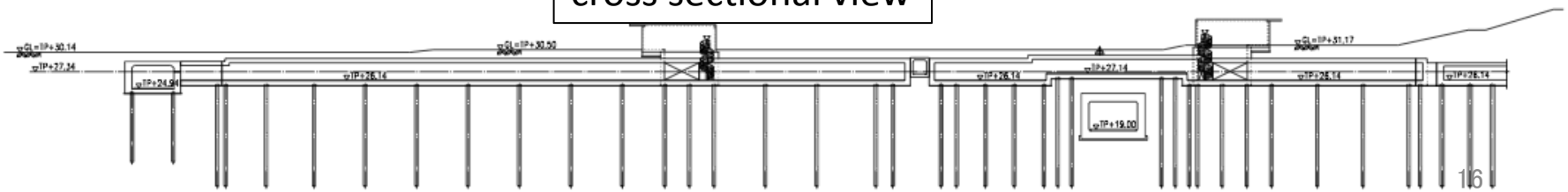


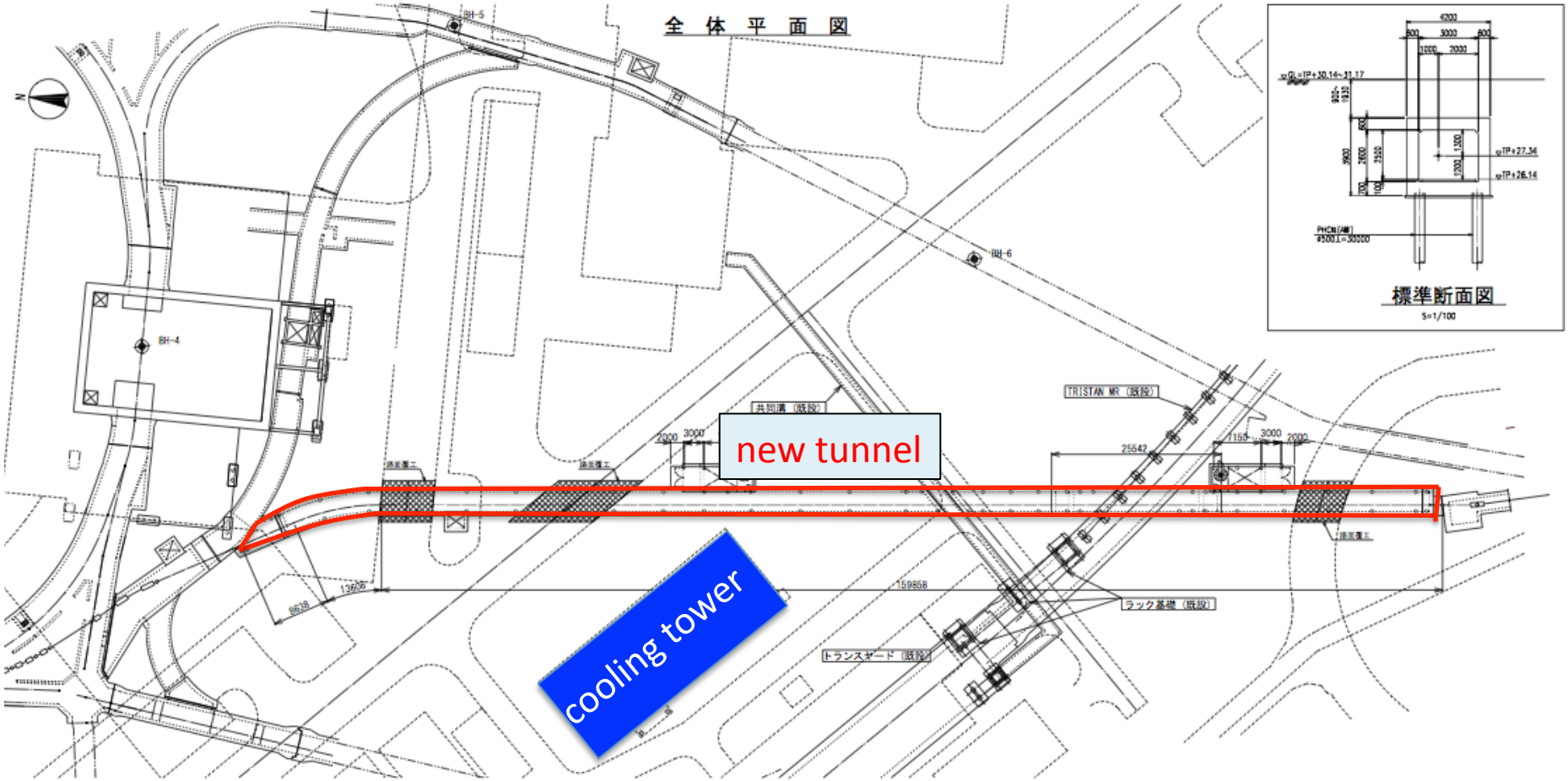
New tunnel



