ATTACHMENT F

Engineering Recommendation on Donlin Gold Pipeline Lease

MEMORANDUM
State of Alaska
Department of Natural Resources Division of Oil and Gas/SPCS

TO: Graham Smith
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LETTER NO: 18-319-AS

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SUBJECT: **Engineering Recommendation on Donlin Gold Pipeline Lease**

Recommendation
The review of the provided technical documents concluded that the preliminary design of the DONLIN GOLD PIPELINE falls within acceptable practices, standards, and norms of design for a natural gas pipeline. The proposed preliminary design meets the technical requirements of the lease application. Therefore, approval of the DONLIN GOLD PIPELINE right-of-way lease is recommended by the Division of Oil and Gas.

Of note, as the design is at a preliminary level, a detailed review of the Issued For Construction (IFC) documents will be required through the Notice to Proceed (NTP) process prior to construction activities beginning.

Discussion
The proposed Donlin Gold pipeline project will consist of a buried 14-inch diameter, dedicated natural gas transmission pipeline and a single compressor station. The system will receive natural gas from the existing Enstar Natural Gas Company 20-inch diameter Beluga pipeline near Beluga, Alaska, and transport the product to the proposed Donlin Gold mine. The gas will be used to generate electricity to power industrial equipment, heat buildings, and support mine operations.

The Donlin Gold pipeline, approximately 315 miles long, will connect with the Beluga natural gas pipeline at a tie-in location within the Susitna Flats State Game Refuge in the Matanuska-Susitna Borough. The pipeline will extend to the Donlin Gold mine located in Southwest Alaska about ten miles north of the village of Crooked Creek. The pipeline route crosses an area with no significant preexisting infrastructure and does not follow any existing utility corridors.

This 14-inch diameter pipeline will be constructed using API 5L X52 PSL2 line pipe. It will be designed to operate at a maximum allowable operating pressure (MAOP) of 1,480 pounds per square inch gauge (psig) with a maximum throughput of approximately 76 million standard cubic feet per day (mmscfd) of natural gas. A single compressor station located at

approximately Milepost (MP) 0.4 of the pipeline will be required to boost the gas pressure to a level sufficient to deliver the gas to the pipeline terminus at a minimum pressure of 100 psig. The compressor station will be accessible by utilizing the existing Pretty Creek Road. No additional compression along the pipeline route is planned.

PHMSA Authority
The pipeline will be regulated by the U.S. Department of Transportation (DOT) under Title 49 of the *Code of Federal Regulations*, Part 192 – Transportation of Natural Gas and Other Gas by Pipeline: Minimum Federal Safety Standards (49 CFR 192).

Minimum Standards
The pipeline will be designed, constructed, and operated in accordance with the applicable requirements of 49 CFR 192 and will incorporate launching and receiving facilities for in-line maintenance and inspection tools, mainline block valves, cathodic protection, leak detection and a supervisory control and data acquisition (SCADA) system. Specific leak detection methods will be reviewed during final design review and meet all mandated operational requirements prior to NTP.

Hydrology/Waterbody Crossings
Several hundred water body crossings are expected along the pipeline route. Suitable trenching methods will be engineered later and dependent on factors related to the hydrological conditions and environmental concerns as well as aquatic life forms. Directional drilling or aerial spanning using bridge structures will be employed where conditions dictate their benefits. Direct-trenching at stream crossings may have the least impact in some cases, especially during freezing weather conditions, and be the method chosen to cross flowing waters. Stream crossings do not include swales, non-incised wetlands, lakes or ponds.

Permafrost
Permafrost, continuous and/or discontinuous frozen ice-rich soil, is expected along some portions of the proposed pipeline route. Thaw settlement may occur where pipeline influence or construction disturbance lead to thawing of initially frozen ice-rich soils. Also, frost heaving will be addressed and reviewed in the final design of the pipeline.

Frost heaves and mitigation for thaw settlement depends on identifying portions of the alignment vulnerable to these geohazards. Evaluating the depth extent and associated soil movement of the hazard and accounting for the structural interaction between the pipeline and surrounding soil is necessary for pipeline integrity for the expected design life. Mitigation is indicated if modeling suggests pipeline deflections could exceed allowable values. Thaw settlement can be mitigated by replacing thaw unstable soils with compact structural fill, applying insulation to control ground thawing in localized areas, or by controlling the operational temperature of the pipeline. These issues will be addressed and reviewed in the detailed engineering and design phase of the project.

Preliminary pipeline hydraulic analyses indicate the operational pipeline will largely follow the ambient conditions of the subsurface rather than being an important heat source or heat sink.

Thaw settlement, mainly due to construction disturbance of the right-of-way, has been identified as a potential risk to long term pipeline stability.

Seismic
Alaska is a region with a history of high seismicity. Seismic events pose a well-documented risk to the pipeline along the alignment. The Denali fault is a significant geohazard that the proposed pipeline route crosses and parallels. Mitigating measures planned for such areas include above-ground fault crossing of the pipeline with enough flexibility provided for the pipeline to remain intact in the event of land displacement. These measures will be further defined and reviewed in the detailed engineering phase prior to construction.

Strain Based Design
For the evaluation of the effect of earth movements from inelastic large displacement, analysis methods will be employed to determine the expected site specific strain demand in the pipeline. If the calculated strain demand is greater than the yield strain of 0.5%, the capacity of the pipe material to safely resist the strain demand must be further evaluated, and corrective measures taken prior to proceeding with the design.

The strain capacity will be analyzed through engineering modeling to evaluate the tensile and compressive strain capacities at the limit states of the pipe material. The strain demand will be compared to the strain demand limit to ensure it does not exceed the material allowable at any place along the alignment. The U.S. Department of Transportation Pipeline and Hazardous Materials Safety Administration has approved this proposed strain based design method through a special permit, PHMSA-2016-0149, with Donlin Gold.

Design Life
The engineering design life of the proposed pipeline is 30 years. As used herein, engineering design life is defined as the period over which the systems, components, and structure are required to perform their primary functions with acceptable safety, regulatory, and environmental performance, and with acceptable probability they will not experience large failures, require extensive replacements, or need significant repairs. All time-dependent calculations utilize this 30-year period for design analysis.

Reviewed Documents

1. Design Basis Memorandum Rev 2, April 2018.
2. EIS Documents: http://www.donlingoldeis.com/EISDocuments.aspx
3. Natural Gas Pipeline Plan of Development, Donlin Gold Project, Revision 1, December 2013. Prepared by SRK Consulting, Inc.
4. Supplemental Information for the Donlin Gold Natural Gas Pipeline State Pipeline Right-of-Way Lease Application (ADL 231908), December 7, 2017
5. Donlin Creek Natural Gas Pipeline, Revision C, Issued for Final Report, April 29, 2011, Sheets 402896-01-001 to 402896-01-140, Pipeline Plan and Profile Drawings