U.S. Department
of Transportation
**Pipeline and Hazardous
Materials Safety
Administration**

1200 New Jersey Avenue, SE
Washington, DC 20590

March 7, 2023

VIA ELECTRONIC MAIL TO: richard_prior@tcenergy.com

Richard Prior
TC Oil Pipeline Operations, Inc.
700 Louisiana Suite 700
Houston, TX 77002

Re: CPF No. 3-2022-074-CAO

Dear Mr. Prior,

Enclosed please find an Amended Corrective Action Order (ACAO or Amended Order) issued by the Pipeline and Hazardous Materials Safety Administration (PHMSA), Office of Pipeline Safety (OPS), in the above-referenced case. It requires TC Oil Pipeline Operations, Inc., to take certain additional corrective actions with respect to the pipeline failure that occurred on December 7, 2022, on the 36-inch Keystone pipeline three miles east of Washington, Kansas.

Service of the ACAO by electronic mail is effective upon the date of transmission and acknowledgment of receipt as provided under 49 C.F.R. § 190.5. The terms and conditions of this Amended Order are effective upon completion of service.

Sincerely,

ALAN KRAMER MAYBERRY
Digitally signed by ALAN KRAMER MAYBERRY
Date: 2023.03.07 09:16:39 -05'00'

Alan K. Mayberry
Associate Administrator
for Pipeline Safety

Enclosure: ACAO

cc: Mr. Gregory Ochs, Director, Central Region, Office of Pipeline Safety, PHMSA

CONFIRMATION OF RECEIPT REQUESTED

U.S. DEPARTMENT OF TRANSPORTATION
PIPELINE AND HAZARDOUS MATERIALS SAFETY ADMINISTRATION
OFFICE OF PIPELINE SAFETY
WASHINGTON, D.C. 20590

In the Matter of	)	
TC Oil Pipeline Operations, Inc.,	)	**CPF No. 3-2022-074-CAO**
Respondent.	)	

AMENDED CORRECTIVE ACTION ORDER

Purpose and Background

This Amended Corrective Action Order (ACAO or Amended Order) is being issued by the Pipeline and Hazardous Materials Safety Administration (PHMSA), Office of Pipeline Safety (OPS), under the authority of 49 U.S.C. § 60112, to require TC Oil Pipeline Operations, Inc. (TC Oil or Respondent), to take necessary corrective actions to protect the public, property, and the environment from potential hazards associated with the December 7, 2022 crude oil pipeline failure that occurred on the 36-inch Keystone pipeline, approximately three miles east of Washington, Kansas (Failure).

The Keystone pipeline is a 2,687-mile hazardous liquid pipeline system between Hardisty, Alberta, Canada, and Patoka, Illinois, and Port Arthur, Texas.[1] The 1,025 miles of TC Oil's 30-inch diameter mainline pipe was Phase 1 of the Keystone pipeline. It spans from the US-Canadian border at Cavalier County, North Dakota, traverses the states of South Dakota, Nebraska, Kansas, and Missouri to Wood River, Illinois. The 36-inch diameter Cushing Extension was Phase 2 of the Keystone pipeline. The Cushing Extension begins in Steele City, Nebraska and goes to Cushing, Oklahoma, and is approximately 291 miles long. The maximum operating pressure (MOP) of both pipelines is 1,440 pounds per square inch gauge (psig), and they operate under special permit PHMSA-2006-26617.

At approximately 09:01 PM CST, a leak detection alarm (volume imbalance) was received indicating a potential loss of commodity from the pipeline. An Emergency-Line Trip alarm was received 6-minutes later. The pipeline was subsequently shut down and isolation valves were commanded closed at 09:08 PM CST. The location of the Failure is Cushing Extension, Mile Point (MP) 14. The segment of the pipeline containing the Failure spans from Steele City pump station (MP 0.0) to Hope pump station (MP 95.7, approximately). Upon receiving the leak

[1] *See* Overview, TC ENERGY, https://www.tcenergy.com/operations/oil-and-liquids/keystone-pipeline-system/ (last accessed March 6, 2023)

alarms, TC Oil personnel were dispatched and identified a crude oil odor north of U.S. Highway 36. The Failure location was subsequently confirmed to be approximately two miles north of the highway crossing. Crude oil from the pipeline impacted Mill Creek, at approximate coordinates of 39-degrees, 50-minutes, 33-seconds, and -96-degrees, 59-minutes, 44-seconds.[2]

Pursuant to 49 U.S.C. § 60117, PHMSA initiated an investigation of the Failure. PHMSA's investigation of the Failure is ongoing.

On December 8, 2022, PHMSA issued a Corrective Action Order (CAO). As a result of the continued investigation and additional information received, PHMSA is issuing this ACAO to prescribe additional corrective actions to the *Affected Segment*, *Keystone Pipeline Phase 1*, and *Keystone Pipeline Phase 2*, as defined below. This ACAO amends and supplements the preliminary findings and the corrective actions prescribed in the CAO. The preliminary findings of the Agency's ongoing investigation are as follows:

Preliminary Findings

Special Permit

- PHMSA issued a special permit, PHMSA-2006-26617, to TC Oil for construction and operation of Keystone pipeline Phase 1 and Phase 2 (the Cushing Extension) on April 30, 2007, to allow the pipeline to be operated at a stress level of 80 percent of the steel pipe's specified minimum yield strength (SMYS). Without a special permit, operating pressure for the hazardous liquid pipeline would be no greater than 72 percent of SMYS.[3] The special permit contained 51 conditions and was designed to provide for a level of safety equal to, or greater than, the applicable regulations by requiring TC Oil to more closely inspect and monitor the pipeline over its operational life than similar pipelines installed without a special permit.

