CO_2 Storage Research Group

CO_2 Storage Technology Development for Practical Application

CO_2 Geological Storage Project

The CO_2 geological storage technology is a technology for safely and securely trapping CO_2, a greenhouse gas, into subsurfaces without releasing it into the atmosphere. There are various methods for the storage, including EOR, which injects CO_2 into depleted oil fields and recovers the enhanced oil; isolation of CO_2 in depleted gas fields; ECBM, which injects CO_2 in coal seams and recovers methane; and storage of CO_2 in highly porous sandstone aquifers, containing formation water.

RITE has been working on aquifer storage, which enables stable storage of CO_2 over long periods because there is a gas- and water-impermeable sealing layer on top of the aquifer where CO_2 is stored(See Fig.1). Since technology of underground natural gas storage can be applied, this method is thought to be the most immediately effective and closest to practical use.

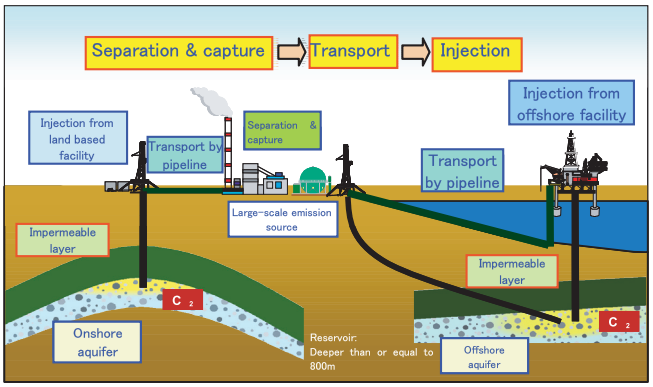

Fig.1 Concept of CO_2 geological Storage

"R&D project of CO_2 Geological Storage Technology" was launched in 2000 to scientifically verify the feasibility of CO_2 storage in subsurface aquifers in Japan, focusing on its effectiveness as a global warming countermeasure. In particular, for the CO_2 injection demonstration test conducted at the Iwanohara site in Nagaoka City, Niigata Prefecture, 10,400 tons of CO_2 were injected in the aquifer of 1,100m depth below the ground during the period from July 2003 to January 2005(See Fig.2). The underground behavior of CO_2 was observed by cross-well seismic tomography and well loggings, and a behavior prediction simulator was developed, based on the observation data. Besides, during testing, the Chuetsu Earthquake took place in Niigata Prefecture, approx. 20 km away from the Iwanohara site, but no abnormalities were found in the injected CO_2, the aquifer, and the well, confirming the safety of the storage. In 2007, the CO_2 stored underground were monitored to improve the accuracy of the prediction technique.

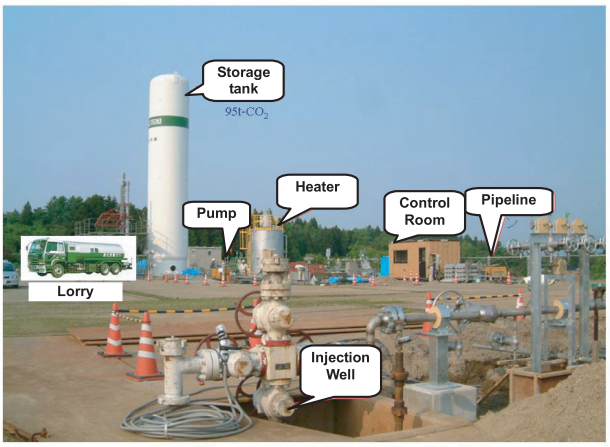

Fig.2 Nagaoka demonstration test site

The passable possibility of the implementation of geological storage in Japan was indicated by the CO_2 injection demonstration test in Nagaoka for eight years. CO_2 geological storage technology development and demonstration is steadily progressing and is closer to practical use as a CO_2 emission reduction measure around the world. Therefore, it is necessary to clarify the effectiveness of CO_2 geological storage and issues for its practical application, and develop a social system.

RITE has performed a comprehensive research & development centered around safety assessment of CO_2 geological storage: the fundamental studies on the assessment of seal performance and reservoir for CO_2 storage, the impact assessment of earthquake in the CO_2 geological storage, the advancement of technology to monitor the leakage of CO_2 under the seabed. In addition, we estimated the potential capacity of the geological storage near the emission sources and performed the trend survey of CCS and risk assessment.

We intend to develop the safety assessment methods including the formulation of criterion for safety assessment to clarify issues in promoting CCS (Carbon dioxide Capture and Storage), and conduct basic studies for the implementation of large scale demonstration project (injecting 100,000 tons of CO_2 per year) targeted by the government.

