The Texaco Gasification Process in 2000
Startups and Objectives

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Introduction

The Texaco Gasification Process (TGP) is a market leader in the conversion of heavy oils, petroleum coke, and other heavy petroleum streams, to valuable products. In the year 2000, the commercial acceptance of the technology for the production of power, hydrogen, ammonia, and other chemicals reached new heights with a record number of startups and capacity additions.

In all, twelve new commercial TGP plants were or will be started up this year in six countries. The feedstocks for these plants include coal, petroleum coke, natural gas, and a wide variety of low-valued heavy oil streams. The total syngas production capacity from these new projects totals 1375 million standard cubic feet per day, increasing the total operating capacity of the TGP around the world by more than fifty percent.

![Texaco Gasification Process syngas capacity additions in 2000, by main product (mmscfd)](image)

The startup of these plants is significant in more ways than just numbers. With these projects, Texaco has begun the transformation from mainly a licensor of the TGP to an equity owner and operator. Texaco committed, even with the strictly licensed projects in this group, to “act like an owner” for the purposes of their startup. In this way, Texaco continues to find means to accelerate the progression of project development to startup and into successful commercial operation.

By becoming a world-class developer-owner-operator of these type projects, Texaco aims to continue to expand the use of the TGP as a significant part of the global energy market.
Startups: By the Numbers

In the calendar year 2000, twelve projects using the TGP will startup. These break down geographically as follows: In Asia, two projects are in China, and two are in Singapore. In Europe, three projects are in Italy, and one is in Germany. Three projects are in the U.S., and the twelfth project is in Australia.

Eight of the projects are fed by some type of heavy oil, three by coal or petroleum coke, and one by natural gas. Power and steam are the main products of five of the projects. Three of the projects mainly produce ammonia, two produce syngas for sale to a merchant chemicals market, one produces methanol and one produces hydrogen.

In all, 1375 million standard cubic feet per day (MMSCFD) of new syngas capacity will be added to the previously operating 2100 MMSCFD capacity of TGP generated syngas worldwide. The eight new oil fed projects generate 1083 MMSCFD, or 79%, of this syngas. Solid feeds - coal or petroleum coke - generate 262 MMSCFD, or 19%. The remaining 2% is generated by a natural gas fed TGP unit.

Fig. 2: Texaco Gasification Process syngas capacity additions in 2000, by region

Total: 1375 mmscfd

Fig. 3: Texaco Gasification Process syngas capacity additions in 2000, by feedstock (MMSCFD)
Startups: By Region

Europe: The four new European TGP units that started up in 2000 are each sited in refineries and are each fed by some type of heavy oil. Three of these four projects are large power projects in Italy, and the fourth produces methanol in Germany.

Italy: In the mid-1990’s, Italy imported about 16% of its power from other countries. Most of the internal power production in Italy was generated from 3% sulfur content fuel oil produced by Italy’s domestic refiners. The European Community directed that this fuel oil must be reduced to 1% sulfur by 1998. Italian refiners would either incur major capital and operational investments in their facilities or face having their high sulfur fuel oil change from a revenue producer to a waste product. At the same time the state run power utility, ENEL, faced major system impacts to its already undersized generation capacity.

To address these potential problems, the Italian government passed legislation to provide price incentives for independent power production that utilized indigenous fuels. Integrated Gasification Combined Cycle (IGCC) power, based on Texaco Gasification Power Systems (TGPS), provided Italian refiners with the ideal means to utilize their high sulfur petroleum streams to produce power in an environmentally superior way.

Texaco executed licenses for three gasification to power projects in Italy. These were with:

- ISAB S.p.A., 500 MW
- API S.p.A., 250 MW
- SARAS S.p.A., 500 MW

These projects are the first integrated gasification power projects to attain non-recourse project financing. As this type financing has traditionally been an engine for independent power production (IPP) project development, this is a significant breakthrough for the gasification to power business. Many of the aspects of the financial arrangements for these projects will undoubtedly serve as a model for new TGPS projects.

In September 1997, Texaco became an equity partner in API Energia, the consortium that owns the API Project. This venture is a partnership, made up of API, Asea Brown Boveri (ABB), and Texaco. This project gasifies visbreaker residue from the API refinery in Falconara to produce steam and power. API Energia closed its project financing in November 1996.

The API Energia project is fed by 1470 short tons per day (sTPD) of visbreaker bottoms. The two-train gasification unit feeds an ABB GT-13E2 combustion turbine. The power plant, which also includes an Ansaldo steam turbine, produces a nominal 280 MW and steam. Despite several construction delays, the longest of which was caused by the discovery of numerous faulty valves, the startup has progressed to its final stages of startup and will begin its performance test run in November. Both gasifiers were running at 100% of rated capacity by mid-July, and the ABB turbine has run for extended periods at full capacity.
The ISAB project was organized into a joint venture called ISAB Energy, made up of ISAB and Mission Energy. This project gasifies 3174 STPD of deasphalter bottoms from the ISAB Sicily refinery in Priolo Gargallo, Siracusa to produce a nominal 510 MW of power. The ISAB Energy venture closed its project financing in July 1996.

