Magellan Pipeline Company

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2020 Operational Reliability Assessment of the Longhorn Pipeline System

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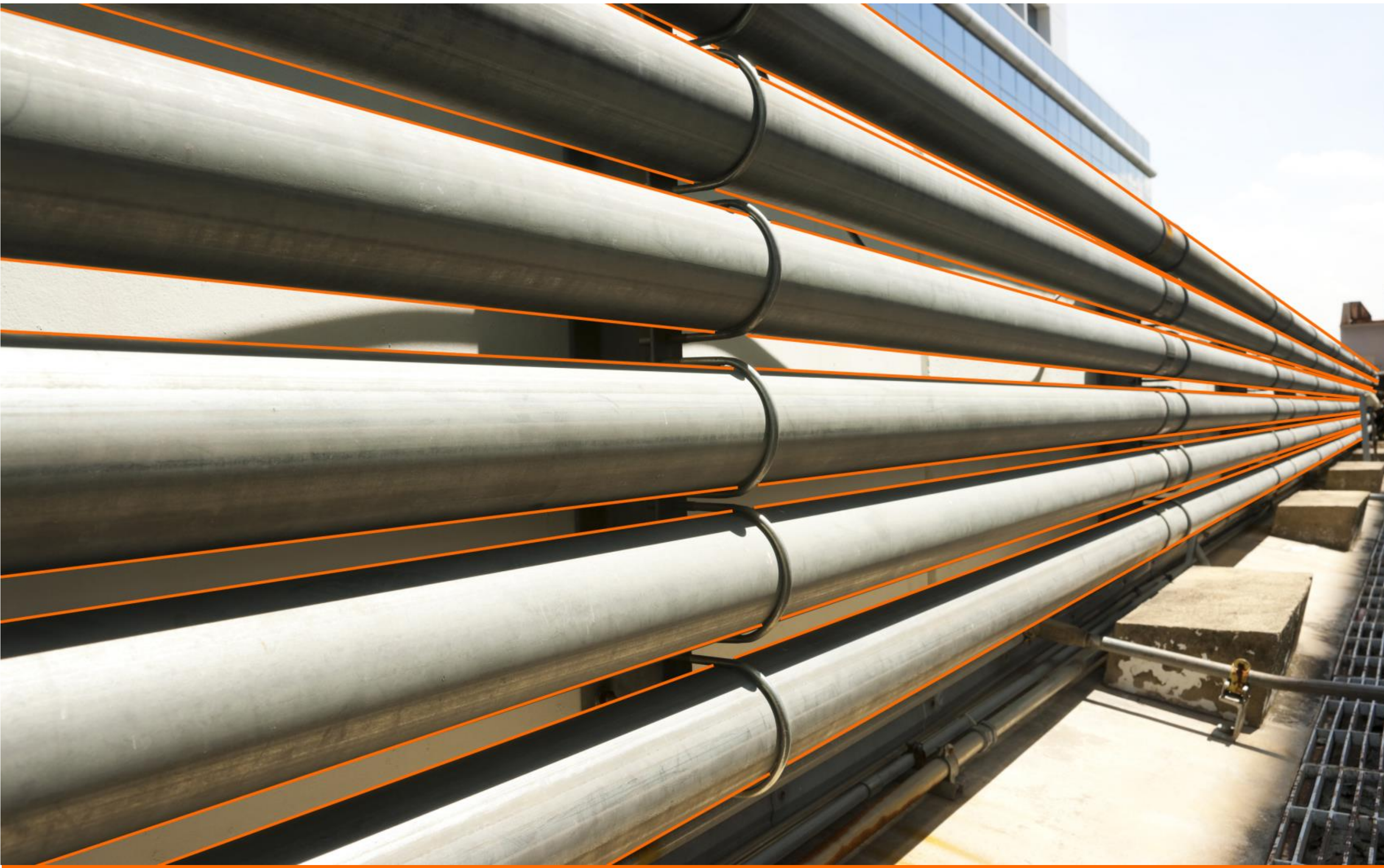
March 30, 2022



ENERGY & INDUSTRY DIVISION

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to

Magellan Pipeline Company

on

March 30, 2022

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EXECUTIVE SUMMARY

This report presents the annual Operational Reliability Assessment (ORA) of the Longhorn Pipeline System for the 2020 operating year. Kiefner and Associates, Inc. (Kiefner) conducted the ORA, which provides Magellan Pipeline Company, L.P. (Magellan) with a technical assessment of the effectiveness of the System Integrity Plan (SIP). The technical assessment incorporates results from all SIP elements to evaluate the condition of the Longhorn assets. In addition, recommendations are provided to preserve the long-term integrity and mitigate areas of potential concern.

The Crane to Texon segment will require reassessment in 2024 based on pressure cycle fatigue susceptibility. Magellan planned digs in 2021 to address two crack-like features on the Crane to Texon segment, which will extend the re-assessment date to 2026. The Crane to Texon analysis was based on the 2018 ultrasonic crack detection (UCD) tool run.

The 2020 maintenance and non-destructive evaluation (NDE) reports were reviewed and correlated to in-line inspection (ILI) assessments from 2019 and 2020 to validate the ILI specified tool performance using the supplied background information and the API 1163 ILI validation methodology. Magellan performed 249 ILI anomaly investigations in 2020. The ILI anomaly investigations found correlating features on all referenced digs. Ninety-two of the anomaly investigations targeted crack-like, crack colony, or crack-like inspection sheets, targeting 113 ILI-reported crack-like features. In-ditch evaluations confirmed 83 cracks, 16 linear indications, 12 lack of fusion (LOF), one mill defect, and once found no anomaly. Kiefner performed a run-to-run comparison to determine external and internal corrosion growth rates (CGRs) for the ILI assessments conducted or received in 2020. Calculated external upper bound CGRs ranged from 5.0 to 7.4 mpy. There were insufficient data pairs to support CGR calculations for internal metal loss features. Magellan continues to conduct field investigations to remediate and validate metal loss as necessary.

The corrosion management data have been reviewed, including internal corrosion coupon data, rectifier inspection, test point survey, close interval surveys (CIS), atmospheric inspections, and tank inspection reports. Internal corrosion coupons show low corrosion rates (≤0.88 mpy). A CIS was performed in November 2019 and received by Magellan in February 2020 for the pipeline right-of-way (ROW) from stationing 395+56 to 26340+35. A CIS was also performed in October 2020 and received by Magellan in November 2020 for pipeline ROW 6645 segments from stationing 6221+42 to 10257+91. Semi-annual surveys are conducted on Tier II and Tier III areas per Longhorn Mitigation Commitment (LMC) 32. AC pipe to soil voltages was collected during the CIS, showing the highest reading of 6.9 V at stationing 9451+37. Atmospheric inspection and tank inspection reports indicate no immediate action is required. Monitoring should continue to identify future potential changes.

Laminations were reviewed concurrently with reported inside diameter (ID) reductions to determine if there were any potential hydrogen blisters on the line segments inspected in 2020. Kiefner compared the 2,299 ID reductions identified from the 2019/2020 electronic geometry pig (EGP) assessments to the existing laminations reported by the 2009/2010 UT assessments. Fourteen dents and 142 geometric anomalies (GMA) either correlated or were present on the same joint as a lamination reported from the 2009/2010 UT assessments. Four dents and eight GMAs correlations have either been previously repaired or addressed in a 2020 ILI anomaly investigation dig. Based on the 2020 maintenance reports, Magellan found 15 laminations during in-ditch inspections. Monitoring reported laminations for ID reductions might indicate the initiation of a hydrogen blister. Magellan reported one blister found during in-ditch inspections, the target anomaly was an external metal loss feature, and no lamination or ID reductions were reported on the target joint. Magellan should continue to monitor for lamination anomalies with ILI tools.

Earth movement and water forces can result in primary integrity concerns of ground movement from aseismic faults and soil erosion caused by scouring from floods at specific points along the pipeline. The analysis results show that the overall movement rates at Akron, Melde, Breen, Negyev, and Oates continue to be slow, and the pipeline crossing those faults has more than 100 years[1] to reach the allowable displacement. However, the short-term rate of movements at these faults reveals that they have been more active lately, suggesting closer monitoring. In particular, in the past few resurveys, the Akron fault has undergone large displacement oscillations around a mean value resulting in self-equilibrating. Magellan performed maintenance activities following the December 2018 fault monitoring to relieve possible strain on the pipeline at the Hockley fault. However, Kiefner recommends closer monitoring of this fault due to its continuously high rate of movement, particularly in recent years (0.037 inches/year). The analysis shows that since December 2019, the McCarty fault has been moving at a rate of 0.034 inches/year. Given such a large rate of movement and the small amount of allowable displacement at the pipeline crossing the fault, Kiefner recommends a 3-months monitoring interval at McCarty fault to assess the need for any future intervention.

A depth-of-cover (DOC) survey was conducted for the Greens Bayou crossing in 2020. The maximum cover depth at Greens Bayou crossing was found to be 3 feet and 8 inches. Magellan plans to address the Greens Bayou crossing in 2021. DOC surveys for the four other river crossings (Colorado River, Pin Oak Creek, Cypress Creek, and Brazos River) were conducted in previous years and were considered acceptable. Magellan should continue to conduct flood monitoring and crossing surveys in accordance with the Longhorn Mitigation Plan (LMP) procedures.

The Longhorn third-party damage (TPD) prevention program exceeds the minimum requirements of federal and Texas state pipeline safety regulations. Aerial surveillance and ground patrol frequencies met the LMP goals, with one exception due to weather events in October of 2020. However, Magellan began and completed patrols following event cessation within 72 hours.

Magellan performs incident investigations on all events, including near misses. During 2020, there were four incident investigations on the Longhorn Pipeline; three minor and one significant. Two of the three minor incidents were classified as releases and the third as

[1] This is the total time calculated from when the pipe is free of stress, i.e. since installation or the last time some form of stress relief was performed on it.

property damage. The significant incident was classified as a product quality incident at the El Paso Terminal. None of these incidents were reportable to PHMSA.

Magellan has recorded no stress-corrosion cracking (SCC) on the 449 miles of pipeline. Kiefner recommends Magellan continue to carry out inspections per procedure as part of the normal dig program by conducting an SCC examination program that uses magnetic particle testing at each dig site.

The 2020 facilities data indicates that the pump stations and terminal facilities have been properly maintained and operated and have had no adverse impact on public safety. Magellan performs Process Hazard Analyses (PHAs) on all new above-ground facilities, when any modifications to existing facilities occur, and at 5-year intervals to evaluate and control potential hazards associated with the operation and maintenance of the facilities. No PHAs were completed in 2020.

A probabilistic risk model is used to effectively manage pipeline integrity and evaluate risk per 49 CFR 195.452. The results show that none of the pipeline segments exceeded Magellan's risk threshold; therefore, no additional mitigation measures were required or recommended.

The technical assessment of the SIP indicated that Magellan is achieving its goal of preventing incidents that threaten human health or safety or cause environmental harm. However, further emphasis on reducing operational errors is needed. In terms of activity measures, Magellan exceeded the minimum required mileage for aerial surveillance and ground patrol in the total number of miles patrolled and met the frequency requirement for patrol when weather permitted. In addition, Magellan held public-awareness meetings and implemented their damage prevention program in order to ensure the safety and reliability of the Longhorn Pipeline System.

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TERMS, DEFINITIONS, AND ACRONYMS

The terms and definitions are taken directly from Section 2.0 of the ORA Process Manual (ORAPM), titled Terms, Definitions, and Acronyms. Definitions in the ORAPM or Longhorn Mitigation Plan are italicized.

Accident	An undesired event that results in harm to people or damage to property.
AC	Alternating Current
API	American Petroleum Institute
ASME	American Society of Mechanical Engineers
Bbl	barrels
BHGE	Baker Hughes, a GE Company
bpd	barrels per day
bph	barrels per hour
CFR	Code of Federal Regulations
CGR	Corrosion growth rate
CIS	Close interval survey
CMP	Corrosion Management Plan
CP	Cathodic Protection – A method of protection against galvanic corrosion of a buried or submerged pipeline through the application of protective electric currents.
Def	Deformation
Defect	An imperfection of a type or magnitude exceeding acceptable criteria. Definition based on API Publication 570 – Piping Inspection Code. (Also see, anomaly).
Dent	An ID Reduction greater than or equal to 2% of the pipe diameter
DOC	Depth-of-cover
DOT	Department of Transportation

EA	Environmental Assessment – The National Environmental Policy Act (NEPA) process begins when a federal agency develops a proposal to take major federal action. These actions are defined in 40 CFR 1508.18. The environmental review under NEPA can involve three different levels of analysis: • Categorical Exclusion determination (CATEX) • Environmental Assessment/Finding of No Significant Impact • Environmental Impact Statement (EIS)
EFW	Electric-flash weld is a type of EW using electric-induction to generate weld heat.
EGP	Electronic geometry pig
Encroachments	Unannounced or unauthorized entries of the pipeline right-of-way by persons operating farming, trenching, drilling, or other excavating equipment. Also, debris and other obstructions along the right-of-way must periodically be removed to facilitate prompt access to the pipeline for routine or emergency repair activities. The System Integrity Plan (SIP) includes provisions for surveillance to prevent and minimize the effects of right-of-way encroachments.
EPA	Environmental Protection Agency
ERW	Electric-resistance weld is a type of EW using electric-resistance to generate weld heat.
EW	Electric welding is a process of forming a seam for electric resistance (ERW) or electric-induction (EFW) welding wherein the edges to be welded are mechanically pressed together, and the heat for welding is generated by the resistance to the flow of the electric current. EW pipe has one longitudinal seam produced by the EW process.
Excavation Damage	Any excavation activity that results in the need to repair or replace a pipeline due to a weakening, or the partial or complete destruction, of the pipeline, including, but not limited to, the pipe, appurtenances to the pipe, protective coatings, support, cathodic protection or the housing for the line device or facility.
Existing Pipeline	Originally defined in the EA, it consists of the portion of the pipeline originally constructed by Exxon in 1949-1950 that runs from Valve J-1 to Crane pump station. Currently, the in-service portion of the Existing Pipeline runs from MP 9 to Crane because the 2-mile section from Valve J-1 to MP 9 is not in use.
External Corrosion	Deterioration of the pipe due to an electrochemical reaction between the pipe material and the environment outside the pipe
FAD	Failure Assessment Diagram
FEA	Finite element analysis

GMA	Geometric Anomaly – An ID Reduction less than 2% of the pipe diameter
HCA	High Consequence Area – As defined in 49 CFR 195.450, a location where a pipeline release might have a significant adverse effect on one or more of the following: • Commercially navigable waterway • High population area • Other populated area • Unusually sensitive area (USA)
Hydrostatic Test	An integrity verification test that pressurizes the pipeline with water is also called a hydro test or hydrostatic pressure test.
ID	Inside nominal diameter of line pipe
ID Reduction	A deformation of pipe diameter detected by the ILI tool
ILI	In-Line Inspection – The use of an electronically instrumented device that travels inside the pipeline to measure characteristics of the pipe wall and detect anomalies such as metal loss due to corrosion, dents, gouges, and/or cracks depending upon the type of tool used.
ILI Final Report	ILI vendor report that provides the operator with a comprehensive interpretation of the data from an ILI.
IMP	Integrity Management Program
Incident	An event defined in the Incident Investigation Program of the LMP: Includes accidents, near-miss cases, repairs, and/or any combination thereof. Incidents are divided into three categories: major incidents, significant incidents, and minor incidents. A "PHMSA (or DOT) reportable incident" is a failure in a pipeline system in which there is a release of product resulting in explosion or fire, volume exceeding 5 gallons (5 barrels from a pipeline maintenance activity), death of any person, personal injury necessitating hospitalization, or estimated property damage exceeding $50,000.
Internal Corrosion	Deterioration of the pipe due to an electrochemical reaction between the pipe material and the environment outside the pipe
J-1 Valve	Mainline pipeline valve in the Houston area, described in the LMP as the junction of the Existing Pipeline and a New Pipeline extension. Although this valve still exists, it is not a part of the currently active Longhorn Pipeline, and the actual junction is at MP 9 (2 miles from the J-1 Valve).
Jct	Junction
Kiefner	Kiefner and Associates, Inc.
L	Defect length

Leak Detection System	Two technology-based leak detection systems are used for the Longhorn system: (1) A system-wide computer-based monitoring and alarm network using real-time flow information from various locations along the pipeline, and (2) a buried sensing cable installed over the Edwards Aquifer recharge zone and the Slaughter Creek watershed in the Edwards Aquifer contributing zone.
LMC	Longhorn Mitigation Commitment – Commitments made by Longhorn are described in Chapter 1 of the LMP.
LMP	Longhorn Mitigation Plan – Commitments made by Longhorn to protect human health and the environment by conducting up front (prior to pipeline start-up) and ongoing activities regarding pipeline system enhancements and modifications, integrity management, operations and maintenance, and emergency response planning.
Magellan	Magellan Pipeline Company, L.P.
Major Incident	Per the Longhorn Mitigation Plan – Includes events which result in: • Fatality • Three or more people hospitalized • Major news media coverage • Property loss, casualty, or liability potentially greater than $500,000 • Major uncontrolled fire/explosion/spill/release that presents an imminent and serious or substantial danger to employees, public health, or the environment
MASP	Maximum Allowable Surge Pressure
Minor Incident	Per the Longhorn Mitigation Plan – Includes events which result in: • Fire/explosion/spill/release or other events with casualty/property/liability loss potential under $25,000 • Employee or contractor OSHA recordable injury/illness without lost workday cases • Citations under $25,000
MFL	Magnetic flux leakage – The flow of magnetic flux from a magnetized material, such as the steel wall of a pipe, into a medium with lower magnetic permeability, such as gas or liquid. Often used in reference to an ILI tool that makes MFL measurements.
ML	Metal loss
MOP	Maximum Operating Pressure
MOCR	Management of Change Request
MP	Mile Post
mpy	Mils per year – Often referenced in conjunction with corrosion growth rates

NACE	NACE International – Formerly known as the National Association of Corrosion Engineers
NDE	Non-destructive Evaluation
Near-Miss	The number of unplanned/undesired third-party-related events that did not result in a significant loss but which, under slightly different circumstances, could have resulted in a minor, serious, or major incident. Near miss data are obtained from Hazard / Near Miss cards, incident investigations, aerial patrol reports, maintenance reports, and ROW inspection reports. An event defined in the Incident Investigation Program of the LMP as an undesired event that could have resulted in harm to people or damage to property under slightly different circumstances. In addition, the LMP states: a specific scenario of a minor accident (minor actual loss) could also be a major near-miss (major potential loss). Thus, a near-miss may or may not result in an incident.
NEPA	National Environmental Policy Act
New Pipeline	In 1998 extensions were added to the Existing Pipeline to make the current Longhorn Pipeline. Extensions were added from Galena Park to MP 9 and Crane to El Paso Terminal. Laterals were added from Crane to Odessa and El Paso Terminal to Diamond Junction. In 2010 a 7-mile loop (3 ½ miles each way) was added, connecting Magellan's East Houston terminal to MP 6.
OD	Outside nominal diameter of line pipe.
One-Call	A notification system through which a person can notify pipeline operators of planned excavation to facilitate the locating and marking of any pipelines in the excavation area. Texas 811 is a computerized notification center that establishes a communications link between those who dig underground (excavators) and those who operate underground facilities. The Texas Underground Facility Damage Prevention Act requires that excavators in Texas notify a One-Call notification center 48 hours before digging, so the location of an underground facility can be marked. The Texas 811 System can be reached at toll-free number 811 or website http://www.texas811.org/.
One-Call Violation	A violation of the requirements of the Texas Underground Facility Damage Prevention and Safety Act by an excavator. This ORA is concerned about violations within the Longhorn Pipeline ROW.

One-Call Violations	The number of excavations that occurred within the ROW boundaries where a one-call was not made and should have been. Texas One-Call (Utilities Code: Title 5, Chapter 251, Section 251.002, Sub-Section 5) defines excavate as "to use explosives or a motor, engine, hydraulic or pneumatically powered tool, or other mechanized equipment of any kind and includes auguring, backfilling, boring, compressing, digging, ditching, drilling, dragging, dredging, grading, mechanical probing, plowing-in, pulling-in, ripping, scraping, trenching, and tunneling to remove or otherwise disturb the soil to a depth of 16 or more inches." Additionally, one-call violations are identified when company personnel discover third-party activity on the ROW and inform the third party that a one-call is required. One-call violation data are obtained from Hazard / Near-Miss cards, One-Call tickets, incident investigations, aerial patrol reports, maintenance reports, and ROW inspection reports.
Operator	An entity or corporation responsible for day-to-day operation and maintenance of pipeline facilities
OPS	Office of Pipeline Safety – Co-lead agency who performed the EA, now a part of PHMSA
ORA	Operational Reliability Assessment – Annual assessment activities to be performed on the Longhorn Pipeline System to determine its mechanical integrity and manage risk over time
ORAPM	The Operational Reliability Assessment Process Manual
PHA	Process Hazard Analysis
PHMSA	The Pipeline and Hazardous Materials Safety Administration – a federal agency within the DOT with safety jurisdiction over interstate pipelines.
PMI	Positive Material Identification
Positive Material Identification (PMI) Field Services	A process and procedure developed by T. D. Williamson to determine tensile strength, yield strength, and chemical composition on pipe in the field. The process includes mobile automated ball indention for mechanical properties and optical emission spectrometry for chemical composition.
POE	Probability of Exceedance – The likelihood that an event will be greater than a pre-determined level; used in the ORA to evaluate corrosion defect failure pressures versus intended operating pressures. The POE for depth (POE_D) is the probability that an anomaly is deeper than 80% of wall thickness. The POE for pressure (POE_P) is the probability that the burst pressure of the remaining wall thickness will be less than the system operating pressure or surge pressure. The POE for each pipe joint is POE joint.
POF	Probability of Failure
Recommendation	Suggestion for activities or changes in procedures that are intended to enhance integrity management systems but are not specifically mandated in the LMP

Repair	The LMP describes a repair as a temporary or permanent alteration made to the pipeline or its affiliated components intended to restore the allowable operating pressure capability or correct a deficiency or possible breach in the mechanical integrity of the asset.
Requirement	Activities that must be performed to comply with the LMP commitments
Risk	A measure of loss measured in terms of both incident likelihood of occurrence and magnitude of the consequences
Risk Assessment	A systematic, analytical process in which potential hazards from facility operation are identified and the likelihood and consequences of potential adverse events are determined. Risk assessments can have varying scopes and be performed at varying levels of detail depending on the operator's objectives.
ROW	Right-of-way – A strip of land where, through a legal agreement, some property rights have been granted to Magellan and its affiliates. The ROW agreement enables Magellan to operate, inspect, repair, maintain or replace the pipeline.
SCC	Stress-Corrosion Cracking – A form of environmental attack on the pipe steel involving the interaction of local corrosive environment and tensile stresses in the metal resulting in formation and growth of cracks. (ASME 31.8S[2])
Significant Incident	Per the Longhorn Mitigation Plan – Includes events which result in: • Fire/explosion/spill/release/ less than three hospitalized or other events with casualty/property/liability loss potential of $25,000 - $500,000 • Employee or contractor OSHA recordable injury/illness lost workday cases • Citations with potential fines greater than $25,000
SIP	System Integrity Plan – A program designed to gather unique physical attributes on the Longhorn Pipeline System, identify and assess risks to the public and the environment, and actively manage those risks through the implementation of the identified Process Elements. Also, Chapter 3 of the LMP.
SMYS	Specified Minimum Yield Strength – A common measure of the minimum
Surge Pressure	Short-term pipeline pressure increases due to equipment operation changes such as valve closure or pump start-up. Surge pressures must be limited to no more than MOP in Tier II and Tier III areas and no more than 110% of MOP elsewhere.
TDW	T.D. Williamson
Tier I Areas	Areas of normal cross-country pipeline

[2] ASME 31.8S (2016), Managing System Integrity of Gas Pipelines, ASME Code for Pressure Piping, B31

Tier II Areas	Areas designated in the EA as environmentally sensitive due to population or environmental factors
Tier III Areas	Areas designated as in the EA as environmentally hypersensitive due to the presence of high population or other environmentally sensitive areas
TFI	Transverse Field Inspection – An MFL Inspection tool with the magnetic field oriented in the circumferential direction. The tool differs from conventional MFL because these conventional tools have their field oriented in the axial direction or along the axis of the pipe.
TPD	Third-party damage – Accidental or intentional damage by a third party (that is, not the pipeline operator or contractor) that causes an immediate failure or introduces a weakness (such as a dent or gouge) into the pipe
TPD Annual Assessment	"Longhorn System Annual Third-Party Damage Prevention Program Assessment" Report. The annual report written by the operator summarizes the TPD prevention program. This report is found in the ORAPM process manual Appendix D as Item 71 Annual Third-Party Damage Assessment Report.
UltraScan™ CD (UCD)	BHGE's ultrasonic crack detection in-line inspection tool.
UT	Ultrasonic testing – A non-destructive testing technique using ultrasonic waves
WT	Wall thickness of line pipe
WTI	West Texas Intermediate (crude oil grade)
WTS	West Texas Sour (crude oil grade)

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2020 Operational Reliability Assessment of the Longhorn Pipeline System

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1 INTRODUCTION

1.1 Objective

Kiefner and Associates, Inc. (Kiefner) has conducted the annual Operational Reliability Assessment (ORA) report on the Longhorn Pipeline System for the 2020 operating year. The ORA report provides Magellan Pipeline Company, L.P. (Magellan), with a technical assessment of the Longhorn Pipeline System Integrity Plan (SIP) effectiveness on the Longhorn Pipeline. Results from all SIP elements are incorporated into the technical assessment to help evaluate the condition of the Longhorn assets. Kiefner provides recommendations to preserve the long-term integrity and mitigate areas of potential concern.

1.2 Background

Magellan has operated the Longhorn pipeline system since 2005 and has held ownership since 2009. The previous owner, Longhorn Partners Pipeline, LP, participated in an Environmental Assessment (EA) prepared by the U.S. Environmental Protection Agency (EPA) and the Department of Transportation (DOT) in 1999 and 2000. The EA took place before the then newly configured pipeline refined product service. The EA "Finding of No Significant Impact" was conditioned upon Longhorn's commitment to implement certain integrity-related activities and plans before pipeline start-up and periodically throughout the system's operation. The Longhorn Mitigation Plan (LMP) specifies Longhorn's commitment to minimize the likelihood and consequences of product releases. These commitments included the Longhorn Continuing Integrity Commitment, wherein Longhorn agreed to implement System Integrity and Mitigation Commitments and conduct annual ORAs. A list of the Longhorn Mitigation Commitments (LMCs) addressed in the ORA report is provided in Appendix A – Mitigation Commitments.

The LMP committed Longhorn to retain an independent third-party technical company to perform the annual ORA, subject to the review and approval of the Pipeline and Hazardous Materials Safety Administration (PHMSA). Longhorn selected, PHMSA approved Kiefner as the ORA contractor, and Magellan continues with this agreement.

The LMP stipulates specific and general requirements of the ORA. Those requirements were extracted from the LMP and used to develop the Operational Reliability Assessment Process Manual (ORAPM). The ORA is carried out according to the ORAPM. The "Mock ORA for Longhorn Pipeline" that Kiefner performed before the pipeline commissioning provided additional information on the execution of the ORA. The ORAPM requires the ORA contractor to provide annual reports to Magellan and PHMSA.

The ORA contractor will assess the pipeline operating data and the results of integrity assessments, surveys, and inspections and make appropriate recommendations regarding the seven potential threats to pipeline integrity. The ORAPM identifies the list of data needed to conduct the ORA; Appendix B – New Data used in this analysis provides the data used for the 2020 ORA Report. Managing these threats and preserving the integrity of the Longhorn system assets are among the goals of the SIP. The seven pipeline integrity threats are:

1. Pressure-Cycle-Induced Fatigue
2. Corrosion
3. Laminations and Hydrogen Blisters
4. Earth Movement and Water Forces
5. Third-Party Damage (TPD)
6. Stress-Corrosion Cracking (SCC)[3]
7. Threats to Facilities Other than Line Pipe

1.3 ORA Interaction with the SIP

Magellan's SIP is the direct operator interface with the daily operations and maintenance of the Longhorn system assets. The SIP contains 12 process elements (listed below) used to formulate prevention and mitigation recommendations that are directly implemented periodically throughout pipeline operations. The SIP serves as the primary mechanism for generating and collecting pipeline system operation and inspection data required for the performance of ORA functions.

1. Corrosion Management Plan
2. In-Line Inspection (ILI) and Rehabilitation Program
3. Key Risk Area Identification and Assessment
4. Damage Prevention Program
5. Encroachment Procedures
6. Incident Investigation Program
7. Management of Change
8. Depth-of-Cover Program
9. Fatigue Analysis & Monitoring Program
10. Scenario-Based Risk Mitigation Analysis
11. Incorrect Operations Mitigation
12. System Integrity Plan Scorecarding and Performance Metrics Plan

1.4 Longhorn Pipeline System Description

The Longhorn pipeline system is comprised of a crude oil system (Eastern portion) and a refined products system (Western portion). Figure 1 through Figure 3 show the Longhorn System Map, Tier Levels, and a close-up of the Houston area.

The Eastern portion of the Longhorn system transports crude oil through an 18-inch pipeline over 424 miles from Crane Station to Satsuma Station. Intermediate pumping stations are located at Texon, Barnhart, Cartman, Kimble, James River, Eckert, Cedar Valley, Bastrop,

[3]SCC has not been identified as a threat of concern to the Longhorn Pipeline and has not been recognized as a threat in the past but was added as SCC has been an unexpected problem for some pipelines.

Warda, and Buckhorn. The crude system continues with 32 miles of 20-inch pipe from Satsuma Station to East Houston Terminal and 9 miles of 20-inch pipe from East Houston Terminal to 9th Street Junction. The crude system contains some of the Existing Pipeline (as named in the original EA) built-in 1949-1950 with some replacements and extensions in the Houston area.

The Western portion of the Longhorn system transports refined products from Odessa to El Paso, TX. The refined product system is 237-miles of 18-inch pipe from Crane Station to the El Paso Terminal and 29 miles of 8-inch pipe from Odessa to Crane Station. At the El Paso Terminal, there are four 9.4-mile laterals connecting the El Paso Terminal to El Paso Junction (also known as the El Paso Laterals). Most of the refined pipe system was built in 1998.

Table 1 shows the station locations for the Longhorn pipeline systems. The current flow rate for the crude system is 292,000 barrels per day (bpd) from Crane to East Houston. The flow rate for the refined product system increased from 64,000 to 92,180 bpd from Odessa to El Paso in September of 2020, in accordance with LMP commitment 39, the rate increase was approved by PHMSA. Figure 4 shows a timeline with the history of the Longhorn Pipeline System.

Table 1. Longhorn Pipeline Station Locations

System	Station	Type	Milepost	Tier	MOP (psig)
Crude	Crane	Pump	457.5	II	1034
	Texon	Pump	416.6	II	898
	Barnhart	Pump	373.4	II	898
	Cartman	Pump	344.3	II	952
	Kimble	Pump	295.2	II	898
	James River	Pump	260.2	I	965
	Eckert	Pump	227.9	I	959
	Cedar Valley	Pump	181.6	II	965
	Bastrop	Pump	141.8	I	981
	Warda	Pump	112.9	I	965
	Buckhorn	Pump	68.0	I	787
	Satsuma	Pump	34.1	III	786
	E. Houston	Terminal	2.35	II	1168
Refined Product	Odessa[4]	Meter	NA	I	1440
	Crane	Pump	457.5	I	1440
	Cottonwood	Valve	576.3	I	1440
	El Paso	Terminal	694.4	I	1440

[4] The Longhorn Mitigation Plan (LMP) covers the Odessa pig trap. The tanks and metering are not covered by the LMP.

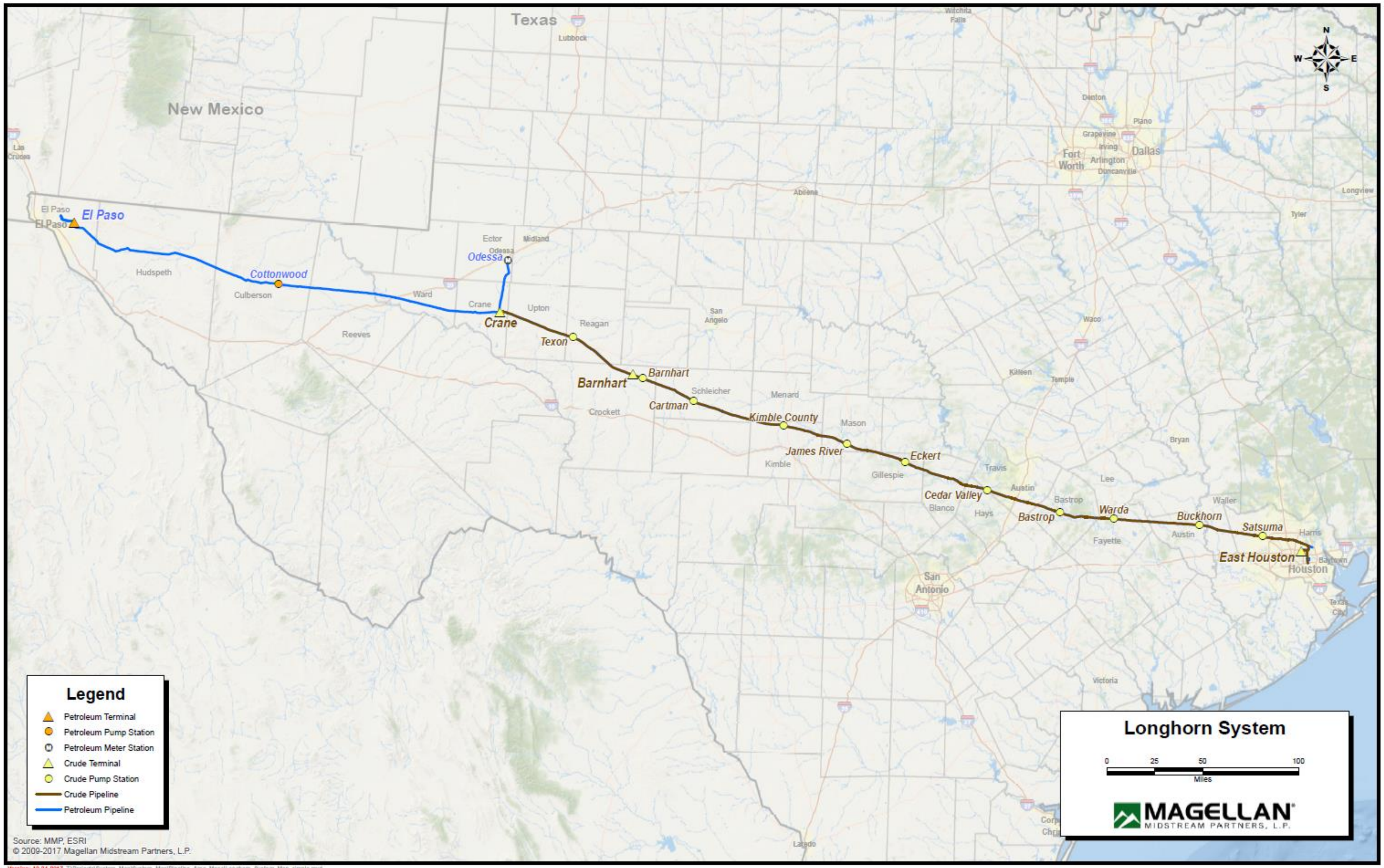

Figure 1. Longhorn System Map (2020)

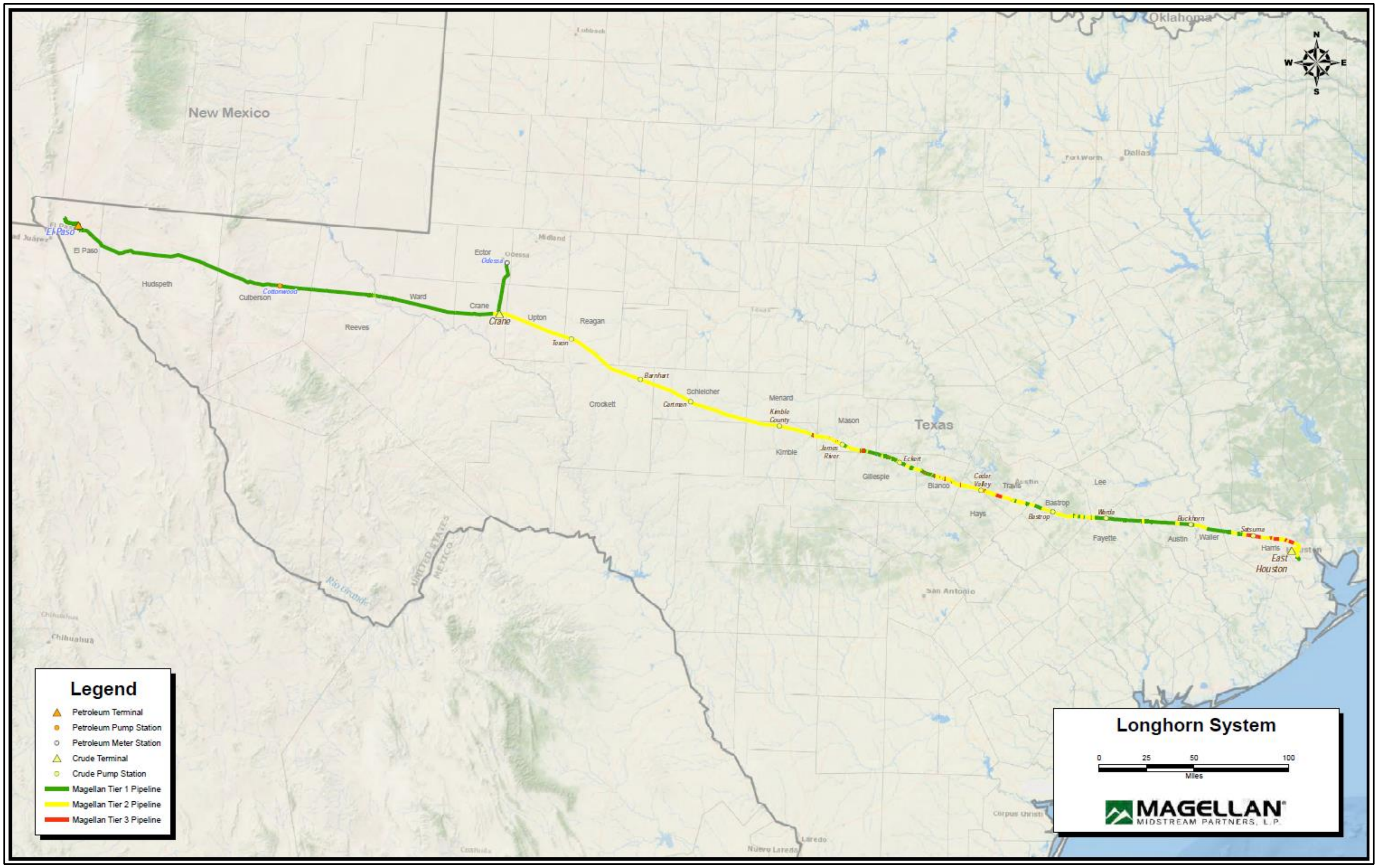

Figure 2. Longhorn System Map showing Tier Level (2020)

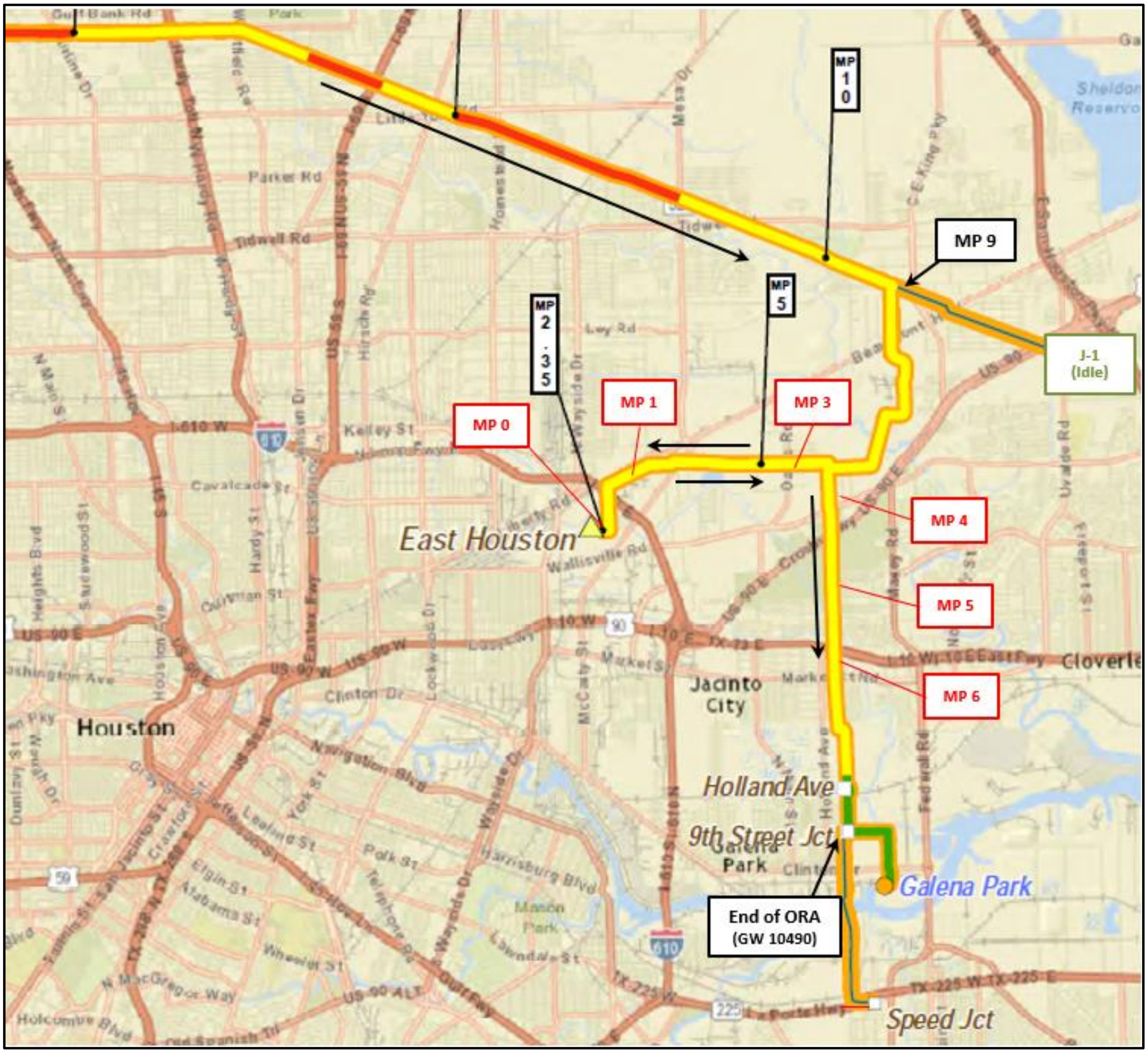

Figure 3. Map of Longhorn System within Houston Area (2020)

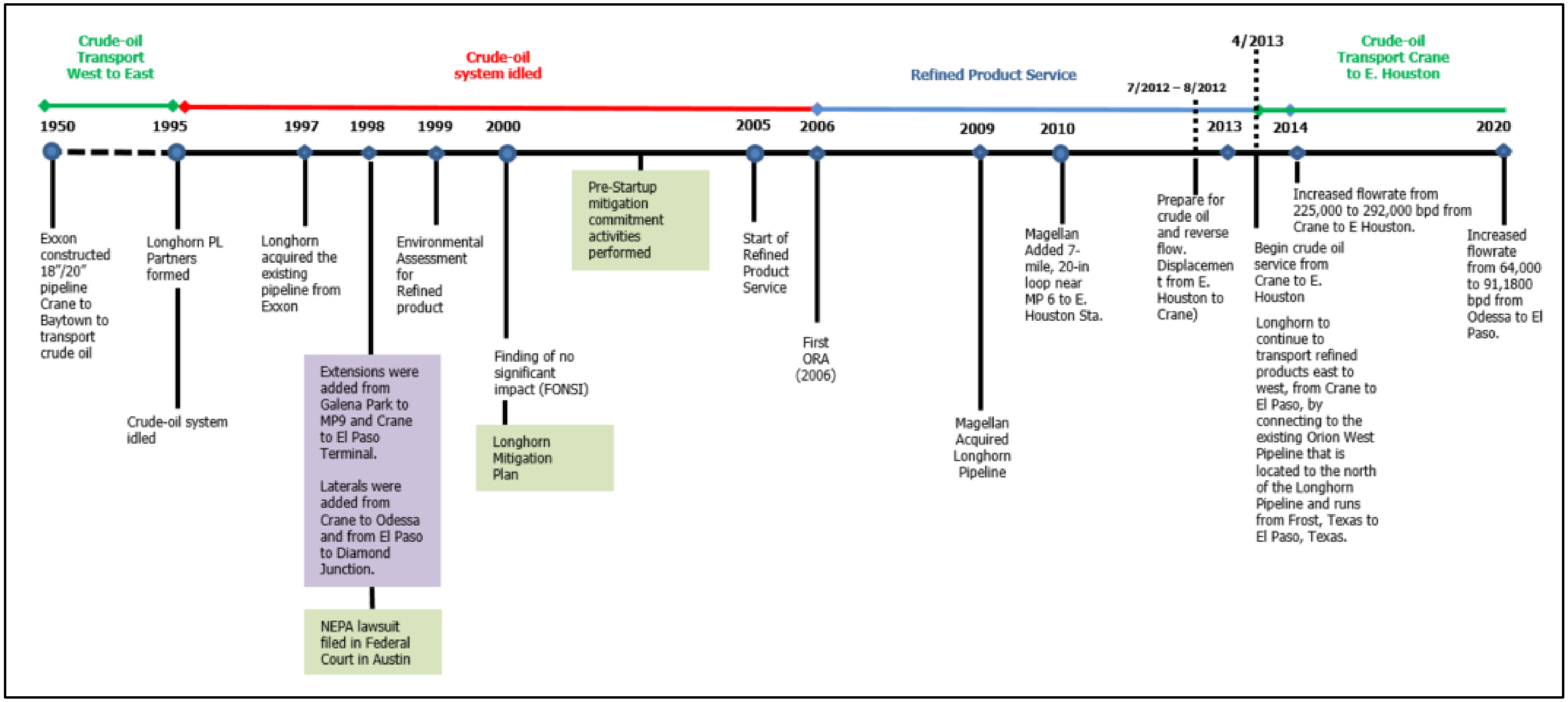

Figure 4. Timeline of the Longhorn Pipeline System

2 LMP AND SIP ANALYSES AND REVIEW

To maintain the integrity and reliability of the Longhorn pipeline, Magellan identifies, analyzes, and manages the risks associated with the operation of the pipeline and its associated assets. The LMP and SIP both help implement this policy.

The LMP helps maintain the integrity of the Longhorn pipeline by identifying and monitoring threats such as pressure-cycle-induced fatigue cracking, corrosion, pipe laminations, and hydrogen blisters, earth movement, TPD, SCC, and threats to facilities other than line pipe. Magellan had nine pipeline segments assessed with final reports received in 2020; one additional segment was assessed in late 2019, with final reports received in 2020. The segment assessed in 2019 and reports received in 2020 was Warda to Buckhorn. The following ILI assessment tools were used for all pipeline segments assessed in 2020: Baker Hughes, a General Electric company (BHGE) Ultrascan™ CD (UCD) tool, BHGE's Magnescan (MF4) tool, and BHGE's Deformation tool. Refer to Table 2 for a list of assessments performed in 2020 by pipeline segment.

The SIP maintains the integrity of the Longhorn pipeline by identifying and managing incidents that would threaten human health and safety or cause environmental harm. The SIP contains 12 process elements. These elements are most closely related to the threats addressed by the ORAPM and are summarized in detail with recommendations that are provided to preserve the long-term integrity and mitigate areas of potential concern. These 12 process elements are listed in Section 1.3 ORA Interaction with the SIP.

Table 2. Longhorn System ILI Assessments

Buckhorn to Satsuma	Warda to Buckhorn	Bastrop to Warda	Cedar Valley to Bastrop	Eckert to Cedar Valley	James River to Eckert	Kimble to James River	Cartman to Kimble	Barnhart to Cartman	Texon to Barnhart
68.0 to 34.1	**112.9 to 68.0**	**141.8 to 112.9**	**181.6 to 141.8**	**227.9 to 181.6**	**260.2 to 227.9**	**295.2 to 260.2**	**344.3 to 295.2**	**373.4 to 344.3**	**416.6 to 373.4**
Corrosion									
MFL	MFL*	MFL	MFL	MFL	MFL	MFL	MFL	MFL	MFL
1/14/2020	11/5/2019	1/9/2020	1/6/2020	2/4/2020	3/4/2020	8/11/2020	7/8/2020	6/12/2020	5/5/2020
Pressure Cycle Induced Fatigue									
UCD*	UCD*	UCD	UCD	UCD	UCD	UCD**	UCD**	UCD	UCD
12/6/2019	11/8/2019	1/28/2020	1/16/2020	3/4/2020	3/11/2020	10/20/2020	8/25/2020	6/16/2020	5/15/2020
Third-Party Damage									
Deformation	Deformation*	Deformation	Deformation	Deformation	Deformation	Deformation	Deformation	Deformation	Deformation
1/14/2020	11/5/2019	1/9/2020	1/6/2020	2/4/2020	3/4/2020	8/11/2020	7/8/2020	6/12/2020	5/5/2020

*Assessment performed in 2019, with final reports received in 2020.
**Final reports for the UCD assessment on Kimble to James River received in 2021; analysis to be part of the 2021 ORA Report.

2.1 Fatigue Analysis and Monitoring Program

Linear indications could potentially enlarge in service due to fatigue if subjected to pressure cycling loads sufficient to cause crack growth. Longitudinal seam flaws that may be affected by pressure cycles are more prevalent in pipes manufactured using older welding technology such as low-frequency electrical resistance weld (LF-ERW) and flash welded (FW) pipe. Also, pipe seams in vintage pipes manufactured prior to 1970 typically exhibit low toughness compared to pipes produced using modern welding technology. As a result, manufacturing flaws in or adjacent to the longitudinal electric resistance welded (ERW) or electric flash welded (EFW) seams of the 1950 line pipe material contained in the Existing Pipeline are considered to be the primary concern. The concern is that a flaw that initially may be too small to fail at the operating pressure could grow through fatigue cracking and become large enough to cause a failure if exposed to sufficient numbers of large pressure fluctuations. Accordingly, Section 3 of the ORAPM requires monitoring of pressure cycles during the operation of the pipeline, calculating the worst-case crack growth in response to such cycles, and reassessing the integrity of the pipeline at appropriate intervals to find and eliminate potentially growing cracks before they reach a critical size.

The failure pressure of each potential flaw is controlled not only by its size but by the pipe's diameter and wall thickness, the strength of the pipe, and the toughness of the pipe. Toughness is the ability of the material containing a given-size crack to resist tearing at a particular value of applied tensile stress. Toughness in line pipe materials has been found to correspond reasonably well to the value of "upper-shelf" energy as determined utilizing standard Charpy V-notch impact tests. As noted in Reference [1], the full-size Charpy V-notch energy levels for samples of the 1950 material ranged from 15 to 26 ft-lb. Prior to completing the TFI tool run, the ORAPM specified a process that used the previous hydrostatic test pressure levels to determine a starting flaw size. When using hydrostatic test pressure, toughness is a factor for establishing starting flaw sizes. It is more conservative to use a higher toughness value as it allows for a larger flaw to remain after the hydrostatic test. However, no starting flaw sizes determined by hydrostatic test pressure were used in this analysis.

Toughness is not a factor in establishing either starting defect size using the ILI detection threshold, the N10 notch (the basis for an initial flaw size from API 5L), or crack detection (CD) tool indicated sizes. Toughness is needed to calculate the size of the flaw that will cause failure at the operating pressure. In these cases, a lower toughness value generally leads to more conservatively calculated fatigue lives. All starting flaw sizes for this analysis were based on the inspection tool threshold for detection (Existing Pipeline), API Specification 5L N10 notch size (New Pipeline), or crack detection tool reported indication sizes (inspected segments).

The fatigue assessment methodology involved:

- Operating pressure data processing using rainflow cycle counting.
- Segmenting the pipeline to account for pipe properties and attribute changes, including outside diameter, grade, wall thickness, and elevation changes.
- Establish initial crack sizes from the detection threshold from the ILI vendor performance specification, ILI-indicated dimensions, or API inspection parameters.

- Determine final sizes of flaws at failure or critical size (predicted burst pressure equal to the MOP of the pipeline segments adjusted for elevation at the location of the segment analyzed).
- Fatigue crack growth assessment using fracture mechanics principles.
- Estimate the length of time for both ILI-indicated and hypothetical threshold anomalies to grow to critical size.

2.1.1 Pressure Cycle Processing

Magellan supplied one year of operational pressure data for the crude oil pipeline system from Crane Station through Satsuma Station, receipt point at East Houston Terminal, discharge point at the East Houston Station, and receipt point at Speed Jct. Pressure data in the same format was supplied for the refined products segments of the pipeline between Crane Station and El Paso Terminal. The pressure data used in the analysis were recorded at the discharge, suction, and receipt points of stations and facilities. The pressure readings were recorded from January 1, 2020, to December 31, 2020, at 1-minute intervals. The pressure data supplied was added to pressure data from the previous analyses to create an operational pressure history for each segment.

Rainflow counting was used to prepare the pressure data for analysis. The pressure spectrum based on pressure records for each pump station was rainflow cycle-counted to reduce the stochastic signal into cycles that can be used in the fatigue model. The basic concept of the rainflow counting method is to determine the peaks and valleys of the randomly-varying pressure data and to eliminate the intermediate pressures between the peaks and valleys (smaller peaks and valleys are also recognized by the process). The cycle-counting analysis produces count and sequence of cycles of various amplitudes, which are then used with crack-growth calculation schemes. Kiefner's rainflow cycle counting process complies with ASTM E-1049 guidelines for rainflow counting methods.[5]

Due to the density of liquid products, elevation changes impact the internal pressure loading of the pipe due to hydrostatic head losses and gains. Data for the intermediate locations between the pressure measurement locations were calculated based on elevation changes and the hydraulic pressure gradient.

The pressure cycle data recorded since the date of each ILI inspection were used in the fatigue evaluation of pipeline segments for which the starting crack size was based on the crack detection tool inspections. For the 2020 analysis, pressure cycles from January 1, 2020, through December 31, 2020, were used for the following segments: Barnhart to Cartman, Bastrop to Warda, Cartman to Kimble, Cedar Valley to Bastrop, Eckert to Cedar Valley, James River to Eckert, and Texon to Barnhart. Additionally, pressure cycles from October 19, 2018, through December 31, 2020, were used for the Crane to Texon segment, August 16, 2019, through December 31, 2020, for the Satsuma to East Houston segment, December 5, 2019, through December 31, 2020, for the Buckhorn to Satsuma segment, and November 7, 2019, through December 31, 2020, for the Warda to Buckhorn segment.

[5] ASTM, "Standard Practices for Cycle Counting in Fatigue Analysis", E 1049, Annual Book of Standards, 2002.

2.1.2 Initial Flaw Size

The Eastern section of the Longhorn pipeline system that carries crude oil from Crane Station to Satsuma Station was internally inspected by General Electric (GE) in 2015 using a TFI tool. The TFI tool detects and sizes narrow axial indications such as linear indications in the longitudinal seam of ERW and FW pipe. The segment from Satsuma to Speed Junction was inspected by TDW in 2014 using their SMFL technology to detect and size longitudinal seam flaws. The line segment between Crane and Texon was inspected using a UCD tool in late 2018; inspection results were provided in 2019. The segments between Satsuma and East Houston, Warda to Buckhorn, and Buckhorn to Satsuma were inspected using a UCD tool in 2019. Additionally, the segments between Barnhart to Cartman, Bastrop to Warda, Cartman to Kimble, Cedar Valley to Bastrop, Eckert to Cedar Valley, James River to Eckert, and Texon to Barnhart were inspected by UCD tools in 2020. The line segment between Kimble and James River was inspected using a UCD tool in 2020 with the final report received in 2021. Results for the Kimble to James River section will be presented in the 2021 ORA Report. Tool tolerance was added to all of the defects detected by the UCD tool. This tolerance was taken from the manufacturer's specification; 0.30-inches for defect length and 0.036-inches for defect depth.

For the segments where the TFI or SMFL inspections were used, the fatigue assessment was conducted for sixteen points along the pipeline's crude oil segments from Kimble to James River and East Houston to Speed Junction. The fatigue assessment was conducted for seven points for the refined product portion of the pipeline from Crane to El Paso. Each of these points corresponds to a pipe property change, including OD, grade, wall thickness, elevation, proximity to pump station discharge, and installation date. For the segments where the UCD inspections were used, the actual pipe properties at each defect location were used.

For Existing Pipeline segments (1947 to 1953 pipe material), the initial flaw sizes were determined by the threshold detection limit of TFI or SMFL inspections. Pursuant to the procedure in Section 3.4 of the ORAPM, the detection threshold capabilities of the TFI tool were used to calculate an appropriate reassessment for anomalies that have not been detected by the TFI tool. The TFI tool can detect seam weld features with a depth of 50% WT for features between one and two inches in length and a minimum depth of 25% WT for features greater than two inches in length. The analysis assumes that a 50% through wall, 2-inch long crack-like feature could have been missed based on these detection capabilities. A 50% through wall flaw has a shorter life than a 25% through wall flaw. In the Existing Pipe, it was assumed the flaw could have been missed in a location that will provide the most conservative reassessment interval. The pipe located closest to the discharge of a pump or right at a wall thickness or pipe grade transition was chosen to capture the strongest effects of the pressure cycles.

Although the likelihood of such flaws being present in the newer pipe material (1998, 2010, 2012, and 2013) is much less than that associated with the 1950 pipe material, pressure-cycle monitoring, and crack-growth analyses were considered for the New Pipeline. A slightly different procedure is applied to the calculation of time to failure for the new pipe installed from 1995 through 2013, including the entire western refined products section of the line from Crane to El Paso and the segments of the crude line from Kimble County to James River and from East Houston to Speed Junction. Instead of using the sizes of flaws detected by the TFI tool, the starting flaw size was based on the largest flaw that could have escaped detection by the manufacturer's ultrasonic seam inspection. That would be the size of the "calibration" flaw used to test the ultrasonic seam inspection detection threshold. The calibration flaw size comes from API Specification 5L and is assumed by Kiefner to be the largest of the acceptable calibration flaws in that standard, namely, the N10 notch. The N10 notch has an axial length of two inches and a depth of 10% of the nominal wall thickness of the pipe and is used as the starting flaw size in the analysis of locations containing the newer pipe.

Locations near a pump discharge typically experience more aggressive pressure cycles than locations away from the pump discharge. For the current analysis, where pipe with similar attributes (grade, wall thickness, and other attributes) was present in a given Discharge-Suction/receipt segment, the pipe closest to the upstream pump station was used in the analysis. It is not necessary to calculate a fatigue life at all the points where the susceptible pipe exists because pipe further downstream will have a longer fatigue life based on the hydraulic gradient and need not be evaluated as long as its difference in elevation, relative to upstream locations, is not significant.

The recent crack detection ILI conducted on the Crane to Texon, Texon to Barnhart, Barnhart to Cartman, Cartman to Kimble, James River to Eckert, Eckert to Cedar Valley, Cedar Valley to Bastrop, Bastrop to Warda, Warda to Buckhorn, Buckhorn to Satsuma, and Satsuma to East Houston segments allowed the calculation of fatigue life based on the inspection results. The inspection of the Crane to Texon segment resulted in 397 indications that remained in the line after repairs, 130 indications on Texon to Barnhart, 40 indications on Barnhart to Cartman, 180 indications on Cartman to Kimble, 113 indications on James River to Eckert, 355 indications on Eckert to Cedar Valley, 149 indications on Cedar Valley to Bastrop, 144 indications on Bastrop to Warda, 112 indications on Warda to Buckhorn, 139 indications on Buckhorn to Satsuma, and 335 indications identified on the Satsuma to East Houston segment. The starting point for fatigue analysis on these pipeline segments was the size of the anomalies reported.

A complete summary of the pipe segments evaluated in this study is presented in Appendix C – Threshold Anomaly Fatigue Evaluation Results and Appendix D – Crack Detection ILI Anomaly Fatigue Evaluation Results. The case locations were chosen with reference to the operating direction and pump locations as of 2020. The analysis was performed using pressure data collected from the most recent ILI inspections to December 2020.

