Four Years and Counting

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Abstract

Since the introduction of guidance pertaining to Engineering Critical Assessment (ECA) in gas regulation, operators have been grappling with exactly what is required to complete an ECA and the question of what good looks like? Over the past few years, there has been intensive discussion between the regulator, operators, and service providers. This open dialogue and collaboration, combined with operators actively working on ECA's, has paved the way for a clearer understanding of what is required. The regulatory language has been digested to define a transparent laundry list of tasks and data requirements required to close an ECA. Engagement with the regulator has helped add color to the outlines given in regulation, with appreciation on the timelines and milestones expected to complete an ECA. There are several significant tasks that require focus early in the process to establish a successful path, and planning is key. This paper will discuss the current and established route for ECA's used to reconfirm MAOP and conclude by identifying when an ECA can be considered complete and taken credit for in relation to the deadlines of 50% of §192.624[1] covered segments by 2028 and 100% by 2035.

1. Introduction

Reconfirmation of the Maximum Allowable Operating Pressure (MAOP) is required when there are no records to support the MAOP, §192.624(a)(1), or when the MAOP was established using the 'grandfather' rule, §192.624(a)(2). MAOP reconfirmation only applies when a specific set of criteria is met, namely when there is no Traceable, Verifiable, and Complete (TVC) pressure test record, and the segment is in a HCA, MCA, Class 3 or Class 4 location (i.e. covered segment). In lieu of pipe replacement and/or pressure testing, many operators are intending to use Engineering Critical Assessments (ECA), as detailed in §192.632, to reconfirm the MAOP. Regulation mandates that 50% of the pipeline mileage that requires MAOP reconfirmation must be completed by 2028, which is now only four years away. Driven by the impending deadline, operators are ramping up their ECA activities and the first flurry of ECAs are being completed.

2. Background

Although §192.632 contains prescriptive guidance, many operators who are trying to implement the approach have identified areas of ambiguity and questions that need clarification to ensure that the work completed will be considered acceptable by the regulator when audited. This issue has been recognized by PHMSA, who has the same desire to ensure the ECA work is of an acceptable standard and to reach an industry consensus on what good looks like. Ideally all operators who are using ECAs will be aligned and working to the same expectations. Several collaboration meetings were held between operators, PHMSA and service providers in 2024 to discuss the pertinent issues that were creating roadblocks in the process. The discussions were conducted with a common aim – to define

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[1] Throughout this document, the United States code of federal regulation (CFR) Section 49 Part 192 is abbreviated as §192.

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exactly what is required in an ECA as early as possible ahead of the first deadline of 2028. Williams was part of these discussions, and the outcomes were incorporated into the Williams ECA plan to complete several ECAs by the end of 2026. This paper presents the alignment achieved between operators and the regulator on several specific topics, and the structured route Williams is taking to complete ECAs that will meet these expectations.

3. Planning

ECAs are complicated and structured around interrelated activities that are summarized in the list below:

1. Identification of covered segments that require an ECA for §192.624(a)(1) or §192.624(a)(2).
2. Risk and threat assessment in covered segments.
3. Defining inputs for the ECA
4. Assessment using in-line inspection (ILI).
5. ILI validation
6. Defect assessment to analyze the fitness for service (FFS) of anomalies existing in the covered segments.
7. Material properties verification through ILI and records review
8. Remediation/repair and confirmation of material properties to establish MAOP.
9. Addressing gaps.
10. Reporting and close out.

Many of these activities are time intensive and create a heavy workload. If the clock were to start when ILI commences, it is fair to expect an ECA to take at least 18 months to complete. If the line is susceptible to a wide range of threats, has many covered segments, and a significant number of digs and remediation activities are required, it could easily take up to 2 years to complete. Spending effort to plan each activity at the start is imperative. Aligning ILI reporting dates and FFS analysis with dig and remediation windows is critical if an operator wants to shorten the completion date but may not be practical given construction schedules and commercial constraints. One activity that requires special attention is defining TVC material properties and attributes in the covered segments. Any gaps identified in the threat assessment should be closed out as soon as possible at the start of the project as the properties are used as input to the defect assessments. Material property verification activities can be aligned with responses to ILI findings and ILI validation digs. There are opportunities to algin and perform several of the ECA tasks shown simultaneously, which could bring the timeline closer to 1 year duration in a best-case scenario.

