Curriculum Vitae **Hang Jingkuan**

Vice chief engineer of CPPEI

Mr. Han Jingkuan, senior engineer and deputy chief engineer of PetroChina Planning & Engineering Institute, male, age of 42. Mr. Han graduated from Petroleum processing department of Daqing petroleum university in 1987, and obtain master degree in oil and gas engineering from Petroleum university (Beijing). Mr. Han has participated in hundreds of Front End Engineering Design, design and scientific study projects in the fields of oil and gas gathering, storage and processing, some of them have been implemented and achieved good economic and social results.

The projects Mr. Han participated have won many awards, including 1 national excellent design award of third class, 1 excellent engineering award of second class of ministerial level and 3 excellent engineering award of third class of ministerial level, 3 excellent engineering consulting awards of first class and 3 excellent engineering consulting awards of second class from oil and gas branch of China consulting association, 10 engineering design and scientific research awards of division level.

Mr. Han has released 7 technical papers in various magazines and 3 technical books. He has been invited to participate and host many review meeting of various projects and standards. He has hold posts in various organizations, like member of standardization committee of PetroChina exploration and production company, member of standardization committee of oil and gas transportation and storage, member of committee on publish of articles related to study results on oil and gas production facilities, member of China transportation association, and member of expert panel under committee of registered survey design engineer in oil and gas sector.

Current Status and Development Forecast of Natural Gas Supply and Demand in China

Following decades of development of gas Industry in China, there are 6 huge gas supply fields, including Chuanyu gas field, Shanganning gas field, Tarim gas field, Qinghai gas field, South Sea gas field and East Sea gas field, with estimated recoverable gas reserve of 10-15×$10^{12}$$m^3$.

In 2004, gas production in China, mainly from the above 6 gas fields, hit 408×$10^8$$m^3$; gas consumption reach 360×$10^8$$m^3$, accounting for about 3% of primary energy consumption. Until the end of 2004, gas pipeline of 25000km has been built, forming gas pipeline grids from Southwest to Middle South, from Northwest to North and across Yangtze River Delta. Especially after the operation of the West to East Gas Pipeline, gas industry in China has been in development phase instead of start-up phase, signaling that gas will be fully utilized in China and gas industry has entered a new era.

1 Analysis of energy supply and demand in China

1.1 Current status of energy supply

Production of primary energy in China hit 18.46×10^8tce in 2004, rising by 15.2% compared with 2003, among them, coal, oil, gas production and power generated reached 19.56×10^8t ,1.75×10^8t ,398×$10^8$$m^3$ and 2.187×10^{12}KWh respectively ,up by 17.3%, 2.9%, 16.7% and 14.5% respectively , ranked as No.1, No.5, No.17 and No.3 in the world respectively.

In general, there are abundant energy resources in China, however, per capita energy resource is very low. For example, coal proven reserve in China, per capita of which is about half of world average, is one of richest in the world; per capita of oil and gas is only

one tenth of world average.

With the rapid development of China's economy, energy demand in China grows continually while domestic production capacity can not keep the pace with the demand, therefore, energy shortage occurred as supply can not meet demand.

Breakdown of energy production in China is shown in table 1.

Table 1 Energy production in China

Year	Energy production (10^4tce)	Proportion (%)			
		Coal	Oil	Gas	Hydropower
2000	106988	66.6	21.8	3.4	8.2
2001	120900	68.6	19.4	3.3	8.7
2002	138369	71.2	17.3	3.1	8.4
2003	160300	74.2	15.2	2.9	7.7
2004	184600	75.6	13.5	3.0	7.9

1.2 Current status of energy consumption

With the booming economic development of China and increasing growth rate, energy consumption in China grows continually. Since 1996, primary energy consumption has increased by about 5% annually, about three times of world average.

In 2003, China became second-largest oil consumption country (after the United State). In 2004, energy consumption was 19.7×10^8tce ,up by 15.2% compared with last year, among them, coal, oil, gas , hydropower consumption and nuclear power reached 18.7×10^8t, 2.9×10^8t, 360×10^8m^3 and 3280×10^8kwh and 501×10^8kwh respectively, up by 14.4%,16.8%,18%,15.6% and 15.6% respectively.

Energy consumption contributed to GDP growth of 10×10^4 Yuan is 1.58tce, up by 5.3%, equivalent to 4 times of that in US and 12 times of that in Japan. China's dependence on energy imports stood at 6%. Coal is still the dominant energy in China's energy mix, shown in table 2.

Table 2 Energy consumption in China

Year	Energy consumption (10^4tce)	Proportion (%)			
		Coal	Oil	Gas	Hydropower
2000	130297	66.1	24.6	2.5	6.8
2001	134914	65.3	24.3	2.7	7.7
2002	148222	65.6	24.0	2.6	7.8
2003	167800	67.1	22.7	2.8	7.4
2004	197000	67.7	22.7	2.6	7

1.3 Analysis of balance between energy supply and demand

Based on current status of energy supply and market demand, with rapid development of China's economy, it is estimated that domestic energy resource will not satisfy the domestic market demand in the long term, higher dependence on energy import is inevitable, making the participation of development of oil and gas fields in foreign country a must. Therefore, how to guarantee long term stable energy supply become a strategic issue concerning safe, stable, sustainable and rapid economic development in the future.

