Preliminary Studies of Radiation Safety Issues for E160 Experiment in the ESA

June 3, 2002

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Three operation modes in E160 experiment:

- Use electron beams to produce photon beams for E160 experiment.
- Use electron beams to calibrate SEQ quantameter.
- Use electron beams to calibrate Spent electron ion chamber.

1. Electron beam parameters in the A-line when the photon beam is produced:

To produce the photons, an electron beam hits a diamond crystal, and is bent to an electron dump located at the end of A-line by the four dump magnets (B33, B34, B35, and B36).

Electron beam energy:	Up to 48.3 GeV
Beam power:	Up to 60 kW
Diamond crystal:	Up to 1.5 mm thick, 0.015 rl Located downstream of ST29.

Table 1. Nominal dump magnet setting for 48.3 GeV Beam when the photon beam is produced

	Dipole B33	Dipole B34	Dipole B35	Dipole B36	Sweep Magnet
Magnet Field	56.3 kG-m	56.3 kG-m	56.3 kG-m	56.3 kG-m	55 kG-m
Polarity (Ver. Plane)	e^- to ground	e^- to ground	e^- to ground	e^- to ground	μ^- to ground

2. Electron beam parameters in the A-line when the electron beam is used to calibrate Quantameter (SEQ):

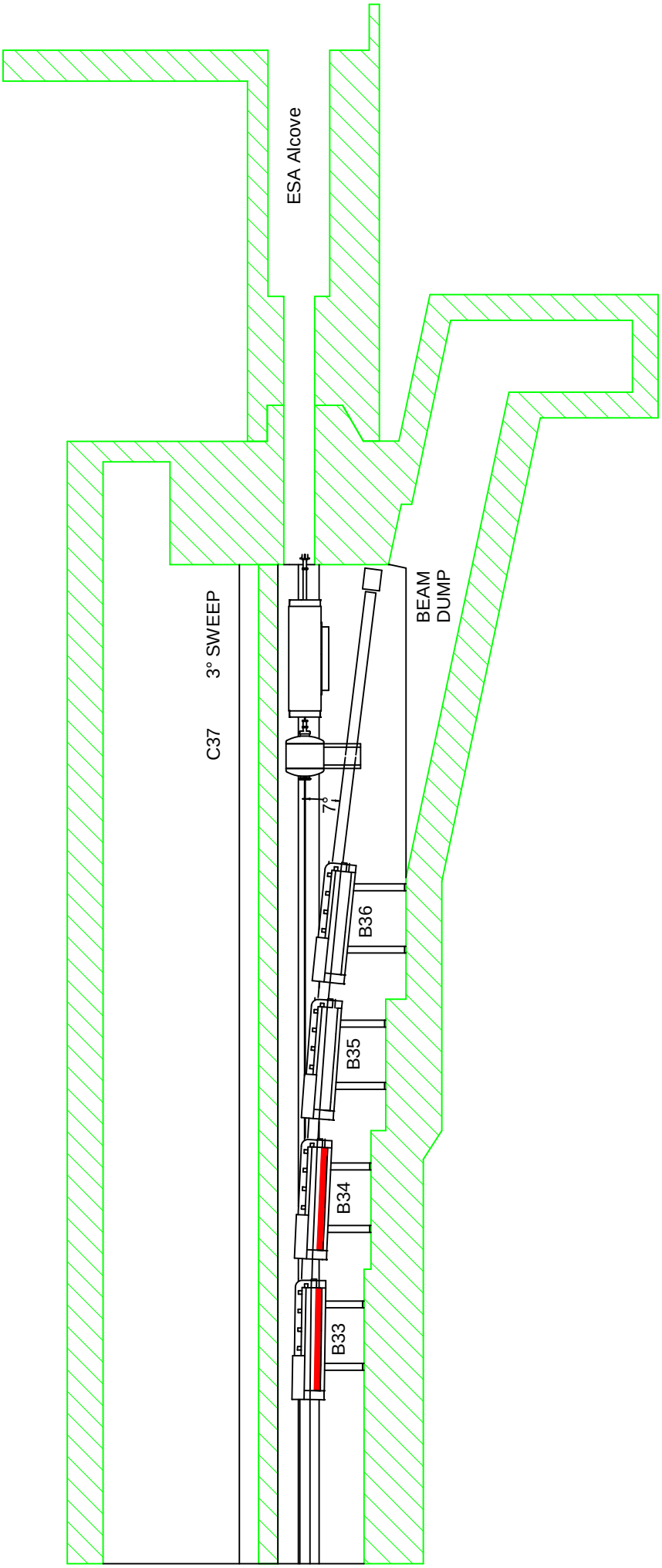
An electron beam is delivered into the ESA to calibrate the SEQ Quantameter. The four dump magnets (B33, B34, B35, and B36) and Sweep magnet are off. All magnets in the ESA are off. The electron beam parameters for the calibration are listed as follows:

