

## Peru LNG Pipeline Project

### Project Significance

Peru LNG Project, the largest infrastructure project in Peru's history, will position Peru as a world leader in the LNG industry. U.S. based Hunt Oil Company is the majority partner and principal operator, operating under the subsidiary Hunt Oil Peru. The international consortium members, partnering with Hunt, include SK Corporation of Korea, Repsol YPF of Spain and Marubeni Corporation of Japan.

The Peru LNG Project is made up of 2 major segments. The first segment consists of a gas supply pipeline connecting to the existing Transportada de Gas Del Peru S.A. (TGP) pipeline. This 408 kilometer, 34-inch natural gas pipeline stretches from Chiquintirca in the Andes Mountains, east of Ayacucho to an LNG Plant at Pampa Melchorita, located in the coastal area. Development of the pipeline began in 2005 and with project operations running according to schedule, the pipeline is projected to have gas flowing and be fully commissioned in the first quarter of 2010. By 2010, the pipeline will be used to transport natural gas resources in excess of domestic demand from the Camisea base gas fields to the southern coastal region of Peru for export at the LNG Plant.

Gulf is providing services on the pipeline portion of the project; however, there is a second segment to the project

Gulf Interstate Engineering Company (Gulf) was competitively selected by Peru LNG, S.R.L. to provide basic design services (FEED), including assessment of the route selection and constructability analysis and the development of a capital cost estimate and project schedule; subsequently, Gulf was awarded the detailed engineering, design and procurement services on the Peru LNG Pipeline Project. Specifically, Gulf provided the following engineering services: designed the pipeline system in accordance with the requirements of ASME B31.8 and Peruvian Government Regulations, specified and procured materials, prepared the construction bid documents, evaluated the bids, provided additional field surveys and data gathering that was required to complement existing field data, provided construction management assistance in Lima, and conducted site visits for technical and telecommunications clarifications.

The Peru LNG Project is a world-class engineering project, set to be one of the most important resources of Peru's future energy strategy. The 408 kilometer, 34-inch natural gas pipeline system originates in Chiquintirca in the Andes Mountains, east of Ayacucho extending to an LNG Plant at Pampa Melchorita, located in the coast area. The pipeline system includes mainline valves, scraper receiver/launcher facilities, pressure control station, 1 meter station, fiber optic cable and a SCADA system. The pipeline system traverses some 310 kilometers of rugged mountain terrain with numerous river crossings and some 98 kilometers of coastal desert plain. This major system also crosses through 22 districts: nine in Ayacucho (Paras, Socos, Vinchos, Tambillo, Acocro, Chiara, Acos Vinchos, San Miguel and Anco), four in Huancavelica (Ayaví, Tambo, Huaytará and Pilpichaca), eight in Ica (Huancano, Humay, Independencia – in the province of Pisco and El Carmen, Alto Larán, Chíncha Alta, Pueblo Nuevo and Grocio Prado – in the province of Chíncha) and one in Lima (Cañete).

which consists of a liquefied natural gas (LNG) plant. The LNG plant includes a marine loading terminal from which LNG will be transported. The LNG plant and marine facilities are located between Canete and Chíncha, 170 kilometers south of Lima. Initial commissioning activities

are planned for early 2010, with the first shipment expected in mid 2010. The facility will have the capacity to produce 4.45 million metric tons of LNG per year.

Total investment for the project, including the pipeline segment, liquefaction plant and marine facilities is

estimated at \$3.6 billion, the largest direct foreign investment in the history of Peru. The project is expected to generate roughly \$1.4 billion annually from export revenues.