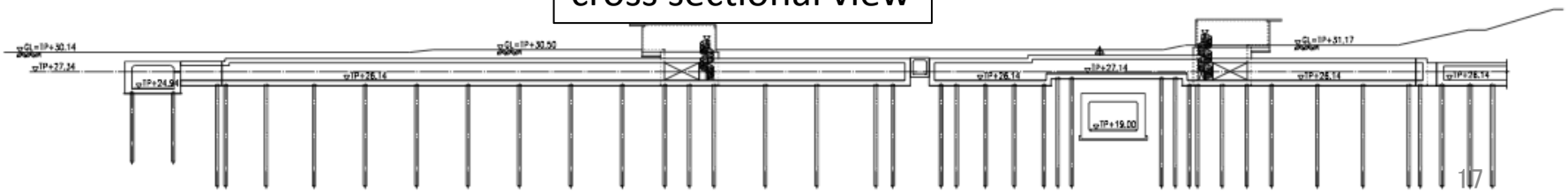
cross sectional view



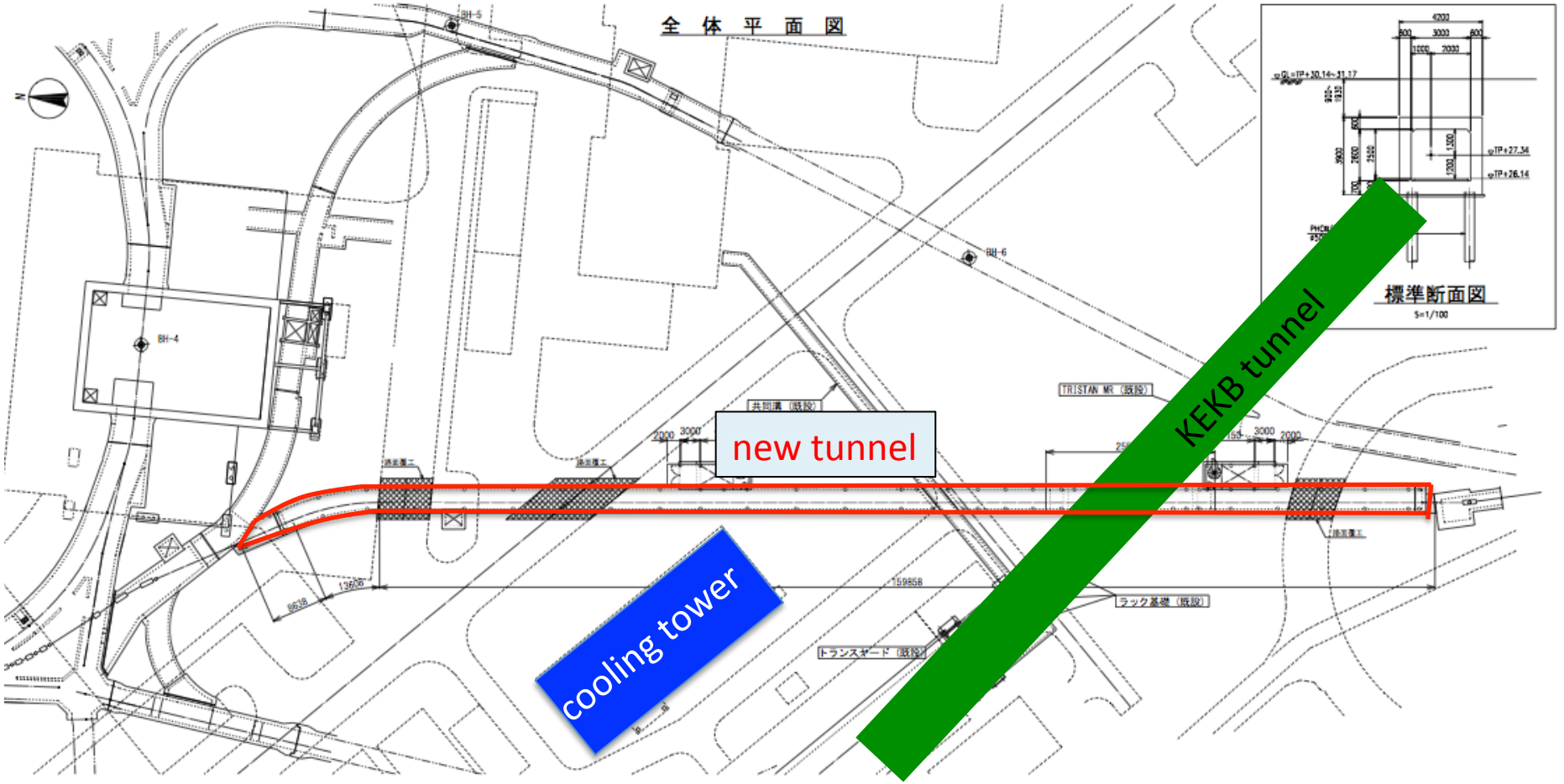
