APPENDIX H

HORIZONTAL DIRECTIONAL DRILLING (HDD) OPERATIONS MONITORING AND CONTINGENCY PLAN

Horizontal Directional Drilling (HDD) Operations Monitoring and Contingency Plan

Introduction

Transcontinental Gas Pipe Line Company, LLC (Transco) seeks to connect their 26-inch diameter Lower New York Bay Lateral to National Grid's proposed 26-inch diameter pipeline, tying-in on Rockaway Peninsula in Queens County, New York. The connection will be made by way of the proposed 26-inch diameter Rockaway Delivery Lateral (3.20 miles in length). A section of the Rockaway Delivery Lateral will cross under Jacob Riis Park in the Gateway National Recreation Area (GNRA) using the horizontal directional drilling (HDD) method. The proposed HDD will begin onshore near the Marine Parkway interchange and will terminate offshore beyond Rockaway Beach.

The HDD method of construction was chosen because it is environmentally friendly and has been proven to be a safe and efficient method for crossing rivers, wetlands, and other sensitive areas such as the public beach located along the onshore portion of the proposed alignment.

The purpose of this document is 1) to describe a program designed to monitor for potential failures during pipeline installation and for potential indicators of drilling fluid loss from the borehole (thereby reducing the likelihood of inadvertent drilling fluid returns at the surface), and 2) to describe the response plan that would be employed in the event of a pipeline installation failure or drilling fluid reaching the surface.

Drilling Fluid and Drilling Fluid System

The HDD process involves a drilling fluid composed primarily of fresh water and bentonite, naturally occurring, nonhazardous clay that serves as a viscosifier. If needed to manipulate the rheological properties for optimized drilling operations, the drilling fluid may also be augmented with starch, cellulose, non-toxic polymers, and/or crystalline silica. As currently envisioned, the fresh water will be sourced from fire hydrants located near the onshore entry workspace on Tri-Borough Tunnel Authority (TBTA) property north of Jacob Riis Park. The HDD contractor will source the bentonite and additives through its network of suppliers.

The primary purposes of the drilling fluid are to remove the cuttings from the enlarged hole, to stabilize the enlarged hole, and to act as a coolant and lubricant during the drilling process. The drilling fluid is denser than water, which helps to provide a higher hydrostatic pressure in the hole than in the surrounding formation. The drilling fluid generally consists of 1% to 5% bentonite, from 0% to 40% inert solids, and water. The inert solids are the cuttings

generated from drilling and are carried in the bentonite fluid to the entry and or exit points. These solids are then typically removed mechanically through the drilling fluid cleaning system.

The drilling fluid is first prepared in a mixing tank. The drilling fluid is typically pumped at 150 to 800 gallons per minute (gpm) through the center of the steel drill pipe to the downhole tools. Return flow is via the annulus created between the wall of the drilled hole and the drill pipe. The drill cuttings are carried back to the entry pit by the drilling fluid. Once in the entry pit, the drilling fluid is pumped to the drilling fluid processing equipment. The drilling fluid processing equipment typically employs shaker screens, desanders, desilters and possibly centrifuges to remove increasingly finer cuttings from the drilling fluid. The cleaned and recycled drilling fluid is then pumped back downhole. Additional drilling fluid is mixed to account for the increased volume of the drilled hole as drilling operations progress. The cuttings that return to the entry pit will be disposed of at an approved disposal site.

Pipeline Installation Failure Modes

Pilot Hole

The failure mode that may occur during the pilot hole drilling is the hole collapsing on the drill pipe string. This is typically caused by either not being able to maintain hole stability or unfavorable drilling strata that contain noncohesive alluvial material, e.g., gravel and cobbles. If the hole collapses on the drill pipe and creates high friction on the drill pipe's surface, the torque required to rotate the drill pipe will likely increase. The increased friction may either bind the drill pipe in such a way that it cannot be moved, or if the torque applied to the drill pipe by the drill rig exceeds the strength of the drill pipe, the force may cause the drill pipe to either shear or twist into two pieces. The longer the drill length, the more probability there is of this type of failure if noncohesive alluvial materials are present.