2.1.3 Fatigue Crack Growth Assessment

The pressure-cycle analysis for the Longhorn Pipeline was conducted using the well-known and widely accepted "Paris Law" model. The crack-growth calculations were performed using Kiefner's Pipelife software.[6] Pipelife uses the Paris Law[7] equation, $da/dN=C(\Delta K)^n$, to estimate the incremental crack growth for a given feature in response to the pressure cycles counted from the rainflow method (da/dN is the increment of crack growth per load cycle, ΔK is the range of cyclic stress-intensity at the crack-tip, and C and n are material crack-growth parameters). The

[6] Kiefner, J. F., Kolovich, C. E., Wahjudi, T. F., and Zelenak, P. A., *"Estimating Fatigue Life For Pipeline Integrity Management"*, Paper Number IPC04-0167, Proceedings of IPC 2004, International Pipeline Conference, Calgary, Alberta, Canada (October 4 - 8, 2004).

[7] Paris, P. C. and Erdogan, F., *"A Critical Analysis of Crack Propagation Laws"*, Transactions of the ASME, Journal of Basic Engineering, Series D, Vol. 85, No. 5, pp 405-09.

cyclic stress intensity factor was determined using the Newman-Raju equation.[8] These equations are available in the Mock ORA (Reference [2]). The pressure cycles were applied, and crack growth was calculated until failure was predicted at the MOP at the feature location. The cumulative number of pressure cycles at failure was then converted to a time to failure in years based on the interval of the pressure data collected. The fatigue life is the time, in years, for the defect to grow from the initial crack size to the final critical size. The recommended reassessment interval is calculated by taking 45% of the shortest fatigue life, which corresponds to a safety factor of 2.22 (1/0.45) as specified in the ORAPM.

The material-parameter constants used in the Paris equation affect the amount of crack growth that is calculated in response to a given pressure cycle. The constants are commonly referred to as the "crack-growth rate" parameters. These parameters are constants that depend on the nature of the material and the environment in which the crack exists. In the absence of empirical data for the particular crack-growth environment of the Longhorn Pipeline, values for the constants have been established through large numbers of laboratory tests published in the Fitness-For-Service API Standard 579-1/ASME FFS-1[9] were used.

Magellan can use the time to failure and reassessment intervals estimated by Kiefner to reassess the pipeline's integrity as required and in accordance with the LMP.

2.1.4 Fatigue Assessment Results

Table 3 shows the flaws with a predicted reassessment interval of less than ten years. The pressure cycle data since the most recent ILI tool run for each segment were used in the fatigue evaluation. A safety factor of 2.22 was applied to the calculated time to failure for each of the postulated flaws to determine a reassessment interval.

The analysis showed that the shortest time to failure for a possible feature that the 2015 TFI tool run could have missed is 27.5 years (from August 11, 2015) on the Kimble to James River segment. The shortest time to failure occurred on an 18-inch, 0.219 WT, Grade X52 pipe installed in 1967 and located at Station Number 14758+39. A safety factor of 2.22 was applied, a reassessment interval of 12.4 years is recommended based on the current operating pressures. This reassessment interval is relative to the latest inspection date of August 11, 2015. Calculated reassessment intervals for all of the threshold indications that could have been missed by the 2015 TFI tool run are Appendix C – Threshold Anomaly Fatigue Evaluation Results, along with the results for API N10 size features.

The shortest time to failure predicted for the newer installed pipe was 500 years with a reassessment interval of 225.2 years. The hypothetical API N10 size flaw was evaluated at all seven analysis points on the Crane to Cottonwood and Cottonwood to El Paso pipeline segments. These results suggest that the newer pipe is unlikely to be susceptible to pressure-cycle induced fatigue crack growth if future operation is similar to or less aggressive than historical operation.

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[8] Newman, J.C. and Raju, I.S., "An Empirical Stress-Intensity Factor Equation for the Surface Crack", Engineering Fracture Mechanics, Vol 15, No 1-2, pp. 185-192, 1981.
[9] API RP 579-1/ASME FFS-1, Fitness-For-Service, Third Edition, 6/1/2016

The shortest calculated time to failure for indications reported from the recent UCD ILI is 12.7 years, resulting in a reassessment interval of 5.7 years from the inspection date. The indication that this reassessment interval is based on was reported by the ILI tool to be 0.115 inches deep and 2.89 inches long (with tool tolerance added to both length and depth) on 18 inch OD, 0.246-inch WT, Grade X52 pipe at Station Number 23866+47 in the Crane to Texon segment. Calculated reassessment intervals for all of the indications reported by the UCD ILI are included in Appendix D – Crack Detection ILI Anomaly Fatigue Evaluation Results.

The results for the crude pipeline segment remained relatively consistent with the 2019 assessment performed by Kiefner, suggesting that pressure cycling for this pipeline has not changed significantly since the 2019 Kiefner assessment. Table 4 compares the current 2020 fatigue assessment results with those from the previous assessments.

Table 3. Reassessment Interval of Less than 10 Years

Pipeline Segment	OD (inch)	WT (inch)	Yield Stress (psi)	Defect Location (feet)	Elevation (feet)	Calc. Time to Failure (years)	Re-assessment Interval (years)	Re-assessment Due Date	ILI Date
Crane-Texon	18	0.246	52,000	23866+47	2,585	12.7	5.7	06/29/2024*	10/19/2018
Crane-Texon	18	0.256	52,000	24060+59	2,525	12.9	5.8	08/11/2024*	10/19/2018
Crane-Texon	18	0.246	52,000	24015+71	2,539	17.4	7.8	08/23/2026	10/19/2018
Crane-Texon	18	0.285	65,000	24080+38	2,540	17.4	7.8	08/23/2026	10/19/2018
Crane-Texon	18	0.246	52,000	23603+80	2,678	20.1	9.1	11/13/2027	10/19/2018
Crane-Texon	18	0.256	52,000	24040+22	2,531	21.7	9.8	07/28/2028	10/19/2018

*Magellan plans to address feature in 2021.

Table 4. Comparison of Reassessment Dates from Past ORAs

Segment	2015 Report	2016 Report	2017 Report	2018 Report	2019 Report	2020 Report
East Houston to 9th Street Jct	5/15/2214	8/23/2202	7/11/2174	3/15/2195	3/23/2170	08/04/2173
Satsuma to East Houston	9/14/2027	11/14/2032	4/1/2035	9/7/2034	4/3/2084*	03/03/2045*
Buckhorn to Satsuma	6/15/2028	1/31/2039	3/1/2034	10/17/2034	5/5/2034	11/27/2046*
Warda to Buckhorn	12/27/2020	10/23/2027	11/23/2027	9/19/2030	3/6/2030	03/22/2039*
Bastrop to Warda	6/16/2020	4/7/2025	4/5/2024	10/6/2024	8/9/2024	08/10/2035*
Cedar Valley to Bastrop	3/6/2039	8/13/2046	2/9/2040	3/8/2044	8/8/2043	06/11/2053*
Eckert to Cedar Valley	8/1/2023	9/30/2033	8/9/2034	10/7/2032	9/12/2031	04/04/2042*
James River to Eckert	7/9/2027	11/5/2023	6/27/2025	3/28/2025	4/30/2025	02/20/2043*
Kimble to James River	9/25/2034	9/11/2027	8/28/2030	9/6/2027	10/28/2027	01/16/2028
Cartman to Kimble	11/23/2024	3/29/2022	10/20/2023	5/20/2024	7/4/2024	11/13/2040*
Barnhart to Cartman	12/16/2053	1/17/2040	4/22/2045	12/1/2036	10/22/2037	01/31/2039*
Texon to Barnhart	9/9/2024	7/23/2021	12/11/2022	12/25/2022	12/28/2022	06/24/2037*
Crane to Texon	4/24/2023	4/13/2022	10/14/2027	1/28/2023	8/7/2025*	06/29/2024*
Crane to El Paso	11/29/2238	11/29/2238	3/22/2109	1/4/2498	1/4/2498	03/25/2233

*Based on as-called ILI indication sizes with tool tolerance added.

2.2 In-Line Inspection and Rehabilitation Program

Magellan is committed to performing ILI assessments on the Longhorn pipeline system. Nine pipeline segments were assessed using MFL technology in 2020, and one additional segment (Warda to Buckhorn) was assessed in 2019, with the final report received in 2020. These segments were also assessed using UCD and EGP tool technologies. Refer to Table 2 for a list of assessments performed in 2020 by pipeline segment. Magellan performed 249 ILI anomaly investigations in 2020. Kiefner's review of the in-line inspection and rehabilitation program included the following: performing a run-to-run comparison corrosion growth assessment, reviewing reported crack-like features, performing a girth weld anomaly assessment, reviewing maintenance reports and in-ditch evaluations, reviewing reported ID reductions, and comparing ID reductions to laminations for hydrogen blisters.

2.2.1 Run-to-Run Comparison Corrosion Growth Assessment

Kiefner reviewed the current ILI assessments with an understanding of the background and approach for API 1163 ILI verification. API 1163 Second Edition, April 2013, describes methods in Section 7 and 8 that can be applied to verify that the ILI tool was performing as expected and reported inspection results are within the performance specification for the pipeline being inspected. For further background and approach on API 1163 Section Edition, April 2013 refers to Appendix E – Approach to API 1163 Verification.

Process verification and quality control were reviewed for each assessment listed in Table 2. The general results for all of the reviewed 2020 MFL and UCD assessments were that the functionality of the inspection tools was determined to be within normal standard operating conditions, and the locating of reference points by the ILI tool was determined to be consistent over the entirety of the ILI assessments. Items to note:

- Buckhorn to Satsuma:
  - MFL assessment – primary sensors 73-75 were under responding for the entire assessment affecting the overall percentage of pipe recorded by 1.47%. Baker Hughes noted revised detection specifications and revised sizing in the affected area.
- Warda to Buckhorn:
  - Baker Hughes noted areas of moderate debris in the pipeline listing. These areas of moderate debris have a degraded detection and sizing specification.
- Bastrop to Warda:
  - GPS Survey – One area had a distance gap greater than 1.86 miles; locational specifications in this area are reduced.
- Eckert to Cedar Valley:
  - GPS Survey – Supplied survey does not comply with work instructions and could affect survey accuracy. Six areas had a distance gap greater than 1.86 miles; locational specifications in these areas are reduced.
- James River to Eckert:
  - MFL assessment – primary sensors 73-75 were faulty between 92,471 ft and 169,8282 ft, affecting the overall percentage of pipe recorded by 0.67%. Baker Hughes notes no metal loss detected in the affected area but noted revised detection specifications and revised sizing.

- EGP assessment – Sensors 22-23 were under responding for the entire assessment affecting the overall percentage of pipe recorded by 4.44%. Baker Hughes notes a revised detection specification and sizing accuracy.
    - GPS Survey – Supplied survey does not comply with work instructions and could affect survey accuracy. Three areas had a distance gap greater than 1.86 miles; locational specifications in these areas are reduced.
- Kimble to James River:
    - EGP assessment – Sensors 39-40 were under responding from 4,437.0 ft to 184,363.7 ft affecting the overall percentage of pipe recorded by 2.87%. Baker Hughes notes a revised detection specification and sizing accuracy.
- UCD Assessments:
    - All assessments noted:
        - Minor wear to the tool and no visible damage.
        - Debris in front of the tool but sensor carriers free from debris; no debris noted on the Texon to Barnhart segment.
    - James River to Eckert noted debris found in front and on top of the tool but sensor carriers free from debris.

The threat of corrosion can be monitored using ILI assessments, which pipeline operators commonly use as a means for identifying and evaluating corrosion-caused metal loss and planning remediation. This typically involves running an ILI tool to identify and size corrosion features, followed by remediation of features that exceed a depth or a pressure threshold. This method is a valid approach for addressing line pipe corrosion. ILI assessments completed in 2020 are listed in Table 2. An overall ILI reassessment schedule can be found in Section 4, Table 34 for the crude system, and Table 35 for the refined system. The next crude system assessment for corrosion is in 2023 for the Texon to Crane segment. The next refined system assessment for corrosion is due in 2021 for the 8-inch Crane to Odessa segment.

A run-to-run comparison was performed to determine external and internal corrosion growth rates (CGRs) for the ILI assessments performed or received in 2020. The ten segments between Satsuma and Texon were reviewed. Each segment has had a previous MFL and previous UT assessments performed. The run-to-run comparison utilized the ILI assessments received in 2020 and the 2009/2010 UT assessments. The UT tool is known for being a good wall measurement tool. The two segments between Satsuma to Warda had UT assessments performed in 2009, while the eight segments between Warda to Texon had UT assessments performed in 2010. Table 5 shows the overall matched results from the run-to-run comparison. Five of the pipeline segments had pipe replacements with reported metal loss features (10-24% WT) between the current and previous assessments, Texon to Barnhart, Cartman to Kimble, Eckert to Cedar Valley, Cedar Valley to Bastrop, and Buckhorn to Satsuma. Kiefner calculated CGR's for the pipeline segments assessed in 2020 (Table 6). There were not enough data pairs to support CGR calculations for internal ML features and internal ML mill anomalies. Data correlation and calculations were done using Kiefner's CorroSure software.

Table 5. Overall Results of the Run-to-Run Comparisons

Segment	Matched Features		Total Matched Features	Maximum Available Matches	% Matched Features
	Corrosion	Manufacturing			
Buckhorn to Satsuma	48	8	56	125	44.8
Warda to Buckhorn	333	7	340	621	54.8
Bastrop to Warda	189	1	190	361	52.6
Cedar Valley to Bastrop	717	3	720	1217	59.2
Eckert to Cedar Valley	462	5	467	1014	46.1
James River to Eckert	175	4	179	476	37.6
Kimble to James River	75	1	76	116	65.5
Cartman to Kimble	203	0	203	385	52.7
Barnhart to Cartman	260	5	265	415	63.9
Texon to Barnhart	431	13	444	659	67.4

Table 6. Corrosion Growth Rate Results for 2020 ILI Assessments

Segment	EXT ML Upper Bound CGR (mpy)
Buckhorn to Satsuma	7.0
Warda to Buckhorn	5.0
Bastrop to Warda	5.2
Cedar Valley to Bastrop	5.6
Eckert to Cedar Valley	5.8
James River to Eckert	6.7
Kimble to James River	5.5
Cartman to Kimble	6.0
Barnhart to Cartman	5.8
Texon to Barnhart	7.4

External corrosion growth along a pipeline should be expected to have the potential for variability along the length of the pipeline due to differences in cathodic protection, coating conditions, pipe age, and environment. A histogram of ML frequency (occurrences or count) along the linear distance of the pipeline can indicate where external ML features are more likely. Figure 5 through Figure 14 provide external ML frequency histograms for the ten segments assessed in 2019/2020. A general trend for Figure 5 through Figure 14 is that the current ILI assessments (2019/2020) are showing an increase in external metal loss features over the previous assessments (2009/2010). One reason for the possible increase in metal loss feature count could be due to a comparison between different tool technologies; the 2009/2010 assessments were performed using UT tools, while the 2019/2020 assessments were performed using MFL tools. Another reason for the possible increase in metal loss feature count could be due to increased sensitivity in the current MFL tools.

Twelve areas over six segments show increases in metal loss features reported (>100 feature difference) between the current and previous assessments. The six segments are Texon to Barnhart (MP 378.5 to 379.25 and MP 398.5 to 399.25), Barnhart to Cartman (MP 371.25 to 373.0), Eckert to Cedar Valley (MP 213.5 to 214.0 and MP 227.25 to 228.25), Cedar Valley to Bastrop (MP 150.75 to 151.25 and MP 154.0 to 159.0), Bastrop to Warda (MP 114.0 to 115.0, MP 123.75 to 125.5, MP 128.25 to 129.0, and MP 132.75 to 133.25), and Warda to Buckhorn (MP 84.0 to 85.0).

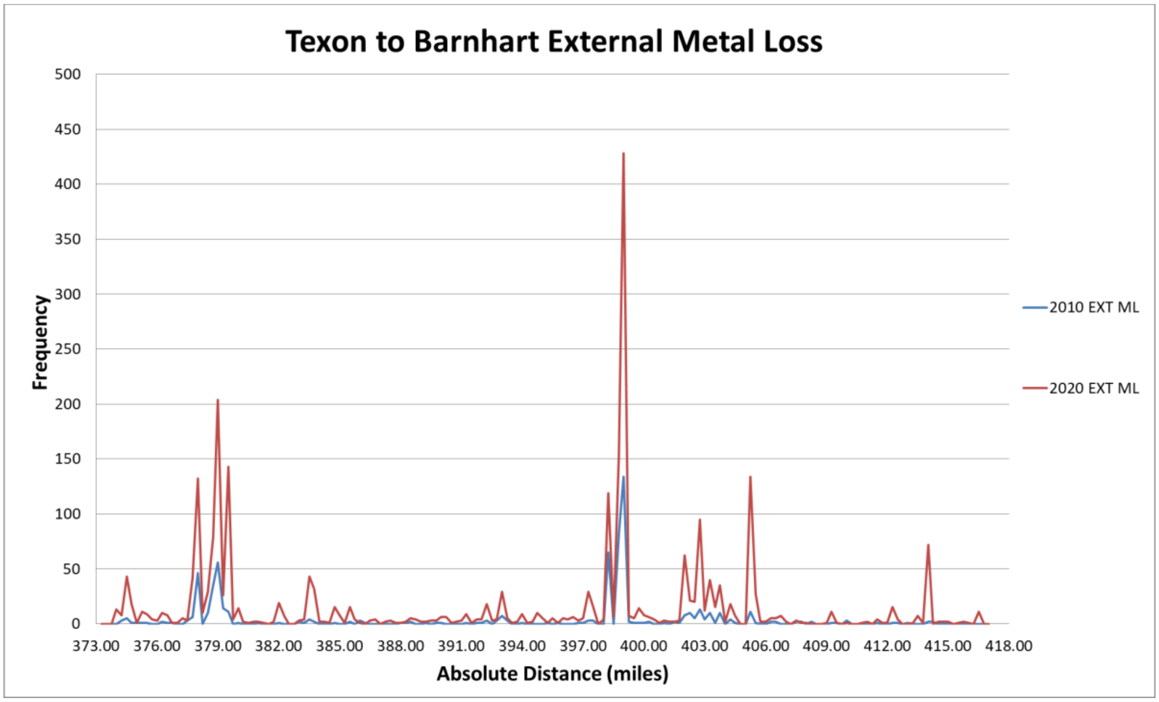

Figure 5. Texon to Barnhart External ML Frequency by Linear Distance along the Pipeline (2010 UT vs. 2020 MFL)

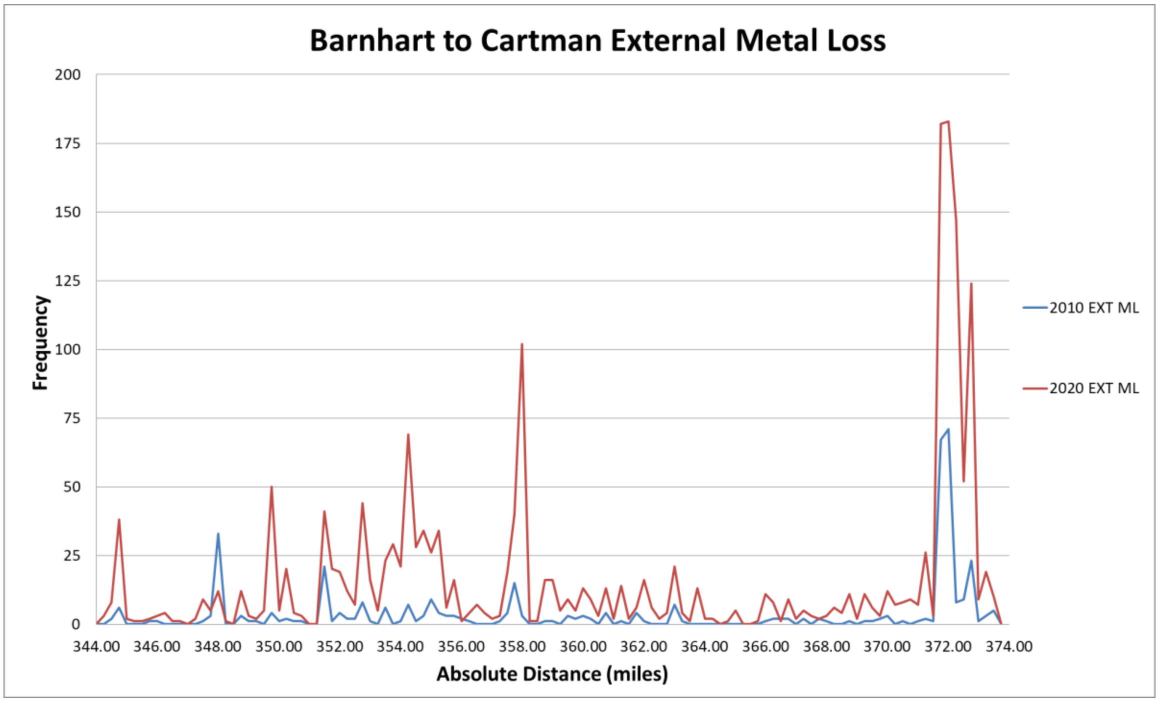

Figure 6. Barnhart to Cartman External ML Frequency by Linear Distance along the Pipeline (2010 UT vs. 2020 MFL)

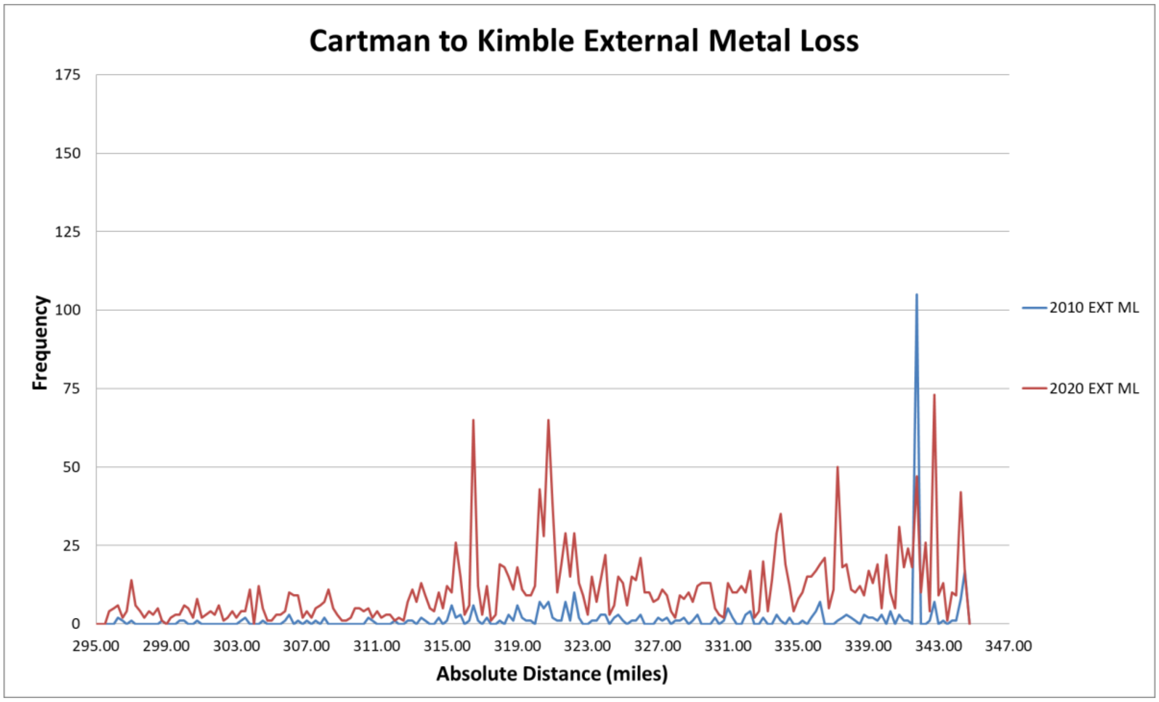

Figure 7. Cartman to Kimble External ML Frequency by Linear Distance along the Pipeline (2010 UT vs. 2020 MFL)

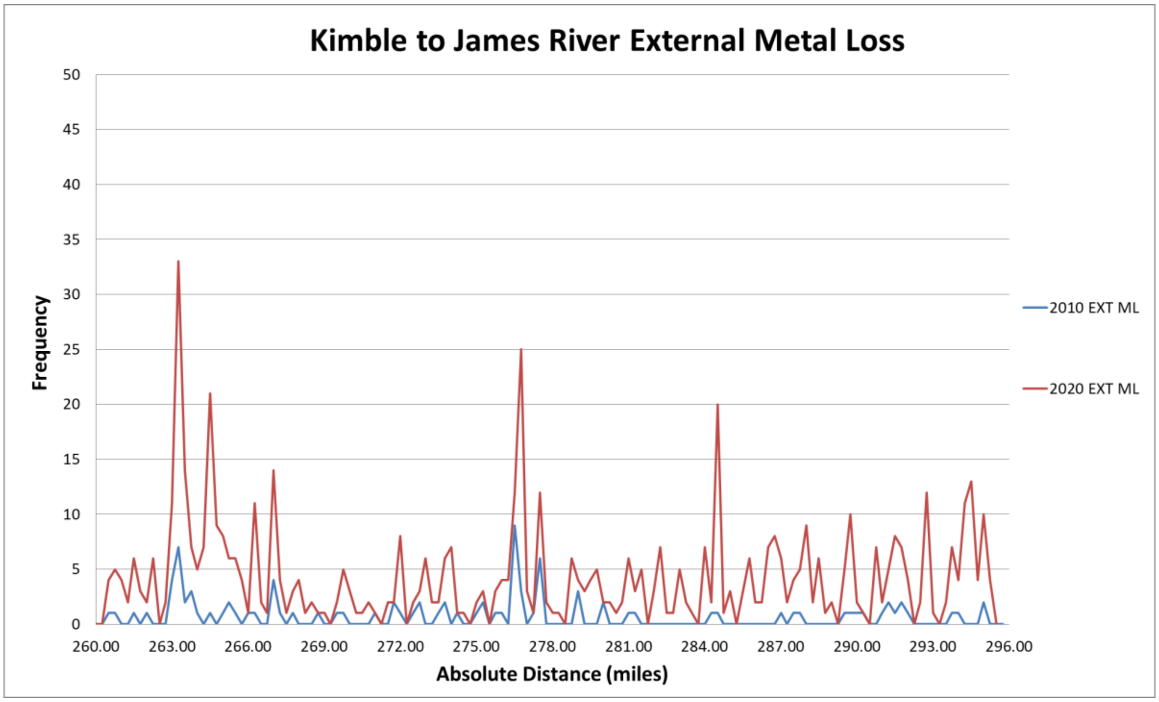

Figure 8. Kimble to James River External ML Frequency by Linear Distance along the Pipeline (2010 UT vs. 2020 MFL)

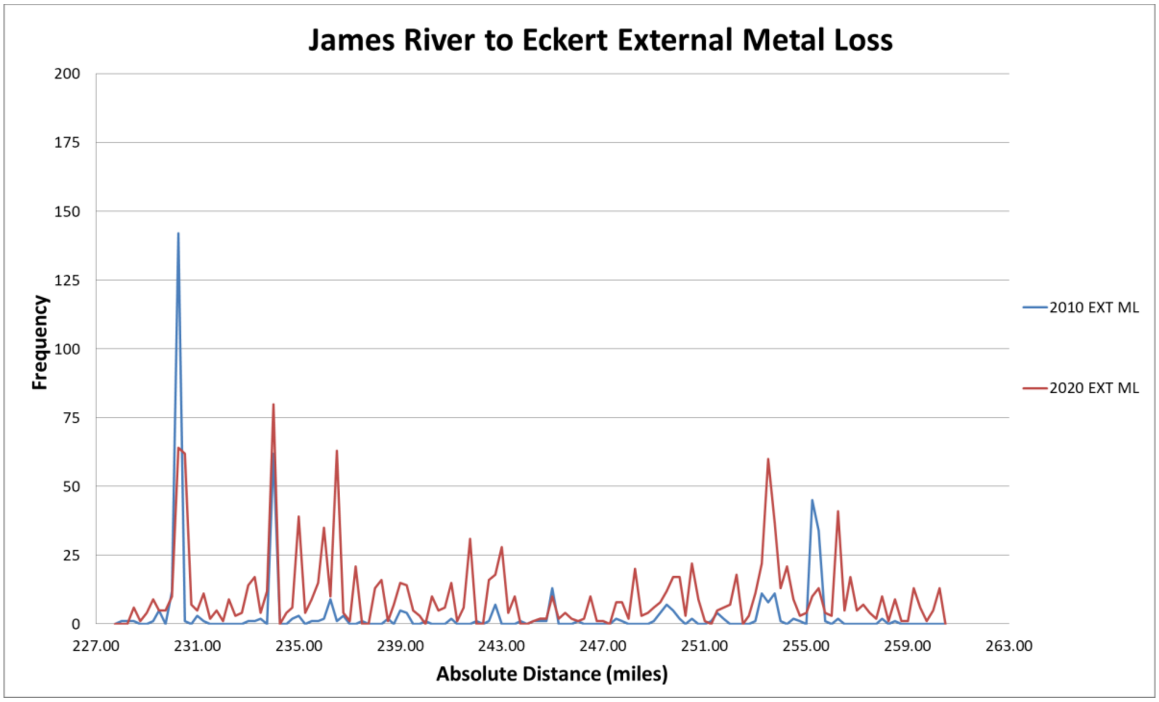

Figure 9. James River to Eckert External ML Frequency by Linear Distance along the Pipeline (2010 UT vs. 2020 MFL)

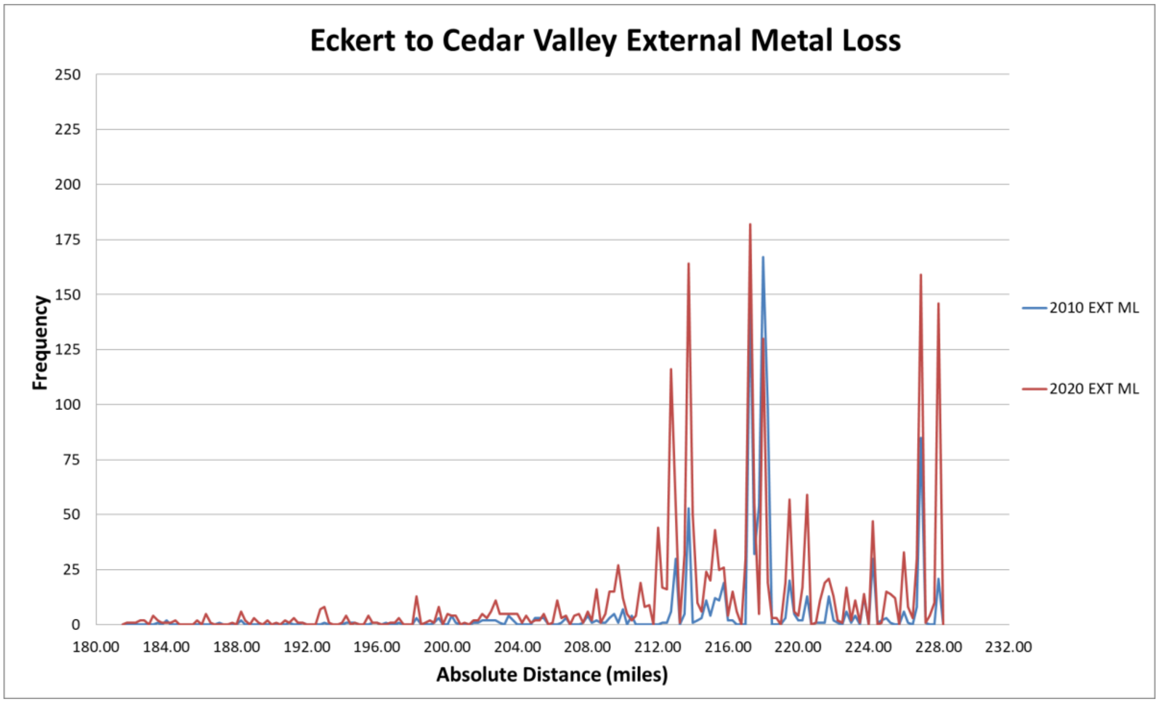

Figure 10. Eckert to Cedar Valley External ML Frequency by Linear Distance along the Pipeline (2010 UT vs. 2020 MFL)

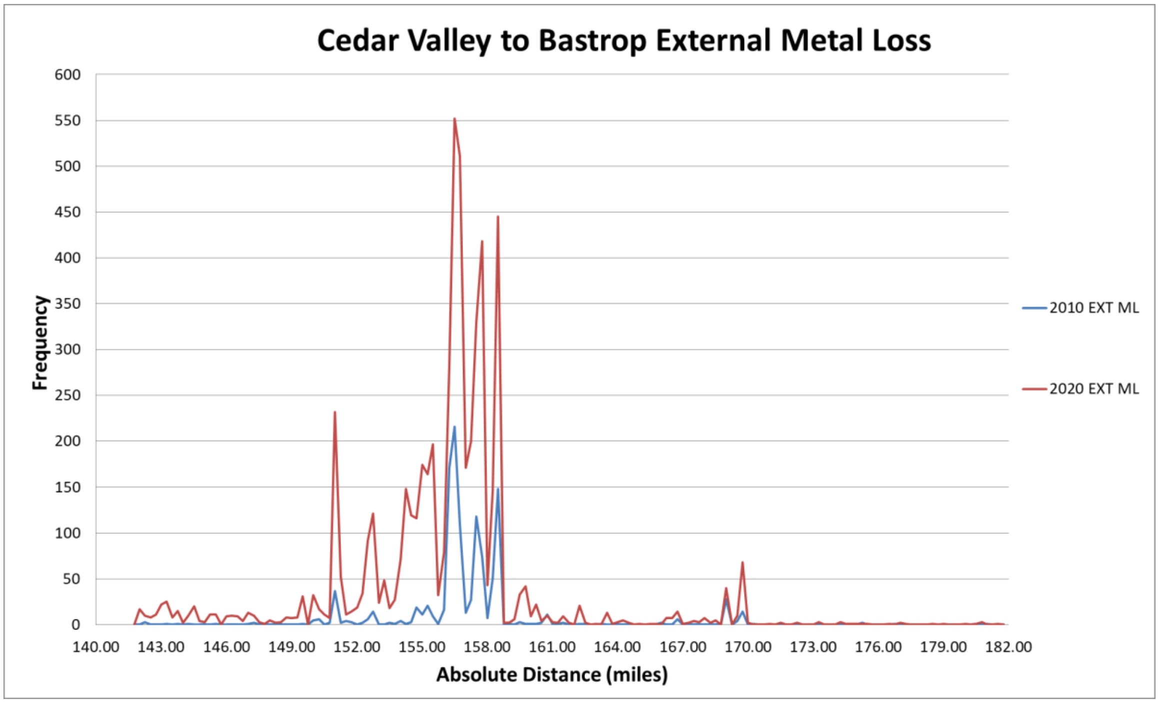

Figure 11. Cedar Valley to Bastrop External ML Frequency by Linear Distance along the Pipeline (2010 UT vs. 2020 MFL)

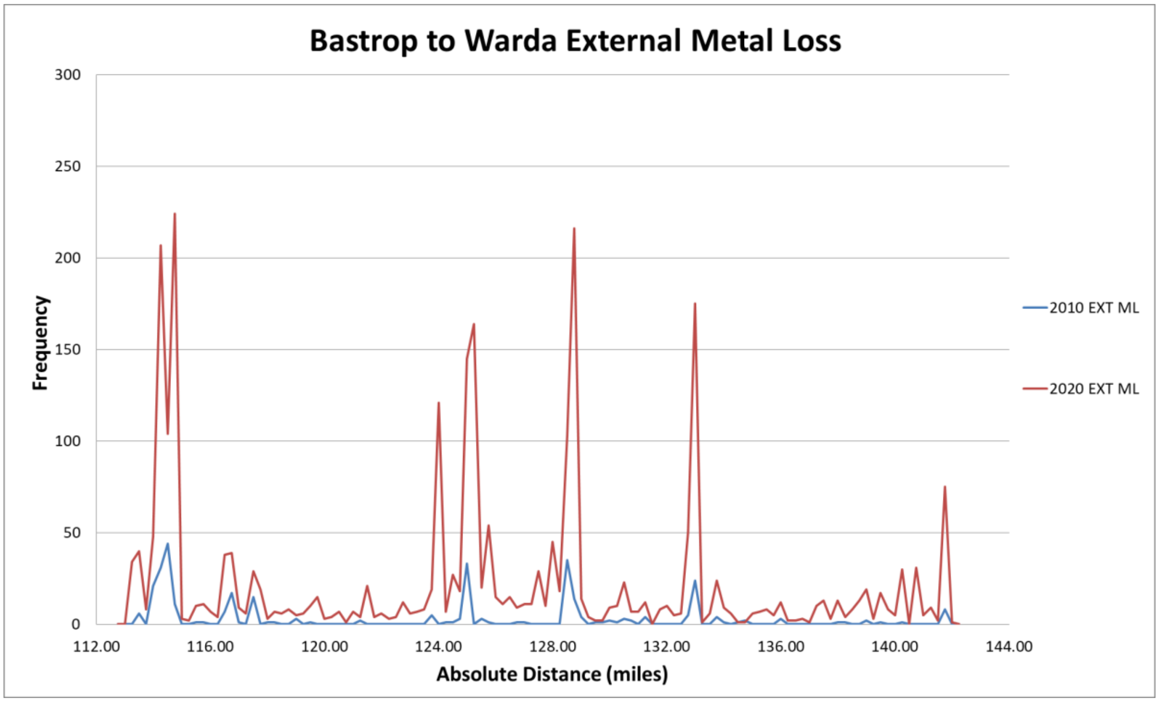

Figure 12. Bastrop to Warda External ML Frequency by Linear Distance along the Pipeline (2010 UT vs. 2020 MFL)

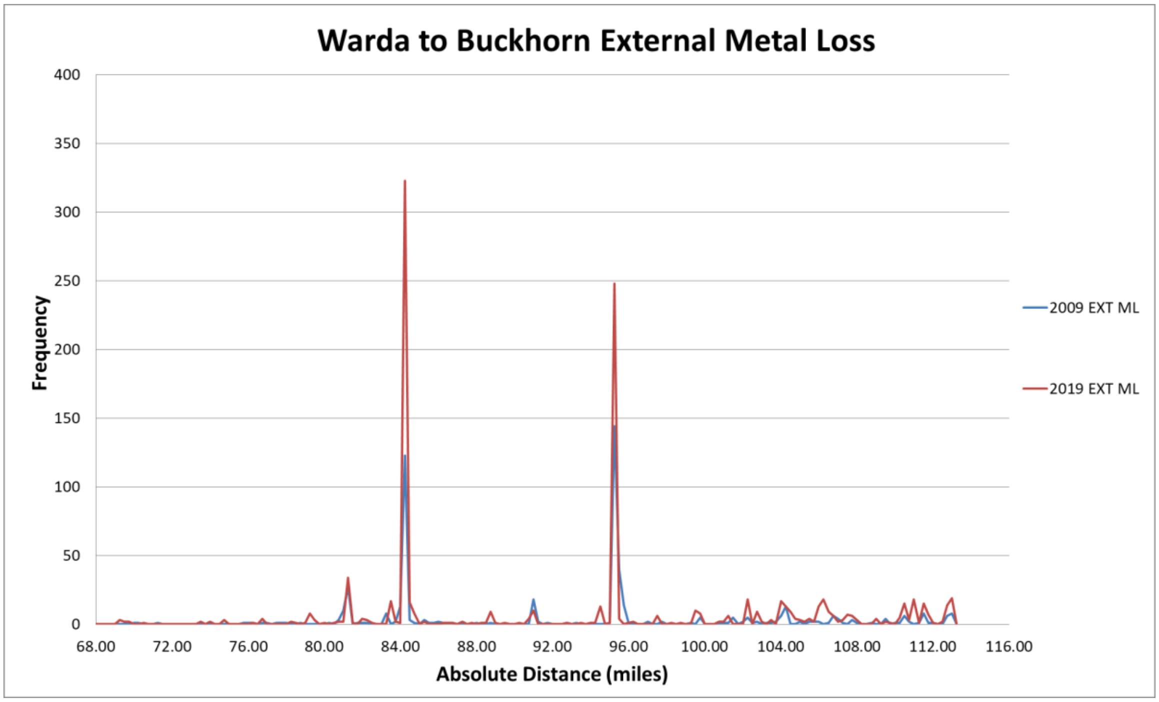

Figure 13. Warda to Buckhorn External ML Frequency by Linear Distance along the Pipeline (2010 UT vs. 2020 MFL)

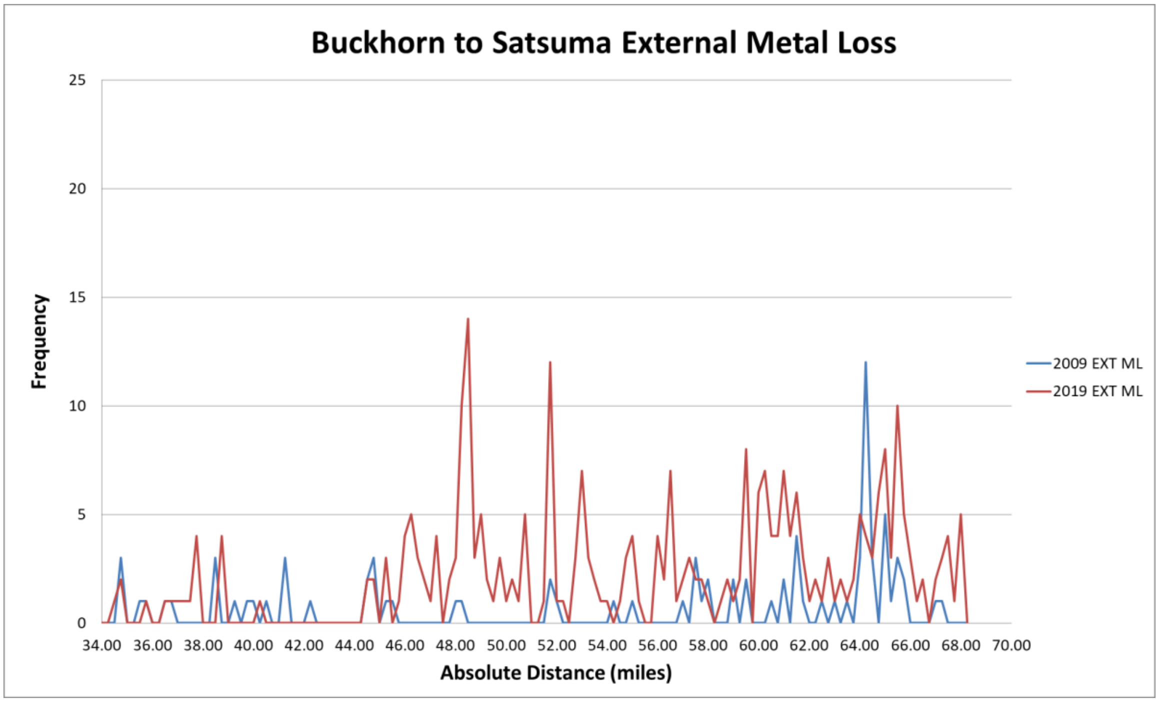

Figure 14. Buckhorn to Satsuma External ML Frequency by Linear Distance along the Pipeline (2010 UT vs. 2020 MFL)

2.2.2 Crack-Like Features

Crack features identified from the 2019/2020 UCD assessments were correlated with crack features reported from TFI assessments performed in 2015. Table 7 provides a breakdown of reported crack features as called by the current UCD assessments and the previous TFI assessments. Eighty-two cracks reported from the UCD assessments were found to either correlate or be present on the same joints with seam features reported from the 2014/2015 TFI assessments; Table 8 provides a breakdown of the correlations. Ten of the matched crack features are noted as being located under a sleeve, five on Eckert to Cedar Valley, two each on Cedar Valley to Bastrop and Bastrop to Warda, and one on Warda to Buckhorn. The matched and unmatched feature quantities provided in Table 8 are based on the 2019/2020 UCD assessments.

Table 7. UCD Reported Feature Comparison

Segment	Reported Features								
	2019/2020 UCD					2014 / 2015 TFI			
	Crack-Like			Crack-Like Seam Weld Inspection Sheet	Crack Colony Pipe Body	SW Anomaly	SW Feature B	External Narrow Axial ML Feature	EXT/INT SWML
	Seam Weld	Girth Weld	Seam & Girth Weld						
Buckhorn to Satsuma	138	-	-	10	-	88	-	8	-
Warda to Buckhorn	116	-	4	11	1	47	6	-	1
Bastrop to Warda	212	-	3	15	-	73	1	9	1
Cedar Valley to Bastrop	216	-	9	9	5	267	4	3	53
Eckert to Cedar Valley	350	1	28	10	2	95	5	13	1
James River to Eckert	135	-	7	9	6	63	-	2	-
Barnhart to Cartman	34	-	-	7	-	188	-	12	3
Texon to Barnhart	139	-	-	15	-	99	1	9	6

Table 8. UCD Crack Feature Correlations[10]

Segment	Quantity			List of Joints with Correlated Features*
	Joint(s)	Matched Crack Features	Unmatched Crack Features	
Buckhorn to Satsuma	5	2	3	5180, 5440, 25230, 27800, and 44610
Warda to Buckhorn	3	2	2	4750~, 7600, and 50880**
Bastrop to Warda	9	6	9	6860, 9470**, 18230, 20410~, 23810~, 23970~, 26430, 30650**, and 32210~
Cedar Valley to Bastrop	18	7	23	16080, 16730, 16890, 16990, 18160, 24940, 31130~, 31720, 33050, 33570, 37800~, 43760, 44060, 45040**, 46050~, 46350**, 47730~, and 50020~
Eckert to Cedar Valley	9	7	9	640, 12320, 20530~, 22070~, 24380, 30880~, 36850~, 42960~**, and 49070~ **
James River to Eckert	2	1	3	7890 and 31400~
Barnhart to Cartman	3	0	3	7540, 8280, and 11520
Texon to Barnhart	4	1	4	460, 7600, 8850, and 15850
Total	**53**	**26**	**56**	

The joint number highlighted in red has a matched crack feature located on the joint.
*The listed joint numbers are from the current UCD assessment.
**Matched feature is reported under a sleeve.
~Multiple crack-like features were reported on the joint from the 2020 UCD assessment.

[10] Features may not be directly correlating (i.e., overlapping area), but were identified in this table if reported on the same joint.

2.2.3 Girth Weld Anomaly Assessment

Kiefner performed an assessment and review of girth weld (GW) anomalies reported by the 2020 combined MFL and UCD assessments. The purpose of this assessment is to determine whether these anomalies are fit for continued safe service. GW anomaly assessments were completed by evaluating the potential for failure due to the circumferential extent of the features subjected to longitudinal stress. The GW anomalies were assumed to be subject to internal pressure loading and external bending loads. The GW anomalies were also assumed to be located at the point of maximum bending stress.

The GW's plastic collapse strength or longitudinal stress capacity with the anomalies was evaluated using Miller Solution. Research performed by the pipeline industry and the Pipeline Research Council International (PRCI) has shown that the Miller Solution, as modified by Wang et al., gives an appropriate expression for determining the load for blunt-tip flaws such as metal-loss corrosion[11,12,13,14]. This approach has been validated by many years of practical application, detailed numerical analysis, and by comparison to full-scale fracture tests.

Although other assessment techniques for axial loads on circumferential flaws have been developed and used, Kiefner's review of the various techniques indicated the Miller analysis to be suitable. In addition, Miller Solution, as modified by Wang et al., has been incorporated into the CSA Z662-2015 standard[15].

An allowable longitudinal stress limit of 80% SMYS as the criterion for critical displacement to account for fault movement due to seismic activity. Therefore, an applied stress level of 80% SMYS has been considered as the worst-case scenario based on the maximum allowable value for fitness for service. The use of 80% SMYS represents a safety factor (SF) of 1.25 relative to SMYS for a defect-free pipe. A feature (GW anomaly) with a safety factor of 1.25 or greater is considered safe and acceptable. The safety factor is defined as:

$$SF = \frac{\sigma_F}{\sigma_L}$$

SF	=	Safety factor
σ_F	=	Predicted failure stress of assumed anomaly using the Miller solution, psi
σ_L	=	Longitudinal stress from MOP and assumed bending stresses, psi

Table 9 summarizes the reported GW anomaly number, circumferential length, predicted failure stress, applied longitudinal stress, and safety factors along the crude pipeline. The safety factors

[11] Rosenfeld, M. J., "Serviceability of Corroded Girth Welds", PRCI Catalog Number L51742 (May 31, 1996).
[12] Wang, Y. Y., Swatzel, J. F., Horsley, D., and Glover, A., "Girth Weld Criteria from the Perspective of Code Revisions in North America", *Proceedings of IPC'02, 4th International Pipeline Conference*, Calgary, Alberta, Canada (September 29-October 3, 2002).
[13] Wang, Y.-Y., and Liu, M., *"A Comprehensive Update in the Evaluation of Pipeline Weld Defects"*, draft report to DOT/PRCI, US DOT Agreement No. DTRS56-03-T0008, PRCI Contract No. PR-276-04503, November 2004, Appendix D.
[14] Wang, Y.Y., Liu, M., Horsley, D., and Bauman, G., *"A Tiered Approach to Girth Weld Defect Acceptance Criteria for Stress-Based Design of Pipelines"*, IPC2006-10491, Proc. of 6th International Pipeline Conference, Sept. 25-29, 2006, Calgary, AB, Canada.
[15] Canadian Standards Association, CSA-Z662-2015, "Oil and Gas Pipeline Systems" (2015)

are greater than 1.25, indicating that the GW anomalies reported by 2020 ILI runs were considered safe and acceptable for continued service.

Table 9. GW Anomalies Summary of Crude Pipeline

Segment	Reported GW Anomaly Numbers	Circ. Length (inch)	Predicted Failure Stress (psi)	Applied Stress (psi)	Safety Factor
Crane-Texon	N/A	N/A	N/A	N/A	N/A
Texon-Barnhart	39	0.55-2.17	39,800-45,247	13,671	2.91-3.31
Barnhart-Cartman	8	0.51-1.26	42,126-45,458	13,671 & 14,528	3.03-3.33
Cartman-Kimble	12	1.58-4.53	37,232-41,132	14,138 & 15,047	2.51-2.91
Kimble-James River	28	1.38-4.13	37,623-57,489	14,528	2.59-3.96
James River-Eckert	2	1.02-1.10	45,680-46,125	15,172	3.01-3.04
Eckert-Cedar Valley	7	1.18-2.17	39,800-42,411	14,199	2.80-2.99
Cedar Valley-Bastrop	92	0.55-7.87	33,894-45,247	14,251-18,122	2.23-3.18
Bastrop-Warda	14	0.79-5.51	36,252-44,061	15,326	2.37-2.87
Warda-Buckhorn	N/A	N/A	N/A	N/A	N/A
Buckhorn-Satsuma	121	1.46-8.5	33,894-43,875	13,462	2.52-3.26
Satsuma-East Houston	N/A	N/A	N/A	N/A	N/A
Note: Crane-Texon, Warda-Buckhorn, and Satsuma-East Houston do not have 2020 ILI data					

2.2.4 Maintenance Reports and In-Ditch Evaluations

In 2020, Magellan performed 249 in-ditch ILI assessments corresponding to current ILI assessments (2018/2019/2020 MFL/UCD). Anomaly investigations also included nondestructive evaluation (NDE) reports with detailed investigation results. Table 10 provides a breakdown, per pipeline segment, of where the in-ditch assessments occurred (HCA, segment, and tier). The total number of ILI anomalies addressed per pipeline segment in 2020 is listed in Table 11; the total number includes the targeted ILI anomalies and any anomaly found in the area of repair for that associated dig.

Magellan requires PMI[16] tests to be completed at 50% of the ILI anomaly investigation locations that do not have material documentation. In 2020, Magellan performed 249 ILI anomaly investigations, and 232 locations met the PMI requirement. Magellan performed PMI testing at 116 of the 232 anomaly investigation locations (50%), satisfying PMI requirements. Table 12 gives an overview of PMI testing since the PMI testing requirement was added.

[16] 2012 Longhorn Pipeline Reversal EA (Reference [6]).

Table 10. ILI Features Remediated per Maintenance Reports Completed in 2020

	18" Cottonwood to El Paso	18" Crane to Cottonwood	18" Crane to Texon	18" Texon to Barnhart	18" Barnhart to Cartman	18" Cartman to Kimble	18" Kimble to James River	18" James River to Eckert	18" Eckert to Cedar Valley	18" Cedar Valley to Bastrop	18" Bastrop to Warda	18" Warda to Buckhorn	18" Buckhorn to Satsuma	20" Satsuma to E. Houston	20" E. Houston to Speed Jct	8" El Paso to Chevron	8" Kinder Morgan Flush Line	8" El Paso to Kinder Morgan	12" El Paso to Kinder Morgan	8" Crane to Odessa
ILI Date*			10/16/18	5/15/20	6/16/20	12/31/20	12/31/20	3/11/20	3/4/20	1/16/20	1/28/20	11/8/19	1/14/20	8/13/19						
Maintenance Report	No	No	Yes	Yes	No	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No	No	No	No
Tier I	0	0	0	0	0	0	0	11	18	31	36	35	10	0	0	0	0	0	0	0
Tier II	0	0	1	5	0	8	0	0	18	23	36	0	6	4	0	0	0	0	0	0
Tier III	0	0	0	0	0	0	0	2	0	0	0	0	1	4	0	0	0	0	0	0
Total Digs	0	0	1	5	0	8	0	13	36	54	72	35	17	8	0	0	0	0	0	0
HCA	0	0	0	0	0	0	0	5	8	36	2	2	3	8	0	0	0	0	0	0
Non-HCA	0	0	1	5	0	8	0	8	28	18	70	33	14	0	0	0	0	0	0	0

*ILI date noted is the more recent data between the 2019/2020 MFL and UCD assessments.

Table 11. Reported ILI Anomalies Excavated per 2020 ILI Anomaly Investigation Reports

ILI Anomaly Called	Number of Anomalies Addressed	18" Cottonwood to El Paso	18" Crane to Cottonwood	18" Crane to Texon	18" Texon to Barnhart	18" Barnhart to Cartman	18" Cartman to Kimble	18" Kimble to James River	18" James River to Eckert	18" Eckert to Cedar Valley	18" Cedar Valley to Bastrop	18" Bastrop to Warda	18" Warda to Buckhorn	18" Buckhorn to Satsuma	20" Satsuma to E. Houston	20" E. Houston to Speed Jct	8" El Paso to Chevron	12" El Paso to Kinder Morgan	8" Crane to Odessa
External ML	**376**	0	0	0	0	0	1	0	17	34	102	160	39	19	4	0	0	0	0
Internal ML	**38**	0	0	0	0	0	0	0	3	1	0	27	5	1	1	0	0	0	0
Internal ML crosses Long Seam	**0**	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mill Anomaly w/ML	**3**	0	0	0	1	0	0	0	0	0	0	0	0	1	1	0	0	0	0
Crack-like feature at Seam Weld	**132**	0	0	1	4	0	2	0	0	17	17	70	9	7	5	0	0	0	0
Crack-like feature at Girth Weld	**0**	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Crack Colony	**2**	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0
ID Reduction	**2**	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0
ID Reduction w/associated ML	**4**	0	0	0	0	0	0	0	0	1	0	1	2	0	0	0	0	0	0
ID Reduction on Weld	**0**	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ID Reduction L<1.5D	**0**	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ID Reduction L>1.5D	**0**	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Geometric Anomaly	**17**	0	0	0	0	0	0	0	0	10	5	1	1	0	0	0	0	0	0
Geometric Anomaly Affecting Seam Weld	**0**	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Geometric Anomaly associated w/Mill Anomaly	**0**	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Geometric Anomaly associated w/ML	**13**	0	0	0	1	0	2	0	4	0	1	2	2	0	1	0	0	0	0
Geometric Anomaly associated w/ML affecting Seam Weld	**4**	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0
Girth Weld Anomaly	**0**	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lack of Fusion External	**0**	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lack of Fusion Mid-wall	**0**	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lack of Fusion Internal	**0**	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lamination	**1**	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
Lamination – Variable Depth	**1**	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
Lamination Intermittent	**0**	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lamination Intermittent associated w/ML	**0**	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Seam Weld Anomaly	**1**	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
TOTAL	**594**	**0**	**0**	**1**	**6**	**0**	**9**	**0**	**24**	**65**	**125**	**262**	**60**	**29**	**13**	**0**	**0**	**0**	**0**

Table 12. Positive Material Identification Testing Activity

	Pipeline Segment	2014	2015	2016	2017	2018	2019	2020
Refined System	8″ El Paso to Chevron	0	0	0	0	0	0	0
	8″ Crane to Odessa	0	0	0	0	0	0	0
	12″ El Paso to Kinder Morgan	0	0	0	0	0	0	0
	18″ Cottonwood to El Paso	0	0	0	0	0	0	0
	18″ Crane to Cottonwood	0	0	0	0	0	0	0
Crude System	18″ Crane to Texon	0	1	7	0	4	15	0
	18″ Texon to Barnhart	0	0	8	3	0	0	2
	18″ Barnhart to Cartman	0	0	11	0	0	0	0
	18″ Cartman to Kimble	0	0	12	0	0	0	0
	18″ Kimble to James River	0	0	5	0	0	0	0
	18″ James River to Eckert	0	1	3	0	0	0	0
	18″ Eckert to Cedar Valley	1	0	6	7	0	0	15
	18″ Cedar Valley to Bastrop	0	0	20	6	0	0	35
	18″ Bastrop to Warda	0	1	3	4	0	0	34
	18″ Warda to Buckhorn	0	2	0	14	0	0	18
	18″ Buckhorn to Satsuma	0	0	0	8	0	0	8
	20″ Satsuma to E. Houston	0	4	0	0	0	3	4
	20″ E. Houston to 9th Street Junction	0	0	0	0	0	0	0
	Total PMI Tests Performed	**1**	**9**	**75**	**42**	**4**	**18**	**116**
	Segments without available Material Documentation	**2**	**18**	**141**	**64**	**7**	**31**	**232**
	Percentage Addressed (Requirement of 50%)	**50%**	**50%**	**53%**	**65%**	**57%**	**58%**	**50%**

The 2019/2020 MFL and UCD assessments for the following segments were correlated with the 2020 dig results: James River to Eckert, Eckert to Cedar Valley, Cedar Valley to Bastrop, Bastrop to Warda, Warda to Buckhorn, Buckhorn to Satsuma, and Satsuma to East Houston. Dig results were provided in the form of in-ditch ILI anomaly investigation maintenance and NDE reports. The ILI anomaly investigation digs resulted in 263 individually correlated metal loss features and 39 individually correlated ID reduction features. Table 13 and Table 14 provide a breakdown of the ILI anomaly investigation dig data correlations for metal loss and ID reduction features, respectively. Fourteen laminations were identified during the ILI investigation digs; one dig on the Buckhorn to Satsuma segment targeted a lamination.

The pipeline segments were reviewed by individual segments (i.e., Buckhorn to Satsuma) and compared to the overall system results to see if any segment differed significantly from the whole. The Buckhorn to Satsuma and Satsuma to East Houston segments had less than five metal loss data pairs and were not considered for individual tool performance as there were not a statistically significant number of ML validation measurements.

The 2020 field investigations resulted in ten internal ML to internal ML data pairs and 217 external ML to external ML data pairs. Seven of the ten internal ML correlations and 170 of the 217 external ML correlations were within the ±10% WT tool performance specification. Figure 15 through Figure 17 show the in-ditch and ILI data pairs expressed as a unity plot; the unity plots indicate that the MFL tool is tending to overcall internal and external corrosion metal loss depths. The 2020 field investigations targeted 240 external metal loss features. External metal loss features were found in-ditch to be external metal loss 218 out of 240 times, for a probability of detection of 90.8%. The remaining 22 external metal features were found in-ditch as a gouge, internal metal loss, lamination, lack of fusion, arc burn, blister, or no anomaly found.