December 2022 Accident

- On December 7, 2022, at approximately 09:01 PM CST, a leak detection alarm (volume imbalance) was received. An Emergency-Line Trip alarm was received 6-minutes later.

- The pipeline was shut down and isolation valves were commanded closed at 09:08 PM CST.

- Upon receiving notification of the Failure, TC Oil personnel were dispatched and identified a crude oil odor north of U.S. Highway 36. The Failure location was subsequently confirmed approximately two miles north of the highway crossing.

- The location of the Failure is Cushing Extension, MP 14. The pipeline segment containing the Failure spans from Steele City pump station (MP 0.0) to Hope pump station (MP 95.7, approximately).

[2] The actual reported spill volume is 12,937 barrels.

[3] *See* 49 C.F.R. § 195.106.

- Crude oil from the pipeline impacted Mill Creek crossing, at approximate coordinates of 39-degrees, 50-minutes, 33-seconds, and -96-degrees, 59-minutes, 44-seconds.

- The initial estimated spill volume was approximately 14,000 barrels of crude oil. The actual reported spill volume is 12,937 barrels of crude oil.

- Per TC Oil, the source of the December 7, 2022 rupture near Washington, Kansas was a failed girth weld. Based on observations by PHMSA investigators, the failed weld was a transition weld that joined the 36-inch diameter pipe to a thicker wall thickness butt-welded fitting.

- The established MOP of the 36-inch Phase 2 pipeline at the point of failure on December 7, 2022, was 1,440 psi. At the time of the rupture, the actual operating pressure at the point of failure was 1,153 psig.

- PHMSA understands TC Energy was monitoring this failure location for geohazards and land movement prior to the failure. TC Energy was required to implement a monitoring/mitigation plan to monitor for and mitigate issues of unstable soil and ground movement as part of Condition 41 of the special permit, PHMSA-2006-26617.

- Onsite personnel observed the failed segment move vertically as overburden was removed, indicating the pipeline was under improper loading and stress. It is not clear whether the pipe segment has been under stress since construction or if land movement in the area may have more recently induced or increased stress.

- The investigation is on-going, and information could change. This ACAO may be amended based on further findings during the investigation.

- Following receipt of the CAO issued December 8, 2022, TC Oil completed and submitted the results of prior in-line inspection (ILI) reviews as required by the CAO. TC Oil has completed the mechanical and metallurgical testing required by the CAO. TC Oil has ensured that the testing laboratory distributed all reports, whether draft or final, in their entirety to the Director at the same time they were made available to TC Oil. The final report was received on February 7, 2023.

Keystone Pipeline Phases 1 and 2

- The 1,025 miles of TC Oil's 30-inch diameter mainline pipe was Phase 1 of the Keystone pipeline. Construction of Phase 1 was completed in June 2010. Phase 1 spans from the US-Canadian border at Cavalier County, North Dakota, traverses the states of South Dakota, Nebraska, Kansas, and Missouri to Wood River, Illinois.

- The approximately 291 miles of TC Oil's 36-inch diameter Cushing Extension was Phase 2 of the Keystone pipeline. Construction of Phase 2 was completed in February 2011. Phase 2 begins in Steele City, Nebraska and goes to Cushing, Oklahoma.

- Multiple wall thicknesses of pipe were used in the construction of Keystone pipeline Phase 1 and Phase 2. For the 30-inch diameter Phase 1 pipeline, pipe wall thickness includes, but is not limited to: 0.386-inch, 0.437-inch, 0.515-inch, and 0.622-inch. For the 36-inch diameter pipeline used in Phase 2 (the Cushing Extension), pipe wall thickness includes, but is not limited to: 0.465-inch, 0.512-inch, 0.572-inch, and 0.615-inch.

- The section of the Phase 2 pipeline subject to the December 7, 2022 Failure was on the 36-inch diameter, 0.465-inch wall thickness, Grade X-70 pipe manufactured by Evraz. The MOP was 1,440 psig. The most recent failure had a wall thickness transition from 0.515 inch pipe to approximately 0.80 inch elbow fitting (30 degree).

- Keystone pipeline traverses several high consequence areas (HCAs) and navigable rivers. Both Phase 1 and Phase 2 of the Keystone pipeline, including the Cushing Extension, traverse could affect HCAs. According to the 2021 Annual Report submitted by TC Oil, the following number of miles on Phase 1 and Phase 2, combined, that could affect HCAs was reported as: Illinois – 22.52 miles, Kansas – 65.29 miles, Missouri – 46.7 miles, Nebraska – 100.17 miles, North Dakota – 14.3 miles, Oklahoma – 42.73 miles, and South Dakota – 14.11 miles.

Additional Accidents

- Since 2009, the Keystone pipeline has experienced three failures on girth welds and additional non-girth weld related accidents.

- On September 21, 2009, the 30-inch Phase 1 Keystone pipeline in Kingsbury County, South Dakota, leaked during hydrostatic testing. The source of the leak was determined to be a girth weld joining 0.386-inch w.t. (wall thickness) pipe and a 0.515-inch w.t. pipe. Butt welds joining unequal thickness of material (e.g., pipe, fittings, and other appurtenances) may also be known as “transition welds.”