Electron beam energy: 10 --- 48.3 GeV
Electron beam power: Up to 10 kW.
The beam time in this operation mode is less than 5 % of E160 running time.

3. Electron beam parameters in the A-line when the electron beam is used to calibrate Spent electron ion chamber.

The four dump magnets (B33, B34, B35, and B36) are set at 48.3 GeV. Electron beams with energies of 10 --- 35 GeV is delivered to and parked at Spent electron ion chamber.

Electron beam energy: 10 --- 35 GeV
Electron beam power: Up to 1 kW.
The beam time in this operation mode is less than 5 % of E160 running time.


ESA Alcove
3° SWEEP
C37
BEAM
DUMP
7°
B36
B35
B34
B33

4. Photon beam parameters for E160:

The produced photon beam parameters are listed as follows:

Primary photon beam energy: 15 --- 35 GeV

Maximum photon beam power: Up to 2 kW

Nominal running photon beam power to SEQ:
1 kW for two months.

E160 targets: Be to Au, up to 0.2 rl.

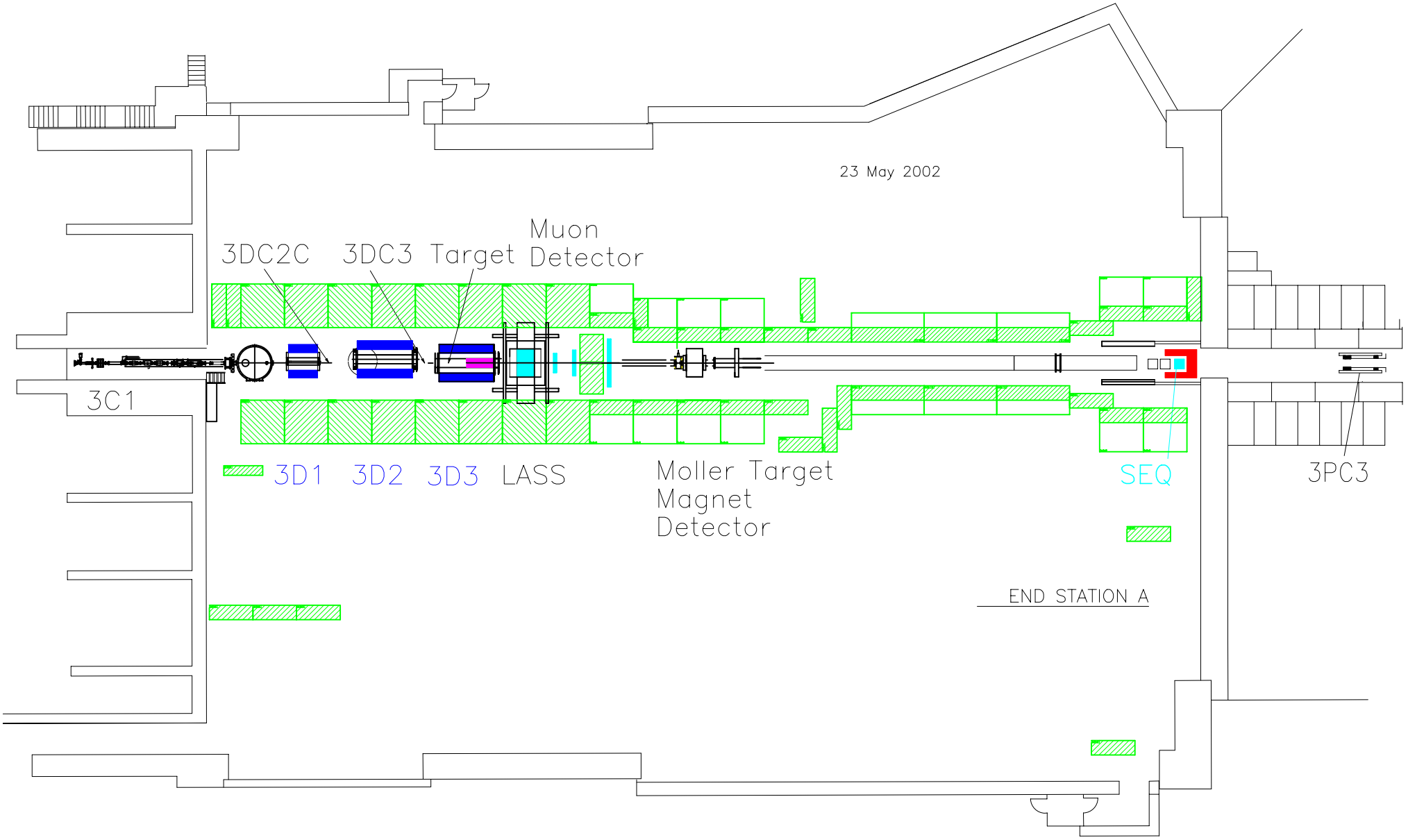

23 May 2002
3DC2C
3DC3
Target
Muon
Detector
3C1
3D1
3D2
3D3
LASS
Moller
Magnet
Target
Detector
SEQ
3PC3
END STATION A

Table 2. Nominal E160 spectrometer magnet setting

	Dipole 3D2	Dipole 3D3	Dipole LASS
Magnet Field	40 kG-m	75 kG-m	45 kG-m
Polarity (Hor. Plane)	North or south	North or south	North or south

4. Compton Polarimeter (to be designed):