Kiefner performed statistical analysis to determine an average, standard deviation, and the presence of outliers or extreme values. Appendix F – Statistics Background provides background on the following terminology: average, standard deviation, outliers, and extreme values. Table 15 shows the results from the statistical analysis; a negative value represents that the ILI tool has under-called the correlated features compared to the in-ditch data. No correlated features were removed from the statistical analysis. The Bastrop to Warda segment removed one correlated feature due to no depth reported in the NDE report. Table 15 shows that overall pipeline segments reviewed the MFL tool is over-calling external metal loss corrosion depth on an average of 3.8% for correctly identified external metal loss features. For correctly identified internal metal loss corrosion features, the MFL tool is over-calling on an average of 4.3%. The breakdown per pipeline segment shows that the MFL tool's average for external metal loss corrosion ranges from 0.0% to 4.9%.

Table 13. 2020 ILI Field Investigation Metal Loss Data Correlations

Pipeline Segment	EXT ML to EXT ML	EXT ML to INT ML	EXT ML to Gouge	EXT ML to Lamination	EXT ML to Arc Burn	EXT ML to Blister in Pipe Body	EXT ML to Lack of Fusion in Girth Weld	EXT ML to No Anomaly Found	EXT ML (SW) to EXT ML	EXT ML (SW) to Located Under Sleeve	EXT ML (GW) to EXT ML Affecting GW	INT ML to INT ML	INT ML to EXT ML	INT ML to Lamination	INT ML to GW Defect	INT Mill Anomaly to Lamination	INT Mill Anomaly to Lack of Fusion	INT Mill Anomaly to ID Mill Anomaly	INT Mill Anomaly to INT De-lamination	Lamination to Lamination	Total Data Correlations
8-in El Paso to Chevron	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
8-in Crane to Odessa	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
12-in El Paso to Kinder Morgan	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
18-in Cottonwood to El Paso	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
18-in Crane to Cottonwood	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
18-in Crane to Texon	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
18-in Texon to Barnhart	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	**1**
18-in Barnhart to Cartman	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
18-in Cartman to Kimble	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	**1**
18-in Kimble to James River	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
18-in James River to Eckert	13	1	2	0	0	0	0	1	0	0	0	0	1	2	0	0	0	0	0	0	**20**
18-in Eckert to Cedar Valley	28	0	1	3	0	0	0	0	0	0	2	0	0	0	1	0	0	1	0	0	**36**
18-in Cedar Valley to Bastrop	100	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	**102**
18-in Bastrop to Warda	38	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	**43**
18-in Warda to Buckhorn	34	0	0	4	0	1	0	0	0	0	0	5	0	0	0	0	0	0	0	0	**44**
18-in Buckhorn to Satsuma	4	2	2	0	1	0	1	0	0	0	0	0	0	0	0	0	1	0	0	1	**12**
18-in Satsuma to E. Houston	1	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	**4**
18-in E. Houston to Speed Jct	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Total	**218**	**3**	**5**	**9**	**1**	**1**	**1**	**2**	**1**	**1**	**2**	**10**	**1**	**2**	**1**	**1**	**1**	**1**	**1**	**1**	**263**

Table 14. 2020 ILI Field Investigation ID Reductions Data Correlations

Pipeline Segment	Dent to Dent w/ML	Dent w/ML to Dent w/ML	Dent w/ML to Dent	Geometric Anomaly to Geometric Anomaly	Geometric Anomaly to Geometric Anomaly w/ML	Geometric Anomaly to Dent	Geometric Anomaly to Dent w/ML	Geometric Anomaly to Dent with Gouge	Geometric Anomaly to Ripple Bend	Geometric Anomaly w/ML to Dent	Geometric Anomaly w/ML to Dent w/ML	Geometric Anomaly w/ML to Dent w/Gouge	Geometric Anomaly w/ML to Geometric Anomaly w/ML	Total Data Correlations
8-in El Paso to Chevron	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
8-in Crane to Odessa	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
12-in El Paso to Kinder Morgan	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
18-in Cottonwood to El Paso	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
18-in Crane to Cottonwood	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
18-in Crane to Texon	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
18-in Texon to Barnhart	0	0	0	0	0	0	0	0	0	0	0	1	0	**1**
18-in Barnhart to Cartman	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
18-in Cartman to Kimble	0	0	0	0	0	0	0	0	0	5	1	0	0	**6**
18-in Kimble to James River	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
18-in James River to Eckert	0	0	0	0	0	0	0	0	0	4	0	0	0	**4**
18-in Eckert to Cedar Valley	1	0	1	1	1	4	1	0	1	0	1	0	2	**13**
18-in Cedar Valley to Bastrop	0	0	0	0	0	2	0	2	0	0	0	1	0	**5**
18-in Bastrop to Warda	0	1	0	0	0	1	0	0	0	1	1	0	0	**4**
18-in Warda to Buckhorn	0	0	2	0	0	1	0	0	0	2	0	0	0	**5**
18-in Buckhorn to Satsuma	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
18-in Satsuma to E. Houston	0	0	0	0	0	0	0	0	0	1	0	0	0	**1**
18-in E. Houston to Speed Jct	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Total	**1**	**1**	**3**	**1**	**1**	**8**	**1**	**2**	**1**	**13**	**3**	**2**	**2**	**39**

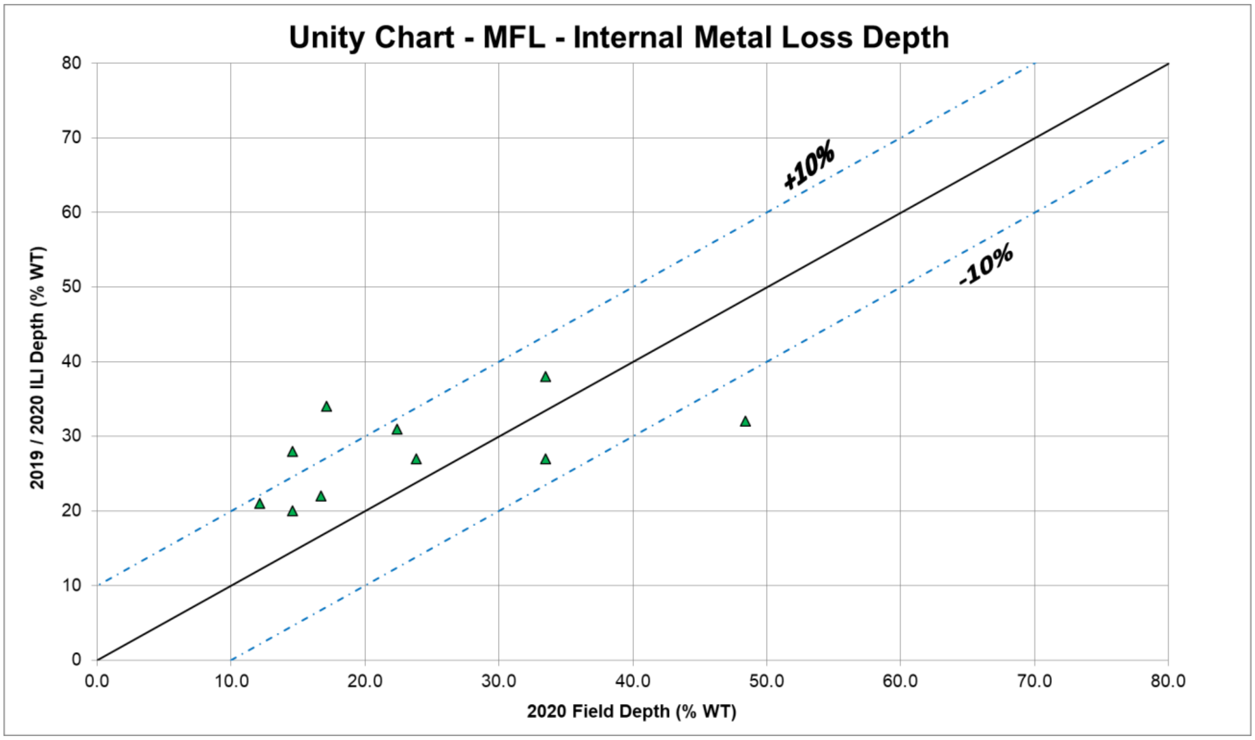

Figure 15. Unity Chart for Depth Verification for MFL Internal Metal Loss (Upper Bound ±10% WT)

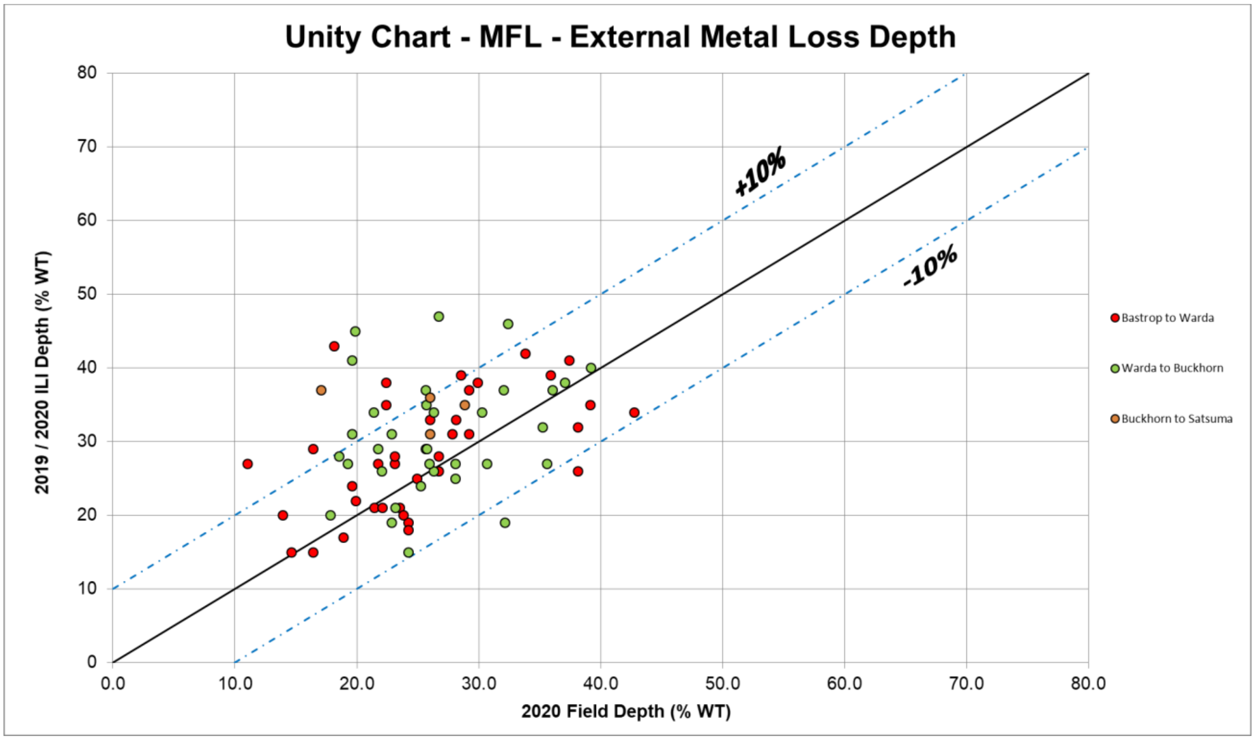

Figure 16. Unity Chart for Depth Verification for MFL External Metal Loss – Bastrop to Satsuma (Upper Bound ±10% WT)

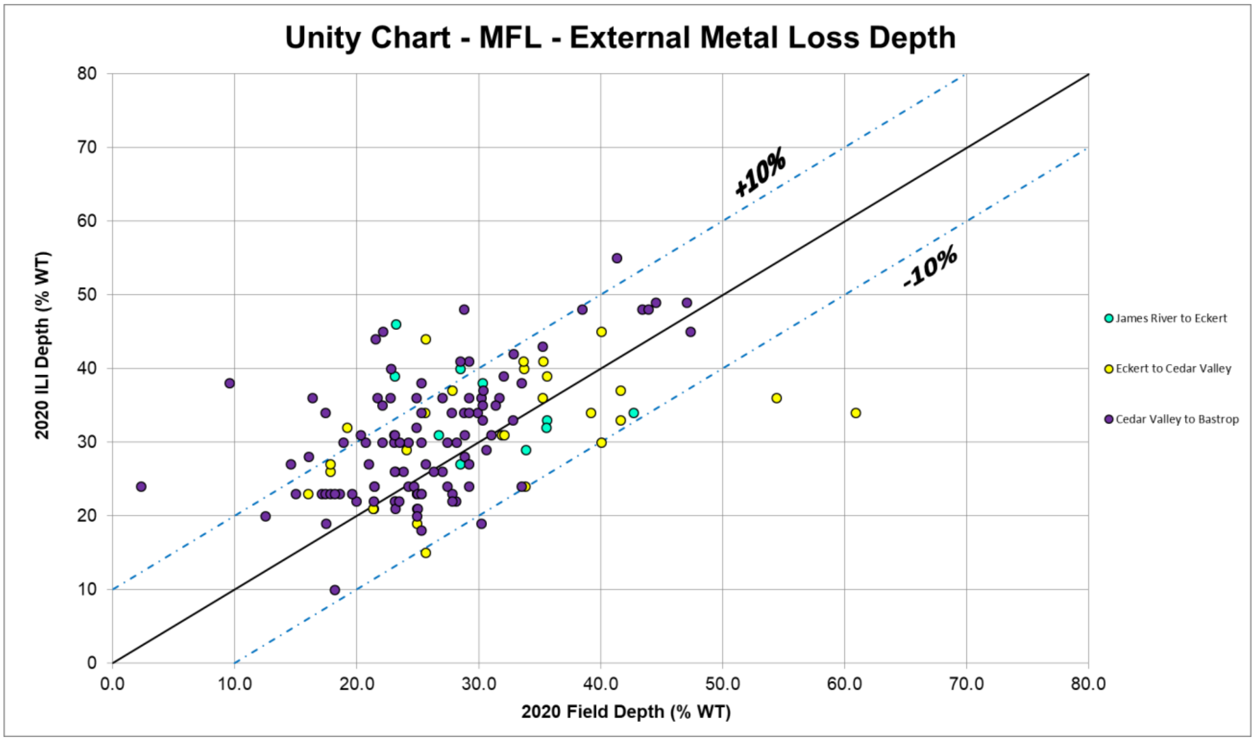

Figure 17. Unity Chart for Depth Verification for MFL External Metal Loss – James River to Bastrop (Upper Bound ±10% WT)

Table 15. Summary of Sizing and Population Density for MFL External Metal Loss Features

	2020 Overall MFL External ML Results	Warda to Buckhorn	Bastrop to Warda	Cedar Valley to Bastrop	Eckert to Cedar Valley	James River to Eckert
Depth Accuracy (%)	±10	±10	±10	±10	±10	±10
Total Number of Matched Features	217	34	38	100	28	13
Number of Features used in Analysis	217	34	37	100	28	13
Total Number of Features within Tool Specification	170	26	30	79	22	10
Average Size Difference (% WT)	3.8	4.2	3.1	4.9	0.0	3.1
Standard Deviation (% WT)	8.1	8.5	7.5	7.3	9.8	9.1
80% Random Error (% WT)	10.4	10.9	9.6	9.4	12.6	11.6

In 2020, 92 of the ILI anomaly investigation digs targeted crack-like, crack colony, or crack-like inspection sheet features reported from the 2019/2020 UCD assessments on ten of the twelve pipeline segments between Crane to East Houston. Magellan will be targeting crack-like features on the Kimble to James River segment in 2021.

Table 16 shows the results for UCD reported crack-like features evaluated in-ditch. Magellan targeted 113 crack-like features in 2020 on seven pipeline segments. Targeted crack-like features were found in-ditch as cracks 83 times. Per pipeline segment, the reported crack-like features were found in-ditch as cracks 40% of the time for the Satsuma to East Houston segment to 94% of the time for the Cedar Valley to Bastrop segment. Linear indications were found in-ditch 16 times, and lack of fusion (LOF) was found in-ditch 12 times. The remaining two features were found as a mill defect and no anomaly.

Table 17 shows the results for UCD reported crack colony and crack-like inspection sheet features evaluated in-ditch. Two crack colonies were reported (one on Satsuma to E. Houston and one on Warda to Buckhorn); one found as gouge, and the other found as a lamination. The UCD reported 19 individual crack-like inspection sheet features that Magellan evaluated in-ditch. ILI reported fourteen crack-like inspection sheet features on the Bastrop to Warda segment; 13 of the 14 features were found in-ditch as cracking (92.9%). ILI reported the five other crack-like inspection sheets on four segments, four of these five features were found in-ditch as cracking, and the fifth feature was found as LOF.

Table 16. In-Ditch Dig Results for ILI Reported Crack-Like Features

Pipeline Segment	ILI Reported Features	In-Ditch Field Results					Percentages (%)				
	Crack-Like	Mill Defect	LOF	Linear Indication	Crack	No Anomaly Found	Crack-like to Mill Defect	Crack-like to LOF	Crack-like to Linear Indication	Crack-like to Crack	Crack-like to No Anomaly Found
Satsuma to E. Houston	5	-	3	-	2	-	-	60.0	-	40.0	-
Buckhorn to Satsuma	5	-	2	-	3	-	-	40.0	-	60.0	-
Warda to Buckhorn	9	-	1	-	8	-	-	11.1	-	88.9	-
Bastrop to Warda	56	-	4	-	51	1	-	7.1	-	91.1	1.8
Cedar Valley to Bastrop	17	-	1	-	16	-	-	5.9	-	94.1	-
Eckert to Cedar Valley	15	1	1	12	1	-	6.7	6.7	80.0	6.7	-
Cartman to Kimble	2	-	-	-	2	-	-	-	-	N/A	-
Texon to Barnhart	4	-	-	4	-	-	-	-	100	-	-

Table 17. In-Ditch Dig Results for ILI Reported Crack Colony and Crack-Like Inspection Sheet Features

Pipeline Segment	ILI Reported Features		In-Ditch Field Results				Percentages (%)			
	Crack Colony	Crack-Like SW Inspection Sheet	Crack	LOF	Lamination	Gouge	Crack Colony to Gouge	Crack Colony to Lamination	Inspection Sheet to Crack	Inspection Sheet to LOF
Satsuma to E. Houston	1	-	-	-	-	1	N/A	-	-	-
Buckhorn to Satsuma	-	2	2	-	-	-	-	-	N/A	-
Warda to Buckhorn	1	1	1	-	1	-	-	N/A	N/A	-
Bastrop to Warda	-	14	13	-	-	-	-	-	92.9	7.1
Eckert to Cedar Valley	-	1	-	1	-	-	-	-	-	N/A
Crane to Texon	-	1	1	-	-	-	-	-	N/A	-

2.2.5 ID Reductions

Magellan runs EGPs to assess the threat of TPD and to monitor for possible hydrogen blistering. The ORA classifies ID reductions as deformation of pipe diameter detected by the ILI tool; ID reductions ≥ 2.0% of the pipe diameter classify as dents, and ID reductions < 2.0% of the pipe diameter classify as GMAs.

The 2019/2020 EGP assessments reported 2,299 ID reductions with depths ranging from 0.7% to 4.1% OD; 125 of the ID reductions have been previously repaired, as noted in the ILI pipeline listings. 91 dents and 2,083 GMAs constitute the remaining 2,174 ID reductions. ILI assessments reported eight dents and 29 GMAs associated with metal loss, three of the dents and eight of the GMAs are located in an HCA. One dent and 194 GMAs were reported as interacting with a seam weld by the ILI assessments with 36 of the GMAs reported in an HCA. The ILI assessments also reported 19 GMAs as interacting with a girth weld; four are reported in an HCA. One GMA associated with metal loss and 10 GMAs interacting with a seam weld are noted as being previously repaired.

Five hundred and fifteen ID reductions are reported in an HCA, with 35 noted as previously repaired; Table 18 provides a breakdown of the ID reductions reported in an HCA. The largest reported ID reduction depth per pipeline segment is noted in Table 18. Three segments did not have ID reductions reported in an HCA; Texon to Barnhart, Barnhart to Cartman, and Cartman to Kimble. Magellan performed an ILI anomaly investigation on nine ID reductions located in HCA in 2020; three dents associated with metal loss and six GMAs associated with metal loss. Magellan plans to address the following features reported by ILI on the Kimble to James River segment in 2021: one dent associated with metal loss and the one GMA associated with metal loss. The remaining unmitigated ID reductions do not meet regulatory repair criteria (equal to or greater than 2% OD and interact with a long seam or girth weld).

Table 18. ID Reductions Reported within HCAs[17]

Segment	Quantity	Quantity Noted as Repaired	Peak Depth (% OD)*	Comment

Buckhorn to Satsuma	19	1	1.1	• 19 GMAs (0.7-2.0% OD)
				  ○ 2 affecting seam weld (0.7 and 0.9% OD)
				  ○ 1 noted as repaired (2.0% OD)

Warda to Buckhorn	35	0	2.1	• 3 Dents (2.0-2.1% OD) • 32 GMAs (0.7-1.8% OD) ○ 2 affecting seam weld (0.8 and 0.9% OD)

Bastrop to Warda	11	0	2.2	• 1 Dent associated with metal loss (2.1% OD)**
				• 1 Dent (2.2% OD)
				• 9 GMAs (0.7-1.3% OD)
				  ○ 1 associated with metal loss (0.8% OD)**
				  ○ 1 affecting seam weld (0.7% OD)

Cedar Valley to Bastrop	46	3	3.0	• 5 Dents (2.1-3.0 % OD)
				  ○ 1 noted as repaired (2.9% OD)
				• 41 GMAs (0.7-1.8% OD)
				  ○ 4 affecting seam weld (0.7-1.7% OD)
				  ○ 2 noted as repaired (0.7 and 0.9% OD)

Eckert to Cedar Valley	137	11	3.8	• 16 Dents (2.0-3.8% OD)
				  ○ 1 associated with metal loss (2.5% OD)**
				  ○ 2 noted as repaired (2.4 and 2.9% OD)
				• 121 GMAs (0.7-2.0% OD)
				  ○ 3 associated with metal loss (0.7-1.5% OD)**
				  ○ 2 affecting seam weld (0.7 and 1.7% OD)
				  ○ 4 affecting girth weld (0.8-1.9% OD)
				  ○ 9 noted as repaired (0.8-1.9% OD)

James River to Eckert	118	8	2.8	• 4 Dents (2.1-3.1% OD)
				  ○ 1 noted as repaired (3.1% OD)
				• 114 GMAs (0.7-2.0% OD)
				  ○ 2 associated with metal loss (0.8 and 1.2% OD)**
				  ○ 1 associated with metal loss and affecting seam weld (1.4% OD)**
				  ○ 10 affecting seam weld (0.8-1.6% OD); 1 is noted as repaired (1.4% OD)
				  ○ 6 noted as repaired (0.7-1.7% OD)

Kimble to James River	149	12	3.4	• 14 Dents (2.1-4.1% OD)
				  ○ 1 associated with metal loss (3.1% OD)~
				  ○ 4 noted as repaired (2.3-4.1% OD)
				• 135 GMAs (0.7-1.8% OD)
				  ○ 1 associated with metal loss (1.0% OD)~
				  ○ 14 affecting seam weld (0.7-1.6% OD)
				  ○ 8 noted as repaired (0.7-1.8% OD)

Total	**515**	**35**		

*Peak depth is the largest unmitigated ID Reduction located in an HCA for that pipeline segment.
**Magellan performed ILI Anomaly investigations in 2020 to address feature(s).
~Magellan plans to address the feature in 2021.

[17] ID reductions are classified as either dents or geometric anomalies. A dent is an ID reduction greater than or equal to 2% OD and a geometric anomaly is an ID reduction less than 2% OD.

2.2.6 Laminations and Hydrogen Blisters

Continued monitoring of the lamination anomalies for the possibility of blister growth with ILI tools was recommended per the Longhorn Pipeline Reversal EA, Section 6.2.1.2. Laminations can occur due to oxides or other impurities trapped in the material. As the material cools in the manufacturing process, a small pocket may form internally in the steel plate or billet. A lamination can eventually lead to failure when it is oriented such that it eventually grows to the inner or outer wall of the pipe or pipeline component through pressure cycles. Laminations parallel to the pipe wall surface generally do not pose an integrity concern unless the formation of a blister occurs. Crude oil may contain hydrogen sulfide, which can lead to the formation of hydrogen through anaerobic internal corrosion. Laminations in the pipe wall can trap hydrogen from the corrosion reaction and generate blisters. Elevated cathodic protection (CP) can also lead to hydrogen migration and hydrogen blistering. Managing internal corrosion and monitoring CP levels could help mitigate these threats.

Kiefner correlated ID reductions identified from the 2020 EGP assessments with laminations reported from the 2009/2010 UT assessments. Fourteen dents and 142 GMAs reported from the 2020 assessments were found to either correlate or be present on the same joint that had a lamination(s) reported from the 2009/2010 UT assessments (see Table 19). Of those correlated features, four dents and eight GMAs note either having been previously repaired or were addressed in a 2020 ILI anomaly investigation dig. Correlation of the 2020 ILI assessments to the 2009/2010 UT assessments also noted 18 joints where the 2020 assessment reported a GMA or GMAs, while the 2009/2010 assessment reported either 'Inclusion in whole joint' or 'Inclusion field' on the associated joint, see Table 19.

A review of the 2020 maintenance reports showed that one scheduled ILI anomaly investigation dig targeted a reported lamination. Fifteen laminations were found on nine different joints during in-ditch assessments in 2020; nine of these laminations were located on three joints that had laminations reported in the 2009/2010 UT assessments. Monitoring reported laminations for ID reductions might indicate the initiation of a hydrogen blister. The ILI anomaly investigations reported one blister found in-ditch as a blister; the feature is on the Warda to Buckhorn segment. The target anomaly was a 36% WT external metal loss feature; ILI reported no laminations or ID reductions on the target joint. Per the Longhorn EA Section 9.3.2.3, the monitoring frequency recommended should coincide with the EGP tool assessment schedule. EGP assessments are required for the Existing Pipe every three years according to the LMP, except the section between East Houston and Speed Junction. The next EGP assessment for the crude system is in 2021 for the Crane to Texon segment; see Table 34.

Correlation of the 2020 ILI assessments to the 2009/2010 UT assessments noted four joints where crack-like features were reported in the 2020 assessment and were found to either correlate or be present on the same joint with laminations reported from the 2009/2010 assessments. Three of the four joints are on the Eckert to Cedar Valley segment, joints 36060, 41810, and 52080, and the fourth joint on the Cartman to Kimble segment joint 24700.

Table 19. ID Reductions Correlating with Laminations[18]

Segment	Quantity			Peak Depth (% OD)	List of Joints from 2020 Assessment	Comment
	Joint(s)	Dent(s)	GMA(s)			
Buckhorn to Satsuma	2	0	2	1.8	4400 and 25200	• 2020 joints: 10230, 23960, and 42570 have reported GMAs; the 2009 UT assessment reported 'Inclusion in whole joint' on the associated joints.
Warda to Buckhorn	8	2	7	2.5	9820*, 17990, 18020, 19460, 19920, 19990*, 20100, and 36000	• Joint 19990 has one reported dent and one reported GMA. Dent noted as being repaired by a sleeve.
Bastrop to Warda	3	0	3	1.0	11200, 31330, and 36470	• 2020 joint 31720 reported a GMA; the 2010 UT assessment reported 'Inclusion in whole joint' on the associated joint. • 2020 joint 36470 reported a GMA; the 2010 UT assessment noted a lamination and an 'Inclusion Field' on the associated joint.
Cedar Valley to Bastrop	1	0	1	0.9	22490*	• GMA on joint 22490 notes a sleeve repair
Eckert to Cedar Valley	21	5	16	2.6	2520, 3020, 9490, 10800, 15760*, 16390, 18630, 21350, 25980*, 28130, 28180, 30490, 30710, 31860, 33870, 38030, 38160, 40110, 40190, 43160, and 52180	• 2020 joint 5120 reported a GMA, the 2010 UT assessment reported 'Inclusion in whole joint' on the associated joint. • The GMA on joint 25980 notes a sleeve repair.
James River to Eckert	15	1	14	2.1	330, 7050, 9220, 16130, 17900*, 18510, 19670, 26950, 27530, 28280, 36610*, 38320, 39770, 41080, and 42070	• 2020 joints: 9220 and 36610 have reported GMAs; the 2010 UT assessment reported lamination(s) and 'Inclusion in whole joint' on the associated joints. • 2020 joint 41080; the 2010 UT assessment noted a lamination and an 'Inclusion Field' on the associated joint. • The GMAs on joints 17900 and 36610 both note a sleeve repair.
Kimble to James River	23	2	23	2.6	1890, 7590, 7670, 8330, 10050, 10920, 11430, 15530, 21520, 22790, 24130, 24330, 24950, 25300, 26430, 29830, 30670*, 36510, 37180, 37880, 39450, 45300, and 45910	• 2020 joints: 15530, 24330, and 24950 reported a GMA, the 2010 UT assessment reported laminations and 'Inclusion in whole joint' on the associated joint. • The GMA and Dent located on joint 30670 note a sleeve repair.
Cartman to Kimble	52	2	59	3.0	2990*, 4430, 5010, 9990, 12010, 12340, 13490, 13530, 14610, 15090, 16640, 17810, 18500, 19150, 19920, 20140, 20880, 21360, 23680, 24520, 24590, 26240, 26760, 27190, 30080, 31210, 31740, 32510, 32790, 33600, 38230, 38450, 38840, 43260, 47180, 47940, 48390, 48710, 48750, 49250, 50150, 50190, 52020, 59870, 59980, 60640, 60800, 63340, 63710, 64640, 64780, and 65430	• 2020 joint 2990, 5010, 17810, 50190, and 59980 have reported GMAs; the 2010 UT assessment reported laminations and 'Inclusion in whole joint' on the associated joints. • 2020 joint 43260; the 2010 UT assessment noted laminations and an 'Inclusion Field' on the associated joint. • GMA on joint 2990 notes a sleeve repaired.
Barnhart to Cartman	7	1	6	2.8	8090, 8590, 14040, 25760, 26460, 27840, and 35450	• N/A
Texon to Barnhart	9	1	10	2.3	2300, 2370, 4730*, 7590, 28730, 29700, 30920, 33380, and 55450	• The GMA and Dent located on joint 4730 note a sleeve repair.
Total	**142**	**14**	**141**			

*Feature(s) are noted in the pipeline listing as repaired or addressed by a 2020 ILI anomaly investigation dig.

[18] Features may not be directly correlating (i.e., overlapping area), but were identified in this table if reported on the same joint.

2.3 Corrosion Management Plan

The LMP entails an extensive Corrosion Management Plan (CMP) to control the extent of corrosion. The 2020 CMP considered the following items: Probability of Exceedance (POE), review of internal corrosion coupons, review of field digs reports (covered under Section 2.2.4 Maintenance Reports and In-Ditch Evaluations), review of CP system for buried pipelines, review of atmospheric inspection for above grade appurtenances, and review of tank inspections.

2.3.1 Probability of Exceedance Analysis

POE calculations were performed on the nine pipeline segments assessed by MFL in 2020, see Table 2. The POE calculations incorporated the ILI tool specifications (BHGE MF4) and utilized a CGR of 5 mpy for external ML and 1 mpy for internal ML over a 5-year range. Ninety-five metal loss features had a calculated POE value exceeding $10E^{-5}$; see Table G-1 in Appendix G – POE Results.

2.3.2 Internal Corrosion Coupons

Magellan monitors internal corrosion using internal corrosion coupons placed at 62 locations along the Longhorn system and eight locations along the Longhorn Lateral lines. The inserted and removed dates of coupons fell between 9/14/2019 to 12/31/2020. The coupon testing days were from 96 to 166 days for the mainline and from 170 to 197 days for the lateral lines. Due to the long days of exposure at some locations, Magellan cannot achieve the three evaluation times in the calendar year of 2020. The locations that did not have three evaluations in 2020 are highlighted in red in Table 20 and Table 21. One of the 67 coupons was damaged during the testing and could not be processed. According to the coupon testing results for the remaining coupons, corrosion rates observed ranged from no corrosion to the maximum of 0.88 mpy on the internal corrosion coupons for the Longhorn system. Monitoring should continue to identify future potential changes in the pipelines. Table 20 lists internal corrosion coupon results for the crude line and Table 21 for the refined line.

Table 20. Internal Corrosion Coupon Results for Crude Line (pg 1 of 2)

Pipe OD (inch)	Location	Line Designation (Line ID)	Coupon Number	Inserted	Removed	Exposure (days)	Rate (mpy)	Comments
20	Speed Jct	Speed Jct Manifold from E Houston (6643)	AA9118	8/14/2020	12/15/2020	123	0.00	
20	Speed Jct	Speed Jct Manifold from E Houston (6643)	AA2068	4/16/2020	8/14/2020	120	0.00	
20	Speed Jct	Speed Jct Manifold from E Houston (6643)	G9847	12/12/2019	4/16/2020	126	0.02	
20	E. Houston	East Houston ML (6645)	V4167	9/1/2020	12/14/2020	104	0.05	
20	E. Houston	East Houston ML (6645)	Y8905	4/15/2020	9/1/2020	139	0.08	
20	E. Houston	East Houston ML (6645)	V2348	12/15/2019	4/15/2020	122	0.04	
18	Austin	18" Satsuma Station (6645)	AA9122	8/17/2020	12/16/2020	121	0.00	
18	Austin	18" Satsuma Station (6645)	AA2064	4/23/2020	8/17/2020	116	0.00	
18	Austin	18" Satsuma Station (6645)	G9850	12/6/2019	2/17/2020			Coupon lost no data. Email 1-12-21
18	Austin	18" Cedar Valley Station (6645)	AA9121	8/21/2020	12/9/2020	110	0.06	
18	Austin	18" Cedar Valley Station (6645)	AA2066	4/23/2020	8/14/2020	113	0.00	
18	Austin	18" Cedar Valley Station (6645)	G9849	12/5/2019	4/17/2020	134	0.02	
18	Austin	18" Cartman Station (6645)	AA2067	5/19/2020	9/16/2020	120	0.00	
18	Austin	18" Cartman Station (6645)	G9848	12/5/2019	5/19/2020	166	0.00	

*Stations highlighted in red only had two internal corrosion coupon evaluations in 2020.

Table 20 (continued). Internal Corrosion Coupon Results for Crude Line (pg 2 of 2)

Pipe OD (inch)	Location	Line Designation (Line ID)	Coupon Number	Inserted	Removed	Exposure (days)	Rate (mpy)	Comments
24	Crane	24" Tank Manifold	V4354	9/9/2020	12/14/2020	96	0.00	
24	Crane	24" Tank Manifold	Y8902	5/6/2020	9/9/2020	126	0.07	
24	Crane	24" Tank Manifold	V2341	12/16/2019	4/30/2020	136	0.08	
16	Crane	16" Plains WTI (delivery)	V4165	9/9/2020	12/14/2020	96	0.00	
16	Crane	16" Plains WTI (delivery)	Y8904	5/6/2020	9/9/2020	126	0.15	
16	Crane	16" Plains WTI (delivery)	V2346	12/16/2019	4/30/2020	136	0.03	
16	Crane	16" Plains WTS (delivery)	V4168	9/9/2020	12/14/2020	96	0.00	
16	Crane	16" Plains WTS (delivery)	Y8906	5/6/2020	9/9/2020	126	0.03	
16	Crane	16" Plains WTS (delivery)	V2349	10/12/2019	4/30/2020	142	0.07	
16	Crane	16" Medallion (Delivery)	Y8602	9/9/2020	12/14/2020	96	0.00	
16	Crane	16" Medallion (Delivery)	Y8909	5/6/2020	9/9/2020	126	0.12	
16	Crane	16" Medallion (Delivery)	V2339	12/16/2019	4/30/2020	136	0.06	
16	Crane	16" Oryx (Delivery)	Y8603	9/9/2020	12/14/2020	96	0.08	
16	Crane	16" Oryx (Delivery)	Y8908	5/6/2020	9/9/2020	126	0.11	
16	Crane	16" Oryx (Delivery)	V2350	12/16/2019	4/30/2020	136	0.09	
12	Crane	12" Centurion (delivery)	Y8907	5/6/2020	8/14/2020	100	0.12	
12	Crane	12" Centurion (delivery)	V2352	10/12/2019	4/30/2020	142	0.11	
16	Crane	16" Advantage (delivery)	V4353	9/9/2020	12/14/2020	96	0.00	
16	Crane	16" Advantage (delivery)	Y8901	5/6/2020	9/9/2020	126	0.15	
16	Crane	16" Advantage (delivery)	V2340	12/16/2019	4/30/2020	136	0.07	
18	Crane	18" Centurion (delivery)		9/9/2020	12/31/2020			New Project No Coupon Holder 9-9-20
10	Crane	Truck Offload 10" WTI	Y8609	9/9/2020	12/14/2020	96	0.12	
10	Crane	Truck Offload 10" WTI	Y8910	5/6/2020	9/9/2020	126	1.49	
10	Crane	Truck Offload 10" WTI	V2356	12/13/2019	4/30/2020	139	0.98	
10	Crane	Truck Offload 10" WTS	Y8610	9/9/2020	12/14/2020	96	0.00	
10	Crane	Truck Offload 10" WTS	Y8911	5/6/2020	9/9/2020	126	0.16	
10	Crane	Truck Offload 10" WTS	V2351	12/13/2019	4/30/2020	139	0.08	
24	Ozona	24" Downstream Tks 100 & 101	AA9203	8/21/2020	12/17/2020	118	0.88	
24	Ozona	24" Downstream Tks 100 & 101	AA2046	4/15/2020	8/21/2020	128	0.28	
24	Ozona	24" Downstream Tks 100 & 101	G9846	12/12/2019	4/15/2020	125	0.04	
20	Ozona	20" Downstream of Strainers	AA8993	8/21/2020	12/17/2020	118	0.33	
20	Ozona	20" Downstream of Strainers	AA2063	4/15/2020	8/21/2020	128	0.10	
20	Ozona	20" Downstream of Strainers	G9843	12/12/2019	4/15/2020	125	0.06	
18	Ozona	BH 18" to LH 18"	AA8994	8/21/2020	12/17/2020	118	0.11	
18	Ozona	BH 18" to LH 18"	AA2062	4/15/2020	8/21/2020	128	0.13	
18	Ozona	BH 18" to LH 18"	G9844	12/12/2019	4/15/2020	125	0.06	
16	Ozona	JP Energy 16" (Delivery)	AA9202	8/21/2020	12/17/2020	118	0.37	
16	Ozona	JP Energy 16" (Delivery)	AA2065	4/15/2020	8/21/2020	128	0.15	
16	Ozona	JP Energy 16" (Delivery)	G9845	12/12/2019	4/15/2020	125	0.09	

*Stations highlighted in red only had two internal corrosion coupon evaluations in 2020.

Table 21. Internal Corrosion Coupon Results for Refined Line

Pipe OD (inch)	Location	Line Designation (Line ID)	Coupon Number	Inserted	Removed	Exposure (days)	Rate (mpy)	Comments
12*	El Paso	KM 12" (6651)	H0311	9/14/2019	3/4/2020	172	0.03	
12*	El Paso	KM 12" (6651)	AA2022	3/4/2020	9/15/2020	195	0.00	
8*	El Paso	KM 8" flush (6652)	H0315	9/14/2019	3/4/2020	172	0.00	
8*	El Paso	KM 8" flush (6652)	AA2023	3/4/2020	9/15/2020	195	0.00	
8*	El Paso	Strauss 8" (6653)	G9459	9/14/2019	3/4/2020	172	0.01	
8*	El Paso	Strauss 8" (6653)	AA1929	3/4/2020	9/15/2020	195	0.00	
8*	Santa Teresa	Strauss 8" (6653)	H0257	9/14/2019	3/2/2020	170	0.00	
8*	Santa Teresa	Strauss 8" (6653)	AA1862	3/2/2020	9/15/2020	197	0.00	
8	Crane	8" Odessa to Crane (6648)	V4355	9/9/2020	12/14/2020	96	0.02	
8	Crane	8" Odessa to Crane (6648)	Y8903	5/6/2020	9/9/2020	126	0.02	
8	Crane	8" Odessa to Crane (6648)	V2342	12/13/2019	4/30/2020	139	0.01	
18	El Paso	18" ML (6645)	AX0109	8/14/2020	12/10/2020	118	0.00	
18	El Paso	18" ML (6645)	N0021	4/15/2020	8/14/2020	121	0.00	
18	El Paso	18" ML (6645)	V4345	12/13/2019	4/15/2020	124	0.02	
8	El Paso	Plains-8" (6650)	AX0110	8/14/2020	12/10/2020	118	0.12	
8	El Paso	Plains-8" (6650)	N0002	4/15/2020	8/14/2020	121	0.08	
8	El Paso	Plains-8" (6650)	V4346	12/13/2019	4/15/2020	124	0.01	

*Stations highlighted in red only had two internal corrosion coupon evaluations in 2020.

2.3.3 Cathodic Protection System

To evaluate the effectiveness of the CP systems that are currently in place for the Longhorn pipeline system, the rectifier inspections and maintenance, test point surveys, and CIS were reviewed. The rectifiers were inspected in 2020, including the effective date, repair found date, and repair code. A CIS was performed in November 2019 and received by Magellan in February 2020 for pipeline ROW 6645 segments from stationing 395+56 to 26340+35. Another CIS was performed in October 2020 and received by Magellan in November 2020 for pipeline ROW 6645 segments from stationing 6221+42 to 10257+91. Both CIS data were analyzed and summarized in Table 22. Semi-annual surveys are being conducted on Tier II and Tier III areas per LMC 32.

Based on the Longhorn CMP, corrosion control activities are governed by company policies and procedures and DOT Part 195 regulations and are consistent with NACE International RP01-69, ASME, and API recommended practices where applicable.

NACE International has established criteria considered indicative of CP for metallic piping in NACE Standard Practice SP0169-2013 (formerly RP01-69) – "Control of External Corrosion on Underground or Submerged Metallic Piping Systems." The Standard lists the following criteria:

- A minimum of 100 mV of cathodic polarization. Either the formation or the decay of polarization must be measured to satisfy this criterion.
- A structure-to-electrolyte potential of -850 mV or more negative as measured with respect to a saturated copper/copper sulfate (CSE) reference electrode. This potential may be either a direct measurement of the polarized potential or a current-applied potential. Interpretation of a current-applied measurement requires consideration of the significance of voltage drops in the earth and metallic paths.

Table 22 shows the details of the two sets of CIS data, whether the pipe segments are meeting the cathodic protection criteria and which criteria they are meeting or not meeting. The CIS results indicate that all the assessed pipeline segments meet 100 mv shift criteria.

The 2020 CIS data also indicates that some of the pipe sections had the "instant off" readings slightly more electronegative than -1200 mV with respect to a CSE reference electrode, meaning the CP system may overprotect these pipe sections.

Table 22. CIS Summary for Longhorn System

1st Set CIS Survey (Feb. 2020)					2nd Set CIS Survey (Nov. 2020)				
Stationing Start	Stationing End	Meeting 100mV shift criteria	Meeting -0.850 mV criteria	Meeting -1200 mV criteria	Stationing Start	Stationing End	Meeting 100mV shift criteria	Meeting -0.850 mV criteria	Meeting -1200 mV criteria
395+56	480+92	YES	YES	NO	--	--	--	--	--
612+12	900+27	YES	YES	YES	--	--	--	--	--
1037+33	1323+92	YES	YES	NO	--	--	--	--	--
1575+56	2023+12	YES	YES	NO	6221+42	6261+57	YES	NO	YES
8389+38	8414+17	YES	NO	YES	7917+20	7972+80	YES	NO	YES
8627+52	8661+32	YES	NO	YES	8800+30	9056+30	YES	NO	YES
8959+32	9169+12	YES	NO	YES	9056+30	9064+30	YES	NO	YES
9350+93	9357+55	YES	NO	YES	9064+30	9352+30	YES	NO	YES
9451+37	9496+90	YES	NO	YES	9352+30	9360+30	YES	NO	YES
9547+82	9645+07	YES	NO	NO	9360+30	9552+30	YES	NO	YES
9783+92	9816+25	YES	NO	YES	9552+30	9560+30	YES	NO	YES
9864+99	9869+20	YES	NO	YES	9560+30	10257+91	YES	NO	YES
10028+62	10084+02	YES	NO	YES	--	--	--	--	--
10161+36	10591+15	YES	NO	YES	--	--	--	--	--
10658+74	10702+77	YES	NO	NO	--	--	--	--	--
10724+74	10739+47	YES	YES	YES	--	--	--	--	--
10811+87	10894+87	YES	YES	NO	--	--	--	--	--
10955+00	11012+67	YES	YES	NO	--	--	--	--	--
11073+10	11086+42	YES	YES	YES	--	--	--	--	--
11251+52	11280+75	YES	NO	NO	--	--	--	--	--
12091+35	12210+67	YES	YES	NO	--	--	--	--	--
12362+63	12418+60	YES	NO	NO	--	--	--	--	--
12470+70	12502+11	YES	YES	NO	--	--	--	--	--
12648+07	12695+52	YES	YES	YES	--	--	--	--	--
13065+42	13139+02	YES	YES	NO	--	--	--	--	--
13168+94	13221+82	YES	YES	YES	--	--	--	--	--
13920+00	13941+50	YES	YES	NO	--	--	--	--	--
14129+91	14147+60	YES	YES	NO	--	--	--	--	--
14548+49	14618+10	YES	YES	NO	--	--	--	--	--
20027+53	20028+47	YES	NO	NO	--	--	--	--	--
22219+92	22225+00	YES	NO	NO	--	--	--	--	--
22464+45	22470+40	YES	YES	NO	--	--	--	--	--
26340+27	26342+35	YES	YES	NO	--	--	--	--	--

2.3.4 AC Potential Survey

The pipe to soil AC voltage survey was conducted when the CIS was performed for the pipeline ROW segments 6645 from stationing 395+56 to 26340+35. The AC voltage survey collected 127 test points during the first CIS survey received in February 2020, with a maximum reported AC voltage of 6.9 V at stationing of 9451+37. This level of AC voltage should not cause any personnel safety issues. However, the induced AC current travels along the pipeline and tends to dissipate into the earth from a coating anomaly or defect. AC-induced corrosion may occur at these locations depending on the soil resistivity and coating condition. According to NACE SP0177-2014, theoretical AC current densities can be calculated based on the historical AC voltage, soil resistivity, and a coating flaw with an assumed size of 1 cm^2. It is recommended to continue monitoring the AC readings during the future CIS survey, especially for the locations with historically elevated AC readings.

2.3.5 Atmospheric Inspections

Magellan monitors the condition of above-grade appurtenances following annual atmospheric inspection, including station piping, tanks, valve settings, and exposed piping. Table 23 lists the locations of concern in the Longhorn Pipeline System where corresponding repairs are needed.

Table 23. Atmospheric Inspection Summary

Atmospheric Facility Type	Location Description	Repair Found Date	Milepost	Inspection Remarks
Texon-Barnhart exposed pipe	Exposure in the sand flat	6/24/2020	412.2	Re-inspect by 12/31/2020, completed on 1/27/2021
Crane –Texon valve setting	Crane interface site	4/29/2020	452.9	Pipe support needs adjusting, completed on 4/30/2020
Satsuma - East Houston benched crossing	Span 5026 @ Halls Bayou (E of Old Hwy 36)	5/4/2020	17.2	Touch up along the bottom of the line. Coating scratches on WSD.
Satsuma - East Houston exposed pipe	Harris County Flood Control Ditch	5/4/2020	19.0	Return to survey
Buckhorn-Satsuma valve settings	SE2 GV-East side Brazos River	4/28/2020	63.7	Touch-up on nitrogen cabinet nuts/bots and 1” valves on weldolets. Touch-up valve motor case.
Buckhorn-Satsuma valve settings	SE3 GV-East side Brazos River	4/28/2020	64.0	Address pipe support on 4”. Nitrogen cabinet needs touched-up. Touch up nuts/bolts stem and cap on ROV1. Touchup vertical BV202. Lower and coat p2ps area on BV01.
Buckhorn-Satsuma exposed pipe	East of Oil field Rd	4/27/2020	65.8	Large coating deficiency on top of the pipe. Excavate and recoat. The pipe is half silted in.
Warda-Buckhorn exposed pipe	West of Schuster Rd. East of pond	6/18/2020, 10/28/2020	107.2	Silted in/re-inspect by 12/31/2020, completed on 10/28/2020 and 4/20/2021
Warda-Buckhorn exposed pipe	Between Rauch Rd and FM 2145	6/18/2020, 10/28/2020	108.1	Silted in/re-inspect by 12/31/2020, completed on 10/28/2020 and 4/20/2021
Warda-Buckhorn exposed pipe	West of FM 448	6/18/2020, 10/28/2020	117.9	Silted in/re-inspect by 12/31/2020, completed on 10/28/2020 and 4/21/2021
Cedar Valley-Bastrop exposed pipe	East of supported span	7/6/2020	149.9	Dig out and recoat 3ft
Cedar Valley-Bastrop valve setting	Elevated Valve S. Congress Ave.	6/9/2020	166.6	Wear at bypass support, wear at two mainline supports, flange bolts, 1” blowdown on bypass
James River-Eckert exposed pipe	Pasture exposure	6/11/2020	232.0	Resurvey October 2020
James River-Eckert exposed pipe	Pasture exposure	10/28/2020	232.0	Not exposed/resurvey spring 2021

2.3.6 Tank Inspections

Magellan inspected eight tanks in 2020; Table 24 lists the tanks inspected and their inspection type. The inspection reports show that no problems are requiring immediate action were found on foundation, shell, piping and appurtenances, fixed roof, floating roof, and access structure for Tanks 5, 6, 7, 12, and 15 in El Paso and Tanks 57, 58, and 59 in Crane. The anchorage requirements were not part of the evaluation during the foundation inspection for the tanks listed in Table 24. The floating roof inspection was from the access hatch for all the tanks.

Table 24. Tank Inspection Summary

Tank #	Tank location	Product	Inspection type	Inspection date	Comments
5	EI Paso	NEP	External API-653	02-13-2020	No items of concern noted
6	EI Paso	V Grade	External API-653	02-13-2020	No items of concern noted
7	EI Paso	V Grade	External API-653	02-13-2020	No items of concern noted
12	EI Paso	Gasoline	External API-653	02-13-2020	No items of concern noted
15	EI Paso	Transmix	External API-653	02-13-2020	No items of concern noted
57	Crane	Crude Oil	External API-653	04-08-2020	No items of concern noted
58	Crane	Crude Oil	External API-653	04-08-2020	No items of concern noted
59	Crane	Crude Oil	External API-653	04-08-2020	No items of concern noted

2.4 Earth Movement and Water Forces

The LMP evaluates the integrity concerns resulting from the ground movement from aseismic faults and soil erosion caused by scouring from floods. Fault crossings, allowable displacement at faults, and fault movements from the past 16.5 years were compared to evaluate any integrity threats on the Longhorn Pipeline System. In addition, the waterway inspections and periodic depth of cover inspections were conducted at all the river crossings locations.

2.4.1 Fault Crossings

The Longhorn Pipeline System crosses several aseismic faults between Harris County (Houston area) and El Paso, TX. No active fault crossing the pipeline is reported West of Harris County[19]. Within Harris County, the pipeline crosses seven aseismic faults that are considered to be active. Those active faults are Akron, Melde, Breen, and Hockley faults, which cross the original Longhorn pipeline, and McCarty, Negyev, and Oates faults, which cross the new East Houston line constructed in 2012. Table 25 summarizes the location and geologic data for these faults.

[19] "Study of Aseismic Faults and Regional Subsidence Along Longhorn Partners Pipeline", IT Corporation, June 14, 2000.

Table 25. Fault Location and Geologic Data for Akron, Melde, Breen, and Hockley Aseismic Faults in Harris County, TX

	Location			**Fault**				**Soil**	
Fault	MP	Station	±feet	Orientation	Dip	Displacement	Width(ft)	Classification	Formation
Akron	3.84	202+90	60	N85E		down N		CL*	
Melde	5.66	298+60	50	N64E		down N		CL	Beaumont
Breen	25.85	1364+85	50	N50E		down NW	13	CL	Lissie
Hockley	46.34	2446+60	70	N56W	67SW		80	CL	Lissie

*CL refers to low plasticity clay

Note: Blank fields indicate that data were unavailable.

2.4.2 Allowable Displacement at Faults

Kiefner has conducted two series of stress analyses on the pipes to determine the allowable displacements at the faults, one in the 2005 ORA Report and one in the 2014 ORA Report. The original stress analysis in the 2005 ORA Report was conducted for Akron, Melde, Breen, and Hockley faults. Assumptions used in that analysis included: allowable stress levels based on the version of ASME B31.4[20] available at that time; stress resulting from regular operation (instead of fault movement) in the pipeline was determined by ASME B31.4 stress analysis; and soil properties were determined from the best estimate of obtainable properties.

In the 2014 ORA Annual Report, the allowable displacements at the McCarty, Negyev, and Oates faults were determined. Due to the high rate of movement and the relatively low allowable displacement at the Hockley fault, the stress analysis was repeated at this fault for the 2014 ORA Report. In the 2014 analysis, the stresses in the pipelines at various fault displacements were predicted through finite element analysis (FEA) with the same soil properties as were used in the previous 2005 analysis. The allowable fault displacement was then determined when the stress reached the allowable stress levels at the pipe based on the ASME B31.4-2012, which was the latest version at the time. In ASME B31.4-2012, the allowable longitudinal stress level increased compared to the previous versions from 54% SMYS to 90% SMYS. This new limit was considered for stress analysis of McCarty, Negyev, and Oates faults. Given the pipeline vintage of the Hockley fault, Kiefner opted for a lower limit of 80% SMYS to determine the critical displacement. Please see the 2014 ORA Report for details of the analysis. Table 26 presents the resulting allowable displacement at each fault.

2.4.3 Fault Movements

Fault displacement is defined as the difference between two benchmark readings, one on each side of the fault trace: the upthrown block (the side of the fault that appears to move up relative to the opposite side) and the downthrown block (the side of the fault that appears to move down relative to the opposite side).

[20] ASME B31.4-2002, Pipeline Transportation Systems for Liquids and Slurries, ASME Code for Pressure Piping, B31. The standard allows longitudinal stress up to 54% of SMYS.

Monitoring stations across the Akron, Melde, Breen, and Hockley faults were installed in March 2004 in accordance with Section 6.2 of the ORAPM. Baseline readings were taken in late May and early June 2004. Thirty-one subsequent displacement readings[21] have been taken at approximately 6-month intervals. Figure 18 shows a plot of the vertical displacements over time.

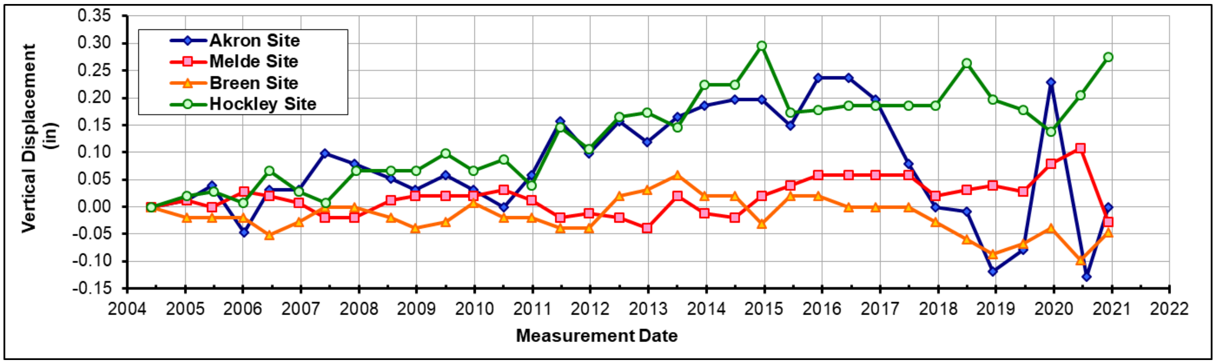

Figure 18. Fault Displacement over the 16.5 Year Monitoring Period at Akron, Melde, Breen, and Hockley Faults

In 2017 and 2018, there was a considerable amount of backward movement in the Akron fault in comparison to the previous years of monitoring. This trend was followed by a rebound in 2019 when the fault approximately got back to its previous displacement prior to 2017. In June 2020 resurvey of the Akron fault (i.e., 32nd resurvey), the measurements showed that the fault experienced a large amount of backward movement. Because of an atypically large change in displacement between survey events (greater than 0.4 inches), verification readings were collected in July 2020. The verification survey yielded a similar displacement value. In December 2020, the Akron fault rebounded and returned to approximately its baseline displacement in 2004.

Data collected at Melde and Breen faults since the benchmarks were installed in 2004 show slow progressive movement, as verified by the 32nd and 33rd resurveys[22] in 2020. At Melde fault, the 33rd resurvey in December showed large backward movement compared to the historical rate of movements at this fault. The recent resurveys indicate continuous movement above the average historical movements regarding the Hockley fault, which suggests continuous monitoring is required at this fault.

In 2012, three additional faults were instrumented for the lines constructed to connect the existing Longhorn line to East Houston. The three faults include the McCarty fault near Station 35+80, Negyev Fault near Station 140+00, and Oates Fault near Station 147+00. Baseline readings were taken for the McCarty, Negyev, and Oates faults in September 2012. After the baseline readings, there have been 19 readings taken between December 2012 and December 2020, as shown in Figure 19.

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[21] Geosyntec Semi-Annual Fault Displacement Monitoring Reports. The last report is for the 2nd half of 2019.
[22] Geosyntec – First-half and second-half Semi-Annual Fault Displacement Monitoring Reports.

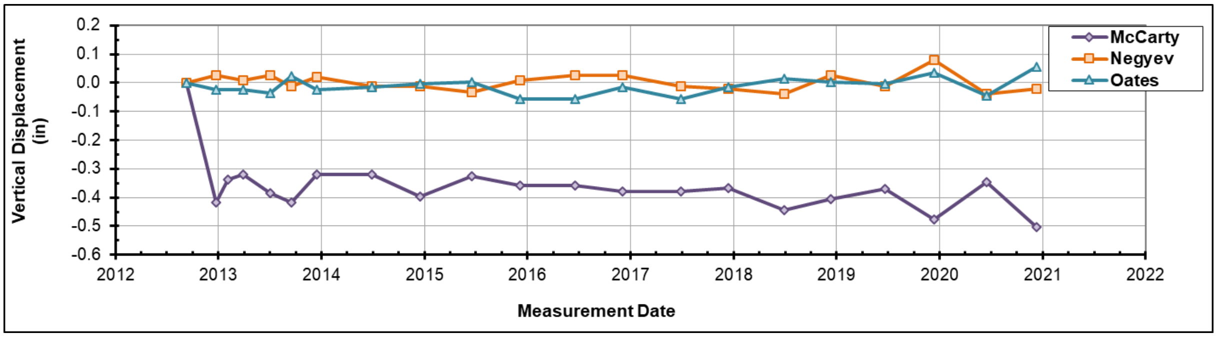

Figure 19. Fault Displacement over the 8.5 Year Monitoring Period at McCarty, Negyev, and Oates Faults

The readings measured at the McCarty station from the baseline measurement in September 2012 to December 2012 indicated a jump of about one-half inch of displacement had occurred. No other large movement has been observed subsequent to the initial jump. This jump could be indicative of the benchmark equilibrating with its environment after installation or due to measurement error of the baseline reading. Accordingly, in the calculation of the McCarty fault's rate of movement, the baseline measurement in September 2012 was not considered. Instead, the December 2012 measurement was set as the basis for calculations. Since 2019, the resurveys show a relatively large rate of movement at McCarty, Negyev, and Oates faults which is above the average historical rate of movements.

Table 26 shows the allowable displacement at each fault, the rate of the movement, which is calculated in four different ways, and the time to reach the allowable displacement based on each of those four rates. The rate of movement for each fault is determined using the following four methods:

- Historical rate: Linear regression of the recorded fault movements over the whole monitoring period.
- Short-term rate: Linear regression of the recorded fault movements over the last two years. This reflects the short-term trend at the fault line and shows if recent movement requires closer monitoring or not.
- Current rate: Dividing the last recorded fault movement (plus measurement error) by the total number of years monitored. This indicator combines the long-term effect and the latest fault motion.
- Max potential rate: Dividing the maximum recorded fault movement (plus measurement error) by the total number of years monitored. This is an indicator to incorporate the maximum fault motion.

The time to reach allowable displacement for each fault shown in the last column of Table 26 is obtained by dividing the allowable displacement by the rate of movement. This is the total time from when the pipe is free of stress (caused by fault movement) to the final failure.

