

PACIFIC GAS AND ELECTRIC COMPANY

ENGINEERING & OPERATIONS
GAS TRANSMISSION AND DISTRIBUTION
GAS ENGINEERING
GAS SYSTEM INTEGRITY
Risk Management



Procedure for Risk Management

Procedure No. RMP-04

Rev. 5

Ground Movement and Natural Forces Threat Algorithm

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1.0 PURPOSE

The purpose of this procedure is to provide a guideline for determining the Ground Movement and Natural Forces Threats Algorithm for the determination of Likelihood of Failure and Risk for PG&E's Gas Transmission and Distribution's Risk Management Programs (RMP) and Integrity Management Programs.



2.0 SCOPE

This guideline is applicable to all of PG&E's gas transmission pipeline and distribution facilities and is to be used in conjunction with RMP Procedure 01. The algorithm provided in this procedure is for Natural Gas Pipelines. It is not applicable to regulator, compressor, or underground 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 transmission and distribution facilities and shall be in conformance with this procedure. The Integrity Management Program Manager shall be responsible for compliance with this procedure.

3.0 INTRODUCTION

Gas Transmission: The risk management process is a process of integrating data to calculate 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 Transmission Integrity Management Program. This procedure supports the calculation of risk, required by Procedure RMP-01, due to one of the basic threats imposed on gas pipelines, Ground Movement (GM).

As described in RMP-01, Risk is defined as the product of the Likelihood of Failure (LOF) and the Consequence of Failure (COF). [Risk = LOF X 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. GM is weighted at 20%. 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 GM, the scoring is based on direction from the GM Steering Committee. The GM Steering Committee shall meet once each calendar year and shall review this procedure per the requirements of RMP-01.

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 of Integrity Management	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> Arrange meetings. Review procedure with committee per RMP-01 Provides meeting minutes Ensures action items are completed.
Steering Committee Members (Subject Matter Experts)	Various	<ul style="list-style-type: none"> Attend meetings as requested by Steering Committee Chairman. Provide review and direction to procedure.
Risk Management Engineers	Integrity Management Program Manager	<ul style="list-style-type: none"> Perform calculations per procedure.



5.0 Training and Qualifications

See RMP-06 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-04	<ul style="list-style-type: none"> • Upon initial assignment • Once each calendar year.
Steering Committee Chairman	Procedure review of RMP-01 and RMP-04	<ul style="list-style-type: none"> • Upon initial assignment • Once each calendar year. • As changes are made to the procedure.
Steering Committee Members (Subject Matter Experts)	RMP-04 and Steering Committee requirements of RMP-01	<ul style="list-style-type: none"> • Once each calendar year at the time of the steering committee meeting.
Risk Management Engineers	Per RMP-06 Integrity Management Program	<ul style="list-style-type: none"> • Upon initial assignment • Once each calendar year. • As changes are made to the procedure.

6.0 GROUND MOVEMENT THREAT ALGORITHM

6.1 Gas Transmission: Ground Movement (GM) algorithm shall be calculated per the direction of the GM Steering Committee. The committee has determined that the factors in A through H of this section are significant to estimate the Likelihood of Failure (LOF) of a gas pipeline due to *ground movement* damage. The GM contribution to LOF shall be the summation of assigned points times the assigned weighting for the following factors:

A) Crossings* (30% Weighting): Points will be awarded as follows:

Criteria	Points	Contrib.
Major Water Crossing Present**	40	12
Seismic Fault Crossing Present ***	A	B
No Major Water or Fault Not Present	0	0

* Points for each factor are additive.

** A Major Water Crossing is defined as waterway identified by the Office of Pipeline Safety (OPS) as being a Commercially Navigable Waterway".

*** Seismic Fault Crossings as defined in Attachment 1.
 $A=300*PR$ (Prob. of Rupture in Attachment 1, the number, 300, is a non-dimensional multiplier used to appropriately weight fault crossings as agreed by the GM Committee), for example: Hayward Fault, $PR = 31\%$, $A = (300*0.31) = 93$ and $B=(0.3*A)=27.9$.

B) Unstable Soil (Susceptibility to either slope instability or liquefaction) (15% Weighting): Points will be awarded as follows:

Criteria	Points	Contrib.
Known Soil Instability or Landslide	120	18
Moderate-High Slope Instability	100	15
Liquefaction*	100	15
None	0	0

* Liquefaction shall be considered for areas defined as Moderate-High or Known Liquefaction within GIS and pipelines installed prior to 1947.

C) Seismic Area* (15% Weighting): Points awarded as follows:

Criteria	Points	Contrib.
Seismic Ground Acceleration** $\geq 0.5g$	150	22.5
Seismic Ground Acceleration $\geq 0.2g$ to $0.49g$	100	15
Seismic Ground Acceleration $< 0.2g$	0	0

* Seismic Area shall be considered only if it is in an area of unstable soil. For the purpose of this factor, unstable soil shall be defined as an area of Moderate-High Soil Instability within GIS or areas of Moderate-High or Known Liquefaction within GIS.

** Seismic Ground Acceleration is the peak ground acceleration values to 10% probability of exceedance in 50 years (or 475-year return period).

D) Erosion Area* (10% Weighting): Points awarded as follows:

Criteria	Points	Contrib.
Pipe segment within 100 meters of identified erosion area	100	10
Not in erosion area	0	0

* Erosion Area's are reported by the Gas Transmission Erosion Project Manager and also include levee crossings per Pipeline Levee Crossings in the Delta list from the enterprise risk management (ERM) study (Attachment 2) that are susceptible to failure are recorded into GIS on an ongoing basis.



E) Ground Movement Mitigation (5% Weighting): Points awarded as follows:

Criteria	Points	Contrib.
Full Ground Movement mitigation* of Known Landslide performed	-360	-18
Partial Ground Movement Mitigation** of Known Landslide performed	-240	-12
Full Ground Movement mitigation* of Known Erosion performed	-200	-10
Partial Ground Movement Mitigation** of Known Erosion performed	-140	-7
Fault Crossing Mitigation***	-6*A	-B
None	0	0



* "Full Ground Movement Mitigation" efforts are projects whose scope substantially removed the ground movement threat of pipeline failure. This information is reported to the RMP on a case-by-case basis by the appropriate Pipeline Engineer and is documented in the RMP files.



** "Partial Ground Movement Mitigation" efforts are projects whose scope removed some, but not all of the ground movement issues related to a threat to the pipeline. This information is reported to the RMP on a case-by-case basis by the appropriate Pipeline Engineer and is documented in the RMP files.



*** "Fault Crossing Mitigation" is pipeline fault crossing segment that has been evaluated/mitigated per seismic fitness-for-service(F-F-S) (see Attachment 1) and the "Crossing Points" awarded will be removed.



F) Girth Weld Condition (20% Weighting): Points awarded as follows:

Criteria	Points	Contrib.
Pre 1947 Girth Welds within area of ground acceleration $\geq 0.5g$	120	24
Pre 1947 Girth Welds within area of ground acceleration $\geq 0.2g$ to $< 0.5g$	80	16
All Other	0	0