EXHIBIT 4 – ATTACHMENT E

SUMMARY OF RISK ASSESSMENT METHODOLOGY FOR 2021 PSIA PROGRAMS

Summary:
The PSIA risk ranking methodology used for the 2021 PSIA initiatives and Projects was developed consistent with Staff's proposal in Proceeding No. 15AL-0135G, which was approved by the Colorado Public Utilities Commission ("Commission") in Decision No. C16-0123 (adopting with modification Recommended Decision No. R15-1204)("2016 PSIA Decision"). Exemptions to the requirement for risk ranking assessments were set forth in Attachment A to that Decision, and, as applicable to the 2021 PSIA initiatives, are summarized in Table 1 below. Public Service's risk assessment methodology is reflected in Appendices 1 and 2 to this Attachment E. As noted in this Attachment E, as well as in Exhibit 4, the model utilized for the vintage steel projects within the Programmatic Risk-Based Pipe Replacement Program ("PPRP") has been updated from the Optimain DS commercial software to the J-DIMP™ model.

In accordance with the Company's integrity management programs the Company identifies and evaluates the threats to its gas transmission and gas distribution systems. Public Service's risk assessment methodology is a process used to evaluate unwanted consequences and the likelihood of the consequences occurring on the Company's natural gas infrastructure. The goal of the Company's integrity work is to protect the public, property and the environment from pipeline failures.

The purpose of this risk assessment methodology is to develop a quantitative risk score and assign a risk category (high, medium, low) for identified initiatives that are funded through the Company's PSIA rider. These initiatives include gas distribution programmatic risk-based pipe replacement (vintage and/or problematic steel, problematic plastic, and coupled IP), and gas distribution valve replacements.[1] Potential projects are initially identified utilizing commercial risk software and/or subject matter expert ("SME") feedback. Quantitative risk scores are then developed for each project by assigning numeric values to likelihood and consequences utilizing empirical data, quantifying assessments, and SME input. Based on the resulting risk score each project is assigned a risk category (high, medium, low) in accordance with the methodology outlined in Appendices 1 and 2 to this Attachment E.

For those 2021 PSIA Projects requiring a quantitative risk assessment, the Company's goal is to execute on them to programmatically address the highest priority system risks in an efficient and

[1] These initiatives previously included shorted casings, but that PSIA work has been completed and will not continue under the PSIA for 2021. As a result, the shorted casings risk assessment methodology is not included in this Attachment E.

cost effective manner. However, it is important to recognize that any plan is part of an iterative process and, as a result, priorities for these risk-ranked Projects are subject to change. A number of factors, including but not limited to the following, can result in shifting priorities and costs for these Projects during the course of the year: (a) scheduling work with the least amount of disruption for our customers and communities, including bundling work with municipal improvement projects; (b) allocating resources where they will provide the best value to customers in terms of both safety and cost; (c) changing circumstances, such as those resulting from field verification and encountered new developments; and (d) outside factors, such as permitting, weather, and availability of required contracted resources. See also the discussion regarding integrity management planning in Section I (A) of the 2021-2025 PSIA Business Plan to which this document is attached.

Table 1 below contains a list of 2021 PSIA initiatives and Projects and designates whether each Project is required to undergo the risk assessment methodology, consistent with the 2016 PSIA Decision and the Settlement Agreement approved by the Commission in Decision No. C18-0983 mailed November 6, 2018 in Proceeding No. 18A-0422G.[2] For those Projects requiring a quantitative risk assessment, Table 1 also contains a reference to the appropriate Appendix to this Attachment E.

Table 1

PSIA Initiative / Project*	**Quantitative Risk Assessment Required**	**Appendix**
Transmission Integrity Management Program ("TIMP")		
Pipeline Assessments & Repairs	No	n/a
Maximum Allowable Operating Pressure ("MAOP") Validation	No	n/a
Automatic Shut-off Valves /Remotely Controlled Valves ("ASV/RCV")	No	n/a
Distribution Integrity Management Program ("DIMP")		
AMRP	No	n/a
Programmatic Risk-Based Pipe Replacement Program("PPRP")	Yes	1
Distribution Valve Replacements	Yes	2

* Note that the Shorted Casings (TIMP) and Shorted Casings (DIMP) Projects were completed in 2020 and, thus, are not reflected on the above Table.