- On May 7, 2011, a reportable, non-girth weld related accident occurred on pump station piping on Phase 1 Keystone crude oil pipeline at the Ludden Pump Station. On May 29, 2011, a second reportable failure incident occurred on piping at the Severance Pump Station also in Phase 1. On June 3, 2011, PHMSA issued a Corrective Action Order (CAO) requiring Respondent to take corrective actions (CPF No. 3-2011-5006H). On June 13, 2011, Respondent submitted a response to this CAO requesting a hearing. Following informal discussions between Respondent and PHMSA, based on the most up-to-date information, PHMSA agreed to make minor changes and clarifications to the original CAO in an Amended CAO issued June 28, 2011. The Amended CAO was closed on January 13, 2015, after TC Oil had completed all the required corrective actions.

- On April 2, 2016, a reportable accident due to a leak in a cracked tie-in weld occurred on the Phase 1 Keystone pipeline on the 48.1-mile segment between Freeman (Pump Station 23) and Hartington (Pump Station 24). Per the “Accident Report – Hazardous Liquid Pipeline Systems, Form PHMSA F 7000-1” submitted by TC Oil, approximately 20,400

tons of solid materials were removed from the spill site, and 1,170 tons of liquid wastes were disposed. On April 9, 2016, PHMSA issued a CAO requiring Respondent to take corrective actions (CPF No. 3-2016-5002H). The CAO was closed on March 30, 2017, after TC Oil had completed all the required corrective actions.

- On November 16, 2017, an incident occurred on Phase 1, due to a fracture that initiated at an area of previous mechanical damage, resulting in crude oil release. On November 28, 2017, PHMSA issued a CAO (CPF No. 3-2017-5008H) to TC Oil addressing this incident to require Respondent to take corrective actions. This CAO was closed on January 29, 2019, after Respondent completed all the required corrective actions.

- On October 30, 2019, a reportable non-girth weld accident occurred on the 41.9-mile Phase 1 Keystone pipeline segment that runs between the Edinburg Pump Station and the Niagara Pump Station, near Niagara, North Dakota. This failure exhibited characteristics of fatigue from pressure cycles. On November 5, 2019, PHMSA issued a CAO requiring Respondent to take corrective action (CPF No. 3-2019-5023H). The CAO was closed on February 3, 2022, after TC Oil had completed all the required corrective actions.

- On October 14, 2022, PHMSA issued a Notice of Probable Violation, Proposed Civil Penalty, and Proposed Compliance Order (CPF No. 3-2022-025-NOPV) following a special inspection of TC Oil's Lucas delivery facility in Beaumont, Texas following a crude oil spill that occurred on the Keystone Gulf Coast system on May 7, 2020. The proceeding remains open at this time.

- The spills of 2011, 2016, 2017, 2019, 2020, and 2022 which resulted in reported releases of 400, 400, 6,592, 4,515, 442, 12,937 barrels of crude oil, respectively, show a tendency or pattern in recent years of increasingly frequent incidents resulting in larger releases.

Regulations and Advisory Bulletins

- Per 49 C.F.R. §195.106, the anticipated external loads and external pressures that are concurrent with internal pressure must be considered in the pipe design. After determining the internal design pressure, the nominal wall thickness of pipe must be increased as necessary to compensate for these concurrent loads and pressures. Different wall thickness of pipe can be necessary in various locations along a pipeline depending on operating pressure and external loadings, such as: road crossings, water crossings, railroad crossings, above ground piping, etc.

- On March 24, 2010, PHMSA published an advisory bulletin, ADB 2010-03, "Girth Weld Quality Issues Due to Improper Transitioning, Misalignment, and Welding Practices of Large Diameter Line Pipe."[4] The advisory bulletin notified pipeline operators of large diameter natural gas pipeline and hazardous liquid pipeline systems of the potential for girth weld failures. The advisory bulletin also described how issues with girth weld quality may cause in-service leaks and ruptures at pressures well below 72 percent SMYS. It described that metallurgical testing results of failed girth welds in pipe wall

[4] 75 Fed. Reg. 14,243 (March 24, 2010).

thickness transitions found pipe segments with line pipe weld misalignment, improper bevel and wall thickness transitions, and other improper welding practices that occurred during construction. A number of the failures were located in pipeline segments with concentrated external loading due to support and backfill issues.

- On June 2, 2022, PHMSA published an advisory bulletin, ADB 2022-0063, "Potential for Damage to Pipeline Facilities Caused by Earth Movement and Other Geological Hazards."[5] The advisory bulletin reminds owners and operators of gas and hazardous liquid pipelines of the potential for damage to those pipeline facilities caused by earth movement in variable, steep, and rugged terrain and terrain with varied or changing subsurface geological conditions. The advisory bulletin noted that geohazards, including land movement, can pose a threat to the integrity of pipeline facilities if those threats are not identified and mitigated.

Determination of Necessity for Corrective Action Order and Right to Hearing

Section 60112 of title 49, United States Code, authorizes PHMSA to determine that a pipeline facility is or would be hazardous to life, property, or the environment and if there is a likelihood of serious harm, to expeditiously order the operator of the facility to take necessary corrective action, including suspended or restricted use of the facility, physical inspection, testing, repair, replacement, or other appropriate action. An order issued expeditiously must provide an opportunity for a hearing as soon as practicable after the order is issued.