ISAB Energy started-up initially in late 1999. The project passed its full rate plant acceptance test in April 2000. The project has had extended runs at full rates and has produced as much as 525 MW during these periods. The project has met or exceeded its environmental targets and has successfully demonstrated their two Ansaldo/Siemens V94.2 combustion turbines’ operation on 100% syngas feed.
The SARAS project formed a joint venture called Sarlux, made up of SARAS and Enron. This project gasifies 3771 sTPD of visbreaker residue to produce steam, 550 MW of power, and hydrogen at the Saras refinery in Sarroch, Cagliari. Sarlux reached financial closure on its project financing in November 1996.

The project was initially started up in April 2000, but the startup was interrupted by the collapse of a retaining wall in the refinery. Although this wall and its failure were unrelated to the gasification facility, the wall collapse damaged piping critical to the operation of the refinery and all operations were suspended during its repair.

The gasification unit was restarted in August, and the startup has proceeded exceptionally smoothly. By mid-September, one gasifier was in its 46th day of continuous operation, and a second unit was in its 27th. The plant acceptance test for this unit is expected to commence shortly. The combined cycle unit, made up of three General Electric S109EC combustion turbines and steam turbines on a single shaft, has functioned well on syngas feed.

Fig. 6: Sarlux Startup; Sarroch (Cagliari), ITALY

Germany: The DEA refinery in Wesseling, Germany licensed a TGP unit fed by 600 sTPD of heavy oil. The unit produces methanol from its syngas. The refinery has experience with gasification, having existing units based on a competing technology. The plant had its initial light-offs in late May and early April. The startup proceeded very well with the experienced DEA operators and has been in nearly continuous operation since early June.
Asia: There will be four Asian TGP startups in 2000, two each in Singapore and in the People’s Republic of China (PRC). Three of the four are fed by heavy oil fractions, the fourth by coal. Both Chinese plants produce ammonia. One of the Singapore projects produces syngas that is sold for chemicals production, while the other is primarily a power plant.

A fifth Asian project, at the Ningxia plant in Yin-Chuan in the PRC, is converting its TGP feedstock from heavy oil to gas. Although this is a notable event, we have not included this effort as a new plant startup for the purposes of this paper.

China: The Huainan project, located in Hefei City in the PRC, utilizes 990 sTPD of coal to generate ammonia. Its initial start-up was in August 2000. A scheduled turn-around of the entire Huainan facility took place in the latter part of August and was completed September 10. Startups activities have resumed at this writing.
The Nanjing project, located in the Dachang District of the PRC, is projected to begin startup activities in November 2000. This project will gasify 850 sTPD of heavy oil to produce ammonia.

Singapore: The Singapore Syngas Proprietary Ltd. (SSPL) project is a joint venture between Texaco and Messer Industries. The project gasifies 630 sTPD of heavy oil from the local Caltex Refinery and sells syngas to chemical producers in the area. The project started up initially in late June, and was selling syngas product by mid-July. Both trains are currently running.

Esso Singapore plans to startup its 1019 sTPD gasification project in December 2000. This project will be fed by steam cracker tar and will fuel a large on-site cogeneration project. A small amount of syngas will also be used for chemical production.

Australia: The BOC Group has licensed the TGP for this project that converts 15 MMSCFD of natural gas to hydrogen. This hydrogen is sold to the British Petroleum refinery in Brisbane, Australia. The project has completed its pre-commissioning and will begin its startup activities in early October.
North America: Three projects have been started up in North America this year, all in the U.S. All are located at a refinery or petrochemical plant. Two are fed by petroleum coke, and the third by deasphalter bottoms. The products are varied: steam, power, ammonia, and syngas are produced among the three facilities.

The ExxonMobil Baytown Syngas Project is located within the ExxonMobil Chemical plant in Baytown, Texas. The project is fed by 1213 sTPD of deasphalter bottoms from the adjacent ExxonMobil refinery. The project produces syngas, which is sold to an industrial gas company that markets various syngas products throughout the region.

The Baytown project started up initially in late April 2000. The project achieved 100% design throughput by mid-June, and completed all of its guarantee tests in July. Performance and reliability of the unit has been very good.

The Farmland Industries petrochemical plant in Coffeyville, Kansas is the site of a 1084 sTPD gasification unit that produces ammonia. The project was started up initially in mid-July, 2000. Operations of the plant have progressed well, and startup activities continue there at this writing.
The Motiva Delaware City project gasifies 2300 sTPD of petroleum coke to produce about 160 MW (net) and up to one million pounds per hour of steam. The gasification unit was started up initially in late July and early August. The facility successfully transferred syngas to its two General Electric MS-6001FA combustion turbines in late September, and continues its startup activities.

**Startup Lessons Learned**

Texaco gains a wealth of knowledge from startups and plant operations that is cycled back to existing plants and into the project development and engineering of new projects. In this way Texaco gains continuous improvement of its existing operations and its technology and know-how for new projects.