In 2003, China became second-largest oil consumption country, with net oil import of 9112×10^4t; in 2004, imported oil exceeded 1×10^8t and reached 1.2272×10^8t, with dependence on oil imports rose to about 40%; in first half of 2005, oil imported reached 6342×10^4t, up by 3.9%. In 2004, dependence on energy imports was 6%.

According to medium and long term energy development strategy of China, it is estimated

that energy demand in China will reach 30×10^8tce in 2020, and dependence on oil imports will stand at about 60%, making China become the first largest oil import country in the world, with oil import exceeding the total of net import by members of OECD in the pacific, including Japan, Korea, Australia and New Zealand. It is estimated that China will import gas to satisfy 40% - 50% of domestic demand in 2020.

1.4 Characteristics of energy consumption

The pattern of China's energy consumption, with coal as dominant fuel, will not be changed in near term. In the future two decades, energy consumption will have following characteristics probably:

(1) The pattern of energy consumption, with coal as dominant fuel, will not be changed, however, the proportion of coal in energy mix will drop gradually.

(2) Demand of crude and product oil will rise stably, causing the simultaneous increase of oil imports. In 2003, China has replaced Japan as second-largest oil importing country; in 2004, oil imports of China reached 1.2272×10^8t.

(3) Significant change in energy mix is the rapid growth of clean and excellent energy demand, especially those of gas, power and oil.

(4) While optimizing the energy mix, improvement of economic benefit due to energy consumption efficiency should be paid great attention and environmental issue be addressed.

2. Current status of gas supply and demand

2.1 Current status of availability of gas reserve and gas production

According to results of third round of assessment on oil and gas resource, gas in place of China amounted to $47\times10^{12}m^3$, accounting for 11% of world total of $436\times10^{12}m^3$, among them, onshore gas in place was $30\times10^{12}m^3$, accounting for 64% of national total. At present, proved recoverable gas in place of China is $14\times10^{12}m^3$, accounting for 8% of world total of $175.78\times10^{12}m^3$. Natural gas reserves are mainly located at 6 huge gas fields, including Shanganning, Tarim, Sichuan, Qinghai, East Sea and Ying-qiong basin gas field

etc.

Until the end of 2004, there are $4.38\times10^{12}m^3$ of proved gas reserve and $2.77\times10^{12}m^3$ of proved recoverable gas reserve, excluding resource and recoverable reserve of solution gas of oil fields of $11678\times10^8m^3$ and $3807\times10^8m^3$. China National Petroleum Corporation (CNPC) owned proved gas reserve of $20942\times10^8m^3$, accounting for 75.5% of national total, with Sinopec, CNOOC and local companies accounting for 15.1%, 9.0% and 0.4% respectively.

In 2004, gas production reached $408\times10^8m^3$, up by 19.7% compared with last year, including $285.29\times10^8m^3$ of CNPC , $56.91\times10^8m^3$ of Sinopec, $48.88\times10^8m^3$ of CNOOC and $16.62\times10^8m^3$ of others, mainly from 6 huge gas fields.

2.2 Current status of gas consumption

Gas consumption amounted to $360\times10^8m^3$ in China in 2004, accounting for 2.6% of primary energy consumption. Chemical industry consumed 33% of national total, industrial fuel 26%, city gas 29%, power generation 12%. The capacity of ammonia and methanol production, with gas as feedstock, accounted for 20% and 25% of national total. In China, rate of gasification, with natural gas as city gas, is 15%; capacity of gas-fired power generation only accounted for 1% of national total installed capacity. Natural gas utilization has been diversified gradually instead of being used in chemical industry mainly in the past.

Gas utilization is subject to availability of gas resource, gas pipeline and gas market traditionally, with the characteristics of localized consumption. Since the operation of Shaanxi-Beijing gas pipeline in 1997, the construction and operation of Seninglan pipeline, the West to East Pipeline and the Zhongwu pipeline in recent years, gas has been delivered via long distance pipelines from the regions, with gas resource, to gas market.

Until the end of 2004, gas pipelines of more than 25000km had been built, setting up gas pipeline grids from Southwest to Middle South, from Northwest to North and across Yangtze River Delta.

3 Forecast of development of gas industry in China

3.1 Estimate of gas reserve and production

It is estimated that accumulated proved gas reserve in 2020, will reach $10\times10^{12}m^3$ in 2020 following the accelerating investment on gas exploration. Based on estimated development potential of available reserve, proved unavailable reserve, newly added proved reserve and solution gas of oil field, considering gas resource, market demand and planning of pipeline construction, it is estimated that prior to 2010, by developing proved reserve, gas production in China will reach $846\times10^8m^3$ in 2010. After 2010, by accelerating the development of newly added proved reserve, gas production will hit $1277\times10^8m^3$ in 2020, detail is outlined in table 3.