Hole Opening

In soil formations, if the hole-opening passes take a long time, there is one main type of failure. This failure mode consists of the material falling into the hole. Hole stability is reduced in these conditions, and the bridging material can keep the drilling fluid from returning to the surface. If the drilling fluid is no longer able to carry the drilled cuttings out of the hole, excess cuttings will remain in the hole. The cuttings may slowly build up in the bottom of the hole, increasing the friction on the drill pipe and inducing added wear on the drill pipe. Wearing will decrease the wall thickness of the drill pipe and may cause the drill pipe to fail. The increased friction may also cause the drill pipe to slow or stop rotation to a point where the drill rig cannot

supply enough torque to continue drilling without causing a failure of the drill pipe. The drill pipe may fail by shearing or twisting into two pieces.

Pullback

Failure of the pullback process occurs when the carrier pipe becomes lodged in the hole and is unable to be moved in either direction. If the pipeline encounters an obstruction, the pull of the drilling rig may increase to a level that causes the drill pipe to fail. This results in the greatest setback because the only alternative is to abandon the drilled hole and pipeline, relocate the pipeline alignment, and start the drilling process from the beginning. If the carrier pipe becomes lodged in the hole, the HDD contractor may use specialized equipment on the exit side to assist in trying to free the pipe and either push or pull the pipe out of the drilled hole.

Mechanical

The last type of failure occurs if the HDD contractor has a major mechanical breakdown. If the drill pipe remains idle for an extended time, there is a possibility the drill pipe may not continue to rotate or move in either direction. This can be the result of having no activity in the hole for an extended period of time, allowing the material contained within the drilled hole annulus to seize the drill pipe string in place and prevent further movement. If this occurs during pilot hole drilling, the contractor will be required to change the alignment of the crossing to miss the abandoned hole and start the drilling process from the beginning.

HDD Failure Criteria

Pilot Hole

The HDD installation method may be considered a failure if, after several attempts by the HDD contractor, completing the pilot hole is unsuccessful. Transco may determine the pilot hole a failure after two attempts if the actual subsurface materials are determined to be not conducive to the HDD method of installation. If this happens the HDD contractor shall then demobilize and remove the equipment from the site after approval from Transco.

Hole Opening

The HDD installation method may be considered a failure after several attempts at opening the hole to the required diameter have failed, as long as the failure does not include losing parts of the hole-opening tool or the entire hole-opening tool downhole. Transco may determine the hole-opening process a failure after two attempts if the actual subsurface materials are determined to be not conducive to the HDD method of installation. The HDD

contractor will then be allowed 14 working days to attempt to retrieve the missing tool or tool parts from the hole and continue the hole opening process. If failure occurs, the HDD contractor shall then demobilize and remove the equipment from the site after approval from Transco.

Pullback

The HDD installation method may be considered a failure after several attempts at completing the pullback unless the pipe can be removed from the hole. Then additional attempts will be made after the hole has been reopened and reconditioned with any necessary hole opening passes as determined jointly by the HDD contractor and Transco. Transco may determine the pullback process a failure after two attempts if the actual subsurface materials are determined to be not conducive to the HDD method of installation. If failure occurs, the HDD contractor shall then demobilize and remove the equipment from the site after approval from Transco.

Mechanical

The HDD installation method may be considered a failure if the HDD contractor has a major breakdown and after either repairing or replacing the broken drilling rig or vital piece of ancillary equipment, the drill pipe, hole opening tool, or pipeline cannot be rotated or pulled. If failure occurs, the HDD contractor shall then demobilize and remove the equipment from the site after approval from Transco.

