Beam Dumps

SNOWMASS, 15 August, 2005

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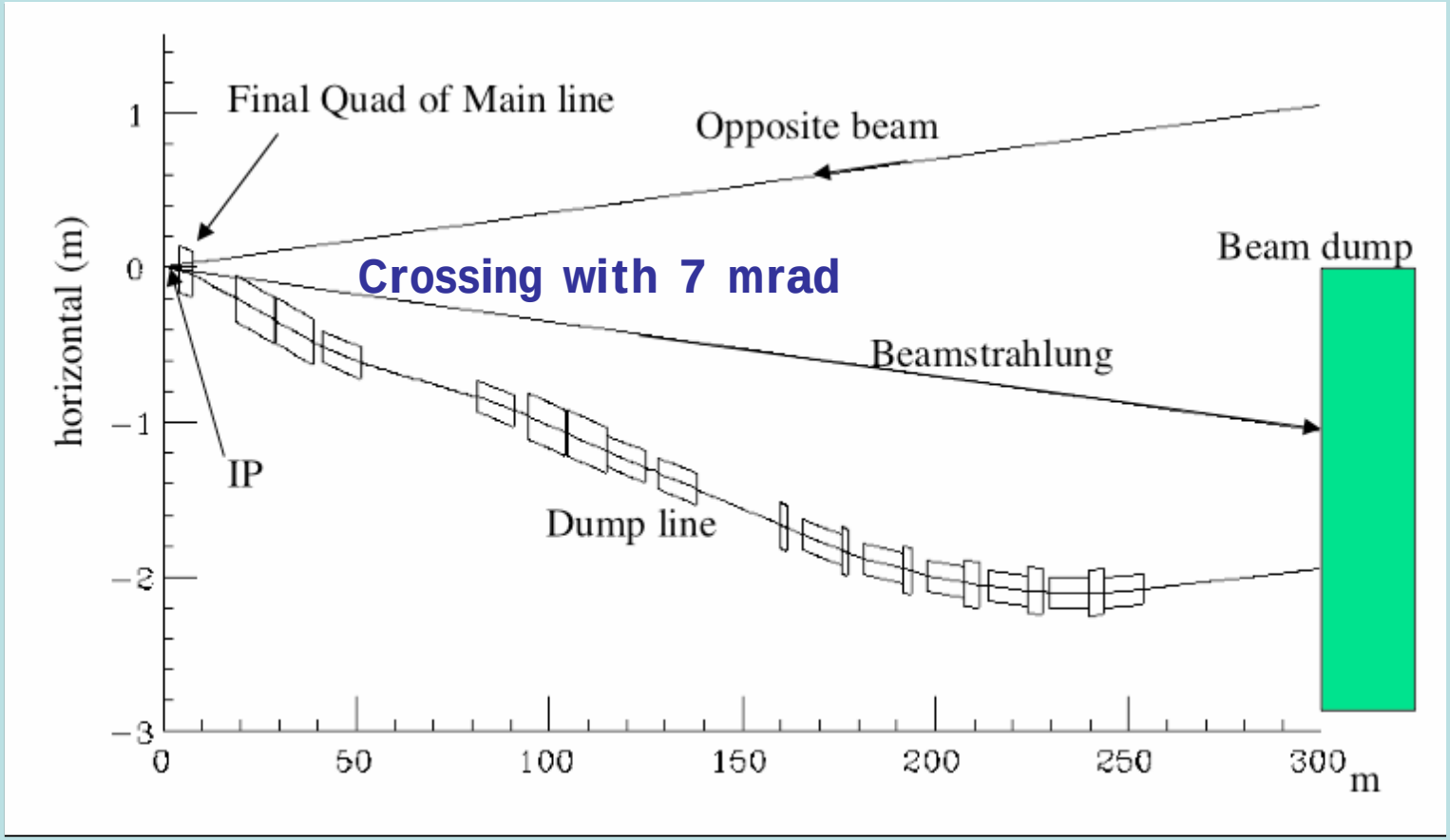
KEK

- These are results studied by GLC Conventional Facility Study Group.
  (Study on ILC beam dump system is going to be started.)

- Radiation problem was studied in detail by S. Ban et al. of KEK Radiation Science Center.

- System and layout were studied and designed under the coope-ration with Nikken Sekkei Ltd., Hitachi Engineering Co., Ltd. and Hitachi High-Technologies Corporation.