In deciding whether to issue an order, PHMSA must consider the following, if relevant: (1) the characteristics of the pipe and other equipment used in the pipeline facility, including the age, manufacture, physical properties, and method of manufacturing, constructing, or assembling the equipment; (2) the nature of the material the pipeline facility transports, the corrosive and deteriorative qualities of the material, the sequence in which the material is transported, and the pressure required for transporting the material; (3) the aspects of the area in which the pipeline facility is located, including climatic and geologic conditions and soil characteristics; (4) the proximity of the area in which the hazardous liquid pipeline facility is located to environmentally sensitive areas; (5) the population density and population and growth patterns of the area in which the pipeline facility is located; (6) any recommendation of the National Transportation Safety Board made under another law; and (7) any other factors PHMSA may consider as appropriate.

After evaluating the foregoing preliminary findings of fact, and having considered the characteristics of the pipeline, including the prior and most current failures of the pipeline; the hazardous nature of the material (crude oil) transported; the existing and potential additional impacts to property, the environment, and wildlife; the indications that TC Oil's operating, maintenance, and/or integrity management programs may be inadequate to address the repetitious pattern of failures related to the original design, manufacture, and construction of Keystone pipeline Phase 1 and Phase 2; the tendency of flaws to grow from operating pressure cycles; the tendency or pattern of girth weld failures in large diameter pipelines on the Keystone pipeline; the occurrence of girth weld in-service leaks and ruptures at pressures below 72 percent SMYS, suggesting issues with girth weld quality; the increasing severity of spills in recent years;

[5] 87 Fed. Reg. 33,576 (June 2, 2022).

the possibility of future failures caused by a combination of factors similar to those involved in the 2022 and prior failures, including transition welds and the potential for earth movement; and the possibility that the same condition(s) that may have caused the Failure remain present and could lead to additional failures in Keystone pipeline Phase 1 and Phase 2; I find that continued operation of the *Affected Segment, Keystone Pipeline Phase 1,* and *Keystone Pipeline Phase 2*, as defined below, without corrective measures is or would be hazardous to life, property, or the environment, and that failure to issue this Amended Order expeditiously would result in the likelihood of serious harm.

Accordingly, this Amended Order mandating immediate corrective action is issued expeditiously without prior notice and opportunity for a hearing. The terms and conditions of this Amended Order are effective upon completion of service.

Within 10 days of receipt of this Amended Order, Respondent may request a hearing, to be held as soon as practicable, by notifying the Associate Administrator for Pipeline Safety in writing, with a copy to the Director, PHMSA, OPS Central Region. If a hearing is requested, it will be held in accordance with 49 C.F.R. § 190.211.

After receiving and analyzing additional data in the course of this investigation, PHMSA may identify other corrective measures that need to be taken. Respondent will be notified of any additional measures required and, if appropriate, PHMSA will consider a further amended order. To the extent consistent with safety, Respondent will be afforded notice and an opportunity for a hearing prior to the imposition of any additional corrective measures.

Definitions

Affected Segment – The *"Affected Segment"* means the approximately 96 miles of TC Oil's Keystone pipeline, which is a part of Keystone Pipeline Phase 2, that contains the 36-inch diameter pipe from Steele City pump station (MP 0.0) to Hope pump station (MP 95.7, approximately), which was subject to the December 7, 2022 Failure. The *Affected Segment* traverses the following counties: Jefferson County, Nebraska, Washington County, Kansas, Clay County, Kansas, and Dickinson County, Kansas.

Keystone Pipeline Phase 1 – *"Keystone Pipeline Phase 1"* means the approximately 1,025 miles of TC Oil's Keystone Pipeline Phase 1 that contains the 30-inch diameter mainline pipe from the US-Canadian border at Cavalier Country, North Dakota, traverses the states of South Dakota, Nebraska, Kansas, and Missouri to Wood River, Illinois and Patoka, Illinois.

Keystone Pipeline Phase 2 – "*Keystone Pipeline Phase 2*" means the approximately 291 miles of TC Oil's Keystone Pipeline Phase 2 that contains the 36-inch diameter pipe from Steele City, Nebraska through Kansas to Cushing, Oklahoma.

Director – The "Director" means the Director, PHMSA, OPS Central Region.

Required Corrective Actions

Pursuant to 49 U.S.C. 60112, I hereby order TC Oil to take the following corrective actions:

1. Operating Pressure Restriction.

a. TC Oil must continue to reduce the operating pressure along the length of the*Affected Segment* to the previously agreed upon 923 psig limit. This pressure restriction is to remain in effect until Items 2, 3, 4, 5, and 6 have been completed as specified below. Following completion of the aforementioned Items and upon receipt of written approval by the Director, TC Oil may increase the operating pressure along the *Affected Segment* to no more than 72 percent SMYS.

b. TC Oil must reduce and maintain pressure reduction in the actual operating pressure along the remainder of *Keystone Pipeline Phase 2* such that the operating pressure will not exceed 72 percent SMYS, consistent with 49 C.F.R. § 195.406. This pressure restriction is to remain in effect until written approval to increase the pressure or return the pipeline to its pre-failure operating pressure is obtained from the Director.