New tunnel



cross sectional view



New tunnel



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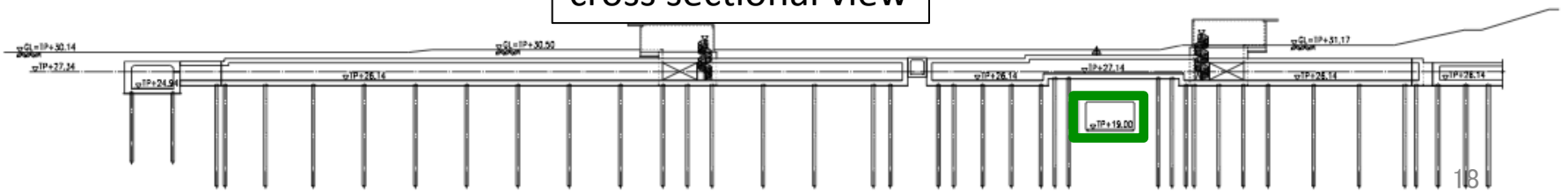
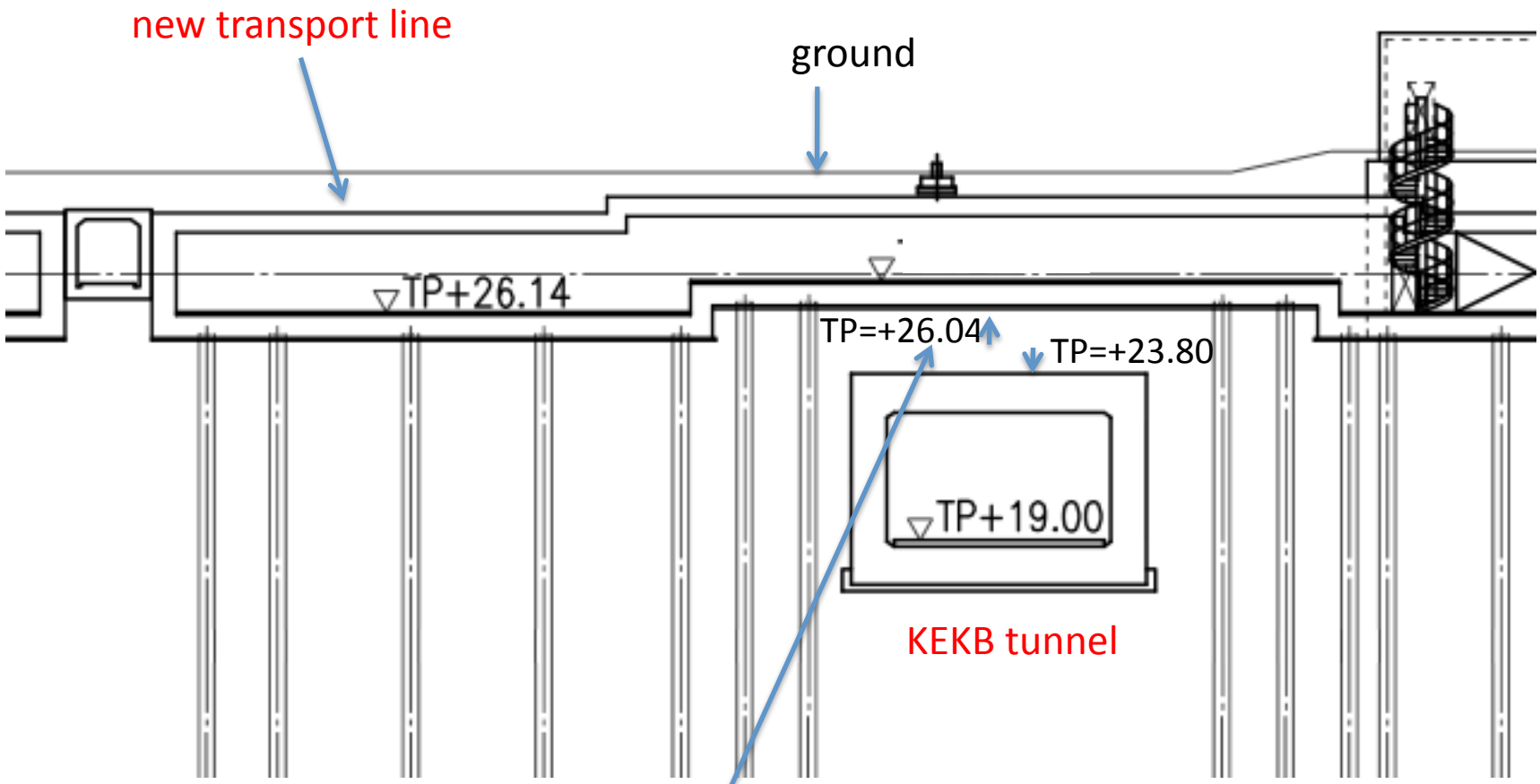