[2] *See* Appendix A to Decision No. C18-0983, at Table 2 on page 12. The Commission approved the extension of the PSIA to recover capital costs for 11, specifically-identified "Projects" that fall under two of the original PSIA initiatives – DIMP and TIMP.

Appendix 1

DIMP – Programmatic Risk-Based Pipe Replacement Program ("PPRP")

Vintage and/or Problematic Steel Risk

Uses Commercial Software: J-DIMP™ by JANA ("J-DIMP™"). Prior to 2021, the Commercial software used was Optimain DS by Opvantek ("Optimain"). The J-DIMP™ software was implemented as part of the Company's Gas Distribution Integrity Management Program ("DIMP") and utilizes a probabilistic form of risk modeling. This model allows the Company to better utilize the detailed data available in the SAP work and asset management system and the Company's Geographic Information System ("GIS").

Data Inputs include data such as Leak Date, Leak Class, Leak Cause, Pipe Length, Pipe Material, Pipe Pressure, Pipe Diameter, Pipe Coating, Year Installed, Cathodic Protection, Presence of Excess Flow Valve on Service, Building Class and proximity to pipeline, and Population Density.

A bundle (as used in J-DIMP™) is a grouping of mains and services with similar material, diameter, pressure, cathodic protection status, and installation year. Typical projects will consist of 1 or more bundles, whose length is approximately 1500 feet of main and associated services and risers. Bundle lengths can vary significantly from project to project and can serve as a starting point for establishing the scope of various projects.

Under J-DIMP™, the risk score used to rank the risk associated with each bundle is calculated using the risk scores of each asset within the bundle and is then normalized by the length (in feet) of the assets within the bundle.

$$Bundle\ Risk/length = \frac{\sum Main, Service, Valve, and\ Riser\ Asset\ Risk}{\sum Length\ of\ all\ Assets\ in\ Bundle}$$

An asset risk such as main, service, valve or a riser risk is calculated by multiplying the likelihood of failure by the consequence of failure for each threat and summing the associated threat risks. The risk scores are recalculated every year to allow for an understanding of the rate of change of the risks associated with the bundles and their respective assets.

Asset Risk = $\sum$ (Likelihood of Failure x Consequence of Failure) for each respective threat

Likelihood of failure in the J-DIMP™ model is calculated utilizing a Weibul Proportional Hazard Model for 25 specific threat types derived from the 8 primary threat categories established by PHMSA in 49 C.F.R. §192.1007.

Consequence of failure in the J-DIMP™ model is calculated for each threat for each individual asset and is based on the probability and magnitude of a number of loss of function or loss of containment scenarios that may come about due to each threat, and considers consequence factors such as Health and Safety, Property Damage, and Economic Loss.

As can be noted from the calculation above, Main & Service project risk scores (i.e. the Bundle Risk / Length scores) are calculated on a per foot basis. This allows for a direct comparison of projects that may vary significantly in length. The projects are grouped into high-, medium- and low-risk categories based on the resulting Bundle Risk / Length scores generated by the model.

As the J-DIMP™ model is primarily used to rank and evaluate potential replacement projects, it is important to calculate not only the inherent risk presented by an asset in the Company’s gas distribution network, but also the risk reduction achieved by replacing the asset, or mitigated risk. Mitigated risk is calculated as the difference in risk between a current asset (the baseline risk condition) and a hypothetical new asset in the same location and subject to the same operating conditions.

The two risk profiles needed to calculate the mitigated risk for every bundle (or project) are evaluated in the same way as the baseline bundle risk score, and the resulting mitigated bundle risk score is provided on a per foot basis to allow for a direct comparison of assets and bundles that may vary significantly in length. The projects are grouped into high-, medium- and low-risk reduction categories based on the resulting mitigated bundle risk per length scores by the model.

