TANGGUH LNG:
COMMERCIAL SUCCESS IN A CHALLENGING ENVIRONMENT

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ABSTRACT

This paper details the development path of BP’s Tangguh LNG Project, in Papua, Indonesia. The launch of Tangguh was achieved in March 2005, paving the way for Indonesia’s third LNG supply centre. The Project has now entered the construction phase and is scheduled to come onstream in late 2008.

The Tangguh Project will be a substantial new addition to Indonesia’s existing two LNG supply centres at Bontang and Arun, and will add another 7.6 mtpa from its initial two trains. Tangguh has secured long-term sales contracts to China, Korea, and Mexico, thus firmly underpinning its position in the Asia-Pacific LNG trade for years to come.
I. TABLE OF CONTENTS

1. INTRODUCTION

2. HISTORY OF INDONESIAN LNG

3. THE RISE OF TANGGUH
   3.1 Tangguh Gas Fields and PSCs
   3.2 Early Challenges
   3.3 A Changing Regulatory Landscape

4. LNG SALES
   4.1 Fujian
   4.2 POSCO and K-Power
   4.3 Sempra Energy
   4.4 Phase II Expansion and Future Marketing

5. GEARING UP: TANGGUH PROJECT AND FACILITIES
   5.1 Offshore Plan
   5.2 Onshore Plan
   5.3 Shipping
   5.4 Environment and Social Responsibility
   5.5 Current Project Update

6. REFERENCES

II. LIST OF TABLES

Table 1: Reserves by Field
Table 2: Comparison of Contractual Structure under Traditional and Tangguh Model
Table 3: Tangguh LNG Sales Agreements

III. LIST OF FIGURES

Figure 1: Regional Map
Figure 2: Estimated Indonesian LNG Sales
Figure 3: Tangguh Location Map
Figure 4: Tangguh Supply Commitments
Figure 5: Offshore Plan
Figure 6: Concept of the initial Tangguh LNG Plant
Figure 7: Project Schedule
1. **INTRODUCTION**

Indonesia has been the world’s largest LNG exporter for many years. Its entry into the LNG industry began over thirty years ago with the parallel development of the world-class Bontang LNG Plant in East Kalimantan and the Arun LNG Plant in Aceh. With its LNG leadership position now being challenged by growing supplies from the Middle East, Indonesia has responded by launching the country’s third LNG supply centre, the BP operated Tangguh LNG Project. This was accomplished in March 2005 with the release of EPC contracts for the LNG plant and offshore facilities, and marks the culmination of the efforts of BP and its partners working in close cooperation with the Indonesian Government’s upstream oil and gas regulatory authority, Badan Pelaksana Kegiatan Usaha Hulu Minyak dan Gas Bumi (BPMIGAS). Tangguh will keep Indonesia firmly atop the list of LNG suppliers to the Asia-Pacific markets when it comes on stream in 2008.

Located in the Bintuni Bay area of Papua Province, the Tangguh LNG Project has been in development since the mid-1990s when its vast gas fields were discovered. The launch of Tangguh was achieved through years of perseverance under some very challenging conditions: marketing launch volumes in an over-supplied Asian LNG market; gaining government support for a major new project during an evolving political scene in Indonesia; structuring a project during changes in local oil and gas laws and regulatory regimes; and now, executing the project in an over-heated market for energy and raw materials. The award of the two main EPC contracts, worth approximately US$2.5 billion, for the construction of the two-train 7.6 mtpa plant and the associated upstream facilities, marks the onset of the construction phase and also one of the most significant injections of capital into the Indonesian upstream industry in recent years. The Tangguh project will be the first new addition of Indonesian LNG capacity for almost a decade and the first greenfield LNG plant in the country in 30 years. Given its remote location in eastern Indonesia (Figure 1), the LNG plant design was based on well established technology to maximize reliability and availability. Tangguh’s 14 trillion cubic feet proved reserve base will be developed using conventional offshore platforms that will support very prolific well production rates and deliver gas to the plant via two sub-sea pipelines.