A Compton polarimeter is needed to measure the circular polarization of the photon beam for E159 and E161. It will be used to measure the photon spectrum of E160. The polarimeter consists of a Moller target, a magnet and a detector. The polarimeter magnet field strength is 20 kG-m, and bends the electrons to north or south.

5. Beam Losses in Nominal running condition

	Energy deposition by photon beam
Collimator C37	2000 W
Collimator 3DC2	10 W
E160 target	100 W
Beam pipe	< 10 W
SEQ	1 kW

6. Radiation Shielding

a. Shielding for electron the dump

b. The existing E158 concrete tunnel inside the ESA provides very good shielding for E160 Experiment as well. It is planned to keep most part of E158 concrete tunnel in the ESA to meet requirements of both radiation safety and earthquake protection.

c.Shielding for photon dump (16" lead on the northside of the dump, 12" lead on the southside of the dump, 7" lead on the top of the dump, 16" at the downstream of the dump,

Table 3 Beam Containment system (BCS) for the E160

Beam Containment System	Status	Protection Devices	Setting
Average Current monitor I1, I10, I28	existing		Limit the beam power to 60 kW
Electron dump **100 kW, water cooling**	**new**	**Two flow switches** **BTMs**	
Collimator 3C1 5 kW, water cooling	existing	Two ion chambers Two BTMs	Ion Chamber 3IC1A/B setting @ 2 KW
Lions 3LION1A, 3LION1B	existing		2 kW
Lions 3LION2A, 3LION2B	existing		10 kW
Photon dump **10 kW, water cooling**	**new**	**Two flow switches** **One BTM**	