Table 26. Summary of Estimated Allowable Fault Displacement at Faults

Fault	Allowable Displacement (inch)	Average Rate of Movement (inch/year)				Time to Reach Allowable Displacement (years)			
		long-term[ii]	short-term[iii]	current[iv]	potential max[v]	long-term	short term	current	potential max
Akron	4.17	0.002	0.031	0.005	0.019	2422	136	875	219
Melde	4.13	0.003	0.010	0.006	0.011	1401	399	642	365
Breen	1.50	0.002	0.009	0.008	0.011	876	161	197	140
Hockley[i]	1.25	0.014	0.037	0.021	0.023	87	34	58	55
McCarty	0.95	0.010	0.034	0.021	0.021	99	28	46	46
Negyev	2.65	0.001	0.025	0.012	0.019	1866	106	222	139
Oates	2.65	0.003	0.012	0.018	0.016	819	218	144	163

[i] Following the December 2018 fault monitoring, Magellan performed maintenance activities to relieve stress on the pipeline near the Hockley fault.

[ii] Average of movement over the monitoring period.

[iii] Average based on the last two years.

[iv] Based solely on the last recorded fault movement.

[v] Based on the maximum recorded fault movement.

Calculations based on the long-term historical rate of movement indicate that all the faults, except Hockley and McCarty, continue to move slowly. The pipeline crossing those faults has more than 100 years to reach the allowable displacement.

In some cases, the long-term historical rates appear to be less conservative estimates of time to potential failure. Hence, Kiefner also computed three additional assessments for each fault by considering the behavior of the fault during the last two years as well as its last recorded displacement and the maximum displacement it has experienced during the monitoring years. These assessments reveal that Akron, Melde, Breen, Hockley, McCarty, and Negyev faults have been more active lately. In recent years, the relatively large displacement at the Akron fault grants closer monitoring. Since the pipeline crossing the Akron fault allows for a relatively large displacement at the fault location (4.17 inches), the semi-annual survey would be sufficient for now. At the Melde and Breen faults, higher recent rates of movements than the historical rate suggest continuous semi-annual monitoring is required at these faults. The shortest time to reach allowable displacement at the Hockley fault is calculated as 34 years. Following the December 2018 fault monitoring, Magellan performed maintenance activities to relieve strain on the pipeline near the Hockley benchmark. Given this intervention, semi-annual monitoring would be sufficient.

Since December 2019, the resurveys show large activity in the McCarty fault. Based on the short-term trend of movement and the small allowable displacement at the pipeline crossing this fault, the time to reach allowable displacement is found to be 28 years. Kiefner recommends a 3-months interval resurvey compared to the default semi-annual frequency at McCarty fault due to such high activities. In Negyev and Oates, the shortest time to reach allowable displacement is found to be more than 100 years. This indicates that the pipelines crossing is far from approaching the acceptance limits at these two faults; nevertheless, Kiefner recommends continuing the semi-annual resurveys. According to the U.S. Geological Survey of September 2005[23], there are documented cases of fault movement reinitiating.

It should be noted that Section 6.4 on Aseismic Faulting/Subsidence Hazards in Appendix 9E of the EA (Reference [5]) estimated the rates of movement on the order of 0.20 inch/year based on field observations at the top four faults listed in Table 26. Actual measurements over the past 16.5 years show rates that are less than an order of magnitude of the estimates from the EA. Thus, one of the original reasons for monitoring these four faults was overly conservative in estimating fault movement rates.

2.4.4 Waterway Inspections and Depth-of-Cover Program

Since 2015, Magellan has conducted annual waterway inspections to survey the depth-of-cover (DOC) of the pipeline at the five water crossings (Colorado River, Pin Oak Creek, Cypress Creek, Greens Bayou, and Brazos River). The pipeline has been buried deep below the Brazos River and Colorado River crossing via horizontal direction drilling (HDD).

In 2020, Onyx Services (Onyx) performed a DOC survey on the 20" East Houston to Satsuma line segment at the Greens Bayou crossing in Harris County. The Onyx inspection report indicated no exposures. However, a minimum DOC of 1'-11" at the channel center with a maximum DOC of 3'-8" was observed for the Greens Bayou crossing. A priority level of 3 was indicated, with a proposed recommendation to re-inspect the crossing before October 2023. Magellan plans to address the Greens Bayou crossing in 2021.

Onyx Services performed a DOC survey of the East Houston to El Paso 18" (Longhorn) Line crossing Pin Oak Creek in Bastrop County, Texas, on March 30, 2019, including waterway banks. The survey found 5 feet of exposed pipeline off the west bank. The pipeline has a maximum DOC of 4 feet at the east bank's water's edge. An inspection conducted in 2017 indicated no exposed pipelines at Pin Oak Creek and Cypress Creek Crossing. However, a shallow cover at the Pin Oak Creek Crossing and an exposed segment at the Cypress Creek Crossing were reported.

Flood monitoring should be conducted periodically to identify existing and potential problem areas, especially for lack of coating at flooded regions. Flood monitoring was not conducted in 2020 and should be undertaken in the future to make sure the pipeline integrity is not compromised. Weather events like tropical depressions and hurricanes may aggravate the flooding, and additional monitoring should be done after such major weather events to ensure the pipeline's integrity is not jeopardized.

2.5 Damage Prevention Program

The Longhorn Damage Prevention Program far exceeds the minimum requirements of federal or Texas State Pipeline Safety Regulations, and it represents a model program for the industry. Damage prevention and inspection activities that continued to be successful in 2020 include ROW surveillance, One-Call System, and public-awareness activities. The aerial surveillance and

[23] Verbeek, E.R., Ratzlaff, K.W., Clanton, U.S., Faults in Parts of North-Central and Western Houston Metropolitan Area, Texas, U.S. Geological Survey, September 2005.

ground patrol frequencies for ROW surveillance exceeded the frequencies outlined in the LMP, with one exception due to severe weather and poor visibility in October of 2020. If three or more one-call violations occur on any 25-mile pipeline segment within 12 months, an ILI tool should be run. These ILI assessments are required per the ORAPM using EGP and high-resolution MFL or UT tools. LMC 12A requires that ILI assessments for TPD detection between Valve J-1[24] and Crane Station be performed within three years of the previous inspection. EGP inspection tools were run in 2020 on eight sections from Texon to Warda and Buckhorn to Satsuma. For specific inspection dates to fulfill the requirement for each of these 12 intervals spanning the Existing Pipeline from Crane to East Houston, see Section 5, Table 34 on Integration of Intervention Requirements.

2.5.1 Third-Party Damage

TPD refers to accidental or intentional damage by a third party; that is, not the pipeline operator or subcontractor – that causes an immediate failure or introduces a weakness (such as a dent or gouge) in the pipe. A pipelines susceptibility to third-party excavation damage is dependent on characteristics such as the extent and type of excavation or agricultural activity along the pipeline ROW, the effectiveness of the One-Call System in the area, the amount of patrolling of the pipeline by the operator, the placement and quality of ROW markers, and the DOC over the pipeline. In all cases, different threats could exist at different locations along the pipeline.

The annual Third-Party Damage Prevention Program Assessment contains information and data specific to the Longhorn pipeline. Including the number of detected unauthorized ROW encroachments, changes in activity levels and one-call frequency, physical hits, near-misses, DOC, and repairs that occurred along the pipeline. Potential TPD such as dents, scrapes, and gouges detected by both ILI tools and maintenance activities are also part of this assessment.

Kiefner received a complete log of aerial patrol and ground patrol reports for 2020. Each patrol report includes the date of inspections, the date of the previous inspection, the number of inspections year-to-date (YTD), ROW miles covered, and deadhead miles, in addition to the observations of the patroller. These observations range in significance from those that have no impact on the ROW to those that could damage the pipeline without the intervention of the pipeline operator. Each patrol report is identified by location (MP), by the inspection date, and whether or not there has been an emergency observation. In addition to the observations, these planned actions are recorded as well.

Based on a review of the TPD data and a review of the 2020 Third-Party Damage Annual Assessment, Kiefner concluded:

- There was one physical hit to the pipeline as a result of a one-call violation.
- There was one ROW near-miss (the same incident that resulted in the physical hit).
- There was one one-call violation.
- There was an increase of approximately 26% in aerial patrol observations.
- There was one unauthorized encroachment recorded.

[24] Valve J-1 is no longer in service. ILI assessments for TPD are currently performed from E. Houston to Crane.

- One-call frequency decreased by 19%, and the number of tickets sent to Field Operations for clearing/locating decreased by 19% from 2019 to 2020.

2.5.2 ROW Surveillance

Total possible surveillance mileage includes the 694-mile mainline plus the 29-mile lateral from Crane to Odessa and the four 9.4 mile laterals from El Paso Terminal to Diamond Junction. The 3.5-mile double lateral from East Houston to MP 6 added to the patrol mileage in 2011. Tier-II and Tier-III areas from Galena Park to Pecos River (Segment 301) must be inspected every 2½ days, not exceeding 72 hours. The Tier-I area from the Pecos River to El Paso (Segment 303) needs to be inspected once per week, not exceeding 12 days, and at least 52 times per year. Daily patrols are also required over the Edwards Aquifer Recharge Zone (MP 170.5 to 173.3), with one patrol per week to be a ground-level patrol. To meet the minimum ROW surveillance mileage, Magellan would need to perform 64,560 miles of aerial patrol for the Galena Park to MP 528 segment and 8,153 miles of aerial patrol from MP 528 to 694. For ground patrol, Magellan would need to perform a minimum of 583 miles in the Edwards Aquifer area.

The pipeline ROW was flown over daily from the Galena Park to Pecos River (MP 528) segment (weather permitting) as well as weekly from the Pecos River (MP 528) to the El Paso Terminal (MP 694) segment (weather permitting). In addition, regular ground patrols were made in the Edwards Aquifer Recharge Zone (MP 170.5 to 173.3), weather permitting. Table 27 shows the 2020 cumulative miles of patrols for these three areas listed by month.

Table 27. Cumulative Miles of Patrols

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Tiers II & III: Aerial Patrol (every 2.5 days, not to exceed 72 hours)													
301: Galena Park to MP 528	11,282	6,790	11,142	8,448	13,055	13,029	12,810	16,251	8,547	11,747	12,670	14,240	**140,008**
Tier I: Aerial Patrol (once/week, not to exceed 12 days)													
303: MP 528 to 694	789	929	1,052	1,315	1,052	1,315	1,052	1,052	1,316	819	1,052	1,841	**13,584**
Ground Patrol (once/week)													
Edwards Aquifer: MP 170.5 to 173.3	55	55	55	55	55	55	55	55	55	55	55	55	**660**

Magellan met the Longhorn commitment to inspect Tier I areas from the Pecos River (MP 528) to the El Paso Terminal (MP 694), including the El Paso Laterals, at least once a week. The Annual Third-Party Damage Prevention Program reported one unauthorized ROW encroachment.

2.5.3 One-Call Ticket Analysis

In 2020 there were 15,789 one-call tickets, of which 63.5% of the required "field locates" were potential ROW encroachments. There was one one-call violation during the 2020 year. The violation was due to a contractor boring further than was agreed upon during locate activities.

The ORA Process Manual requires that in any 25-mile pipeline segment where three or more one-call violations occur within 12 months, an ILI tool capable of detecting TPD should be run.

Based on this requirement, no additional ILI inspections regarding TPD are required. No additional direct examinations are recommended at this time.

Magellan is effectively screening the one-calls and separating them based on the location, information associated with each "ticket," and the likely encroachments from the "no locates" (one-call locations that are sufficiently remote from the ROW to assure that no effort is needed to mark the location of the pipeline).

Most one-call tickets continue to occur in Harris and Travis counties. Harris County (Houston) accounted for 3943 (25%) of the one-call tickets, while Travis County (Austin) accounted for 887 (6%) of the one-call tickets. Thus, 31% of the one-call notifications on the pipeline occurred in these large metropolitan areas. These two areas present the greatest potential for third-party damage based on those data. El Paso has the next highest number of one-calls with 273 tickets (2%).

2.5.4 Public Awareness

The Longhorn Public Awareness Plan incorporates various activities to reach stakeholder audiences and provide them with damage prevention information. The damage prevention information includes annual mailings, emergency response/excavator meetings, door-to-door visits, meetings with emergency response agencies, school presentations, public service announcements, and safety information provided on the Magellan website. Magellan's website is a communication tool used to inform the public about pipeline safety, damage prevention, and mitigation measures. There was a total of 2,867 website visits in 2020, with an average view time of 56 seconds.

2.5.5 Encroachment Procedures

Encroachments are entries to the pipeline ROW by persons operating farming, trenching, drilling, or other excavating equipment. Removing debris and other obstructions along the ROW to facilitate prompt access to the pipeline for routine or emergency repair activities is also considered an encroachment.

The SIP includes provisions for surveillance to prevent and minimize the effects of unannounced or unauthorized ROW encroachments. Magellan conducted four incident investigations as part of the SIP, none of which were associated with Third-Party Unauthorized Encroachment.

There was only one unauthorized encroachment during 2020 and was followed up with corrective actions to help prevent a recurrence. There was no damage to the pipeline. When followed by the encroaching party, the encroachment procedures have been effective at preventing TPD to the pipeline.

2.6 Stress-Corrosion Cracking (SCC)

SCC is a form of environmental attack on the pipe steel involving the interaction of a local corrosive environment and tensile stresses in the metal resulting in the formation and growth of cracks. The Longhorn Pipeline has not identified SCC as a threat but added SCC as a threat since SCC has been an unexpected problem for some pipelines. In the 71 years, the existing pipeline has been in operation, there have been no SCC failures, and no SCC has been discovered at any location on the pipeline.

Per the LMC 19(a) and the 2003 Office of Pipeline Safety (OPS) Advisory Bulletin ADM-05-03 "Stress-Corrosion Cracking (SCC) Threat to Gas and Hazardous Liquid Pipelines," Longhorn was required to inspect for SCC for the first three years (2005-2007) by selecting specific sites most susceptible to SCC. Subsequent inspection for SCC has been continued by Magellan as a supplemental examination when the pipe is exposed and examined for other reasons, such as ILI anomaly excavations.

In 2020 Magellan continued checking the exposed pipe surface for SCC using magnetic particle testing during ILI investigation digs. Magnetic particle inspection is conducted on the entire pipe circumference between coating cuts. The coating is typically removed a couple of feet to either side of the ILI target anomaly. If multiple ILI target anomalies within a single joint, the coating is typically removed for the entire distance between anomaly targets (unless the two target anomalies are at extreme opposite ends of the joint). Since no evidence of SCC has been detected, it is not necessary to recommend an intervention measure. Magellan will continue to monitor this threat through their current method, which consists of looking for evidence of SCC when maintenance excavations are performed.

2.7 Threats to Facilities

Threats to facilities address the operational reliability of facilities other than line pipe, including pump stations, terminals, and associated mechanical components. Magellan monitors the integrity of these facilities through scheduled maintenance and inspection activities prescribed by the SIP. The SIP Mechanical Integrity Program focuses on maintaining the integrity of all equipment within the Longhorn system (e.g., station pumps, tanks, valves, and control systems). The program includes the following activities:

- Identification and categorization of equipment and instrumentation
- Inspection and testing methods and procedures
- Testing acceptance criteria and documentation of test results
- Maintenance procedures and training of maintenance personnel
- Documentation of specific manufacturer recommendations

Magellan implements their preventive maintenance program through its Enviance/Compliance Management System. This software system establishes an inspection and maintenance schedule for equipment items in the Longhorn System and can be adjusted based on the risk level. An Action Item Tracking and Resolution Initiative (database) provides a method of tracking mechanical integrity recommendations.

A Facility Risk Management Program is in place to manage the risks at above-ground facilities. The LMP requires that all changes on the Longhorn system be evaluated using an appropriate PHA methodology and that the change be assessed to ensure that the appropriate risk mitigation levels on the system are maintained. PHAs are also conducted on a 5-year interval to evaluate and control the hazards associated with the Longhorn facilities. No PHAs were completed in 2020.

Facility inspections addressing items related to safety, security, and environmental compliance are conducted regularly. Staffed facilities are inspected once a year; unstaffed facilities are inspected every two years. Pump stations located in sensitive and hypersensitive areas are inspected every two and one-half days. Technicians are onsite on a regular basis to perform routine maintenance and operation activities. Technicians are also on-call to respond to emergencies or other operational events at any time. Additionally, remote cameras are in place for monitoring purposes. Atmospheric Inspection surveys are conducted annually at pre-assigned above-ground piping and facilities. Kiefner received 11 facility inspection reports, as listed in Table 28.

Table 28. Facility Inspections received in 2020

Facility	Inspection Date
Bastrop	5/21/2020
Buckhorn	5/12/2020
Cartman	5/4/2020
Cedar Valley	5/19/2020
Cedar Valley	5/5/2020
Eckert	10/31/2020
James River	6/18/2020
Kimble	5/5/2020
Satsuma	5/13/2020
Warda	5/12/2020
Crane Terminal	10/28/2020

From the standpoint of facility data acquired for 2020, one can conclude that the facilities were well maintained. However, additional emphasis is needed to reduce operational errors. Kiefner recommends that Magellan continue its detailed documentation of incidents, its facility integrity processes, and its reporting of the facility maintenance program.

2.8 Incident Investigation Program and Incorrect Operations Mitigation Program

Magellan performs incident investigations on all incidents and near-misses whether or not they are all Department of Transportation (DOT)-reportable[25]. For each of these incidents, corrective actions were implemented following Magellan's incident investigation report and were provided to PHMSA. Magellan should continue to record all relevant data on incident data reports, including a detailed description of the incident, root cause, and contributing factors to help improve the overall effectiveness of the incident investigation program.

In addition to their incident investigation program, Magellan also implements an Incorrect Operations Mitigation Program to identify and reduce the likelihood of human errors that could

[25] DOT-Reportable Requirement**.** A "PHMSA (or DOT) reportable incident" is a failure in a pipeline system in which there is a release of product resulting in explosion or fire, volume exceeding 5 gallons (5 barrels from a pipeline maintenance activity), death of any person, personal injury necessitating hospitalization, or estimated property damage exceeding $50,000.

impact the mechanical integrity of the Longhorn Pipeline System. "Incorrect Operations" is described as incorrect operation or maintenance procedures or a failure of pipeline operator personnel to follow procedures correctly.

There were four Longhorn system incidents in 2020; one incident was classified as significant, while the other three were minor incidents. None of these incidents were DOT reportable. These incidents were all formally documented and investigated. Corrective actions were implemented following Magellan's incident investigation report.

The significant incident occurred on July 9, 2020, involving incorrect operations at the El Paso to Albuquerque location. While performing their daily walk down after shift turnover, local operations noticed that the tank 6 manifold valve on the 3" gas return line was left partially open. Although the valve indicator showed that the valve was closed, the operator was able to turn the T-handle one and a half more times. This incident resulted in the transmix leaking into the float operation to Albuquerque. Further investigation into this incident revealed that the Tank 6 valve indicator was broken, resulting in the valve being left partially open. Although no exact cost was specified for the property damage from the incident, it is estimated between $25,000 and $500,000.

The three remaining incidents were all classified as minor. One incident involved the damage of a pipe plug that exited the 24-inch pipe after too much nitrogen pressure built up when the hose supplying the N2 became kinked. The other two incidents involved the accidental release of products into concrete and soil. One was due to the backup and overfill of drainage pots during maintenance. For information regarding response times, volumes, and costs on this incident, see Section 3 Table 32. The other release incident was a pump seal failure on a delivery truck. Although these incidents resulted in a product release, they were not DOT reportable.

2.9 Risk Analysis Program

In the SIP, two functions address Risk on the Longhorn Pipeline system: 1.) Key Risk Areas Identification and Assessment, 2.) Scenario-Based Risk Mitigation Analysis. The objective of Magellan's Key Risk Areas Identification and Assessment program is to ensure that resources are focused on those areas of the Longhorn Pipeline System with the highest identified or perceived risks. While the objective of Magellan's Scenario-Based Risk Mitigation Analysis program is to identify preventive measures and/or modifications that can be recommended that would reduce the risks to the environment and the population in the event of a product release. The Key Risk Area Identification and Assessment Program results are incorporated into the Scenario-Based Risk Mitigation Analysis Program.

2.9.1 Key Risk Areas Identification and Assessment

The Longhorn Pipeline System traverses various unique areas of land use, topography, and population density; it presents a variety of risk concerns to these lands and to the people who either inhabit or are present in these areas. To help prioritize risk management efforts, Magellan has categorized the Longhorn Pipeline System with the following designations:

- Tier I – normal cross-country pipeline

- Tier II – sensitive areas
- Tier III – hypersensitive areas

Further, the area across the Edwards Aquifer in South Austin is a Tier III designated area of additional heightened environmental sensitivity that has resulted in even more scrutiny and the commitment to incremental risk mitigation measures.

Magellan's probabilistic risk model utilizes integrated data and incorporates a dynamic segmentation process to maintain adequate resolution and avoid mischaracterization or loss of detail. The risk measurement methodology includes a POF threshold management to manage pipeline integrity and evaluate risk in accordance with 49 CFR 195.452. The POF measurement integrates all available information about the integrity of the pipeline. This integration aids in the identification of preventive and mitigation measures to protect areas along the pipeline.

The LMP risk management plan commitment is to maintain pipeline-related failure rates at or below a probability level of 1 in 10,000 (0.0001) per mile-year. The scenario-based risk mitigation analysis (SBRMA) for the 2018 operating year was performed in 2019. The results show that none of the pipeline segments exceeded the risk threshold; therefore, no additional mitigation measures were required or recommended.

Magellan enhanced its Facility Integrity Management Program (FIMP) in late 2018 and early 2019 and began conducting more rigorous integrity evaluations for its surface facilities and equipment in 2019. In 2020, Magellan implemented a new FIMP element of its Asset Integrity Plan. The FIMP requires a detailed FRA, which provides risk analysis and re-inspection interval recommendation based on an assessment of data from the various FIMP elements in place to protect the integrity of the facility. The FRAs are prioritized on a risk-based schedule. Magellan completed FRAs for 12 LPS facilities in 2020. FRAs focused on leak detection, mechanical integrity, prime equipment, corrosion control, operating pressure programs, fire safety, and re-inspection intervals.

2.9.2 Scenario-Based Risk Mitigation Analysis

The primary focus of Magellan's scenario-based risk mitigation analysis is mechanical integrity, operating controls, and prevention of TPD. The pipeline risk model was updated with information from operations in 2020 and executed. Results show no areas along the pipeline with POF greater than $1E^{-4}$ failures and, as such, supports the effectiveness of Magellan's existing Integrity Management Program.

2.10 Management of Change Program

Magellan has established an effective program to manage changes to process chemicals, technology, equipment, procedures, and facilities across the Longhorn Pipeline System. The Longhorn Mitigation Plan requires that all changes on the Longhorn system be evaluated using an appropriate PHA. The Magellan Management of Change Request (MOCR) process helps identify changes that impact the LMP. In 2020 Magellan had 67 MOCRs on the Longhorn Pipeline System, 26 of the 67 were determined to have some impact the LMP. Per the Self-Audit Report, all 26 MOCRs had detailed reports and were reviewed by the appropriated impacted Magellan personnel and/or departments.

2.11 System Integrity Plan Scorecarding and Performance Metrics Plan

Magellan has implemented an effective method for evaluating the effectiveness of the SIP on an annual basis using performance measures (or scorecarding) from three categories:

- Activity measures – proactive activities aimed at preserving pipeline integrity;
- Deterioration measures – evidence of deterioration of pipeline integrity; and
- Failure measures – occurrences of failures or near-failures.

The technical assessment of the SIP indicated that Magellan is achieving the goal of the SIP, namely, to prevent incidents that would threaten human health or safety or cause environmental harm. Magellan exceeded the minimum required mileage for both aerial surveillance and ground patrol. In addition, ROW markers and signs were repaired or replaced where necessary, and public-awareness meetings were held (Table 29). In the Houston area, four schools participated in the "Safe at Home School Program" that Magellan offers. Due to COVID-19 concerns, Austin schools participated in an online survey that tied in with the "Pipelines All Around You" presentation. A total of 21 elementary schools participated.

Regarding metal loss deterioration measures, 95 metal loss features met POE dig requirements from the 2020 ILI runs. In terms of failure measures, there were no DOT-reportable incidents but there was one physical hit to the pipeline as a result of a one-call violation.

Table 29. Educational and Outreach Meetings

EVENT	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Emergency Responder / Excavator Meetings	14	12	11	11	11	11	11	11	11	25	30	30	16	16	24	25
School Program - Houston	2	2	3	4		6	5	6	1	3	4	4	5	5	5	4
School Program - Austin	3	2	7	3	4	3	4	5	5	2	2	2	3	2	3	
Texas Statewide School Pipeline Safety Outreach													16	3	30	
Neighborhood Meetings	2	2														
Misc. Meetings:													*	*	*	*
Creekside Nursery	1															
Cy Fair ISD	1															
Region 6 LEPC Conference (Houston)	1															
Public Events	4		4	3	2	2							*	12	12	17
TOTAL	28	18	25	21	17	22	20	22	17	30	36	36	24	38	75	46

NOTE: Public meetings were tallied for the years 2005-2020 as follows:

- Emergency Responder / Excavator Meetings: Count only the number of meetings (not the total number of counties).
- School Program: Houston Program - count the schools that request the Safe at Home Program; Austin Program - count only schools where Longhorn/Magellan gave presentations.
- Texas Statewide: Texas School Safety Conference
- Neighborhood Meetings: Phased out in 2007 and replaced by enhancements to the school programs and public events.
- Misc. Meetings: Count all other meetings that are not public events (i.e., daycares, church meetings, public speaking engagements, etc.).
- Public Events: Count events such as rodeos, county fairs, fundraisers, home shows, Safety Day Camps, etc.

*Refer to the 2020 TPD Annual Assessment for details.

3 OVERALL SIP PERFORMANCE MEASURES

The LMP describes the philosophy of the SIP. By this philosophy, Magellan commits to "constructing, operating and maintaining the Longhorn Pipeline assets in a manner that ensures the long-term safety of the public, and to its employees, and that minimizes the potential for negative environmental impacts." The ORAPM provides a method for evaluating the effectiveness of the SIP on an annual basis using performance measures (or scorecarding) from three categories (listed below). The 2020 status of each of these measures is evaluated in Sections 3.1 through 3.3.

- Activity measures – proactive activities aimed at preserving pipeline integrity
- Deterioration measures – evidence of deterioration of pipeline integrity
- Failure measures – occurrences of failures or near-failures

3.1 Activity Measures

The activity measures are metrics that monitor the surveillance and preventive activities that Magellan has implemented during the period since the preceding ORA. These measures provide indicators of how well Magellan is implementing the various elements of the SIP; Table 30 summarizes the SIP Activity Measures from 2005 through 2020. The activity measures are:

- The number of miles inspected in 12-months by aerial and ground survey (per pipeline segment). The minimum patrol mileage needed for ROW aerial surveillance to meet this requirement is 64,560 miles for Galena Park to MP 528 and 8,153 miles for MP 528 to 694. For ground patrol, 583 miles are needed for the Edwards Aquifer area. This metric is compared to the previous 12-month period. Magellan met this commitment in 2020.
- The number of warning or ROW identification signs installed, replaced, or repaired 12-months. The metric is compared to previous Magellan performance. This metric is used to measure consistent effort by Magellan to protect the ROW and to prevent TPD. There is no "passing grade" because proper placement and maintenance of signs may lead to fewer signs being replaced or repaired in future years, and this decline will not indicate any failing on the part of Magellan. On the other hand, tracking the replacement or repair of signs by pipeline segment may indicate third-party vandalism or carelessness in certain segments of the system, which could be used as a leading indicator that additional public education might be needed in that region of the pipeline route.
- The number of outreach or training meetings (listed with locations and dates) to educate and train the public and third parties about pipeline safety. This metric is used to gauge consistent effort by Magellan to educate the public regarding pipeline safety, to prevent TPD to the pipeline. There is no "passing grade," although comparing the results from this metric with sign placement, repair, and replacement can be used to see if public education is being emphasized in the same geographic region where sign maintenance indicates problems.
- The number of calls into the one-call system to mark or flag the Longhorn Pipeline (sorted by Tier-I, Tier-II, or Tier-III). This is completed to measure the effectiveness of the one-call system in preventing TPD. The measure is compared to previous years of Magellan records. Since this is a metric that is not subject to control by Magellan, there

is no "passing grade." However, this metric can be compared to encroachments allowing an overall measurement of how efficiently the one-call process is being used.

Table 30. System Integrity Plan Activity Measures

Year	Measure		
	Miles of pipelines inspected by aerial and ground survey (73,296 mi required)	*No. of warning or ROW identification signs installed, replaced, or repaired*	*No. of outreach or training meetings to educate and train the public and third parties about pipeline safety*
2005	203,081	979	28
2006	197,234	732	18
2007	188,884	237	25
2008	187,931	536	21
2009	181,308	460	17
2010	180,045	291	22
2011	188,564	76	20
2012	188,722	66	22
2013	179,107	539	17
2014	176,884	266	30
2015	175,920	130	36
2016	173,996	315	36
2017	162,030	194	24
2018	152,322	105	24
2019	160,553	93	33
2020	154,252	195	29

3.2 Deterioration Measures

Deterioration measures are metrics that evaluate maintenance trends to indicate when the system's integrity could be seen as potentially declining despite preventive actions. Table 31 provides a summary of the deterioration measures from 2006 through 2020. In 2020 there were:

- Twelve immediate conditions, all ID Reductions with metal loss, defined by the SIP and 49 CFR 195.452.
- Ninety-five ILI reported metal loss features met POE evaluation dig requirements in 2020.
- Hydrostatic test leaks per mile have not been an indicator of performance because no hydrostatic reassessment tests have been performed for pipeline integrity purposes.

The monitoring and excavation program should continue to address significant ILI reported anomalies, and POE calculations should continue to be performed.

Table 31. System Integrity Plan Deterioration Measures

Measure		2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Number of immediate ILI anomalies per mile pigged		0.029	0.0203	0.038	0.004	0	0	0	0	0	0	0.004	0	0	0	0	0.036
Number of immediate ILI anomalies, per mile pigged, sorted by tier classification	Tier I	NA	0.0212	0.035	0.006	0	0	0	0	0	0	0	0	0	0	0	0.012
	Tier II	NA	0.0208	NA	NA	0	0	0	0	0	0	0.004	0	0	0	0	0.024
	Tier III	0.192	NA	0.003	NA	0	0	0	0	0	0	0	0	0	0	0	0
Total number of anomalies per hydrostatic tests*		N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Number of POE Evaluations per mile pigged		1.48	0.54	0.69	0	0.017	0.14	0.035	0.025	0.033	0.017	0.013~	0	0	0.067	0.15	0.28^

*Hydrostatic tests were performed for pipeline commissioning purposes.
~POE calculations only performed on the MFL assessments; the number of POE evaluations per mile pigged did not include the TFI mileage.
^The number of POE evaluations per mile pigged did not include the UCD mileage.

3.3 Failure Measures

Failure Measures are generated from leak history, incident reports, incident responses, and product loss accounting. These metrics can be used to gauge progress towards fewer spills and improved response or to measure the deterioration of overall system integrity. These measures are listed below in Table 32. Response times, volumes, and costs are for DOT-reportable leaks. Service interruptions reported during 2020 are shown in Table 33.

Table 32. System Integrity Plan Failure Measures

Measure		2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Number of leaks (DOT-reportable)		2	0	1	3	0	1	2	0	2	2	0	0	3	1	0	1
Average response time in hours for a product release.	Tier I	Immed.	NA	Immed.	Immed.	NA	Immed.	Immed.	NA	Immed.	Immed.	NA	NA	Immed.	Immed.	N/A	Immed.
	Tier II	NA	NA	NA	NA	NA	NA	NA	NA	Immed.	Immed.	NA	NA	NA	NA	N/A	N/A
	Tier III	NA	NA	NA	NA	NA	NA	NA	NA	Immed.	Immed.	NA	NA	Immed.	NA	N/A	N/A
Average product volume released per incident (bbl)	Tier I	5.7	0	5.7	0.4	0	0.4	1.2	NA	0.47	2.74	0	NA	1048	282	0	0.24
	Tier II	0	0	0	0	0	0	0	NA	0	0	0	NA	NA	NA	0	0
	Tier III	0	0	0	0	0	0	0	NA	4	0	0	NA	28	NA	0	0
Total product vol. released in the 12-month period (bbl)	Tier I	17	0	5.7	1.3	0	0.4	2.5	NA	0.47	5.48	0	NA	2096	94	0	0.24
	Tier II	0	0	0	0	0	0	0	NA	0	0	0	NA	NA	NA	0	0
	Tier III	0	0	0	0	0	0	0	NA	4 bbls	0	0	NA	28	NA	0	0
Cleanup cost totals per year		< $100k	$0	< $200k	< $150k	0	< $50	< $50	NA	> $100k	< $25	0	NA	>$528k	$7.2M	<$500K	$500
Cleanup cost per incident		< $35k	NA	< $200k	< $50k	0	< $50	< $25	NA	< $25k < $50k > $100k	< $25	0	NA	$28k $500k No info	$7.2M	<$500K	$500
Reports from aerial surveys or ground surveys of encroachments into the pipeline ROW without proper one-call		1	0	1	3	3	1	1	2	2	0	3	2	4	5	4	1
Number of known physical hits (contacts with pipeline) by third-party activities		0	0	0	0	0	0	2	0	0	0	0	0	1	0	0	0
Number of near-misses to the pipeline by third parties		7	1	7	5	6	2	4	3	2	0	4	0	8	2	1	1
Number of service interruptions		115	165	155	74	16*	17	9	8	15	15	11	8	13	114	141	43

Table 33. Service Interruptions per Month for 2020

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Total
No./Month	3	0	4	7	3	6	4	1	5	4	3	3	**43**

4 INTEGRATION OF INTERVENTION REQUIREMENTS AND RECOMMENDATIONS

4.1 Integration of Primary Line Pipe Inspection Requirements

Section 11 of the ORAPM specifies integration of primary line pipe inspection requirements addressing corrosion, fatigue-cracking, lamination and hydrogen blisters, TPD, and earth movement. Magellan has four remediation commitments for using ILI for the pipeline: LMC 10, LMC 11, LMC 12, and LMC 12A. These commitments required Magellan to: use an MFL tool for corrosion inspection in the first three months of operation; a TFI tool for seam inspection (which includes hook cracks and preferential seam corrosion) within the first three years of operation; a UT wall measurement tool within the first five years of operation for inspection of laminations and detection of blisters; and an EGP tool at least every three years for inspection of TPD to the pipe. Future inspection requirements are based on reassessment interval procedures set by the ORAPM, with the additional requirement that EGP tools must be run at least every three years.

There is overlap in anomaly detection capabilities of the various commercially available ILI tools and considerable variability in vendor availability. As each cycle of the ORA is performed, additional data will become available not only from ILI tools but also from routine maintenance reports and ILI anomaly investigation reports. The ORA process will integrate these data continuingly to minimize the level of risk to the pipeline system integrity from each of the identified failure modes. To maintain and further reduce risk where possible, the ORA will identify and recommend the most appropriate ILI technology to obtain the necessary additional information. The use of one ILI tool technology may satisfy multiple inspection requirements for a pipe segment. The tools Magellan has committed to using have multiple capabilities.

Table 34 and Table 35 present the most recently completed ILI assessment and note requirement dates for future planned assessments for the crude and refined pipelines, respectively. The required reassessments are specified per the ORAPM. Reassessment requirements for pressure-cycle-fatigue crack growth reassessment intervals were based on the analysis performed in Section 2.1 Fatigue Analysis and Monitoring Program. Reassessment requirements for corrosion and TPD are based on the most recent inspection date; corrosion inspections are required to be run every five years, while TPD is required every three years for the crude line and five years for the refined line. Earth movement, the fifth component for threat integration, is not included in Table 34 because it is currently addressed using surface surveys rather than ILI technology. For a complete listing of all ILI assessments on both the crude and refined pipelines, refer to the 2017 Longhorn ORA Final Report.

Table 34. Completed ILI Runs and Planned Future ILI's for Longhorn Crude System

		E. Houston to Speed Jct	E. Houston to Satsuma	Satsuma to Buckhorn	Buckhorn to Warda	Warda to Bastrop	Bastrop to Cedar Valley	Cedar Valley to Eckert	Eckert to James River	James River to Kimble	Kimble to Cartman	Cartman to Barnhart	Barnhart to Texon	Texon to Crane
	Mileage	**0 to 10.8**	**2.35 to 34.1**	**34.1 to 68.0**	**68.0 to 112.9**	**112.9 to 141.8**	**141.8 to 181.6**	**181.6 to 227.9**	**227.9 to 260.2**	**260.2 to 295.2**	**295.2 to 344.3**	**344.3 to 373.4**	**373.4 to 416.6**	**416.6 to 457.5**
Assessments	**Corrosion**													
	Tool	Multi-Data	Multi-Data	TFI	TFI	TFI	TFI	TFI	TFI	TFI	TFI	TFI	TFI	TFI
	Date of Tool Run	2-Oct-14	1-Oct-14	18-Dec-15	16-Dec15	11-Dec-15	8-Dec-15	4-Dec-15	19-Aug-15	1-Sep-15	29-Aug-15	24-Aug-15	11-Aug-15	17-Jul-15
	Tool	GMFL	MFL		MFL									MFL
	Date of Tool Run	28-Aug-19	13-Aug-19		5-Nov-19									16-Oct-18
	Tool			MFL		MFL	MFL	MFL	MFL	MFL	MFL	MFL	MFL	
	Date of Tool Run			14-Jan-20		9-Jan-20	6-Jan-20	4-Feb-20	4-Mar-20	11-Aug-20	8-Jul-20	12-Jun-20	5-May-20	
	Pressure Cycle Induced Fatigue													
	Tool		TFI ‡	TFI	TFI	TFI	TFI	TFI	TFI	TFI	TFI	TFI	TFI	TFI
	Date of Tool Run		6-Jul-07	18-Dec-15	16-Dec-15	11-Dec-15	8-Dec-15	4-Dec-15	19-Aug-15	1-Sep-15	29-Aug-15	24-Aug-15	11-Aug-15	17-Jul-15
	Tool		UCD	UCD	UCD									UCD
	Date of Tool Run		16-Aug-19	6-Dec-19	8-Nov-19									19-Oct-18
	Tool					UCD	UCD	UCD	UCD	UCD	UCD	UCD	UCD	
	Date of Tool Run					28-Jan-20	16-Jan-20	4-Mar-20	11-Mar-20	31-Dec-20	31-Dec-20	16-Jun-20	15-May-20	
	Laminations & Hydrogen Blisters													
	Tool		UT	UT	UT	UT	UT	UT	UT	UT	UT	UT	UT	UT
	Date of Tool Run		22-Sep-09	24-Nov-09	24-Nov-09	24-Jan-10	24-Jan-10	20-Feb-10	25-Jun-10	25-Jun-10	25-Jun-10	8-Jul-10	8-Jul-10	8-Jul-10
	Third-Party Damage													
	Tool	Def.	Def.	Def.	Def.	Def.	Def.	Def.	Def.	Def.	Def.	Def.	Def.	Def.
	Date of Tool Run	2-Oct-14	14-Sep-17	13-Sep-17	12-Sep-17	4-Jan-18	3-Jan-18	7-Mar-18	6-Mar-18	27-Feb-18	22-Feb-18	20-Feb-18	16-Feb-18	16-Oct-18
	Tool	Def.	Def.		Def.									
	Date of Tool Run	28-Aug-19	13-Aug-19		5-Nov-19									
	Tool			Def.		Def.	Def.	Def.	Def.	Def.	Def.	Def.	Def.	
	Date of Tool Run			14-Jan-20		9-Jan-20	6-Jan-20	4-Feb-20	4-Mar-20	11-Aug-20	8-Jul-20	12-Jun-20	5-May-20	
	Next Required Assessment													
	Corrosion	28-Aug-24	13-Aug-24	14-Jan-25	5-Nov-24	9-Jan-25	6-Jan-25	4-Feb-25	4-Mar-25	11-Aug-25	8-Jul-25	12-Jun-25	5-May-25	16-Oct-23
	Pressure-Cycle Induced Fatigue	Not susceptible	2045	2046	2039	2035	2053	3-Jun-23	2043	2028	2040	2039	2037	29-Jun-24
	Third-Party Damage*	28-Aug-24	13-Aug-22	14-Jan-23	5-Nov-22	9-Jan-23	6-Jan-23	4-Feb-23	4-Mar-23	11-Aug-23	8-Jul-23	12-Jun-23	5-May-23	16-OCt-21

‡The TFI was used to remediate Phase I and Phase II corrosion anomalies and, in some cases, was used to remediate POE anomalies but was not used to set the next corrosion reassessment using the POE process.
*Per Longhorn EA section 9.3.2.3, EGP assessments are required every 3 years in accordance with the LMP. Deformations identified from these assessments will be correlated to the existing laminations found from the UT assessments.

Table 35. Completed ILI Runs and Planned Future Inspections for Longhorn Refined System

		Crane to Cottonwood	Cottonwood to El Paso	Crane to Odessa	8" El Paso to Chevron	8" Kinder Morgan Flush Line	8" El Paso to Strauss	12" El Paso to Kinder Morgan
	Mileage	457.5 to 576.3	576.3 to 694.4	0 to 29.26	0 to 9.4	0 to 9.4	0 to 9.4	0 to 9.4
Assessments	**Corrosion**							
	Tool			SMFL				
	Date of Tool Run			5-Oct-2016				
	Tool		MFL		SMFL	SMFL		SMFL
	Date of Tool Run		1-Nov-17		13-Jul-17	13-Jul-17		14-Jul-17
	Tool	MFL					MFL	
	Date of Tool Run	18-Apr-18					25-Oct-18	
	Third-Party Damage							
	Tool			Deformation				
	Date of Tool Run			5-Oct-2016				
	Tool		Deformation		Deformation	Deformation		Deformation
	Date of Tool Run		1-Nov-17		13-Jul-17	13-Jul-17		14-Jul-17
	Tool	Deformation					Deformation	
	Date of Tool Run	18-Apr-18					25-Oct-18	
Next Required Assessment								
	Corrosion	18-Apr-23	1-Nov-22	5-Oct-2021	13-Jul-22	13-Jul-22	25-Oct-23	14-Jul-22
	Pressure-Cycle Induced Fatigue	Not susceptible	Not susceptible	Not susceptible				
	Third-Party Damage	18-Apr-23	1-Nov-22	Oct-5-2021	13-Jul-22	13-Jul-22	25-Oct-23	14-Jul-22

4.2 Integration of DOT HCA Inspection Requirements

Magellan must be compliant with the DOT Integrity Management Rule, 49 CFR 195.452, for HCAs in addition to meeting the requirements in the LMP. The pipeline from 9th Street Junction to El Paso is under DOT jurisdiction, and the four laterals connecting El Paso to Diamond Junction and the lateral from Odessa to Crane.

The HCA rule states that an operator must establish 5-year intervals to continually assess the pipeline's integrity, not to exceed 68 months. An operator must base the assessment intervals on the risk the line pipe poses to the HCA to determine the priority for assessing the pipe. At this time, corrosion has proven to be the higher priority risk of the five threats to pipeline integrity. Because of the LMP requirements and the multiple capabilities of each of the required tools, the HCA line pipe between the 9th Street Junction and Crane has been inspected in intervals of less than five years. The HCA requirement will continue to be integrated into the ILI requirements as additional tool runs are completed to ensure the required 5-year interval is not exceeded.

LMC 12A requires an EGP tool to be run every three years on the existing pipeline (between Valve J-1 and Crane). This interval is due to a greater risk of mechanical damage to the existing pipeline. The existing pipeline is often buried shallower than 30 inches in depth below the surface because of burial requirements when the pipeline was built. The HCA requirement (49

CFR 195.452) for the new pipeline extensions requires an EGP tool to be run every five years. The risk for mechanical damage on the New Pipeline is less because the pipeline is buried at least 30 inches deep.

4.3 Pipe Replacement Schedule

There were no pipe replacements in 2020.

5 NEW INTEGRITY MANAGEMENT TECHNOLOGIES

5.1 Positive Material Identification Procedures

Magellan requires PMI tests to be completed for at least 50% of the digs performed on pipe that does not have material documentation. These tests are currently performed based on a process and procedure developed by T. D. Williamson to determine tensile strength, yield strength, and chemical composition in the field. Over time as technologies or processes improve, there may be a need to review the current procedures. This review should integrate industry knowledge and field experience to ensure all the data gathered is appropriate for making integrity decisions and managing overall resources. If there are new, more efficient technologies or equipment available to obtain information, these should be considered as well.

5.2 Crack and Linear Anomaly Prioritization Using API 579 Calculations

Cracks or crack-like anomalies are significant threats to the safety and structural integrity of pipelines. Various crack-assessment models have been developed and used within the pipeline industry to predict the burst capacity for pipelines containing longitudinally-oriented surface cracks. These models have different levels of conservatism, accuracy, and precision, which significantly impacts pipeline operators' integrity mitigation decisions such as pressure restriction, excavation, and repair and leads to different safety levels.

Several pipeline-specific methods include Ln-Sec, Modified Ln-Sec, PAFFC, CorLAS, and Mat-8, while a few generic methods include API-579, BS7910, and R6 methods. API-579 is typically popular as it uses the Failure Assessment Diagram (FAD) along with extended capabilities to calculate the stress intensity factor and reference stresses from various operating conditions. API-579 has a Level 1-3 crack assessment that can be used depending upon the operational and functional severities. Kiefner recommends using API 579 Level 2 approaches for assessing crack features as reported by ILI.

The accuracy of crack assessment models has been extensively studied by industry using various types of test data, model assumptions, and inputs. API 579 Level 2 Crack Assessment has yielded burst pressure with sufficient accuracy and desired conservatism. A crack is considered safe if the crack assessment point is inside the FAD and is considered unacceptable if the assessment point is outside the boundary. Modified Ln-Sec has also demonstrated comparable results for pipeline material but turns non-conservative for brittle materials or for seam weld anomalies (i.e., especially when the CVN is below 15 ft-lbs). CorLAS and Mat-8 approaches have also demonstrated acceptable and accurate burst pressure results, with a significant computational grind.

Kiefner has developed an API-579 Level 2 assessment to predict the burst pressure for circumferential and axially oriented flaws. In addition, there are several capabilities that ease the crack assessment and also justify whether a crack is safe or unacceptable. They are as follows:

1. Capability to use either US-customary or metric units.
2. Capabilities to obtain Fracture toughness using several conversions suited for upper shelf, lower shelf, and transition behavior
3. Obtain the burst pressure for circumferential and axially oriented cracks and compare Modified Ln-Sec and Raju-Newman approaches.
4. Obtain the stresses from a polynomial distribution, well suited for application where the stresses are not primarily from pressure. This functionality incorporates the presence of residual stresses, especially for seam weld anomalies.
5. Capabilities for infinite and finite-length through wall or surface cracks is also demonstrated
6. Sentence plot features showing the critical crack length for a given crack depth or critical crack depth for a given crack length are demonstrated to make justifiable claims for crack assessment.
7. Batch mode processing features to assess hundreds of cracks with one click.

Overall, the API-579 crack assessment approach is well suited for a wide range of applications with various operating scenarios, crack orientation, crack dimensions, and loading scenarios. These features are not present in pipeline-specific crack assessment approaches (Modified Ln-Sec, CorLAS, or Mat-8). Capabilities to obtain accurate burst pressure with brittle, ductile, or elastic-plastic material characteristics are well demonstrated with API-579 Level 2 Assessment that makes it more robust for a broad set of applications.

6 REFERENCES

1. Kiefner, J. F. and Mitchell, J. L., "Charpy V-Notch Impact Data for Six Samples of Seam-Weld Material from the Longhorn Pipeline," Kiefner and Associates, Inc., Final Report 06-6 to Longhorn Partners Pipeline Company, (January 19, 2006).
2. Kiefner, J. F., Johnston, D. C., and Kolovich, C. E., "Mock ORA for Longhorn Pipeline," Kiefner and Associates, Inc., Final Report 00-49 to Longhorn Pipeline Partners, LP (October 16, 2000).
3. Kiefner, J. F., Kolovich, C. E., Zelenak, P. A., and Wahjudi, T. F., "Estimating Fatigue Life for Pipeline Integrity Management," Paper No. IPC04-0167, Proceedings of IPC 2004 International Pipeline Conference, Calgary, Alberta, Canada (October 4-8, 2004).
4. Verbeek, E.R., Ratzlaff, K.W., Clanton, U.S., Faults in Parts of North-Central and Western Houston Metropolitan Area, Texas, U.S. Geological Survey, September 2005.
5. Environmental Assessment, Appendix 9E, Longhorn Mitigation Plan Mandated Studies Summaries.
6. Final Environmental Assessment of the Longhorn Pipeline Reversal, PHMSA-2012-0175, December 2012.
7. The Longhorn Mitigation Plan, September 2000.

APPENDIX A – MITIGATION COMMITMENTS

Table A-1. Longhorn Mitigation Commitments (pg. 1 of 7)

No.	Description	Timing of Implementation	Risk(s) Addressed
1	Longhorn shall hydrostatically test the hypersensitive (Tier III) and sensitive (Tier II) areas of the pipeline and those portions of the pipeline identified by the Surge Pressure Analysis as being potentially subject to surge pressures in excess of current MASP. See Mitigation Appendix, Item 1 and 9.	Prior to startup / Completed	Outside Force Damage, Corrosion, Material Defects, and Previous Defects; Establish Safety Factor
2	Longhorn shall "proof test" all portions of the pipeline from the J-1 Valve to Crane Station that have not been hydrostatically tested pursuant to Mitigation Commitment No. 1. See Mitigation Appendix, Item 2	Prior to startup / Completed	Outside Force Damage, Corrosion, Material Defects, and Previous Defects
3	Longhorn shall replace approximately 19 miles of the existing pipeline over the Edwards Aquifer recharge and contributing zones with thick-walled pipe; the pipe will be protected by a concrete barrier. See Mitigation Appendix, Item 3	Prior to startup / Completed	Outside Force Damage, Corrosion, Material Defects, and Operator Error
4	Longhorn shall perform the following additional cathodic protection mitigation work: (a) Install 13 additional CP ground beds at locations described in Mitigation Appendix, Item 4. (b) Perform interference testing at 20 locations, if necessary, as described in Mitigation Appendix, Item 4. (c) Replace at least 600 feet of coating identified by the CP survey analysis as described in Mitigation Appendix, Item 4. (d) Repair or replace, as necessary, 12 shorted casings identified by the CP survey analysis at the locations described in Mitigation Appendix, Item 4.	Prior to startup / Completed	Corrosion
5	Longhorn shall lower, replace, or recondition, if necessary, the pipe at 12 locations per the Environmental Assessment (including Marble Creek). See Mitigation Appendix, Item 5.	Prior to startup / Completed	Outside Force Damage, Corrosion, and Material Defects
6	Longhorn shall remove stopple fittings at the following locations: Station Nos. 9071+36, 8936+35, and 8796+99 (MP 171.86, 169.25, and 166.61). See Mitigation Appendix, Item 6.	Prior to startup / Completed	Material Defects
7	Longhorn shall excavate the pipeline at two locations, near Satsuma Station and in Waller County, indicated by the 1995 in-line inspection, and determine condition and repair, if necessary. See Mitigation Appendix, Item 7.	Prior to startup / Completed	Material Defects and Corrosion
8	Longhorn shall replace the pipeline at the crossing of Rabb's Creek and investigate at least 5 dent locations identified by Kiefner, based upon the 1995 in-line inspection and repair, if necessary. See Mitigation Appendix, Items 8 and 19.	Prior to startup / Completed	Material Defects, Corrosion, and Outside Force Damage

Table A-2 (continued). Longhorn Mitigation Commitments (pg. 2 of 7)

No.	Description	Timing of Implementation	Risk(s) Addressed
9	Longhorn shall remediate any maximum allowable surge pressure (MASP) problems identified by Longhorn's most recent Surge Pressure Analysis by hydrostatically testing those portions of the pipeline which the Surge Pressure Analysis indicates could exceed MASPs. The hydrostatic test will requalify the portions of the pipeline, which will be tested to a MASP which is within permissible limits as established by the most recent Surge Pressure Analysis. Further, Longhorn will implement appropriate measures in all Tier II and Tier III areas of the pipeline to eliminate the possibility of conditions causing a surge pressure which would exceed maximum operating pressure (MOP). See Mitigation Appendix, Item 9 and Longhorn Mitigation Commitment 34.	Prior to startup / Completed	Material Defects and Corrosion
10	Longhorn shall, following the use of sizing and (where appropriate) geometry tools, perform an in-line inspection of the Existing Pipeline (Valve J-1 to Crane) with a transverse field magnetic flux inspection (TFI) tool and remediate any problems identified. See the Longhorn Pipeline System Integrity Plan at Sec. 3.5.2 and the associated Operational Reliability Assessment at Sec. 4.0.	At such intervals as are established by the ORA, provided that an inspection shall be performed no more than 3 years after system startup in Tier II and III areas	Material Defects, Corrosion, Outside Force Damage and Previous Defects
11	Longhorn shall, following the use of sizing and (where appropriate) geometry tools, perform an in-line inspection of the Existing Pipeline (Valve J-1 to Crane) with a high-resolution magnetic flux leakage (HRMFL) tool and remediate any problems identified. Until Mitigation Item 11 has been completed, an interim MOP (MOPi) shall be established for the Existing Pipeline at a pressure equal to 0.88 times the MOP. (NOTE: 1.25 times the MOPi is equal to the Proof Test Pressure discussed in Mitigation Item 2 above). See the SIP at Sec. 3.5.2 and the associated ORA at Sec. 4.0.	Within 3 months of startup and thereafter at such intervals as are established by the ORA	Corrosion, Outside Force Damage, and Previous Defects
12	Longhorn shall, following the use of sizing and (where appropriate) geometry tools, perform an in-line inspection of the Existing Pipeline (Valve J-1 to Crane) with an ultrasonic wall measurement tool and remediate any problems identified. See the SIP at sec: 3.5.2 and the associated ORA at Sec. 4.0.	At such intervals, as are established by the ORA, provided that an inspection shall be performed no more than 5 years after system startup	Corrosion, Material Defects, Outside Force Damage, and Previous Defects
12A	Longhorn shall perform an in-line inspection of the Existing Pipeline (Valve J-1 to Crane) with a "smart" geometry inspection tool and remediate any problems identified. See the SIP at Sec. 3.5.2 and the associated ORA at Sec. 4.0.	At such intervals as are established by the ORA, provided that no more than 3 years shall pass without an in-line inspection being performed using an inspection tool capable of detecting third-party damage (e.g., TFI, MFL, or geometry)	Outside Force Damage

Table A-3 (continued). Longhorn Mitigation Commitments (pg. 3 of 7)

No.	Description	Timing of Implementation	Risk(s) Addressed
13	Longhorn shall install an enhanced leak detection and control system, which will include a transient model-based leak detection system utilizing 9-meter stations (6 clamp-on meters and 3 turbine meters). Additionally, a leak detection system will be installed over the Edwards Aquifer Recharge Zone and the Slaughter Creek watershed in the Edwards Aquifer Contributing Zone that will detect a leak of extremely minute volume in 12 to 120 minutes from contact, depending upon the product sensed by the system. That leak detection system will be a buried hydrocarbon sensing cable system designed to meet the leak detection performance specifications described in the preceding sentence. The pipeline system is designed to achieve emergency shut down within 5 minutes of a probable leak indication. See Mitigation Appendix, Item 13.	System installation prior to startup and system operational within 6 months of startup / Completed	Leak Detection and Control
14	Longhorn shall perform close interval pipe to soil potential surveys to survey (a) hypersensitive areas and (b) pipeline segments which were not surveyed by the 1998 close interval survey (Station Nos. 10753+40 – 10811+06 [MP 203.66 – 204.75], 8897+60 – 8945+40 [MP 168.52 – 169.42], and 1729+24 – 1734+81 [MP 32.75 – 32.86]), and remediate corrosion-related conditions identified by the surveys as necessary. See Mitigation Appendix, Item 4 (Areas 12, 13, and 15) and the Longhorn Pipeline System Integrity Plan, section 3.5.1.	Prior to startup / Completed	Corrosion
15	Longhorn shall perform an engineering analysis to verify that all pipeline spans are adequately supported and protected from external loading. Longhorn shall implement the recommendations of such analysis to ensure the stability of such spans. Longhorn shall provide documentary or analytical confirmation of the pipe grade or the pipeline across the Colorado River. See Mitigation Appendix, Item 15.	Prior to startup / Completed	Material Defects, Outside Force Damage and Corrosion, Establish Safety Factors
16	Longhorn shall remove all encroachments along the pipeline right-of-way that could reasonably be expected to obstruct prompt access to the pipeline for routine or emergency repair activities or that could reasonably be expected to hinder Longhorn's ability to promptly detect leaks or other problems. Potential encroachments will be evaluated using the guidelines found in section 3.5.5, Encroachment Procedures of the Longhorn Pipeline System Integrity Plan.	Within one year of startup / Completed	Outside Force Damage, Leak Detection and Control
17	Longhorn shall clear the right-of-way to excellent condition (right-of-way encroachments shall be resolved by Longhorn pursuant to Mitigation Commitment 16). See Mitigation Appendix, Item 17.	Prior to startup and continuously thereafter	Outside Force Damage, Leak Detection and Control

Table A-4 (continued). Longhorn Mitigation Commitments (pg. 4 of 7)

No.	Description	Timing of Implementation	Risk(s) Addressed
18	Longhorn shall inspect and repair or replace, as necessary, 26 locations identified by Williams in its risk assessment model as areas requiring further investigation. See Mitigation Appendix, Item 18.	Prior to startup / Completed	Outside Force Damage, Material Defects, Corrosion, and Previous Defects
19	Longhorn has performed studies evaluating each of the following matters along the pipeline and shall implement the recommendations of such studies:	Prior to startup / Completed	Outside Force Damage, Corrosion, and Material Defects
	(a) Stress-corrosion cracking potential.		Outside Force Damage and Corrosion
	(b) Scour, erosion, and flood potential.		Outside Force Damage
	(c) Seismic activity.		Outside Force Damage
	(d) Ground movement, subsidence, and aseismic faulting.		Outside Force Damage
	(e) Landslide potential.		Outside Force Damage
	(f) Soil stress.		Outside Force Damage
	(g) Root cause analysis on all historical leaks and repairs.		Outside Force Damage, Corrosion, Material Defects, and Operator Error
20	Longhorn shall increase the frequency of patrols in hypersensitive and sensitive areas to every two and one-half days, daily in the Edwards Aquifer area, and weekly in all other areas. See the SIP, Section 3.5.4.	Continuously after startup	Outside Force Damage, Corrosion, Material Defects, Leak Detection and Control
21	Longhorn shall increase the frequency of inspections at pump stations to every two and one-half days in sensitive and hypersensitive areas. Additionally, remote cameras for monitoring pump stations will be installed within 6 months of startup for existing stations and at future stations prior to startup. See Mitigation Appendix, Item 21.	Continuously after startup	Outside Force Damage, Corrosion, Material Defects, Leak Detection and Control
22	Longhorn shall commission a study that quantifies the costs and benefits of additional valves at the following river and stream crossings: Marble Creek; Onion Creek; Long Branch; Barton Creek; Fitzhugh Creek; Flat Creek; Cottonwood Creek; Hickory Creek; White Oak Creek; Crabapple Creek; Squaw Creek; Threadgill Creek; and James River. Longhorn shall install additional valves if it determines, on the basis of the study, with DOT/OPS concurrence, that additional valves will be beneficial. See Mitigation Appendix, Item 22.	Prior to startup / Completed	Outside Force Damage, Corrosion, Material Defects, and Leak Detection and Control
23	Longhorn shall develop a response center in the middle area of the pipeline, which will include available response equipment and personnel such that under normal conditions, a maximum 2-hour full response can be assured. See Mitigation Appendix, Item 23, 24, and 26. (Items 23, 24, and 26 are grouped under the heading "Enhanced Facility Response Plan" in the Mitigation Appendix.)	Prior to startup / Completed	Leak Detection and Control

Table A-5 (continued). Longhorn Mitigation Commitments (pg. 5 of 7)

