Regulatory issues in
RITE's Field Test of CO$_2$
Aquifer Sequestration

November 7,
2003

Takashi OHSUMI
RITE
(Research Institute of Innovative Technology for the Earth)
## Field Injection Studies for Aquifer Sequestration

<table>
<thead>
<tr>
<th>Location</th>
<th>Target formation</th>
<th>CO$_2$ injection rate &amp; source</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>SACS at Sleipner Field</td>
<td>offshore saline aquifer with a depth of 1.0 km</td>
<td>1 mil. ton/year, captured from natural gas</td>
<td>Ended (1998 – 2002) Continued to CO2STORE</td>
</tr>
<tr>
<td>Weyburn Monitoring Project</td>
<td>on-land oil reservoir with a depth of 1.0 km</td>
<td>1 mil. ton/year, generated in a gasification plant</td>
<td>continuing</td>
</tr>
<tr>
<td>RITE field test for injection at NAGAOKA</td>
<td>on-land saline aquifer with a depth of 1.1 km in a gas field</td>
<td>20 ton/day, purchased in the market</td>
<td>500-day injection started in July, 2003</td>
</tr>
<tr>
<td>Ohio Valley</td>
<td>Inland deep saline aquifer with a depth of 3km</td>
<td>1 mil. ton/year, supplied from on-site?</td>
<td>On-going (drilled hole for site Characterization completed)</td>
</tr>
</tbody>
</table>
R&D on the CO2 geological storage started in FY 2000 in Japan, operated by RITE.

METI

RITE

( subsidy )

In-house study

SEC

Safty & Environmental Center for Oil Development

Site owner

CO2 Storage Lab.
- Laboratory Experiment

System Analysis Lab.
- LCA, Risk Analysis etc.
Japanese Target Site for Aquifer Sequestration = OFFSHORE AQUIFER

The site of on-going Test Injection is not regarded as the target site in the implementation phase: the Regulational Framework of the test injection was the same as those for the EOR R&D’s in Japan in 1990’s.
Regulatory issues experienced by RITE in 2000 - 2003

**CO₂ Pipeline laying**

CO₂ is now being scrubbed at a plant located 2 km from the injection site with daily capacity of ca 100 tonne/day, but we abandoned to use this source due to an expected legal barriers in pipeline laying along a road and over a river.

**Preservation of Groundwater Quality**

Scrubbed CO₂ contains Benzene, which could not handled by the regulation within the laws on mining.
RITE field demonstration study at NAGAOKA

site:
  inland gas field (on-going operation at 3 km depth)

injection point:
  an associated saline aquifer with seal layers at 1.1 km depth
Objective

Test Scheme

- Observe CO₂ behavior in aquifer by logging & crosswell seismic
- Provide data for verification of simulation code
Nagaoka site
owned and operated by Teikoku Oil Co. Ltd.
CO$_2$ injection Scheme in Field Demonstration Experiment

Depth; approximately 1100 meter

Lorry carrying liquefied CO$_2$

Tank

Pump

Heater

Injection well

Observation well

Ground level

Impermeable layer (cap rock)

Aquifer

40 ~ 120 meter
Nagaoka site
Nagaoka site
- well head-
Nagaoka site
- site facilities -
Nagaoka site
- storage tank -
Dimension

- **Target aquifer**: 20 m in thickness
  sandstone (Pleistocene)
  depth: 1100 m deep from ground surface

- **Facilities**
  - One injection well
  - Three observation wells

- **Amount of CO$_2$**
  Max. daily rate of 20 ton $\times$ 500 days $<$ 10,000 ton
simulation grid

Areal Grid Size $25m \times 25m$ in fine grid
$50m \times 50m / 200m \times 200m$ in coarse grid
prediction by simulation code
horizontal view

100 years
prediction by simulation code
cross sectional view

100 years

aquifer
経過日数-圧入レート、累計圧入量

経過日数 (day): 基準日 2003年7月7日

-10 0 10 20 30 40 50

 Injection Rate (t/d)

最大圧入能力
48 t/day

Date

Total injected quantity (t-CO2)

累計圧入量: 187.9 t-CO2
2003年8月17日時点
plan of observation

• wellhead P, T and pressure at injection point
• continuous aquifer monitoring of P, T in an observation well
• downhole logging at 3 observation wells at regular basis
• time-lapse crosswell seismic
• time-lapse surface seismic
• tiltmetry at surface
• spontaneous polarization monitoring
baseline results of crosswell seismic
## Timeline until 2005

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>site selection</td>
<td>site characterization &amp; baseline of tomography</td>
<td>simulation</td>
<td>observation</td>
<td>verification</td>
</tr>
<tr>
<td></td>
<td></td>
<td>facility design</td>
<td>installation</td>
<td>injection</td>
</tr>
<tr>
<td></td>
<td></td>
<td>installation</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>