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4. Identifying covered segments and justifying an ECA

Credit can only be taken for ECAs that have been conducting to meet the requirements of §192.624 on segments that meet the definition of a covered segment. An open question was whether credit can be taken for ECAs performed proactively on segments that are currently not 'covered' i.e. not in a HCA, MCA, Class 3 or Class 4, but are expected to be in future? This is not permitted. Operators can certainly perform proactive ECAs, but the mileage is not eligible towards the 50% required by 2028 until the segment actually becomes a covered segment. In a similar vein, ECAs cannot be used to close out missing pressure test records in Class 1 and Class 2 locations and satisfy the requirements of §192.619. Although an ECA is acknowledged as a rigorous engineering analysis that can provide the requisite level of safety, the language in regulation does not permit a path through §192.619 using ECA. This merits further discussion in the industry as an ECA seems to present an effective approach to close gaps in Class 1 and 2 locations at the same time as its being used to reconfirm MAOP in higher risk segments.

Williams started planning the ECA process in 2023 with ROSEN on five pipelines. ECAs were only planned on segments of each pipeline that currently meet the definition of a covered segment. Any changes resulting in more covered segments would be addressed in future programs. There is a total of 3.2 miles of covered segment that is part of the ECA plan. 32% is needed to address missing pressure test records and 68% is needed to address grandfathered pipe. These five pipeline segments were evaluated in 2023. There were compliance ILI projects in 2023 on these five segments, so operational efficiencies could be realized by adding ILI technology for ECA requirements at the same time as running ILI tools to address the compliance requirements. The ECA mileage of covered segments for these pipelines were evaluated since the total mileage per segment was above 0.5 miles where pressure testing or pipe replacement would be considered a more costly option versus ECA. Additionally, the prior ILI data and defect history were reviewed in the covered segments and there were not a considerable number of anomalies that would have to be addressed from the ECA process, so the cost of digs was also evaluated here. It is important to note that depending on location of the covered segments and terrain, there may be cases where pipe replacement or hydrotesting may be more economical, even when the total mileage is above 0.5 miles.

5. Risk and threat assessment

A significant part of the ECA is a comprehensive risk and threat assessment to ensure that all of the threats inside the covered segments are accounted for. Williams identifies and evaluates threats to pipeline segments subject to DOT 49 CFR 192, Subpart O, and §192.710 using an internal risk assessment procedure. The risk algorithm evaluates engineering, construction, operational, maintenance, and inspection data variables to identify potential threats and calculate the probability and consequence of failure for each identified threat. The probability and consequence of a pipeline failure are then used to calculate quantitative risk and identify the category of risk exposure for each segment.

