PACIFIC GAS AND ELECTRIC COMPANY

GAS TRANSMISSION AND DISTRIBUTION
GAS ENGINEERING
GAS INTEGRITY MANAGEMENT AND TECHNICAL SUPPORT
Risk Management

Procedure for Risk Management

Procedure No. RMP-05
Rev. 4
Design/Materials Threat Algorithm

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1.0 PURPOSE

The purpose of this procedure is to provide a guideline for determining the Design/ Materials (DM) Threat Algorithm for the determination of Likelihood of Failure and Risk PG&E's Risk Management Program (RMP) and Integrity Management Program. 4

2.0 SCOPE

2.1 Transmission

This guideline is applicable to all of PG&E's gas transmission pipeline facilities and is to be used in conjunction with RMP Procedure 01. The algorithm provided in this procedure is Pipelines. It is not applicable to regulator, compressor, or storage station facilities

The Integrity Management Group is responsible for managing risk within the scope of this procedure. The Integrity Management Group shall establish and manage the risk of each pipeline facility by utilizing industry and regulatory accepted methodologies appropriate for PG&E's CGT facilities and shall be in conformance with this procedure. The Integrity Management Program Manager shall be responsible for compliance with this procedure.

2.2 Distribution

Gas Distribution System Integrity risk ranking is intended to meet the requirements of subpart P of 49 CFR 192. Currently it uses a Subject Matter Expert approach to identify and prioritize risks. That process is detailed in Section 7.0 of this document. 5

3.0 INTRODUCTION

The risk management process is a process of calculating risk, developing risk mitigation plans to bring and maintain risk within an acceptable risk profile, and monitoring risk to accommodate changes in the factors which affect risk. The Transmission Integrity Management Program (TIMP) is a program established by PG&E to address the integrity management rules in 49 CFR Part 192 Subpart O. (Procedure RMP-01 provides a procedure for the Risk Management Process.) Procedure RMP-06 provides procedures for compliance with the Integrity Management Program. This procedure supports the calculation of risk, required by Procedure RMP-01 and RMP-06, due to one of the basic threats imposed on gas pipelines, Design/ Materials (DM). 4

As described in RMP-01, Risk is defined as the product of the Likelihood of Failure (LOF) and the Consequence of Failure (COF). A relative risk calculation methodology is used to establish risk for all pipeline segments within the scope of RMP-01. The method used to calculate risk is based on an index model and qualitative scoring approach. Likelihood Of Failure (LOF) is defined as the sum of the following threat categories: External Corrosion (EC), Third Party (TP), Ground Movement (GM) and Design/Materials (DM).

Each threat category is weighted in proportion to PG&E and industry failure experience. DM is weighted at 10%. The weightings on the threat categories will be reviewed and approved annually by the Consequence Steering Committee. For each threat category, the appropriate steering committee will identify the significant factors that influence the threat's likelihood of failure. For each factor, a percentage weighting will be established to identify the factor's relative significance in determining the threat's likelihood of failure within the threat algorithm. Points will be established based on criteria that the committee feels is significant to determining the threat's likelihood of failure due to each factor and the relative severity of failure (leak-before-break vs. rupture). (Negative points may be assigned where current assessments have been made to confirm pipeline integrity and/or mitigation efforts have eliminated or lowered susceptible to a threat.) Generally, the summation of the percentage weightings for all of the factors within each threat will be 100%. (There may be exceptions to permit the consideration of very unusual conditions.)

For the threat of DM, the scoring is based on direction from the DM Steering Committee. The DM Steering Committee shall meet once each calendar year and shall review this procedure per the requirements of RMP-01.

The Distribution Integrity Management Program (DIMP) is a program established by PG&E to address the integrity management rules in 49 CFR Part 192 Subpart P. Procedure RMP-15 provides details for compliance with the Integrity Management Program. This procedure supports the calculation of risk due to one of the basic threats imposed on gas pipelines, Design/Materials (DM).

The DM threat for distribution piping is addressed in section 7 of this document. Currently this algorithm determines the highest risk items so they can be prioritized as a group.

4.0 Roles and Responsibility

Specific responsibilities for ensuring compliance with this procedure are as follows:

Title	Reports to:	Responsibilities
Integrity Management Program Manager	Manager System Integrity	• Supervise completion of work (schedule/quality) • Monitor compliance to procedure – take corrective actions as necessary. • Assign qualified individuals • Ensure Training of assigned individuals • Assign Steering Committee Chairman, and ensure that meetings are held once each calendar year.
Steering Committee Chairman (Risk Management Engineers)	Integrity Management Program Manager (except for TP Steering Committee – chairman reports to Manager System Integrity)	• Arrange meetings. • Review procedure with committee per RMP-01 • Provides meeting minutes • Ensures action items are completed.
Steering Committee Members (Subject Matter Experts)	Various	• Attend meetings as requested by Steering Committee Chairman. • Provide review and direction to procedure.
Risk Management Engineers	Integrity Management Program Manager	• Perform calculations per procedure.