No.	Description	Timing of Implementation	Risk(s) Addressed
24	Longhorn shall revise its facilities response plan to better address firefighting outside of metropolitan areas (Houston, Austin, and El Paso) where HAZMAT units do not exist. See Mitigation Appendix, Item 23, 24, and 26. (Items 23, 24, and 26 are grouped under the heading "Enhanced Facility Response Plan" in the Mitigation Appendix.)	Prior to startup / Completed	Leak Detection and Control
25	Longhorn shall develop enhanced public education/damage prevention programs to, inter alia, (a) ensure awareness among contractors and potentially affected public, (b) promote cooperation in protecting the pipeline, and (c) to provide information to potentially affected communities with regard to detection of and responses to well water contamination. See the SIP, Section 3.5.4. See Mitigation Appendix, Item 25. (This item has been superseded in large part by API RP 1162.)	Continuously after startup	Outside Force Damage, Leak Detection and Control
Appendix Item 3	Longhorn will replace approximately six miles of Existing Pipeline in the Pedernales River watershed that is characterized as having a time of travel for a spill from Lake Travis of eight hours or less.	Segment 5 crossing the Pedernales River will be completed prior to the date of pipeline startup. Segments 1 through 4 will be replaced as determined by the System Integrity Plan and ORA, but in any case, no later than seven years from the startup date.	Outside force damage
26	Longhorn shall revise its facility response plan to provide for more detailed response planning for areas where high populations of potentially sensitive receptors are on or adjacent to the pipeline right-of-way. See Mitigation Appendix, Item 23, 24, and 26. (Items 23, 24, and 26 are grouped under the heading "Enhanced Facility Response Plan" in the Mitigation Appendix.)	Prior to startup / Completed	Leak Detection and Control
27	Longhorn shall provide evidence (as-built engineering drawings and similar such documentation) that secondary containment was installed, during construction, under and around all storage and relief tanks, in accordance NFPA 30. Longhorn shall install secondary containment at the Cedar Valley pump station in Hays County.	Prior to startup / Completed	Leak Detection and Control
28	Longhorn shall revise its facility response plan, if or as necessary, to make it consistent, to the extent practicable, the referenced plans are Control with the City of Austin's Barton Springs oil spill developed contingency plan and the United States Fish and Wildlife Service's Barton Springs Salamander Recovery Plan. See Mitigation Appendix, Item 28.	Prior to startup / Completed	Leak Detection and Control

Table A-6 (continued). Longhorn Mitigation Commitments (pg. 6 of 7)

No.	Description	Timing of Implementation	Risk(s) Addressed
29	Longhorn shall provide funding for a contractor (employing personnel with the necessary education, training, and experience) to conduct water quality monitoring at each of 12 locations in proximity to stream crossings of the pipeline to determine the presence of gasoline constituents. See Mitigation Appendix, Item 29.	For a period of two years after startup to evaluate the effectiveness of the program and thereafter as dictated by the Longhorn ORA (See Section 4.0).	Leak Detection and Control
30	Longhorn shall provide alternate water supplies to certain water municipalities and private well users as detailed in Longhorn's contingency plans. See Mitigation Appendix, Item 30.	Prior to startup / Completed	Leak Detection and Control
31	Longhorn shall perform a surge pressure analysis prior to any increase in the pumping capacity above those rates for which analyses have been performed or any other change which has the capability to change the surge pressures in the system. Longhorn will be required to submit mitigation measures acceptable to DOT/OPS prior to any such change in the system, which mitigation measures will adequately address any MASP problems on the system identified by the surge pressure analysis.	Prior to any change in the system that has the capability to cause surge pressures to occur on the system.	Material Defects
32	Longhorn shall perform pipe-to-soil potential surveys semi-annually over sensitive and hypersensitive areas (which is twice the frequency required by DOT regulation – 49 CFR 195.573), and corrective measures will be implemented, as necessary, where indicated by the surveys. See Longhorn Pipeline System Integrity Plan, Section 3.5.1.	No more than six months after startup and semi-annually thereafter.	Corrosion
33	(a) Longhorn shall provide the necessary funding to establish an adequate refugium and captive breeding program for the Barton Springs Salamander to offset any losses that might occur in the highly unlikely event of a release that caused the loss of individual salamanders. This program will be conducted in coordination with the Austin Ecological Services Field Office of the U.S. Fish and Wildlife Service; and	Within 30 days of startup / Completed	Potential adverse effects to the Barton Springs Salamander
	(b) Longhorn shall perform conservation measures developed in consultation with the U.S. Fish and Wildlife service to mitigate potential impacts to threatened and endangered specifies in the highly unlikely event that future pipeline construction activities and operation may adversely affect such species or their habitat. See Mitigation Appendix, Item 33.	At any time, such activity could have an adverse effect on listed species or habitat.	Potential adverse effects to listed species or habitat

Table A-7 (continued). Longhorn Mitigation Commitments (pg. 7 of 7)

No.	Description	Timing of Implementation	Risk(s) Addressed
34	Longhorn shall implement system changes through system and equipment modification and/or observance of operating practices to limit surge pressure to no more than MOP in sensitive and hypersensitive areas. Such system changes shall include (a) replacement of the pipe at the following locations: 6752+06 – 6758+40 (MP 127.88 – 128.00) and 10489+47 – 10490+00 (MP 198.66 – 198.67) and (b) installation of pressure active by-pass systems at the Brazos, Colorado, Pedernales, and Llano rivers. In addition, Longhorn shall replace one 671 foot section of pipe previously characterized as Grade B. See Mitigation Appendix, Item 34 and Longhorn Mitigation Commitment 9.	Prior to startup and thereafter	Outside Force Damage, Corrosion, Operator Error, and Material Defects
35	Longhorn shall not transport products through the pipeline system which contain the additive methyl tertiary butyl ether (MTBE) or similar aliphatic ether additives (e.g., TAME, ETBE, and DIPE) in greater than trace amounts. This limitation with be incorporated into the Longhorn product specifications.	During the operational life of the pipeline system	Potential adverse impacts to water resources
36	Longhorn shall prepare site-specific environmental studies for each new pump station planned for construction. These studies shall be responsive to National Environmental Policy Act (NEPA) requirements as supplements to the EA of the Proposed Longhorn Pipeline System. For each such pump station, Longhorn shall submit the site-specific environmental study to the U.S. DOT no less than 180 days prior to commencement of construction.	Prior to construction of any new pump station	Consistency with NEPA
37	Longhorn shall maintain pollution legal liability insurance of no less than $15 million to cover on-site and off-site third-party claims for bodily injury, property damage, and costs of response and clean-up in the event of a release of product from the Longhorn Pipeline System.	Prior to startup and during the operational life of the pipeline system	Financial Assurance
38	Longhorn shall submit periodic reports to DOT/OPS that will include information about the status of mitigation commitment implementation, the character of interim developments as related to mitigation commitments, and the results of mitigation-related studies and analyses. The reports shall also summarize developments related to its ORA. The reports shall be made available to the public.	Quarterly during the first 2 years of system operation and annually thereafter for the operational life of the pipeline system.	Assurance of mitigation commitment implementation and public access to related information
39	The Longhorn Mitigation Plan and associated Pipeline System Integrity Plan and ORA shall not be unilaterally changed. The LMP may be modified only after Longhorn has reviewed proposed changes with DOT/OPS and has received from DOT/OPS written concurrence with the proposed modifications.	During the operational life of the pipeline system	Assurance of full implementation of the Longhorn Mitigation Commitments

APPENDIX B – NEW DATA USED IN THIS ANALYSIS

Table B-1. 2020 ORA Data List (pg. 1 of 2)

Topics	Data / Notes
1. Pipeline and Facilities	• Alignment Sheets – 6643 – E. Houston to 9th Street – 6645 – E. Houston to El Paso • Linefill Sheets • Maps and Flow Schematics (strip maps, KMZ files) • Tier Classifications • List of HCAs • Facility Inspection Reports – Bastrop (5/20) – Buckhorn (5/20) – Cartman (5/20) – Cedar Valley (5/20) – Eckert (10/20) – James River (6/20) – Kimble (5/20) – Satsuma (5/20) – Warda (5/20) – Crane (10/20)
2. Flow and Pressure Data	• Monthly spreadsheet of flow and pressures • Service Interruptions
3. ILI & Anomaly Investigation Reports	• MFL, UCD, & Deformation ILI Reports: – Texon to Barnhart – Barnhart to Cartman – Cartman to Kimble – Kimble to James River – James River to Eckert – Eckert to Cedar Valley – Cedar Valley to Bastrop – Bastrop to Warda – Warda to Buckhorn – Buckhorn to Satsuma • Tool specifications
4. Hydrostatic Testing Reports	• No hydrostatic tests were performed in 2020.
5. Corrosion Management Surveys & Reports	• Cathodic Protection Data – Rectifier Inspection Reports – Rectifier Maintenance Reports – Test Point Exception Reports • Coupon Data • Atmospheric Inspection Reports • Tank Inspections • 7.04-ADM-001 Corrosion Control Program

Table B-2 (continued). 2020 ORA Data List (pg. 2 of 2)

Topics	Data / Notes
6. Earth Movement & Water Forces	• Fault monitoring (semi-annual reports) • Depth of cover survey – Greens Bayou • Master River Inspections Spreadsheet • Flood monitoring (daily)
7. Maintenance and Inspection Reports	• Maintenance Reports • Nondestructive Evaluation (NDE) • Positive Material Identification (PMI) • Mainline Valve Inspection Reports • Longhorn Year-end Preventive Maintenance Tasks Summary
8. Project Work Progress and Quality Control Reports	• CMS Year-End Task Report • Preventive Maintenance Summary • Scorecards • Annual Asset Integrity Summary for 2020 • 2020 Annual Commitment Implementation Status Report • 2020 Annual Self-Audit
9. One-Call Violations and Third-Party Damage Prevention Data	• Third-Party Damage Report • One-call list • Encroachments • Patrol Data • Website Visits • Damage Prevention Training
10. Incident, Root Cause, and Metallurgical Failure Analysis Reports	• Incident Data and Incident Investigation Reports
11. Other SIP / Risk Assessment Studies, Evaluations, and other Program Data	• Process Hazard Analyses – None performed in 2020.
12. Leak Detection	• Pipeline Leak Monitoring (PLM) Records • Description of System(s)
13. Integrity Management Plan (IMP) & Related Procedures	• IMP Plan and related procedures

B.2. Major Pipeline Incidents, Industry, or Agency Advisories Affecting Pipeline Integrity

B.2.1 PHMSA Advisories

None were applicable to the Longhorn Pipeline during 2020.

B.2.2 PHMSA Notices

Pipeline Safety: Public Meeting on Implementing the Recently Published Gas Transmission and Hazardous Liquid Final Rules, 1/29/2020.
PHMSA published this document to announce a public meeting for Pipeline Safety officials to discuss with pipeline safety stakeholders the implementation of the gas transmission and the hazardous liquid pipeline final rules published in the Federal Register on October 1, 2019.

Pipeline Safety: Information Collection Activities, 3/9/2020.
PHMSA published this document to seek public comments on proposed revisions to the hazardous liquid accident report form and associated instructions. Proposed revisions include reorganizing existing questions and adding more detailed questions about accident response, accident consequences, operating conditions, cause, and contributing factors.

Pipeline Safety: Regulatory Reform for Hazardous Liquid Pipelines, 4/16/2020.
PHMSA published this document to seek public comments on proposed amendments to the Federal Pipeline Safety Regulations that would revise the definition for accidents and consider repealing, replacing, or modifying other specific regulations with the intent of reducing and clarifying regulatory requirements without compromising safety and environmental protection. PHMSA is proposing:

- Adjustment of monetary damage criterion for reporting pipeline accidents for inflation.
- Revision of 195.573(c) to clarify that operators may monitor rectifier stations remotely.
- Minor corrections to the guidance for implementing Integrity Management programs with regard to identification HCA.
  - Revised guidance for considering spills in fields and moving details for considering the physical support of pipelines, maximum operating pressure (MOP) exceedances, and natural force damage caused by earth movement or seismicity from the guidance for identifying segments that could-affect HCAs to the guidance on identifying threats.

B.2.3 DOT Regulations

No new regulations affecting the Longhorn ORA occurred in 2020.

B.2.4 Literature Reviewed

See references.

APPENDIX C – THRESHOLD ANOMALY FATIGUE EVALUATION RESULTS

Table C-1 and Table C-2 show the fatigue lives predicted for threshold anomalies accounting for pipe properties and attribute changes, including wall thickness, grade, pipe OD, elevation changes, and nearness to the pump station discharge locations. The fatigue results are presented in increasing order of time to failure or reassessment interval.

Note that, in cases where the calculated times to failure were in excess of 500 years, an artificial cap of 500 years was imposed to reduce the calculation time. Also, note that the reassessment intervals were calculated using a safety factor of 2.22, consistent with the specification for safety factor in the Magellan ORA Manual, which requires that the reassessment interval be taken as 45% of the shortest fatigue life.

Table C-1. Pressure-Cycle-Induced Fatigue Cracking Analysis Locations on Refined Products Pipeline

Pipeline Segment	Assessment Location	OD (inch)	Wall Thickness (inch)	Grade	Elevation (feet)	Year of Installation	Threshold Flaw Depth (inch)	Threshold Anomaly Depth at ILI Detection Threshold (% WT)	Defect Failure Press (psig)	Calculated Time to Failure (years)	Re-assessment Interval (years)	Re-assessment Due Date
Crane-Cottonwood	27879+57	18	0.500	X52	2,621	2008	0.050	10%	3,409	500.0	225.2	03/25/2233
Crane-Cottonwood	30429+00	18	0.281	X65	3,843	1998	0.028	10%	2,291	500.0	225.2	03/26/2223
Crane-Cottonwood	30429+60	18	0.375	X65	3,840	2008	0.038	10%	3,068	500.0	225.2	03/25/2233
Crane-Cottonwood	30430+16	18	0.375	X52	3,841	2008	0.038	10%	2,551	500.0	225.2	03/25/2233
Cottonwood-El Paso	36642+98	18	0.375	X65	4,017	1998	0.038	10%	3,068	500.0	225.2	03/26/2223
Cottonwood-El Paso	36664+58	18	0.281	X65	4,022	1998	0.028	10%	2,289	500.0	225.2	03/26/2223
Cottonwood-El Paso	36665+05	18	0.375	X52	4,022	1998	0.038	10%	2,550	500.0	225.2	03/26/2223

Table C-2. Pressure-Cycle-Induced Fatigue Cracking Analysis Locations in Crude Pipeline

Pipeline Segment	Assessment Location	OD (inch)	Wall Thickness (inch)	Grade	Elevation (feet)	Year of Installation	Threshold Flaw Depth (inch)	Threshold Anomaly Depth at ILI Detection Threshold (% WT)	Defect Failure Press (psig)	Calculated Time to Failure (years)	Re-assessment Interval (years)	Re-assessment Due Date
Kimble-James River	14758+39	18	0.219	X52	1,669	1967	0.110	50%	898	27.5	12.4	01/16/2028
Kimble-James River	15584+59	18	0.281	X45	2,223	1950	0.141	50%	898	34.0	15.3	12/25/2030
Kimble-James River	14604+19	18	0.375	X45	1,511	1950	0.188	50%	898	267.9	120.7	05/04/2136
EHS-9th Str. (U/S of Speed JCT)	0+02	20	0.375	B	37	2010	0.038	10%	1,168	352.6	158.8	08/04/2173
EHS-9th Str. (U/S of Speed JCT)	0+14	20	0.375	X52	37	2010	0.038	10%	1,168	364.3	164.1	10/31/2178
EHS-9th Str. (U/S of Speed JCT)	188+83	20	0.312	X52	17	1998	0.031	10%	1,168	434.3	195.7	05/30/2210
Kimble-James River	14878+99	18	0.375	X42	1,827	1995	0.038	10%	2,134	500.0	225.2	11/23/2240
EHS-9th Str. (U/S of Speed JCT)	403+64	20	0.500	X42	0	2011	0.050	10%	2,576	500.0	225.2	12/25/2239
Kimble-James River	14607+19	18	0.385	X65	1,528	2000	0.039	10%	3,139	500.0	225.2	11/23/2240
Kimble-James River	15260+29	18	0.281	X65	2,123	2013	0.028	10%	2,164	500.0	225.2	11/23/2240
Kimble-James River	15144+49	18	0.375	X65	2,106	2002	0.038	10%	3,046	500.0	225.2	11/23/2240
Kimble-James River	14596+69	18	0.375	X45	1,533	2013	0.038	10%	2,258	500.0	225.2	11/23/2240
Kimble-James River	15585+23	18	0.375	X52	2,221	1998	0.038	10%	2,515	500.0	225.2	11/23/2240
EHS-9th Str. (U/S of Speed JCT)	187+12	20	0.375	X60	19	2013	0.038	10%	2,523	500.0	225.2	12/25/2239
EHS-9th Str. (U/S of Speed JCT)	235+10	20	0.344	X52	18	1998	0.034	10%	2,049	500.0	225.2	12/25/2239
EHS-9th Str. (U/S of Speed JCT)	363+98	20	0.500	X52	5	1998	0.050	10%	3,066	500.0	225.2	12/25/2239

APPENDIX D – CRACK DETECTION ILI ANOMALY FATIGUE EVALUATION RESULTS

Table D-1 through Table D-11 shows the fatigue lives predicted for anomalies by the crack detection ILI. The fatigue results are presented in increasing order of time to failure or reassessment interval of the as-called anomaly sizes.

Note that in cases where the calculated times to failure were in excess of 500 years, an artificial cap of 500 years was imposed to reduce the calculation time. Also, note that the reassessment intervals were calculated using a safety factor of 2.22, consistent with the specification for safety factor in the Magellan ORA Manual, which requires that the reassessment interval be taken as 45% of the shortest fatigue life.

Table D-1. Pressure-Cycle-Induced Fatigue Cracking Analysis of ILI Indicated Anomalies
Barnhart to Cartman – ILI Date June 16, 2020

Station Number	Elevation (feet)	OD (inch)	WT (inch)	YS (psi)	ILI Length (inch)	ILI Depth (inch)	Re-assessment Interval (years)	Re-assessment Due Date
19118+60	2,520	18	0.276	45,000	10.22	0.088	18.6	01/31/2039
19287+94	2,529	18	0.295	45,000	4.32	0.107	27.0	06/29/2047
18958+56	2,509	18	0.276	45,000	4.08	0.083	45.5	12/30/2065
18469+86	2,463	18	0.266	45,000	3.61	0.076	52.8	04/14/2073
18236+71	2,445	18	0.266	45,000	4.20	0.068	57.1	08/07/2077
18805+39	2,503	18	0.276	45,000	4.55	0.075	58.2	08/17/2078
18202+48	2,438	18	0.285	45,000	4.91	0.076	58.3	10/18/2078
19595+59	2,581	18	0.315	45,000	5.85	0.074	61.7	02/24/2082
19406+59	2,498	18	0.315	45,000	4.67	0.083	63.1	07/11/2083
19652+97	2,597	18	0.305	45,000	1.60	0.094	74.3	10/03/2094
19521+58	2,539	18	0.315	45,000	2.90	0.083	76.4	11/06/2096
19652+96	2,597	18	0.305	45,000	1.95	0.082	77.6	01/28/2098
18242+03	2,446	18	0.276	45,000	1.72	0.088	79.8	04/11/2100
19423+72	2,483	18	0.315	45,000	2.55	0.090	80.7	02/10/2101
18674+38	2,484	18	0.276	45,000	2.07	0.083	83.3	10/18/2103
18284+26	2,440	18	0.266	45,000	1.95	0.068	93.9	05/21/2114
18930+70	2,523	18	0.276	45,000	2.31	0.069	98.7	02/28/2119
18564+20	2,471	18	0.276	45,000	2.07	0.075	99.8	04/03/2120
18200+03	2,435	18	0.276	45,000	2.07	0.069	100.3	10/17/2120
19590+62	2,579	18	0.315	45,000	1.72	0.083	104.2	08/29/2124
18201+61	2,437	18	0.276	45,000	1.36	0.083	105.8	04/16/2126
19354+46	2,516	18	0.315	45,000	3.02	0.074	107.4	11/20/2127
19129+04	2,526	18	0.276	45,000	1.48	0.075	107.8	04/22/2128
19501+18	2,500	18	0.315	45,000	4.44	0.061	108.0	06/15/2128
18960+78	2,508	18	0.276	45,000	2.31	0.064	111.4	11/25/2131
18493+91	2,473	18	0.276	45,000	2.55	0.064	113.2	08/28/2133
18930+75	2,523	18	0.276	45,000	2.07	0.064	120.9	04/28/2141
19051+68	2,506	18	0.276	45,000	1.48	0.064	141.0	06/09/2161
19590+85	2,579	18	0.315	45,000	1.60	0.068	144.6	01/27/2165
19590+85	2,579	18	0.315	45,000	1.13	0.083	148.4	10/31/2168
19537+14	2,560	18	0.315	45,000	1.60	0.068	152.7	03/04/2173
19331+09	2,510	18	0.305	45,000	1.36	0.070	172.0	06/16/2192
19521+62	2,539	18	0.315	45,000	1.36	0.068	173.0	06/25/2193
19280+09	2,532	18	0.315	45,000	1.48	0.074	182.4	10/25/2202
19510+15	2,511	18	0.315	45,000	1.13	0.074	183.2	08/12/2203
19697+08	2,589	18	0.315	45,000	1.13	0.061	183.3	10/24/2203
19334+90	2,509	18	0.315	45,000	1.36	0.074	185.1	07/07/2205
19334+87	2,509	18	0.315	45,000	1.36	0.068	205.4	11/11/2225
19315+42	2,514	18	0.315	45,000	1.13	0.074	219.2	09/07/2239
19436+06	2,521	18	0.315	45,000	1.13	0.061	225.2	09/08/2245

Table D-2. Pressure-Cycle-Induced Fatigue Cracking Analysis of ILI Indicated Anomalies Bastrop to Warda – ILI Date January 27, 2020 (pg. 1 of 4)

Station Number	Elevation (feet)	OD (inch)	WT (inch)	YS (psi)	ILI Length (inch)	ILI Depth (inch)	Re-assessment Interval (years)	Re-assessment Due Date
6835+22	244	18	0.256	45,000	4.44	0.082	15.5	08/10/2035
7471+93	294	18	0.266	45,000	2.79	0.076	17.2	04/18/2037
7125+72	250	18	0.256	65,000	2.90	0.082	18.5	07/22/2038
7365+39	307	18	0.256	45,000	2.31	0.074	18.9	12/14/2038
7145+34	259	18	0.256	65,000	4.68	0.069	19.4	07/01/2039
7194+49	258	18	0.256	45,000	3.14	0.069	21.0	02/11/2041
6812+08	243	18	0.256	45,000	4.21	0.074	21.8	11/11/2041
6445+54	268	18	0.246	45,000	4.21	0.075	22.1	02/19/2042
6973+04	251	18	0.256	45,000	4.21	0.069	22.2	04/05/2042
7418+82	322	18	0.246	45,000	1.60	0.068	22.5	07/25/2042
7354+10	292	18	0.285	45,000	2.67	0.087	22.8	11/16/2042
7331+25	284	18	0.256	45,000	3.14	0.062	23.1	02/16/2043
7351+19	303	18	0.256	45,000	1.84	0.074	23.2	03/30/2043
7365+37	307	18	0.256	45,000	2.08	0.069	23.4	07/02/2043
7366+36	307	18	0.256	45,000	2.79	0.062	23.8	11/23/2043
6246+87	302	18	0.256	45,000	6.69	0.074	24.0	02/03/2044
7468+31	323	18	0.266	45,000	1.60	0.081	24.2	04/10/2044
6653+39	224	18	0.256	45,000	4.32	0.074	24.7	10/07/2044
7479+43	306	18	0.266	45,000	2.19	0.068	25.1	02/14/2045
7078+67	272	18	0.256	45,000	2.90	0.069	25.2	04/20/2045
7353+49	296	18	0.256	45,000	2.55	0.062	25.5	07/28/2045
7417+96	323	18	0.266	45,000	1.84	0.076	25.5	08/09/2045
6413+88	251	18	0.256	45,000	7.28	0.069	25.9	12/18/2045
6078+41	305	18	0.256	45,000	4.21	0.082	27.0	01/11/2047
7478+84	308	18	0.266	45,000	1.96	0.068	27.1	03/08/2047
7471+94	293	18	0.266	45,000	1.96	0.068	27.3	05/25/2047
6720+52	327	18	0.256	45,000	3.50	0.074	27.4	06/13/2047
6578+83	373	18	0.256	45,000	9.89	0.062	27.5	07/29/2047
6418+40	260	18	0.256	45,000	4.80	0.074	27.8	11/07/2047
6449+16	260	18	0.246	45,000	2.43	0.083	28.0	02/14/2048
6147+08	311	18	0.256	45,000	5.63	0.074	28.4	07/05/2048
7331+08	283	18	0.256	45,000	2.19	0.062	28.7	09/30/2048
6438+09	267	18	0.256	45,000	2.55	0.090	28.8	10/28/2048
6488+48	234	18	0.256	45,000	2.43	0.090	29.0	01/20/2049
6414+66	254	18	0.256	45,000	6.10	0.069	29.2	03/25/2049
6321+82	226	18	0.256	45,000	4.80	0.074	29.2	04/28/2049
6059+29	300	18	0.256	45,000	2.55	0.095	29.7	10/27/2049
6578+85	373	18	0.256	45,000	4.92	0.069	29.9	01/08/2050
6306+14	237	18	0.256	45,000	2.55	0.090	31.0	01/30/2051
6246+48	301	18	0.256	45,000	4.68	0.074	31.1	03/16/2051
6435+88	265	18	0.256	45,000	2.31	0.090	31.8	11/20/2051
6329+19	223	18	0.256	45,000	2.43	0.090	32.0	02/09/2052
6411+45	257	18	0.266	45,000	2.19	0.103	32.3	05/16/2052
6403+08	273	18	0.256	45,000	5.15	0.069	32.6	09/16/2052
7145+26	259	18	0.256	65,000	2.08	0.069	32.8	10/30/2052
6812+10	243	18	0.256	45,000	1.48	0.095	32.8	11/29/2052
6535+13	313	18	0.256	45,000	2.08	0.090	33.2	04/13/2053

Table D-2 (continued). Pressure-Cycle-Induced Fatigue Cracking Analysis of ILI Indicated Anomalies Bastrop to Warda – ILI Date January 27, 2020 (pg. 2 of 4)

Station Number	Elevation (feet)	OD (inch)	WT (inch)	YS (psi)	ILI Length (inch)	ILI Depth (inch)	Re-assessment Interval (years)	Re-assessment Due Date
6953+86	247	18	0.256	45,000	1.96	0.074	33.7	10/21/2053
7476+53	312	18	0.266	45,000	1.72	0.063	33.8	11/11/2053
5983+69	231	18	0.256	45,000	3.14	0.082	34.5	08/15/2054
6713+44	273	18	0.256	45,000	2.55	0.074	34.7	10/01/2054
6584+17	352	18	0.266	45,000	2.43	0.089	35.0	01/23/2055
6093+93	277	18	0.256	45,000	2.43	0.090	35.4	06/21/2055
6418+05	259	18	0.256	45,000	4.32	0.069	35.9	12/05/2055
6713+49	274	18	0.256	45,000	2.43	0.074	36.0	02/02/2056
6458+08	255	18	0.266	45,000	2.55	0.089	36.4	06/12/2056
7211+28	250	18	0.256	45,000	1.84	0.062	36.7	10/11/2056
7228+92	257	18	0.256	45,000	1.37	0.069	37.7	10/20/2057
6310+59	241	18	0.256	45,000	4.21	0.069	38.7	10/15/2058
6450+54	258	18	0.266	45,000	3.73	0.076	38.7	10/23/2058
7192+06	260	18	0.256	45,000	1.37	0.069	39.3	05/06/2059
6577+75	372	18	0.256	45,000	2.55	0.074	39.6	09/03/2059
6331+03	228	18	0.256	45,000	1.96	0.090	40.0	01/18/2060
5971+32	259	18	0.256	45,000	4.56	0.069	40.5	08/04/2060
6281+64	226	18	0.256	45,000	1.96	0.090	41.0	01/15/2061
6147+03	311	18	0.256	45,000	4.32	0.069	41.1	02/23/2061
6410+23	259	18	0.256	45,000	2.79	0.074	41.1	03/09/2061
6285+23	237	18	0.256	45,000	2.31	0.082	41.9	12/11/2061
6259+74	258	18	0.256	45,000	3.02	0.074	42.0	01/30/2062
6363+67	270	18	0.256	45,000	3.50	0.069	42.3	05/24/2062
6432+81	266	18	0.256	45,000	3.26	0.069	42.4	06/05/2062
6261+90	253	18	0.256	45,000	1.72	0.095	42.5	08/06/2062
6577+75	372	18	0.256	45,000	2.31	0.074	42.8	11/02/2062
6567+25	349	18	0.256	45,000	1.84	0.082	43.5	07/20/2063
6593+85	348	18	0.256	45,000	2.19	0.074	43.9	12/08/2063
6193+80	322	18	0.256	45,000	2.31	0.082	44.0	02/09/2064
6236+79	308	18	0.256	45,000	2.90	0.074	44.1	02/28/2064
6578+85	373	18	0.256	45,000	2.67	0.069	44.2	04/02/2064
7149+29	256	18	0.256	65,000	1.72	0.062	44.7	09/25/2064
6288+74	242	18	0.256	45,000	2.67	0.074	45.5	08/03/2065
6608+94	394	18	0.256	45,000	2.08	0.074	45.6	09/09/2065
6535+12	313	18	0.256	45,000	2.19	0.074	45.8	11/19/2065
6720+71	328	18	0.256	45,000	1.48	0.082	46.3	05/19/2066
6277+88	226	18	0.256	45,000	1.72	0.090	46.8	11/05/2066
6835+23	244	18	0.256	45,000	1.72	0.069	47.6	09/10/2067
6425+10	269	18	0.256	45,000	4.09	0.062	48.5	08/12/2068
6307+21	239	18	0.256	45,000	4.56	0.062	49.1	03/03/2069
6578+86	373	18	0.256	45,000	3.26	0.062	49.4	07/09/2069
6563+30	349	18	0.256	45,000	3.26	0.062	49.9	12/16/2069
6966+18	246	18	0.256	45,000	1.37	0.069	50.1	02/15/2070
7405+31	323	18	0.266	45,000	1.13	0.063	50.1	02/21/2070
7126+68	253	18	0.256	65,000	1.48	0.062	50.6	08/31/2070
6424+32	270	18	0.256	45,000	2.08	0.074	51.5	08/06/2071
6833+96	242	18	0.256	45,000	1.37	0.074	51.7	09/26/2071

Table D-2 (continued). Pressure-Cycle-Induced Fatigue Cracking Analysis of ILI Indicated Anomalies Bastrop to Warda – ILI Date January 27, 2020 (pg. 3 of 4)

Station Number	Elevation (feet)	OD (inch)	WT (inch)	YS (psi)	ILI Length (inch)	ILI Depth (inch)	Re-assessment Interval (years)	Re-assessment Due Date
6263+01	258	18	0.256	45,000	2.31	0.074	51.7	10/19/2071
6617+13	310	18	0.256	45,000	1.72	0.074	52.2	04/06/2072
6186+35	331	18	0.266	45,000	4.44	0.068	52.7	09/23/2072
6031+11	279	18	0.256	45,000	1.96	0.082	52.9	12/14/2072
6835+23	244	18	0.256	45,000	1.13	0.082	53.6	08/18/2073
6586+78	340	18	0.256	45,000	1.25	0.090	53.6	09/16/2073
6481+22	233	18	0.256	45,000	3.02	0.062	54.5	07/25/2074
6886+45	286	18	0.256	45,000	1.37	0.069	54.6	09/07/2074
6231+26	293	18	0.256	45,000	2.19	0.074	54.9	01/01/2075
6299+99	243	18	0.256	45,000	2.43	0.069	56.0	01/17/2076
6439+91	269	18	0.256	45,000	1.84	0.074	56.3	05/20/2076
6463+80	253	18	0.256	45,000	1.48	0.082	56.7	09/26/2076
6412+34	255	18	0.256	45,000	1.96	0.069	61.7	09/21/2081
6409+63	260	18	0.266	45,000	2.08	0.076	61.7	09/28/2081
6268+05	227	18	0.256	45,000	2.08	0.069	63.8	11/02/2083
6125+24	310	18	0.256	45,000	2.19	0.069	65.2	04/08/2085
6748+88	303	18	0.256	45,000	1.60	0.062	65.7	10/21/2085
6571+15	342	18	0.256	45,000	1.48	0.069	68.7	10/24/2088
6267+97	228	18	0.256	45,000	1.60	0.074	69.4	06/18/2089
6268+68	215	18	0.256	45,000	1.84	0.069	69.8	11/03/2089
5970+89	258	18	0.256	45,000	1.72	0.074	70.4	06/18/2090
6690+39	233	18	0.266	45,000	1.96	0.063	70.8	11/29/2090
6821+47	243	18	0.256	45,000	1.25	0.062	73.0	02/12/2093
6094+83	277	18	0.256	45,000	1.60	0.074	74.0	02/03/2094
6102+74	269	18	0.256	45,000	1.84	0.069	74.4	06/13/2094
6301+30	240	18	0.256	45,000	2.08	0.062	76.7	10/21/2096
6199+59	312	18	0.256	45,000	1.25	0.082	77.6	09/16/2097
6678+76	228	18	0.256	45,000	1.13	0.069	77.7	10/13/2097
6125+59	310	18	0.256	45,000	1.48	0.074	78.8	11/17/2098
6809+32	243	18	0.256	45,000	1.13	0.062	79.9	01/08/2100
6298+32	244	18	0.256	45,000	1.13	0.082	81.5	08/03/2101
6006+53	251	18	0.256	45,000	2.08	0.062	83.9	12/27/2103
6069+92	309	18	0.256	45,000	2.08	0.062	84.0	01/15/2104
6414+90	255	18	0.256	45,000	1.60	0.062	85.7	10/05/2105
6694+95	237	18	0.266	45,000	1.25	0.068	87.1	03/11/2107
5973+04	255	18	0.256	45,000	1.13	0.082	88.8	11/12/2108
6233+02	301	18	0.256	45,000	1.37	0.069	90.5	07/18/2110
6135+25	278	18	0.256	45,000	1.25	0.074	91.1	02/25/2111
6580+61	369	18	0.256	45,000	1.25	0.062	92.4	06/06/2112
6305+25	239	18	0.256	45,000	1.25	0.069	93.6	08/28/2113
6414+67	254	18	0.256	45,000	1.37	0.062	96.0	02/15/2116
6186+38	331	18	0.266	45,000	1.25	0.081	96.6	08/27/2116
5988+07	213	18	0.266	45,000	1.72	0.068	98.6	09/20/2118
5982+61	225	18	0.256	45,000	1.13	0.069	111.3	05/31/2131
6002+92	237	18	0.256	45,000	1.13	0.069	111.4	07/06/2131
6404+95	271	18	0.256	45,000	1.13	0.062	112.1	03/04/2132

Table D-2 (continued). Pressure-Cycle-Induced Fatigue Cracking Analysis of ILI Indicated Anomalies Bastrop to Warda – ILI Date January 27, 2020 (pg. 4 of 4)

Station Number	Elevation (feet)	OD (inch)	WT (inch)	YS (psi)	ILI Length (inch)	ILI Depth (inch)	Re-assessment Interval (years)	Re-assessment Due Date
6431+25	267	18	0.266	45,000	1.13	0.068	117.2	03/24/2137
6132+90	284	18	0.266	45,000	1.13	0.063	149.2	04/17/2169
7108+88	244	18	0.364	45,000	1.48	0.083	170.0	01/24/2190

Table D-3. Pressure-Cycle-Induced Fatigue Cracking Analysis of ILI Indicated Anomalies Buckhorn to Satsuma – ILI Date December 5, 2019 (pg. 1 of 4)

Station Number	Elevation (feet)	OD (inch)	WT (inch)	YS (psi)	ILI Length (inch)	ILI Depth (inch)	Re-assessment Interval (years)	Re-assessment Due Date
3007+90	107	18	0.285	45,000	7.40	0.107	27.0	11/27/2046
3512+93	69	18	0.285	45,000	6.69	0.082	31.5	06/14/2051
3502+52	72	18	0.266	45,000	5.51	0.068	37.7	09/04/2057
3518+43	68	18	0.285	45,000	5.51	0.076	41.3	03/19/2061
3445+54	58	18	0.266	45,000	1.84	0.095	44.6	07/27/2064
3518+82	68	18	0.285	45,000	8.23	0.067	47.6	07/13/2067
3462+42	58	18	0.266	45,000	4.68	0.063	51.6	06/29/2071
3105+21	78	18	0.266	45,000	2.55	0.095	55.2	02/11/2075
3402+96	48	18	0.266	45,000	3.26	0.068	57.1	12/26/2076
3484+54	72	18	0.266	45,000	2.55	0.068	58.8	09/19/2078
3462+17	58	18	0.266	45,000	3.38	0.063	60.0	12/12/2079
3518+81	68	18	0.285	45,000	4.32	0.067	60.2	03/02/2080
2954+08	119	18	0.266	45,000	6.45	0.076	62.4	04/28/2082
3565+60	58	18	0.285	45,000	2.43	0.076	62.7	08/20/2082
3105+11	78	18	0.266	45,000	3.85	0.076	64.7	08/11/2084
3391+88	51	18	0.285	45,000	5.51	0.067	65.8	09/23/2085
2170+24	55	18	0.285	45,000	6.57	0.116	69.0	12/04/2088
3239+53	67	18	0.285	45,000	9.05	0.067	71.0	12/04/2090
2702+88	89	18	0.266	45,000	6.81	0.081	73.9	10/31/2093
3108+95	78	18	0.266	45,000	4.68	0.068	74.6	07/24/2094
1934+25	37	18	0.256	45,000	4.44	0.103	75.2	02/22/2095
3463+75	59	18	0.266	45,000	1.84	0.068	75.5	06/07/2095
3354+05	52	18	0.295	45,000	3.73	0.074	81.5	06/04/2101
3514+10	68	18	0.266	45,000	1.72	0.063	82.8	09/07/2102
3494+24	75	18	0.285	45,000	3.38	0.062	83.0	12/20/2102
3462+41	58	18	0.266	45,000	1.60	0.068	83.5	05/31/2103
2825+08	93	18	0.256	45,000	3.97	0.074	83.8	09/26/2103
3255+15	71	18	0.285	45,000	2.43	0.082	88.7	08/03/2108
3136+90	78	18	0.295	45,000	2.90	0.089	94.4	05/06/2114
3085+10	80	18	0.266	45,000	4.20	0.063	97.2	01/31/2117
3397+97	51	18	0.285	45,000	3.26	0.062	97.5	06/19/2117
2368+15	65	18	0.285	45,000	8.23	0.096	97.6	07/09/2117
2300+79	60	18	0.285	45,000	6.69	0.102	98.5	06/18/2118
3179+68	67	18	0.285	45,000	4.56	0.067	98.9	10/18/2118
3486+86	74	18	0.266	45,000	1.13	0.068	105.8	09/25/2125
3188+40	67	18	0.295	45,000	4.80	0.068	110.1	12/28/2129

Table D-3 (continued). Pressure-Cycle-Induced Fatigue Cracking Analysis of ILI Indicated Anomalies Buckhorn to Satsuma – ILI Date December 5, 2019 (pg. 2 of 4)

Station Number	Elevation (feet)	OD (inch)	WT (inch)	YS (psi)	ILI Length (inch)	ILI Depth (inch)	Re-assessment Interval (years)	Re-assessment Due Date
3564+02	58	18	0.285	45,000	1.60	0.062	113.2	02/01/2133
2531+64	76	18	0.266	45,000	6.69	0.076	117.5	05/30/2137
2959+22	120	18	0.285	45,000	3.73	0.076	121.8	09/13/2141
2968+72	120	18	0.285	45,000	3.61	0.076	122.3	04/02/2142
2568+46	74	18	0.266	45,000	5.03	0.076	128.3	04/01/2148
3261+04	49	18	0.295	45,000	3.85	0.063	128.5	05/29/2148
2951+31	119	18	0.285	45,000	2.67	0.082	134.0	12/15/2153
3412+86	60	18	0.295	45,000	1.13	0.089	138.5	06/03/2158
3294+84	51	18	0.285	45,000	1.13	0.087	144.1	01/05/2164
2417+21	67	18	0.266	45,000	3.14	0.089	147.9	11/15/2167
2986+58	117	18	0.295	45,000	3.49	0.074	151.1	01/27/2171
2838+89	95	18	0.266	45,000	3.61	0.063	154.7	08/15/2174
2531+63	76	18	0.266	45,000	3.97	0.076	155.4	04/20/2175
2205+79	55	18	0.266	45,000	3.14	0.095	160.2	02/18/2180
2711+40	89	18	0.266	45,000	5.15	0.063	161.8	10/02/2181
2080+15	46	18	0.266	45,000	5.51	0.081	166.8	09/28/2186
3281+24	51	18	0.295	45,000	1.25	0.083	168.1	01/17/2188
2964+75	120	18	0.266	45,000	2.07	0.063	173.7	08/03/2193
2620+69	79	18	0.266	45,000	1.48	0.103	175.4	05/07/2195
3153+88	65	18	0.285	45,000	2.19	0.062	175.5	06/02/2195
2953+97	119	18	0.266	45,000	1.25	0.081	177.3	04/11/2197
3084+96	80	18	0.295	45,000	3.26	0.063	182.8	09/10/2202
2358+64	65	18	0.266	45,000	7.99	0.068	186.1	01/19/2206
3108+97	78	18	0.266	45,000	1.13	0.068	189.6	07/11/2209
2363+76	65	18	0.266	45,000	4.09	0.076	190.0	11/28/2209
3160+47	66	18	0.285	45,000	1.25	0.076	193.5	06/10/2213
2823+35	93	18	0.295	45,000	2.55	0.083	195.0	12/21/2214
3028+64	94	18	0.295	45,000	3.38	0.063	196.6	06/28/2216
1900+36	35	18	0.266	45,000	5.62	0.076	197.7	08/08/2217
2402+24	66	18	0.266	45,000	10.47	0.063	202.3	03/10/2222
1899+95	35	18	0.285	45,000	5.62	0.087	202.7	08/23/2222
1970+89	36	18	0.266	45,000	3.97	0.081	208.0	12/22/2227
2673+20	88	18	0.266	45,000	1.96	0.076	208.8	10/01/2228
2715+08	85	18	0.285	45,000	1.72	0.096	210.6	07/10/2230
2839+00	95	18	0.266	45,000	1.72	0.068	211.3	03/15/2231
2821+48	93	18	0.295	45,000	3.97	0.068	214.5	06/25/2234
2171+81	54	18	0.285	45,000	4.80	0.087	215.0	11/21/2234
1961+01	39	18	0.285	45,000	7.40	0.082	216.5	06/11/2236
2536+77	76	18	0.285	45,000	3.14	0.082	224.6	07/25/2244
2823+87	93	18	0.295	45,000	3.38	0.068	225.2	02/27/2245
2164+68	52	18	0.285	45,000	4.09	0.082	225.2	02/27/2245
2174+59	54	18	0.285	45,000	3.97	0.087	225.2	02/27/2245
2097+56	46	18	0.285	45,000	2.19	0.076	225.2	02/27/2245
2102+08	48	18	0.285	45,000	7.99	0.076	225.2	02/27/2245
2074+57	46	18	0.266	45,000	2.31	0.068	225.2	02/27/2245
2078+78	46	18	0.285	45,000	2.55	0.076	225.2	02/27/2245
2986+70	117	18	0.295	45,000	1.37	0.063	225.2	02/27/2245

Table D-3 (continued). Pressure-Cycle-Induced Fatigue Cracking Analysis of ILI Indicated Anomalies Buckhorn to Satsuma – ILI Date December 5, 2019 (pg. 3 of 4)

Station Number	Elevation (feet)	OD (inch)	WT (inch)	YS (psi)	ILI Length (inch)	ILI Depth (inch)	Re-assessment Interval (years)	Re-assessment Due Date
2823+46	93	18	0.295	45,000	2.55	0.063	225.2	02/27/2245
3361+94	53	18	0.305	45,000	1.13	0.063	225.2	02/27/2245
1936+26	37	18	0.266	45,000	1.13	0.063	225.2	02/27/2245
2739+49	88	18	0.295	45,000	1.25	0.068	225.2	02/27/2245
1878+16	33	18	0.285	45,000	2.67	0.067	225.2	02/27/2245
2986+92	117	18	0.295	45,000	1.37	0.074	225.2	02/27/2245
2666+41	85	18	0.266	45,000	1.25	0.063	225.2	02/27/2245
3179+70	67	18	0.285	45,000	1.13	0.062	225.2	02/27/2245
2192+94	55	18	0.285	45,000	3.38	0.076	225.2	02/27/2245
2367+73	65	18	0.285	45,000	3.73	0.067	225.2	02/27/2245
1874+84	33	18	0.285	45,000	1.48	0.141	225.2	02/27/2245
1936+74	37	18	0.285	45,000	1.37	0.062	225.2	02/27/2245
1964+77	39	18	0.266	45,000	3.85	0.063	225.2	02/27/2245
2290+70	60	18	0.285	45,000	1.60	0.062	225.2	02/27/2245
2198+42	54	18	0.285	45,000	2.19	0.062	225.2	02/27/2245
2163+10	53	18	0.285	45,000	4.32	0.067	225.2	02/27/2245
2170+63	55	18	0.285	45,000	5.27	0.076	225.2	02/27/2245
2087+34	46	18	0.285	45,000	1.25	0.076	225.2	02/27/2245
2554+74	73	18	0.266	45,000	1.37	0.068	225.2	02/27/2245
2556+26	75	18	0.285	45,000	1.72	0.067	225.2	02/27/2245
2499+22	81	18	0.266	45,000	3.26	0.063	225.2	02/27/2245
3169+51	68	18	0.285	45,000	1.13	0.067	225.2	02/27/2245
2087+36	46	18	0.285	45,000	1.13	0.067	225.2	02/27/2245
1918+91	36	18	0.266	45,000	1.13	0.068	225.2	02/27/2245
1924+56	35	18	0.285	45,000	5.03	0.082	225.2	02/27/2245
2164+29	52	18	0.285	45,000	1.13	0.067	225.2	02/27/2245
2094+32	46	18	0.285	45,000	2.31	0.067	225.2	02/27/2245
2036+81	44	18	0.285	45,000	1.25	0.067	225.2	02/27/2245
2339+76	63	18	0.266	45,000	2.43	0.068	225.2	02/27/2245
2527+30	77	18	0.266	45,000	1.13	0.095	225.2	02/27/2245
2433+72	67	18	0.266	45,000	1.72	0.089	225.2	02/27/2245
2361+37	65	18	0.285	45,000	2.78	0.067	225.2	02/27/2245
2083+91	46	18	0.266	45,000	1.84	0.068	225.2	02/27/2245
1817+22	25	18	0.266	45,000	2.67	0.063	225.2	02/27/2245
1919+72	35	18	0.266	45,000	3.38	0.081	225.2	02/27/2245
1923+09	35	18	0.266	45,000	5.86	0.063	225.2	02/27/2245
2418+81	66	18	0.285	45,000	1.60	0.076	225.2	02/27/2245
2301+58	60	18	0.285	45,000	1.13	0.067	225.2	02/27/2245
3029+03	94	18	0.295	45,000	2.55	0.063	225.2	02/27/2245
2414+51	63	18	0.266	45,000	2.07	0.076	225.2	02/27/2245
2415+65	65	18	0.295	45,000	1.13	0.068	225.2	02/27/2245
2362+57	65	18	0.266	45,000	1.37	0.063	225.2	02/27/2245
2823+20	93	18	0.295	45,000	1.60	0.083	225.2	02/27/2245
2301+77	60	18	0.285	45,000	5.03	0.062	225.2	02/27/2245
2301+97	60	18	0.285	45,000	1.25	0.062	225.2	02/27/2245
2371+28	65	18	0.285	45,000	2.31	0.082	225.2	02/27/2245
2178+16	54	18	0.285	45,000	2.90	0.082	225.2	02/27/2245

Table D-3 (continued). Pressure-Cycle-Induced Fatigue Cracking Analysis of ILI Indicated Anomalies Buckhorn to Satsuma – ILI Date December 5, 2019 (pg. 4 of 4)

Station Number	Elevation (feet)	OD (inch)	WT (inch)	YS (psi)	ILI Length (inch)	ILI Depth (inch)	Re-assessment Interval (years)	Re-assessment Due Date
2112+83	47	18	0.285	45,000	1.96	0.062	225.2	02/27/2245
1975+48	40	18	0.285	45,000	6.81	0.067	225.2	02/27/2245
1975+54	40	18	0.295	45,000	2.19	0.074	225.2	02/27/2245
2177+77	54	18	0.285	45,000	4.91	0.067	225.2	02/27/2245
2414+36	63	18	0.266	45,000	1.60	0.076	225.2	02/27/2245
1898+77	35	18	0.285	45,000	1.13	0.062	225.2	02/27/2245
2107+89	48	18	0.285	45,000	2.31	0.082	225.2	02/27/2245
2082+35	46	18	0.266	45,000	4.09	0.068	225.2	02/27/2245
1991+40	40	18	0.285	45,000	3.49	0.096	225.2	02/27/2245

Table D-4. Pressure-Cycle-Induced Fatigue Cracking Analysis of ILI Indicated Anomalies Cartman to Kimble – ILI Date August 25, 2020 (pg. 1 of 5)

Station Number	Elevation (feet)	OD (inch)	WT (inch)	YS (psi)	ILI Length (inch)	ILI Depth (inch)	Re-assessment Interval (years)	Re-assessment Due Date
18091+77	2,434	18	0.276	45,000	13.38	0.094	3.3	12/19/2023
18058+13	2,424	18	0.276	45,000	8.78	0.094	5.9	08/03/2026
18010+58	2,398	18	0.276	45,000	6.07	0.088	10.7	05/03/2031
18054+93	2,423	18	0.266	45,000	7.37	0.076	11.3	12/01/2031
17690+62	2,337	18	0.266	45,000	5.49	0.089	11.7	05/04/2032
18116+16	2,438	18	0.276	45,000	3.01	0.102	11.9	07/11/2032
18114+30	2,438	18	0.276	45,000	9.96	0.075	12.3	12/15/2032
17698+67	2,357	18	0.276	45,000	6.90	0.088	13.1	10/08/2033
17688+47	2,333	18	0.266	45,000	9.37	0.076	13.6	04/07/2034
17863+21	2,370	18	0.276	45,000	2.89	0.108	13.9	07/11/2034
18058+07	2,424	18	0.276	45,000	4.78	0.083	14.6	03/30/2035
18091+88	2,434	18	0.276	45,000	3.95	0.083	16.1	09/23/2036
18110+06	2,439	18	0.276	45,000	5.96	0.075	16.1	10/17/2036
18094+59	2,436	18	0.276	45,000	5.72	0.075	16.7	05/10/2037
17121+65	2,190	18	0.276	45,000	13.03	0.083	17.0	08/28/2037
18054+81	2,423	18	0.266	45,000	3.60	0.076	17.6	04/02/2038
17041+95	2,235	18	0.276	45,000	8.90	0.088	19.3	12/14/2039
17570+86	2,372	18	0.266	45,000	4.54	0.081	20.2	11/13/2040
18162+65	2,441	18	0.276	45,000	2.42	0.083	21.9	07/16/2042
18140+79	2,439	18	0.276	45,000	3.84	0.069	23.6	04/08/2044
18167+30	2,440	18	0.276	45,000	3.48	0.069	24.3	11/26/2044
18020+93	2,407	18	0.276	45,000	4.42	0.069	24.7	04/20/2045
16836+64	2,331	18	0.305	45,000	5.37	0.121	24.8	06/12/2045
18086+30	2,433	18	0.266	45,000	2.78	0.068	25.6	04/13/2046
17995+86	2,397	18	0.276	45,000	6.55	0.064	25.8	06/20/2046
17092+04	2,238	18	0.266	45,000	14.91	0.068	26.0	09/03/2046
17986+95	2,397	18	0.276	45,000	1.95	0.088	27.8	06/23/2048
17676+63	2,331	18	0.276	45,000	6.07	0.069	29.5	03/13/2050
18012+39	2,398	18	0.276	45,000	4.42	0.064	29.7	05/08/2050
18117+32	2,437	18	0.276	45,000	2.66	0.069	30.1	09/25/2050
18162+60	2,441	18	0.276	45,000	2.42	0.069	30.5	03/02/2051

Table D-4 (continued). Pressure-Cycle-Induced Fatigue Cracking Analysis of ILI Indicated Anomalies Cartman to Kimble – ILI Date August 25, 2020 (pg. 2 of 5)

Station Number	Elevation (feet)	OD (inch)	WT (inch)	YS (psi)	ILI Length (inch)	ILI Depth (inch)	Re-assessment Interval (years)	Re-assessment Due Date
17570+34	2,371	18	0.266	45,000	2.07	0.089	31.6	03/17/2052
17071+65	2,284	18	0.276	45,000	5.84	0.083	31.9	07/28/2052
18168+66	2,440	18	0.276	45,000	1.24	0.094	32.5	03/04/2053
17457+58	2,376	18	0.266	45,000	3.25	0.076	33.7	05/05/2054
17331+27	2,298	18	0.276	45,000	3.72	0.083	34.4	01/27/2055
17439+71	2,373	18	0.266	45,000	4.42	0.068	36.5	02/08/2057
18053+73	2,424	18	0.285	45,000	4.07	0.062	37.3	12/09/2057
17101+57	2,194	18	0.266	45,000	2.66	0.089	37.5	02/10/2058
17448+93	2,376	18	0.276	45,000	4.07	0.075	37.6	03/22/2058
17235+84	2,329	18	0.266	45,000	5.84	0.068	38.1	10/12/2058
17308+30	2,271	18	0.276	45,000	10.43	0.064	41.4	01/25/2062
17561+65	2,355	18	0.276	45,000	3.72	0.069	42.0	09/04/2062
17732+39	2,314	18	0.285	45,000	6.66	0.062	42.1	10/18/2062
17326+61	2,300	18	0.276	45,000	5.37	0.069	43.2	11/04/2063
17186+22	2,261	18	0.266	45,000	7.61	0.063	43.4	01/09/2064
17727+59	2,313	18	0.266	45,000	2.07	0.068	43.9	07/20/2064
17007+76	2,300	18	0.266	45,000	10.32	0.063	44.8	06/30/2065
17965+34	2,405	18	0.276	45,000	1.83	0.069	44.9	07/03/2065
17089+28	2,235	18	0.276	45,000	7.84	0.069	44.9	07/19/2065
17107+84	2,193	18	0.276	45,000	3.25	0.083	46.0	08/28/2066
17549+62	2,367	18	0.276	45,000	3.01	0.069	48.2	10/19/2068
17491+53	2,327	18	0.266	45,000	3.25	0.063	48.3	12/05/2068
17494+70	2,318	18	0.276	45,000	4.42	0.064	48.7	04/24/2069
17538+97	2,365	18	0.276	45,000	2.42	0.075	48.7	05/15/2069
17436+94	2,377	18	0.276	45,000	5.01	0.064	49.0	09/06/2069
16670+45	2,224	18	0.315	45,000	9.49	0.096	50.8	06/06/2071
17095+56	2,226	18	0.276	45,000	1.83	0.102	51.4	01/26/2072
18114+21	2,438	18	0.276	45,000	1.13	0.069	56.4	01/14/2077
17216+30	2,294	18	0.276	45,000	2.78	0.075	59.0	08/19/2079
17927+07	2,418	18	0.266	45,000	1.24	0.063	59.4	01/08/2080
18046+56	2,426	18	0.276	45,000	1.13	0.069	60.3	12/22/2080
17471+74	2,347	18	0.276	45,000	3.01	0.064	60.3	12/25/2080
17302+87	2,267	18	0.266	45,000	2.30	0.068	60.5	02/21/2081
17717+58	2,323	18	0.276	45,000	1.95	0.064	61.6	04/07/2082
15747+66	2,210	18	0.276	45,000	8.08	0.075	64.3	12/02/2084
16860+88	2,278	18	0.305	45,000	11.02	0.076	69.0	08/17/2089
17033+60	2,243	18	0.266	45,000	2.66	0.068	69.8	06/08/2090
17713+21	2,313	18	0.266	45,000	1.24	0.063	72.3	12/11/2092
17688+57	2,334	18	0.266	45,000	1.13	0.068	72.6	04/17/2093
16332+31	2,385	18	0.315	45,000	7.25	0.096	73.3	12/17/2093
17519+76	2,365	18	0.276	45,000	1.95	0.064	74.8	06/05/2095
17099+93	2,193	18	0.276	45,000	2.78	0.069	74.8	06/06/2095
16873+99	2,302	18	0.315	45,000	7.13	0.083	75.5	03/09/2096
17384+39	2,331	18	0.276	45,000	2.30	0.064	76.2	10/23/2096
15743+26	2,220	18	0.266	45,000	2.89	0.081	78.8	05/30/2099
16850+80	2,290	18	0.315	45,000	6.31	0.083	81.3	12/02/2101
17337+62	2,290	18	0.276	45,000	2.19	0.064	81.7	05/08/2102

Table D-4 (continued). Pressure-Cycle-Induced Fatigue Cracking Analysis of ILI Indicated Anomalies Cartman to Kimble – ILI Date August 25, 2020 (pg. 3 of 5)

Station Number	Elevation (feet)	OD (inch)	WT (inch)	YS (psi)	ILI Length (inch)	ILI Depth (inch)	Re-assessment Interval (years)	Re-assessment Due Date
17007+81	2,300	18	0.266	45,000	2.66	0.063	83.4	01/09/2104
17034+58	2,240	18	0.266	45,000	2.42	0.063	85.5	02/25/2106
16533+14	2,313	18	0.315	45,000	9.37	0.083	86.8	06/04/2107
16935+45	2,311	18	0.305	45,000	8.08	0.070	89.3	12/29/2109
17004+84	2,301	18	0.276	45,000	1.95	0.075	91.9	07/13/2112
16640+91	2,286	18	0.315	45,000	4.78	0.090	92.8	07/02/2113
17403+11	2,357	18	0.276	45,000	1.60	0.064	94.9	08/05/2115
17217+23	2,297	18	0.266	45,000	1.60	0.063	95.6	04/17/2116
17325+30	2,298	18	0.276	45,000	1.60	0.064	101.3	12/04/2121
17020+69	2,267	18	0.276	45,000	1.13	0.094	104.7	05/21/2125
16935+19	2,310	18	0.305	45,000	4.78	0.070	108.4	01/01/2129
16149+32	2,378	18	0.315	45,000	5.60	0.090	109.2	11/08/2129
16638+92	2,292	18	0.305	45,000	2.78	0.088	118.7	05/14/2139
16201+58	2,337	18	0.315	45,000	2.42	0.115	120.6	04/01/2141
17247+79	2,324	18	0.276	45,000	1.36	0.064	121.7	05/27/2142
17181+03	2,279	18	0.276	45,000	1.13	0.075	122.7	05/22/2143
16731+77	2,284	18	0.315	45,000	2.42	0.096	124.9	07/10/2145
16550+31	2,281	18	0.305	45,000	5.84	0.070	133.6	03/15/2154
16862+16	2,276	18	0.315	45,000	2.66	0.083	134.5	02/14/2155
17108+10	2,193	18	0.276	45,000	1.36	0.064	136.0	09/05/2156
16079+52	2,261	18	0.315	45,000	3.95	0.090	136.2	10/30/2156
16976+70	2,317	18	0.315	45,000	4.31	0.068	136.5	02/12/2157
16705+01	2,282	18	0.305	45,000	7.02	0.063	137.1	10/04/2157
16781+46	2,276	18	0.315	45,000	6.31	0.068	138.1	10/09/2158
16677+51	2,217	18	0.315	45,000	4.66	0.074	139.5	02/10/2160
15776+20	2,205	18	0.276	45,000	3.48	0.064	142.3	12/28/2162
16837+58	2,328	18	0.315	45,000	10.43	0.061	142.9	07/11/2163
16984+27	2,310	18	0.305	45,000	2.54	0.070	144.2	11/22/2164
16795+01	2,328	18	0.305	45,000	1.83	0.088	147.0	08/28/2167
16605+67	2,284	18	0.315	45,000	2.54	0.090	148.6	04/01/2169
16938+63	2,324	18	0.305	45,000	2.07	0.076	150.1	09/23/2170
16112+32	2,299	18	0.315	45,000	4.31	0.083	150.6	04/17/2171
16438+89	2,310	18	0.305	45,000	8.55	0.063	155.2	11/09/2175
16407+12	2,301	18	0.305	45,000	3.48	0.076	157.0	08/10/2177
16449+58	2,290	18	0.305	45,000	2.19	0.088	161.6	03/19/2182
16550+44	2,281	18	0.305	45,000	1.95	0.088	166.3	12/05/2186
16989+67	2,325	18	0.315	45,000	1.71	0.083	167.4	01/20/2188
16980+30	2,320	18	0.305	45,000	2.42	0.063	171.4	01/26/2192
16508+90	2,307	18	0.315	45,000	1.60	0.108	173.6	04/16/2194
16503+06	2,326	18	0.315	45,000	13.14	0.061	173.7	04/21/2194
16545+66	2,289	18	0.315	45,000	11.26	0.061	173.7	05/23/2194
16756+30	2,243	18	0.305	45,000	1.71	0.082	176.8	06/07/2197
16705+82	2,283	18	0.305	45,000	3.36	0.063	180.4	02/05/2201
16292+67	2,394	18	0.315	45,000	4.31	0.074	184.5	02/11/2205
16948+83	2,351	18	0.305	45,000	2.19	0.063	186.8	06/11/2207
16595+09	2,302	18	0.315	45,000	2.89	0.074	191.7	05/17/2212
16651+34	2,260	18	0.315	45,000	1.13	0.121	196.2	10/29/2216