Drilling Fluid Seepage

Prevention

The installation of HDD crossings does present potential for ground surface disturbance if inadvertent drilling fluid returns surface along the HDD alignment. Pressurization of the drilled hole beyond the containment capability of the surrounding soils can cause breaks in the formation. This allows the drilling fluid to migrate both horizontally and vertically through the formation and, potentially, to the surface. In some instances, elevated downhole drilling fluid pressures may impact the formation but the drilling fluid may never migrate to the surface. Providing adequate depth of cover for the installation can substantially reduce this potential. In some cases, inadvertent returns can also be caused by preexisting conditions in the geotechnical strata even if the downhole pressures are low. Maintaining drilling fluid circulation during HDD operations usually helps to keep downhole pressures from building to excessive levels.

Suitable Material and Adequate Overburden

In the contingency planning for this project, the prevention of inadvertent drilling fluid returns has been a major consideration in determining the preliminary design profile of the crossing. The primary factors that were used in selecting the pipeline crossing profile design were the composition, density, and shear strength of the soil materials at the site and the depth of cover. Based on Transco's expectations for predominantly encountering sand along the HDD profile selected, it is anticipated there will be a greater resistance to breaks in the formation since sands generally have a high shear strength. The second factor considered in developing the design profile was adequate depth of cover below the ground surface and seafloor. An inadvertent returns analysis was completed for the proposed HDD installation to determine the minimum depth of cover.

There is greater potential for inadvertent drilling fluid returns near the entry and exit locations where the drill profile nears the surface and the depth of cover is reduced. Large-diameter conductor casing will be installed on the entry side (onshore) of the crossing in order to mitigate the risks of inadvertent drilling fluid returns where there the cover is less deep.

Pipeline Geometry

The geometry of the pipeline profile can also affect the potential for breaks in the formation and inadvertent drilling fluid returns. In a profile that forces the pipe to make compound or excessively tight radius turns, annular drilling fluid pressures can build up, thereby increasing the potential for breaks and inadvertent drilling fluid returns. The HDD design profile for this crossing reduces this potential with very smooth and gradual curves, reducing the, the potential for pressure buildup caused by pipeline geometry.

Responsibility of HDD Contractor

The HDD contractor is responsible for executing the HDD operation, including detecting and controlling inadvertent drilling fluid returns. Transco will have an on-site representative to closely supervise the progress and actions of the HDD contractor.

Detection

HDD is a technically advanced process that needs skilled operators. The detection of drilling conditions that may cause formation breaks and potentially inadvertent returns prior to actual occurrence is highly dependent upon the skills and experiences of the drilling crew. Each drilling situation is unique in that the behavior of the subsurface materials may vary and be difficult to predict. There is no downhole monitoring equipment that can detect impacts to the

formation. It is a combination of factors, which must be properly interpreted, that may indicate conditions that have the potential for this outcome.

The most obvious signs are a reduction in the quantity of drilling fluid returning to the work site (loss of circulation) and inadvertent returns along the crossing alignment. One of the functions of the drilling fluid is to seal the hole to maintain the downhole pressure. The loss of circulation is a sign that pressure is not being contained in the drill hole and that drilling fluid is seeping into the formation. Some loss of drilling fluid to the formation should be expected during the HDD process. There can be instances in the HDD process where a loose or coarse granular soil unit is encountered. These units have the potential to absorb larger volumes of drilling fluid than fine grained silt and clay units. Consequently, a partial loss of drilling fluid circulation in and of itself is not an indication that the formation has been impacted or that inadvertent returns are imminent. It is the loss of drilling fluid in combination with other factors that may indicate a potential seepage condition.

One tool proposed for use to monitor the potential for formation impacts and inadvertent drilling fluid returns is an annular pressure tool that is used in conjunction with the HDD contractor's downhole survey probe during pilot hole operations. The annular pressure tool provides real-time monitoring of the annular drilling fluid pressure in the drilled hole. By monitoring the annular drilling fluid pressure, the HDD contractor is able to observe rapid increases in the annular pressure that may indicate the annulus is becoming blocked with cuttings. A rapid decrease in annular pressure may indicate that drilling fluid is being lost to the formation. The HDD contractor can use this information in conjunction with observations of the drilling fluid returns to the entry point to help evaluate the potential for formation impacts and inadvertent returns.