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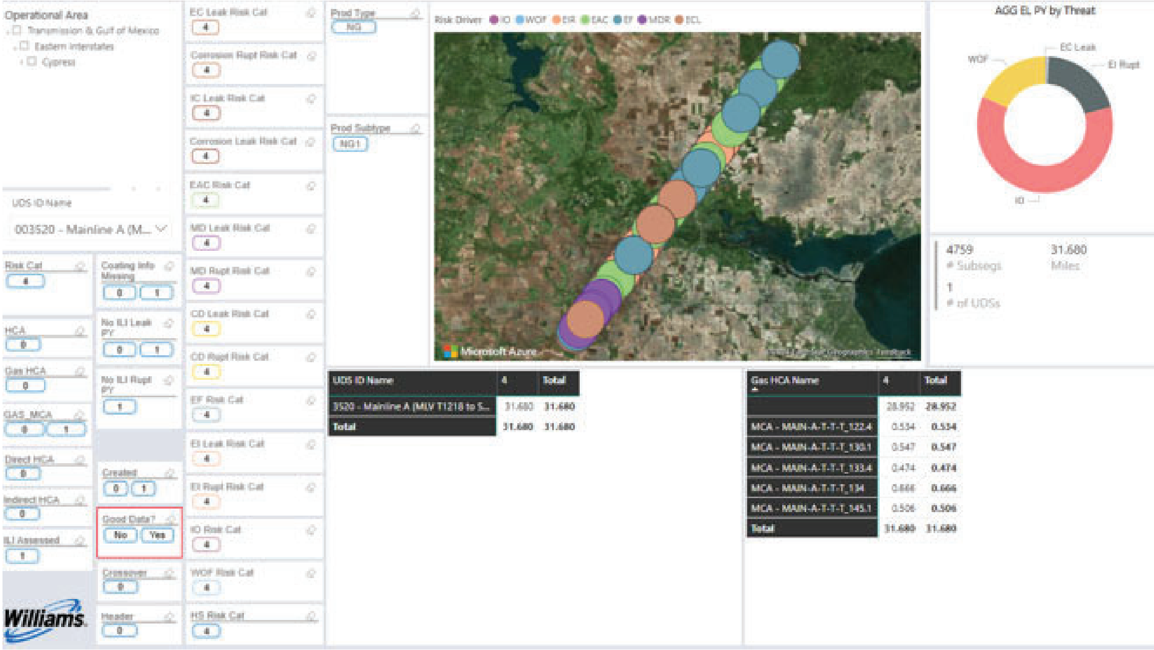
Williams creates a standard risk result report using the Microsoft business intelligence (BI) platform. The Risk Algorithm Document (RAD) defines how pipeline risk is modelled and provides details on how probability is calculated for each potential threat. Consequence estimates are also calculated and combined with the probability scores to obtain a total risk value for each pipeline. The RAD details how these data variables are integrated in calculating the overall risk. The Risk Results for this pipeline segment from the Power BI Dashboard are shown in Figure 1. The latest risk results show that all threats are at the lowest risk, Category 4, for the entire segment. Williams identified that the pipelines were susceptible to the threats shown in Table 1 and that a comprehensive scope of ILI was required to assess the pipeline segments for these threats. Williams ran the full suite of tools when ILI data was more than two years old, which was on four of the five segments, to ensure all pipeline threats were assessed with ILI where possible.

PHMSA confirmed that gaps may be identified in the ECA reports that could not be actioned before approving the ECA, and these can be covered in future ECAs, noting that affected mileage cannot be included in the completed mileage. Examples could be defects that could not be remediated, or areas that are affected by ILI data issues. Similarly, not all covered segments in an assessment path must be closed in the same ECA. An example could be a segment that is susceptible to hard spots, but a suitable ILI technology was not implemented to assess them at the time. Although Williams has no gaps on the five pipelines related to missing threats, there was an issue on one of the lines that required attention, which is discussed later.



UDS ID Name: 003520 - Mainline A (M...

Risk Cat: 4
Coating Info Missing: 0 1
HCA: 0
No ILI Leak PY: 0 1
Gas HCA: 0
No ILI Rupt PY: 1
GAS_MCA: 0 1
Direct HCA: 0
Created: 0 1
Indirect HCA: 0
Good Data?: No Yes
ILI Assessed: 1
Crossover: 0
Header: 0

EC Leak Risk Cat: 4
Corrosion Rupt Risk Cat: 4
IC Leak Risk Cat: 4
Corrosion Leak Risk Cat: 4
EAC Risk Cat: 4
MD Leak Risk Cat: 4
MD Rupt Risk Cat: 4
CD Leak Risk Cat: 4
CD Rupt Risk Cat: 4
EF Risk Cat: 4
EI Leak Risk Cat: 4
EI Rupt Risk Cat: 4
IO Risk Cat: 4
WOF Risk Cat: 4
HS Risk Cat: 4

Prod Type: NG
Prod Subtype: NG1

4759
Subsegs
1
# of UDSs
31.680
Miles

UDS ID Name	4	Total
3520 - Mainline A (MLV T1218 to S...	31.680	31.680
Total	31.680	31.680

Gas HCA Name	4	Total
	28.952	28.952
MCA - MAIN-A-T-T-T_122.4	0.534	0.534
MCA - MAIN-A-T-T-T_130.1	0.547	0.547
MCA - MAIN-A-T-T-T_133.4	0.474	0.474
MCA - MAIN-A-T-T-T_134	0.666	0.666
MCA - MAIN-A-T-T-T_145.1	0.506	0.506
Total	31.680	31.680