Table 3 Estimated gas production in China (10^8m^3)

Gas		2010	2015	2020
Gas from gas reservoir	Available reserve	206	130	62
	Proved unavailable reserve	490	500	520
	Newly added proved reserve	50	300	550
	Subtotal	746	930	1132
Solution gas		95	95	95
Coalbed gas		5	25	50
	Total	846	1050	1277

3.2 Estimated gas consumption

Based on results of analysis by the means of energy elasticity coefficient, gas customers analysis and industrial planning and statistic, it is estimated that gas demand will be $1068\times10^8m^3$, $1535\times10^8m^3$ and $2107\times10^8m^3$ in 2010, 2015 and 2020 respectively. The regions,

with huge gas consumption, include Beijing, Tianjin, Hebei, Shandong, Shanxi, coastal area in Southeast region, Northeast region and Yangtze River Delta. It is estimated that the proportion of gas for power generation and that of city gas will rise gradually, reaching 32.3% and 29.7% respectively in 2010.

3.3 Balance between gas supply and demand

According to assessment on potential of gas resource and estimation of future market demand, it is concluded that gap between gas supply and demand will be $222\times10^8m^3$, $485\times10^8m^3$ and $830\times10^8m^3$ in 2010, 2015 and 2020 respectively. In 2020, the proportion of gas in primary energy will rise from 3% to 10%, making natural gas become third largest energy (after coal and oil). Balance between gas supply and demand in China is shown in table 4.

Table 4 Balance between gas supply and demand in China (10^8m^3)

	2010	2015	2020
Domestic gas production	846	1050	1277
Gas demand	1068	1535	2107
Gap between supply and demand	-222	-485	-830

4 Proposals on development of gas industry

4.1 Accelerating the exploration and development of domestic gas reserve to ensure the

stable gas supply

At present, the proportion of gas in primary energy is less than 3%, lower than average rate in Asia of 8% and far less that average rate in Europe and US. There is great potential for development of domestic energy resource, so the exploration and development of domestic gas reserve should be accelerated to ensure stable increase of gas reserve in 6 huge gas fields while increasing investment on exploration of offshore area to discover new reserve in East Sea, South Sea and Bohai Bay etc., securing the stable supply of domestic gas supply.

4.2 Enhancing international cooperation to play an active role in upstream activities abroad and participate global gas trade

China, Japan and Korea, as energy consuming countries in Northeast Asia, have great potential in market development, meanwhile, neighboring Russia, Middle Asia and Middle East, have abundant gas resource, therefore, China, Japan and Korea, can take advantage of their excellent geographical positions, with the countries with rich gas reserve in their neighbors, to achieve mutual benefit.

As a result, it is suggested that China, Japan and Korea should enhance cooperation in the following fields:

- To participate upstream activities of neighboring countries to get share of gas being developed.
- To enhance cooperation with neighboring countries to push forward the development of gas pipeline projects to import gas from Russia and Middle Asia, setting up gas pipeline grid across Northeast Asia.
- China, Japan and Korea should coordinate with each other to engage in global LNG trade to minimize the price and transportation cost of LNG.

4.3 The construction of pipeline and associated facilities should be one of priority of gas industry development

Following four decades of development of gas pipeline industry in China, until the end of 2004, the pipelines of more than 24000km, 4 underground storages, with working gas of

$15.77\times10^8 m^3$, have been built. At present, gas pipeline industry has developed very rapidly, however, it still lags far behind developed countries, with the features of uneven development of pipelines in various regions, less number of pipeline and storage facilities, no national gas pipeline grid in place.

China should learn experiences of US to accelerate the pace of building pipelines to import gas from neighboring countries, to set up gas pipeline grid from West to East and from North to South, to construct connection pipelines and underground storages to coordinate gas supply and make gas supply flexible, to accelerate the pace of LNG import from coastal area and build coastal gas pipeline grid to satisfy the demand of clean energy in the coastal area.

4.4 Developing gas industry should follow the sustainable energy development strategy, with energy conservation as priority, diversified structure, environmental friendly and market developing.

In view of huge population, limited energy resource and industrialization process being carried out in China, the following methods are recommended:

- Efficiency of energy utilization should be improved by adopting advanced technologies.
- To implement preferential taxation policy to encourage China's petroleum corporations to participate the development of foreign gas fields in an effort to diversify the gas supply channel.
- To encourage gas utilization by introducing relevant policies and laws while limiting the usage of fuel causing high pollution to increase the competitiveness of gas indirectly, advocating using gas to replace oil in some sectors and gas-fired power generation and pushing forward the sustainable development of energy, environment and economy.
- To set up modern supervisory mechanism for gas industry and framework of gas laws and regulations to push forward the healthy and orderly development of gas market.