Along its development path, Tangguh achieved several firsts for Indonesia and the Asia-Pacific LNG industry in the areas of marketing, commercial structure, procurement, and environmental and social responsibility. In 2002 Tangguh captured its first market with a sale to Fujian and significantly increased its profile into other markets. In 2004 Tangguh signed Korean sales to POSCO and K-Power, with the first cargoes already being delivered to POSCO’s newly completed Gwangyang Terminal via BP’s global supply network. The launch portfolio was completed with the landmark sales contract across the Pacific to Sempra on the North American West Coast. Tangguh’s sales represent Indonesia’s first ever planned deliveries to China, the industry’s first ever deliveries to private Korean industries, and deliveries to the first LNG import terminal to be constructed on the North American West Coast.

For the future, Tangguh is positioned to offer uniquely attractive supply security and flexibility options to capture other markets throughout the Asia Pacific region. With significant uncommitted proved reserves remaining, and an additional 10 Tcf of probable and possible reserves, the project sponsors are looking forward to new market opportunities. The first phase of Tangguh project expansion is already being planned. Tangguh’s unique commercial structure will provide significant assurance to its customers. BP, as the project leader, is in a comprehensive role as upstream operator, LNG plant operator, and LNG ship charterer such that single point accountability is possible for the entire supply chain to the point of sale. This will significantly underpin Tangguh’s continued growth into the future.
2. HISTORY OF INDONESIAN LNG

Indonesia’s entry into the LNG business was launched on the back of vast gas discoveries in the Badak Field in East Kalimantan and in the Arun Field in Aceh. The development of these fields into the world-class Bontang and Arun LNG projects launched Indonesia’s rise to become the world’s leading LNG exporter and provided a solid foundation for the LNG trade in the Pacific region for many years. Bontang produced Indonesia’s first LNG in 1977, followed by Arun in 1978. The volume of Indonesian LNG exports grew at a steady and stable rate for many years, capturing a significant world market share. Indonesia has long maintained its position as the leading LNG exporter, although recent supply problems at Bontang and the depletion of Arun’s mature fields have presented some challenges. Today, about 70% of Indonesian LNG production goes to Japan, 20% to Korea, and 10% to Taiwan.

The Bontang LNG plant has eight LNG trains with an annual production capacity of 21.6 mtpa, and is among the largest LNG facilities in the world. The historic launch sales contract secured Indonesia’s first market for twenty years to a consortium of Japanese buyers. This has grown to eight long term contracts today to Japan, Korea and Taiwan. Over 3.6 bcf gas per day can be processed and transported to Bontang from surrounding fields operated by VICO Indonesia, Total E&P, and Chevron Indonesia. More than 5,000 LNG cargoes have been delivered to date, and Bontang reserves will continue to supply natural gas well into the future.

Annual production at Arun stands at around 6.5 mtpa with three trains operating. To date, over 4,000 cargoes of LNG have been delivered to customers in Japan and Korea since the plant began operations in 1978. After peaking in 1995, Arun’s LNG production has been declining, and experts estimate that Arun will cease to be an important source of LNG by 2012 or soon thereafter.

As part of Indonesia’s dual economic policy of maintaining security of LNG supply and encouraging the development of foreign-exchange earning projects, realization of the Tangguh LNG Project is a national priority. While Arun and Bontang have dominated Indonesian LNG production in the past, the Tangguh LNG Project is the country’s best option for a third supply project to ensure Indonesia’s position as a leading exporter of LNG for the future, as illustrated in Figure 2.
Indonesia continues to enjoy enormous unexploited gas reserves, with proven and probable natural gas reserves of approximately 178 trillion cubic feet, of which 92 trillion cubic feet is proven\(^3\). It is endowed with the best hydrocarbon potential in Southeast Asia. Significant undeveloped resources have been identified in Natuna D Alpha, INPEX’s Masella discovery, Exxon’s Cepu project, and Medco’s Senoro project in Sulawesi.

3. THE RISE OF TANGGUH

Substantial natural gas deposits were identified with the discovery of the Wiriagar Deep field in 1994. The adjacent Vorwata gas field was discovered in 1996 and delineated during 1997-98. In total since 1990, six gas fields have been discovered in the area covered by the Berau, Muturi, and Wiriagar PSCs. A consortium of international energy companies, together with BPMIGAS, are developing these fields. Working interests in the Tangguh LNG Project are held by subsidiaries of several major oil and gas companies, including BP PLC (37.2%), China National Offshore Oil Corporation (17.0%), Mitsubishi Corporation and INPEX Corporation (together 16.3%), Nippon Oil Exploration, Ltd. and JOGMEC (together 12.2%), Kanematsu Corporation, JOGMEC, Mitsu’s subsidiary, Overseas Petroleum Corporation (together 10%), and LNG Japan Corporation (7.3%). All of the companies represented in the Tangguh PSCs have direct or indirect gas production experience in the region and managerial and marketing expertise in the globalizing LNG business. In anticipation of the development of this valuable resource from one of Indonesia’s most rugged regions, the Project was given the name “Tangguh”, meaning strong and resilient, in 1997.

