INTRODUCTION

The Amursky Gas Processing Plant (Amur GPP) is part of Gazprom’s project for the supply of Russian gas to China via the ‘Power of Siberia’ pipeline from eastern Siberian gas fields. The plant will be built in five phases with planned completion in 2024. The technology company ‘The Linde Group’ has been selected by Gazprom and its general contractor ‘NIPGAS’ as the licensor for cryogenic gas separation technology at the Amursky Gas Processing Plant (Amur GPP), located near Svobodny town in the Far East of Russia. Linde will engineer and supply units for ethane and natural gas liquids (NGL) extraction and nitrogen rejection (NR), as well as for helium purification, liquefaction and storage (HE).
PURPOSE

A detailed and complex geotechnical, hydrogeological and seismic survey in accordance with the valid Russian standards and Linde specification was required with the purpose to study the geotechnical, hydrogeological and seismic site conditions for development of the detailed design documentation and to support the design activities for foundations and piles running in parallel to the investigations. Reports had to be prepared presenting the investigation results, evaluation and interpretation of the field and laboratory test results, dynamic soil properties, recommendations for foundations and conclusions according to SP 47.13330.2012 and SP 11-105-97 and internationally recognized standards in Russian and English language.

Additionally a Seismic microzonation of the site was required to refine the local seismic hazard level in accordance with the Medvedev-Sponheuer-Karnik scale (MSK-64). Refined local definition of seismic hazard level for maps covering 10-percent (Map A), 5-percent (Map B), and 1-percent (Map C) probability of increase over mapped indexes of seismic activity within a 50-year period had to be prepared according SP 14.13330.2014.

FUGRO ООО «ГЕОИНЖСЕРВИС» / GEOINGSERVICE LLP with its base in Moscow was commissioned to perform the investigations under specification and strict supervision of Linde’s selected German based geotechnical consultancy firm BAUGRUND DRESDEN GmbH.

REALIZATION

FUGRO ООО «ГЕОИНЖСЕРВИС» / GEOINGSERVICE LLP was selected as the company that was capable to provide sufficient drilling and state-of the art digital Cone Penetration (CPT), Seismic Dilatometer testing (SDMT), Plate Load Testing (PLT) and Pressuremeter (PM) resources and equipment to site short notice and met the high technical and quality demands. Two (2) 20 t Cone Penetration trucks and one (1) drilling rig were mobilized right after contract award and shipped from Moscow via the Transsiberian Railway to site far East of Russia with arrival just three (3) weeks after contract award. Three (3) additional drilling rigs were subcontracted locally Far East.
Given the complexity of the project, remote location, inevitable difficulties (especially in the middle of the project with toxic liquid found in former missile pits), the tight time schedule, the involvement of several different in-situ geotechnical, geophysical and drilling applications, Fugro proved to be a reliable partner throughout the project demonstrating the company’s ability to serve clients with complex services in a ‘one-stop-shop’ with challenging time schedules.

At peak times six (6) drilling rigs, two (2) CPT trucks and 30 drilling and testing staff as well as geologists were active at site. Geotechnical laboratory testing was performed in a facility established at site (mobile laboratory) for immediate determination and classification of soil properties.

Fugro’s in-situ geotechnical testing capabilities such as Resistivity Cone Penetration Testing with pore water pressure measurement (RCPTU) and Seismic Dilatometer (SDMT) were of significant benefit to the project, providing early availability of data while drilling was still ongoing. RCPTU reached 50 m deep penetration and provided full stratum information for site levelling considerations.

The deformation characteristics of the predominantly sandy soils was of primary interest for design. Static Plate Load Testing (flat plate, type III, with the surface area of 600 cm²) was performed from the surface and at shallow depth in trial pits to determine the deformation characteristics above the groundwater table. Pressuremeter testing using a radial pressuremeter PEV-89MK (slow and fast mode) and a hydro pneumo elastic three-celled pressuremeter (analogue to Ménard pressuremeter) was performed in boreholes to determine the deformation characteristics to greater depth.

To determine the hydraulic properties of the relevant layers at site, to gather information on the design groundwater level and assess if a surface drainage system will be required eight (8) geotechnical boreholes were equipped with PVC and filters and transformed into pumping wells and standpipes. Three (3) express and five (5) long pumping tests were performed at site. Water level monitoring commenced using digital data loggers prior, during and after pump testing. Ground water samples were taken to analyse the groundwater chemistry and to help assess the corrosive potential for design of concrete and steel structures in contact with the groundwater.

Fugro staff worked hand in hand with Main Clients representatives (NIPIgazpererabotka) to comply with all HSE requirements at the construction site. No incident was reported.
SCOPE OF WORK / OVERVIEW

- 150 geotechnical boreholes with sampling up to 40 m depth
- Core storage for 4392 meters of core
- 355 Cone Penetration Tests (RCPTU) extending to a maximum 50 m below ground level
- 29 SDMT’s with P- and S-wave velocity measurement in 1 m depth intervals to maximum 30 m depth
- 47 Static Plate Load Tests (PLT) up to 20 m depth
- 78 Pressuremeter (PM) tests up to 40 m depth
- Standpipe and well installation at 8 locations
- 8 pumping tests (3 express and 5 long)

- Ground water level monitoring using digital data loggers during the field work activities
- > 1000 basic geotechnical and classification tests (sieve analysis, Plastic limits, Proctor, water content, organic content, carbonate content, etc.)
- 81 triaxial tests (CD, CU)
- 105 Oedometer and shear tests
- 31 soil frost heave tests
- 8 chemical analysis of water and 96 chemical analysis of soil
- Factual geotechnical data reports
- Final Geotechnical Report with design recommendations (bilingual English/Russian)
- Seismic microzonation survey Report (bilingual English/Russian)