Figure 1 Risk results visualized in the Power BI Dashboard

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Table 1 Scope of ILI

§192.632(c) Applicable Defects	ILI Technology					
	MFL-A	GEO	DMG	IMU	EMAT-C	MFL-C
Metal Loss (Internal/External)	X					
Dents		X				
Wrinkle Bends		X				
Ovalities		X				
Expansions		X				
Seam Weld Defects (including cracks and selective seam weld corrosion)					X	X
Hard Spots (with cracks)			X		X	
Stress Corrosion Cracking and crack-like anomalies					X	X
Circumferential and girth weld cracks	X[1]			X	X[1]	

[1] MFL-A is optimized for circumferentially orientated volumetric metal-loss anomalies. EMAT-C is optimized for axially orientated anomalies. The reported data can be incorporated into a review to identify areas that could be more susceptible to circumferentially orientated SCC.

In addition to the assessments performed, Williams also implements preventative and mitigative measures including weekly arial patrols, CP inspections, pipeline cleaning and depth of cover surveys along the complete system, including all of the covered segments. These measures are documented within the ECA report.

6. ILI

As previously mentioned, Williams ran the full suite of ILI tools on most of these segments to assess for the threats. The IMU tool was included as part of the scope so that bending strain could be assessed. On one of the pipeline segments, the IMU tool experienced data quality issues preventing a bending strain assessment. During the collaboration meetings, it was confirmed that if justification could be established to confirm that a pipeline is not susceptible to a threat, ILI would not be required. Based on this approach, an Operator could review the geohazard assessment on that pipeline to identify any specific areas that have potential geohazards (or past girth weld failures) and review if a bending strain assessment is required. If areas are identified, then historic inspection datasets could be leveraged to screen the threat and decide on further action. For this pipeline segment, Williams chose to run a cleaning pig with IMU to ensure the C-SCC threat is assessed with recent (within 2 years) IMU data.

Validation of ILI in accordance with API 1163 is required to support the ECA. Despite the language in regulation intimating that unity charts are required, i.e. level 2 or level 3 in API 1163, level 1 validation is a suitable method providing it meets the requirements. API 1163 states that a level 1 validation is suitable when the level of risk is low and there is a large volume of previous data from

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the ILI technology on the same or similar pipelines, or when the number of reported anomalies is small. All ILI technologies used in the ECA require a validation study to confirm that the performance specification is appropriate or to define the as-ran performance. One point to note regarding validation relates to ILI for bending strain assessment and dents. There are no methods available to validate the ILI data for bending strain, and validating dents can be difficult when re-rounding occurs. For both threats, the operator is required to justify the use of the ILI data and consider the difficulty of validation when implementing the ILI data in the ECA.

7. Inputs for the ECA

At its heart, an ECA is a fitness for service assessment to analyze the anomalies present in the pipeline to determine if they are acceptable for the MAOP or need to be remediated. The ECA used for MAOP reconfirmation covers all anomaly types. Three main inputs are needed for an ECA; the anomaly type and dimensions, information about the stress acting on the anomaly, and the material properties of the pipe or weld that contains the anomaly. The anomaly dimensions are established using ILI and in all cases the ILI tool tolerances are used in the ECA.

Establishing the material properties in covered segments is a key area of focus and was a topic of significant discussion in the collaboration meetings with PHMSA. Operators are expected to have a material property verification procedure in place and be able to justify the decisions made when establishing TVC material properties. It is well recognized that the process of reviewing existing documentation and closing gaps with testing is challenging and subject to a significant degree of interpretation and each operator may have their own procedures to define TVC material properties. PRCI has recently initiated a project with a remit to create a consensus approach for reviewing the various combinations of data that exist to establish TVC properties. The aim is to define a common approach and guidelines, which when implemented satisfy the requirements set out in regulation and provide reliable data for integrity management.