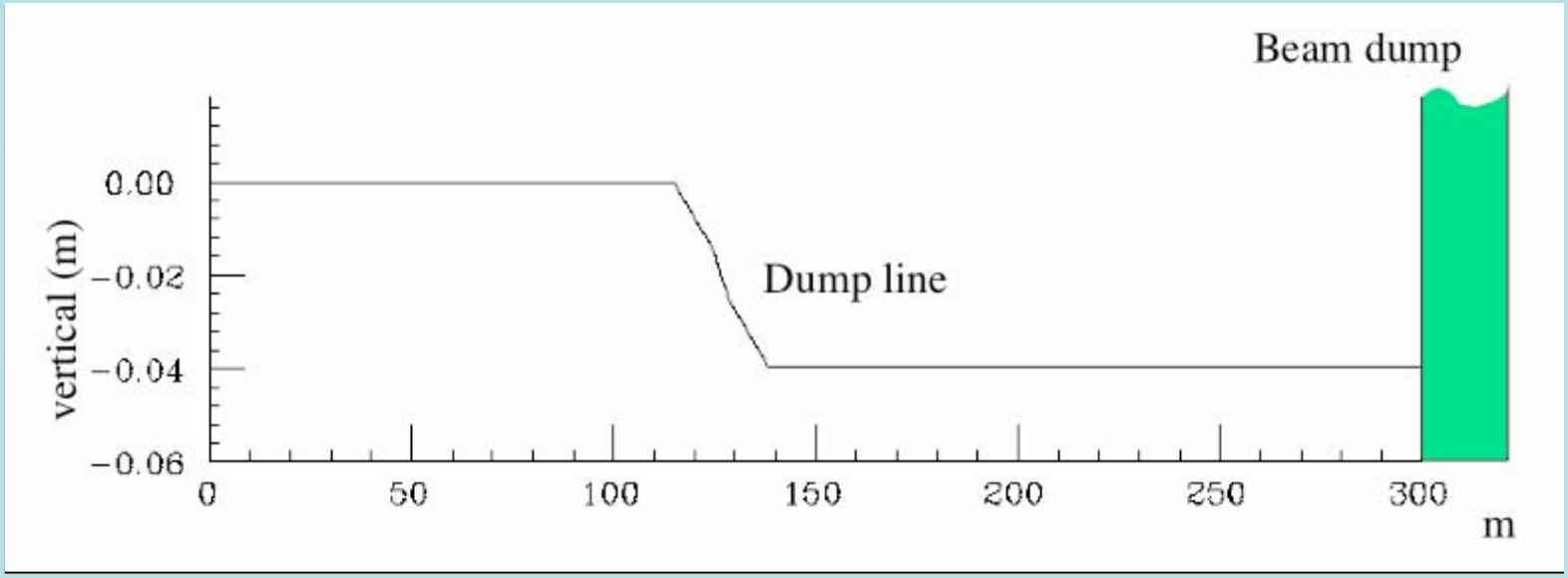
K. Kubo



Apertures ?
Shields ?

Background neutrons, photons to be estimated by the BDS-SIM.

Better with large crossing angle of 20 mrad ?



Beam Dump
1.6m-dia. x 10m

Spec. for Water Beam Dump System

Dumped power of 500 GeV beam
--> 12 MW (e+, e- 11 MW, Gamma 1 MW)

Dimension: 9 m long x 1.6 m diameter
(25 radiation length)
Water pressure: 1 M Pa
Water flow: 333 m^3/h
Amount of water in the dump: 20 m^3
Recovery tank: 60 m^3 … three times larger than beam dump
Amount of H_2 production in the water: 3L/s
--> H_2 Recombiner : 10 L/s … three times larger than H_2 production

H_2 Recombiner must be placed higher than Beam Dump, and
Recovery Tank must be lower than Beam Dump.

Radiation issues

To estimate radioactivity in the water,
Cross Section Calculation Code : PICA3/GEM

Amount of Radioactivity in the water
Be-7: 60 TBq
C-11: 96 TBq
N-13: 72 TBq
O-15: 280 TBq

Air ventilation system
Exchange the air in the dump hall (3200 m^3) in 1.5 hours

Activation in soil around the dump hall
Na-22 in the soil is less than IAEA Exemption Level, 10 Bq/g

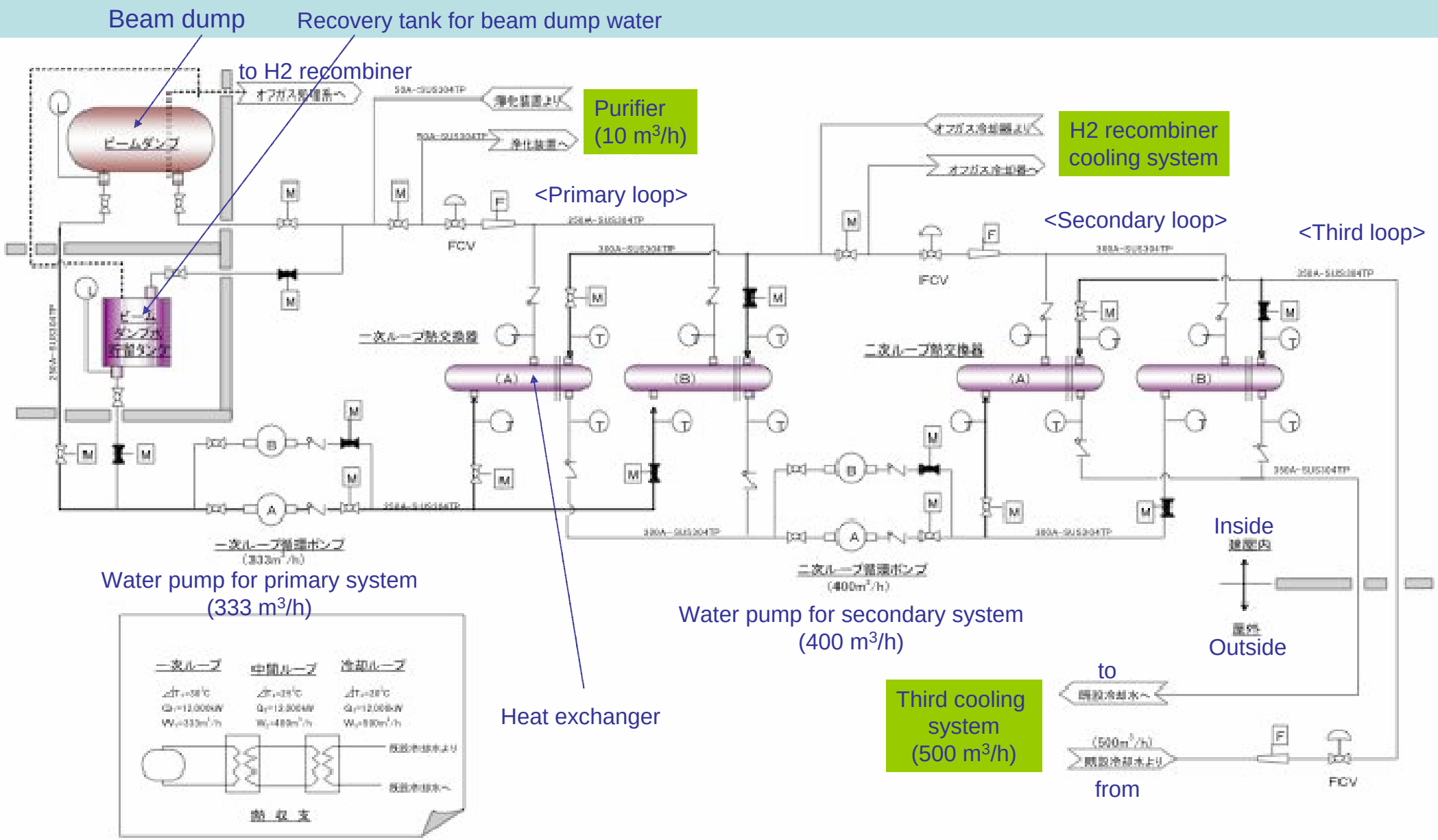
Radiation issues contd.