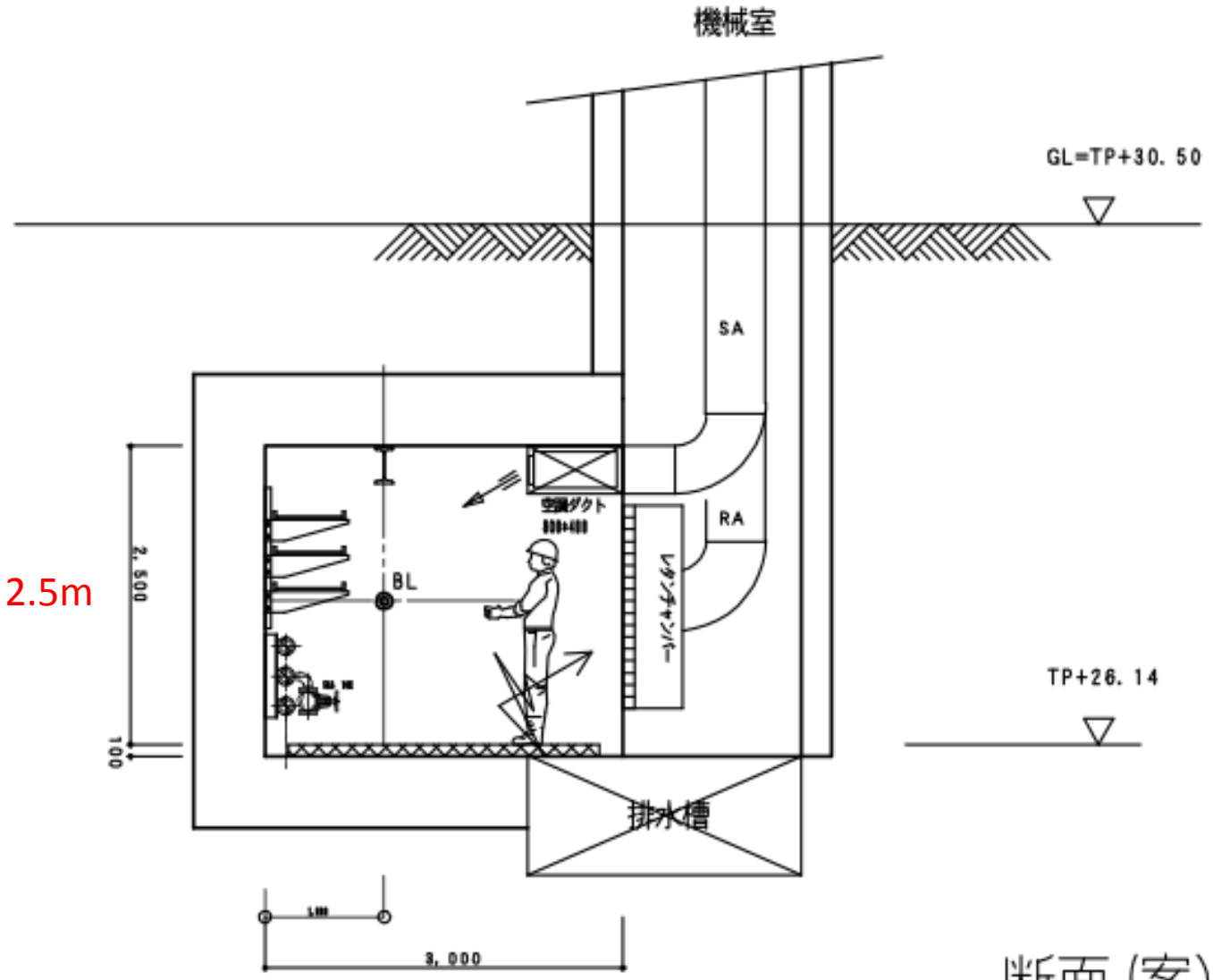
Side view crossing KEKB tunnel



spacing between two tunnels (~7m)
(thickness of ceiling and floor is 0.6 m each)