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5.0 Training and Qualifications

See RMP-05 for qualification requirements. Specific training to ensure compliance with this procedure is as follows:

Position	Type of Training:	How Often
Integrity Management Program Manager	Procedure review of RMP-01 and RMP-05	• Upon initial assignment • Once each calendar year.
Steering Committee Chairman	Procedure review of RMP-01 and RMP-05	• Upon initial assignment • Once each calendar year. • As changes are made to the procedure.
Steering Committee Members (Subject Matter Experts)	RMP-05 and Steering Committee requirements of RMP-01	• Once each calendar year at the time of the steering committee meeting.
Risk Management Engineers	Integrity Management Program Manager	• Upon initial assignment • Once each calendar year. • As changes are made to the procedure.

6.0 DESIGN/ MATERIALS THREAT ALGORITHM

6.1 Gas Transmission

Design Materials (DM) shall be calculated per the direction of the DM Steering Committee. The committee has determined that the factors in A through F of this section are significant to determining the Likelihood of Failure (LOF) of a gas pipeline due to *design/material* issues. The DM contribution to LOF shall be the summation of assigned points times the assigned weighting for the following factors:

A) Pipe Seam Design (30% Weighting): Points will be awarded as follows:

Criteria	Points	Contrib.
Furnace Butt Weld (FBW) (Jef = 0.6)	100	30
Single Submerged Arc Weld SSAW (Jef = 0.6)	60	18
Low Freq. ERW* (Jef = 1.0)	90	27
A.O.Smith or Flash Weld (Jef = 1.0)	90	27
High Freq. ERW (Jef = 1.0)	20	6
Double Submerged Arc Weld (DSAW) (Jef = 1.0)	10	3
Seamless	10	3
Pre 1990 Spiral (Jef = 0.6)	90	27
1990 and newer Spiral (Jef= 1.)	20	6
Other**	100	30
Default (Welds made prior to 1970)	100	30
Default (Welds made in 1970 and after)	20	6

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* Welds made prior to 1970 using the ERW welding process are assumed to be made using low frequency.

B) Girth Weld Condition (15% Weighting): Points will be awarded as follows:

Criteria	Points	Contrib.
Pre 1930 Girth Welds (Both Arc and oxyacetylene, regardless of seismic zone)	100	15
Pre 1947 Girth Welds within area of ground acceleration > 0.2g	100	15
Shielded pre-1960 Bell-Spigot/BBCR**	40	6
Default	0	0

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** Shielded Metal Arc Welds (SMAW) made prior to 1960 or girth weld joints made with Bell-Spigot or BBCR joints.

C) Material Flaws or Unique Joints (20% Weighting): Points awarded as follows:

Criteria	Points	Contrib.
Wrinkle Bends in Pipe w/ OD < 12"	100	20
Wrinkle Bends in Pipe w/ OD > 12"	50	10
Dresser Couplings	100	20
Hard Spots *	100	20
Pre-1950 Miter Bends	90	18
None	0	0

* Hard Spots point shall be awarded based on mill and age regardless of whether hard spots have been found

D) Pipe Age (10% Weighting): Points awarded as follows:

Criteria	Points	Contrib.
Pre 1970 Pipe	100	10
1970 and newer pipe	10	1

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E) MOP vs. Pipe Strength* (20% Weighting): Points awarded as follows:

Criteria	Points	Contrib.
>80%	100	20
50% to 80%	80	16
40% to <50%	50	10
30% to <40%	30	6
20% to <30%	10	2
Less than 20%	5	1

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* Pipe Strength shall be determined to be equal to (SMYS)(2)(t)(Jef)/(OD).

F) Design/Materials Leak Rate (5% Weighting): Points awarded as follows:

Criteria	Points	Contrib.
More than 1 leak	200	10
1 leak	160	8
0 leak	0	0

* Leaks within the last twenty years on a pipe segment or on adjacent segments with the same pipe properties and installed job or project number within a one mile radius of the leak

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G) Test Pressure (TP)** vs. Pipe Strength* (20% Weighting): Points awarded as follows:

Criteria	Points	Contrib.
TP ≥ 100%PS (test is 5 years old or less)	-200	-40
TP ≥ 100%PS (test is more than 5 years old)	-150	-30
TP < 100% PS	-50	-10
No Pressure Test or TP/MOP <1.1	150	30

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* Pipe Strength (PS) shall be determined to be equal to (SMYS)(2)(t)(Jef)/(OD).