Amount of Radioactivity in Ion-exchangers

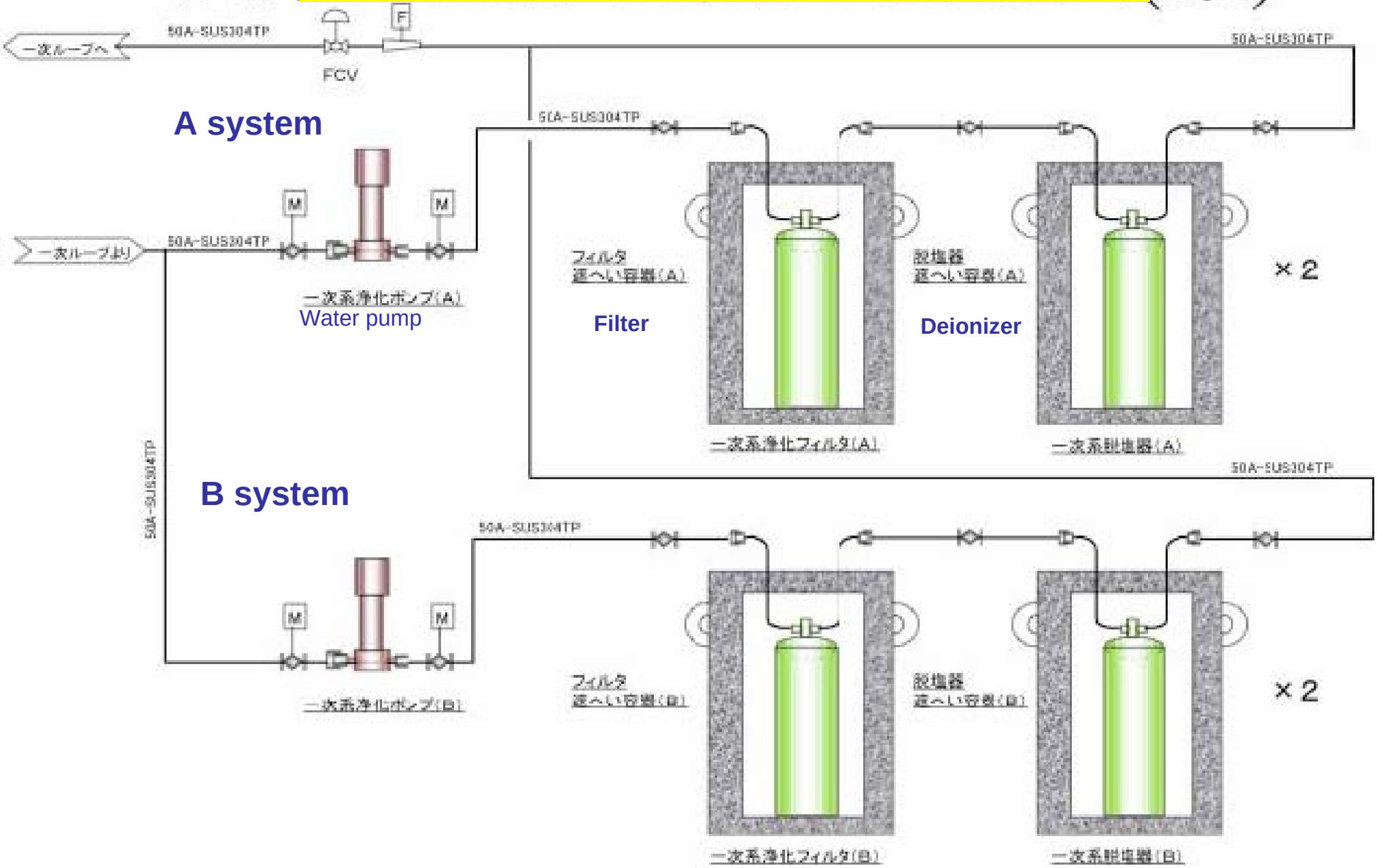
Estimated using the data for the KEK Proton Synchrotron Cooling Water System

Nuclei	Half life	Amount of activity(GBq)	Dose μSv/h@1m
Be-7	53.29Day	60000	428000
Co-58	70.86Day	57.6	7550
Co-57	271.7Day	14.7	258
Mn-54	312.1Day	12.9	1430
Co-56	77.23Day	4.96	2100
Co-60	5.271Year	1.59	485
Total			440000μSv/h

