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 Radiations Science Center. 
System and layout were studied and designed under the cooperation with Nikken Sekkei Ltd., Hitachi Engineering Co., Ltd. and Hitachi High-Technologies Corporation.
Apertures

Shields? Background neutrons, photons to be estimated with the BDS-SIM.

Better with larger crossing angles mrad?

Beam Dump 1.6m-dia. x
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

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

For ventilation system
- Exchange the air in the dump hall (3200 m³) in 1.5 hours

Activity in soil around the dump hall
- Na-22 in the soil is less than IAEA Exemption Level, 10 Bq/
## Amount of Radioactivity in Ion-exchangers
Estimated using the data for the KEK Proton Synchrotron Cooling Water System

<table>
<thead>
<tr>
<th>Nuclei</th>
<th>Half life</th>
<th>Amount of activity (GBq)</th>
<th>Dose $\mu$ Sv/h@1m</th>
</tr>
</thead>
<tbody>
<tr>
<td>Be-7</td>
<td>53.29 Day</td>
<td>60000</td>
<td>428000</td>
</tr>
<tr>
<td>Co-58</td>
<td>70.86 Day</td>
<td>57.6</td>
<td>7550</td>
</tr>
<tr>
<td>Co-57</td>
<td>271.7 Day</td>
<td>14.7</td>
<td>258</td>
</tr>
<tr>
<td>Mn-54</td>
<td>312.1 Day</td>
<td>12.9</td>
<td>1430</td>
</tr>
<tr>
<td>Co-56</td>
<td>77.23 Day</td>
<td>4.96</td>
<td>2100</td>
</tr>
<tr>
<td>Co-60</td>
<td>5.271 Year</td>
<td>1.59</td>
<td>485</td>
</tr>
</tbody>
</table>
beam dump
Recovery tank for beam dump water

Water pump for primary system
(333 m³/h)

Heat exchanger

Water pump for secondary system
(400 m³/h)

Third cooling system
(500 m³/h)

Purifier
(10 m³/h)

H₂ recombiner cooling system

to H₂ recombiner

inside

outside

<Primary loop>

<Secondary loop>

<Third loop>
(Two systems for safety)

A system

Water pump

Filter

Deionizer

B system
Layout

Recovery tank for beam dump water

Klystron tunnel

Separation for the second floor
(6) Primary cooling system
Storage for radio-activated equipment
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 room how to remove the water from the air completely.

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