Through the ECA process with ROSEN, Williams performed a material delineation process on its piggable pipeline sections that contained their covered segments. The process entailed a comprehensive review of data contained in documentation that aligned to the material property data from ILI. Using both sets of data, the TVC status for each unique group of pipes (i.e. population) was confirmed and the gaps that required testing were identified. An example of the delineation process for one of the five lines is shown in Table 2. The pipeline is 31.7 miles long with a 24” diameter, constructed in 1959. There are four populations in the covered segments, A1, B1, D1 and E6. These four populations are TVC for material properties, therefore no material testing is required as part of ECA. As shown in Table 2, there are a further 13 populations in the piggable segment (outside the covered segments), and five of them do not have TVC material properties. These populations will be tested and closed out opportunistically outside of the ECA process.

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Table 2 Populations in the pipeline (those in covered segments are in **bold**)

Population	Cumulative Length (miles)	No. Pipes	OD (in.)	WT (in.)	Grade	Seam Type	Covered Segment 192.624 (a)(1) and (a)(2)	Operator TVC Status	Installation Year	Manufacturer	Tests Performed	Verification Tests Remaining (one per mile)
A1	**25.97**	**3508**	**24**	**0.281**	**X52**	**DSAW**	**Yes**	**TVC**	**1950**	**Kaiser**	**1**	**0**
A2	< 1	3	24	0.290	Y60	EW	No	Non-TVC	1980	American Steel	-	1
B1	**5.33**	**730**	**24**	**0.312**	**X52**	**DSAW**	**Yes**	**TVC**	**1950**	**Kaiser**	**1**	**0**
B2	< 1	24	24	0.312	X52	Seamless	No	TVC	1966	US Steel	1	0
C1	< 1	13	24	0.375	X65	DSAW	No	TVC	2006	Shaw	-	0
D1	**< 1**	**13**	**24**	**0.412**	**X70**	**SAWL**	**Yes**	**TVC**	**2018 / 2019**	**Japan Steel Works**	**1**	**0**
D2	< 1	1	24	0.412	X70	DSAW	No	TVC	2012	Stupp	-	0
E1	< 1	3	24	0.500	X65	HF-ERW	No	TVC	2019	Unknown	-	0
E2	< 1	1	24	0.500	X70	DSAW	No	TVC	2019	Stupp	-	0
E3	< 1	2	24	0.500	X65	SAW - Helical	No	Non-TVC	2019	Stupp	-	1
E4	< 1	1	24	0.500	X70	ERW	No	TVC	2012	Stupp	-	0
E5	< 1	8	24	0.500	X52	DSAW	No	TVC	2011	Various	-	0
E6	**< 1**	**1**	**24**	**0.500**	**X70**	**HF-ERW**	**Yes**	**TVC**	**2018**	**Pioneer Steel & Tube**	**1**	**0**
E7	< 1	6	24	0.500	X52	HF-ERW	No	TVC	2018 / 2019	Various	-	0
E8	< 1	2	24	0.500	X65	HF-ERW	No	Non-TVC	2018	American Steel	-	1
E9	< 1	3	24	0.500	X70	LSAW	No	Non-TVC	2019	Stupp	-	1
E10	< 1	4	24	0.281	X52	DSAW	No	Non-TVC	2011	Unknown	-	1

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8. Fitness for service analysis

The prescriptive guidance in §192.632 is clear and requires very little interpretation. Each anomaly type is analyzed using the appropriate model and representative TVC material data, or conservative data if TVC values are not available. A summary of the threat, ILI used to characterize the threat, and the analysis model used is presented in Table 3.

