Control Center Management and Leak Detection Overview

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EXHIBIT A-46-d

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1 INTRODUCTION

The purpose of this document is to provide an overview of the strategy SCS Carbon Transport LLC (SCS) will employ for pipeline leak detection as well as the general control center responses for alarms and emergency conditions. SCS has contracted Atmos International to provide leak detection software, software configuration, custom programming, and hydraulic simulation for the purposes of creating leak detection and pipeline simulator systems.

2 ATMOS INTERNATIONAL OVERVIEW

2.1 Reliability

Since its release as the first statistical corrected volume balance system in 1995, Atmos Pipe has been at the forefront of leak detection technology. It uses the Sequential Probability Ratio Test (SPRT) with pressure and flow analysis to optimize leak detection. Atmos Pipe has been continually developed for more than 25 years to make it the most sophisticated and effective leak detection system in the industry. The design of Atmos Pipe assures tuning and optimization for every pipeline to minimize the effect of the following:

- Instrument faults, including telecommunication failures
- Operational changes from start-up, running, and shut-in conditions
- Fluid property changes
- Seasonal changes or supply and demand variations
- Instrument drift and calibrations

2.2 Performance

Patented algorithms manage thermal and hydraulic transients to optimize sensitivity and accuracy on the most complex pipelines networks. Self-trained filters automatically compensate for measurement errors to maximize performance:

- Field proven for over 25 years on more than 1,500 pipelines
- Detects onset, slow opening, and existing leaks
- Deployed on pipeline systems with a wide variety of physical characteristics and a variety of services
- Software solution that uses flow and pressure data from SCADA, DCS, PLC or RTU systems
- Detects leaks under all operating conditions using a setpoint of 1.5% of flow based on data from another dense phase CO2 pipeline
- Draining and filling module reduces likelihood of false alarms during pipeline commissioning

Atmos Pipe has been utilized on super critical CO2 pipelines since 2014. This experience coupled with the company's technical capability and reputation in the leak detection space, led SCS to select Atmos Pipe as the operating platform for the MCE system.

3 CONTROL CENTER AND LEAK DETECTION OVERVIEW

3.1 Primary Leak Detection

The Real-Time Transient Model (RTTM) simulates the behavior of a pipeline using computational algorithms. The model, which is driven by instrumentation installed at pipeline facilities, monitors discrepancies between the measured and calculated values which could be potentially caused by a leak. RTTM uses flow, pressure, temperature, and density among many other variables.

Tuning or optimization is the process of analyzing the results from the model and the results from the instrumentation to verify the accuracy of the data from the field.

Robustness captures the ability of the leak detection model to perform under a range of scenarios that happen in real-world operating conditions.

API (American Petroleum Institute) 1130 is a recommended practice incorporated by reference into 49 CFR (Code of Federal Regulations) 195.134 and 49 CFR 195.444 for how pipeline operators should design, operate, and maintain their computational pipeline monitoring (CPM) systems. This recommended practice has been adopted by SCS.

API 1175 is a recommended practice focused on how pipeline operators should maintain their leak detection program. The goal of the standard is to have a highly functioning, highly effect leak detection system incorporating continuous improvement of the individual LDS (Leak Detection System) components (culture, strategies, KPIs (key performance indicators), and testing). This recommended practice has also been adopted by SCS.

3.2 Secondary Detection Methods

In addition to the primary leak detection method, SCS utilizes the following secondary detection methods to create a robust system of overlapping leak detection methods:

- Volume Balance Calculation – The SCADA system monitors line pack or inventory of carbon dioxide within the pipeline system and the fluctuation over time based on deliveries and receipts. Discrepancies of this line pack volume over time will alarm to a Supervisory Control and Data Acquisition (SCADA) system as an indication that carbon dioxide is being lost within the system.
- System Over/Short – A simple calculation comparing real-time volume into the pipeline system versus real-time volume out. Discrepancies of this calculation indicate that volume is rapidly being lost within the system.
- Rate of Change (Pressure) – Automated mainline valves equipped with redundant pressure transmitters will monitor and automatically close upon indication of a rapid rate of change in the local pipeline pressure.
- Aerial Patrols – Each operator shall, at intervals not exceeding three weeks, but at least 26 times each calendar year, inspect the surface conditions on or adjacent to each pipeline right-of-way.