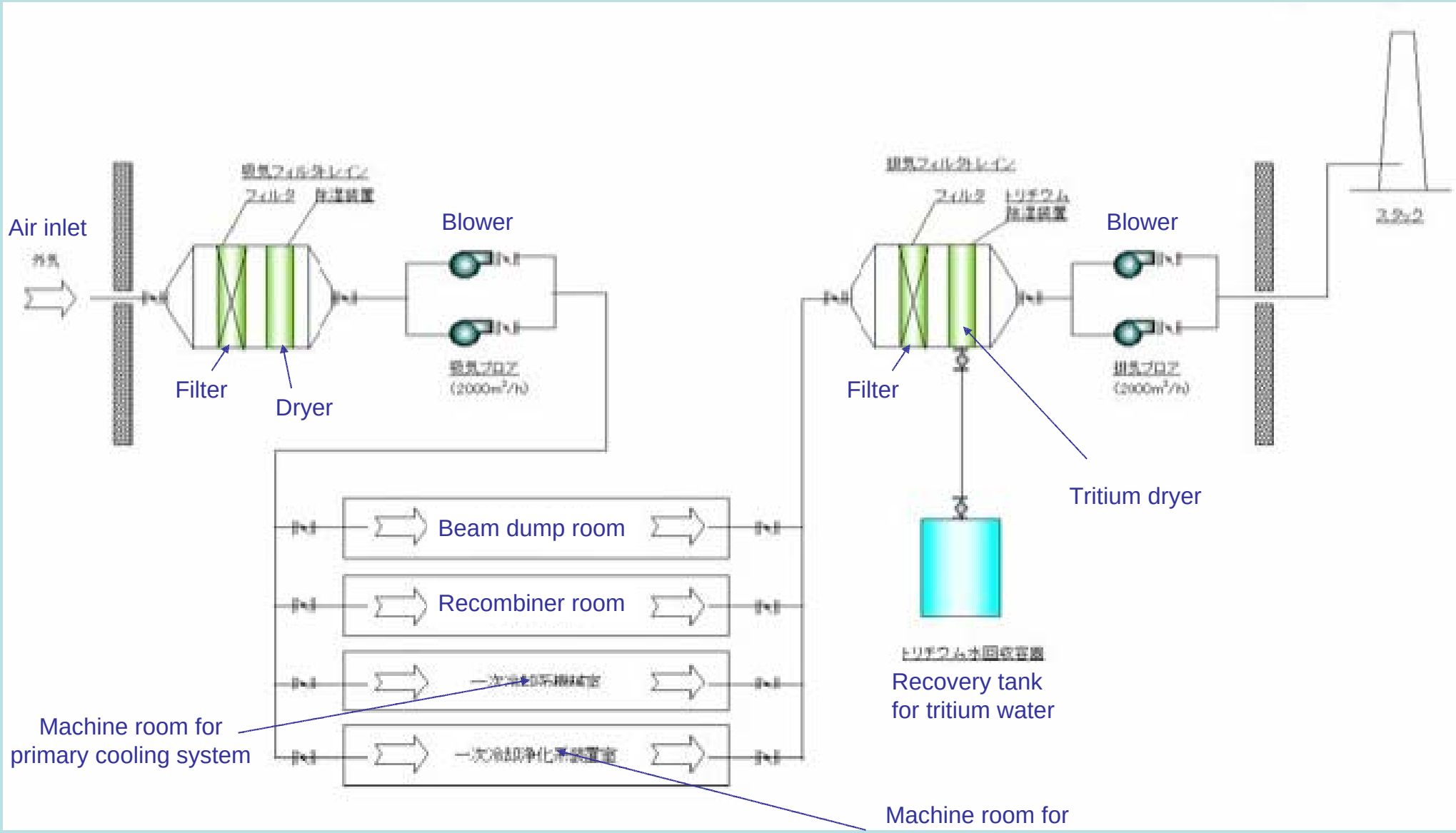
Flow chart of cooling water system



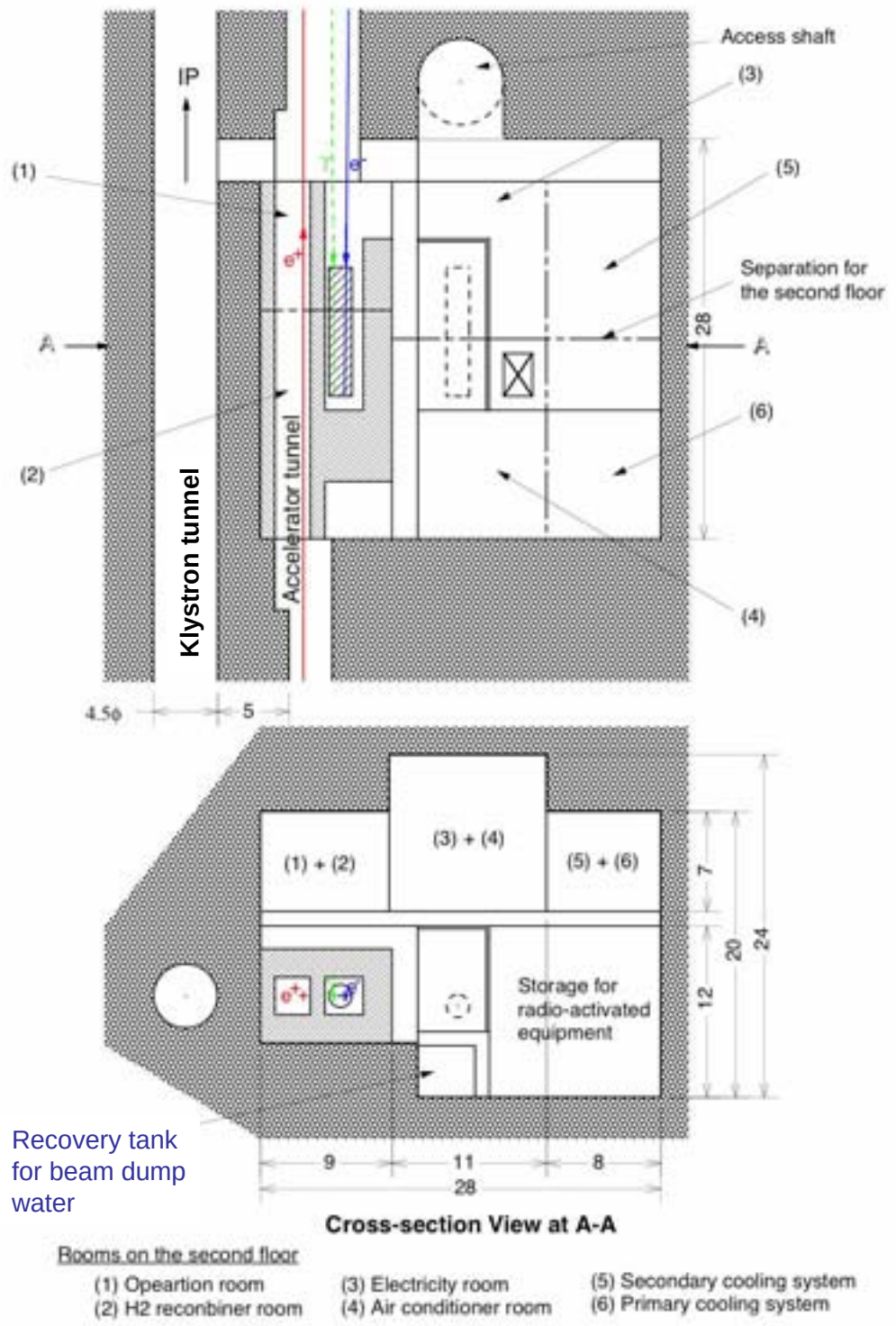
Purifier for primary cooling system
(Two systems for safety)