The detection of a drilling fluid release before it actually occurs depends upon the skill and experience of the drilling crew. HDD contractors must rely on their experience while closely monitoring their operating parameters during HDD operations in order to identify when the risk is increased. It is for this reason that Transco will be using firms that specialize in HDD to perform the proposed crossing. The selection and supervision of this HDD contractor will be the responsibility of Transco.

Corrective Action

The only pressure causing surface seepage to occur is the pressure from the high-pressure drilling fluid pumps. Therefore, the most direct corrective action is to stop the drilling

fluid pumps. By stopping the pumps, the pressure in the hole will quickly bleed off. With no pressure in the hole, the surface seepage will stop.

Onshore Returns

If inadvertent drilling fluid returns are detected onshore, the drilling crew will take immediate corrective action. The HDD contractor will be equipped with straw bales, silt fence, sand bags, pumps, and any other materials or equipment necessary to contain and clean up inadvertent returns onshore. Once the drilling fluid returns have been cleared from the area, they are hauled or pumped to the entry site for processing. With the clean-up process under way, HDD activities can resume.

In the event of an inadvertent return onshore the following actions will be taken:

- Stop the drilling fluid pumps immediately.
- Contain the drilling fluid that has surfaced.
- Notify the Transco representative who will contact the appropriate agencies.
- Evaluate the steps leading up to the inadvertent return to determine the potential to seal off the formation with loss circulation materials (LCM's) or other additives. Because the conditions at each HDD are unique, it is not possible to predict the specific LCMs to be used in the event of an inadvertent return. There are myriad LCM products available in particle sizes ranging from fine to coarse, including Polyswell, sawdust, or walnut hulls among many others. (These additives are only examples and may or may not be implemented if an inadvertent return occurs.)
- Evaluate if there are any additional steps that may increase the potential for regaining returns to entry/exit points. This may include advancing the tools in the opposite direction in an attempt to regain drilling fluid returns.
- Resume drilling and monitor conditions at the return site.

Offshore Returns

If significant inadvertent returns occur offshore, there may be a visible plume. Minor seepage, however, may be difficult to detect because of currents and the high specific gravity of the drilling fluid. If an inadvertent drilling fluid release is detected offshore, outside of the exit pit, it will be monitored and documented. Drilling activities may be temporarily suspended to evaluate the possible implementation of mitigation measures to regain hole integrity. Drilling activities will not be suspended unless the volume of inadvertent drilling fluid returns creates an immediate threat to public health and safety. If an extended shutdown were required to try to reduce the turbidity or amount of drilling fluid being released, this may lead to a hole collapse

and ultimately a failure in the HDD. This may require drilling a new hole and therefore extend the duration of the project.

Removal of drilling fluid surfacing offshore is not feasible due to the strong currents in the area. The exit pit is designed to contain the exiting fluid and cuttings. Drilling fluid returns and cuttings entering the exit pit will be left to naturally dissipate or settle into the excavated pit. Any inadvertent leakage would be expected to disperse naturally with the currents.

In the event an inadvertent return is observed offshore the following actions will be taken:

- Qualitatively determine the magnitude of the offshore return.
- If warranted by the volume of the drilling fluid return, stop the drilling fluid pumps.
- Notify the Transco representative, who will contact the appropriate agencies.
- Evaluate the steps leading up to the inadvertent return to determine the potential to seal off the formation with LCMs or other additives. Because the conditions at each HDD are unique, it is not possible to predict the specific LCMs to be used in the event of an inadvertent return. There are myriad of LCM products available in particle sizes ranging from fine to coarse, including Polyswell, sawdust, or walnut hulls among many others. (These additives are only examples and may or may not be implemented if an inadvertent return occurs.)
- Evaluate if there are any additional steps that may increase the potential for regaining returns to entry/exit points. This may include tripping the tools in the opposite direction in an attempt to regain drilling fluid returns.