3.3 Compliance and Controller Training

3.3.1 General

This section applies to each operator of a pipeline facility with a controller working in a control room who monitors and controls all or part of a pipeline facility via a SCADA system. Each operator must follow written control room management procedures that implement this section's requirements. The procedures required by this section must be integrated, as appropriate, with the operator's written procedures required by **§ 195.402.**

3.3.2 Roles and Responsibilities

Each operator must define the roles and responsibilities which are expected of a controller during normal, abnormal, and emergency operating conditions. SCS's Control Room Management (CRM) document will be used for this purpose. To provide a controller's prompt and appropriate response to operating conditions, an operator must define each of the following:

- A controller's authority and responsibility to make decisions and take actions during normal operations.
- A controller's role when an abnormal operating condition is detected, even if the controller is not the first to detect the condition, including the controller's responsibility to take specific actions and to communicate with others.
- A controller's role during an emergency, even if the controller is not the first to detect the emergency, including the controller's responsibility to take specific actions and communicate with others.
- A method of recording controller shift-changes and any hand-over of responsibility between controllers.
- The roles, responsibilities and qualifications of others who have the authority to direct or supersede the specific technical actions of controllers.

3.3.3 Provide Adequate Information

Each operator must provide its controllers with the information, tools, processes, and procedures necessary for the controllers to carry out the roles and responsibilities the operator has defined by performing each of the following:

- Implement API RP 1165 (incorporated by reference, see § 195.3) whenever a SCADA system is added, expanded, or replaced unless the operator demonstrates that certain provisions of API RP 1165 are not practical for the SCADA system used.
- Conduct a point-to-point verification between SCADA displays and related field equipment when field equipment is added or moved and when other changes that affect pipeline safety are made to field equipment or SCADA displays.
- Test and verify an internal communication plan to provide adequate means for manual operation of the pipeline safely, at least once each calendar year, but at intervals not to exceed 15 months.
- Test any backup SCADA systems at least once each calendar year, but at intervals not to exceed 15 months.
- Implement section 5 of API RP 1168 (incorporated by reference, see § 195.3) to establish procedures for a situation when a different controller assumes responsibility, including the content of information to be exchanged.

3.3.4 Fatigue Mitigation

Each operator must implement the following methods to reduce the risk associated with controller fatigue that could inhibit a controller's ability to carry out the roles and responsibilities the operator has defined:

- Establish shift lengths and schedule rotations that provide controllers off-duty time sufficient to achieve eight hours of continuous sleep.
- Educate controllers and supervisors in fatigue mitigation strategies and how off-duty activities contribute to fatigue.

- Train controllers and supervisors to recognize the effects of fatigue.
- Establish a maximum limit on controller hours-of-service, which may provide for an emergency deviation from the maximum limit if necessary for the safe operation of a pipeline facility.

3.3.5 Alarm Management

Each operator using a SCADA system must have a written alarm management plan to provide effective controller response to alarms. An operator's plan must include provisions to:

- Review SCADA safety-related alarm operations using a process that ensures alarms are accurate and support safe pipeline operations.
- Identify at least once each calendar month points affecting safety that have been taken off scan in the SCADA host, have had alarms inhibited, generated false alarms, or that have had forced or manual values for periods of time exceeding that required for associated maintenance or operating activities.
- Verify the correct safety-related alarm set-point values and alarm descriptions when associated field instruments are calibrated or changed and at least once each calendar year, but at intervals not to exceed 15 months.
- Review the alarm management plan required by this paragraph at least once each calendar year, but at intervals not exceeding 15 months, to determine the effectiveness of the plan.
- Monitor the content and volume of general activity being directed to and required of each controller at least once each calendar year, but at intervals not exceeding 15 months, that will assure controllers have sufficient time to analyze and react to incoming alarms.

3.3.6 Change Management

Each operator must assure that changes that could affect control room operations are coordinated with the control room personnel by performing each of the following:

- Implement section 7 of API RP 1168 (incorporated by reference, see § 195.3) for control room management change and require coordination between control room representatives, operator's management, and associated field personnel when planning and implementing physical changes to pipeline equipment or configuration
- Require field personnel to contact the control room when emergency conditions exist and when making field changes that affect control room operations

3.3.7 Operating Experience

Each operator must assure that lessons learned from its operating experience are incorporated, as appropriate, into its control room management procedures by performing each of the following:

- Review accidents that must be reported pursuant to § 195.50 and 195.52 to determine if control room actions contributed to the event and, if so, correct, where necessary, deficiencies related to:
    - Controller fatigue
    - Field equipment
    - The operation of any relief device
    - Procedures
    - SCADA system configuration

- SCADA system performance

- Include lessons learned from the operator's experience in the training program required by this section

3.3.8 Training

Each operator must establish a controller training program and review the training program content to identify potential improvements at least once each calendar year, but at intervals not to exceed 15 months. An operator's program must provide for training each controller to carry out the roles and responsibilities defined by the operator. In addition, the training program must include the following elements:

- Responding to abnormal operating conditions likely to occur simultaneously or in sequence
- Use of a computerized simulator or non-computerized (tabletop) method for training controllers to recognize abnormal operating conditions
- Training controllers on their responsibilities for communication under the operator's emergency response procedures
- Training that will provide a controller a working knowledge of the pipeline system, especially during the development of abnormal operating conditions
- For pipeline operating setups that are periodically, but infrequently used, providing an opportunity for controllers to review relevant procedures in advance of their application
- Control room team training and exercises that include both controllers and other individuals, defined by the operator, who would reasonably be expected to operationally collaborate with controllers (control room personnel) during normal, abnormal, or emergency situations