Table D-4 (continued). Pressure-Cycle-Induced Fatigue Cracking Analysis of ILI Indicated Anomalies Cartman to Kimble – ILI Date August 25, 2020 (pg. 4 of 5)

Station Number	Elevation (feet)	OD (inch)	WT (inch)	YS (psi)	ILI Length (inch)	ILI Depth (inch)	Re-assessment Interval (years)	Re-assessment Due Date
16733+39	2,284	18	0.315	45,000	1.60	0.090	196.5	02/24/2217
16850+48	2,292	18	0.305	45,000	1.36	0.082	198.8	06/09/2219
16874+91	2,303	18	0.315	45,000	2.30	0.068	203.9	07/22/2224
16455+82	2,268	18	0.315	45,000	2.19	0.083	206.3	12/09/2226
16903+95	2,324	18	0.315	45,000	1.71	0.074	212.3	12/23/2232
16288+27	2,385	18	0.305	45,000	2.89	0.070	216.5	02/20/2237
15748+11	2,209	18	0.276	45,000	1.24	0.075	218.8	06/07/2239
16555+60	2,292	18	0.305	45,000	1.60	0.070	225.2	11/17/2245
16219+36	2,339	18	0.315	45,000	1.24	0.061	225.2	11/17/2245
16201+52	2,337	18	0.315	45,000	1.83	0.083	225.2	11/17/2245
16201+62	2,337	18	0.315	45,000	1.13	0.090	225.2	11/17/2245
16216+21	2,340	18	0.315	45,000	2.30	0.068	225.2	11/17/2245
16201+79	2,338	18	0.315	45,000	1.60	0.068	225.2	11/17/2245
16129+49	2,317	18	0.315	45,000	3.84	0.061	225.2	11/17/2245
16125+54	2,306	18	0.325	45,000	3.48	0.069	225.2	11/17/2245
16237+53	2,381	18	0.305	45,000	1.60	0.076	225.2	11/17/2245
16123+74	2,299	18	0.305	45,000	3.36	0.063	225.2	11/17/2245
16638+92	2,292	18	0.305	45,000	1.24	0.070	225.2	11/17/2245
16260+10	2,378	18	0.315	45,000	6.31	0.061	225.2	11/17/2245
16104+61	2,285	18	0.315	45,000	2.78	0.074	225.2	11/17/2245
16826+55	2,340	18	0.315	45,000	1.24	0.061	225.2	11/17/2245
16847+42	2,309	18	0.305	45,000	1.24	0.076	225.2	11/17/2245
16050+13	2,288	18	0.315	45,000	1.71	0.068	225.2	11/17/2245
16304+00	2,406	18	0.315	45,000	1.95	0.074	225.2	11/17/2245
16274+44	2,369	18	0.315	45,000	1.36	0.096	225.2	11/17/2245
16274+46	2,369	18	0.315	45,000	1.36	0.068	225.2	11/17/2245
16329+59	2,384	18	0.315	45,000	1.83	0.074	225.2	11/17/2245
16371+37	2,371	18	0.315	45,000	1.48	0.074	225.2	11/17/2245
16670+52	2,223	18	0.315	45,000	1.71	0.061	225.2	11/17/2245
16428+68	2,316	18	0.305	45,000	1.36	0.063	225.2	11/17/2245
16457+18	2,265	18	0.315	45,000	1.24	0.074	225.2	11/17/2245
16676+20	2,217	18	0.315	45,000	1.60	0.083	225.2	11/17/2245
16318+60	2,408	18	0.305	45,000	3.48	0.063	225.2	11/17/2245
16390+34	2,323	18	0.315	45,000	1.36	0.090	225.2	11/17/2245
16457+16	2,265	18	0.315	45,000	1.24	0.068	225.2	11/17/2245
16457+17	2,265	18	0.315	45,000	1.60	0.068	225.2	11/17/2245
16457+26	2,265	18	0.315	45,000	2.42	0.061	225.2	11/17/2245
16479+33	2,302	18	0.315	45,000	1.60	0.083	225.2	11/17/2245
16414+69	2,298	18	0.315	45,000	1.24	0.083	225.2	11/17/2245
16697+75	2,272	18	0.305	45,000	2.07	0.063	225.2	11/17/2245
16434+09	2,314	18	0.305	45,000	2.07	0.063	225.2	11/17/2245
16450+48	2,287	18	0.325	45,000	1.13	0.082	225.2	11/17/2245
16692+25	2,265	18	0.305	45,000	1.60	0.063	225.2	11/17/2245
16708+46	2,281	18	0.315	45,000	3.13	0.061	225.2	11/17/2245
16456+94	2,265	18	0.315	45,000	1.24	0.090	225.2	11/17/2245
16717+33	2,263	18	0.315	45,000	1.48	0.083	225.2	11/17/2245
16457+05	2,265	18	0.315	45,000	1.83	0.061	225.2	11/17/2245

Table D-4 (continued). Pressure-Cycle-Induced Fatigue Cracking Analysis of ILI Indicated Anomalies Cartman to Kimble – ILI Date August 25, 2020 (pg. 5 of 5)

Station Number	Elevation (feet)	OD (inch)	WT (inch)	YS (psi)	ILI Length (inch)	ILI Depth (inch)	Re-assessment Interval (years)	Re-assessment Due Date
15934+05	2,207	18	0.276	45,000	1.13	0.064	225.2	11/17/2245
16985+12	2,310	18	0.315	45,000	1.60	0.068	225.2	11/17/2245
16521+07	2,286	18	0.315	45,000	1.83	0.083	225.2	11/17/2245
16748+06	2,250	18	0.315	45,000	1.48	0.061	225.2	11/17/2245
16755+73	2,243	18	0.315	45,000	1.24	0.090	225.2	11/17/2245
16756+26	2,243	18	0.305	45,000	1.60	0.063	225.2	11/17/2245
16522+62	2,289	18	0.305	45,000	1.36	0.070	225.2	11/17/2245

Table D-5. Pressure-Cycle-Induced Fatigue Cracking Analysis of ILI Indicated Anomalies Cedar Valley to Bastrop – ILI Date January 16, 2020 (pg. 1 of 4)

Station Number	Elevation (feet)	OD (inch)	WT (inch)	YS (psi)	ILI Length (inch)	ILI Depth (inch)	Re-assessment Interval (years)	Re-assessment Due Date
7833+09	411	18	0.256	45,000	7.40	0.074	33.4	06/11/2053
7513+36	295	18	0.266	45,000	5.74	0.076	37.7	09/28/2057
8607+90	543	18	0.295	45,000	7.99	0.095	38.4	06/09/2058
8272+15	401	18	0.256	45,000	4.44	0.082	40.0	01/26/2060
7499+19	293	18	0.266	45,000	5.03	0.076	40.3	04/20/2060
7798+07	403	18	0.256	45,000	5.50	0.074	40.7	10/07/2060
8271+76	403	18	0.256	45,000	8.82	0.069	41.2	03/16/2061
7739+65	357	18	0.256	45,000	6.57	0.069	43.1	02/18/2063
8066+14	431	18	0.256	45,000	3.97	0.082	43.7	09/21/2063
7968+24	415	18	0.256	45,000	6.92	0.069	47.2	04/09/2067
7786+37	402	18	0.256	45,000	4.09	0.074	49.4	06/05/2069
8761+75	574	18	0.295	45,000	4.20	0.095	54.4	05/24/2074
7524+00	301	18	0.246	45,000	2.43	0.068	55.5	07/02/2075
8473+91	477	18	0.295	45,000	9.88	0.083	57.0	01/19/2077
7646+55	338	18	0.256	45,000	3.61	0.069	57.1	02/26/2077
8487+29	450	18	0.285	45,000	7.04	0.082	57.2	03/23/2077
8031+80	405	18	0.256	45,000	3.85	0.074	57.4	05/30/2077
8698+84	464	18	0.295	45,000	3.02	0.107	57.6	08/10/2077
8066+02	431	18	0.256	45,000	3.85	0.074	58.0	01/18/2078
7853+38	402	18	0.256	45,000	7.99	0.062	58.4	06/17/2078
7523+78	301	18	0.246	45,000	2.55	0.063	62.2	03/13/2082
7897+02	435	18	0.266	45,000	6.21	0.068	66.3	05/08/2086
8053+41	424	18	0.256	45,000	4.09	0.069	66.3	05/08/2086
8937+33	680	18	0.295	45,000	5.62	0.074	71.1	03/02/2091
8223+31	507	18	0.246	45,000	3.49	0.063	73.7	09/14/2093
7853+37	402	18	0.256	45,000	2.43	0.074	75.2	04/09/2095
8194+18	456	18	0.266	45,000	2.67	0.081	79.8	10/26/2099
7990+77	395	18	0.256	45,000	4.68	0.062	79.8	11/21/2099
8843+36	574	18	0.295	45,000	2.07	0.101	83.0	01/18/2103
8669+22	449	18	0.295	45,000	6.33	0.074	84.7	10/13/2104
8239+18	497	18	0.256	45,000	4.32	0.062	86.5	07/02/2106
8828+83	577	18	0.295	45,000	14.97	0.063	87.0	01/09/2107

Table D-5 (continued). Pressure-Cycle-Induced Fatigue Cracking Analysis of ILI Indicated Anomalies Cedar Valley to Bastrop – ILI Date January 16, 2020 (pg. 2 of 4)

Station Number	Elevation (feet)	OD (inch)	WT (inch)	YS (psi)	ILI Length (inch)	ILI Depth (inch)	Re-assessment Interval (years)	Re-assessment Due Date
8787+38	566	18	0.295	45,000	4.91	0.074	87.0	01/13/2107
8843+56	575	18	0.295	45,000	2.31	0.089	94.6	08/14/2114
8200+37	483	18	0.266	45,000	3.61	0.068	94.7	09/16/2114
8753+37	570	18	0.295	45,000	4.32	0.074	95.8	10/22/2115
8761+23	573	18	0.295	45,000	2.90	0.083	97.1	02/15/2117
8258+50	430	18	0.256	45,000	1.96	0.074	98.0	01/04/2118
8843+70	576	18	0.295	45,000	2.55	0.083	99.2	04/09/2119
8813+53	542	18	0.285	45,000	5.74	0.062	99.6	09/11/2119
8798+28	547	18	0.295	45,000	5.27	0.068	100.0	01/28/2120
8807+11	544	18	0.285	45,000	5.62	0.062	101.0	01/15/2121
8434+39	471	18	0.295	45,000	9.88	0.068	102.1	02/08/2122
7647+33	339	18	0.256	45,000	2.07	0.062	102.5	07/21/2122
8803+37	545	18	0.295	45,000	3.38	0.074	105.0	02/02/2125
8685+49	446	18	0.295	45,000	2.78	0.083	105.7	09/20/2125
7540+25	306	18	0.246	45,000	1.25	0.063	105.7	10/10/2125
8456+55	453	18	0.295	45,000	8.46	0.068	106.3	05/11/2126
8886+54	609	18	0.295	45,000	1.25	0.116	108.5	07/08/2128
8258+49	430	18	0.256	45,000	1.96	0.069	111.0	01/10/2131
8151+95	480	18	0.266	45,000	2.67	0.068	113.9	12/10/2133
9199+29	812	18	0.354	65,000	3.38	0.096	114.0	01/20/2134
8487+18	449	18	0.285	45,000	1.60	0.102	114.1	02/06/2134
8099+49	467	18	0.256	45,000	1.60	0.074	115.5	08/02/2135
7816+52	401	18	0.256	45,000	1.60	0.069	115.6	08/25/2135
8687+17	447	18	0.295	45,000	4.56	0.068	116.3	04/30/2136
8027+52	397	18	0.266	45,000	3.14	0.063	117.1	02/08/2137
8484+09	455	18	0.295	45,000	6.10	0.068	117.9	12/28/2137
8487+19	449	18	0.285	45,000	4.20	0.067	119.1	02/11/2139
9171+04	812	18	0.374	65,000	5.03	0.096	121.8	11/02/2141
8194+37	454	18	0.266	45,000	1.84	0.076	122.6	08/07/2142
8293+91	386	18	0.256	45,000	2.19	0.062	124.1	02/13/2144
8285+44	391	18	0.256	45,000	2.19	0.062	124.4	05/31/2144
8473+51	478	18	0.305	45,000	7.99	0.070	124.6	08/19/2144
8242+51	463	18	0.256	45,000	1.25	0.082	125.0	01/29/2145
8194+47	453	18	0.266	45,000	2.31	0.068	125.0	02/02/2145
7918+48	432	18	0.256	45,000	1.96	0.062	127.5	07/10/2147
8194+17	457	18	0.266	45,000	1.72	0.076	129.4	05/26/2149
8502+42	474	18	0.305	45,000	3.38	0.082	129.4	06/10/2149
8726+20	519	18	0.295	45,000	5.15	0.063	129.5	07/16/2149
8581+47	484	18	0.295	45,000	3.14	0.074	130.7	09/17/2150
8681+32	446	18	0.295	45,000	5.27	0.063	132.5	07/11/2152
8214+87	500	18	0.266	45,000	2.67	0.063	132.6	08/24/2152
8246+27	456	18	0.256	45,000	1.37	0.074	132.9	12/06/2152
8880+88	613	18	0.295	45,000	1.48	0.089	133.9	11/25/2153
8246+24	456	18	0.256	45,000	1.96	0.062	135.4	06/06/2155
8737+50	554	18	0.295	45,000	3.14	0.068	135.8	10/31/2155
8272+95	401	18	0.256	45,000	1.13	0.082	136.6	08/31/2156
8251+28	452	18	0.256	45,000	1.48	0.069	137.8	10/26/2157

Table D-5 (continued). Pressure-Cycle-Induced Fatigue Cracking Analysis of ILI Indicated Anomalies Cedar Valley to Bastrop – ILI Date January 16, 2020 (pg. 3 of 4)

Station Number	Elevation (feet)	OD (inch)	WT (inch)	YS (psi)	ILI Length (inch)	ILI Depth (inch)	Re-assessment Interval (years)	Re-assessment Due Date
7905+38	435	18	0.256	45,000	1.37	0.069	137.9	12/10/2157
8246+06	456	18	0.256	45,000	1.48	0.069	137.9	12/20/2157
8699+48	466	18	0.295	45,000	4.56	0.063	138.0	02/02/2158
7791+91	403	18	0.256	45,000	1.25	0.069	139.4	06/10/2159
8761+75	574	18	0.295	45,000	2.31	0.074	139.4	06/14/2159
8292+11	387	18	0.256	45,000	1.25	0.074	142.1	02/18/2162
8843+45	574	18	0.295	45,000	1.60	0.083	143.0	02/02/2163
8704+02	469	18	0.295	45,000	2.90	0.068	144.9	12/18/2164
8839+52	570	18	0.295	45,000	3.14	0.063	144.9	12/27/2164
8880+90	613	18	0.295	45,000	2.19	0.068	147.5	08/04/2167
9171+05	812	18	0.374	65,000	3.61	0.096	149.0	01/14/2169
8503+22	475	18	0.305	45,000	4.68	0.070	149.9	12/14/2169
8496+64	468	18	0.295	45,000	3.49	0.068	150.7	09/14/2170
8487+18	449	18	0.285	45,000	3.61	0.062	152.0	01/01/2172
7843+26	402	18	0.256	45,000	1.13	0.069	156.4	06/11/2176
8296+78	386	18	0.256	45,000	1.25	0.069	156.8	10/20/2176
8843+39	574	18	0.295	45,000	2.67	0.063	157.0	01/17/2177
8713+33	499	18	0.295	45,000	3.26	0.063	158.6	08/31/2178
8678+18	447	18	0.295	45,000	3.38	0.063	159.7	10/11/2179
8441+24	464	18	0.295	45,000	3.26	0.068	160.6	08/20/2180
8843+67	575	18	0.295	45,000	2.43	0.063	165.1	02/22/2185
7977+34	391	18	0.256	45,000	1.13	0.069	165.9	12/27/2185
8607+96	543	18	0.295	45,000	1.37	0.095	166.0	02/01/2186
8678+02	447	18	0.295	45,000	1.96	0.074	166.2	04/04/2186
8843+69	576	18	0.295	45,000	1.60	0.074	167.8	11/18/2187
8443+43	461	18	0.295	45,000	4.09	0.063	169.8	11/19/2189
8441+24	464	18	0.295	45,000	4.09	0.063	170.0	01/26/2190
8947+09	690	18	0.295	45,000	1.60	0.068	170.7	10/09/2190
8575+84	477	18	0.295	45,000	2.55	0.068	172.2	03/28/2192
8681+91	446	18	0.295	45,000	2.67	0.063	179.4	05/26/2199
8475+50	476	18	0.295	45,000	1.48	0.089	181.0	01/28/2201
8113+81	476	18	0.266	45,000	1.60	0.063	181.8	10/31/2201
8491+09	455	18	0.305	45,000	4.56	0.063	182.1	03/06/2202
8194+19	456	18	0.266	45,000	1.13	0.076	185.6	09/02/2205
8588+93	489	18	0.295	45,000	1.84	0.074	186.0	02/05/2206
8658+24	445	18	0.295	45,000	1.37	0.083	190.7	10/09/2210
8027+55	397	18	0.266	45,000	1.25	0.068	191.2	03/15/2211
7980+87	391	18	0.256	45,000	1.13	0.062	192.6	08/20/2212
8744+68	569	18	0.295	45,000	1.48	0.074	194.7	09/25/2214
8468+02	473	18	0.295	45,000	2.19	0.068	200.4	06/09/2220
8608+93	535	18	0.295	45,000	2.43	0.063	200.7	09/17/2220
8194+26	455	18	0.266	45,000	1.37	0.063	204.2	04/04/2224
8537+87	552	18	0.295	45,000	1.25	0.089	206.9	12/13/2226
7806+88	404	18	0.266	45,000	1.13	0.063	208.0	01/19/2228
8765+40	564	18	0.295	45,000	1.84	0.063	208.2	04/16/2228
8027+59	397	18	0.266	45,000	1.25	0.063	212.1	03/03/2232
8606+44	550	18	0.305	45,000	2.19	0.070	212.9	12/03/2232

Table D-5 (continued). Pressure-Cycle-Induced Fatigue Cracking Analysis of ILI Indicated Anomalies Cedar Valley to Bastrop – ILI Date January 16, 2020 (pg. 4 of 4)

Station Number	Elevation (feet)	OD (inch)	WT (inch)	YS (psi)	ILI Length (inch)	ILI Depth (inch)	Re-assessment Interval (years)	Re-assessment Due Date
8194+20	456	18	0.266	45,000	1.13	0.068	213.6	09/04/2233
8788+99	565	18	0.295	45,000	1.25	0.074	215.1	02/07/2235
8581+47	484	18	0.295	45,000	1.25	0.083	219.1	02/19/2239
8940+10	693	18	0.295	45,000	1.13	0.068	223.6	09/07/2243
8752+28	571	18	0.295	45,000	1.25	0.063	225.2	04/10/2245
9167+84	815	18	0.374	65,000	3.02	0.062	225.2	04/10/2245
8770+11	555	18	0.305	45,000	1.13	0.063	225.2	04/10/2245
8363+31	432	18	0.295	45,000	1.25	0.074	225.2	04/10/2245
8650+22	444	18	0.295	45,000	1.25	0.063	225.2	04/10/2245
8660+16	424	18	0.354	65,000	1.96	0.068	225.2	04/10/2245
8660+16	424	18	0.354	65,000	1.13	0.061	225.2	04/10/2245
8659+49	422	18	0.354	65,000	1.13	0.075	225.2	04/10/2245
8678+01	447	18	0.295	45,000	1.13	0.074	225.2	04/10/2245
8659+54	422	18	0.354	65,000	1.25	0.089	225.2	04/10/2245
8671+60	449	18	0.295	45,000	1.60	0.063	225.2	04/10/2245
8585+10	486	18	0.295	45,000	1.37	0.068	225.2	04/10/2245
8683+76	446	18	0.295	45,000	1.60	0.063	225.2	04/10/2245
8588+93	489	18	0.295	45,000	1.60	0.063	225.2	04/10/2245
8843+63	575	18	0.295	45,000	1.25	0.068	225.2	04/10/2245
8843+37	574	18	0.295	45,000	1.25	0.068	225.2	04/10/2245
8606+44	550	18	0.305	45,000	1.96	0.063	225.2	04/10/2245
9067+64	724	18	0.354	65,000	1.13	0.075	225.2	04/10/2245
8619+12	495	18	0.295	45,000	1.25	0.068	225.2	04/10/2245

Table D-6. Pressure-Cycle-Induced Fatigue Cracking Analysis of ILI Indicated Anomalies Eckert to Cedar Valley – ILI Date March 2, 2020 (pg. 1 of 9)

Station Number	Elevation (feet)	OD (inch)	WT (inch)	YS (psi)	ILI Length (inch)	ILI Depth (inch)	Re-assessment Interval (years)	Re-assessment Due Date
11653+65	1,532	18	0.295	45,000	8.81	0.095	22.1	04/04/2042
11874+86	1,710	18	0.285	45,000	6.56	0.087	22.4	07/17/2042
11835+05	1,664	18	0.295	45,000	6.56	0.095	22.5	08/31/2042
11866+04	1,647	18	0.285	45,000	8.92	0.082	23.1	04/23/2043
11690+42	1,467	18	0.285	45,000	5.26	0.096	23.6	09/21/2043
11863+65	1,633	18	0.285	45,000	6.09	0.087	23.6	10/18/2043
11929+59	1,771	18	0.305	45,000	7.51	0.094	25.0	02/13/2045
11825+97	1,664	18	0.295	45,000	24.16	0.074	27.9	02/01/2048
12026+26	1,679	18	0.295	45,000	9.99	0.074	30.5	08/15/2050
11465+59	1,570	18	0.295	45,000	4.55	0.107	30.9	02/11/2051
11885+64	1,697	18	0.305	45,000	10.93	0.082	32.3	06/29/2052
11882+04	1,708	18	0.305	45,000	5.14	0.094	32.4	07/12/2052
11859+51	1,636	18	0.285	45,000	6.56	0.076	33.8	12/25/2053
11888+02	1,674	18	0.305	45,000	9.40	0.082	34.3	06/10/2054
11855+64	1,658	18	0.295	45,000	11.76	0.074	34.7	11/16/2054
10798+69	1,114	18	0.305	45,000	11.64	0.103	35.5	09/09/2055
11811+06	1,621	18	0.295	45,000	29.48	0.068	35.9	01/15/2056

Table D-6 (continued). Pressure-Cycle-Induced Fatigue Cracking Analysis of ILI Indicated Anomalies Eckert to Cedar Valley – ILI Date March 2, 2020 (pg. 2 of 9)

Station Number	Elevation (feet)	OD (inch)	WT (inch)	YS (psi)	ILI Length (inch)	ILI Depth (inch)	Re-assessment Interval (years)	Re-assessment Due Date
11755+18	1,639	18	0.285	45,000	7.27	0.076	36.1	04/19/2056
11490+19	1,556	18	0.295	45,000	10.22	0.083	38.0	03/21/2058
11885+22	1,698	18	0.285	45,000	3.73	0.082	38.2	05/08/2058
11859+85	1,634	18	0.305	45,000	13.06	0.076	39.1	03/30/2059
11811+03	1,621	18	0.295	45,000	5.14	0.083	39.1	03/30/2059
10095+95	1,044	18	0.295	45,000	12.47	0.095	42.3	07/06/2062
10705+70	1,051	18	0.295	45,000	7.86	0.101	42.7	11/28/2062
11150+24	1,253	18	0.295	45,000	6.68	0.095	43.1	04/01/2063
11785+68	1,756	18	0.295	45,000	2.66	0.101	44.3	06/30/2064
11509+88	1,587	18	0.295	45,000	5.03	0.089	45.6	10/03/2065
11895+66	1,714	18	0.295	45,000	5.50	0.074	45.6	10/06/2065
11660+53	1,521	18	0.295	45,000	9.75	0.074	45.7	11/29/2065
11204+17	1,319	18	0.295	45,000	11.76	0.083	45.9	01/21/2066
11850+88	1,688	18	0.305	45,000	8.45	0.076	46.2	05/25/2066
12006+41	1,740	18	0.295	45,000	5.73	0.068	47.8	12/10/2067
11928+80	1,773	18	0.305	45,000	3.61	0.088	47.8	12/19/2067
11850+23	1,689	18	0.295	45,000	5.50	0.074	47.8	12/23/2067
11972+91	1,709	18	0.295	45,000	4.08	0.074	48.5	08/19/2068
11792+73	1,690	18	0.295	45,000	6.09	0.074	48.7	11/03/2068
11914+87	1,760	18	0.305	45,000	6.44	0.076	49.0	03/04/2069
11924+83	1,782	18	0.295	45,000	7.51	0.068	49.6	09/26/2069
11911+74	1,746	18	0.295	45,000	12.94	0.063	51.4	08/07/2071
11142+47	1,229	18	0.295	45,000	6.80	0.089	52.2	05/31/2072
11931+18	1,768	18	0.285	45,000	2.78	0.076	53.0	03/07/2073
11077+32	1,212	18	0.295	45,000	7.27	0.089	53.1	04/05/2073
11839+97	1,670	18	0.305	45,000	5.73	0.076	54.5	09/20/2074
11493+36	1,560	18	0.295	45,000	9.63	0.074	54.8	12/18/2074
11755+31	1,641	18	0.285	45,000	2.66	0.082	55.9	02/06/2076
11535+89	1,639	18	0.305	45,000	3.96	0.094	56.3	06/11/2076
11889+40	1,671	18	0.295	45,000	9.52	0.063	56.4	08/11/2076
11578+43	1,526	18	0.285	45,000	2.78	0.087	56.6	10/04/2076
12011+18	1,719	18	0.295	45,000	5.97	0.063	56.6	10/15/2076
11054+10	1,219	18	0.305	45,000	7.27	0.094	57.3	06/09/2077
11792+71	1,690	18	0.295	45,000	4.32	0.074	57.5	08/17/2077
11542+51	1,618	18	0.305	45,000	10.22	0.076	59.7	11/05/2079
11803+06	1,637	18	0.285	45,000	1.95	0.087	60.3	06/21/2080
11267+42	1,329	18	0.295	45,000	12.11	0.074	61.5	09/08/2081
11778+25	1,701	18	0.295	45,000	5.73	0.068	61.5	09/16/2081
11884+06	1,702	18	0.285	45,000	2.31	0.076	61.9	02/05/2082
11850+96	1,688	18	0.305	45,000	6.56	0.070	62.0	03/06/2082
11854+85	1,662	18	0.295	45,000	2.43	0.083	62.3	07/08/2082
11493+24	1,560	18	0.295	45,000	6.92	0.074	62.6	10/03/2082
11067+68	1,284	18	0.295	45,000	7.98	0.083	63.0	03/16/2083
11543+45	1,613	18	0.305	45,000	8.57	0.076	63.5	09/02/2083
11772+55	1,714	18	0.305	45,000	7.98	0.070	63.5	09/14/2083
11051+71	1,200	18	0.305	45,000	14.71	0.082	63.5	09/19/2083
10769+11	1,128	18	0.285	45,000	5.97	0.087	64.1	04/05/2084

Table D-6 (continued). Pressure-Cycle-Induced Fatigue Cracking Analysis of ILI Indicated Anomalies Eckert to Cedar Valley – ILI Date March 2, 2020 (pg. 3 of 9)

Station Number	Elevation (feet)	OD (inch)	WT (inch)	YS (psi)	ILI Length (inch)	ILI Depth (inch)	Re-assessment Interval (years)	Re-assessment Due Date
11485+82	1,557	18	0.295	45,000	6.56	0.074	64.4	08/08/2084
11616+82	1,491	18	0.295	45,000	7.74	0.068	64.4	08/12/2084
11520+07	1,622	18	0.295	45,000	5.85	0.074	65.8	12/05/2085
11130+16	1,219	18	0.295	45,000	6.44	0.083	66.3	06/26/2086
11688+93	1,474	18	0.295	45,000	1.48	0.116	66.4	07/14/2086
11535+88	1,639	18	0.305	45,000	7.74	0.076	66.6	10/20/2086
11510+29	1,589	18	0.305	45,000	3.96	0.088	67.2	05/06/2087
11852+76	1,675	18	0.295	65,000	6.68	0.063	67.6	10/05/2087
11493+26	1,560	18	0.295	45,000	2.43	0.095	71.1	04/06/2091
11622+83	1,487	18	0.295	45,000	3.96	0.074	71.1	04/06/2091
11493+37	1,560	18	0.295	45,000	8.45	0.068	71.4	07/30/2091
11283+59	1,343	18	0.295	45,000	4.44	0.083	72.1	03/22/2092
11756+34	1,665	18	0.305	45,000	5.73	0.070	72.1	04/17/2092
12012+77	1,704	18	0.295	45,000	2.43	0.068	72.8	12/11/2092
11654+27	1,533	18	0.295	45,000	9.16	0.063	73.0	02/23/2093
11610+94	1,474	18	0.305	45,000	4.91	0.076	74.1	03/23/2094
11770+27	1,718	18	0.305	45,000	2.43	0.088	74.5	08/23/2094
11815+01	1,630	18	0.305	45,000	1.95	0.094	74.7	11/18/2094
11599+13	1,475	18	0.285	45,000	2.66	0.076	74.8	12/22/2094
11658+68	1,518	18	0.295	45,000	3.37	0.074	75.3	06/16/2095
11850+24	1,689	18	0.295	45,000	4.44	0.063	75.6	10/04/2095
11607+35	1,470	18	0.305	45,000	7.39	0.070	76.2	05/15/2096
11332+28	1,486	18	0.305	45,000	8.92	0.076	76.5	09/13/2096
10760+77	1,136	18	0.305	45,000	9.28	0.088	76.7	10/29/2096
11153+80	1,261	18	0.295	45,000	4.79	0.083	77.0	02/26/2097
11125+42	1,245	18	0.295	45,000	3.84	0.089	77.5	08/20/2097
10767+51	1,133	18	0.305	45,000	15.19	0.082	77.5	09/06/2097
11683+57	1,451	18	0.305	45,000	5.50	0.070	78.1	04/07/2098
11324+33	1,427	18	0.305	45,000	8.45	0.076	78.4	07/18/2098
11483+44	1,558	18	0.295	45,000	6.44	0.068	79.3	06/16/2099
11535+91	1,639	18	0.305	45,000	8.33	0.070	79.8	01/03/2100
11308+97	1,348	18	0.295	45,000	9.75	0.068	80.5	08/24/2100
10724+38	1,039	18	0.295	45,000	7.51	0.083	82.4	08/11/2102
11283+58	1,343	18	0.295	45,000	3.61	0.083	82.5	08/23/2102
10550+67	983	18	0.285	45,000	9.75	0.076	82.7	11/15/2102
11612+17	1,479	18	0.305	45,000	2.55	0.088	83.2	06/03/2103
11806+68	1,643	18	0.305	45,000	2.31	0.082	83.3	06/15/2103
11542+58	1,618	18	0.305	45,000	15.54	0.063	84.1	04/24/2104
11051+76	1,200	18	0.305	45,000	13.18	0.076	84.4	08/05/2104
10868+32	1,222	18	0.295	45,000	4.55	0.089	84.5	08/31/2104
11542+41	1,619	18	0.305	45,000	15.07	0.063	84.7	11/11/2104
10445+83	907	18	0.295	45,000	3.84	0.101	85.1	04/11/2105
11339+92	1,464	18	0.295	45,000	7.74	0.068	85.1	04/13/2105
10970+17	1,260	18	0.295	45,000	10.11	0.074	85.2	05/03/2105
11066+86	1,281	18	0.295	45,000	7.86	0.074	87.0	03/01/2107
10162+13	1,050	18	0.295	45,000	6.09	0.089	87.2	05/01/2107
11082+56	1,167	18	0.295	45,000	7.39	0.074	87.3	06/07/2107

Table D-6 (continued). Pressure-Cycle-Induced Fatigue Cracking Analysis of ILI Indicated Anomalies Eckert to Cedar Valley – ILI Date March 2, 2020 (pg. 4 of 9)

Station Number	Elevation (feet)	OD (inch)	WT (inch)	YS (psi)	ILI Length (inch)	ILI Depth (inch)	Re-assessment Interval (years)	Re-assessment Due Date
11851+68	1,684	18	0.305	65,000	4.67	0.063	87.3	06/27/2107
11789+89	1,718	18	0.295	45,000	3.73	0.063	87.4	08/07/2107
11653+55	1,532	18	0.295	45,000	2.66	0.074	87.9	01/17/2108
11333+07	1,482	18	0.295	45,000	4.55	0.074	88.4	07/19/2108
11895+77	1,714	18	0.295	45,000	2.19	0.068	88.8	01/04/2109
11528+45	1,662	18	0.305	45,000	5.97	0.070	90.5	08/24/2110
11150+95	1,255	18	0.295	45,000	3.73	0.083	90.5	09/19/2110
11479+47	1,561	18	0.295	45,000	7.51	0.063	92.7	11/26/2112
11850+95	1,688	18	0.305	45,000	2.66	0.070	94.7	10/30/2114
11763+80	1,738	18	0.295	45,000	3.37	0.063	95.4	08/01/2115
11522+85	1,635	18	0.305	45,000	3.61	0.076	96.5	09/13/2116
10873+47	1,213	18	0.305	45,000	5.26	0.088	96.8	12/17/2116
11124+26	1,243	18	0.305	45,000	5.03	0.082	96.8	12/22/2116
11305+79	1,356	18	0.305	45,000	8.57	0.070	97.5	08/31/2117
10715+66	1,056	18	0.295	45,000	4.20	0.089	97.9	01/12/2118
10724+59	1,038	18	0.295	45,000	10.58	0.074	98.0	03/21/2118
10748+65	1,091	18	0.295	45,000	10.22	0.074	98.3	06/25/2118
12012+37	1,709	18	0.295	45,000	1.84	0.063	98.5	09/14/2118
10247+06	974	18	0.295	45,000	6.80	0.083	99.5	09/08/2119
10770+30	1,128	18	0.285	45,000	5.38	0.076	99.5	09/10/2119
11243+87	1,318	18	0.295	45,000	4.08	0.074	100.8	12/10/2120
11540+27	1,630	18	0.305	45,000	3.25	0.076	100.8	12/24/2120
11911+70	1,745	18	0.295	45,000	2.19	0.063	100.8	12/30/2120
11490+20	1,556	18	0.295	45,000	3.61	0.068	101.5	08/23/2121
10681+49	1,024	18	0.295	45,000	2.55	0.107	101.9	02/10/2122
11690+41	1,467	18	0.285	45,000	2.43	0.062	102.5	09/15/2122
10742+10	1,050	18	0.295	45,000	4.91	0.083	102.9	01/24/2123
11230+81	1,270	18	0.305	45,000	8.81	0.070	103.1	04/08/2123
11201+51	1,314	18	0.295	45,000	4.20	0.074	103.1	04/24/2123
11301+17	1,370	18	0.295	45,000	5.03	0.068	103.3	06/12/2123
11406+29	1,544	18	0.295	45,000	3.96	0.068	105.2	05/13/2125
11210+07	1,301	18	0.295	45,000	2.07	0.095	105.7	11/27/2125
11339+85	1,464	18	0.295	45,000	7.51	0.063	105.8	12/17/2125
11553+44	1,564	18	0.305	45,000	5.97	0.063	106.0	03/10/2126
11599+00	1,474	18	0.305	45,000	2.66	0.076	106.3	06/16/2126
11625+67	1,504	18	0.295	45,000	2.07	0.074	106.9	01/20/2127
11493+14	1,560	18	0.295	45,000	1.72	0.089	107.3	06/08/2127
10763+97	1,142	18	0.305	45,000	6.92	0.082	108.5	08/18/2128
11119+91	1,227	18	0.285	45,000	7.74	0.062	108.5	09/20/2128
10078+22	1,096	18	0.285	45,000	3.49	0.087	108.8	12/13/2128
11665+07	1,521	18	0.295	45,000	2.31	0.068	108.9	02/13/2129
10970+06	1,260	18	0.295	45,000	9.28	0.068	109.6	10/19/2129
11615+06	1,495	18	0.305	45,000	2.07	0.082	109.6	10/21/2129
11204+14	1,319	18	0.295	45,000	5.26	0.068	110.5	09/06/2130
10925+34	1,303	18	0.295	45,000	5.85	0.074	110.7	11/27/2130
11083+79	1,158	18	0.295	45,000	6.68	0.068	110.8	12/15/2130
11221+97	1,324	18	0.305	45,000	4.44	0.076	113.2	05/16/2133

Table D-6 (continued). Pressure-Cycle-Induced Fatigue Cracking Analysis of ILI Indicated Anomalies Eckert to Cedar Valley – ILI Date March 2, 2020 (pg. 5 of 9)

Station Number	Elevation (feet)	OD (inch)	WT (inch)	YS (psi)	ILI Length (inch)	ILI Depth (inch)	Re-assessment Interval (years)	Re-assessment Due Date
11654+02	1,533	18	0.295	45,000	1.84	0.074	113.2	05/18/2133
11222+96	1,321	18	0.285	45,000	3.49	0.067	114.0	02/19/2134
11867+70	1,659	18	0.305	45,000	2.31	0.063	115.8	01/07/2136
10877+61	1,212	18	0.305	45,000	7.98	0.076	116.0	03/03/2136
11598+99	1,474	18	0.305	45,000	3.96	0.063	117.1	04/16/2137
11003+72	1,262	18	0.305	45,000	11.05	0.070	117.3	07/02/2137
11920+84	1,781	18	0.305	45,000	2.19	0.063	118.0	03/15/2138
11432+94	1,624	18	0.295	45,000	2.43	0.074	118.1	03/27/2138
11048+89	1,188	18	0.295	45,000	2.43	0.089	118.5	09/12/2138
11163+62	1,257	18	0.295	45,000	8.45	0.063	118.6	10/17/2138
11156+90	1,268	18	0.295	45,000	3.49	0.074	118.8	12/07/2138
11114+00	1,222	18	0.295	45,000	9.75	0.063	118.8	12/16/2138
11402+33	1,522	18	0.295	45,000	3.14	0.068	119.2	05/03/2139
11201+66	1,314	18	0.295	45,000	2.07	0.089	119.2	06/01/2139
11474+77	1,566	18	0.285	45,000	2.19	0.067	119.4	08/06/2139
11120+99	1,231	18	0.305	45,000	7.39	0.070	120.1	03/27/2140
11653+64	1,532	18	0.295	45,000	1.25	0.089	121.4	07/21/2141
11758+85	1,720	18	0.295	45,000	1.72	0.068	121.5	09/16/2141
11233+60	1,281	18	0.305	45,000	10.46	0.063	121.8	12/05/2141
11500+50	1,571	18	0.295	45,000	2.55	0.068	122.2	05/16/2142
10970+05	1,260	18	0.295	45,000	3.02	0.083	122.5	08/30/2142
11228+43	1,289	18	0.285	45,000	4.20	0.062	122.9	01/22/2143
11542+35	1,619	18	0.305	45,000	4.08	0.063	123.9	01/25/2144
11525+34	1,647	18	0.305	45,000	4.20	0.063	124.9	01/17/2145
11644+56	1,501	18	0.305	45,000	1.48	0.088	125.3	06/16/2145
11156+53	1,267	18	0.295	45,000	7.03	0.063	126.1	04/26/2146
10836+64	1,160	18	0.295	45,000	4.91	0.074	127.1	04/02/2147
11102+36	1,240	18	0.305	45,000	4.20	0.076	128.9	01/29/2149
11868+49	1,670	18	0.285	45,000	1.25	0.062	130.3	07/02/2150
11339+45	1,463	18	0.295	45,000	4.08	0.063	131.0	03/01/2151
10792+17	1,109	18	0.285	45,000	5.26	0.067	131.1	03/31/2151
11097+97	1,202	18	0.285	45,000	2.31	0.076	131.5	09/13/2151
11220+48	1,327	18	0.295	45,000	3.49	0.068	132.1	03/28/2152
10440+68	920	18	0.295	45,000	6.44	0.074	133.7	11/15/2153
11589+52	1,509	18	0.285	45,000	1.84	0.062	134.6	10/19/2154
10603+53	1,069	18	0.295	45,000	9.75	0.068	135.1	04/17/2155
10188+57	862	18	0.295	45,000	3.84	0.083	137.4	08/02/2157
10102+74	1,009	18	0.295	45,000	3.84	0.083	137.5	08/22/2157
11084+47	1,158	18	0.295	45,000	6.09	0.063	139.4	07/13/2159
10871+09	1,215	18	0.285	45,000	6.44	0.062	141.0	02/18/2161
11883+26	1,704	18	0.305	45,000	1.36	0.070	141.7	11/09/2161
11099+14	1,209	18	0.305	45,000	8.92	0.063	142.3	06/12/2162
11301+09	1,370	18	0.295	45,000	2.66	0.068	142.9	01/25/2163
10695+53	1,023	18	0.295	45,000	6.92	0.068	144.2	05/30/2164
11533+47	1,652	18	0.285	45,000	1.13	0.082	144.3	06/27/2164
10223+76	969	18	0.295	45,000	9.75	0.068	144.8	12/22/2164
11124+72	1,244	18	0.315	45,000	2.66	0.090	145.1	04/03/2165

Table D-6 (continued). Pressure-Cycle-Induced Fatigue Cracking Analysis of ILI Indicated Anomalies Eckert to Cedar Valley – ILI Date March 2, 2020 (pg. 6 of 9)

Station Number	Elevation (feet)	OD (inch)	WT (inch)	YS (psi)	ILI Length (inch)	ILI Depth (inch)	Re-assessment Interval (years)	Re-assessment Due Date
11168+91	1,223	18	0.295	45,000	3.14	0.068	145.4	07/25/2165
11934+76	1,760	18	0.305	45,000	1.25	0.070	146.0	03/12/2166
11779+76	1,712	18	0.295	45,000	1.13	0.074	147.0	02/21/2167
11606+91	1,471	18	0.305	45,000	2.43	0.063	147.5	09/10/2167
11408+67	1,568	18	0.295	45,000	2.78	0.063	147.8	12/24/2167
10882+36	1,212	18	0.295	45,000	4.67	0.068	151.1	04/09/2171
10445+82	907	18	0.295	45,000	7.62	0.068	153.0	02/27/2173
11431+77	1,621	18	0.295	45,000	1.95	0.068	155.0	03/16/2175
11165+98	1,238	18	0.295	45,000	3.84	0.063	155.4	07/11/2175
11676+91	1,469	18	0.305	45,000	1.60	0.070	155.6	10/12/2175
10894+84	1,223	18	0.295	45,000	4.20	0.068	157.3	07/06/2177
11492+97	1,560	18	0.295	45,000	1.72	0.068	157.9	01/14/2178
11151+42	1,256	18	0.295	45,000	2.78	0.068	158.5	09/15/2178
10879+98	1,213	18	0.295	45,000	6.92	0.063	158.7	11/01/2178
11510+03	1,588	18	0.305	45,000	2.55	0.063	160.0	03/18/2180
10868+44	1,221	18	0.295	45,000	3.14	0.074	160.1	04/23/2180
10896+22	1,227	18	0.295	45,000	6.44	0.063	160.4	07/22/2180
11414+23	1,569	18	0.295	45,000	1.60	0.074	160.5	09/05/2180
10769+12	1,128	18	0.285	45,000	3.49	0.067	162.0	02/17/2182
10603+54	1,069	18	0.295	45,000	3.96	0.074	162.1	03/23/2182
10724+38	1,039	18	0.295	45,000	4.91	0.068	162.4	08/02/2182
11267+40	1,329	18	0.295	45,000	2.90	0.063	163.0	02/23/2183
11210+05	1,301	18	0.295	45,000	1.60	0.083	163.4	07/12/2183
11663+79	1,523	18	0.295	45,000	1.48	0.063	164.0	03/10/2184
11284+38	1,346	18	0.295	45,000	2.78	0.063	164.1	04/13/2184
10401+51	981	18	0.305	45,000	5.73	0.076	164.4	08/06/2184
11789+50	1,724	18	0.295	45,000	1.25	0.063	164.6	10/13/2184
11653+87	1,532	18	0.295	45,000	1.13	0.074	165.9	01/14/2186
10748+67	1,091	18	0.295	45,000	7.74	0.063	166.4	08/03/2186
11648+92	1,517	18	0.295	45,000	1.13	0.074	166.6	09/27/2186
11150+93	1,255	18	0.295	45,000	3.37	0.063	167.4	07/27/2187
11511+44	1,593	18	0.295	45,000	1.13	0.083	169.0	02/17/2189
10068+18	1,093	18	0.305	45,000	3.14	0.088	169.6	09/24/2189
10438+56	929	18	0.295	45,000	3.96	0.074	169.6	09/29/2189
11059+74	1,272	18	0.305	45,000	3.61	0.070	171.0	02/21/2191
11490+58	1,557	18	0.295	45,000	1.13	0.083	172.1	04/24/2192
10445+81	907	18	0.295	45,000	5.50	0.068	172.7	11/03/2192
10924+98	1,303	18	0.295	45,000	4.91	0.063	173.2	05/07/2193
11125+44	1,245	18	0.295	45,000	2.43	0.068	175.8	12/03/2195
10895+84	1,226	18	0.295	45,000	4.91	0.063	176.1	04/21/2196
11510+12	1,588	18	0.305	45,000	1.48	0.076	176.7	11/19/2196
11614+23	1,494	18	0.305	45,000	1.72	0.063	179.0	02/18/2199
10969+24	1,259	18	0.295	45,000	1.84	0.083	179.0	03/12/2199
10532+80	922	18	0.305	45,000	6.80	0.070	179.1	03/23/2199
11150+66	1,254	18	0.295	45,000	1.25	0.095	179.2	05/15/2199
10863+56	1,214	18	0.305	45,000	3.25	0.076	180.3	06/20/2200
10873+07	1,214	18	0.285	45,000	3.37	0.062	181.9	01/16/2202

Table D-6 (continued). Pressure-Cycle-Induced Fatigue Cracking Analysis of ILI Indicated Anomalies Eckert to Cedar Valley – ILI Date March 2, 2020 (pg. 7 of 9)

Station Number	Elevation (feet)	OD (inch)	WT (inch)	YS (psi)	ILI Length (inch)	ILI Depth (inch)	Re-assessment Interval (years)	Re-assessment Due Date
11679+97	1,447	18	0.305	45,000	1.48	0.063	183.0	03/15/2203
10707+04	1,054	18	0.295	45,000	3.84	0.068	184.0	03/05/2204
11419+94	1,591	18	0.295	45,000	1.84	0.063	184.8	12/16/2204
11089+00	1,178	18	0.295	45,000	2.31	0.068	186.1	04/22/2206
10246+75	974	18	0.295	45,000	3.49	0.074	186.9	01/27/2207
11553+46	1,564	18	0.305	45,000	1.48	0.070	188.0	03/09/2208
10245+57	975	18	0.295	45,000	4.79	0.068	188.2	05/05/2208
11510+27	1,589	18	0.305	45,000	1.36	0.076	188.5	09/20/2208
11222+52	1,323	18	0.295	45,000	1.60	0.074	189.8	12/14/2209
10070+99	1,104	18	0.295	45,000	3.25	0.074	193.0	02/26/2213
10558+65	1,020	18	0.285	45,000	3.02	0.067	194.4	07/24/2214
11636+88	1,477	18	0.305	45,000	1.25	0.070	195.2	05/01/2215
10525+02	904	18	0.305	45,000	9.99	0.063	197.1	04/11/2217
11539+74	1,632	18	0.305	45,000	1.25	0.076	197.5	08/16/2217
10226+55	985	18	0.295	45,000	7.03	0.063	198.4	08/15/2218
11665+82	1,520	18	0.295	45,000	1.13	0.063	198.5	09/06/2218
11679+99	1,447	18	0.305	45,000	1.13	0.070	201.1	04/26/2221
10070+98	1,104	18	0.295	45,000	3.02	0.074	202.1	04/29/2222
11406+29	1,544	18	0.295	45,000	1.36	0.068	202.7	11/02/2222
10071+18	1,104	18	0.295	45,000	3.84	0.068	206.5	08/30/2226
11346+80	1,473	18	0.295	45,000	1.25	0.074	207.5	08/23/2227
11120+99	1,231	18	0.305	45,000	2.31	0.070	208.0	03/07/2228
10225+78	985	18	0.295	45,000	3.84	0.068	208.7	11/09/2228
10704+32	1,046	18	0.295	45,000	1.48	0.095	209.5	09/09/2229
10224+97	982	18	0.295	45,000	2.90	0.074	209.5	09/19/2229
10808+68	1,126	18	0.305	45,000	5.14	0.063	209.9	01/22/2230
11225+97	1,305	18	0.295	45,000	1.60	0.068	211.4	07/26/2231
11156+47	1,267	18	0.295	45,000	1.48	0.074	212.7	11/30/2232
10257+21	994	18	0.295	45,000	2.78	0.074	215.5	08/22/2235
11222+52	1,323	18	0.295	45,000	1.13	0.083	220.0	02/22/2240
10096+75	1,041	18	0.295	45,000	3.37	0.068	221.1	04/16/2241
11510+12	1,588	18	0.305	45,000	1.25	0.070	223.8	12/05/2243
10830+35	1,143	18	0.295	45,000	2.66	0.063	225.2	05/26/2245
11314+16	1,371	18	0.305	45,000	1.25	0.076	225.2	05/26/2245
10823+56	1,127	18	0.295	45,000	1.13	0.074	225.2	05/26/2245
10823+57	1,127	18	0.295	45,000	1.13	0.089	225.2	05/26/2245
10521+48	917	18	0.305	45,000	2.43	0.063	225.2	05/26/2245
10649+77	1,057	18	0.295	45,000	1.95	0.063	225.2	05/26/2245
11051+75	1,200	18	0.305	45,000	1.95	0.063	225.2	05/26/2245
10251+57	966	18	0.295	45,000	2.31	0.063	225.2	05/26/2245
10257+23	994	18	0.295	45,000	1.72	0.089	225.2	05/26/2245
10644+54	1,055	18	0.295	45,000	1.72	0.068	225.2	05/26/2245
10527+66	900	18	0.305	45,000	1.13	0.063	225.2	05/26/2245
10644+51	1,055	18	0.295	45,000	1.72	0.068	225.2	05/26/2245
10511+40	927	18	0.305	45,000	3.61	0.063	225.2	05/26/2245
10519+29	924	18	0.295	45,000	1.25	0.083	225.2	05/26/2245
10658+76	993	18	0.285	45,000	1.48	0.076	225.2	05/26/2245

Table D-6 (continued). Pressure-Cycle-Induced Fatigue Cracking Analysis of ILI Indicated Anomalies Eckert to Cedar Valley – ILI Date March 2, 2020 (pg. 8 of 9)

Station Number	Elevation (feet)	OD (inch)	WT (inch)	YS (psi)	ILI Length (inch)	ILI Depth (inch)	Re-assessment Interval (years)	Re-assessment Due Date
10873+86	1,213	18	0.305	45,000	1.36	0.082	225.2	05/26/2245
10873+50	1,213	18	0.305	45,000	1.25	0.063	225.2	05/26/2245
10075+36	1,100	18	0.285	45,000	1.13	0.062	225.2	05/26/2245
10859+14	1,202	18	0.305	45,000	1.13	0.063	225.2	05/26/2245
11067+81	1,285	18	0.295	45,000	1.36	0.068	225.2	05/26/2245
9793+23	1,058	18	0.374	45,000	1.25	0.077	225.2	05/26/2245
10074+76	1,101	18	0.305	45,000	2.19	0.076	225.2	05/26/2245
10309+62	1,080	18	0.354	45,000	2.19	0.107	225.2	05/26/2245
11067+96	1,285	18	0.295	45,000	1.84	0.063	225.2	05/26/2245
10074+83	1,101	18	0.305	45,000	1.25	0.063	225.2	05/26/2245
11337+99	1,464	18	0.295	45,000	1.25	0.063	225.2	05/26/2245
10875+04	1,213	18	0.305	45,000	1.36	0.082	225.2	05/26/2245
11337+13	1,466	18	0.295	45,000	1.13	0.074	225.2	05/26/2245
11247+72	1,262	18	0.295	45,000	1.36	0.063	225.2	05/26/2245
10714+75	1,058	18	0.295	45,000	2.55	0.068	225.2	05/26/2245
10117+48	1,062	18	0.285	45,000	2.78	0.062	225.2	05/26/2245
10883+56	1,212	18	0.295	45,000	1.25	0.068	225.2	05/26/2245
10119+05	1,077	18	0.305	45,000	1.60	0.076	225.2	05/26/2245
11095+12	1,192	18	0.305	45,000	1.36	0.076	225.2	05/26/2245
10088+32	1,045	18	0.295	45,000	1.25	0.089	225.2	05/26/2245
10110+85	1,050	18	0.285	45,000	2.43	0.067	225.2	05/26/2245
10553+05	992	18	0.305	45,000	2.43	0.063	225.2	05/26/2245
10115+50	1,052	18	0.285	45,000	1.72	0.076	225.2	05/26/2245
10724+36	1,039	18	0.295	45,000	1.36	0.068	225.2	05/26/2245
10556+65	1,009	18	0.305	45,000	3.02	0.070	225.2	05/26/2245
10556+66	1,009	18	0.305	45,000	3.14	0.063	225.2	05/26/2245
10364+79	992	18	0.354	45,000	2.55	0.121	225.2	05/26/2245
10975+44	1,241	18	0.295	45,000	1.25	0.063	225.2	05/26/2245
11012+28	1,280	18	0.305	45,000	1.36	0.063	225.2	05/26/2245
11012+36	1,280	18	0.305	45,000	1.36	0.063	225.2	05/26/2245
11012+42	1,280	18	0.305	45,000	1.48	0.063	225.2	05/26/2245
10724+35	1,039	18	0.295	45,000	1.25	0.063	225.2	05/26/2245
10765+29	1,141	18	0.305	45,000	2.07	0.063	225.2	05/26/2245
11018+39	1,284	18	0.305	45,000	1.36	0.070	225.2	05/26/2245
11271+18	1,328	18	0.305	45,000	1.36	0.070	225.2	05/26/2245
10749+29	1,095	18	0.295	45,000	1.13	0.074	225.2	05/26/2245
10401+50	981	18	0.305	45,000	2.43	0.063	225.2	05/26/2245
10742+09	1,050	18	0.295	45,000	1.13	0.074	225.2	05/26/2245
10748+67	1,091	18	0.295	45,000	1.36	0.068	225.2	05/26/2245
11120+96	1,231	18	0.305	45,000	1.84	0.070	225.2	05/26/2245
10585+57	1,051	18	0.305	45,000	1.25	0.076	225.2	05/26/2245
10420+32	947	18	0.295	45,000	1.72	0.074	225.2	05/26/2245
10749+17	1,094	18	0.295	45,000	2.07	0.063	225.2	05/26/2245
10751+69	1,101	18	0.295	45,000	1.13	0.074	225.2	05/26/2245
10158+68	1,049	18	0.295	45,000	1.72	0.074	225.2	05/26/2245
10445+83	907	18	0.295	45,000	2.43	0.063	225.2	05/26/2245
10786+78	1,132	18	0.285	45,000	1.13	0.062	225.2	05/26/2245

Table D-6 (continued). Pressure-Cycle-Induced Fatigue Cracking Analysis of ILI Indicated Anomalies Eckert to Cedar Valley – ILI Date March 2, 2020 (pg. 9 of 9)

Station Number	Elevation (feet)	OD (inch)	WT (inch)	YS (psi)	ILI Length (inch)	ILI Depth (inch)	Re-assessment Interval (years)	Re-assessment Due Date
10998+00	1,254	18	0.285	45,000	1.25	0.062	225.2	05/26/2245
10436+13	940	18	0.295	45,000	1.36	0.074	225.2	05/26/2245
10441+75	916	18	0.295	45,000	2.31	0.068	225.2	05/26/2245
10445+98	906	18	0.295	45,000	1.25	0.063	225.2	05/26/2245

Table D-7. Pressure-Cycle-Induced Fatigue Cracking Analysis of ILI Indicated Anomalies James River to Eckert – ILI Date March 11, 2020 (pg. 1 of 3)

Station Number	Elevation (feet)	OD (inch)	WT (inch)	YS (psi)	ILI Length (inch)	ILI Depth (inch)	Re-assessment Interval (years)	Re-assessment Due Date
12885+69	1,562	18	0.266	45,000	4.20	0.089	22.9	02/20/2043
13381+10	1,630	18	0.266	45,000	3.84	0.076	23.0	02/23/2043
13021+94	1,672	18	0.266	45,000	5.02	0.081	23.3	06/27/2043
12975+73	1,725	18	0.266	45,000	6.56	0.076	25.1	04/27/2045
13383+06	1,636	18	0.266	45,000	4.67	0.068	26.7	11/06/2046
13291+08	1,661	18	0.266	45,000	5.50	0.068	27.2	06/10/2047
13493+35	1,697	18	0.266	45,000	3.61	0.068	27.4	07/20/2047
13353+07	1,589	18	0.266	45,000	3.02	0.076	27.9	02/06/2048
13381+07	1,630	18	0.266	45,000	1.95	0.089	28.4	08/05/2048
12861+12	1,582	18	0.266	45,000	6.09	0.076	28.8	01/04/2049
12994+88	1,766	18	0.266	45,000	14.47	0.063	29.3	06/20/2049
13695+53	1,644	18	0.266	45,000	2.19	0.068	29.7	11/26/2049
13700+68	1,656	18	0.266	45,000	2.07	0.068	30.7	12/04/2050
13508+59	1,672	18	0.266	45,000	3.84	0.063	30.8	12/19/2050
13282+73	1,641	18	0.266	45,000	5.97	0.063	32.3	06/28/2052
13370+81	1,562	18	0.266	45,000	4.43	0.063	33.0	03/22/2053
12672+49	1,664	18	0.266	45,000	5.85	0.076	34.9	01/30/2055
13195+13	1,456	18	0.285	45,000	4.91	0.076	35.5	09/12/2055
13195+11	1,456	18	0.285	45,000	3.02	0.087	35.8	12/25/2055
13342+56	1,619	18	0.266	45,000	3.84	0.063	36.7	12/02/2056
12134+99	1,571	18	0.266	45,000	3.96	0.089	37.2	05/07/2057
13175+65	1,493	18	0.266	45,000	3.49	0.068	38.3	07/06/2058
12955+75	1,702	18	0.266	45,000	5.38	0.068	38.7	12/01/2058
13346+51	1,610	18	0.266	45,000	2.54	0.068	39.5	09/17/2059
13431+83	1,693	18	0.256	45,000	1.60	0.069	40.3	07/08/2060
12141+65	1,589	18	0.266	45,000	6.68	0.076	40.9	02/19/2061
12324+44	1,599	18	0.266	45,000	5.73	0.076	43.2	05/15/2063
13605+79	1,688	18	0.266	45,000	1.48	0.068	43.9	02/07/2064
12151+72	1,561	18	0.256	45,000	3.13	0.082	44.2	06/01/2064
13175+13	1,496	18	0.266	45,000	2.66	0.068	45.4	07/24/2065
12316+07	1,593	18	0.266	45,000	9.16	0.068	46.0	03/18/2066
12579+56	1,678	18	0.266	45,000	7.03	0.068	46.3	07/03/2066
12893+00	1,564	18	0.266	45,000	2.78	0.076	46.9	02/13/2067
12867+31	1,578	18	0.266	45,000	4.08	0.068	47.8	12/18/2067
13047+44	1,607	18	0.285	45,000	3.02	0.082	48.5	09/20/2068
13575+73	1,702	18	0.266	45,000	1.36	0.068	48.5	09/22/2068

