

GreenGen Project: Update and Outlook

1. Introduction

GreenGen officially started to construct Tianjin IGCC Demonstration Power Plant in July 6th 2009, which marks the implementation of GreenGen Project has stepped into a new phase. As an important action initiated by Chinese energy enterprises to actively combat the challenges of climate change, GreenGen Project has drawn concerns from the society, especially focusing in whether the project could achieve its anticipated goals.

2. GreenGen Project

GreenGen Project was initiated by China Huaneng Group (CHNG) in 2004, which aims to research, develop and demonstrate a coal-based power generation system without pollutants and CO₂ emission. GreenGen Project is similar in key technologies, development process, objectives, tasks, etc. with some other plans or projects in the world, such as FutureGen in the U.S. and ZeroGen in Australia.

In order to effectively promote the GreenGen Project, CHNG and several other energy companies founded GreenGen Co., Ltd. GreenGen Project consists of three stages in which mission of the first stage is to build an IGCC demonstration unit and master key technologies. The second and third stages aim to master the IGCC + CCS key technologies and build a CCS demonstration power plant in China, which will help to achieve near-zero emissions coal-fired power generation targets. As the first stage of GreenGen Project, Tianjin IGCC demonstration power plant plans to put into operation in 2011. Meanwhile, some syngas will be extracted to a small-scale CCS pilot for testing CO₂ capture technologies. GreenGen Co., Ltd. will initiate an industrial-scale IGCC+CCS demonstration project with the estimated capacity of 450MW, when the technologies are available.

3. Tianjin IGCC demonstration power plant

Tianjin IGCC demonstration project, whose capacity is about 250MW, is China's first IGCC generation unit. The demonstration project locates in Lingang Industry Park which is in the central of Tianjin Binhai New Area. The project adopts a 2,000 tons/d TPRI gasifier, a set of 46,000 Nm³/h Air Separation Unit to produce oxygen

(purity is 99.5%), cyclones and ceramic filters to remove the dust, MDEA process and LO-CAT technology to reduce SO₂ emission to 1.4mg/Nm³ and recover 23 tons sulfur per year. The power island consists of one Siemens V94.2 gas turbine burning low heat value syngas, one HRSG and one steam turbine. The outputs of GT and ST are respectively 173MW and 95MW. Some nitrogen and steam will be injected into the gas turbine to control NO_x emission. The net efficiency is 41% when using Shenhua coal under design conditions, which achieved the international advanced level.

Tianjin IGCC demonstration project is the first step for China's utility companies to reduce carbon dioxide which is also very important. We need a demonstration project to study IGCC+CCS system tech-economic characteristics, to accumulate design and operation experiences for IGCC. More than two thirds of the CCS cost derives from CO₂ capture so it is critical to decrease capture cost. Tianjin IGCC demonstration project will give an important test platform for CCS technologies, especially for pre-combustion capture technologies.

4. Challenges

A large number of studies have shown that pre-combustion carbon dioxide capture techniques, namely the IGCC + CCS technology solutions, is the relatively economic option for power industry to curb CO₂ emissions. However, practical experience from the demonstration preparation shows that we still face significant challenges to master such technologies. These challenges include: i. IGCC + CCS technology is still not mature, with higher energy penalty and directly or indirectly cost which will impact its performance; ii. The research base of key technologies is still unsubstantial, e.g. lackness of engineering experience, relative human resources and process system design capabilities, which bring potential uncertainties for system design, manufacture, installation and operation; iii. The CCS industry chain has not been constituted in China and utility companies have little experience about CO₂ transportation and storage. As a result, it is difficult for utility companies to afford CCS cost especially when there are not enough infrastructure, market environment and policies. In one word, there is still a long way to develop CCS in power industry.

5. Comments

There have been several CCS demonstration projects proposed all over the world which will give a platform for development of CCS technologies, process and

commercialization test, which is very important for CO₂ reduction. According to our experience in progress of demonstration project, there are four problems must be solved to assure demonstration projects to be successful.

i. Insufficient funds. The technologies and process development need large quantity of capital, so it is necessary to deliver the certified demonstration project some financial support.

ii. Obstacles of technology development and transfer. An effective platform for clean energy technologies transfer and sharing should be established. The developed countries have the responsibility to help developing countries to master and distribute advanced technologies, assistant to train high quality technological professionals.

iii. Weak recognition of important role for CCS. Public acceptance have great effect on development of CCS demonstration projects, however, there are still some disputes about CCS. The only way to eliminate these disagreements is to accelerate the demonstration projects. The performances of demonstration projects would clarify to the public whether CCS is a good choice for combating climate change.

iv. Policies are unmatchable. The proper policies supporting CCS demonstration projects are necessary for utility companies to control the financial risk.

6. Conclusions

Under the government support, GreenGen Project has made a great progress. After 3 years of hard work, the first stage of GreenGen Project -- Tianjin IGCC demonstration power plant has finished engineering design and has been in construction. The demonstration projects are necessary to verify CCS technologies but we still face serious challenges to achieve the anticipated goal. It is still a bumpy way to perfect the technologies, market environment and policies. Utility companies are facing some problems to develop CCS, such as lack of finance and policy support, and high cost. In order to overcome these obstacles, the utility companies need the support from the government and public sectors.