### Extensive Experience

Gulf's proven experience in designing natural gas transportation facilities in the remote, mountain terrains of Peru was a key factor in being selected by Peru LNG, S.R.L. for the Peru LNG Project. With a talented project team having just completed a very similar project in Peru, Gulf assembled a technically sound, experienced team to conquer this new challenge. In 2004, Gulf completed work on the Camisea Natural Gas and Natural Gas Liquids Transportation Project, a state-of-the-art natural gas and NGL transportation system for Transportada de Gas del Peru S.A. For this project, Gulf served as the Construction Manager/Owner's Engineer, participating in the management and administration of the engineering, procurement, and construction activities.

The Peru LNG pipeline system approximates the general routing of the existing TGP Pipeline though it deviates significantly in three major areas. The biggest area of deviation occurs at Kilometer 240 to Kilometer 340; the pipeline deviates significantly to the south and is some 10 kilometers distant from the existing line. This deviation

avoids a very rugged descent from a mountainous ridge, the narrow and sensitive Pisco River valley and the six crossings of the Pisco River that the existing TGP Pipeline Transportation System encountered. This knowledge transfer from one project to another was very beneficial to Gulf in resolving the many challenges that arose on this project.

### Challenges

Familiar issues, similar to the challenges Gulf faced on the Camisea Project included terrain conditions, landslides, altitude considerations, government regulations, and challenging environmental and ecological conditions. Gulf gave special consideration and applied lessons learned when evaluating the possible pipeline routes for the Peru LNG Project.

To ensure the route was technically feasible and environmentally safe, specialists were brought in to identify the route with the least environmental impact and to mitigate the project's imprint on the environment. With selected specialists, Gulf evaluated routes based on areas of the Andes that were more geo-technically stable, and based on decreasing the number of steep gradients and river crossings. Gulf engaged the services of subcontractors to provide satellite imagery and perform control surveys, geotechnical investigations, hydrological investigations and topographic surveys. From this, Gulf developed reports detailing design recommendations for all river crossings; a report providing assessment of the entire

route, including identification of any seismic areas crossed by the pipeline system; and additional field surveys to complement existing survey data. Subcontractors hired to perform fieldwork were all Peruvian companies.

The Peru LNG Project features diverse challenging terrain with much of the pipeline route traversing through areas of rugged mountain terrain, rolling mountain terrain, narrow mountain ridges, river crossings and coastal desert plains; the Peru LNG Project is an engineering feat from any standard. The pipeline follows an undulating route, winding along narrow mountain ridges through the Andes Mountains with near inaccessible locations and terrain conditions that are considered the toughest in the world when engineering and constructing a pipeline project of this sort.

While passing the high plains of the Andes the pipeline reaches its maximum elevation of 16,080 feet (4901 meters). When designing this pipeline system, Gulf had to take into account this very high and uncommon altitude and

how it would affect the many aspects of this project, such as the design and operation of power generation systems, construction, equipment certification, etc.

Slope instability is one of the most serious concerns in constructing a pipeline in this area. Innovative technology was implemented to monitor movement on the ground. A specialized fiber optic cable is buried beside the pipeline to measure strain and movement. This system can alert the operator and perhaps prevent a landslide.

In addition to serious design and construction hurdles due to the terrain, Gulf encountered difficulties due to the ecologically sensitive region and stringent government regulations.

### Equipment and Material Purchase & Manufacture

In addition to typical procurement activities, such as preparing vendor lists, purchase requisitions, evaluation of bids received, accompanied by recommendations, purchase orders, etc., Gulf provided inspection personnel to carry out the quality inspection

of all major material and equipment to be purchased at the point of manufacture thorough preparation for shipment. Gulf's inspectors were actively involved at each pipe mill to monitor the production and quality process of the pipes. The pipes were made at three different pipe mills in India and Italy. With varying production schedules, the inspectors were in the pipe mills for more than 11 months.

### Construction Phase

During the construction phase, Gulf was responsible for providing supplemental engineering and technical staff as needed; this consisted of preparing the quality plans and procedures for the inspection and progress reporting of all construction activities, assisted in evaluating and performing required field design and construction changes, etc. Gulf will also provide assistance during the commissioning and start-up of the system.



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