Table D-7 (continued). Pressure-Cycle-Induced Fatigue Cracking Analysis of ILI Indicated Anomalies James River to Eckert – ILI Date March 11, 2020 (pg. 2 of 3)

Station Number	Elevation (feet)	OD (inch)	WT (inch)	YS (psi)	ILI Length (inch)	ILI Depth (inch)	Re-assessment Interval (years)	Re-assessment Due Date
12430+28	1,611	18	0.266	45,000	3.25	0.081	50.9	02/18/2071
13463+37	1,733	18	0.266	45,000	1.25	0.076	51.3	06/12/2071
13510+91	1,680	18	0.266	45,000	1.60	0.063	51.8	01/03/2072
13206+51	1,448	18	0.266	45,000	2.54	0.063	52.0	03/20/2072
12672+53	1,664	18	0.266	45,000	4.79	0.068	52.2	05/26/2072
13044+90	1,620	18	0.285	45,000	5.14	0.067	54.1	04/06/2074
13057+98	1,556	18	0.285	45,000	4.91	0.067	54.1	04/29/2074
13603+39	1,690	18	0.266	45,000	1.13	0.068	54.9	01/29/2075
12722+31	1,579	18	0.266	45,000	3.96	0.068	55.0	03/01/2075
12923+46	1,629	18	0.266	45,000	2.19	0.076	55.2	05/10/2075
13021+55	1,676	18	0.266	45,000	1.95	0.076	55.3	06/29/2075
12427+94	1,595	18	0.266	45,000	9.16	0.063	55.7	11/16/2075
12656+53	1,708	18	0.285	45,000	5.50	0.076	56.0	02/26/2076
12955+80	1,702	18	0.266	45,000	3.61	0.063	56.6	10/18/2076
12880+77	1,576	18	0.266	45,000	3.96	0.063	57.2	05/11/2077
12805+23	1,581	18	0.266	45,000	3.25	0.068	57.4	08/14/2077
12893+03	1,564	18	0.266	45,000	3.61	0.063	59.1	04/23/2079
12868+24	1,575	18	0.266	45,000	2.78	0.068	59.9	02/09/2080
12863+87	1,584	18	0.266	45,000	2.78	0.068	60.2	05/19/2080
13109+57	1,472	18	0.266	45,000	2.31	0.063	61.2	05/05/2081
12515+50	1,623	18	0.266	45,000	4.32	0.068	61.3	06/15/2081
12793+99	1,587	18	0.266	45,000	2.90	0.068	62.3	06/25/2082
12885+72	1,562	18	0.266	45,000	2.54	0.068	62.4	07/20/2082
12529+16	1,688	18	0.285	45,000	3.84	0.082	63.3	07/08/2083
12046+84	1,617	18	0.266	45,000	5.14	0.068	64.1	04/11/2084
12929+84	1,620	18	0.266	45,000	2.90	0.063	64.7	11/12/2084
12137+70	1,572	18	0.266	45,000	5.02	0.068	64.9	01/17/2085
12372+52	1,582	18	0.266	45,000	4.43	0.068	64.9	02/12/2085
12212+51	1,592	18	0.266	45,000	6.80	0.063	68.6	10/07/2088
12440+59	1,631	18	0.266	45,000	3.73	0.068	69.4	07/31/2089
13089+92	1,513	18	0.266	45,000	1.95	0.063	69.6	11/02/2089
12715+87	1,587	18	0.266	45,000	3.49	0.063	70.2	06/06/2090
12321+24	1,600	18	0.266	45,000	3.96	0.068	70.6	10/15/2090
12678+15	1,645	18	0.266	45,000	3.37	0.063	74.1	04/10/2094
12462+18	1,656	18	0.266	45,000	4.55	0.063	74.2	05/17/2094
12842+62	1,582	18	0.266	45,000	2.07	0.068	74.6	11/01/2094
12956+68	1,696	18	0.266	45,000	2.19	0.063	75.1	04/29/2095
12976+52	1,727	18	0.285	45,000	3.02	0.067	76.0	03/27/2096
12888+92	1,570	18	0.266	45,000	2.31	0.063	76.4	08/03/2096
13071+56	1,578	18	0.266	45,000	1.48	0.068	76.8	01/14/2097
13253+93	1,533	18	0.266	45,000	1.13	0.068	79.0	03/28/2099
12208+93	1,614	18	0.266	45,000	2.43	0.076	80.2	05/24/2100
12997+42	1,768	18	0.295	45,000	1.60	0.095	80.6	10/01/2100
12896+62	1,578	18	0.266	45,000	2.07	0.063	81.2	05/27/2101
13103+16	1,484	18	0.285	45,000	2.66	0.062	82.0	03/29/2102
12202+65	1,666	18	0.266	45,000	1.25	0.108	82.1	04/29/2102
13003+31	1,765	18	0.266	45,000	1.48	0.068	83.9	01/29/2104

Table D-7 (continued). Pressure-Cycle-Induced Fatigue Cracking Analysis of ILI Indicated Anomalies James River to Eckert – ILI Date March 11, 2020 (pg. 3 of 3)

Station Number	Elevation (feet)	OD (inch)	WT (inch)	YS (psi)	ILI Length (inch)	ILI Depth (inch)	Re-assessment Interval (years)	Re-assessment Due Date
12666+46	1,684	18	0.285	45,000	2.66	0.076	86.0	02/26/2106
12452+71	1,626	18	0.266	45,000	3.37	0.063	86.1	04/14/2106
13006+50	1,754	18	0.285	45,000	3.02	0.062	86.7	11/18/2106
12595+88	1,642	18	0.266	45,000	1.72	0.076	87.9	02/14/2108
12168+17	1,546	18	0.266	45,000	3.84	0.063	88.4	07/25/2108
12707+42	1,598	18	0.266	45,000	2.31	0.063	89.5	09/21/2109
12449+55	1,612	18	0.266	45,000	1.60	0.081	91.5	09/13/2111
12315+80	1,592	18	0.266	45,000	2.54	0.068	92.5	08/29/2112
12142+62	1,587	18	0.266	45,000	3.49	0.063	93.4	07/21/2113
12413+75	1,597	18	0.285	45,000	4.43	0.067	94.5	09/23/2114
12227+19	1,617	18	0.266	45,000	2.54	0.068	95.1	04/24/2115
12647+93	1,684	18	0.266	45,000	1.84	0.068	96.4	08/17/2116
12429+84	1,608	18	0.266	45,000	2.07	0.068	101.1	04/15/2121
12899+32	1,577	18	0.266	45,000	1.25	0.068	103.7	11/08/2123
12817+56	1,590	18	0.266	45,000	1.25	0.068	111.7	11/09/2131
12224+27	1,617	18	0.266	45,000	1.84	0.068	119.1	05/04/2139
12341+24	1,599	18	0.266	45,000	2.07	0.063	120.3	06/19/2140
12340+05	1,599	18	0.266	45,000	2.07	0.063	120.3	07/06/2140
12251+14	1,503	18	0.266	45,000	2.07	0.063	122.9	02/22/2143
13028+04	1,659	18	0.285	45,000	1.48	0.062	127.5	09/24/2147
12241+38	1,565	18	0.285	45,000	3.49	0.062	133.8	01/14/2154
12656+20	1,708	18	0.285	45,000	2.07	0.062	143.5	09/04/2163
12443+76	1,621	18	0.266	45,000	1.48	0.063	143.6	10/02/2163
12413+77	1,597	18	0.285	45,000	2.43	0.062	151.5	09/29/2171
12515+52	1,623	18	0.266	45,000	1.25	0.063	156.3	06/24/2176
12428+32	1,597	18	0.266	45,000	1.25	0.063	163.8	01/16/2184
12515+47	1,623	18	0.266	45,000	1.13	0.063	168.7	12/05/2188
12372+64	1,581	18	0.266	45,000	1.13	0.063	181.4	08/15/2201
12847+03	1,580	18	0.285	45,000	1.13	0.062	181.7	12/11/2201
12241+37	1,566	18	0.285	45,000	1.25	0.062	225.2	06/03/2245

Table D-8. Pressure-Cycle-Induced Fatigue Cracking Analysis of ILI Indicated Anomalies Texon to Barnhart – ILI Date May 15, 2020 (pg. 1 of 3)

Station Number	Elevation (feet)	OD (inch)	WT (inch)	YS (psi)	ILI Length (inch)	ILI Depth (inch)	Re-assessment Interval (years)	Re-assessment Due Date
21982+31	2,575	18	0.246	52,000	2.43	0.075	17.1	06/24/2037
21804+33	2,577	18	0.246	52,000	2.90	0.075	18.3	08/17/2038
21666+58	2,612	18	0.246	52,000	2.66	0.083	18.6	12/28/2038
21981+44	2,574	18	0.246	52,000	3.13	0.063	20.6	12/17/2040
21827+85	2,575	18	0.246	52,000	1.72	0.088	20.9	04/06/2041
21946+18	2,553	18	0.256	52,000	1.95	0.082	22.6	01/01/2043
21983+33	2,575	18	0.246	52,000	2.07	0.068	23.5	11/07/2043
21876+02	2,571	18	0.246	52,000	1.36	0.088	24.9	04/05/2045
21915+00	2,576	18	0.246	52,000	2.43	0.063	26.1	06/29/2046
21826+56	2,575	18	0.246	52,000	1.36	0.088	26.4	09/21/2046
21890+20	2,577	18	0.256	52,000	1.36	0.095	26.7	01/17/2047
21960+10	2,550	18	0.246	52,000	1.25	0.083	27.0	05/07/2047
21412+58	2,590	18	0.256	52,000	3.13	0.082	27.1	07/02/2047
21854+80	2,570	18	0.246	52,000	2.43	0.063	28.0	05/12/2048
21647+30	2,626	18	0.246	52,000	3.61	0.063	28.0	05/17/2048
21938+04	2,559	18	0.246	52,000	1.13	0.088	28.2	07/15/2048
21634+35	2,634	18	0.256	52,000	2.90	0.074	28.6	12/04/2048
21826+43	2,575	18	0.246	52,000	1.25	0.088	28.9	04/12/2049
21647+68	2,625	18	0.256	52,000	2.78	0.074	29.0	05/14/2049
21817+14	2,575	18	0.246	52,000	1.60	0.075	29.4	10/06/2049
21808+61	2,577	18	0.256	52,000	1.48	0.090	29.5	11/03/2049
21984+76	2,577	18	0.246	52,000	1.48	0.068	30.3	08/25/2050
21694+78	2,600	18	0.256	52,000	4.55	0.062	30.9	04/03/2051
21674+08	2,606	18	0.256	52,000	2.43	0.074	31.2	07/15/2051
21647+03	2,626	18	0.246	52,000	1.84	0.075	31.8	02/20/2052
21446+55	2,635	18	0.256	52,000	2.43	0.082	32.7	02/04/2053
21819+19	2,574	18	0.246	52,000	1.36	0.075	33.7	01/31/2054
21878+58	2,572	18	0.246	52,000	1.25	0.075	34.1	07/07/2054
21432+84	2,612	18	0.246	52,000	1.36	0.095	35.4	09/22/2055
21550+21	2,675	18	0.246	52,000	1.48	0.083	36.6	12/26/2056
21811+98	2,576	18	0.246	52,000	1.25	0.075	36.9	03/31/2057
21609+40	2,631	18	0.246	52,000	1.36	0.083	37.0	05/19/2057
21761+11	2,566	18	0.246	52,000	1.13	0.083	37.6	12/10/2057
21587+09	2,658	18	0.246	52,000	1.25	0.088	38.0	05/08/2058
21834+04	2,573	18	0.256	52,000	1.48	0.074	38.5	11/07/2058
21890+22	2,577	18	0.256	52,000	1.36	0.074	38.7	01/29/2059
21911+69	2,578	18	0.256	52,000	1.84	0.062	40.0	05/04/2060
21927+98	2,568	18	0.256	52,000	1.25	0.074	40.0	05/31/2060
21728+63	2,582	18	0.246	52,000	1.48	0.068	40.7	02/03/2061
21800+13	2,576	18	0.246	52,000	1.48	0.063	42.0	05/06/2062
21739+68	2,575	18	0.246	52,000	1.36	0.068	42.9	04/25/2063
20955+37	2,588	18	0.295	45,000	5.02	0.095	44.1	06/30/2064
21499+37	2,648	18	0.256	52,000	1.95	0.074	44.6	01/01/2065
21834+03	2,573	18	0.256	52,000	1.25	0.074	44.7	01/12/2065
21403+89	2,587	18	0.246	52,000	1.36	0.083	45.6	12/28/2065
21675+54	2,606	18	0.256	52,000	2.19	0.062	46.8	03/01/2067
21441+31	2,626	18	0.246	52,000	1.84	0.068	47.1	06/24/2067

Table D-8 (continued). Pressure-Cycle-Induced Fatigue Cracking Analysis of ILI Indicated Anomalies Texon to Barnhart – ILI Date May 15, 2020 (pg. 2 of 3)

Station Number	Elevation (feet)	OD (inch)	WT (inch)	YS (psi)	ILI Length (inch)	ILI Depth (inch)	Re-assessment Interval (years)	Re-assessment Due Date
20401+90	2,618	18	0.315	45,000	4.55	0.121	48.0	05/10/2068
21620+84	2,636	18	0.256	52,000	1.72	0.069	48.7	01/28/2069
21673+85	2,605	18	0.256	52,000	1.84	0.062	52.5	11/04/2072
21446+63	2,635	18	0.256	52,000	2.66	0.062	53.1	06/24/2073
21553+51	2,675	18	0.246	52,000	1.13	0.075	54.3	08/27/2074
21671+62	2,609	18	0.246	52,000	1.13	0.068	54.5	11/15/2074
21668+23	2,611	18	0.246	52,000	1.25	0.063	55.6	01/06/2076
21390+04	2,581	18	0.246	52,000	1.13	0.083	55.8	02/21/2076
21420+28	2,599	18	0.246	52,000	1.25	0.075	56.3	09/14/2076
21499+38	2,648	18	0.256	52,000	1.25	0.082	56.4	09/24/2076
21487+01	2,649	18	0.246	52,000	1.36	0.068	56.8	02/27/2077
21891+07	2,577	18	0.256	52,000	1.13	0.062	58.0	05/29/2078
21608+91	2,630	18	0.246	52,000	1.13	0.068	58.5	11/01/2078
21696+60	2,599	18	0.256	52,000	1.48	0.062	59.1	07/02/2079
21537+58	2,672	18	0.256	52,000	1.13	0.082	59.8	03/13/2080
21413+97	2,589	18	0.256	52,000	1.25	0.082	61.2	07/19/2081
21572+81	2,675	18	0.246	52,000	1.25	0.063	62.1	07/08/2082
21408+92	2,588	18	0.246	52,000	1.13	0.075	62.4	10/20/2082
20940+52	2,604	18	0.305	45,000	5.50	0.088	63.4	09/27/2083
21422+84	2,600	18	0.246	52,000	1.25	0.068	65.0	05/22/2085
21765+68	2,563	18	0.256	52,000	1.13	0.062	66.9	03/27/2087
21446+58	2,635	18	0.256	52,000	1.25	0.074	68.3	08/18/2088
20261+92	2,631	18	0.315	45,000	3.25	0.121	69.8	02/26/2090
21273+18	2,553	18	0.305	45,000	4.43	0.076	76.1	06/18/2096
20742+69	2,664	18	0.305	52,000	5.14	0.088	76.2	07/24/2096
21495+30	2,653	18	0.256	52,000	1.13	0.069	78.0	05/14/2098
21448+26	2,637	18	0.256	52,000	1.13	0.069	81.7	01/28/2102
21328+17	2,567	18	0.305	45,000	3.25	0.076	85.9	04/06/2106
20264+44	2,631	18	0.305	45,000	4.79	0.088	90.2	08/08/2110
19944+89	2,546	18	0.305	45,000	3.61	0.094	90.5	11/01/2110
20871+29	2,655	18	0.305	45,000	4.67	0.076	103.0	05/21/2123
19762+06	2,526	18	0.315	45,000	3.72	0.090	107.4	09/28/2127
21268+48	2,553	18	0.315	45,000	2.07	0.090	109.6	12/08/2129
21204+14	2,582	18	0.315	45,000	2.19	0.090	111.4	10/12/2131
20937+88	2,606	18	0.305	45,000	10.10	0.063	111.6	12/04/2131
20504+01	2,616	18	0.305	45,000	5.50	0.076	113.6	12/25/2133
19786+15	2,528	18	0.315	45,000	7.86	0.074	117.1	06/10/2137
21115+52	2,587	18	0.305	45,000	3.25	0.070	121.4	10/07/2141
20179+80	2,597	18	0.305	45,000	9.04	0.070	121.6	12/05/2141
20494+75	2,609	18	0.315	45,000	3.96	0.083	130.4	10/11/2150
21261+87	2,549	18	0.315	45,000	3.02	0.068	136.1	07/02/2156
21111+46	2,574	18	0.305	45,000	1.72	0.082	143.0	05/12/2163
20326+14	2,640	18	0.315	45,000	5.73	0.074	145.5	11/24/2165
20689+66	2,623	18	0.315	52,000	2.78	0.083	154.5	11/24/2174
20325+08	2,640	18	0.315	45,000	4.91	0.074	155.5	11/04/2175
21110+22	2,572	18	0.305	45,000	1.25	0.094	156.6	12/19/2176
20326+13	2,640	18	0.315	45,000	3.02	0.083	161.5	11/14/2181

Table D-8 (continued). Pressure-Cycle-Induced Fatigue Cracking Analysis of ILI Indicated Anomalies Texon to Barnhart – ILI Date May 15, 2020 (pg. 3 of 3)

Station Number	Elevation (feet)	OD (inch)	WT (inch)	YS (psi)	ILI Length (inch)	ILI Depth (inch)	Re-assessment Interval (years)	Re-assessment Due Date
20780+74	2,652	18	0.305	45,000	1.25	0.109	162.2	07/18/2182
21273+17	2,553	18	0.305	45,000	1.60	0.070	162.5	11/01/2182
19898+67	2,534	18	0.315	45,000	2.54	0.083	172.6	01/04/2193
20368+09	2,622	18	0.305	45,000	2.66	0.076	175.3	09/19/2195
20416+95	2,600	18	0.305	45,000	2.07	0.082	181.4	10/14/2201
21057+86	2,570	18	0.305	45,000	1.48	0.076	186.0	05/27/2206
20439+50	2,604	18	0.305	45,000	3.96	0.063	189.9	03/27/2210
20661+16	2,596	18	0.305	45,000	2.43	0.070	193.3	09/14/2213
20188+04	2,599	18	0.315	45,000	2.19	0.083	203.2	08/10/2223
21231+82	2,547	18	0.315	45,000	1.36	0.074	204.1	06/25/2224
21138+22	2,613	18	0.305	45,000	1.36	0.070	206.4	10/12/2226
20307+69	2,637	18	0.315	45,000	3.84	0.068	206.4	10/22/2226
19895+69	2,532	18	0.315	45,000	1.72	0.090	207.3	09/12/2227
21204+14	2,582	18	0.315	45,000	1.48	0.068	219.6	12/18/2239
20156+22	2,596	18	0.305	45,000	3.02	0.063	221.5	11/11/2241
20641+54	2,615	18	0.315	45,000	1.60	0.068	225.2	08/07/2245
20847+62	2,663	18	0.305	45,000	1.13	0.070	225.2	08/07/2245
21348+18	2,582	18	0.344	45,000	1.25	0.081	225.2	08/07/2245
20871+85	2,654	18	0.315	45,000	2.66	0.061	225.2	08/07/2245
19765+45	2,526	18	0.315	45,000	1.95	0.068	225.2	08/07/2245
21122+88	2,612	18	0.305	45,000	1.13	0.063	225.2	08/07/2245
20113+46	2,572	18	0.315	45,000	1.48	0.083	225.2	08/07/2245
20550+79	2,617	18	0.315	45,000	1.13	0.061	225.2	08/07/2245
20414+93	2,606	18	0.315	45,000	1.13	0.061	225.2	08/07/2245
19923+86	2,551	18	0.315	45,000	1.13	0.096	225.2	08/07/2245
20573+75	2,610	18	0.305	45,000	1.36	0.063	225.2	08/07/2245
21226+11	2,545	18	0.315	45,000	1.36	0.061	225.2	08/07/2245
20338+59	2,631	18	0.315	45,000	1.48	0.068	225.2	08/07/2245
19895+66	2,532	18	0.315	45,000	1.25	0.083	225.2	08/07/2245
20392+06	2,629	18	0.315	45,000	1.36	0.068	225.2	08/07/2245
20798+21	2,653	18	0.315	45,000	1.48	0.068	225.2	08/07/2245
20611+97	2,621	18	0.315	45,000	1.13	0.061	225.2	08/07/2245
20635+89	2,624	18	0.315	45,000	1.60	0.083	225.2	08/07/2245
20261+93	2,631	18	0.315	45,000	1.13	0.074	225.2	08/07/2245
19868+96	2,515	18	0.305	45,000	1.84	0.070	225.2	08/07/2245
20262+01	2,631	18	0.315	45,000	1.13	0.068	225.2	08/07/2245

Table D-9. Pressure-Cycle-Induced Fatigue Cracking Analysis of ILI Indicated Anomalies Warda to Buckhorn – ILI Date November 7, 2019 (pg. 1 of 3)

Station Number	Elevation (feet)	OD (inch)	WT (inch)	YS (psi)	ILI Length (inch)	ILI Depth (inch)	Re-assessment Interval (years)	Re-assessment Due Date
5844+01	331	18	0.276	45,000	4.67	0.083	19.4	03/22/2039
5018+76	431	18	0.276	45,000	4.31	0.108	24.6	06/25/2044
4464+86	335	18	0.276	45,000	6.32	0.108	26.3	02/20/2046
5776+42	374	18	0.276	45,000	2.07	0.102	26.6	06/04/2046
5472+17	481	18	0.276	45,000	3.60	0.094	27.2	01/10/2047
5461+55	451	18	0.276	45,000	5.61	0.083	27.3	02/23/2047
5668+47	413	18	0.276	45,000	2.66	0.094	28.2	01/10/2048
5874+66	308	18	0.276	45,000	2.66	0.083	28.4	03/18/2048
5307+23	448	18	0.276	45,000	5.14	0.088	28.5	05/18/2048
5080+54	397	18	0.276	45,000	3.49	0.108	29.0	11/11/2048
5776+42	374	18	0.276	45,000	1.83	0.102	30.2	01/03/2050
5781+10	373	18	0.276	45,000	2.42	0.088	30.4	03/17/2050
5401+22	494	18	0.276	45,000	4.19	0.088	30.6	06/18/2050
5781+13	373	18	0.276	45,000	4.78	0.069	32.5	05/10/2052
5566+17	524	18	0.276	45,000	3.13	0.088	32.8	08/25/2052
5881+58	326	18	0.276	45,000	1.83	0.088	34.4	04/17/2054
5952+41	343	18	0.276	45,000	2.90	0.069	35.2	01/10/2055
4938+66	436	18	0.276	45,000	5.02	0.094	36.1	12/27/2055
5894+47	320	18	0.276	45,000	3.01	0.069	36.5	04/22/2056
5484+39	501	18	0.276	45,000	3.01	0.088	36.7	08/03/2056
5901+47	305	18	0.276	45,000	2.31	0.075	37.4	04/17/2057
5893+29	321	18	0.276	45,000	3.72	0.064	38.2	01/15/2058
5883+73	328	18	0.276	45,000	2.66	0.069	40.0	10/27/2059
5258+91	392	18	0.276	45,000	2.90	0.094	41.0	11/16/2060
5822+06	371	18	0.276	45,000	2.31	0.075	41.5	05/19/2061
5605+17	479	18	0.276	45,000	3.25	0.075	43.3	02/08/2063
5748+89	369	18	0.276	45,000	1.13	0.116	43.5	05/12/2063
4970+51	378	18	0.276	45,000	4.55	0.088	44.5	05/08/2064
4913+29	380	18	0.276	45,000	6.08	0.083	46.6	06/04/2066
5671+85	414	18	0.276	45,000	2.31	0.075	49.7	07/21/2069
5799+32	371	18	0.276	45,000	2.66	0.064	51.4	03/30/2071
4920+84	386	18	0.276	45,000	1.95	0.122	51.5	05/06/2071
4997+35	404	18	0.276	45,000	4.55	0.083	51.8	08/25/2071
5825+43	371	18	0.276	45,000	1.95	0.069	52.9	10/19/2072
4980+64	399	18	0.276	45,000	2.90	0.094	55.9	09/26/2075
4496+72	367	18	0.276	45,000	6.08	0.088	56.8	08/14/2076
4975+29	390	18	0.276	45,000	2.19	0.102	61.7	07/28/2081
5781+14	373	18	0.276	45,000	1.95	0.064	63.3	02/27/2083
5749+69	362	18	0.276	45,000	1.24	0.083	63.4	04/07/2083
5341+46	442	18	0.276	45,000	3.49	0.069	64.5	05/05/2084
5141+78	395	18	0.276	45,000	5.02	0.069	65.6	06/25/2085
4502+47	343	18	0.276	45,000	19.41	0.069	65.9	10/06/2085
4883+39	347	18	0.276	45,000	2.66	0.094	66.7	07/03/2086
5757+09	352	18	0.276	45,000	1.83	0.064	67.4	03/28/2087
3618+43	173	18	0.276	45,000	3.72	0.094	70.9	10/01/2090
5566+95	522	18	0.276	45,000	2.07	0.069	72.1	12/27/2091
5307+79	446	18	0.276	45,000	3.96	0.064	74.3	03/13/2094

Table D-9 (continued). Pressure-Cycle-Induced Fatigue Cracking Analysis of ILI Indicated Anomalies Warda to Buckhorn – ILI Date November 7, 2019 (pg. 2 of 3)

Station Number	Elevation (feet)	OD (inch)	WT (inch)	YS (psi)	ILI Length (inch)	ILI Depth (inch)	Re-assessment Interval (years)	Re-assessment Due Date
3680+61	175	18	0.276	45,000	5.85	0.083	74.7	07/31/2094
4580+52	340	18	0.276	45,000	3.84	0.088	74.9	09/27/2094
5707+85	394	18	0.276	45,000	1.72	0.064	75.1	12/25/2094
5662+83	399	18	0.276	45,000	1.72	0.064	79.2	01/03/2099
5335+20	457	18	0.276	45,000	2.07	0.075	80.1	11/28/2099
5165+83	375	18	0.276	45,000	2.54	0.075	81.2	01/20/2101
4426+77	287	18	0.276	45,000	8.09	0.075	83.9	09/19/2103
5625+88	435	18	0.276	45,000	1.24	0.075	85.5	05/05/2105
4584+22	323	18	0.276	45,000	2.31	0.102	85.7	07/18/2105
5460+05	447	18	0.276	45,000	2.19	0.064	86.6	06/29/2106
4970+57	378	18	0.276	45,000	2.31	0.083	89.1	01/01/2109
4935+93	421	18	0.276	45,000	2.42	0.083	89.8	08/25/2109
4981+51	396	18	0.276	45,000	2.90	0.075	91.2	02/03/2111
3875+95	262	18	0.276	45,000	3.96	0.088	92.4	03/17/2112
4912+43	380	18	0.276	45,000	3.13	0.075	92.9	10/07/2112
4177+99	212	18	0.276	45,000	12.81	0.069	94.4	04/21/2114
5419+55	479	18	0.276	45,000	1.48	0.075	95.1	12/20/2114
4579+80	341	18	0.276	45,000	5.14	0.075	95.3	03/04/2115
4849+11	354	18	0.276	45,000	3.25	0.075	96.5	05/19/2116
3625+65	165	18	0.276	45,000	1.95	0.108	100.3	02/27/2120
4848+46	353	18	0.276	45,000	2.31	0.083	101.2	01/05/2121
5358+36	473	18	0.276	45,000	1.72	0.069	101.6	07/03/2121
5547+87	490	18	0.276	45,000	1.13	0.075	104.1	12/18/2123
4430+69	304	18	0.276	45,000	5.26	0.075	105.3	02/13/2125
5371+83	485	18	0.276	45,000	1.60	0.069	105.9	10/16/2125
5367+04	474	18	0.276	45,000	1.36	0.075	107.8	09/01/2127
4502+43	343	18	0.276	45,000	10.92	0.064	111.2	01/18/2131
5165+62	375	18	0.276	45,000	2.31	0.064	114.3	03/09/2134
3971+26	267	18	0.276	45,000	3.72	0.083	116.2	01/23/2136
5202+50	340	18	0.276	45,000	1.48	0.075	116.5	05/25/2136
4911+17	380	18	0.276	45,000	2.78	0.069	116.8	08/20/2136
5556+04	521	18	0.276	45,000	1.24	0.064	117.7	07/08/2137
4518+26	364	18	0.276	45,000	9.15	0.064	117.9	10/05/2137
4965+07	400	18	0.276	45,000	3.25	0.064	118.0	11/12/2137
3625+61	165	18	0.276	45,000	3.84	0.075	122.2	01/14/2142
4288+24	208	18	0.276	45,000	2.54	0.088	127.9	10/21/2147
4846+61	347	18	0.276	45,000	3.49	0.064	128.0	10/26/2147
4503+39	341	18	0.276	45,000	3.25	0.075	133.7	08/05/2153
4311+63	251	18	0.276	45,000	3.84	0.075	134.6	05/28/2154
4846+52	347	18	0.276	45,000	3.01	0.064	138.2	01/13/2158
4705+84	268	18	0.276	45,000	1.83	0.083	140.0	11/21/2159
4328+40	273	18	0.276	45,000	3.37	0.075	145.3	02/17/2165
4139+84	291	18	0.276	45,000	2.42	0.083	161.7	07/22/2181
4418+06	310	18	0.276	45,000	2.66	0.075	162.4	04/18/2182
4288+25	208	18	0.276	45,000	2.90	0.075	162.9	09/23/2182
5141+68	395	18	0.276	45,000	1.36	0.064	166.6	06/23/2186
3655+52	160	18	0.276	45,000	3.84	0.064	175.0	11/22/2194

Table D-9 (continued). Pressure-Cycle-Induced Fatigue Cracking Analysis of ILI Indicated Anomalies Warda to Buckhorn – ILI Date November 7, 2019 (pg. 3 of 3)

Station Number	Elevation (feet)	OD (inch)	WT (inch)	YS (psi)	ILI Length (inch)	ILI Depth (inch)	Re-assessment Interval (years)	Re-assessment Due Date
4341+50	283	18	0.276	45,000	3.01	0.069	181.0	11/11/2200
4609+61	363	18	0.276	45,000	1.24	0.094	183.4	04/01/2203
4589+30	299	18	0.276	45,000	1.24	0.094	185.0	11/11/2204
4541+60	329	18	0.276	45,000	2.90	0.064	188.8	09/01/2208
3988+90	293	18	0.276	45,000	2.54	0.075	192.7	07/28/2212
4609+60	363	18	0.276	45,000	1.83	0.069	207.8	09/09/2227
5062+57	379	18	0.276	45,000	1.13	0.064	208.9	10/19/2228
4543+55	332	18	0.276	45,000	1.95	0.069	209.8	08/27/2229
3625+65	165	18	0.276	45,000	1.13	0.083	225.2	01/30/2245
4494+61	371	18	0.276	45,000	1.13	0.064	225.2	01/30/2245
4064+66	280	18	0.276	45,000	1.60	0.075	225.2	01/30/2245
3889+84	287	18	0.276	45,000	1.36	0.083	225.2	01/30/2245
4143+80	288	18	0.276	45,000	1.24	0.069	225.2	01/30/2245
4349+95	313	18	0.276	45,000	1.24	0.069	225.2	01/30/2245
3709+78	183	18	0.276	45,000	2.19	0.064	225.2	01/30/2245
4353+02	312	18	0.276	45,000	1.13	0.088	225.2	01/30/2245
4694+95	312	18	0.276	45,000	1.13	0.064	225.2	01/30/2245
4473+98	363	18	0.276	45,000	1.72	0.064	225.2	01/30/2245

Table D-10. Pressure-Cycle-Induced Fatigue Cracking Analysis of ILI Indicated Anomalies Crane to Texon – ILI Date October 19, 2018 (pg. 1 of 8)

Station Number	Elevation (feet)	OD (inch)	WT (inch)	YS (psi)	ILI Length (inch)	ILI Depth (inch)	Re-assessment Interval (years)	Re-assessment Due Date
23866+47	2,585	18	0.246	52,000	2.89	0.115	5.7	06/29/2024*
24060+59	2,525	18	0.256	52,000	2.77	0.120	5.8	08/11/2024*
24015+71	2,539	18	0.246	52,000	3.83	0.088	7.8	08/23/2026
24080+38	2,540	18	0.285	65,000	4.07	0.122	7.8	08/23/2026
23603+80	2,678	18	0.246	52,000	5.13	0.088	9.1	11/13/2027
24040+22	2,531	18	0.256	52,000	7.83	0.074	9.8	07/28/2028
22041+83	2,663	18	0.246	52,000	3.24	0.107	10.3	02/16/2029
22496+50	2,697	18	0.256	52,000	8.07	0.090	10.4	03/02/2029
23905+26	2,577	18	0.256	52,000	4.07	0.090	10.5	05/06/2029
22274+39	2,674	18	0.256	52,000	4.30	0.108	10.8	07/27/2029
24047+56	2,530	18	0.246	52,000	6.30	0.068	11.1	12/02/2029
24015+66	2,539	18	0.246	52,000	4.42	0.075	11.2	12/24/2029
22330+21	2,664	18	0.250	52,000	3.60	0.109	11.3	02/01/2030
23009+60	2,702	18	0.256	52,000	3.24	0.120	11.8	07/30/2030
22169+17	2,655	18	0.256	52,000	5.36	0.095	12.6	05/19/2031
23983+38	2,549	18	0.256	52,000	4.07	0.082	12.6	05/26/2031
23574+82	2,712	18	0.256	52,000	4.07	0.095	12.8	07/25/2031
23538+93	2,763	18	0.256	52,000	3.24	0.103	13.5	05/03/2032
23973+77	2,561	18	0.256	52,000	2.77	0.090	14.2	12/27/2032
22528+36	2,697	18	0.246	52,000	2.18	0.127	14.2	12/29/2032
23087+02	2,662	18	0.256	52,000	8.54	0.082	14.4	03/30/2033
23060+85	2,696	18	0.246	52,000	3.83	0.095	14.8	08/22/2033

*Magellan plans to address these features in 2021.

Table D-10 (continued). Pressure-Cycle-Induced Fatigue Cracking Analysis of ILI Indicated Anomalies Crane to Texon – ILI Date October 19, 2018 (pg. 2 of 8)

Station Number	Elevation (feet)	OD (inch)	WT (inch)	YS (psi)	ILI Length (inch)	ILI Depth (inch)	Re-assessment Interval (years)	Re-assessment Due Date
23395+80	2,792	18	0.246	52,000	3.95	0.088	15.0	10/30/2033
23464+41	2,785	18	0.246	52,000	2.89	0.095	15.9	09/18/2034
23983+37	2,549	18	0.256	52,000	4.30	0.074	15.9	09/21/2034
24012+05	2,541	18	0.246	52,000	3.83	0.068	16.1	11/20/2034
23717+74	2,630	18	0.246	52,000	2.65	0.088	16.2	01/10/2035
23710+02	2,634	18	0.256	52,000	3.13	0.090	16.9	09/30/2035
23053+11	2,681	18	0.256	52,000	1.60	0.154	17.3	01/21/2036
23901+65	2,578	18	0.246	52,000	2.89	0.075	17.8	08/22/2036
22151+61	2,646	18	0.256	52,000	6.42	0.082	18.0	10/22/2036
22614+78	2,707	18	0.256	52,000	4.54	0.095	18.1	11/06/2036
23960+12	2,561	18	0.246	52,000	2.07	0.083	18.1	11/08/2036
23591+08	2,691	18	0.256	52,000	1.95	0.115	18.3	01/24/2037
22403+42	2,662	18	0.256	52,000	5.01	0.090	18.6	06/10/2037
24006+01	2,543	18	0.256	52,000	3.24	0.074	18.9	08/27/2037
23824+96	2,592	18	0.246	52,000	1.71	0.095	19.5	04/28/2038
24040+95	2,531	18	0.246	52,000	1.36	0.095	19.6	05/22/2038
22261+55	2,670	18	0.246	52,000	3.60	0.088	19.7	07/11/2038
22944+94	2,629	18	0.246	52,000	3.83	0.088	19.9	08/25/2038
24000+46	2,543	18	0.256	52,000	6.19	0.062	20.1	12/05/2038
23816+52	2,597	18	0.246	52,000	2.77	0.075	20.3	02/17/2039
22237+61	2,661	18	0.256	52,000	3.48	0.095	21.2	01/10/2040
23957+54	2,563	18	0.246	52,000	1.24	0.102	21.2	01/10/2040
23736+57	2,624	18	0.246	52,000	1.71	0.095	21.5	05/02/2040
23637+28	2,666	18	0.246	52,000	1.36	0.115	21.6	05/31/2040
22082+18	2,658	18	0.246	52,000	1.71	0.115	21.7	06/17/2040
23983+43	2,549	18	0.256	52,000	5.36	0.062	22.0	10/07/2040
23999+74	2,543	18	0.246	52,000	2.42	0.068	22.4	03/26/2041
23983+43	2,549	18	0.256	52,000	2.65	0.074	22.5	04/22/2041
22316+25	2,666	18	0.246	52,000	2.30	0.102	22.6	05/30/2041
23445+69	2,774	18	0.246	52,000	2.54	0.088	22.7	06/23/2041
22316+35	2,666	18	0.246	52,000	1.83	0.115	22.7	07/02/2041
22656+09	2,713	18	0.256	52,000	2.18	0.120	23.0	10/06/2041
23538+79	2,764	18	0.256	52,000	1.71	0.115	23.0	10/21/2041
23532+45	2,776	18	0.246	52,000	1.60	0.107	23.1	11/17/2041
24012+12	2,541	18	0.246	52,000	1.36	0.088	23.1	11/28/2041
22528+44	2,697	18	0.246	52,000	1.60	0.127	23.2	01/08/2042
24015+78	2,539	18	0.246	52,000	2.77	0.063	23.3	01/31/2042
24001+84	2,543	18	0.246	52,000	1.36	0.088	23.4	03/14/2042
22758+47	2,698	18	0.246	52,000	4.07	0.083	23.4	03/20/2042
23293+68	2,769	18	0.246	52,000	1.48	0.122	23.5	04/02/2042
22024+89	2,666	18	0.256	52,000	6.30	0.074	23.7	06/17/2042
22205+98	2,659	18	0.246	52,000	2.42	0.095	24.0	10/23/2042
23727+74	2,629	18	0.246	52,000	3.36	0.068	24.3	02/14/2043
23529+07	2,774	18	0.256	52,000	1.83	0.108	24.6	05/08/2043
23076+67	2,661	18	0.246	52,000	4.89	0.075	24.8	08/01/2043
23983+38	2,549	18	0.256	52,000	2.77	0.069	25.1	12/03/2043
22537+13	2,698	18	0.256	52,000	2.18	0.115	25.2	12/19/2043

Table D-10 (continued). Pressure-Cycle-Induced Fatigue Cracking Analysis of ILI Indicated Anomalies Crane to Texon – ILI Date October 19, 2018 (pg. 3 of 8)

Station Number	Elevation (feet)	OD (inch)	WT (inch)	YS (psi)	ILI Length (inch)	ILI Depth (inch)	Re-assessment Interval (years)	Re-assessment Due Date
24028+80	2,534	18	0.256	52,000	2.54	0.069	25.3	02/16/2044
22322+80	2,666	18	0.246	52,000	4.77	0.075	25.5	04/06/2044
23521+84	2,767	18	0.256	52,000	2.54	0.090	25.7	06/24/2044
23428+08	2,762	18	0.256	52,000	2.07	0.103	25.7	07/07/2044
22807+78	2,654	18	0.246	52,000	2.54	0.095	26.1	11/19/2044
22519+65	2,698	18	0.246	52,000	1.71	0.115	26.7	06/25/2045
24048+17	2,530	18	0.256	52,000	1.24	0.095	26.8	07/31/2045
23994+37	2,545	18	0.256	52,000	3.48	0.062	26.8	08/19/2045
22830+50	2,662	18	0.246	52,000	1.95	0.107	26.9	08/30/2045
23948+94	2,567	18	0.246	52,000	1.12	0.095	27.1	11/26/2045
24023+50	2,536	18	0.256	52,000	1.95	0.074	27.4	02/26/2046
24019+76	2,537	18	0.246	52,000	1.12	0.088	28.0	10/18/2046
23771+58	2,602	18	0.256	52,000	1.60	0.095	28.1	12/10/2046
23612+46	2,673	18	0.246	52,000	1.12	0.115	28.5	04/19/2047
23308+00	2,785	18	0.256	52,000	2.07	0.103	28.5	04/30/2047
22279+25	2,672	18	0.246	52,000	2.89	0.083	28.9	09/30/2047
22632+38	2,710	18	0.256	52,000	1.95	0.115	29.7	06/29/2048
23845+50	2,591	18	0.256	52,000	1.24	0.103	29.8	07/20/2048
22840+70	2,646	18	0.256	52,000	1.60	0.128	30.0	09/30/2048
23996+83	2,544	18	0.256	52,000	1.48	0.082	30.2	01/01/2049
23960+82	2,562	18	0.256	52,000	2.18	0.069	30.6	05/16/2049
24035+87	2,533	18	0.256	52,000	2.54	0.062	30.6	06/01/2049
23925+54	2,574	18	0.256	52,000	2.30	0.069	30.7	06/23/2049
22769+90	2,687	18	0.256	52,000	8.77	0.069	31.0	10/23/2049
24017+51	2,538	18	0.256	52,000	1.95	0.069	31.1	11/11/2049
24000+46	2,543	18	0.256	52,000	1.71	0.074	31.2	01/06/2050
23439+51	2,770	18	0.256	52,000	1.60	0.108	31.3	02/12/2050
24043+13	2,530	18	0.256	52,000	1.60	0.074	31.5	04/03/2050
23442+16	2,769	18	0.246	52,000	1.60	0.095	31.7	07/05/2050
22945+89	2,626	18	0.246	52,000	1.48	0.115	31.7	07/11/2050
22100+06	2,662	18	0.256	52,000	3.13	0.082	31.9	09/14/2050
23956+01	2,564	18	0.256	52,000	2.07	0.069	32.0	11/03/2050
23665+38	2,651	18	0.256	52,000	2.65	0.074	32.2	12/18/2050
22721+23	2,700	18	0.246	52,000	2.07	0.095	33.4	03/03/2052
23158+08	2,752	18	0.246	52,000	1.60	0.102	34.0	10/01/2052
22718+16	2,699	18	0.246	52,000	7.60	0.063	34.1	11/06/2052
22461+31	2,673	18	0.256	52,000	2.07	0.103	34.3	02/19/2053
22486+89	2,693	18	0.246	52,000	1.71	0.102	34.5	04/26/2053
22372+74	2,662	18	0.256	52,000	2.65	0.090	34.5	04/28/2053
22009+84	2,675	18	0.246	52,000	3.36	0.068	34.6	05/18/2053
23651+85	2,658	18	0.256	52,000	1.48	0.095	34.8	07/30/2053
22818+99	2,654	18	0.256	52,000	2.77	0.090	35.0	10/05/2053
23933+21	2,572	18	0.256	52,000	1.36	0.082	35.2	01/14/2054
22517+70	2,698	18	0.246	52,000	3.36	0.075	35.7	06/21/2054
23864+26	2,585	18	0.256	52,000	1.24	0.090	36.1	12/02/2054
24012+23	2,541	18	0.246	52,000	1.48	0.063	36.2	12/30/2054
23984+97	2,548	18	0.246	52,000	1.12	0.075	36.7	07/13/2055

Table D-10 (continued). Pressure-Cycle-Induced Fatigue Cracking Analysis of ILI Indicated Anomalies Crane to Texon – ILI Date October 19, 2018 (pg. 4 of 8)

Station Number	Elevation (feet)	OD (inch)	WT (inch)	YS (psi)	ILI Length (inch)	ILI Depth (inch)	Re-assessment Interval (years)	Re-assessment Due Date
22354+97	2,665	18	0.256	52,000	2.18	0.095	37.1	11/24/2055
23434+38	2,771	18	0.256	52,000	1.36	0.108	38.0	10/30/2056
22661+48	2,713	18	0.256	52,000	1.95	0.103	38.1	11/29/2056
23651+31	2,659	18	0.256	52,000	1.12	0.108	38.3	02/18/2057
22160+42	2,650	18	0.246	52,000	2.54	0.075	38.4	02/25/2057
23282+94	2,764	18	0.246	52,000	2.42	0.075	38.5	04/27/2057
22694+43	2,705	18	0.256	52,000	2.54	0.090	38.7	06/25/2057
23925+58	2,574	18	0.256	52,000	1.24	0.082	38.7	07/07/2057
22406+99	2,661	18	0.256	52,000	1.83	0.103	38.7	07/07/2057
22494+28	2,696	18	0.246	52,000	3.01	0.075	38.7	07/09/2057
23996+39	2,544	18	0.256	52,000	1.12	0.082	39.3	02/06/2058
23994+88	2,544	18	0.256	52,000	1.48	0.069	39.5	04/03/2058
22045+68	2,662	18	0.246	52,000	1.60	0.088	39.6	06/06/2058
23751+36	2,612	18	0.246	52,000	1.95	0.063	40.0	10/09/2058
23566+84	2,720	18	0.256	52,000	2.77	0.069	40.0	10/18/2058
23561+10	2,730	18	0.256	52,000	1.83	0.082	40.4	03/11/2059
23816+48	2,597	18	0.246	52,000	1.24	0.075	40.6	06/01/2059
23463+42	2,785	18	0.246	52,000	2.42	0.068	40.8	08/19/2059
23845+46	2,591	18	0.256	52,000	1.12	0.090	41.0	10/16/2059
23853+47	2,590	18	0.256	52,000	1.71	0.069	41.5	04/10/2060
23535+12	2,773	18	0.256	52,000	2.30	0.074	41.7	06/29/2060
23845+23	2,591	18	0.256	52,000	1.71	0.069	41.9	08/27/2060
23241+44	2,752	18	0.246	52,000	3.83	0.063	42.1	11/22/2060
22614+77	2,707	18	0.256	52,000	2.07	0.095	42.3	01/27/2061
23263+07	2,730	18	0.246	52,000	2.18	0.075	42.3	02/19/2061
23458+97	2,781	18	0.256	52,000	3.01	0.069	42.4	03/23/2061
23974+41	2,561	18	0.246	52,000	1.12	0.068	42.5	04/28/2061
22733+22	2,705	18	0.246	52,000	1.36	0.107	42.6	06/06/2061
23406+31	2,782	18	0.246	52,000	2.42	0.068	42.8	08/23/2061
22049+12	2,661	18	0.246	52,000	1.48	0.088	42.9	09/25/2061
22403+20	2,661	18	0.256	52,000	2.65	0.082	43.1	11/18/2061
23385+38	2,796	18	0.256	52,000	1.71	0.090	43.2	01/02/2062
23764+41	2,606	18	0.256	52,000	1.60	0.074	43.3	02/18/2062
22128+79	2,653	18	0.246	52,000	1.36	0.095	43.5	04/24/2062
22567+86	2,703	18	0.246	52,000	2.07	0.083	44.0	10/08/2062
23533+89	2,775	18	0.246	52,000	2.42	0.063	44.2	12/14/2062
23534+09	2,774	18	0.256	52,000	1.71	0.082	44.5	04/05/2063
23500+62	2,752	18	0.256	52,000	1.48	0.090	44.8	08/05/2063
22959+30	2,632	18	0.246	52,000	1.95	0.083	44.8	08/12/2063
22109+70	2,663	18	0.256	52,000	1.60	0.095	45.1	11/29/2063
23148+27	2,746	18	0.256	52,000	3.01	0.074	45.7	06/15/2064
22423+10	2,664	18	0.256	52,000	1.83	0.095	45.9	08/26/2064
22823+25	2,660	18	0.246	52,000	1.36	0.102	46.1	11/10/2064
23328+41	2,814	18	0.246	52,000	2.42	0.068	46.1	11/14/2064
22899+53	2,626	18	0.246	52,000	1.24	0.107	46.2	01/14/2065
22820+97	2,658	18	0.256	52,000	1.36	0.115	46.5	04/19/2065
22727+73	2,703	18	0.256	52,000	3.48	0.074	46.6	05/13/2065

Table D-10 (continued). Pressure-Cycle-Induced Fatigue Cracking Analysis of ILI Indicated Anomalies Crane to Texon – ILI Date October 19, 2018 (pg. 5 of 8)

Station Number	Elevation (feet)	OD (inch)	WT (inch)	YS (psi)	ILI Length (inch)	ILI Depth (inch)	Re-assessment Interval (years)	Re-assessment Due Date
23972+81	2,561	18	0.256	52,000	1.24	0.069	46.7	06/28/2065
23816+43	2,597	18	0.246	52,000	1.24	0.068	46.8	07/20/2065
23688+18	2,642	18	0.246	52,000	1.24	0.075	46.8	08/06/2065
23322+88	2,805	18	0.256	52,000	2.54	0.074	46.8	08/19/2065
22558+77	2,701	18	0.246	52,000	1.12	0.115	46.8	08/24/2065
23539+02	2,763	18	0.256	52,000	1.12	0.103	46.9	09/02/2065
22774+47	2,686	18	0.256	52,000	2.07	0.090	47.3	02/08/2066
23024+26	2,672	18	0.256	52,000	1.48	0.103	48.8	08/11/2067
22042+51	2,663	18	0.256	52,000	1.83	0.082	48.9	09/25/2067
23021+92	2,671	18	0.256	52,000	3.71	0.069	49.0	10/08/2067
23399+68	2,789	18	0.246	52,000	1.24	0.088	49.4	03/13/2068
23671+54	2,649	18	0.256	52,000	1.12	0.090	49.6	05/07/2068
23207+54	2,752	18	0.246	52,000	1.12	0.102	49.8	08/06/2068
23527+95	2,773	18	0.246	52,000	1.71	0.068	49.8	08/08/2068
22230+54	2,656	18	0.256	52,000	2.07	0.082	49.8	08/16/2068
23241+44	2,752	18	0.246	52,000	1.83	0.075	50.1	12/03/2068
22018+99	2,669	18	0.246	52,000	1.36	0.083	50.3	02/01/2069
22899+42	2,625	18	0.246	52,000	1.24	0.102	50.3	02/21/2069
23471+39	2,778	18	0.246	52,000	1.48	0.075	50.6	05/21/2069
22669+53	2,712	18	0.236	52,000	2.07	0.069	50.8	08/14/2069
23733+39	2,625	18	0.246	52,000	1.24	0.068	51.3	01/28/2070
23432+96	2,771	18	0.256	52,000	3.24	0.062	51.4	03/16/2070
22746+56	2,703	18	0.246	52,000	3.71	0.063	51.5	04/25/2070
23426+99	2,761	18	0.256	52,000	3.24	0.062	51.5	05/01/2070
22114+87	2,663	18	0.256	52,000	2.30	0.074	51.6	06/02/2070
23757+67	2,609	18	0.246	52,000	1.36	0.063	51.6	06/03/2070
22928+97	2,678	18	0.246	52,000	3.48	0.063	51.7	06/29/2070
22879+76	2,617	18	0.246	52,000	1.71	0.083	51.8	08/15/2070
23083+10	2,658	18	0.256	52,000	1.71	0.090	51.9	08/31/2070
23892+60	2,579	18	0.256	52,000	1.48	0.062	51.9	09/11/2070
23205+84	2,751	18	0.246	52,000	1.48	0.083	52.3	02/05/2071
23205+85	2,751	18	0.246	52,000	1.48	0.083	52.3	02/05/2071
23691+23	2,641	18	0.256	52,000	1.60	0.069	52.4	03/02/2071
22928+96	2,678	18	0.246	52,000	2.07	0.075	52.5	04/22/2071
22288+85	2,665	18	0.246	52,000	1.12	0.102	52.6	05/28/2071
22958+97	2,632	18	0.246	52,000	1.48	0.088	52.8	08/24/2071
24052+17	2,529	18	0.256	52,000	1.12	0.062	52.9	08/30/2071
23527+39	2,773	18	0.256	52,000	2.65	0.062	53.1	11/10/2071
23574+64	2,712	18	0.256	52,000	1.60	0.074	53.2	01/09/2072
22733+18	2,705	18	0.246	52,000	1.71	0.083	53.3	01/21/2072
23525+11	2,770	18	0.246	52,000	1.12	0.083	53.4	02/26/2072
23120+63	2,706	18	0.256	52,000	1.12	0.115	53.4	03/13/2072
22704+04	2,699	18	0.256	52,000	2.18	0.082	54.3	02/07/2073
22354+33	2,665	18	0.246	52,000	1.24	0.095	54.3	02/10/2073
23374+93	2,801	18	0.256	52,000	1.12	0.103	54.7	06/28/2073
23751+35	2,612	18	0.246	52,000	1.12	0.068	54.7	07/13/2073
22141+15	2,638	18	0.256	52,000	1.48	0.090	54.8	07/30/2073

Table D-10 (continued). Pressure-Cycle-Induced Fatigue Cracking Analysis of ILI Indicated Anomalies Crane to Texon – ILI Date October 19, 2018 (pg. 6 of 8)

Station Number	Elevation (feet)	OD (inch)	WT (inch)	YS (psi)	ILI Length (inch)	ILI Depth (inch)	Re-assessment Interval (years)	Re-assessment Due Date
23827+03	2,591	18	0.256	52,000	1.12	0.074	54.8	08/08/2073
23951+85	2,566	18	0.256	52,000	1.24	0.062	55.1	12/02/2073
22665+96	2,712	18	0.246	52,000	1.48	0.088	55.5	04/12/2074
22632+54	2,710	18	0.256	52,000	3.36	0.069	55.7	07/14/2074
23817+00	2,596	18	0.256	52,000	1.24	0.069	55.8	07/26/2074
23207+49	2,752	18	0.246	52,000	1.12	0.095	55.8	08/20/2074
23607+01	2,673	18	0.246	52,000	1.12	0.075	56.0	10/08/2074
23147+75	2,745	18	0.256	52,000	1.24	0.103	56.3	02/23/2075
22534+85	2,697	18	0.256	52,000	1.36	0.103	56.5	04/03/2075
22995+61	2,688	18	0.246	52,000	1.36	0.088	57.2	12/15/2075
22289+91	2,664	18	0.256	52,000	2.77	0.069	57.2	12/24/2075
23752+28	2,611	18	0.256	52,000	1.60	0.062	57.4	03/27/2076
23009+91	2,702	18	0.256	52,000	4.30	0.062	58.0	10/22/2076
23276+79	2,750	18	0.256	52,000	1.36	0.090	58.5	05/03/2077
23360+53	2,809	18	0.256	52,000	1.83	0.074	58.9	09/03/2077
22274+27	2,674	18	0.256	52,000	1.48	0.090	59.3	02/06/2078
23085+40	2,660	18	0.256	52,000	1.36	0.095	59.8	07/30/2078
22865+78	2,601	18	0.256	52,000	1.60	0.090	59.9	09/15/2078
22551+84	2,700	18	0.256	52,000	1.60	0.090	60.5	04/07/2079
23521+95	2,767	18	0.256	52,000	1.24	0.082	60.5	04/13/2079
23300+37	2,775	18	0.256	52,000	1.83	0.074	61.1	11/09/2079
23214+03	2,754	18	0.246	52,000	1.48	0.075	61.5	04/23/2080
22362+55	2,664	18	0.246	52,000	1.36	0.083	61.9	08/31/2080
22718+18	2,699	18	0.246	52,000	2.18	0.068	62.5	05/05/2081
23150+84	2,748	18	0.256	52,000	1.12	0.103	63.2	01/06/2082
22359+00	2,665	18	0.246	52,000	1.95	0.068	63.4	02/23/2082
22008+86	2,676	18	0.246	52,000	1.24	0.075	63.4	03/26/2082
23149+72	2,747	18	0.256	52,000	1.95	0.074	63.9	09/05/2082
22831+45	2,659	18	0.246	52,000	2.54	0.063	64.2	01/04/2083
23264+00	2,730	18	0.256	52,000	1.24	0.090	64.6	05/26/2083
23121+33	2,706	18	0.256	52,000	1.24	0.095	64.9	09/03/2083
22516+52	2,698	18	0.246	52,000	1.24	0.088	64.9	09/16/2083
22661+60	2,713	18	0.256	52,000	1.48	0.090	66.3	02/02/2085
23646+44	2,661	18	0.256	52,000	1.24	0.069	67.2	12/21/2085
23009+93	2,701	18	0.256	52,000	2.30	0.069	68.1	11/23/2086
22820+12	2,656	18	0.256	52,000	2.42	0.069	69.0	10/17/2087
22122+41	2,661	18	0.256	52,000	2.42	0.062	69.4	03/04/2088
22247+53	2,668	18	0.256	52,000	1.24	0.090	69.7	07/03/2088
22248+72	2,668	18	0.256	52,000	1.24	0.090	69.7	07/18/2088
22480+25	2,688	18	0.256	52,000	1.24	0.095	70.4	03/18/2089
22560+99	2,701	18	0.246	52,000	1.83	0.068	70.6	06/03/2089
22331+50	2,664	18	0.256	52,000	1.48	0.082	70.9	09/02/2089
22504+99	2,698	18	0.246	52,000	1.24	0.083	71.0	10/05/2089
23671+40	2,649	18	0.256	52,000	1.12	0.069	71.2	12/24/2089
22708+93	2,691	18	0.256	52,000	3.24	0.062	71.3	02/22/2090
23133+69	2,728	18	0.246	52,000	1.12	0.083	71.4	03/24/2090
22209+96	2,656	18	0.256	52,000	1.36	0.082	72.1	11/08/2090

Table D-10 (continued). Pressure-Cycle-Induced Fatigue Cracking Analysis of ILI Indicated Anomalies Crane to Texon – ILI Date October 19, 2018 (pg. 7 of 8)

Station Number	Elevation (feet)	OD (inch)	WT (inch)	YS (psi)	ILI Length (inch)	ILI Depth (inch)	Re-assessment Interval (years)	Re-assessment Due Date
22939+60	2,645	18	0.246	52,000	1.71	0.068	72.3	01/31/2091
22776+27	2,685	18	0.256	52,000	1.24	0.095	72.4	03/17/2091
22624+51	2,709	18	0.246	52,000	1.24	0.083	72.5	04/09/2091
23485+80	2,751	18	0.246	52,000	1.12	0.068	72.6	06/08/2091
22232+43	2,658	18	0.246	52,000	1.48	0.068	73.9	09/29/2092
23157+46	2,752	18	0.246	52,000	1.24	0.075	74.5	04/06/2093
22181+97	2,661	18	0.256	52,000	1.12	0.090	74.5	05/06/2093
23551+00	2,748	18	0.256	52,000	1.24	0.069	74.7	07/03/2093
23461+94	2,784	18	0.256	52,000	1.71	0.062	74.8	08/20/2093
22708+87	2,691	18	0.256	52,000	2.18	0.069	75.1	11/16/2093
22007+62	2,676	18	0.256	52,000	1.48	0.069	75.4	03/05/2094
22659+80	2,713	18	0.256	52,000	1.83	0.074	76.1	11/28/2094
22965+56	2,629	18	0.256	52,000	1.71	0.074	76.4	03/14/2095
22928+95	2,678	18	0.246	52,000	1.60	0.068	76.9	08/26/2095
23192+17	2,728	18	0.246	52,000	1.36	0.068	77.5	04/28/2096
22390+27	2,657	18	0.256	52,000	1.36	0.082	78.4	03/22/2097
23344+92	2,815	18	0.256	52,000	1.12	0.082	78.7	07/05/2097
22076+71	2,659	18	0.256	52,000	1.12	0.082	79.3	01/19/2098
22719+49	2,700	18	0.246	52,000	1.60	0.068	79.6	05/22/2098
22460+43	2,674	18	0.256	52,000	1.36	0.082	80.3	02/21/2099
23558+58	2,737	18	0.256	52,000	1.12	0.069	80.5	04/27/2099
22905+54	2,645	18	0.256	52,000	1.36	0.082	81.1	11/15/2099
22041+78	2,663	18	0.246	52,000	1.12	0.068	81.7	07/06/2100
23228+97	2,755	18	0.256	52,000	1.36	0.074	81.8	08/10/2100
22537+80	2,698	18	0.256	52,000	1.36	0.082	82.1	11/17/2100
22459+30	2,673	18	0.256	52,000	1.83	0.069	82.3	02/09/2101
22050+86	2,661	18	0.246	52,000	1.12	0.068	82.3	02/19/2101
23259+98	2,729	18	0.256	52,000	1.48	0.069	82.5	05/07/2101
23647+45	2,661	18	0.256	52,000	1.12	0.062	83.5	04/21/2102
22694+40	2,705	18	0.256	52,000	1.36	0.082	83.5	05/05/2102
22559+31	2,701	18	0.246	52,000	1.24	0.075	83.6	05/28/2102
23448+55	2,776	18	0.256	52,000	1.48	0.062	83.7	07/12/2102
22571+05	2,703	18	0.256	52,000	2.42	0.062	83.9	09/21/2102
22807+07	2,659	18	0.246	52,000	1.71	0.063	84.3	02/22/2103
22638+28	2,711	18	0.256	52,000	1.60	0.074	85.0	10/08/2103
22716+78	2,697	18	0.246	52,000	1.71	0.063	85.2	01/01/2104
23014+75	2,691	18	0.256	52,000	1.24	0.082	85.4	03/17/2104
22443+11	2,673	18	0.246	52,000	1.60	0.063	85.9	08/25/2104
22999+90	2,692	18	0.256	52,000	1.24	0.082	85.9	09/30/2104
22338+31	2,661	18	0.256	52,000	2.07	0.062	86.3	02/04/2105
23179+91	2,737	18	0.246	52,000	1.36	0.063	87.3	02/16/2106
22117+92	2,662	18	0.256	52,000	1.36	0.069	87.8	07/25/2106
22410+69	2,661	18	0.246	52,000	1.12	0.075	88.0	10/17/2106
22303+97	2,661	18	0.256	52,000	1.36	0.074	88.3	01/24/2107
23137+69	2,733	18	0.256	52,000	1.12	0.082	88.9	09/26/2107
22822+16	2,659	18	0.246	52,000	1.36	0.068	89.4	03/13/2108
23222+48	2,755	18	0.246	52,000	1.12	0.068	89.6	05/16/2108