Flow chart for air conditioner



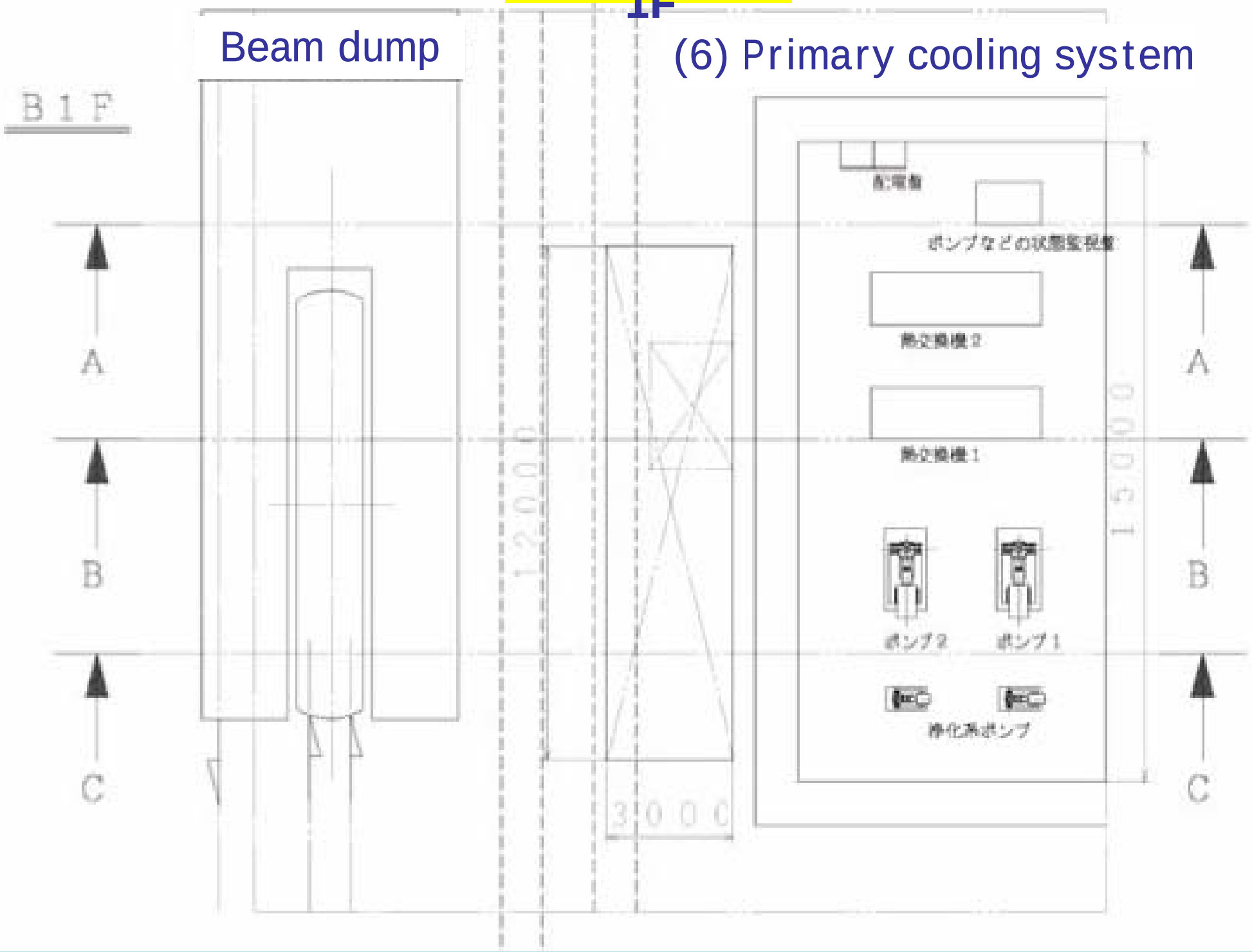
Layout


Access shaft
(3)
IP
(1)
(5)
Separation for
the second floor
28
A
A
(6)
(2)
Klystron tunnel
Accelerator tunnel
(4)
4.5ϕ
5
(1) + (2)
(3) + (4)
(5) + (6)
7
20
24
12
Storage for
radio-activated
equipment
Recovery tank
for beam dump
water
9
11
8
28
Cross-section View at A-A
Booms on the second floor
(1) Opeartion room
(2) H2 reconbiner room
(3) Electricity room
(4) Air conditioner room
(5) Secondary cooling system
(6) Primary cooling system