Follow-up

After the inadvertent drilling fluid return has been assessed, the HDD contractor and Transco will make every effort to determine why the seepage occurred. Once the cause of the drilling fluid release has been determined, measures will be developed to control the factors causing the seepage and to minimize the chance of recurrence. Developing the corrective measure will be a joint effort of Transco and the HDD contractor and will be site- and problem-specific.

Response Equipment

For the duration of drilling operations, the drilling personnel will be aware of what materials are necessary when responding to an onshore release of drilling fluid and have these items available on-site. Since inadvertent drilling fluid returns can be easily controlled onshore, containment items will be stored in the entry site work area. Containment items may include lumber for temporary shoring, sand bags, portable pumps, hand tools, silt fencing, and hay

bales. The HDD contractor will also have heavy equipment such as excavators and backhoes that can be used to control and clean up the drilling fluid in accessible locations. Transfer pumps, hoses, and, potentially, vacuum trucks may be used if necessary for transferring back to entry any inadvertent drilling fluid released onshore. After removal of the released drilling fluid, the release area will be returned as close to the original condition as feasible. It may be necessary to store the drilling fluid on site prior to disposal.

Abandoning the Hole

In some cases, the corrective measure may involve a determination that the existing hole encountered a void or subsurface fracture, which could be bypassed with a slight change in the profile. In other cases, it may be determined that the existing hole encountered a zone of unsatisfactory soil material, or there was a failure during pipeline installation and the hole may have to be abandoned. If the hole is abandoned, the HDD contractor will grout the top 5 vertical feet of the abandoned hole at the entry side of the crossing by inserting a grout tremie pipe into the drilled hole annulus. The grout will be a cement type grout. As the grout is pressured into the drilled hole annulus, the tremie pipe will be extracted from the hole so the grout mixture is allowed to sufficiently displace any drilling fluid that may have remained within the hole. The top 12-inches of the hole will be backfilled with the native topsoil or previously excavated surface material and the HDD contractor will not demobilize until Transco approval has been received.

Alternatives

Alternative HDD design criteria may be considered, in the event circumstances lead to hole abandonment. However, subsurface conditions could still negatively impact design revisions, depending upon the circumstances encountered for the specific crossing. Transco and the HDD contractor will evaluate the alternative HDD options and determine a path forward. In the event HDD is determined no longer feasible at the project location, alternative construction methods will be evaluated. Agency approval will be required by Transco prior to initiating any alternative construction options.

Company/Agency Notification and Approval Information

Transco will provide a technical consultant on-site during the HDD process to keep adequate documentation such as daily progress reports, as-built information, etc., describing the events leading up to the failure. Transco will then submit this documentation to the necessary agencies for their review and approval that the drill has failed at the present alignment. The HDD contractor will not demobilize until Transco approval has been received.

If an inadvertent return occurs, Transco staff will notify the following parties:

- Federal Energy Regulatory Commission
- National Park Service
- New York State Department of Environmental Conservation
- U.S. Army Corps of Engineers
- U.S. Coast Guard (offshore only)

The following contact information will be used to notify these agencies unless updated or alternative information is provided by the agency:

Federal Energy Regulatory Commission Enforcement Hotline (202) 502-8390 (888) 889-8030 (Toll Free)	U.S. Army Corps of Engineers New York District – Regulatory Branch Eastern Permit Section (917) 790-8511
NPS Gateway National Recreation Area Jamaica Bay Unit (718) 338-3799	U.S. Coast Guard Station – New York Waterways Management Division Main: (718) 354-4101 Secondary: (718) 354-4099
NYS Dept. of Environmental Conservation Region 2 Permit Administrator (718) 482-4997	