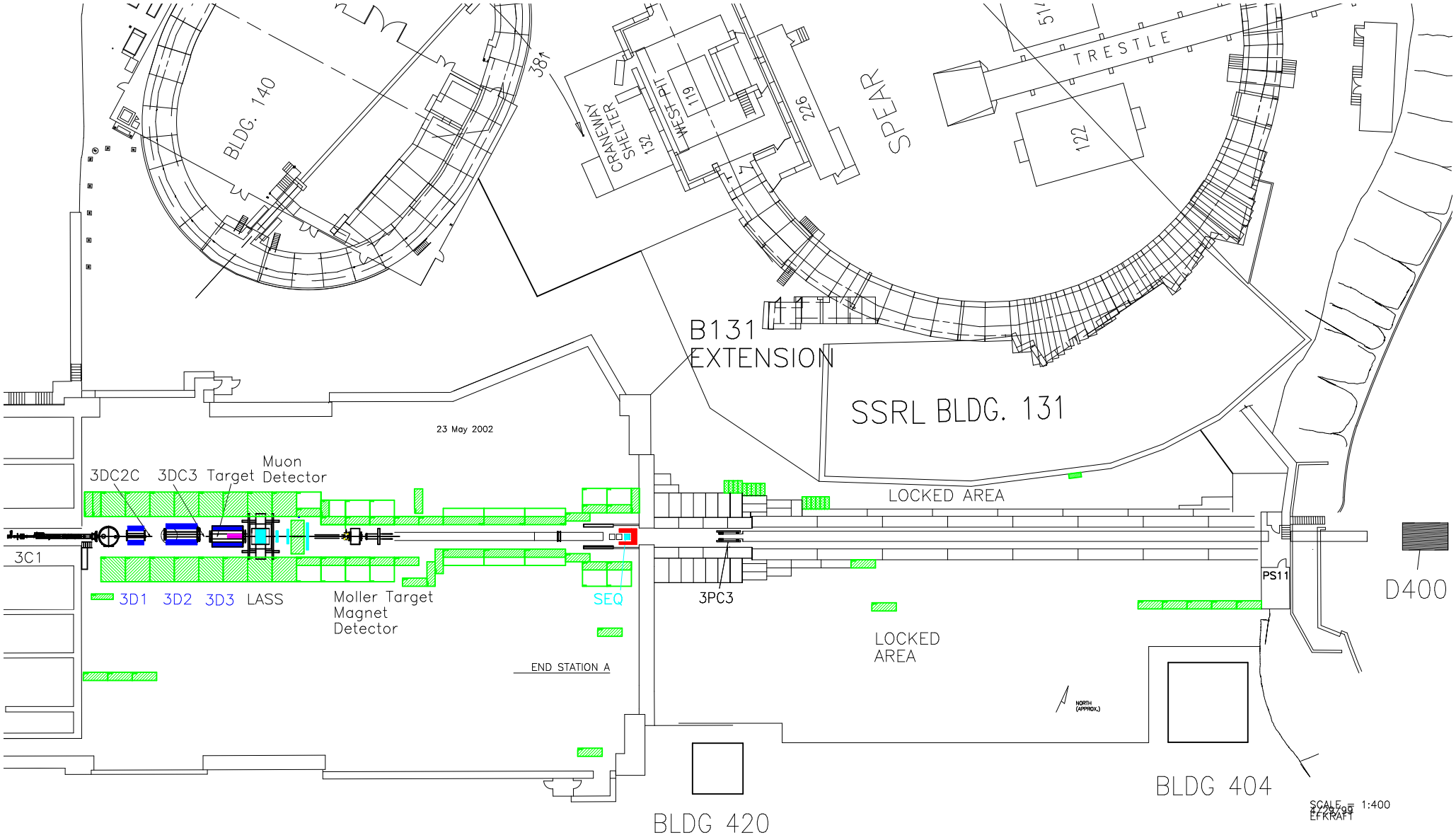
Failure analysis:

1. Mis-steering condition: 2 kW

2. Maximum credible accident: 1300 kW

Radiation Dose during E160 Experiment

	Design goal
Counting House	< 100 mrem one year
Around ESA	< 0.5 mrem/hr
SSRL	40 mrem from ESA operation for one year
Mis-steering	< 400 mrem/hr
Max. Accident	< 25 rem/hr


BLDG. 140
381
CRANEWAY SHELTER
131
WEST PIT
119
226
SPEAR
TRESTLE
122
B131 EXTENSION
SSRL BLDG. 131
23 May 2002
3DC2C
3DC3
Target
Muon Detector
3C1
3D1
3D2
3D3
LASS
Moller Target Magnet Detector
SEQ
3PC3
LOCKED AREA
PS11
D400
LOCKED AREA
END STATION A
NORTH (APPROX.)
BLDG 404
BLDG 420
SCALE = 1:400
EFKRAFT