Layout of 1F

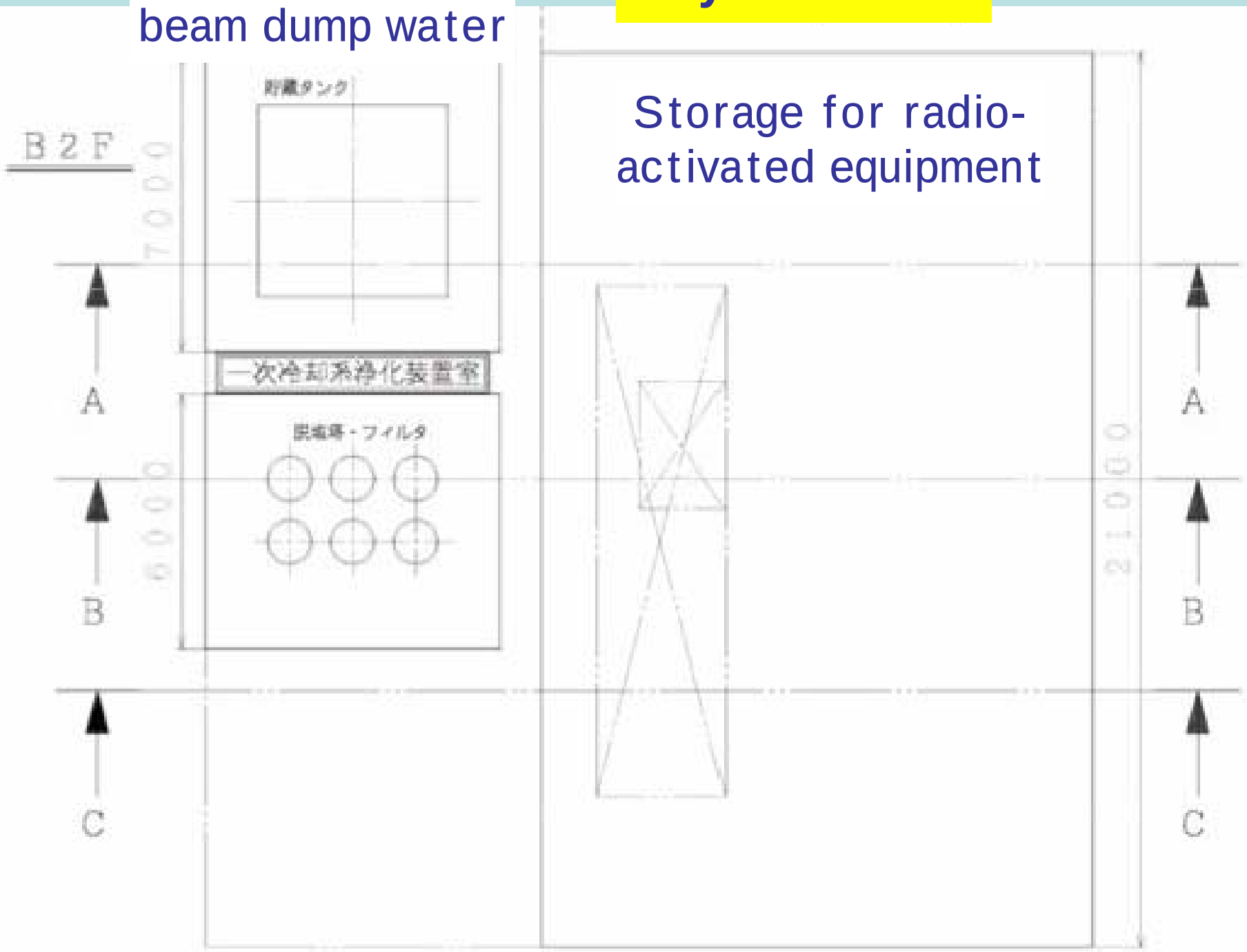
Beam dump

(6) Primary cooling system



Layout of 1FB

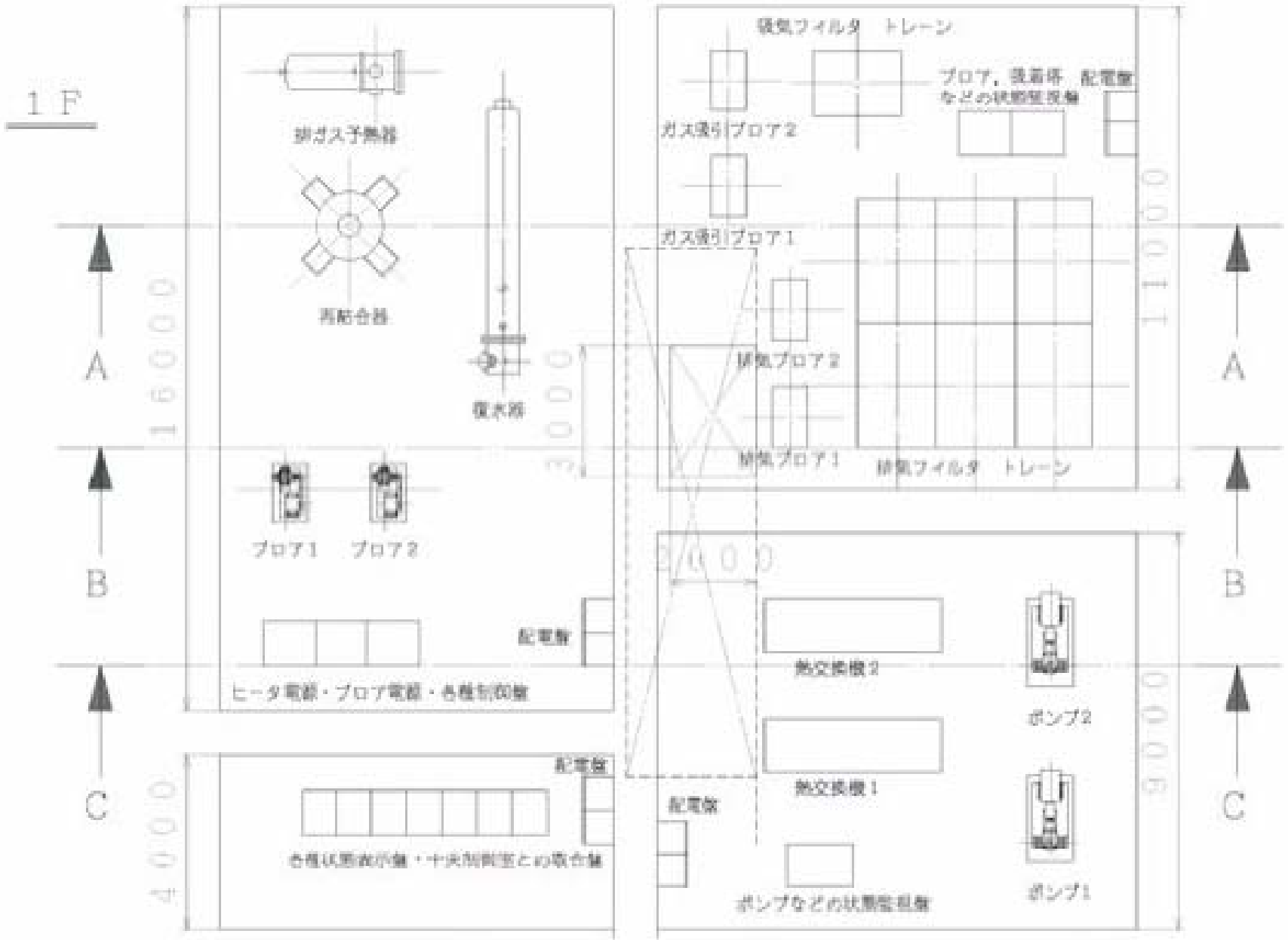
Recovery tank for beam dump water



Storage for radio-activated equipment

Layout of 2F

(2) H2 recombiner room (4) Air conditioner room



(1) Operation room (5) Secondary cooling system

Summary

- Detailed study on following items is needed:
  - Beam dump structure
  - Beam window
  - Scenario how to change the beam window
  - How to move used beam dump to the storage room
  - How to move used radio-activated equipment to the storage room
  - Maintenance scenario for each equipment
  - etc. …..

- Need to study the case that tritium water in the beam dump leaks in the air. How to remove the water from the air completely.

- Need to update to ILC version
  - Beam power: 11MW --> 23MW
  - Power of bremss-gamma: 1MW --> 2MW