i. Within seven days of receipt of the ACAO, TC Oil must provide the Director the planned pressure set-points at all pump stations and facilities necessary to limit the operation of *Keystone Pipeline Phase 2* to 72 percent SMYS.

ii. This pressure restriction requires any relevant remote or local alarm limits, software programming set-points or control points, and mechanical over-pressure devices to be adjusted accordingly.

iii. When determining the pressure restriction set-points, TC Oil must take into account any ILI) features or anomalies present in *Keystone Pipeline Phase 2* to provide for continued safe operation as required by 49 C.F.R. § 195.401 and the anomaly evaluation and repair requirements of special permit PHMSA-2006-26617.

iv. Adequate controls and protective equipment must be in place to maintain pressure within the limit required by 49 C.F.R. § 195.406(b) during surges and other variations from normal operations.

v. Within 30 days of receipt of the ACAO, TC Oil must provide the Director documentation that all set-points to maintain a maximum operating pressure of 72 percent SMYS for *Keystone Pipeline Phase 2* have been implemented, including any necessary updates or changes to controls and protective equipment.

vi. TC Oil must review the pressure restriction monthly by analyzing the operating pressure data, taking into account any ILI features or anomalies present in *Keystone Phase 2.* TC Oil must immediately reduce the operating pressure further to maintain the safe operations of *Keystone Phase 2*, if warranted by the monthly review. Further, TC Oil must submit the results of the monthly review to the Director including, at a

minimum, the current discharge set-points (including any additional pressure reductions), and any pressure exceedance at discharge set-points. Submittals may be made quarterly, in accordance with Item 13 below.

c. TC Oil must reduce and maintain pressure reduction in the actual operating pressure along the entire length of *Keystone Pipeline Phase 1* such that the operating pressure along its entire length will not exceed 72 percent of SMYS, consistent with 49 C.F.R. § 195.406. This pressure restriction on *Keystone Pipeline Phase 1* is to remain in effect until written approval to increase the pressure above 72 percent SMYS is obtained from the Director.

   i. Within seven days of receipt of the ACAO, TC Oil must provide the Director the planned pressure set-points at all pump stations and facilities necessary to limit the operation of *Keystone Pipeline Phase 1* to 72 percent SMYS.

   ii. This pressure restriction requires any relevant remote or local alarm limits, software programming set-points or control points, and mechanical over-pressure devices to be adjusted accordingly.

   iii. When determining the pressure restriction set-points, TC Oil must take into account any ILI features or anomalies present in *Keystone Pipeline Phase 1* to provide for continued safe operation as required by 49 C.F.R. § 195.401 and the anomaly evaluation and repair requirements of special permit PHMSA-2006-26617.

   iv. Adequate controls and protective equipment must be in place to maintain pressure within the limit required by 49 C.F.R. § 195.406(b) during surges and other variations from normal operations.

   v. Within 30 days of receipt of the ACAO, TC Oil must provide the Director documentation that all set-points to maintain a maximum operating pressure of 72 percent SMYS for *Keystone Pipeline Phase 1* have been implemented, including any necessary updates or changes to controls and protective equipment.

   vi. TC Oil must review the pressure restriction monthly by analyzing the operating pressure data, taking into account any ILI features or anomalies present in *Keystone Phase 1.* TC Oil must immediately reduce the operating pressure further to maintain the safe operations of *Keystone Phase 1*, if warranted by the monthly review. Further, TC Oil must submit the results of the monthly review to the Director including, at a minimum, the current discharge set-points (including any additional pressure reductions), and any pressure exceedance at discharge set-points. Submittals may be made quarterly, in accordance with Item 13 below.

2. Review of Prior In-line Inspection (ILI) Results.

a. The CAO issued December 8, 2022, required TC Oil to conduct a review of any previous ILI results of the *Affected Segment*. In its review, TC Oil had to re-evaluate all ILI results from the past 10 calendar years, including a review of the ILI vendors' raw data and analysis. TC Oil had to determine whether any features were present in the failed pipe joints from the December 7, 2022 Failure. Also, TC Oil had to determine if any features with similar characteristics are present elsewhere on the *Affected Segment*. TC Oil was required to submit documentation of this ILI review to the Director within 45 days of receipt of the CAO, with the following:

    i. List all ILI tool runs, tool types, and the calendar years of the tool runs;

    ii. List, describe (type, size, wall loss, etc.), and identify the specific location of all ILI features present in the failed joint and other pipe removed;

    iii. List, describe (type, size, wall loss, etc.), and identify the specific location of all ILI features with similar characteristics present elsewhere on the *Affected Segment*; and

    iv. Explain the process used to review the ILI results and the results of the reevaluation.

b. In compliance with the CAO terms, TC Oil submitted this review to PHMSA on January 20, 2023, and it is currently under review.

3. Mechanical and Metallurgical Testing.

a. The CAO issued December 8, 2022, required TC Oil to complete mechanical and metallurgical testing and failure analysis of the failed pipe, including an analysis of soil samples and any foreign materials. Mechanical and metallurgical testing had to be conducted by an independent third-party acceptable to the Director, and had to document the decision-making process and all factors contributing to the failure. TC Oil was required to complete the testing and analysis as follows:

    i. Document the chain-of-custody when handling and transporting the failed pipe section and other evidence from the failure site;

    ii. Within 10 days of receipt of the CAO, develop and submit the testing protocol and the proposed testing laboratory to the Director for prior approval;

    iii. Prior to beginning the mechanical and metallurgical testing, provide the Director with the scheduled date, time, and location of the testing to allow for an OPS representative to witness the testing; and

iv. Ensure the testing laboratory distributes all reports whether draft or final in their entirety to the Director at the same time they are made available to TC Oil.

b. In compliance with the CAO terms, TC Oil submitted this report to PHMSA on February 7, 2023, and it is currently under review.