3.1 Tangguh Gas Fields and PSCs

The gas resource for the Tangguh LNG Project is comprised of six recently discovered gas fields which are located mainly offshore in the shallow, protected water of the Bintuni Bay area in Papua, Indonesia (formerly Irian Jaya). The giant Vorwata and Wiriagar Deep gas fields are by far the largest discoveries and together account for almost 13.3 TCF, or over 90%, of Tangguh’s proven gas reserves. The main reservoir is an excellent quality Jurassic sandstone. The area covered by the Vorwata field is approximately 80,000 acres and that covered by the Wiriagar Deep field is approximately 60,000 acres. In the 21 wells already drilled and evaluated on these two fields, the permeability is as high as 830 millidarcies, average porosity is over 12%, and continuous pay thickness is as high as 430 feet. The high-quality, thick reservoirs are capable of very high rates of production. By July 1998, the full certification was completed as follows in Table 1:
Table 1: Tangguh Reserves by field

<table>
<thead>
<tr>
<th>Field</th>
<th>Proved</th>
<th>Proved+Probable</th>
<th>Proved+Probable+Possible</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vorwata Field</td>
<td>10.4</td>
<td>12.1</td>
<td>14.0</td>
</tr>
<tr>
<td>Wiriagar Deep Field</td>
<td>2.9</td>
<td>4.4</td>
<td>6.1</td>
</tr>
<tr>
<td>Ofaweri Field</td>
<td>0.4</td>
<td>0.5</td>
<td>1.0</td>
</tr>
<tr>
<td>Roabiba Field</td>
<td>0.4</td>
<td>0.6</td>
<td>0.9</td>
</tr>
<tr>
<td>Ubadari Field</td>
<td>0.3</td>
<td>0.7</td>
<td>1.5</td>
</tr>
<tr>
<td>Wos Field</td>
<td>0.0</td>
<td>0.0</td>
<td>0.2</td>
</tr>
</tbody>
</table>
| Total           | 14.4   | 18.3            | 23.7                     

The contractual framework under which gas is produced and sold in Indonesia has been developed around the Indonesian production sharing contract (PSC) system. This system was developed to apportion risk and return between the Indonesian State and oil and gas contractors. As portrayed in Figure 3 below, there are three PSC areas involved in Tangguh’s gas field complex. These are the Berau PSC, the Muturi PSC and the Wiriagar PSC. The Tangguh partners agreed in 2003 to establish a Tangguh Joint Venture unit area encompassing the three PSCs. BP was assigned operatorship of the entire area. This arrangement will greatly aid the optimization of development and future exploration. It will also maximize operating efficiency and accountability. The contractor parties also established a clear and efficient decision making mechanism to further streamline management processes.

Figure 3:

3.2 Early Challenges

Following reserves certification in July 1998, Japan became the primary target for Tangguh sales. The Asian crisis had not yet fully impacted demand projections and the industry still foresaw incremental LNG demand in Japan in the 2005 timeframe. Japan is the world’s largest LNG consumer and was the launch customer for both Arun and Bontang. Its LNG buyers have long and successful track records. They are typically utility companies with very strong financial standing that make them very attractive LNG customers.

However, as the Asian economic crisis continued to unfold and deepen in the late 1990’s, the appetite for new LNG supply commitments entered a period of stagnation during these critical early years for Tangguh. To further compound the difficulties facing a successful Tangguh launch, Indonesia entered a period of dramatic political change. President Suharto resigned in May 1998, ending his rule that started in 1966. This cast a shadow of political uncertainty on Indonesia that was further darkened by the civil unrest in Aceh that triggered the closure of the Arun LNG plant for several months in 2001.

Despite this turbulent period in Indonesia’s history, ARCO took an opportunity to present the reserve certificates to Indonesian President Habibie in September 1998 to raise the profile of the Tangguh Project in the new administration. In April 1999, BP announced the agreement to
acquire ARCO and took over the lead role in the Tangguh consortium. Through 1999-2000 potential LNG plant sites were gradually narrowed to the final selection of the Tanah Merah village location on virtue of the good ground conditions and the high elevation. Tsunamis were a concern given that Papua is in an earthquake prone area. After extensive consultations with the villagers and land owners were concluded, an agreement was signed such that the existing village site could be used for the LNG plant in exchange for financial support and the construction of new and refurbished houses.