Table 3 Threat, ILI technology and analysis approach

Threat	ILI	Model and/or analysis method
Geometric anomalies	Geometry caliper tool	Dents are assessed as per the current regulatory requirements depending on extent of the dent and the location around the circumference. If required dents can be assessed using an ECA to confirm that the strain is acceptable.
Crack-like anomalies	EMAT	Crack-like anomalies analyzed using API 579 to determine the predicted failure pressure and compared to the MAOP x the safety factor for class location. A fatigue assessment is also performed to identify if any fatigue crack growth is expected, and if so when reassessment is required.
Metal loss	MFL-A. MFL-C	Metal loss anomalies analyzed using ASME B31.G to determine the predicted failure pressure and compared to the MAOP x the safety factor for class location. A corrosion growth assessment is performed to determine any change in dimensions by the time the ECA is closed out. MFL-A and MFL-C inspections are performed to assess corrosion in both directions, and also address the threat of selective seam weld corrosion.
SCC	EMAT	SCC is analyzed using API 579 to determine the predicted failure pressure and compared to the MAOP x the safety factor for class location. Typical SCC growth rates are used to assess the future life and determine when reassessment is required.
Hard spots	Dual field MFL-A	Hard spots are considered stable unless exposed to other threats, with the biggest being cracking. This is addressed by remediating hard spots and/or ensuring there is no source of hydrogen interacting with the hard spot. If cracking already exists and is associated with hard spots, then it is remediated immediately.
Circumferential and Girth weld cracks	IMU	Bending strain is calculated using data from the IMU. Regions with high bending stress are assessed on a case-by -case basis. If the bending strain alone is considered a threat or it is interacting with other threats, such as circumferential planar anomalies, then remediation is required. EMAT-C and MFL-A data is also reviewed to identify locations where the combination of bending strain and signals from these technologies could indicate a higher susceptibility to circumferential cracks.

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Existing models for corrosion, cracks and dents are well understood. Selective seam weld corrosion must be assessed as a crack-like anomaly. Until recently, there were no methods available to analyze the fitness for service of hard spots alone. The PRCI MAT 7-2A project proposes a fitness for service model to assess hard spots. Since the PRCI MAT 7-2A report is not published at the time this paper was written, a simple response is to remediate all hard spots that meet the definition provided in regulation of a hardness value ≥ 327HB and > 2 inches in any direction. However, hard spots are only considered a threat when they are combined with a source of hydrogen or interacting with other threats. The option exists to align hard spots with other information, such as potential sources of hydrogen and defining a response based on the interaction. If the number of hard spots interacting with a potential source of hydrogen in the covered segments is large, then a fitness for service analysis could be performed treating the hard spots as a crack (assuming that the hard spot will crack when exposed to the hydrogen).

Williams completed hard spot assessments on all the lines in the scope of the ECA. Williams has included hard spots in their IMP, which includes assessment requirements and response criteria. Analysis is performed to prioritize the response for hard spots. Another threat identified by ILI is regions of high bending strain. There is no analytical model available to define if a certain level of strain is acceptable or not linked to predicted burst pressure that can be compared to the MAOP. The approach taken by Williams is to assess reported bending strain on a case-by-case basis in line with their geohazard threat team. If the level of bending strain is considered above a level that merits a response action, the bending strain region will be excavated. The bending strain results are also integrated with the EMAT-C and MFL-A to review areas that could be more susceptible to circumferentially orientated cracking mechanisms.

A summary of the anomalies detected by ILI on the 31.7 mile 24" pipeline, is shown in Table 4.

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Table 4 Anomalies reported on the whole piggable segment by ILI

Inspection Tool	Feature Type	ILI Features
RoCombo MFL-A/XT	EXT Metal Loss	2337
	Max Depth	49% wt
	INT Metal Loss	None
	Mill Anomalies	46
	Max Depth	30% wt
	Dents	None
	Wrinkle Bends	None
	Ovalities	None
	Expansions	None
RoCD EMAT-C	Linear Anomaly B (SCC B)	7
	Max Depth	38% wt
	Seam Weld Anomalies (SWAs)	6
	Max Depth	42% wt
RoMat DMG/PGS	Hardness Anomalies (HA)	87
	Max Hardness (BHN)	255
	Material Change (MC)	33

The covered segments in the 31.7-mile pipeline are summarized in Table 5. There is a total of 3,852 ft. of covered pipe, which is 0.56 miles (approx. 2% of the pipeline length). These locations are all MCAs with a grandfathered MAOP.

Table 5 Summary of the covered segments in the pipeline.

Covered Segment No.	Class	Pipe populations from material verification in the 624 area[1]	Length (ft.)	Length (Mile)
1	1	A1	1,470	0.28
		B1	231	0.04
		A1	1,504	0.28
2	1	A1	275	0.05
3	1	A1, D1, E6	372	0.07

The anomalies that exist in the covered segments are shown in Table 6. Because there is less than 1 mile of covered segment that requires MAOP reconfirmation, there are very few anomalies that required analysis. All of the covered segments are Class 1 locations, and therefore in order to reconfirm an MAOP of 878 psi, the predicted failure pressure for the metal loss and mill anomalies must be above 1,097.5 psi (1.25 x MAOP), which they were. The lowest predicted failure pressure was 1431.3 psi associated with a 20% deep external metal loss anomaly in Covered Segment No. 1.