** Pressure Tests performed earlier than 1950 will not be credited.

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6.2 Gas Distribution

PG&E's Distribution Integrity Management Plan (DIMP) (RMP-15) addresses each of the GPTC Appendix G-192-8 guide's seven major components. These components are as follows:

A. Knowledge of the distribution system – design, maintenance and operation
B. Threat identification process
C. Risk evaluation and ranking of threats
D. Implement measures to manage risks
E. Measure and monitor results
F. Periodic evaluation of program for improvements
G. Reports to government agencies

Design Material (DM) (i.e. Material or Welds) threat algorithms for Gas Distribution are developed following the guidelines in RMP-15 and they are described as follows:

A) Knowledge of the system – PG&E's records and data bases that define the distribution system and what type of information they provide are described in Table 1.3 of RMP-15.

B) How Threats are identified – The GM threats to the distribution system are identified by Subject Matter Experts (SME). The pool used to select the members will include Gas Engineers at PG&E, Gas Planners at PG&E, experts from the PG&E Geosciences Department, members of the PG&E System Integrity Group and other industry experts inside and outside of PG&E.

C) Risk Evaluation and ranking of threats – Identification is performed by the SME team who then rank the Likelihood and Consequence of each threat with H, M or L. A value is then assigned to each of the ranks such as: H = 3, M = 2 and L = 1. The value of the Likelihood (L) X Consequence (C) of each SME's judgment will be calculated and then the average of all SMEs' risk values will be calculated as the relative risk value, R.

The relative risk values of the threat, $R = 1/n\ (\sum (L_i \times C_i))$ (i = 1 to n)

n: Total number of SMEs.

In the table below, the consequence of the threat is that it will not be able to safely and reliably perform it's intended function.

Summary Table of Relative Risk Value (R) Per SMEs ballot results

MATERIAL/ WELDS	SUB-CATEGORY	THREAT	Ave Risk Rank	NOTES
Non Plastic	Steel	Homemade Service Tees (<60 psig)	6.00	

MATERIAL/ WELDS	SUB-CATEGORY	THREAT	Ave Risk Rank	NOTES
Non Plastic		Copper, internal corrosion - Corrosion products flake off interior walls and plug customer house lines and appliances	9.00	
Non Plastic		Threaded Joints in distribution main	3.60	
Non Plastic	Cast Iron	Cast Iron - Bell and spigot joints prone to leakage	3.00	
Non Plastic		Non Shielded Arc Welds	3.00	
Non Plastic		Threaded Services	2.80	
Non Plastic		Homemade Service Tees (>60 psig)	2.40	
Non Plastic		Brazing Tees (>60 psig)	1.40	
Non Plastic		Asbestos castings - Pose a environmental and employee safety hazard.	1.00	
Non Plastic		Oxy Acetylene Welds	1.00	
Non Plastic		Material Defects in Steel	1.00	
Non Plastic		Mechanical Fittings/Couplings Category 1 (seal plus resistance force on the pipe)	1.00	
Non Plastic		Mechanical Fittings/Couplings Category 2 (seal only)	1.00	
Plastic Pipe		Out of tolerance	3.00	
Plastic Fittings		"MET FIT" couplings are known for failure of metal retainer band and premature leakage.	9.00	
Plastic Fittings		Perfection/Green Risers installed between 1976 and 1979 can develop cracks in the Delrin insert allowing blow by down riser casing into surrounding soil.	9.00	
Plastic Fittings		Risers - Insert kits are know for premature leakage at transitions or threads	9.00	
Plastic Fittings		DuPont Aldyl- A service tees with cracking in Delrin seat due to thermal fatigue will produce leakage.	6.00	
Plastic Fittings		Risers - "Rector Seal 5" pipe dope. This pipe dope is known to dry out and cause leaks at riser stop cock threaded joint.	6.00	Environmental Issue
Plastic Fittings		Tee Caps – Caps can leak due to cracking from over tightening, and blow by through threads when under tightened.	4.50	
Plastic Fittings		"AMP" valves are known for premature leaks in bonnet.	2.50	
Plastic Fittings		"AMP FIT" compression joints are known for premature leakage.	1.50	H- In SF only L- Outside SF area
Plastic Fittings		1/2" CTS tees and Ells have a smaller than typical port size (0.235" compared to typical (.375). These are most susceptible to fouling and internal corrosion	1.00	

MATERIAL/ WELDS	SUB-CATEGORY	THREAT	Ave Risk Rank	NOTES
Plastic Pipe		DuPont Aldyl A manufactured before 1973, installed from the 1960s to 1980s is vulnerable to brittle-like cracking and leakage.	7.50	
Plastic Pipe		Pre 1960 Tenite Plastic	1.00	

D) Implement Measure to Manage Risk – These risk rankings will be used to identify and implement measures to manage the risk.