While progress continued on the ground, competition in the LNG market remained fierce. Various greenfield and expansion supply projects vied for limited market opportunities. Buyers in Japan and Korea remained distracted by weak domestic economies and regulatory uncertainty. Fundamentals in the North American market began to improve but environmental and regulatory hurdles loomed large, making a trans-Pacific LNG trade seem unrealistic. China, with its growing economy, seized the opportunity to launch its first LNG import terminal project in Guangdong with the hope of securing a LNG supply at reasonable prices. Tangguh, along with several other bidders, competed to win the market. By submitting an attractive proposal, Tangguh positioned itself for subsequent success in China.

3.3 A changing regulatory landscape

Prior to 2002, Pertamina was the coordinator for Indonesian LNG management, production, and marketing. To “unbundle” the sector, the Indonesian legislature passed the Oil and Gas Law 22/2001 in October of 2001, limiting Pertamina’s monopoly on upstream development and transferring its regulatory and administrative functions to a new body, BPMIGAS, and to the Energy Ministry, and Finance Ministry. This energy sector reshuffle raised questions about which parties have control over LNG assets, which parties are authorized to negotiate and execute new LNG contracts, and how Pertamina’s existing financial and contractual LNG obligations are to be managed.

These changes had to be dealt with and understood quickly in order for Tangguh to progress. As a first step, with the handover of regulatory management to BPMIGAS in March 2003, BP was designated the single operator of the entire Project. This brought together the full operational responsibilities of the upstream gas production facilities, the pipelines, and the LNG facilities. This scheme has significant advantages which result in lower operating costs and optimized development. The structure also offers the customer clear accountability for the entire LNG supply chain.

Tangguh’s commercial structure is similar to past Indonesian LNG developments, but with some adjustments to comply with the new oil and gas law. The Indonesian Government will own the LNG facility and all Project assets. BP will operate and maintain the gas fields, transportation systems, and LNG facility. LNG sales agreements will be entered into by or on behalf of the producers and BPMIGAS. Similarly, LNG marketing activities will be jointly managed by the PSC contractors and BPMIGAS.

Table 2 compares the new Tangguh operational and contractual model with the existing Bontang model.

<table>
<thead>
<tr>
<th>Function</th>
<th>Traditional Bontang Model</th>
<th>Tangguh Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>PSC Counter-Party</td>
<td>PERTAMINA</td>
<td>BPMIGAS</td>
</tr>
<tr>
<td>Seller of LNG</td>
<td>PERTAMINA</td>
<td>PSC Contractors and BPMIGAS nominee</td>
</tr>
<tr>
<td>LNG Plant Owner</td>
<td>Government of Indonesia</td>
<td>Government of Indonesia</td>
</tr>
<tr>
<td>LNG Plant Operator</td>
<td>PT Badak</td>
<td>BP Berau, the PSC Contractor</td>
</tr>
<tr>
<td>Upstream Operator(s)</td>
<td>VICO, TOTAL, Chevron</td>
<td>BP Berau, the PSC Contractor</td>
</tr>
<tr>
<td>Ship Charterer</td>
<td>PERTAMINA</td>
<td>BP Berau, the PSC Contractor</td>
</tr>
</tbody>
</table>
4. LNG SALES

Tangguh’s LNG sales commitment portfolio includes deliveries to China, Korea and Mexico (Figure 4). All of the buyers are new to the LNG industry representing a significant diversification of Indonesia’s customer base. These trades also represent Indonesia’s entry into what are expected to be very large and growing LNG markets for the future. The contracts have varying price formulae that will provide a combination of stable revenues and more responsive pricing to capture future price upside. While retaining many of the features of traditional LNG sales contracts, there are also some distinct differences that will allow Tangguh to continue making unique offers to the market to capture future supply opportunities.