Table D-10 (continued). Pressure-Cycle-Induced Fatigue Cracking Analysis of ILI Indicated Anomalies Crane to Texon – ILI Date October 19, 2018 (pg. 8 of 8)

Station Number	Elevation (feet)	OD (inch)	WT (inch)	YS (psi)	ILI Length (inch)	ILI Depth (inch)	Re-assessment Interval (years)	Re-assessment Due Date
23347+11	2,814	18	0.256	52,000	1.12	0.074	90.2	01/13/2109
22517+79	2,698	18	0.246	52,000	1.12	0.075	91.0	10/09/2109
22074+67	2,659	18	0.256	52,000	1.24	0.069	91.6	05/10/2110
22807+79	2,654	18	0.246	52,000	1.12	0.075	92.0	10/26/2110
22537+10	2,698	18	0.256	52,000	1.60	0.069	93.3	02/06/2112
23031+39	2,644	18	0.246	52,000	1.36	0.063	93.7	06/20/2112
22572+81	2,703	18	0.246	52,000	1.48	0.063	93.9	09/12/2112
22402+16	2,661	18	0.256	52,000	1.12	0.082	94.5	05/03/2113
22012+27	2,674	18	0.256	52,000	1.12	0.069	94.7	06/23/2113
22135+39	2,646	18	0.256	52,000	1.12	0.074	94.8	08/23/2113
23283+57	2,765	18	0.246	52,000	1.12	0.063	95.0	11/03/2113
22614+77	2,707	18	0.256	52,000	1.95	0.062	97.0	10/05/2115
22648+82	2,711	18	0.256	52,000	1.36	0.074	97.3	02/04/2116
23347+09	2,814	18	0.256	52,000	1.12	0.069	98.9	09/02/2117
22600+57	2,705	18	0.256	52,000	1.12	0.082	99.5	04/30/2118
22389+15	2,657	18	0.256	52,000	1.36	0.069	101.1	12/09/2119
22954+89	2,631	18	0.256	52,000	1.71	0.062	101.4	03/03/2120
22928+41	2,680	18	0.256	52,000	1.24	0.074	101.9	09/05/2120
23374+45	2,802	18	0.256	52,000	1.24	0.062	102.0	10/26/2120
22899+31	2,625	18	0.246	52,000	1.12	0.068	103.0	10/21/2121
23112+12	2,697	18	0.256	52,000	1.12	0.074	103.2	01/16/2122
22944+89	2,629	18	0.246	52,000	1.24	0.063	103.7	06/19/2122
22571+01	2,703	18	0.256	52,000	1.24	0.074	104.1	12/13/2122
22571+03	2,703	18	0.256	52,000	1.24	0.074	104.1	12/13/2122
22578+24	2,704	18	0.256	52,000	1.24	0.074	104.3	01/27/2123
22553+38	2,700	18	0.246	52,000	1.12	0.068	104.7	06/17/2123
23095+91	2,683	18	0.256	52,000	1.24	0.069	104.7	06/20/2123
22777+42	2,684	18	0.246	52,000	1.24	0.063	107.8	08/22/2126
22405+91	2,661	18	0.256	52,000	1.12	0.074	108.8	08/13/2127
22847+46	2,624	18	0.256	52,000	1.60	0.062	109.4	03/08/2128
22858+68	2,607	18	0.256	52,000	1.12	0.074	112.7	07/09/2131
22537+48	2,698	18	0.256	52,000	1.24	0.069	114.0	10/06/2132
23293+75	2,769	18	0.256	52,000	1.12	0.062	116.2	12/16/2134
22750+92	2,702	18	0.246	52,000	1.12	0.063	117.2	01/03/2136
22656+82	2,713	18	0.256	52,000	1.48	0.062	117.6	05/14/2136
22131+45	2,650	18	0.256	52,000	1.12	0.062	118.5	05/04/2137
22825+21	2,663	18	0.256	52,000	1.12	0.069	124.8	07/20/2143
22389+15	2,657	18	0.256	52,000	1.24	0.062	125.4	03/06/2144
22667+16	2,712	18	0.256	52,000	1.24	0.062	133.6	05/22/2152
22911+56	2,662	18	0.256	52,000	1.12	0.062	140.0	10/18/2158
22673+63	2,712	18	0.256	52,000	1.12	0.062	144.4	03/02/2163

Table D-11. Pressure-Cycle-Induced Fatigue Cracking Analysis of ILI Indicated Anomalies Satsuma to East Houston – ILI Date August 16, 2019 (pg. 1 of 8)

Station Number	Elevation (feet)	OD (inch)	WT (inch)	YS (psi)	ILI Length (inch)	ILI Depth (inch)	Re-assessment Interval (years)	Re-assessment Due Date
1679+53	116	20	0.305	35,000	5.38	0.115	25.5	03/03/2045
1752+00	123	20	0.295	35,000	5.62	0.101	26.2	11/07/2045
1729+58	119	20	0.305	35,000	3.14	0.121	36.4	01/08/2056
1598+51	111	20	0.315	35,000	3.25	0.140	36.8	05/16/2056
1632+14	112	20	0.305	35,000	4.67	0.109	37.7	05/02/2057
1675+02	116	20	0.305	35,000	5.85	0.094	45.3	12/13/2064
1643+16	111	20	0.305	35,000	2.54	0.128	47.2	10/31/2066
1485+41	105	20	0.305	35,000	3.02	0.128	50.9	06/27/2070
1711+20	117	20	0.295	35,000	2.54	0.107	51.1	09/26/2070
1728+75	118	20	0.295	35,000	8.10	0.074	55.5	02/21/2075
1653+96	112	20	0.305	35,000	4.55	0.094	55.8	06/13/2075
939+66	67	20	0.315	35,000	5.50	0.146	57.2	10/13/2076
1771+12	121	20	0.305	35,000	2.31	0.109	59.7	05/10/2079
1684+38	116	20	0.305	35,000	2.78	0.103	64.8	05/17/2084
1653+52	112	20	0.305	35,000	3.37	0.094	70.3	12/17/2089
1684+70	116	20	0.305	35,000	3.02	0.094	73.0	08/06/2092
1745+85	121	20	0.305	35,000	3.14	0.088	73.2	10/15/2092
1709+88	117	20	0.295	35,000	3.02	0.083	75.0	08/22/2094
1471+69	105	20	0.315	35,000	2.90	0.121	77.3	11/23/2096
1712+44	117	20	0.305	35,000	2.90	0.088	82.1	09/23/2101
1736+11	120	20	0.305	35,000	4.08	0.076	84.9	06/28/2104
1723+67	119	20	0.295	35,000	1.84	0.095	86.3	11/29/2105
982+92	70	20	0.305	35,000	3.61	0.140	87.2	11/03/2106
1657+46	113	20	0.305	35,000	3.02	0.088	87.5	02/28/2107
1477+77	106	20	0.315	35,000	2.31	0.127	88.6	03/30/2108
1632+04	112	20	0.305	35,000	2.19	0.103	88.8	06/07/2108
1618+48	113	20	0.305	35,000	1.84	0.115	88.8	06/12/2108
1447+79	105	20	0.315	35,000	6.44	0.090	89.2	10/19/2108
1483+79	106	20	0.315	35,000	4.32	0.096	90.7	05/03/2110
1239+99	87	20	0.305	35,000	3.14	0.121	91.1	09/24/2110
1695+61	115	20	0.305	35,000	1.72	0.109	91.4	01/22/2111
1658+61	114	20	0.315	35,000	2.19	0.108	92.8	05/19/2112
1654+28	113	20	0.305	35,000	1.95	0.103	95.3	11/24/2114
1089+63	79	20	0.305	35,000	6.80	0.103	96.5	02/16/2116
1347+08	87	20	0.305	35,000	4.43	0.094	100.7	04/18/2120
1696+43	116	20	0.315	35,000	2.07	0.102	101.3	12/07/2120
1483+02	106	20	0.315	35,000	2.78	0.108	101.3	12/18/2120
1692+74	117	20	0.295	35,000	5.14	0.063	101.8	05/21/2121
1717+61	118	20	0.305	35,000	1.60	0.103	103.7	05/13/2123
1544+58	109	20	0.305	35,000	2.66	0.094	103.8	06/11/2123
1301+14	88	20	0.305	35,000	3.02	0.109	107.9	07/24/2127
1641+92	112	20	0.295	35,000	3.84	0.068	108.1	09/21/2127
1759+74	124	20	0.305	35,000	3.25	0.070	108.3	12/01/2127
1731+29	118	20	0.305	35,000	1.95	0.088	108.7	05/04/2128
1401+21	99	20	0.315	35,000	2.19	0.127	108.8	05/31/2128
1674+30	115	20	0.305	35,000	2.19	0.088	109.2	11/11/2128
1713+88	117	20	0.305	35,000	1.95	0.088	111.9	07/26/2131

Table D-11 (continued). Pressure-Cycle-Induced Fatigue Cracking Analysis of ILI Indicated Anomalies Satsuma to East Houston – ILI Date August 16, 2019 (pg. 2 of 8)

Station Number	Elevation (feet)	OD (inch)	WT (inch)	YS (psi)	ILI Length (inch)	ILI Depth (inch)	Re-assessment Interval (years)	Re-assessment Due Date
1203+57	87	20	0.295	35,000	1.95	0.133	113.5	02/22/2133
1256+98	89	20	0.305	35,000	1.60	0.155	117.7	04/13/2137
1729+13	118	20	0.295	35,000	1.60	0.083	119.2	10/10/2138
1551+52	108	20	0.305	35,000	1.84	0.103	121.4	01/17/2141
1657+39	113	20	0.305	35,000	2.78	0.076	122.1	09/24/2141
1775+82	123	20	0.305	35,000	1.36	0.094	125.6	03/18/2145
887+08	60	20	0.295	35,000	9.04	0.095	127.5	02/28/2147
742+35	57	20	0.305	35,000	7.39	0.115	128.0	08/16/2147
939+67	67	20	0.315	35,000	3.49	0.140	128.4	01/07/2148
1678+02	116	20	0.315	35,000	1.84	0.096	128.8	06/16/2148
1097+90	79	20	0.295	35,000	4.67	0.095	128.9	07/04/2148
1687+28	117	20	0.305	35,000	1.72	0.088	130.5	01/28/2150
1627+77	112	20	0.305	35,000	1.36	0.109	130.9	06/27/2150
1744+30	121	20	0.295	35,000	2.43	0.063	132.3	11/27/2151
1476+08	104	20	0.305	35,000	2.66	0.088	133.8	06/02/2153
1737+32	119	20	0.295	35,000	1.95	0.068	135.8	06/11/2155
1512+75	106	20	0.315	35,000	2.43	0.096	136.2	10/21/2155
1487+09	106	20	0.315	35,000	2.90	0.090	139.7	04/26/2159
1610+10	112	20	0.305	35,000	2.54	0.076	140.5	02/27/2160
1632+18	112	20	0.305	35,000	1.36	0.103	141.0	09/02/2160
1609+58	111	20	0.305	35,000	1.84	0.088	141.2	11/12/2160
1510+93	107	20	0.315	35,000	2.31	0.096	142.5	02/09/2162
1478+76	106	20	0.315	35,000	1.95	0.108	143.2	10/29/2162
1516+22	107	20	0.305	35,000	2.19	0.088	144.9	06/28/2164
1666+98	115	20	0.325	35,000	1.36	0.121	145.8	05/27/2165
1461+18	105	20	0.305	35,000	3.73	0.076	145.8	05/27/2165
985+35	71	20	0.305	35,000	4.43	0.109	145.9	07/19/2165
853+16	59	20	0.305	35,000	7.86	0.103	147.0	08/14/2166
1320+67	88	20	0.295	35,000	2.31	0.095	147.2	11/12/2166
1471+75	105	20	0.315	35,000	1.72	0.115	148.4	01/13/2168
1075+65	77	20	0.305	35,000	2.78	0.121	148.9	07/05/2168
1697+43	117	20	0.315	35,000	1.36	0.102	150.3	12/19/2169
1481+59	106	20	0.315	35,000	2.31	0.096	150.4	01/20/2170
1632+09	112	20	0.305	35,000	1.60	0.088	152.4	01/14/2172
1632+14	112	20	0.305	35,000	1.60	0.088	152.4	01/25/2172
1713+49	117	20	0.295	35,000	1.48	0.074	152.8	05/19/2172
1717+46	118	20	0.305	35,000	1.48	0.082	155.0	08/11/2174
1776+39	123	20	0.305	35,000	1.72	0.070	155.7	05/07/2175
1551+32	108	20	0.305	35,000	1.84	0.088	156.8	06/19/2176
1632+08	112	20	0.305	35,000	1.72	0.082	159.3	12/03/2178
1447+77	105	20	0.315	35,000	8.57	0.068	160.3	12/09/2179
808+97	63	20	0.315	35,000	2.54	0.168	161.7	05/02/2181
945+55	68	20	0.305	35,000	7.86	0.094	163.9	07/01/2183
1684+70	116	20	0.305	35,000	1.48	0.082	163.9	07/01/2183
1501+47	106	20	0.295	35,000	2.78	0.068	166.0	09/02/2185
1548+95	110	20	0.305	35,000	1.72	0.088	166.6	03/11/2186
1512+30	106	20	0.305	35,000	2.54	0.076	167.8	06/11/2187

Table D-11 (continued). Pressure-Cycle-Induced Fatigue Cracking Analysis of ILI Indicated Anomalies Satsuma to East Houston – ILI Date August 16, 2019 (pg. 3 of 8)

Station Number	Elevation (feet)	OD (inch)	WT (inch)	YS (psi)	ILI Length (inch)	ILI Depth (inch)	Re-assessment Interval (years)	Re-assessment Due Date
1509+45	107	20	0.305	35,000	4.91	0.063	169.7	05/12/2189
1464+95	105	20	0.305	35,000	2.31	0.082	172.5	02/20/2192
1541+21	108	20	0.305	35,000	1.48	0.094	174.6	03/31/2194
1755+70	123	20	0.295	35,000	1.48	0.063	175.3	11/17/2194
1248+51	87	20	0.305	35,000	2.07	0.109	175.5	02/14/2195
1260+44	87	20	0.295	35,000	11.99	0.063	176.1	10/09/2195
1632+12	112	20	0.305	35,000	1.72	0.076	177.6	04/06/2197
1741+81	119	20	0.315	35,000	1.25	0.090	179.3	11/17/2198
785+44	64	20	0.305	35,000	3.25	0.134	179.3	12/13/2198
881+98	60	20	0.305	35,000	2.54	0.140	179.8	05/23/2199
1713+79	117	20	0.305	35,000	1.60	0.070	181.6	04/08/2201
1610+76	112	20	0.305	35,000	1.25	0.094	181.8	05/24/2201
1680+35	116	20	0.315	35,000	2.19	0.068	189.8	06/11/2209
1289+55	87	20	0.305	35,000	2.31	0.094	191.6	03/08/2211
1187+21	86	20	0.305	35,000	6.56	0.076	191.6	04/08/2211
1510+84	107	20	0.315	35,000	3.73	0.068	193.1	09/16/2212
1478+69	106	20	0.315	35,000	1.72	0.096	195.3	12/20/2214
1628+50	112	20	0.315	35,000	1.25	0.096	200.6	03/29/2220
1705+62	116	20	0.305	35,000	1.25	0.076	201.2	10/23/2220
1006+86	70	20	0.295	35,000	5.50	0.083	204.1	09/10/2223
1729+13	118	20	0.295	35,000	1.13	0.068	204.7	04/21/2224
1097+89	79	20	0.295	35,000	3.84	0.083	207.8	06/10/2227
1374+72	94	20	0.305	35,000	1.72	0.094	209.1	09/29/2228
1512+49	106	20	0.305	35,000	1.60	0.082	209.2	11/02/2228
1717+71	118	20	0.305	35,000	1.13	0.076	214.3	12/03/2233
1556+18	107	20	0.315	35,000	3.73	0.061	214.4	01/27/2234
1666+35	114	20	0.305	35,000	1.25	0.076	215.1	09/25/2234
1400+92	99	20	0.315	35,000	1.36	0.115	217.3	11/27/2236
1403+90	100	20	0.305	35,000	1.72	0.088	218.6	03/10/2238
1265+49	88	20	0.295	35,000	1.25	0.116	220.4	12/24/2239
1740+10	120	20	0.305	35,000	1.36	0.063	221.1	10/06/2240
961+67	68	20	0.295	35,000	3.49	0.095	221.4	01/11/2241
1523+47	107	20	0.305	35,000	1.95	0.070	222.1	09/18/2241
1499+60	106	20	0.295	35,000	1.25	0.083	222.2	10/19/2241
1501+72	107	20	0.295	35,000	2.07	0.063	222.2	10/28/2241
1193+78	87	20	0.305	35,000	1.84	0.109	222.4	01/12/2242
886+57	60	20	0.305	35,000	1.72	0.076	225.2	11/07/2244
856+86	59	20	0.305	35,000	2.31	0.088	225.2	11/07/2244
849+57	62	20	0.305	35,000	1.13	0.070	225.2	11/07/2244
832+86	57	20	0.315	35,000	4.43	0.090	225.2	11/07/2244
811+65	61	20	0.315	35,000	2.43	0.083	225.2	11/07/2244
808+84	63	20	0.315	35,000	2.66	0.096	225.2	11/07/2244
798+47	62	20	0.305	35,000	2.54	0.109	225.2	11/07/2244
1187+19	86	20	0.305	35,000	3.49	0.063	225.2	11/07/2244
563+10	43	20	0.305	35,000	1.60	0.103	225.2	11/07/2244
1400+93	99	20	0.315	35,000	2.19	0.083	225.2	11/07/2244
508+18	41	20	0.295	35,000	2.54	0.101	225.2	11/07/2244

Table D-11 (continued). Pressure-Cycle-Induced Fatigue Cracking Analysis of ILI Indicated Anomalies Satsuma to East Houston – ILI Date August 16, 2019 (pg. 4 of 8)

Station Number	Elevation (feet)	OD (inch)	WT (inch)	YS (psi)	ILI Length (inch)	ILI Depth (inch)	Re-assessment Interval (years)	Re-assessment Due Date
973+78	69	20	0.315	35,000	1.36	0.102	225.2	11/07/2244
939+85	67	20	0.315	35,000	1.48	0.083	225.2	11/07/2244
939+85	67	20	0.315	35,000	4.20	0.083	225.2	11/07/2244
1261+03	88	20	0.305	35,000	1.13	0.070	225.2	11/07/2244
1259+57	88	20	0.305	35,000	1.60	0.070	225.2	11/07/2244
1237+09	86	20	0.305	35,000	1.25	0.088	225.2	11/07/2244
719+27	56	20	0.305	35,000	5.03	0.070	225.2	11/07/2244
1226+82	87	20	0.305	35,000	1.72	0.103	225.2	11/07/2244
1223+33	87	20	0.305	35,000	1.25	0.103	225.2	11/07/2244
673+91	52	20	0.315	35,000	1.36	0.068	225.2	11/07/2244
796+00	64	20	0.305	35,000	2.66	0.088	225.2	11/07/2244
1121+31	82	20	0.305	35,000	1.84	0.063	225.2	11/07/2244
1121+28	82	20	0.305	35,000	1.25	0.076	225.2	11/07/2244
788+96	65	20	0.305	35,000	3.84	0.094	225.2	11/07/2244
1096+91	79	20	0.295	35,000	2.07	0.083	225.2	11/07/2244
636+21	49	20	0.315	35,000	2.31	0.115	225.2	11/07/2244
977+10	70	20	0.315	35,000	1.95	0.061	225.2	11/07/2244
957+06	68	20	0.305	35,000	1.72	0.063	225.2	11/07/2244
957+07	68	20	0.305	35,000	2.43	0.076	225.2	11/07/2244
563+85	43	20	0.305	35,000	1.13	0.094	225.2	11/07/2244
940+60	67	20	0.305	35,000	1.60	0.094	225.2	11/07/2244
1239+30	87	20	0.295	35,000	1.60	0.089	225.2	11/07/2244
1227+08	86	20	0.315	35,000	1.60	0.061	225.2	11/07/2244
903+71	61	20	0.305	35,000	1.36	0.082	225.2	11/07/2244
731+09	57	20	0.315	35,000	1.25	0.090	225.2	11/07/2244
849+49	62	20	0.305	35,000	1.36	0.076	225.2	11/07/2244
845+45	58	20	0.315	35,000	1.25	0.102	225.2	11/07/2244
836+54	58	20	0.315	35,000	2.54	0.083	225.2	11/07/2244
832+63	57	20	0.315	35,000	1.84	0.074	225.2	11/07/2244
1089+28	79	20	0.295	35,000	1.36	0.063	225.2	11/07/2244
796+69	64	20	0.305	35,000	1.72	0.088	225.2	11/07/2244
682+38	53	20	0.305	35,000	4.67	0.103	225.2	11/07/2244
680+73	52	20	0.295	35,000	4.08	0.083	225.2	11/07/2244
786+87	64	20	0.305	35,000	1.84	0.076	225.2	11/07/2244
1598+97	111	20	0.315	35,000	1.48	0.074	225.2	11/07/2244
643+60	50	20	0.315	35,000	1.13	0.068	225.2	11/07/2244
1258+58	89	20	0.315	35,000	2.54	0.074	225.2	11/07/2244
1157+16	85	20	0.305	35,000	1.95	0.070	225.2	11/07/2244
561+20	43	20	0.315	35,000	3.14	0.083	225.2	11/07/2244
762+34	63	20	0.315	35,000	2.07	0.121	225.2	11/07/2244
849+48	62	20	0.305	35,000	1.36	0.070	225.2	11/07/2244
1062+00	75	20	0.305	35,000	1.60	0.128	225.2	11/07/2244
1029+37	71	20	0.305	35,000	1.13	0.094	225.2	11/07/2244
1545+07	109	20	0.295	35,000	1.60	0.063	225.2	11/07/2244
680+89	52	20	0.295	35,000	3.61	0.063	225.2	11/07/2244
995+31	70	20	0.305	35,000	1.36	0.076	225.2	11/07/2244
1487+92	106	20	0.305	35,000	1.25	0.076	225.2	11/07/2244

Table D-11 (continued). Pressure-Cycle-Induced Fatigue Cracking Analysis of ILI Indicated Anomalies Satsuma to East Houston – ILI Date August 16, 2019 (pg. 5 of 8)

Station Number	Elevation (feet)	OD (inch)	WT (inch)	YS (psi)	ILI Length (inch)	ILI Depth (inch)	Re-assessment Interval (years)	Re-assessment Due Date
1396+18	99	20	0.315	35,000	1.72	0.061	225.2	11/07/2244
1041+74	70	20	0.305	35,000	3.02	0.063	225.2	11/07/2244
732+71	57	20	0.305	35,000	1.48	0.094	225.2	11/07/2244
1008+81	70	20	0.315	35,000	3.02	0.074	225.2	11/07/2244
544+13	40	20	0.315	35,000	3.73	0.108	225.2	11/07/2244
1471+72	105	20	0.315	35,000	1.25	0.083	225.2	11/07/2244
1207+91	87	20	0.305	35,000	1.48	0.094	225.2	11/07/2244
1422+10	98	20	0.315	35,000	1.36	0.074	225.2	11/07/2244
971+31	69	20	0.295	35,000	1.36	0.068	225.2	11/07/2244
965+41	69	20	0.295	35,000	1.48	0.127	225.2	11/07/2244
514+07	41	20	0.315	35,000	2.43	0.061	225.2	11/07/2244
952+21	68	20	0.295	35,000	2.54	0.068	225.2	11/07/2244
674+77	53	20	0.305	35,000	2.31	0.070	225.2	11/07/2244
896+23	61	20	0.305	35,000	1.72	0.088	225.2	11/07/2244
1548+94	110	20	0.305	35,000	1.13	0.063	225.2	11/07/2244
1052+80	73	20	0.315	35,000	1.60	0.074	225.2	11/07/2244
1501+73	107	20	0.295	35,000	1.36	0.068	225.2	11/07/2244
1499+41	106	20	0.295	35,000	1.48	0.068	225.2	11/07/2244
1253+10	87	20	0.315	35,000	3.12	0.068	225.2	11/07/2244
746+69	59	20	0.305	35,000	1.36	0.070	225.2	11/07/2244
1013+46	71	20	0.295	35,000	1.25	0.083	225.2	11/07/2244
1442+68	103	20	0.315	35,000	1.36	0.083	225.2	11/07/2244
736+10	53	20	0.305	35,000	2.31	0.103	225.2	11/07/2244
1207+92	87	20	0.305	35,000	1.13	0.082	225.2	11/07/2244
811+17	61	20	0.315	35,000	1.60	0.083	225.2	11/07/2244
991+37	71	20	0.305	35,000	1.36	0.070	225.2	11/07/2244
573+12	43	20	0.315	35,000	1.36	0.074	225.2	11/07/2244
1193+79	87	20	0.305	35,000	1.36	0.076	225.2	11/07/2244
970+12	69	20	0.305	35,000	1.36	0.063	225.2	11/07/2244
1168+59	85	20	0.295	35,000	1.60	0.068	225.2	11/07/2244
548+22	42	20	0.315	35,000	3.25	0.127	225.2	11/07/2244
705+71	54	20	0.295	35,000	1.48	0.068	225.2	11/07/2244
1551+35	108	20	0.305	35,000	1.36	0.063	225.2	11/07/2244
1520+37	107	20	0.305	35,000	1.25	0.076	225.2	11/07/2244
641+90	50	20	0.315	35,000	2.19	0.061	225.2	11/07/2244
1407+41	99	20	0.315	35,000	1.25	0.068	225.2	11/07/2244
1581+56	109	20	0.305	35,000	1.25	0.063	225.2	11/07/2244
1153+65	85	20	0.295	35,000	1.72	0.089	225.2	11/07/2244
1151+04	85	20	0.295	35,000	1.25	0.063	225.2	11/07/2244
965+29	69	20	0.295	35,000	1.60	0.074	225.2	11/07/2244
1130+14	82	20	0.305	35,000	3.37	0.063	225.2	11/07/2244
1525+59	106	20	0.315	35,000	2.43	0.068	225.2	11/07/2244
926+27	62	20	0.305	35,000	1.36	0.088	225.2	11/07/2244
1482+04	106	20	0.305	35,000	1.48	0.063	225.2	11/07/2244
1477+96	106	20	0.315	35,000	1.84	0.068	225.2	11/07/2244
1654+27	113	20	0.305	35,000	1.36	0.063	225.2	11/07/2244
1054+82	73	20	0.295	35,000	1.84	0.068	225.2	11/07/2244

Table D-11 (continued). Pressure-Cycle-Induced Fatigue Cracking Analysis of ILI Indicated Anomalies Satsuma to East Houston – ILI Date August 16, 2019 (pg. 6 of 8)

Station Number	Elevation (feet)	OD (inch)	WT (inch)	YS (psi)	ILI Length (inch)	ILI Depth (inch)	Re-assessment Interval (years)	Re-assessment Due Date
1052+39	72	20	0.315	35,000	3.02	0.096	225.2	11/07/2244
1027+67	70	20	0.295	35,000	2.66	0.089	225.2	11/07/2244
1017+86	70	20	0.305	35,000	1.25	0.076	225.2	11/07/2244
870+10	61	20	0.295	35,000	3.25	0.074	225.2	11/07/2244
782+10	65	20	0.315	35,000	1.48	0.090	225.2	11/07/2244
1012+82	71	20	0.305	35,000	2.07	0.094	225.2	11/07/2244
1011+66	71	20	0.315	35,000	1.95	0.096	225.2	11/07/2244
856+11	59	20	0.305	35,000	3.25	0.076	225.2	11/07/2244
648+16	51	20	0.315	35,000	1.48	0.074	225.2	11/07/2244
991+55	70	20	0.305	35,000	1.13	0.070	225.2	11/07/2244
625+80	48	20	0.305	35,000	3.02	0.094	225.2	11/07/2244
625+81	48	20	0.305	35,000	3.25	0.082	225.2	11/07/2244
1477+86	106	20	0.315	35,000	2.43	0.068	225.2	11/07/2244
1649+14	112	20	0.305	35,000	1.13	0.063	225.2	11/07/2244
1462+20	105	20	0.305	35,000	1.72	0.076	225.2	11/07/2244
792+29	65	20	0.315	35,000	1.72	0.102	225.2	11/07/2244
925+91	61	20	0.305	35,000	3.61	0.076	225.2	11/07/2244
1549+78	109	20	0.305	35,000	1.48	0.063	225.2	11/07/2244
881+98	60	20	0.305	35,000	1.25	0.088	225.2	11/07/2244
865+86	60	20	0.295	35,000	2.78	0.074	225.2	11/07/2244
1156+67	85	20	0.305	35,000	1.48	0.063	225.2	11/07/2244
853+17	59	20	0.305	35,000	2.54	0.103	225.2	11/07/2244
1142+04	84	20	0.315	35,000	1.48	0.090	225.2	11/07/2244
760+49	62	20	0.315	35,000	7.27	0.096	225.2	11/07/2244
1126+83	83	20	0.315	35,000	3.02	0.090	225.2	11/07/2244
517+95	40	20	0.315	35,000	2.90	0.090	225.2	11/07/2244
1098+95	79	20	0.295	35,000	1.95	0.068	225.2	11/07/2244
633+06	49	20	0.305	35,000	1.13	0.076	225.2	11/07/2244
735+28	53	20	0.305	35,000	1.36	0.082	225.2	11/07/2244
1241+15	87	20	0.305	35,000	1.36	0.076	225.2	11/07/2244
1241+10	87	20	0.305	35,000	1.48	0.082	225.2	11/07/2244
1227+91	86	20	0.315	35,000	1.13	0.083	225.2	11/07/2244
1188+37	87	20	0.295	35,000	1.13	0.063	225.2	11/07/2244
853+44	59	20	0.305	35,000	2.43	0.063	225.2	11/07/2244
965+55	68	20	0.305	35,000	3.84	0.094	225.2	11/07/2244
1256+81	88	20	0.305	35,000	1.84	0.063	225.2	11/07/2244
1097+94	79	20	0.295	35,000	1.72	0.101	225.2	11/07/2244
537+82	40	20	0.305	35,000	1.36	0.103	225.2	11/07/2244
937+83	67	20	0.315	35,000	1.25	0.068	225.2	11/07/2244
929+37	63	20	0.305	35,000	1.13	0.109	225.2	11/07/2244
1513+21	107	20	0.315	35,000	1.60	0.074	225.2	11/07/2244
500+71	40	20	0.315	35,000	1.60	0.108	225.2	11/07/2244
1145+34	83	20	0.315	35,000	1.25	0.074	225.2	11/07/2244
1145+24	83	20	0.315	35,000	3.02	0.090	225.2	11/07/2244
1292+79	87	20	0.305	35,000	2.78	0.070	225.2	11/07/2244
879+97	60	20	0.295	35,000	1.13	0.074	225.2	11/07/2244
879+98	60	20	0.295	35,000	3.25	0.063	225.2	11/07/2244

Table D-11 (continued). Pressure-Cycle-Induced Fatigue Cracking Analysis of ILI Indicated Anomalies Satsuma to East Houston – ILI Date August 16, 2019 (pg. 7 of 8)

Station Number	Elevation (feet)	OD (inch)	WT (inch)	YS (psi)	ILI Length (inch)	ILI Depth (inch)	Re-assessment Interval (years)	Re-assessment Due Date
493+73	40	20	0.315	35,000	1.95	0.061	225.2	11/07/2244
1251+17	88	20	0.305	35,000	1.48	0.063	225.2	11/07/2244
1051+84	73	20	0.295	35,000	2.90	0.068	225.2	11/07/2244
928+50	63	20	0.305	35,000	1.72	0.063	225.2	11/07/2244
807+14	62	20	0.305	35,000	1.84	0.088	225.2	11/07/2244
547+96	42	20	0.305	35,000	2.07	0.088	225.2	11/07/2244
642+16	51	20	0.315	35,000	1.60	0.068	225.2	11/07/2244
1013+90	70	20	0.305	35,000	1.36	0.109	225.2	11/07/2244
517+73	40	20	0.315	35,000	1.36	0.102	225.2	11/07/2244
517+62	40	20	0.315	35,000	1.60	0.074	225.2	11/07/2244
1251+54	87	20	0.315	35,000	1.25	0.083	225.2	11/07/2244
1249+21	87	20	0.305	35,000	1.25	0.063	225.2	11/07/2244
987+52	70	20	0.315	35,000	1.25	0.102	225.2	11/07/2244
977+81	70	20	0.305	35,000	1.60	0.076	225.2	11/07/2244
1226+64	87	20	0.305	35,000	1.13	0.063	225.2	11/07/2244
501+75	40	20	0.315	35,000	1.36	0.074	225.2	11/07/2244
965+75	68	20	0.305	35,000	3.84	0.088	225.2	11/07/2244
1077+56	77	20	0.305	35,000	1.36	0.063	225.2	11/07/2244
760+10	62	20	0.305	35,000	3.25	0.088	225.2	11/07/2244
665+51	52	20	0.295	35,000	1.72	0.095	225.2	11/07/2244
1146+26	83	20	0.315	35,000	1.48	0.090	225.2	11/07/2244
735+78	56	20	0.315	35,000	1.48	0.074	225.2	11/07/2244
545+20	42	20	0.315	35,000	3.14	0.061	225.2	11/07/2244
543+44	41	20	0.315	35,000	1.36	0.074	225.2	11/07/2244
636+78	50	20	0.315	35,000	1.13	0.061	225.2	11/07/2244
947+16	67	20	0.305	35,000	1.60	0.063	225.2	11/07/2244
947+16	67	20	0.305	35,000	2.78	0.063	225.2	11/07/2244
940+03	67	20	0.315	35,000	1.13	0.061	225.2	11/07/2244
843+94	59	20	0.305	35,000	1.36	0.070	225.2	11/07/2244
697+57	52	20	0.305	35,000	2.31	0.082	225.2	11/07/2244
817+69	60	20	0.305	35,000	1.72	0.063	225.2	11/07/2244
904+20	60	20	0.295	35,000	3.37	0.089	225.2	11/07/2244
784+32	64	20	0.315	35,000	2.90	0.083	225.2	11/07/2244
568+21	43	20	0.315	35,000	1.36	0.068	225.2	11/07/2244
568+22	43	20	0.315	35,000	2.78	0.083	225.2	11/07/2244
733+74	57	20	0.295	35,000	1.36	0.074	225.2	11/07/2244
875+34	61	20	0.315	35,000	1.36	0.074	225.2	11/07/2244
646+07	50	20	0.315	35,000	2.19	0.090	225.2	11/07/2244
849+64	62	20	0.305	35,000	2.66	0.103	225.2	11/07/2244
939+95	67	20	0.315	35,000	1.25	0.068	225.2	11/07/2244
732+33	57	20	0.305	35,000	1.60	0.063	225.2	11/07/2244
732+34	57	20	0.305	35,000	2.07	0.070	225.2	11/07/2244
771+89	65	20	0.305	35,000	4.79	0.076	225.2	11/07/2244
731+22	57	20	0.305	35,000	1.25	0.070	225.2	11/07/2244
480+77	39	20	0.305	35,000	1.48	0.063	225.2	11/07/2244
509+33	42	20	0.295	35,000	1.95	0.101	225.2	11/07/2244
665+38	52	20	0.295	35,000	1.13	0.074	225.2	11/07/2244

Table D-11 (continued). Pressure-Cycle-Induced Fatigue Cracking Analysis of ILI Indicated Anomalies Satsuma to East Houston – ILI Date August 16, 2019 (pg. 8 of 8)

Station Number	Elevation (feet)	OD (inch)	WT (inch)	YS (psi)	ILI Length (inch)	ILI Depth (inch)	Re-assessment Interval (years)	Re-assessment Due Date
494+73	41	20	0.305	35,000	1.60	0.063	225.2	11/07/2244
564+86	43	20	0.305	35,000	1.72	0.070	225.2	11/07/2244
704+94	54	20	0.315	35,000	1.60	0.102	225.2	11/07/2244
505+07	41	20	0.305	35,000	5.50	0.088	225.2	11/07/2244
554+95	43	20	0.305	35,000	1.72	0.082	225.2	11/07/2244
525+43	20	20	0.305	35,000	1.95	0.088	225.2	11/07/2244

APPENDIX E – APPROACH TO API 1163 VERIFICATION

Approach to API 1163 Verification

API 1163 2nd Edition, April 2013, describes methods in Section 7 and Section 8 that can be applied to verify that the ILI tool was working as expected and reported inspection results are within the performance specification for the pipeline being inspected. Within the Standard, a distinction is made between results with and without field verification measurements. API 1163 Section 7 provides information for what the ILI Vendor is to provide regarding pre-, mid-, and post-inspection checks for proper tool runs. API 1163 Section 8 Figure 6 (Figure E-1 in this document) describes a process for validating ILI measurements using three levels of validation, shown in Figure E-2.

The three levels of validation all consist of the following steps:

- A process verification or quality control (§8.2.2 and Annex C.1)
- A comparison with historical data for the pipeline being inspected (§8.2.3)
- A comparison analysis of pipeline component records (§8.2.4)

The validation levels differ based on the risk of the pipeline segment and the amount of validation data.

Validation Level 1 (Annex C):

- A comparison with large-scale historic data for pipeline segments similar to the pipeline being inspected (§8.2.3)

Validation Level 1 only applies to pipelines with anomaly populations that present low levels of risk of consequence or probability of failure. Typically, there is only a limited number or no validation measurements taken on the inspected pipeline. A Level 1 validation assumes the ILI specified tool performance is neither proven nor disputed for the ILI run. This assumption means the validity of the ILI run cannot be rejected solely based on a Level 1 validation. A Level 2 or Level 3 validation is required before an ILI run can be rejected.

Validation Level 2 (Annex C):

- A comparison with field excavation results warranted by the reporting of significant indications (§8.2.6)

Validation Level 2 applies to pipelines with a lower risk of consequence or probability of failure that has indications of significance reported by ILI. Typically, enough validation measurements are taken on the pipeline being inspected to confidently state whether the ILI tool performs worse than the ILI specification and possibly reject the ILI run. However, a Level 2 validation does not let one confidently state that the ILI tool is performing within ILI specification. The number of validation measurements will typically be greater than or equal to five but not be statistically significant with which to perform a Level 3 validation. If the ILI tool specification can be rejected, there is the option to progress to a Level 3 validation, requiring additional validation measurements.

Validation Level 3 (Annex C):

- A comparison with field excavation results warranted by the reporting of significant indications (§8.2.6)

Validation Level 3 applies to pipelines with a higher risk of consequence or probability of failure that has indications of significance reported by ILI. Typically, there are a statistically significant number of validation measurements taken on the pipeline being inspected to confidently state an as-run tool performance.

Depending upon the analysis of the data using the API 1163 decision chart process, the tool performance can be rejected, accepted, or non-conclusive. If tool performance is determined to be non-conclusive, it does not mean the inspection failed. Instead, an additional course of action may be required. Some actions to consider are: performing additional validation digs to gather more information to possibly improve the current tool performance, accepting the determined tool performance as-is, adjusting the depth accuracy applied to the reported ILI features; or having the ILI Vendor regrade the data. Figure E-1 shows API 1163 Section 8 Figure 6, which summarizes the process for evaluation of system results. For clarity of wording in the flow chart, "historical data" is taken to mean the data limited to the particular line, whereas "large-scale historical data" is taken to mean the data on this line, as well as any similar diameter lines with the same ILI tool type used for inspection.

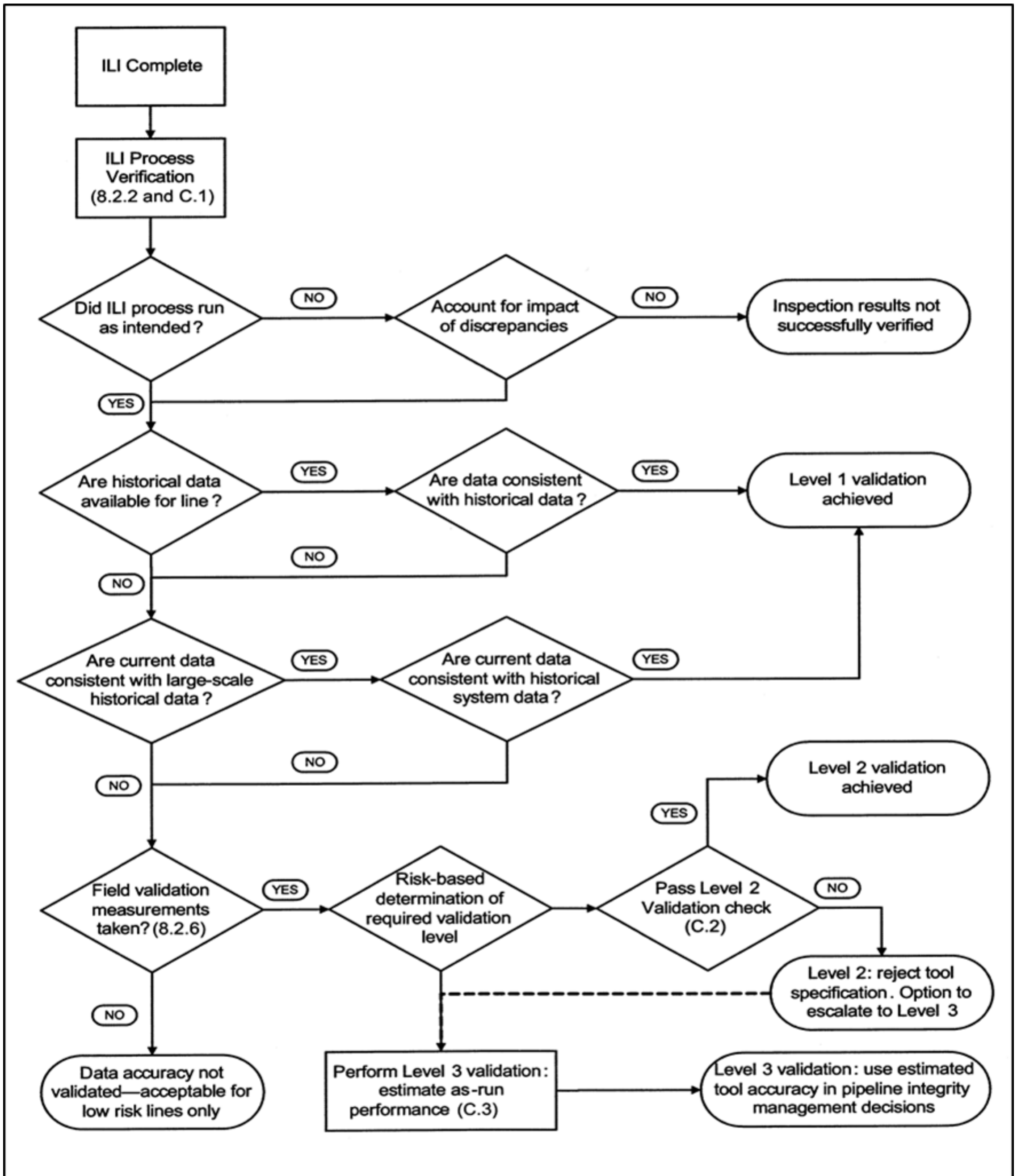

Figure 6—Inspection Results Verification and Validation Process

Figure E-1. Evaluation of System Results from API 1163 Section 8 Figure 6

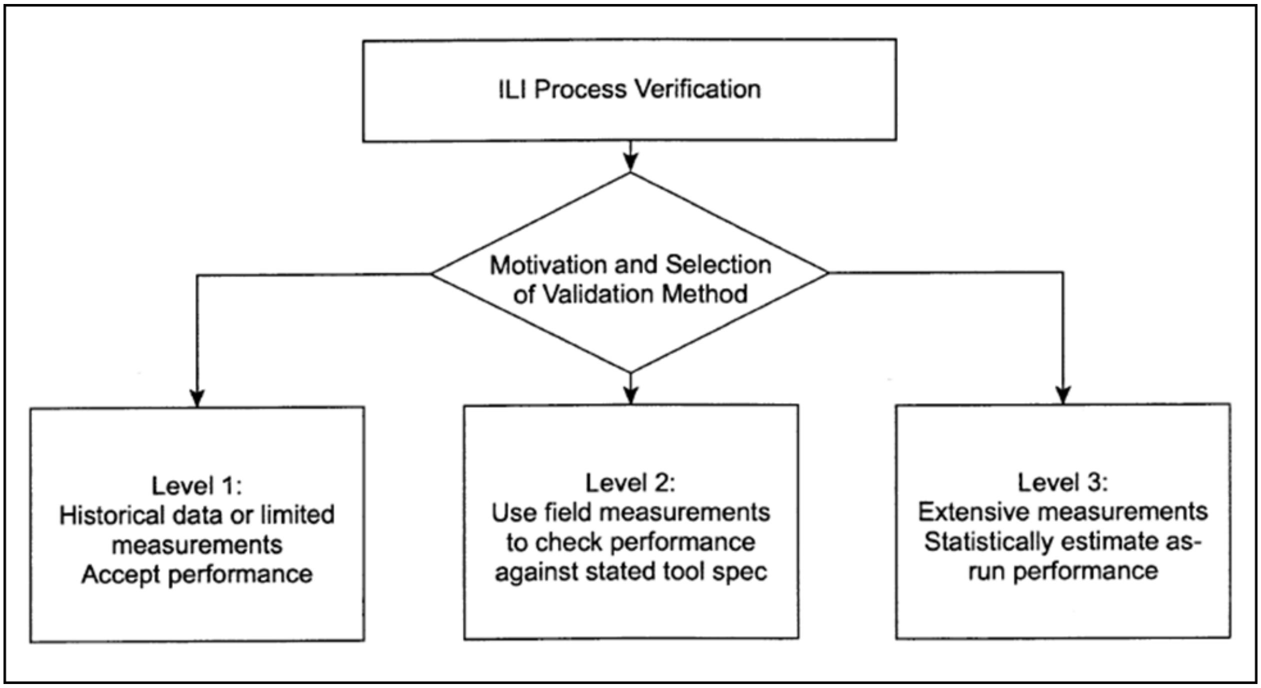

Figure E-2. Overview of Three Levels of Validation

APPENDIX F – STATISTICS BACKGROUND

Introduction to Normal Distribution and Outlier

Before an in-depth probabilistic analysis is performed, some common statistical values should be calculated to determine if any data should be excluded from the analysis. These values would include the average, standard deviation, normal distribution, outliers, and extreme values.

Normal Distribution

A normal distribution is a probability distribution commonly referred to as a bell curve which is symmetrical around the mean value. Errors in measurements tend to closely resemble a normal distribution which is why ILI vendors will use normal distributions to explain the ILI tool's sizing accuracy. Some common parameters associated with a normal distribution are the average (or mean), standard deviation, and cumulative probability. The standard deviation is a quantification of how dispersed a set of data is. The cumulative probability is the probability a value is less than or equal to a specified value of the normal distribution. These values can be determined using Equation 1 through Equation 5 and can be calculated in Excel using the Excel functions in Equation 6 through Equation 9.

$X_i =$ the individual value of each measurement in the data set

$n =$ the total number of values in the data set

$\mu =$ the mean value of the data set

$\sigma =$ the standard deviation of the data set

$CDF_i =$ the cumulative probability from the cumulative distribution function of a normal distribution

$erf =$ the error function associated with the cumulative distribution function

$p =$ a specified cumulative probability

$QF_i =$ the data value for a specified cumulative probability

$$\mu = \frac{1}{n}\sum_{i=1}^{n} X_i \qquad \textbf{Equation 1}$$

$$\sigma = \sqrt{\frac{\sum_{i+1}^{n}\left(X_i - \mu\right)^2}{n-1}} \qquad \textbf{Equation 2}$$

$$CDF_i = \frac{1}{2}\left[1 + erf\left(\frac{X_i - \mu}{\sigma\sqrt{2}}\right)\right] \qquad \textbf{Equation 3}$$

$$erf(x) = \frac{2}{\sqrt{\pi}} \int_0^x e^{-t^2} dt$$ **Equation 4**

$$QF_i = \mu + \sigma\sqrt{2} erf^{-1}(2F - 1)$$ **Equation 5**

$\mu =$ AVERAGE(Range of Values) **Equation 6**

$\sigma =$ *STDEV(Range of Values)* **Equation 7**

$$CDF_i = NORM.DIST(X_{i,} \mu, \sigma, TRUE)$$ **Equation 8**

$$QF = NORM.INV(p, \mu, \sigma)$$ **Equation 9**

Outliers and Extreme Values

An outlier and extreme value is any value that is observed to lie at an abnormal distance from the other values in a data set. These abnormal distances can be quantified using Tukey's schematic box plot method. This method uses the 25th and 75th percentiles of the normal distribution to define an interquartile range (IQR) encompassing 50% of the population. From the IQR, inner and outer fences can be established outside of the 25th and 75th percentiles. An outlier is considered to be any value that is beyond the inner fence. An extreme value is considered to be any value that is beyond the outer fence. These values can be determined using Equation 10 through Equation 14 and can be calculated in Excel using the Excel functions in Equation 15 and Equation 16.

$\mu =$ the mean value of the data set

$\sigma =$ the standard deviation of the data set

$Q_1 =$ the 25th percentile of the normal distribution (value at the cumulative probability of 0.25)

$Q_3 =$ the 75th percentile of the normal distribution (value at the cumulative probability of 0.75)

$IQR =$ the interquartile range of the normal distribution

$LOF =$ the outside fence of the lower 25th percentile

$LIF =$ the inside fence of the lower 25th percentile

$UIF =$ the inside fence of the upper 75th percentile

$UOF =$ the outside fence of the upper 75th percentile

$$IQR = Q_3 - Q_1$$ **Equation 10**

$$LOF = Q_1 - 3 * IQR$$ **Equation 11**

$$LIF = Q_1 - 1.5 * IQR$$ **Equation 12**

$$UIF = Q_3 - 1.5 * IQR$$ **Equation 13**

$$UOF = Q_3 - 3 * IQR$$ **Equation 14**

$$Q_1 = NORM.INV\left(0.25, \mu, \sigma\right)$$ **Equation 15**

$$Q_3 = NORM.INV\left(0.75, \mu, \sigma\right)$$ **Equation 16**

APPENDIX G – POE RESULTS

POE calculations were performed on the nine pipeline segments assessed by MFL in 2020, see Table G-1.

Table G-1. Metal Loss with POE Value Exceeding 10E^{-5} (pg 1 of 2)

Pipeline Segment	Absolute Distance (feet)	Predicted Depth (% WT)	Predicted Length (inch)	POE	POE Type
Buckhorn to Satsuma	104673.4	62	0.39	1.22E-01	Depth
Buckhorn to Satsuma	45454.1	44	0.24	2.61E-04	Depth
Bastrop to Warda	128640.4	32	47.24	1.41E-01	Pressure
Bastrop to Warda	144118.0	38	10.12	7.85E-02	Pressure
Bastrop to Warda	151430.4	39	7.01	2.11E-02	Pressure
Bastrop to Warda	146038.0	34	10.08	1.43E-02	Pressure
Bastrop to Warda	899.5	33	10.98	1.25E-02	Pressure
Bastrop to Warda	70270.7	35	8.50	1.05E-02	Pressure
Bastrop to Warda	145533.8	31	9.72	2.86E-03	Pressure
Bastrop to Warda	128638.3	26	22.44	2.33E-03	Pressure
Bastrop to Warda	146188.8	33	7.64	2.18E-03	Pressure
Bastrop to Warda	143888.9	31	26.58	1.06E-03	Pressure
Bastrop to Warda	143220.5	29	9.69	9.93E-04	Pressure
Bastrop to Warda	49949.1	38	7.60	7.17E-04	Pressure
Bastrop to Warda	16732.9	27	10.39	4.63E-04	Pressure
Bastrop to Warda	69924.6	35	5.43	4.51E-04	Pressure
Bastrop to Warda*	47250.8	28	8.82	3.67E-04	Pressure
Bastrop to Warda	47247.2	27	9.33	2.83E-04	Pressure
Bastrop to Warda	60537.3	43	0.39	1.61E-04	Depth
Bastrop to Warda	83923.2	32	10.35	1.40E-04	Pressure
Cedar Valley to Bastrop	132673.8	55	14.49	1.00E+00	Pressure
Cedar Valley to Bastrop	132317.0	45	9.49	3.79E-01	Pressure
Cedar Valley to Bastrop	166065.2	43	6.85	5.17E-02	Pressure
Cedar Valley to Bastrop	134448.3	35	13.70	3.14E-02	Pressure
Cedar Valley to Bastrop	135547.3	36	10.00	1.73E-02	Pressure
Cedar Valley to Bastrop	131629.7	48	4.33	9.34E-03	Pressure
Cedar Valley to Bastrop	134447.2	33	11.89	7.93E-03	Pressure
Cedar Valley to Bastrop	130794.0	48	4.06	4.30E-03	Pressure
Cedar Valley to Bastrop	133250.8	36	7.40	3.49E-03	Pressure
Cedar Valley to Bastrop	67101.9	35	7.95	3.31E-03	Pressure
Cedar Valley to Bastrop	132550.1	49	1.61	2.33E-03	Depth
Cedar Valley to Bastrop	162415.8	49	1.73	2.33E-03	Depth
Cedar Valley to Bastrop	152839.2	28	19.65	2.18E-03	Pressure
Cedar Valley to Bastrop	67095.7	28	17.95	1.73E-03	Pressure
Cedar Valley to Bastrop	123072.7	40	12.84	1.57E-03	Pressure
Cedar Valley to Bastrop	155747.6	48	1.81	1.55E-03	Depth
Cedar Valley to Bastrop	67084.1	30	11.34	1.38E-03	Pressure
Cedar Valley to Bastrop	133871.5	34	7.44	1.30E-03	Pressure
Cedar Valley to Bastrop	108774.4	48	1.38	1.07E-03	Depth
Cedar Valley to Bastrop	132829.5	34	7.01	8.57E-04	Pressure
Cedar Valley to Bastrop	140790.1	37	5.47	5.21E-04	Pressure
Cedar Valley to Bastrop	131630.3	45	1.06	4.17E-04	Depth
Cedar Valley to Bastrop	130793.5	42	4.13	2.96E-04	Pressure
Cedar Valley to Bastrop	79734.5	44	6.77	2.11E-04	Pressure
Cedar Valley to Bastrop	67089.9	34	5.67	1.52E-04	Pressure

*Feature has been previously repaired.

Table G-1 (continued). Metal Loss with POE Value Exceeding 10E^{-5} (pg 2 of 2)

Pipeline Segment	Absolute Distance (feet)	Predicted Depth (% WT)	Predicted Length (inch)	POE	POE Type
Cedar Valley to Bastrop	126647.1	30	7.44	1.51E-04	Pressure
Cedar Valley to Bastrop	133843.8	30	7.28	1.31E-04	Pressure
Cedar Valley to Bastrop	126647.8	22	26.06	1.27E-04	Pressure
Cedar Valley to Bastrop	133873.1	30	7.24	1.26E-04	Pressure
Cedar Valley to Bastrop	138593.4	21	9.45	1.13E-04	Pressure
Eckert to Cedar Valley	542.8	39	10.04	5.18E-02	Pressure
Eckert to Cedar Valley	22216.4	44	9.92	3.46E-03	Pressure
Eckert to Cedar Valley	184234.2	49	0.35	1.63E-03	Depth
Eckert to Cedar Valley	541.0	34	7.91	1.38E-03	Pressure
Eckert to Cedar Valley	2772.7	53	0.35	5.75E-04	Depth
Eckert to Cedar Valley	64980.3	45	1.14	2.76E-04	Depth
Eckert to Cedar Valley	98672.3	36	15.83	1.75E-04	Pressure
James River to Eckert	98187.7	40	6.30	7.76E-03	Pressure
James River to Eckert	9442.2	31	10.67	1.85E-03	Pressure
James River to Eckert	56548.7	44	4.37	1.57E-03	Pressure
James River to Eckert	34938.6	48	1.38	1.55E-03	Depth
James River to Eckert	138681.7	32	9.02	1.42E-03	Pressure
James River to Eckert	34809.1	46	1.18	6.56E-04	Depth
James River to Eckert	57474.4	46	0.43	6.56E-04	Depth
James River to Eckert	158569.9	39	4.96	5.41E-04	Pressure
James River to Eckert	36464.1	44	2.87	2.61E-04	Depth
James River to Eckert	62494.3	33	6.14	1.81E-04	Pressure
James River to Eckert	58380.1	29	7.80	1.18E-04	Pressure
Kimble to James River	124021.9	45	2.05	4.17E-04	Depth
Kimble to James River	154289.1	39	6.65	1.54E-04	Pressure
Cartman to Kimble	8446.8	42	10.39	1.46E-01	Pressure
Cartman to Kimble	108697.2	35	10.20	6.31E-03	Pressure
Cartman to Kimble	231017.7	40	6.02	2.80E-03	Pressure
Cartman to Kimble	31385.4	36	5.95	3.06E-04	Pressure
Cartman to Kimble	123695.9	45	4.96	2.76E-04	Depth
Cartman to Kimble	132198.8	45	1.93	2.76E-04	Depth
Cartman to Kimble	80661.5	31	8.31	2.40E-04	Pressure
Cartman to Kimble	18778.5	34	6.54	2.32E-04	Pressure
Cartman to Kimble	44856.3	41	4.45	2.00E-04	Pressure
Barnhart to Cartman	90158.8	50	0.20	3.45E-03	Depth
Barnhart to Cartman	20637.6	48	2.09	1.07E-03	Depth
Barnhart to Cartman	82596.3	43	2.56	1.61E-04	Depth
Texon to Barnhart	199239.1	51	0.28	3.61E-03	Depth
Texon to Barnhart	94412.5	41	30.59	1.48E-03	Pressure
Texon to Barnhart	93865.1	41	24.96	7.24E-04	Pressure
Texon to Barnhart	71820.7	47	0.55	6.91E-04	Depth
Texon to Barnhart	97756.0	47	0.71	6.91E-04	Depth
Texon to Barnhart	13944.6	44	0.55	4.37E-04	Depth
Texon to Barnhart	199531.0	45	1.77	2.76E-04	Depth
Texon to Barnhart	108869.5	51	0.39	2.27E-04	Depth
Texon to Barnhart	85129.8	44	0.35	1.70E-04	Depth
Texon to Barnhart	93870.7	44	3.82	1.70E-04	Depth
Texon to Barnhart	199530.9	44	1.69	1.70E-04	Depth
Texon to Barnhart	93867.7	39	24.84	1.70E-04	Depth
Texon to Barnhart	94436.4	43	1.58	1.03E-04	Depth