Table 6 Anomalies reported by ILI in the piggable covered segments.

Covered Segment No.	Feature Type	No. ILI Features	Maximum reported depth	Lowest predicted burst pressure[1] *[defect dimensions]*
1	EXT Metal Loss	3	20% wt.	1431.3 psi (FPR 1.63) *[19% wt, 2-inch length]*
	Mill Anomalies	3	11% wt.	1439 psi (FPR 1.64) *[10% wt, 1.5-inch length]*
2	EXT Metal Loss	9	19% wt.	1359.8 psi (FPR 1.55) *[13% wt, 6.5-inch length]*
3	EXT Metal Loss	8	20% wt	1433.8 psi (FPR 1.63) *[19% wt, 1.3-inch length]*

[1] The lowest predicted burst pressure is calculated for other anomalies than those with the maximum depth due to their width and length dimensions. Tool tolerances are added to the reported depth to calculate the predicted burst pressure.

In addition to those shown in Table 6, two areas of bending strain were reported. One bending strain area was reported to be located within Covered Segment No. 1, with a maximum reported strain value of 0.137% and is associated with a road crossing. One bending strain area was reported to be located within Covered Segment No. 2, with a maximum reported strain value of 0.141% and is associated with a valve setting. None of these reported bending strain calls required action as they were considered artifacts of the installation of pipe at these locations and not associated with geohazards.

There are no components within the covered segments shown in Table 6. Components must be included in the ECA. However, they do not require analysis as such, but they must be demonstrated as fit for service at the MAOP. This will require identifying pressure ratings etc. from records and/or field investigations. Grouping the components into populations using available records and ILI data can help rationalize the required verification work. If the number of digs required to gather information about the components is significant or unmanageable in the desired timeline, operators can leverage the approach of leaving them out of the ECA and capturing them in a separate ECA with its own schedule. This will likely only affect a small percentage of the mileage that requires close out by 2028 and eventual by 2035. Branch lines off the main line that have the same pressure as the main line and are in a covered segment must also be assessed. In most cases, the branch lines will be at lower pressures after the first valve into the branch and there is a good chance that they will be below a pressure of 30% SMYS, therefore exempt from pressure test requirements. If not, the branch lines become part of the ECA.

The final stage of the fitness for service assessments is to review the design pressure calculations to confirm that the MAOP is compliant with §192.619 and §192.611, i.e. the design pressure is greater than or equal to the MAOP for plain pipe with no anomalies. The calculations are performed by

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means of §192.105 and Barlow's equation using the material properties of each population in the covered segment. The results are shown in Table 7, confirming MAOP compliance.

Table 7 MAOP compliance with respect to design pressure

Pop.	OD (in.)	WT (in.)	Grade	Joint factor	Class location in MPL	Safety factor for original design	Calculated design pressure	MAOP
A1	24	0.2813	X52	1	1	0.72	878	878
B1	24	0.3125	X52	1	1	0.72	975	878
D1	24	0.412	X70	1	2	0.6	1442	878
E6	24	0.500	X70	1	1	0.72	2100	878

9. Addressing gaps and closing the ECA

The language in regulation only directs the user to a future integrity assessment for crack-like anomalies, where a fatigue or SCC growth analysis is needed to consider potential growth. As discussed previously, it can take a significant amount of time to complete an ECA. Considerable time may pass whilst performing ILI, assessing the results and closing out the other actions. The user is required to project any changes to threats that may occur as the ECA progresses and account for these.