4. Root Cause Failure Analysis (RCFA).

a. Within 45 days following receipt of the ACAO, TC Oil must complete a root cause failure analysis (RCFA) and submit a final report of this RCFA to the Director.

b. The RCFA must be supplemented or facilitated by an independent third-party acceptable to the Director and must document the decision-making process and all factors contributing to the failure.

c. The RCFA must be comprehensive, including but not limited to: consideration of pipe and fitting design, specification and manufacture of materials, material acquisition, material quality assurance & quality control, fabrication and construction history, girth weld joint design, welding procedures and qualification, previous non-destructive examinations and testing, inline inspection history, operating parameters and pressure cycling, external loading, previous evaluations of land movement, and any prior remediation or repairs.

d. The final report must include findings and any lessons learned and whether the findings and lessons learned are applicable to other locations within TC Oil's pipeline system.

5. Evaluation of Geohazard Program (EGP).

a. Within 60 days of issuance of the ACAO, TC Oil must complete an independent evaluation of TC Oil's geohazard and land movement program and submit the final report, to include findings and any lessons learned, and submit to the Director.

b. The evaluation must utilize an independent third-party, acceptable to the Director, to assess TC Oil's geohazard/land movement program. The third-party must not have been involved with the development or implementation of TC Oil's geohazard/land movement program that was in place prior to the Failure of December 7, 2022.

c. The evaluation must determine if land movement may have contributed to the loading and stresses on the pipeline at the failure location. The evaluation must include a review the processes and implementation of the geohazard/land movement program.

d. The final report must include a plan and schedule to apply the lessons learned to the remainder of TC Oil's pipeline system to determine if other land movement areas could be imposing stress on the pipeline elsewhere along the system.

6. Remedial Work Plan (RWP).

a. Within 60 days of completion of the RCFA, TC Oil must submit a remedial work plan (RWP) to the Director for approval.

b. The Director may approve the RWP incrementally without approving the entire RWP.

c. Once approved by the Director, the RWP will be incorporated by reference into this Amended Order.

d. The RWP must specify the tests, inspections, assessments, evaluations, and remedial measures TC Oil will use to verify the integrity of the *Affected Segment*. It must address all known or suspected factors and causes of the December 7, 2022 Failure. TC Oil must consider the risks and consequences of another failure to develop a prioritized schedule for RWP-related work along the *Affected Segment.*

e. The RWP must include a procedure or process to:

i. Identify pipe in the *Affected Segment* with characteristics similar to the contributing factors identified for the December 7, 2022 Failure, including the age and manufacture of the entire length of the *Affected Segment*.

ii. Gather all data necessary to review the failure history (in service and pressure test failures) of the *Affected Segment* and to prepare a written report containing all the available information such as the locations, dates, and causes of leaks and failures.

iii. Integrate the results of the metallurgical testing, root cause failure analysis, and other corrective actions required by this Amended Order with all relevant pre-existing operational and assessment data for the *Affected Segment.* Pre-existing operational data includes, but is not limited to, design, construction, operations, maintenance, testing, repairs, prior metallurgical analyses, and any third-party consultation information. Pre-existing assessment data includes, but is not limited to, ILI tool runs, hydrostatic pressure testing, direct assessments, close interval surveys, and DCVG/ACVG surveys.

iv. Determine if conditions similar to those contributing to the Failure on December 7, 2022, are likely to exist elsewhere on *the Affected Segment*, *Keystone Pipeline Phase 1*, and *Keystone Pipeline Phase 2.*Conduct additional field tests, inspections, assessments, and evaluations to determine

whether, and to what extent, the conditions associated with the Failure on December 7, 2022, other failures from the failure history (see (e)(ii) above), or any other integrity threats are present elsewhere on the *Affected Segment*, *Keystone Pipeline Phase 1*, and *Keystone Pipeline Phase 2*. At a minimum, this process must consider all failure causes and specify the use of one or more of the following:

1) ILI tools that are technically appropriate for assessing the pipeline system based on the cause of failure on December 7, 2022, and that can reliably detect and identify anomalies;

2) Hydrostatic pressure testing;

3) Close-interval surveys;

4) Cathodic protection surveys, to include interference surveys in coordination with other utilities (e.g., underground utilities, overhead power lines, etc.) in the area;

5) Coating surveys;

6) Stress corrosion cracking surveys;

7) Selective seam corrosion surveys; and

8) Other tests, inspections, assessments, and evaluations appropriate for the failure causes.