Dumpline : Layout

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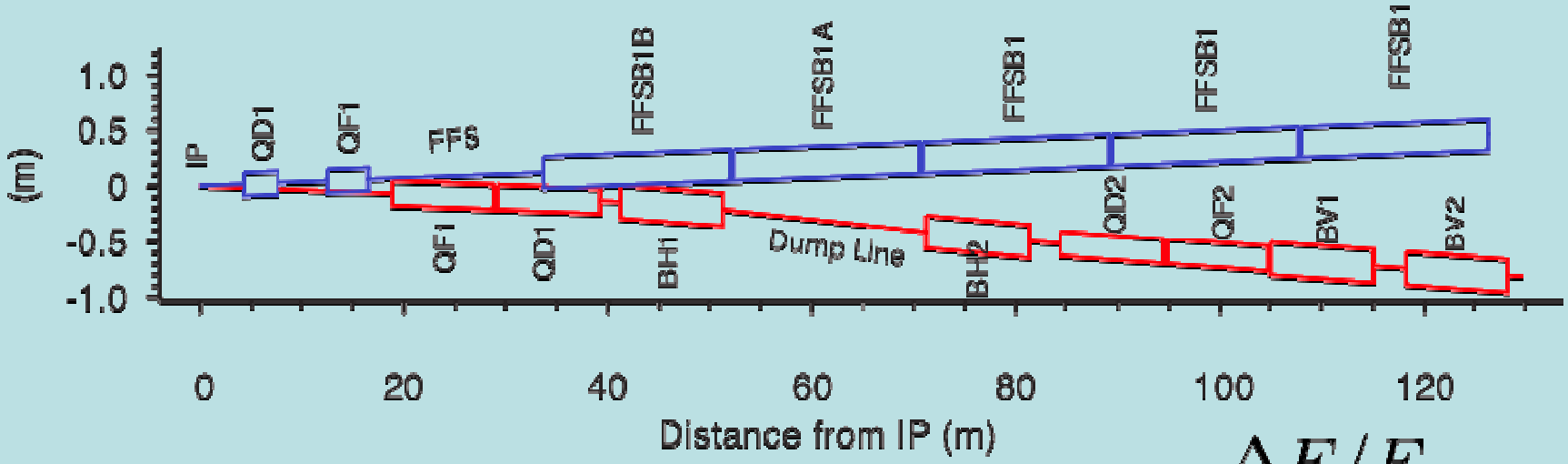
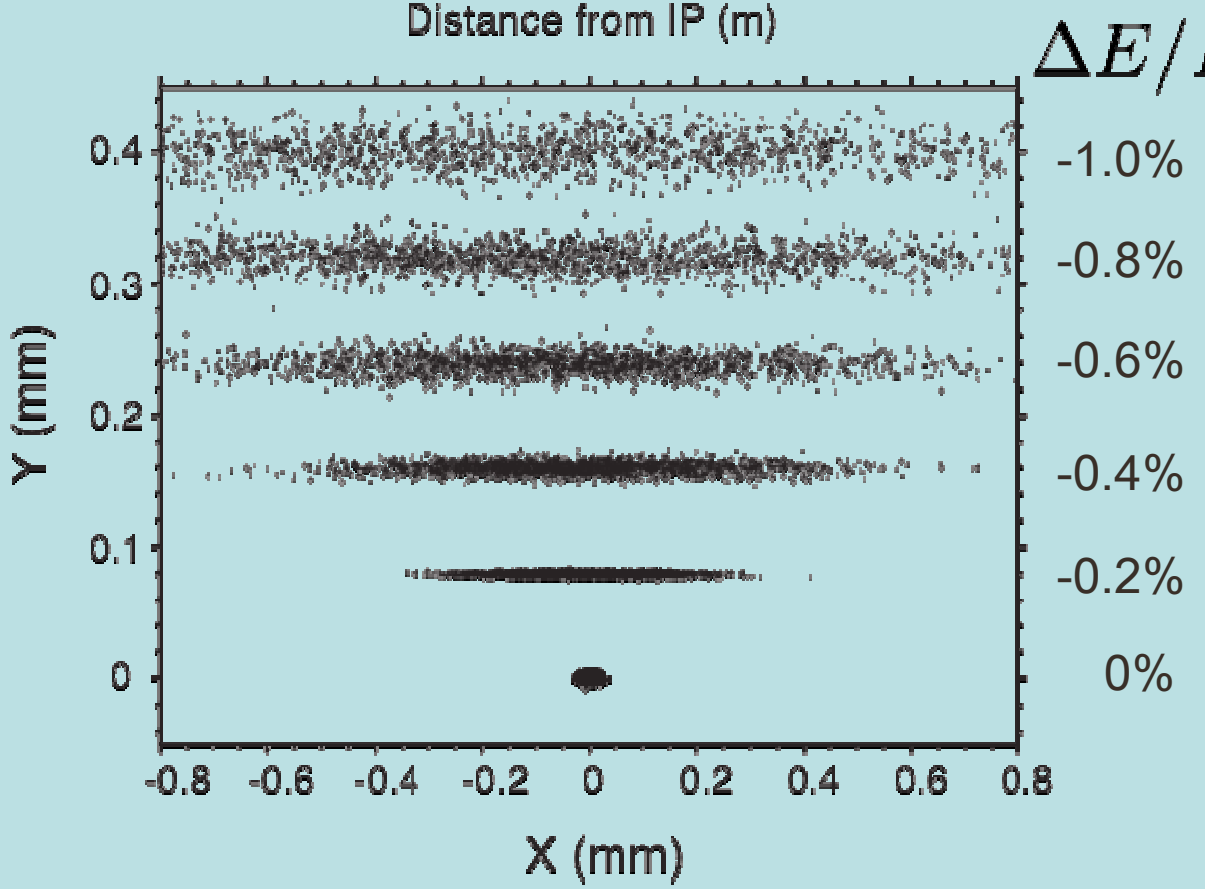
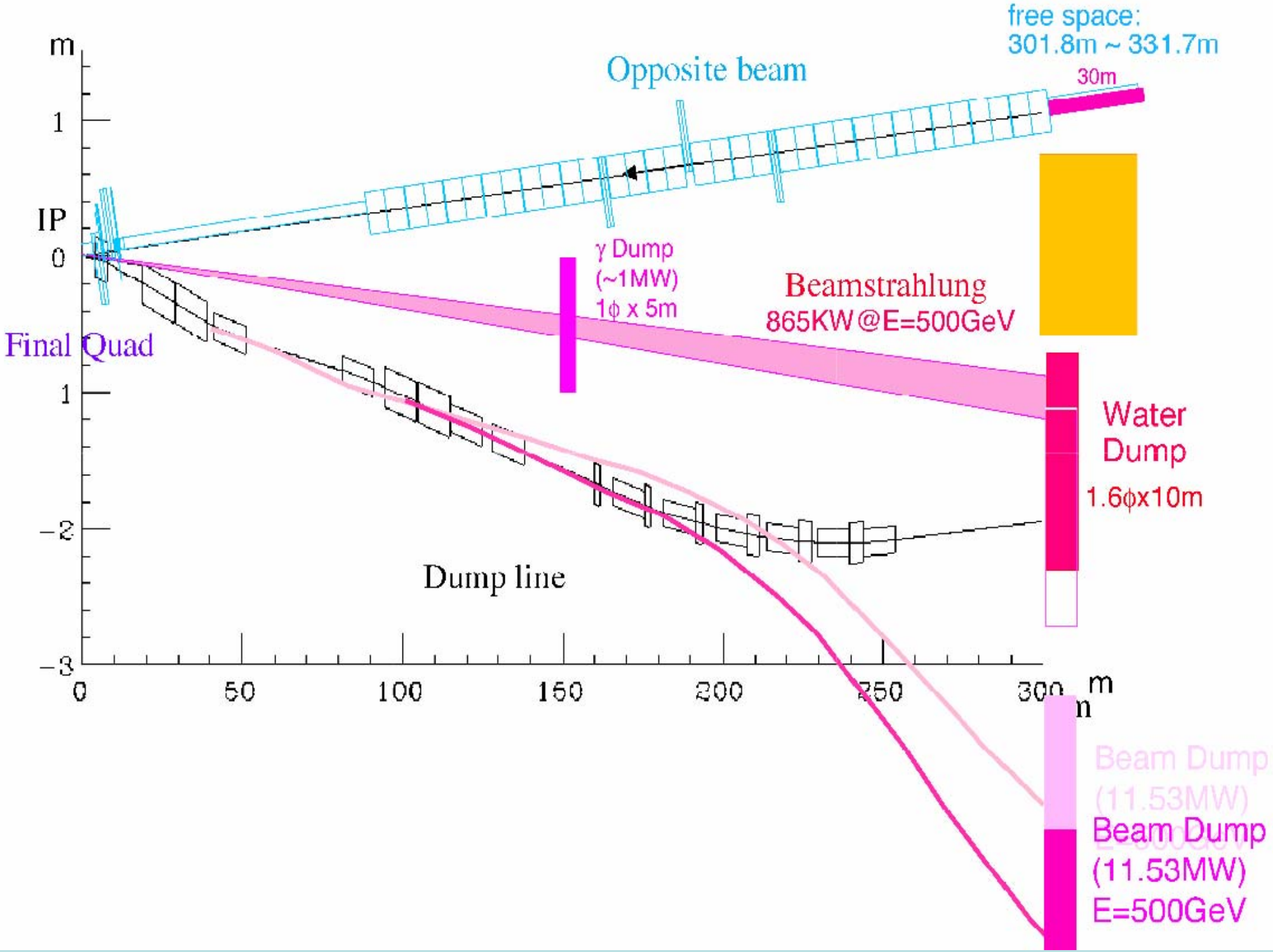
GLC 1TeV



2nd FP at 140m

Beam Spot at the 2nd FP




free space:
301.8m ~ 331.7m
Opposite beam
30m
m
1
IP
0
1
−2
−3
γ Dump
(~1MW)
1ϕ x 5m
Beamstrahlung
865KW@E=500GeV
Final Quad
Water
Dump
1.6ϕx10m
Dump line
0
50
100
150
200
250
300
m
Beam Dump
(11.53MW)
E=500GeV
Beam Dump
(11.53MW)
E=500GeV