The most obvious example is corrosion reported by ILI. A corrosion growth assessment is required so that the calculations account for the size of anomalies on the date that the ECA is closed and not just the size reported by ILI. Based on the ECA schedule, the difference between these dates can be as much as one year. The corrosion growth assessment performed on the 31.7-mile pipeline, confirmed that the highest corrosion growth rate based on repeated ILI's was 5 mils/year. Applying this growth rate for a period between the ILI report date and ECA close out date, takes the metal loss anomalies to a predicted failure pressure of 1279 psi, well above the required value of 1,097.5 psi (1.25 x MAOP). Although no SCC anomalies were identified in the covered areas, as SCC has been historically identified in this pipeline the threat of SCC growth was also considered. In accordance with Williams SCC management plan a growth rate of 0.009 inches per year was used to grow a theoretical linear anomaly just below reporting threshold of the EMAT-C (depth and length). It was confirmed that any SCC below the ILI threshold would not grow to a depth resulting in a predicted failure pressure less than 1.25 x MAOP (975 psi) on the date that the ECA is closed, and the remining life is > 14 years.

Another example is new information coming to light before the ECA is closed, such as a threat being found that was not considered at the planning stage. If the threat assessment has been performed correctly this is unlikely to happen.

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Ovality, wrinkle bends, and expansion anomalies cannot be assessed with analysis models to define a predicted failure pressure in the same way cracks and corrosion can. PHMSA expects these to be assessed using an engineering approach to confirm they are fit for service at the MAOP. This would likely require Finite Element Analysis (FEA), and the decision would be based on how many anomalies existed and whether the threat could be dealt with by remediation more cost effectively.

An interesting option to close gaps in an ECA is Method 6 of §192.632 (c). Although it is called 'Alternative technology', PHMSA considers this to mean alternative methods, as indicated in the first sentence "Operators may use an alternative technical evaluation process that provides a documented engineering analysis for establishing MAOP". An example could be a small segment of pipes that does not have all the requirements of §192.619 (a)(2), but when combined with an engineering analysis the MAOP can be substantiated. A submission to PHMSA is required to utilize method 6, but it provides a 'make your case' option, to close gaps efficiently.

A gap that most of industry is facing is how to address the threat of circumferential crack-like anomalies and growth weld anomalies. There are limited ILI technology platforms for gas pipelines optimized to address these anomaly types, and as a result other assessment methods are required to cover the threat. These threats are linked to susceptibility, and work is required up front to determine if historical information suggests they need to be considered. In both cases, it is possible to identify specific locations where the threat is more likely to occur, or where the associated risk is higher. The best examples of this are areas where there is a higher axial applied stress (high bending strain regions etc.), areas where axial SCC has been identified, or areas with prior girth weld issues. Following a bending strain analysis, regions of increased strain are investigated and prioritized if girth weld issues or SCC has been identified in the same areas. It should be noted that this approach is considered more effective than a pressure test as the hoop stress induced by internal pressure is not the primary stress that will initiate or extend circumferentially oriented anomalies and cracks.

When it comes to closing out ECAs, PHMSA has reiterated that the results of an ECA should be captured in an engineering report, that is set out to address each of the clauses §192.632 and the relevant clauses in §192.624, when it is being used for MAOP reconfirmation. The report must include the detail of the ECA and justify the decisions made. The expectation is that it provides a demonstration of how pipeline operations remain safe and the full range of threats that the line is susceptible too is covered, using all the information available up to the date that the report is signed. With this in mind, Williams has created a reporting template that will be used in all of the ECAs planned for the coming years. Importantly, Williams has engaged with PHMSA through the proactive audit process to demonstrate their intended approach and procedures to solicit feedback. This helped with creating an effective structure for the flow of information that will meet the expectation of PHMSA and facilitate a smooth review process when it comes to inspections.

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10. Conclusions

Many operators are leveraging ECAs to complete MAOP reconfirmation. Over the past couple of years there has been a significant amount of engagement with PHMSA to align on expectations. This open dialogue has resulted in a very clear appreciation of the actions required to close an ECA. With the first deadline of 50% reconfirmation in 2028 fast approaching, PHMSA is anticipating that operators continue the active engagement and share best practices. The whole industry is on a steep learning curve. Sharing experience and aligning on the content and structure of procedures as early as possible will be critical. If similar approaches and templates are used by operators, the audit process will be more effective and harmonious. Each system will have its own unique challenges, but the essential content and actions that must be part of the ECA is elucidated and can be used as the backbone that the ECA can be built around.