Projects may also be designated as high or medium risk via engineering judgment provided by subject matter experts (SMEs) who evaluate factors such as recent leakage which is not yet in the J-DIMP™ model, field observations that the pipe has significant corrosion, or emerging risk factors based on industry incidents or findings.

Problematic Plastic Risk

Data inputs:

- Material Risk Factor
- Pressure Leak Factor
- Population Density

Risk Score = Likelihood of Failure x Consequence of Failure

Risk of Failure = Material Risk Factor + Pressure Risk Factor

Material Risk Factor Lookup Table

Material Type and Year Installed	Score
Low-ductile inner wall "Aldyl A" piping manufactured by DuPont Company before 1973; use installation dates prior to 1975 to account for depletion of inventory	4
Century Products Medium Density Polyethylene (MDPE) designated PE 2306 installed in any year	4
High-Density Polyethylene (HDPE) gas pipe designated PE 3306 installed in any year	4
Aldyl-A installed in 1975 or later	0

Pressure Risk Factor Lookup Table

Pressure system	Score
Pounds High	1
Pounds Medium	0.75
Pounds Low	0.5

Consequence of Failure Lookup Table

Condition	Score
Business District[1]	4
Population Density from Census Block Data ≥ 2000 people per square mile	3
1000 < Population Density from Census Block Data < 2000	2
Population Density from Census Block Data < 1000 people per square mile	1

(1) Business Districts that have a high population during the workday will not be reflected on census data.

Risk Matrix

			Consequence of Failure			
			Population Density from Census Block Data < 1000 people per square mile	1000 < Population Density from Census Block Data < 2000	Population Density from Census Block Data ≥ 2000 people per square mile	Business District
			1	**1.25**	**1.5**	**1.75**
Likelihood of Failure	Low-ductile inner wall "Aldyl A" piping manufactured by DuPont Company before 1973; or Century MDPE 2306 or HDPE 3306 - Pounds High	**5**	5.0	6.3	7.5	8.8
	Low-ductile inner wall "Aldyl A" piping manufactured by DuPont Company before 1973; or Century MDPE 2306 or HDPE 3306 - Pounds Medium	**4.75**	4.8	5.9	7.1	8.3
	Low-ductile inner wall "Aldyl A" piping manufactured by DuPont Company before 1973; or Century MDPE 2306 or HDPE 3306 - Pounds Low	**4.5**	4.5	5.6	6.8	7.9
	Aldyl-A installed in 1975 or later	**≤ 1**	≤ 1	≤ 1.25	≤ 1.5	≤ 1.75

High Risk, Risk Score ≥ 7
Medium Risk, 4 ≤ Risk Score < 7
Low Risk, Risk < 4

Coupled IP Risk

Data inputs:

- Construction Risk Factor - Presence of Mechanical Joint Joining Method
- Construction Risk Factor – Welding Method Modern Pipe (Oxyacetylene or Arc)
- History of Corrosion, 3rd Party Damage and other leakage
- Pipeline Diameter and Operating Pressure

Risk Score = Likelihood of Failure x Consequence of Failure

Likelihood of Failure = (Mechanical Joint Risk Factor + Welding Risk Factor) x Maximum Score of (Corrosion Risk Factor, 3rd Party Damage Risk Factor, Other Leak History Factor)

Consequence of Failure = Potential Impact Radius ("PIR") of downstream pipeline

$$PIR\ (ft) = .69 * \sqrt{Pressure(psig) * Diameter(in)^2}$$

Mechanical Joint Risk Factor Lookup Table

Condition	**Score**
Pipeline Segment Contains Mechanical Joints	3.5
Does Not Include Mechanical Joints	0.5

Welding Risk Factor Lookup Table

Condition	**Score**
Includes Acetylene Welds (Pre 1932)	0.5
Does not Include Acetylene Welds (Pre 1932)	0