Note: TC Oil may use the results of previous tests, inspections, assessments, and evaluations if approved by the Director, provided the results of the tests, inspections, assessments, and evaluations are analyzed with regard to the factors known or suspected to have caused the December 7, 2022 Failure.

v. Describe the inspection and repair criteria TC Oil will use to prioritize, excavate, evaluate, and repair anomalies, imperfections, and other identified integrity threats. Include a description of how any defects will be graded and a schedule for repairs or replacement.

vi. Based on the known history and condition of the *Affected Segment,* describe the methods TC Oil will use to repair, replace, or take other corrective measures to remediate the conditions associated with the Failure on December 7, 2022, and to address other known integrity threats along the *Affected Segment*, *Keystone Pipeline Phase 1*, and *Keystone Pipeline Phase 2*. The repair, replacement, or other corrective measures must meet the criteria specified in (e)(v) above.

vii. Implement continuing long-term periodic testing and integrity verification

measures to ensure the ongoing safe operation of the *Affected Segment*, *Keystone Pipeline Phase 1*, and *Keystone Pipeline Phase 2* considering the results of the analyses, inspections, evaluations, and corrective measures undertaken pursuant to the CAO as amended by this ACAO.

f. Include a proposed schedule for completion of the RWP.

g. TC Oil must revise the RWP as necessary to incorporate new information obtained during the failure investigation and remedial activities, to incorporate the results of actions undertaken pursuant to this Amended Order, and to incorporate modifications required by the Director.

   i. Submit any plan revisions to the Director for prior approval.

   ii. The Director may approve plan revisions incrementally.

   iii. All revisions to the RWP after it has been approved and incorporated by reference into this Amended Order will be fully described and documented in the *ACAO Documentation Report*.

h. Implement the RWP as it is approved by the Director, including any revisions to the plan.

7. Integrity Threat Assessments (ITAs).

a. Within 30 days of completing the RCFA required by this Amended Order, TC Oil must submit to the Director a prioritized schedule for submitting Integrity Threat Assessments (ITAs) of *Keystone Pipeline Phase 1* and *Keystone Pipeline Phase 2* to the Director. The prioritized schedule of ITAs shall be based on all threats, known or suspected, and the consequences of failure in each section of *Keystone Pipeline Phase 1* and *Keystone Pipeline Phase 2*. Threats considered must include all factors that caused or contributed to the December 7, 2022 Failure, in addition to all facts identified or suspected in previous failures (hydrotest and in-service). Along with schedule, provide a listing of all the threat and consequence factors along with the methodology used to establish the prioritized schedule for completing and submitting ITAs.

b. Each ITA shall evaluate the integrity of each assessment section of *Keystone Pipeline Phase 1* and *Keystone Pipeline Phase 2* to assure long-term operational reliability and safe operation of the section. The ITAs shall include the integration of the results of the failure analyses and other actions required by this Amended Order with all relevant operating data, including all historical repair information, construction, operating, maintenance, testing, metallurgical analysis, weather-related and outside force damage information (e.g., mechanical damage, geohazards, third-party activity, etc.), or other third-party consultation information, and assessment data for sections of *Keystone Pipeline Phase 1* and *Keystone Pipeline Phase 2*.

c. Each ITA must include a predicated remaining life for operation at both 72 percent SMYS and 80 percent SMYS for: (1) flaws that would have survived the construction hydrostatic test and subject to operating pressure cycles, and (2) flaws conceivably present after ILI assessment and repairs, considering the verified identification and detection thresholds and tolerances of the various ILI tools utilized to address each threat known or suspected on *Keystone Pipeline Phase 1* and *Keystone Pipeline Phase 2*.

8. Girth Weld Assessments.

a. In addition to the ITAs required above, TC Oil must submit Operational Reliability Assessments (ORAs) analyzing all available information about the integrity of girth welds in *Keystone Pipeline Phase 1* and *Keystone Pipeline Phase 2* and the consequences of girth weld failure *Keystone Pipeline Phase 1* and *Keystone Pipeline Phase 2*. Each of these ORAs must provide the number of girth welds, the number of transition welds, the number of repaired welds, and other relevant information to identify the risk factors that may indicate or contribute to the likelihood and consequences of girth weld failure. Likelihood factors include, but are not limited to: the type of welds, weld repair rate construction, the susceptibility of welds to geohazards, weather conditions when the weld was installed, soil types, terrain, operating pressure level and/or pressure cycling, previous repairs of the welds, other threats or features (such as deformations, strain, etc.) that may interact with welds to increase susceptibility to failure, previous excavation or soil disturbance near the pipeline, and types of backfill or support. Consequences factors include but are not limited to: predicted spill volume, proximity to waterways and HCAs, proximity to highways and railroads, location of emergency flow restricting devices, and leak detection sensitivity.

b. Each ORA must include measures to prevent girth weld failures including the performance of additional field testing, inspections, assessments, and evaluations to determine whether and to what extent the conditions associated with girth weld failures are present elsewhere on *Keystone Pipeline Phase 1* and *Keystone Pipeline Phase 2*.

c. The performance of repairs or other corrective measures to remediate conditions associated with girth weld failures, including implementation of continuing long-term periodic testing and integrity verification measures to ensure ongoing safe operation of *Keystone Pipeline Phase 1* and *Keystone Pipeline Phase 2* must include a detailed description of the criteria and method(s) to be used in undertaking any repairs, replacements, or other remedial actions.

d. TC Oil must revise the ORAs as necessary to incorporate the results of actions undertaken pursuant to this Amended Order and whenever necessary to incorporate new information obtained during the failure investigation, root cause analysis, and remedial activities required by this ACAO.

e. TC Oil must submit to the Director a proposed schedule for developing the girth weld ORAs within 90 days following completion of the RCFA required this Amended Order.