Figure 4: Tangguh Supply Commitments

4.1 Fujian

Following the intense competition for the Guangdong market, Tangguh landed its first sale when the Fujian SPA was signed in September 2002 for 2.6mtpa for 25 years. Prior to this, Tangguh was just another hopeful greenfield LNG project among many other competitors. The Fujian LNG terminal is now under construction in Fujian Province. China continues to enjoy a very strong economy and has emerged as a very important market for future LNG sales. It is the world's most populous country and is the second largest energy consumer. Importantly, this contract significantly increased the viability of Tangguh in other markets, laying the groundwork for the subsequent market successes in Korea and North America.

4.2 POSCO and K-Power

The Korean LNG market is the second largest in Asia, and has grown steadily since its first LNG supply in 1987. Stemming from Korea’s efforts to deregulate its natural gas and LNG markets, POSCO and SK Corporation became the first private Korean companies to invite LNG supply bids. The bid invitation in January 2003 was to supply approximately 1.1 mtpa to POSCO’s proposed import terminal project at Gwangyang, with the LNG used to power POSCO’s steel mills and SK's 1.1 gigawatt merchant power project, K-Power. In July 2003, Tangguh was named a preferred seller. SPA negotiations were finalized in the first half of 2004 with combined sales agreements of up to 1.35 mtpa.

POSCO has completed its new Gwangyang terminal and began taking LNG deliveries in 2005. Supplies to K-Power have also begun with deliveries via POSCO’s terminal. To secure both of these deals, Tangguh partners committed to supply LNG from their combined worldwide LNG portfolio until Tangguh’s expected start-up in 2008. Once Tangguh begins operations, the bridging
Supplies will cease with Tangguh taking over supply for the remainder of the contract terms. Korea continues to have strong energy demand growth that will provide Tangguh with new LNG sales opportunities in the future.

4.3 Sempra Energy

Tangguh’s largest LNG sales contract is the 20-year commitment to supply 3.7 mtpa to Sempra Energy, part of a large San Diego, California based gas and electric utility company. Sempra’s Costa Azul import terminal, now under construction, is about 60 miles south of the US border in Baja California, Mexico. This will be the first LNG import terminal constructed on the North American West Coast. For Indonesia, this is a milestone sales contract that marks the industry’s first long-term supply commitment to North America across the Pacific Ocean.

Meetings between BP and Sempra regarding a Tangguh LNG supply were initially held in 2001 and focused primarily on a possible short-term wedge supply. However, over the course of several months, negotiations matured towards finalization of a long term trade. The Tangguh parties took two key steps when they agreed to use published North American natural gas prices as the basis for LNG pricing, and agreed to take on LNG transportation obligations from Tangguh to Mexico. In December 2003, an initial agreement was signed, followed by detailed negotiations that concluded with SPA execution in October 2004.

Table 3 below details Tangguh’s long-term sales agreements.

<table>
<thead>
<tr>
<th>Buyer</th>
<th>Duration</th>
<th>Delivery Volumes, mtpa</th>
<th>Sales Point</th>
<th>Market</th>
</tr>
</thead>
<tbody>
<tr>
<td>CNOOC Ltd</td>
<td>2008-2033</td>
<td>2.60</td>
<td>FOB</td>
<td>China</td>
</tr>
<tr>
<td>POSCO</td>
<td>2005-2024</td>
<td>0.55</td>
<td>DES</td>
<td>S. Korea</td>
</tr>
<tr>
<td>K Power</td>
<td>2006-2025</td>
<td>Up to 0.80</td>
<td>DES</td>
<td>S. Korea</td>
</tr>
<tr>
<td>Sempra Energy</td>
<td>2008-2029</td>
<td>3.70</td>
<td>DES</td>
<td>North America</td>
</tr>
</tbody>
</table>

4.4 Phase II Expansion and Future Marketing

With most of the capacity of Tangguh’s initial two trains placed into the market, the Tangguh partners and BPMIGAS are now appraising further expansion opportunities. Reserves from identified fields are expected to be sufficient for at least two additional trains, and the region remains significantly under-explored. Design criteria for the initial development included the requirement to accommodate future expansion facilities. Facilities have been arranged with ample space for additional trains and all related facilities. Expansion provisions allow installation of future trains without requiring shutdown of operational trains.

Future marketing efforts will target the traditional Asian buyers and other dynamic markets in the Asia Pacific region. A special emphasis will be placed on Japan, given the important role Japan has played in the development of Indonesian LNG and the significant Tangguh equity position held by Japanese corporations. Supply synergies with Bontang will continue to be explored. With energy demand exhibiting strong growth in Indonesia, especially on the island of Java, Tangguh will also work closely with BPMIGAS to explore ways to fit this potential new LNG market into the Tangguh portfolio.