Corrosion Risk Factor Lookup Table

Condition	**Score**
History of Corrosion Leakage	2
Presence of Corrosion Pitting	2
No history of Corrosion leakage or pitting	1

3rd Party Damage Risk Factor Lookup Table

Condition	**Score**
Presence of 3rd Party Damage	2
No Presence of 3rd Party Damage	1

<u>Other Leak History Risk Factor Lookup Table</u>

Condition	**Score**
History of Leakage due to Causes other than corrosion or 3rd Party Damage	2
No History of Other Leakage	1

<u>Consequence of Failure Lookup Table</u>

Condition	**Score**
PIR > 100 ft.	4
40 ft. < PIR ≤ 100 ft.	3
PIR ≤ 40 ft.	1

<u>Risk Matrix</u>

			Consequence Score		
			PIR ≤ 40 ft.	40 ft. < PIR ≤ 100 ft.	PIR > 100 ft.
			1	**3**	**4**
Likelihood of Failure	Mechanical Coupled AND Acetylene Welded AND Corrosion or 3rd Party Damage	**8**	8	24	32
	Mechanical Coupled AND Corrosion or 3rd Party Damage	**7**	7	21	28
	Mechanical Coupled AND Acetylene Welded and NO Corrosion or 3rd Party Damage	**4**	4	12	16
	Mechanical Coupled and no other risk factors	**3.5**	3.5	10.5	14
	No Mechanical Couplings	**≤ 2**	≤ 2	≤ 6	≤ 8

High Risk, Risk Score ≥ 21
Medium Risk, 10 ≤ Risk Score < 21
Low Risk, Risk < 10

Appendix 2

DIMP - Distribution Valve Replacements

Data inputs:

- Downstream Pipeline Pressure
- Downstream Pipeline diameter
- Valve Operability
- Atmospheric Corrosion History
- Vault Condition

Risk Score = Likelihood of Failure x Consequence of Failure

Likelihood of Failure = Valve Operability Risk Factor + Vault Condition Risk Factor + Atmospheric Corrosion Risk Factor

Consequence of Failure = Potential Impact Radius of downstream pipeline (PIR)

$$PIR\ (ft) = .69 * \sqrt{Pressure(psig) * Diameter(in)^2}$$

Valve Operability Risk Factor Lookup Table

Valve Operable	**Score**
No	3
Yes	0

Vault Condition Risk Factor Lookup Table

Vault Condition	**Score**
Vault Condition Poor (Inaccessible due to water intrusion)	0.75
Vault Condition Good	0

Atmospheric Corrosion Risk Factor Lookup Table

Atmospheric Corrosion Status	**Score**
Atmospheric Corrosion Present	0.25
Atmospheric Corrosion Not Present	0

Consequence of Failure Lookup Table

PIR	**Score**
PIR > 100 ft.	4
40 ft. < PIR ≤ 100 ft.	3
20 ft. < PIR ≤ 40 ft.	2
PIR ≤ 20 ft.	1

Risk Matrix

			Consequence Score			
			PIR ≤ 20 ft.	20 ft. < PIR ≤ 40 ft.	40 ft. < PIR ≤ 100 ft.	PIR > 100 ft.
			1	**2**	**3**	**4**
Likelihood of Failure	Valve Inoperable AND Vault Condition Poor AND Atmospheric Corrosion	**4**	4	8	12	16
	Valve Inoperable AND Vault Condition Poor	**3.75**	3.75	7.5	11.25	15
	Valve Inoperable AND Atmospheric Corrosion	**3.25**	3.25	6.5	9.75	13
	Valve Inoperable	**3**	3	6	9	12
	Valve Operable but Vault Condition Poor AND Atmospheric Corrosion	**1**	1	2	3	4

(dark)	High Risk, Risk Score ≥ 12
(medium)	Medium Risk, 9 ≤ Risk Score < 12
(light)	Low Risk, Risk < 9