In preparing for the year’s unprecedented amount of new plant startups, a conscious effort was made to facilitate and plan for the large amount of coordination needed to acquire and disseminate lessons learned to and from each site.

In addition, Texaco made a strategic decision to treat startups, regardless of their ownership position in the project, as if Texaco were an equity owner of the project rather than simply a technology supplier. This would give projects their best opportunity for an optimal startup, would enhance Texaco’s reputation with its customers, and would give Texaco its best opportunity to gain valuable startup and operations experience.

Some of the many practical means of accomplishing these objectives are: on all Texaco equity projects and many key license-only projects, Texaco established pre-startup, startup, and post-
startup teams. The latter planned to stay with the project well into its normal operations period. Texaco also established “startup manager” positions to coordinate all of its startup activities at a given site, and to interface with the owners’ site and off-site managers and Texaco operations, engineering, and business managers.

Texaco also established weekly conference calls for all startup personnel, on- and off-site, to coordinate activities, discuss pressing issues, and vet lessons learned. In addition, special conference calls are also held weekly for all personnel involved in automation and control systems design, installation, and operation of the plants in startup. Finally, technical bulletins are issued to each site as needed for specific lessons learned of a more urgent or complex nature.

The Path Forward

While Texaco is proud of the growth and commercial acceptance of the TGP represented by the year 2000 startups, we are committed to continuously improving project development and startup cycle time and plant reliability.

Texaco has made reducing the cycle time between project conceptualization and commercial operation a high priority. Three ways of accomplishing this are by taking equity positions in projects, by employing innovative financing methods, and by standardizing plant designs.

Texaco remains a licenser of its gasification technology. However, Texaco is now actively seeking opportunities to be an equity partner in many gasification projects around the world. There are at least three reasons for this.

First, Texaco believes that as an equity partner it can most effectively and rapidly influence technical and business decisions made on the project and thereby give the project its best chance of success. Second, Texaco’s presence as an equity partner may improve the project’s ability to be project financed. Third, as an owner Texaco realizes larger financial returns from its gasification technology. Increased returns justify additional allocation of resources to further grow the business.

Texaco has a proven record of employing strategic partnering and advantageous financing means to facilitate project development speed and success. The TGP’s continuing commercial acceptance is expected to result in the ability to execute non-recourse project financing arrangements like those successfully arranged in the projects in Italy. Other TGP projects have benefited from innovative recourse financing in the form of operating leases coupled with the utilization of low interest solid waste utilization bonds.

Recently Texaco has made a strong push to standardize its plant designs, not only to improve project development cycle time, but also to improve plant operability and reliability. By standardizing gasification plant modules, Texaco expects to:

- Reduce engineering time
- Reduce equipment procurement time
- Reduce startup time
- Improve operability
- Improve reliability
Standardizing would improve engineering and procurement cycle time by avoiding the need to “re-invent the wheel” and by allowing repetitive use of equipment and layout designs. We expect improvements in startups and operations by systematically including lessons learned from operations and maintenance activities into standard designs and by allowing operations personnel to have instant familiarity with TGP plants located anywhere in the world.

Texaco has also placed a high priority on increasing gasification plant reliability. Texaco has found that much of the annual forced outage time at TGP plants is due to required gasifier refractory repairs, feed injector repairs, and safety shutdown system instrument failures. Most of the planned outage time at this plant is for scheduled maintenance on the gasifier refractory and for preventative maintenance on the quench chamber water ring.

Texaco has addressed many of these equipment reliability issues by becoming the supplier of some of the critical gasification equipment. This allows us to assure that the quality of the product is built-in and that the latest “lessons learned” of all of the Texaco licensed gasification facilities are included in the equipment design.

Equipment for which Texaco has become a supplier includes:

- Gasifier thermocouples
- Quench rings
- Gasifier feed injectors
- Gasifier skin temperature measurement system
- Gasifier refractory design, procurement, and installation
- Safety startup and shutdown control systems
- Critical control systems

Texaco continues to address sources of downtime for all gasification units and we have realized significant progress in this area. For example, in the past feed injectors in solids gasification service have been more limited in their service times compared to injectors with liquid or gaseous feeds. But now, feed injectors in coke gasification service at two plants have operated without repair for more than 120 days and are still in very good condition.

Texaco gasification units are typically constructed to have reliability characteristics compatible with process technologies found in refineries and chemical plants. This is true regardless of the feedstock to the unit. We are confident that these results will be achieved in all of our installations.

**Conclusion**

The addition of more than 1.3 billion standard cubic feet per day of new Texaco syngas capacity at twelve sites around the world in a single year is a significant endorsement of the commercial acceptance of the technology. Twenty different companies in diverse businesses have ownership shares in these new projects, which utilize a wide variety of feedstocks and have a broad product slate.
With the existing Texaco gasification projects and projects in advanced stages of development, commercial Texaco gasification units will soon produce more than 4.6 billion scfd of syngas worldwide.

Texaco intends to build on this experience base to enhance its position as a leader in the global energy business of developing, owning, and operating gasification and power projects.

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