5. GEARING UP: TANGGUH PROJECT AND FACILITIES

5.1 Offshore plan

EPC contracts for the upstream facilities were awarded to Saipem. Initial development will generate gas supply from two offshore platforms, VRA and VRB, in Vorwata field. Each LNG train requires up to 750 mmscfd which will require about seven wells per train, assuming a 7-inch monobore completions. Each platform will have a dedicated 24-inch diameter corrosion resistant pipeline to the onshore receiving facility, where any free liquids will be separated from the gas
before it enters the LNG plant. The distances from the platforms to the LNG plant vary from about 15km to 30km. The lines are designed to carry a minimum of 1 BCF per day providing excess deliverability to assure a reliable supply to the LNG plant.

The offshore setting is favorable for development. Bintuni Bay is sheltered, with relatively shallow water, located in a region that does not suffer extreme weather conditions such as typhoons. These characteristics contribute to the Project’s cost competitiveness and operational reliability. Figure 5 below shows the full two-train development layout including the initial start-up:

Figure 5: Offshore plan

5.2 Onshore plan

After a two stage competitive bidding process between three qualified bidding consortia, a group using the Air Products process led by Kellogg, Brown and Root was named preferred EPC Contractor candidate for a turnkey contract covering the two liquefaction trains, two storage tanks, related infrastructure, and marine terminal (Figure 6).

The LNG plant location on the south shore of Bintuni Bay provides good sea access, stable soils and ample area for future expansion. Two liquefaction trains will each have production capacity of 3.8 mtpa. Utility systems will be constructed to meet daily plant requirements. Site planners have anticipated future expansions up to a total of eight liquefaction trains. The marine facilities include a LNG loading berth, with a minimum water depth alongside of 13m at lowest astronomical tide, connected to the shore by a 1250 meter trestle. The LNG storage tanks will each have a working capacity of 170,000m$^3$. 

![Diagram of Offshore Plan](image-url)
5.3 Shipping

Tangguh has chartered seven LNG vessels for the transportation of LNG to customers in Korea and Mexico. Long term time charters were signed in July 2005 with three international consortia:

- K-Line/PT Meratus: 3 vessels
- NYK/Sovcomflot/PT Samudera Shipping: 2 vessels
- Teekay Shipping/PT Fast Marine Services: 2 vessels

The vessels will be constructed in the Korean shipyards of Daewoo, Samsung and Hyundai. All vessels are of the “Membrane type” and range in size from 145,700 – 154,900 m³.

5.4 Environment and Social Responsibility

The Bintuni Bay area is biologically rich and physically dynamic. The area is sparsely populated by indigenous communities belonging to seven distinct ethnic groups. Residing in numerous small villages and temporary settlements, the local people have long been practicing agriculture and fishing.

The Project is pursuing a responsible approach to resource development, integrating environmental, social, and economic concerns into the Project design. The cornerstone of the Project's social responsibility strategy in Papua is that of partnership and joint action with its numerous external stakeholders. The Project team has built partnerships with government organizations, NGOs, other businesses, employees, contractors, universities, local Yayasans, and the local people. The Project will achieve social and economic development founded on sustainability, self-sufficiency, and self-reliance.

The Tangguh Independent Advisory Panel was established to provide expert external advice to Tangguh’s senior decision-makers regarding non-commercial aspects of the project. The Panel advises Tangguh on how the project can be a world-class model for responsible development.
5.5 Current project update

The project is on track and on budget for its planned commissioning in late 2008. As of January 2006, the overall LNG Plant was 28.6% complete, while upstream facilities were 29.3% complete. The majority of tertiary steel orders for platforms are in place, while procurement of major long lead delivery equipment has neared completion and critical bulk materials’ purchasing continues ahead of plan. A brief outline of the project timeline is detailed in Figure 7 below:

Figure 7: Tangguh Project Schedule:

<table>
<thead>
<tr>
<th>2005</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
</tr>
</thead>
<tbody>
<tr>
<td>EPCs tendered</td>
<td>Well Planning</td>
<td>Platform Completions</td>
<td>Onshore Receiving Facilities Completions</td>
<td>First Tanker Delivered</td>
</tr>
</tbody>
</table>

Takeover train 1
Takeover train 2
REFERENCES:

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3. various industry sources