TP: World Geodetic System

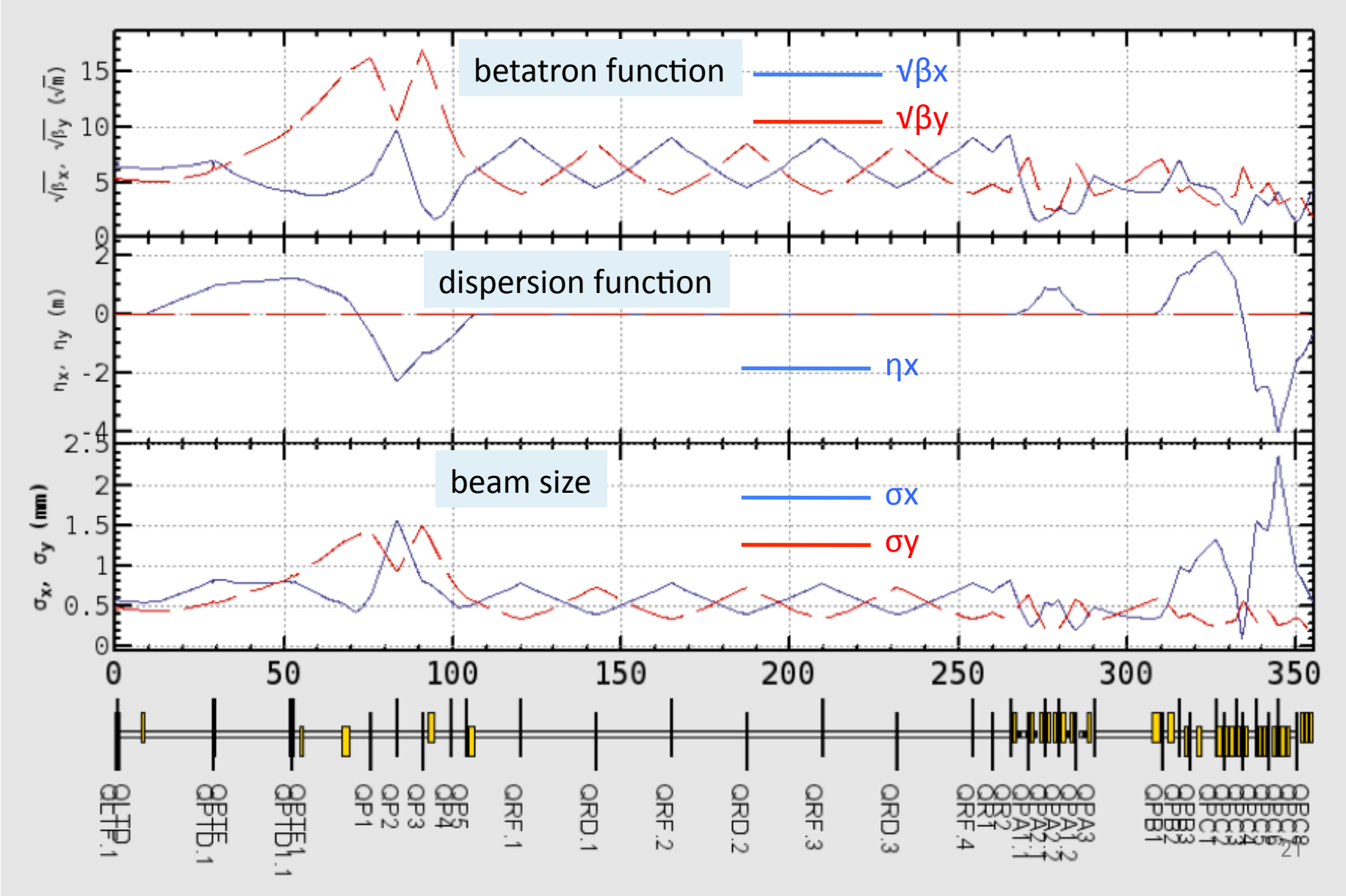
Cross section of the new tunnel



断面（案）

Optics

normalized emittance
= 100×10^{-6} m rad
dE/E = 0.1%



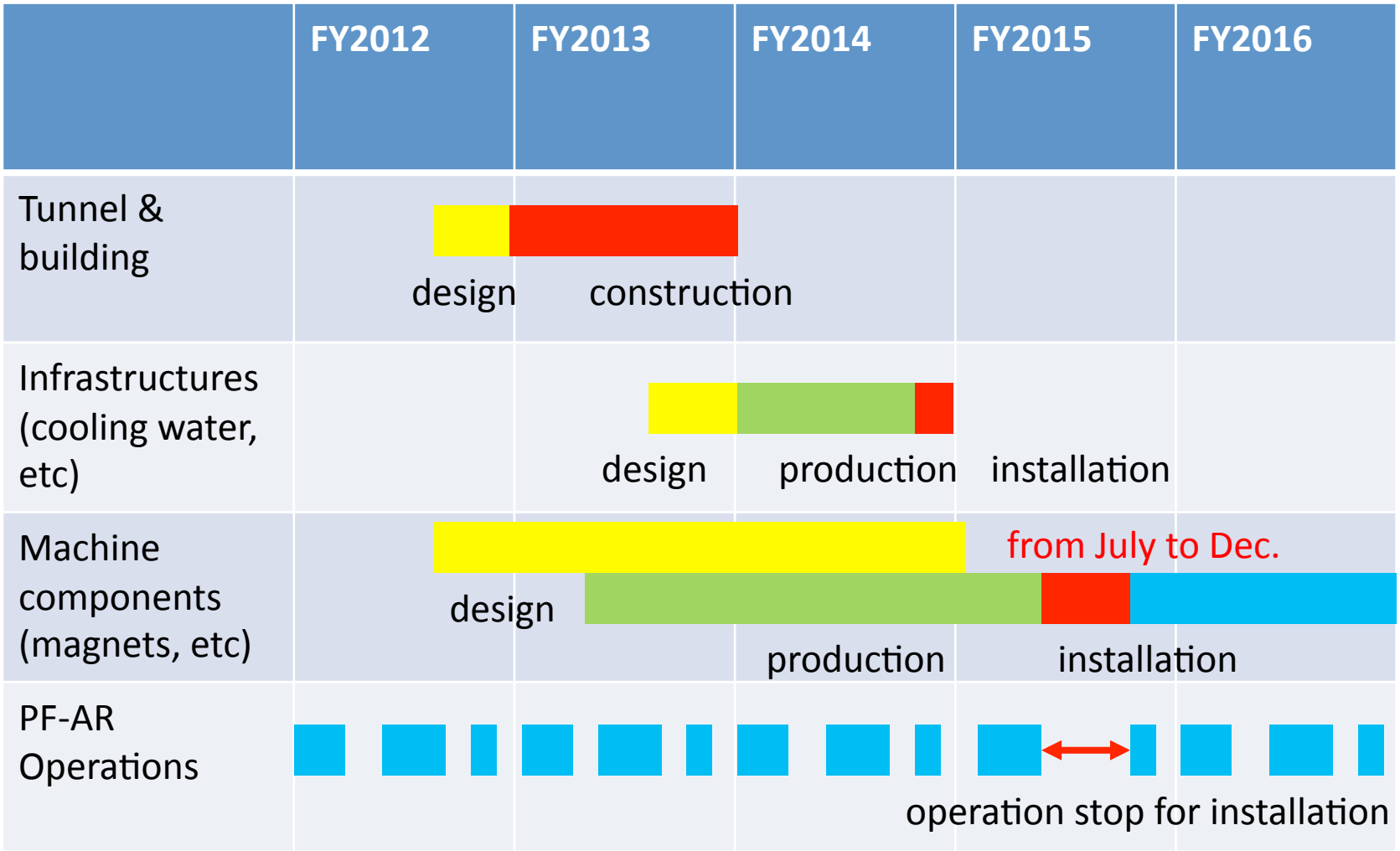
Beam loss at the new transport line

- 6.5GeV
  - Injection Beam
    - 0.2nC/bunch
    - 25Hz
    - 6.5GeV
    - 32.5W
  - Emittance
    - RF Gun 100×10^{-6} m rad
  - energy deviation
    - 0.1%
  - Beam pipe radius at Quadrupole magnet
    - 25mm

Beam loss ratio = 2.2×10^{-16} (with normal distribution)

(1 is all loss)

Upgrade schedule plan of new transport line for PF-AR



Summary

- Upgrade plan of new transport line was started and will be completed by FY2015.
- Beam injection to PF-AR will not disturb SuperKEKB operation any more. The new transport line will contribute to high luminosity operation of SuperKEKB.
- Top-up operation with full energy injection of 6.5 GeV will be realized at PF-AR.

Crossing SuperKEKB transport line