Asian Tunnel Configuration

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**Contents of this talk**

- Specific feature of Asian Sample Site
- Ways of access from ground to underground
- Sections of caverns
- KCS and DRFS configurations
Specific feature of Asian Sample Site
**Elevation**

Higher hill area El. ~400 m

Lower hill area El. ~200 m

Beamline Elevation 80 m

Minimum overburden 50 m
Ways of access from ground to underground
What changes in SB2009?

- ~1200 m (UND) eliminated
- ~6600 m (Sep 25 ver.)
- 5800 m (5200 m in RDR)

Our presentation at Albuquerque based on SB2009 CFS Key Plan 8 21 Version
Access Points (SB2009)

Point (Elevation)
P1(354) P11(354)
P7(319) P7(319)
P5.1(239) P5.1(239)
P5(412) P5(412)
P3.1(670) P3.1(670)
P3(479) P3(479)
P3.3(423) P3.3(423)
P5(412) P5(412)
P5.1(250) P5.1(250)
P7(319) P7(319)
P11(354) P11(354)
P2.2(209) P2.2(209)
P2(156) P2(156)
P2.1(183) P2.1(183)
P4(154) P4(154)
P4.1(154) P4.1(154)
P6(211) P6(211)
P10(170) P10(170)

Beamline Elevation 80 m

What we did up to this meeting

Possibilities of reducing distance from surface to underground tunnel
----- though it may cost higher

<table>
<thead>
<tr>
<th>Case</th>
<th>Access way</th>
<th>Schematic Layout</th>
</tr>
</thead>
<tbody>
<tr>
<td>RDR</td>
<td>Sloped Tunnel</td>
<td>![Sloped Tunnel Diagram]</td>
</tr>
<tr>
<td>Case B</td>
<td>Shaft</td>
<td>![Shaft Diagram]</td>
</tr>
<tr>
<td>Case C</td>
<td>Shaft + Horizontal Tunnel</td>
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<tr>
<td></td>
<td>(surface hall)</td>
<td></td>
</tr>
<tr>
<td>Case D</td>
<td>Shaft + Horizontal Tunnel</td>
<td>![Shaft + Horizontal Tunnel Diagram]</td>
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<tr>
<td></td>
<td>(underground hall)</td>
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We have figured out some sloped tunnels can/should be replaced by shafts/(shafts+horizontal tunnel) taking account of not only access length but also the construction costs.
Sections of caverns
### Tunnel Cross Section assumed in RDR

<table>
<thead>
<tr>
<th>Unit</th>
<th>Description</th>
<th>ALCPG09, Albuquerque, 29 Sep. – 3 Oct. 2009</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Section</strong></td>
<td><strong>Diameter (m)</strong></td>
<td><strong>Unit Costs</strong></td>
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<tr>
<td><strong>1m Diameter</strong></td>
<td>1m diameter shaft, step-by-step Double-tailing of 1m thick</td>
<td></td>
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<tr>
<td><strong>2m Diameter</strong></td>
<td>2m diameter shaft, step-by-step Double-tailing of 1m thick</td>
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<tr>
<td><strong>3m Diameter (bridge holder)</strong></td>
<td>3m diameter shaft, step-by-step Double-tailing of 1m thick</td>
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<tr>
<td><strong>4m Diameter (bridge holder)</strong></td>
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<tr>
<td><strong>5m Diameter</strong></td>
<td>5m diameter shaft, “raise borer” Steal pipe</td>
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### Tunnel Cross Section

- **Tunnel Support**
- **Concrete Radius (R)**
- **Height (H)**
- **Width (W)**

**ALCPG09, Albuquerque, 29 Sep. – 3 Oct. 2009**
Global Design Effort - CFS

Tunnel Cross Section assumed in RDR

Positron generator hall in “1.2km area” of the e-Beamline.
**Granite (compressive strength ~100MPa)**

- Underground structure without concrete lining.
- Basically finished with “Shotcrete” (sprayed concrete).
- Drainage boring and Grouting as supplementary work.

An example of underground facilities constructed in granite geology: Tenryugawa-Sakuma underground dam plant without lining worked more than 50 years without any troubles.
Construction Experiences in Japan

- By S.Shikama (Kumagaigumi Co.Ltd. JAPAN)
  at Asian KOM, Sep. 2007 (following 5 slides).

POWER STATION (CAVERN TYPE)
Global Design Effort  - CFS

Tunnel Cross Section assumed in RDR

Sectional Area (m²)

LEGEND

IR-hall (1,189M²)

Year

1940 1960 1980 2000

Global Design Effort - CFS

Tunnel Cross Section assumed in RDR

CAVERN SECTIONAL SHAPE
Tunnel Cross Section assumed in RDR
KCS and DRFS configurations
Work Assumption (proposal to avoid confusion)

Machine designs should be one for each
- Many designs need more studies and R&Ds

CFS designs should be arranged to match the machine designs even if it raise the CFS cost
- For KCS in Asian site we consider additional underground caverns
- For DRFS in CERN site how much is an extra cost to reinforce the ceiling

Safety solutions will be regional
- Solution of additional tunnel for safety under consideration in Asian team should be treated as an alternative at present.
Work Assumption for KCS (Asia)

Possibilities of reducing distance from surface to underground tunnel
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Additional KCS cavern
Work Assumption for DRFS (Asia)

Tunnel Inner Diameter 4.5 m

Space seems poor for Air conditioning / cooling water / He emergency system. Need more diameter and alcoves for CFS equipment every 4th RF unit.
Work Assumption for DRFS (Asia)

Tunnel Inner Diameter 5.2 m

Space seems better

Alternative solution for safety (not included in SB2009 cost)
Summary
Summary of this talk

- Based on SB2009 CFS key plan, ways of access to the underground tunnel were studied.
- Some of the sloped tunnel can/should be replaced by shaft/ shaft+h. tunnel.
- Cavern section issue in Asian site was reviewed.
- A work assumption was proposed to avoid confusion about KCS and DRFS.
- As SB2009 ML single tunnel size, 5.2 m is chosen to develop civil design and cost.