CO_2 Ocean Sequestration Project

The ocean dissolves a large quantity of CO_2. There is sufficient potentiality to dissolve CO_2 in the middle and deep layers of the ocean, which is rapidly increasing in the atmosphere. CO_2 ocean sequestration technology

captures CO_2 from large emission sources and directly injects it into deep-sea areas without passing through the ocean surface has been proposed. RITE has been developing technology for CO_2 dilution and injection to middle ocean layer using a Moving Ship method, as shown in the Fig.3. According to chapter 6 of the IPCC special report "Carbon Dioxide Capture and Storage" in 2005, ocean sequestration is evaluated as an effective technology to mitigate climate change. The challenge in preparing this technology for practical use lies in controlling the impact of CO_2, which is injected directly into the ocean, on marine species. Development of environmental impact prediction technology is our immediate challenge.

In phase 1 of this project, which was implemented from FY1997 to FY2001, we conducted a CO_2 macroscopic behavioral study, an analysis of CO_2 behavior behind the release nozzles, and predictions and investigations of biological impacts. In the following phase 2 (from FY2002 to FY2011), we are developing and assessing technology aimed at "Study of environmental impact assessment for CO_2 ocean sequestration for mitigation of climate change"

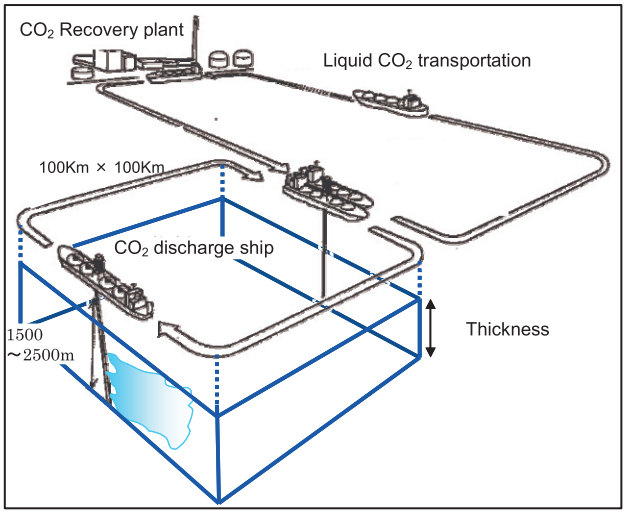

Fig.3 Image of ocean sequestration using a Moving Ship

As a result, for CO_2 discharge using a Moving Ship method, the simulation predicted that within a few hours, the CO_2 concentration is lower than the natural fluctuation range and the acute impact on marine living species is negligible. To clarify the image of ocean sequestration in practical use, the engineering study of its implementation was carried out under the case which is the ocean sequestration of about 50 million tons of CO_2 annually into the ocean near Japan, and got the result that the CO_2 concentration can be reduced to below the level of the predicted no-effect concentration. These results were reported in the special symposium of Japan Ocean Society "CO_2 ocean sequestration: what is the appropriate assessment for the environmental impact" in the autumn of 2005 and in the symposium of Advanced Marine Science and Technology Society in 2007 FY "Development of technologies for CO_2 ocean sequestration" and promoted scientists' understanding. Industrial Structure Council of METI carried out an interim assessment of ocean sequestration project in 2007 FY and evaluated this project as progressing satisfactorily in general. The reliability improvement for the model to predict the CO_2 behavior in the ocean will be promoted along with the future proposal given in this interim assessment.

We have conducted the following activities since 2007 FY: (1) Study on trends in CO_2 ocean sequestration technology (1. Preparing the base to promote understanding and 2. Establishing a global network), (2)Study on biological impact assessment for CO_2 ocean sequestration (1. Developing biological impact assessment techniques, 2. Collecting biological impact data in the actual ocean, and 3. Studying the CO_2 impact on deep-sea living species) and (3) Development of CO_2 behavior technology (1. Developing CO_2 behavior observation and prediction technology, and 2. Potential ocean sequestration assessment).

In future development, we will proceed with development of ocean sequestration technology for practical application by developing a more accurate CO_2 behavior prediction technology, as well as biological models of the middle and deep layers of the ocean and long-term impact prediction technology, by taking advantage of achievements such as environmental impact assessment technology and CO_2 dilution technology. However, to put the ocean sequestration technology into practical use in the future, it is necessary to demonstrate developed technology by conducting experiments in the actual ocean, and ultimately, to trace the CO_2 behavior in several 100 km scale, and to investigate the biological impact. In addition, since the ocean is a human common property, international consensus to implement the ocean sequestration test is essential. Therefore, we will make efforts to establish a global network not only to promote scientists' understanding of ocean sequestration but also to acquire agreement to experiment via international treaty.

IZEC (International Zero Emission Coal)Project

Fossil fuels account for approximately 80% of global energy sources and the long-term use of coal is expected in the future. Clean coal power generation in particular attracts a lot of attention. From the perspective of global warming, it is necessary to combine coal power generation technology and CCS technology that separates, recovers, and stores the emitted CO_2 in the earth in order to achieve this goal.

As such combined technologies, Post-Combustion, Oxy-Fuel and Pre-Combustion are specified (See Fig.4).

At present, many zero emission coal power generation projects such as FutureGen in U.S. are planned all over the world. Also in Japan, some plans such as "Innovative Zero Emission Coal Gasification Generation Project" supervised by NEDO have started.