9. Mitigation Plan.

a. TC Oil must develop and submit to the Director a mitigation plan and schedule within 90 days of receipt of the ACAO for operational and physical improvements to mitigate the consequences of a failure, to include, but not limited to: engineering controls, modifications to pipeline pressure cycle analysis and overpressure protection, additions or modifications of valves to limit spill volume and/or protect waterways and sensitive areas, prestaging of additional spill response resources to limit the impact of spills on water, and other measures to mitigate the consequence of spills on *Keystone Pipeline Phase 1* and *Keystone Pipeline Phase 2*.

10. *ACAO Documentation Report (ACDR*).

a. TC Oil must create and revise, as necessary, an ACAO Documentation Report (ACDR). When TC Oil has concluded all the items in this Amended Order it will submit the final ACDR in its entirety to the Director. This will allow the Director to complete a thorough review of all actions taken by TC Oil with regards to this Amended Order prior to approving its closure. The intent is for the ACDR to summarize all activities and documentation associated with this Amended Order in one document.

b. The Director may approve the ACDR incrementally without approving the entire ACDR.

c. Once approved by the Director, the ACDR will be incorporated by reference into this Amended Order.

d. The ACDR must include, but is not limited to, the following:

i. Table of Contents;

ii. Summary of the pipeline Failure of December 7, 2022, and the response activities;

iii. Summary of pipe data, material properties, and all prior assessments of the *Affected Segment*, *Keystone Pipeline Phase 1*, and *Keystone Pipeline Phase 2*;

iv. Summary of all tests, inspections, assessments, evaluations, and analysis required by this Amended Order;

v. Summary of the mechanical and metallurgical testing as required by this Amended Order;

vi. Summary of the ITAs as required by this Amended Order;

vii. Summary of the Girth Weld Assessments as required by this Amended Order;

viii. Summary of the Mitigation Plan as required by this Amended Order;

ix. Documentation of all actions taken by TC Oil to implement the RWP, the results of those actions, and the inspection and repair criteria used;

x. Documentation of any revisions to the RWP, including those necessary to incorporate the results of actions undertaken pursuant to this Amended Order and whenever necessary to incorporate new information obtained during the failure investigation and remedial activities;

xi. Lessons learned while completing this Amended Order;

xii. A path forward describing specific actions TC Oil will take on its entire pipeline system as a result of the lessons learned from work on this Amended Order; and

xiii. Appendices (if required).

Other Requirements:

11. ***Approvals.*** With respect to each submission under this Amended Order that requires the approval of the Director, the Director may: (a) approve, in whole or part, the submission; (b) approve the submission on specified conditions; (c) modify the submission to cure any deficiencies; (d) disapprove in whole or in part, the submission, directing that Respondent modify the submission, or (e) any combination of the above. In the event of approval, approval upon conditions, or modification by the Director, Respondent shall proceed to take all action required by the submission as approved or modified by the Director. If the Director disapproves all or any portion of the submission, Respondent must correct all deficiencies within the time specified by the Director and resubmit it for approval.

12. ***Extensions of Time.*** The Director may grant an extension of time for compliance with any ofthe terms of this Amended Order upon a written request timely submitted demonstrating good cause for an extension.

13. ***Reporting.*** Submit quarterly reports to the Director that: (1) include all available data and results of the testing and evaluations required by this Amended Order; and (2) describe the progress of the repairs or other remedial actions being undertaken. The first quarterly report is due on April 17, 2023. The Director may change the

interval for the submission of these reports.

14. ***Documentation of the Costs.*** It is requested that Respondent maintain documentation of the costs associated with implementation of this ACAO. Include in each monthly report submitted, the to-date total costs associated with: (1) preparation and revision of procedures, studies, and analyses; (2) physical changes to pipeline infrastructure, including repairs, replacements, and other modifications; and (3) environmental remediation, if applicable.

Be advised that all material you submit in response to this enforcement action is subject to being made publicly available. If you believe that any portion of your responsive material qualifies for confidential treatment under 5 U.S.C. § 552(b), along with the complete original document you must provide a second copy of the document with the portions you believe qualify for confidential treatment redacted and an explanation of why you believe the redacted information qualifies for confidential treatment under 5 U.S.C. § 552(b).

In your correspondence on this matter, please refer to "CPF No. 3-2022-074-CAO" and for each document you submit, please provide a copy in electronic format whenever possible. The actions required by this Amended Order are in addition to and do not waive any requirements that apply to Respondent's pipeline system under 49 C.F.R. Parts 190 through 199, under any other order issued to Respondent under authority of 49 U.S.C. Chapter 601, or under any other provision of federal or state law.

Respondent may appeal any decision of the Director to the Associate Administrator for Pipeline Safety. Decisions of the Associate Administrator shall be final.

Failure to comply with this Amended Order may result in the assessment of civil penalties and in referral tothe Attorney General for appropriate relief in United States District Court pursuant to 49 U.S.C. § 60120.

The terms and conditions of this Amended Order are effective upon service in accordance with 49 C.F.R.
§ 190.5.

ALAN KRAMER MAYBERRY

Digitally signed by ALAN KRAMER MAYBERRY
Date: 2023.03.07 09:15:57 -05'00'

March 7, 2023

Alan K. Mayberry
Associate Administrator
for Pipeline Safety

Date Issued