3.3.9 Compliance Validation

Upon request, operators must submit their procedures to PHMSA (Pipeline Hazardous Material Safety Administration)

3.3.10 Compliance and Deviations

An operator must maintain records for review during inspection:

- Records that demonstrate compliance with the requirements
- Documentation to demonstrate that any deviation from the procedures required was necessary for the safe operation of the pipeline facility

- Controller Training
    - Atmos Trainer - United States federal regulations require pipeline companies to demonstrate that pipeline operators are adequately trained to recognize and react to abnormal operating conditions. API 1168 (Pipeline Control Room Management) and API 1175 (Pipeline Leak Detection Program Management) expect a record of pipeline operator training and a plan for continuous performance improvement. However, it is difficult to expose operators to abnormal operating conditions, such as a leak situation, when only training on a real pipeline system. Atmos Trainer combines the Atmos Sim hydraulic simulator with a SCADA user interface and a sophisticated operator scoring and qualification module to generate a fully integrated, high-fidelity gas, or liquid pipeline training environment for the operator. These hydraulic simulators mimic the pipeline control system allowing a pipeline operator to control a virtual pipeline during normal and abnormal operating

conditions. The experience is as realistic as operating a real pipeline. Although commonly used in the United States, pipeline training simulators are rarely commissioned prior to pipeline startup. SCS will have a commissioned pipeline trainer in service and training pipeline controllers prior to pipeline startup ensuring competent operation from day one of operation.

3.4 Instrumentation Specifications

Emerson Rosemount – Emerson Rosemount has been an industry leader in manufacturing robust and accurate pressure, temperature, and level instrumentation for over 50 years

- Pressure Transmitters – Rosemount 3051S
    - Manufacturer's accuracy statement: 0.035% span accuracy, 150:1 range turndown, 15-year stability
- Temperature Transmitter – Rosemount 3144P
    - Manufacturer's accuracy statement: ± .35% of range

Emerson Micromotion - Emerson Micromotion has been an industry leader in manufacturing top quality Coriolis flow measurement instrumentation for over 45 years. Summit is using Micromotion Coriolis meters at all inlets and outlets of the pipeline. Coriolis meter are used because they offer the best possible metering accuracy compared to other types of flow measurement

- Coriolis Flow Meter (Capture) - Micro Motion Elite 5700 with CMF300H (Capture) CMFHC2Y (Sequestration)
    - Manufacturer's accuracy statement: .05% of Mass Rate

3.5 Additional Safeguards

3.5.1 Geohazard Monitoring

Aside from the techniques employed by field operations, SCS has the ability to utilize satellite imagery along the pipeline after an extreme weather event occurs anywhere to detect leaks or abnormal surface conditions. Using hyperspectral imaging and comparative assessments conducted over time, these satellites can identify alterations in the terrain spanning the pipeline's designated area. This approach facilitates the identification of subtle modifications in the landscape, aiding SCS in identifying exposed pipelines, dislocated earth, or other environmental shifts. Armed with this information, SCS can promptly initiate corrective measures to ensure the integrity of the pipeline

3.5.2 Line Balancing Meters

Additional intermediate flow meters will be used in locations along the pipeline to provide additional data for pipeline inventory, line balance, and leak detection

3.5.3 Redundant Pressure Transmitters

At each block valve site a pair of transmitters will be used instead of a single transmitter providing redundancy in measurement. Anytime there is a discrepancy larger than 1% of span, a field calibration or repair will be initiated

3.5.4 Quorum Software FlowCal Line Pack Calculation

FlowCal is an industry leading volumetric software package designed to provide check and validate calculations, be a system of record, and create statements. FlowCal is currently used on 80% of all midstream pipelines within the United States

3.5.5 Moisture Analysis

To mitigate the risk of moisture ingress at inlets to the pipeline, a moisture analyzer will be installed. Although the manufacturer and model have not been selected at the time of this publication, SCS commits to choosing the best available instrument. The moisture analyzers will assist pipeline controllers in determining when to take a capture facility offline, or if an alarm limit is exceeded, automatically isolate the moisture from entering the pipeline

4 CONCLUSION

SCS has selected reliable and quality instrumentation that will be employed with communication networks designed to provide reliable and fast data for our software systems. We have implemented multiple layers of leak detection to ensure that if a leak occurs, it will be detected, located, and quantified as swiftly as possible. We will train and empower our pipeline controllers to proactively identify potential abnormal or emergency operating conditions and confidently act to either eliminate or mitigate risk.