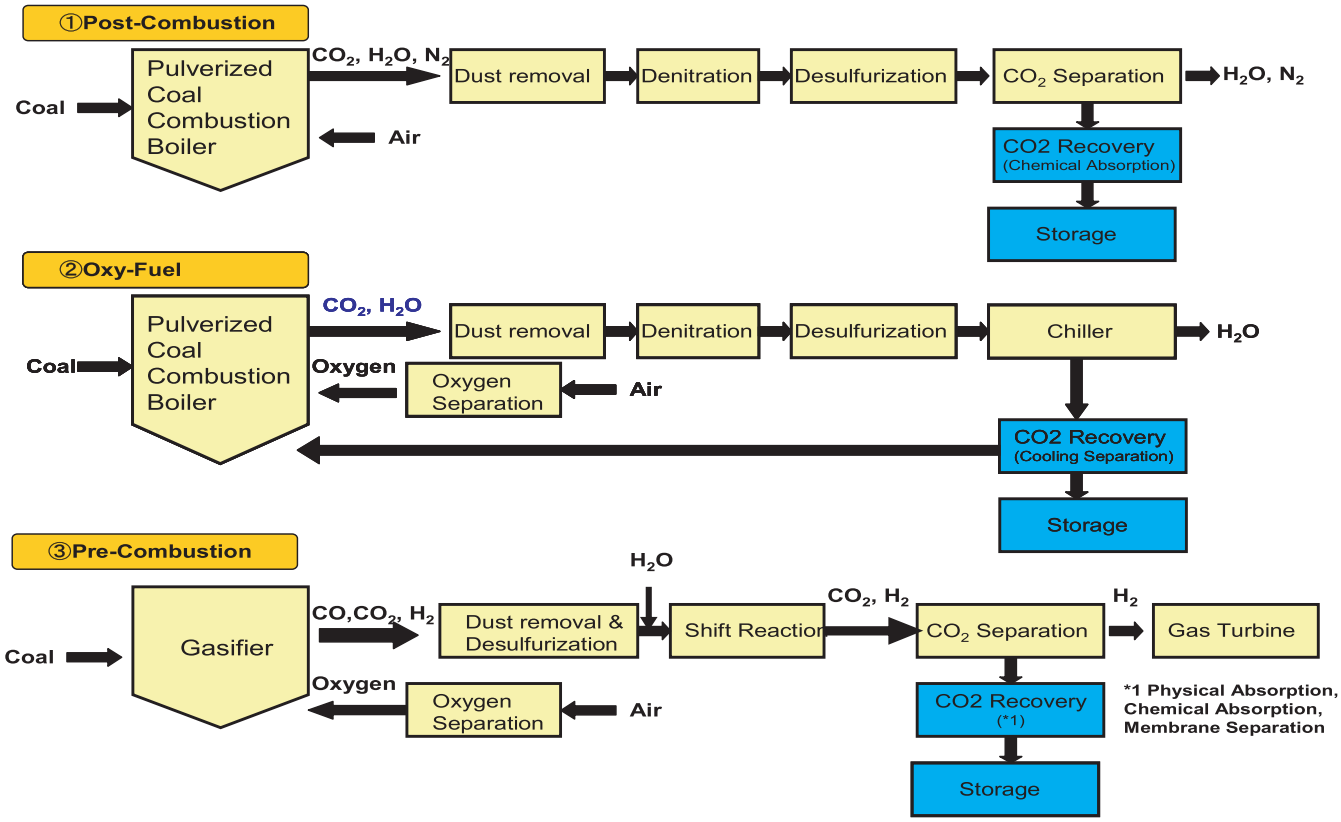

Fig.4 Concept of Coral Power Generation technologies with Storage, such as Post-Combustion, Oxy-Fuel and Pre-Combustion

To demonstrate zero emission, consolidation of a broad range of technologies and strong financial resources are required. Thus, investigating current status of zero emission coal power generation projects all over the world from both view points of technology and management and promoting and enlightening public awareness for zero emission coal power generation is of great significance in considering our comprehensive strategy for its practical use in Japan.

Reflecting the above, RITE conducts IZEC (International Zero Emission Coal) project. The major subjects are (1) Collecting and sorting information regarding zero emission coal power generation projects all over the world; (2) Collecting and sorting information regarding zero emission/CCS initiatives of nations concerned and international organizations; (3) Promoting and enlightening public awareness for zero emission coal power generation through operating "IZEC Forum", "IZEC Workshop" and so on.

In FY 2008, we are conducting surveys with regards to current status of more than forty demonstration and pilot projects mostly in EU, U.S. and Australia while mainly investigating FutureGen in FY 2007. With regards to initiatives, policies and strategies of EU, Britain, Norway, Holland, Germany, U.S., Canada, Australia and so on are investigated.

For popularization and enlightenment, we are now preparing a Web site for IZEC and will introduce schedule, finance, adopted technologies of each project and initiative of each nation and so on. In addition, we hold "IZEC Forum" which informs the related industry of the collected information and "IZEC Workshop" which invites representatives of projects and initiatives overseas.

Through these activities, our objective is to contribute to determine comprehensive strategy for the practical use of zero emission coal power generation in Japan.