

PACIFIC GAS AND ELECTRIC COMPANY

CALIFORNIA GAS TRANSMISSION
 GAS SYSTEM MAINTENANCE & TECHNICAL SUPPORT
 SYSTEM INTEGRITY SECTION
 Risk Management



Procedure for Risk Management

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Risk Management

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1.0 PURPOSE

The purpose of this procedure is to provide a guideline for maintaining California Gas Transmission's (CGT) Risk Management Program (RMP).

2.0 SCOPE

This guideline is applicable to all of CGT's gas transmission pipeline facilities, including line pipe and regulating station facilities. At this time, the RMP is not applicable to the following:

- Compressor Station Facilities;
- Storage Facilities;
- Gas Gathering Facilities
- Parallel Cross-Tie Piping; and
- Pipeline Routes less than 0.5 miles long.

The RMP is responsible for managing risk within the scope of this procedure. The RMP 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 Lead Risk Management Engineer shall be responsible for compliance with this procedure.

Risk information shall be communicated to management and other appropriate CGT personnel for project planning, risk mitigation, inspection planning, and regulatory reporting. Risk for each pipeline segment shall be calculated annually.

3.0 INTRODUCTION

The RMP 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 that affect risk.

An inventory of all the pipeline design attributes, operating conditions, environment (e.g., structures, faults, etc.), threats to the structural integrity, leak experience, and inspection findings must be developed and maintained. Risk must be calculated based on an immense inventory of assembled attributes. The risk values need to be reviewed and criteria for acceptance established, risk mitigation plans developed, budgeted and completed, and conditions monitored to update criteria, risk values, and mitigation plans, as necessary, to accommodate new information. (New information could include new damage prediction models, changes to population in proximity to a pipeline, changes to system operating characteristics which could effect safety margin, damage accumulation, the number of customers out of service, or gas load, new seismic or environmental hazard identification, inspection findings as they relate to the physical condition of the pipe or the systems needed to protect the pipeline or component from damage or degradation, or changes in the potential for third party damage.)

Because threats to the pipeline and consequences of a failure change with time, the process of monitoring and adjusting risk mitigation plans is an ongoing process. RMP is a methodology utilizing pipeline characteristics (physical and environmental), qualitative risk assessment, quantitative risk analysis, and decision-risk analysis methods to determine a cost-effective risk management of CGT's pipeline facilities. The process follows these basic steps:

- Accumulate facility design attributes, existing condition, potential threats, and failure consequence,
- Determine Likelihood of Failure (LOF) for each pipeline segment,
- Determine Consequence of Failure (COF) for each pipeline segment,
- Calculate risk for each pipeline segment based on the Likelihood of Failure and the Consequence of Failure (COF),
- Develop a system wide risk mitigation strategy,
- Propose rehabilitation projects or inspections based on the damage mechanism, threat, and risk, and finally,
- Monitor and adjust the process, as necessary, to incorporate changes in technology, changes in information, or changes in code or regulatory requirements.

4.0 RISK DETERMINATION

- 4.1 RISK shall be defined as the product of the Likelihood of Failure (LOF) and the Consequence of Failure (COF).

$$[RISK = LOF \times COF] \quad (Equation 1)$$

In general, the source of information used to calculate risk shall be obtained from PG&E's Graphical Information System (GIS). Exceptions are noted within RMP procedures. There are also special cases where updated information is made available from other sources (such as from Pipeline Engineers, In-Line-Inspection (ILI) reports, Corrosion Engineers, or District Personnel.).

- 4.2 CALCULATION METHODOLOGY: A relative risk calculation methodology shall be used to establish risk. Risk will be calculated per this procedure for all pipeline segments within the scope of this procedure. A pipeline segment shall be defined as the length of contiguous pipeline with the same piping specification, depth and class location (not to exceed one mile). The method used to calculate risk shall be based on an index model and qualitative scoring approach. The scoring shall be based on expert direction from appropriately staffed Steering Committees. For each major component of the RMP, a Steering Committee shall be established to provide technical review and input to the program. There are currently five committees covering External Corrosion, Third Party damage, Ground Movement, Design/Materials, and Consequence. The Steering Committees are comprised of individuals with expertise in the particular subject matter and the committees meet at least once a year to review and approve the methodology used to calculate risk and determine if changes are advisable.

- 4.3 LIKELIHOOD OF FAILURE (LOF) is the relative measure of the probability that a pipe will fail. Failure, within the context of this procedure, is the breach of the structural integrity of the pipe. The following threat categories shall be used for calculating risk: External Corrosion (EC), Third Party (TP), Ground Movement (GM) and Design/Materials (DM). (As new credible threats are identified as relevant to the determination the LOF, they will be submitted to the Consequence Steering Committee for inclusion into the risk calculations.) Each threat category shall be weighted in proportion to PG&E and industry failure experience. EC is currently weighted 25%, TP shall be weighted 45%, GM shall be weighted 20%, and DM shall be weighted 10%.

$$[LOF = 0.25EC + 0.45TP + 0.20GM + 0.10DM] \quad (\text{Equation 2})$$

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 attributes that influence the threat's Likelihood Of Failure. For each attribute, a percentage weighting will be established to identify the factors' relative significance in determining the threat's Likelihood Of Failure. Points will be established based on criteria that the committee feels is significant to determining the threat's Likelihood Of Failure 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 susceptibility 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.) Points will scored to the threats as follows:

- 4.3.1 The algorithm for the threat of External Corrosion (EC) shall be calculated per the direction of the EC Steering Committee as provided in Procedure RMP-02.
- 4.3.2 The algorithm for the threat of Third Party (TP) shall be calculated per the direction of the TP Steering Committee given in Procedure RMP-03.
- 4.3.3 The algorithm for the threat of Ground Movement (GM) shall be calculated per the direction of the GM Steering Committee given in Procedure RMP-04.
- 4.3.4 The algorithm for the threat of Design Materials (DM) shall be calculated per the direction of the DM Steering Committee given in Procedure RMP-05.
- 4.4 Consequence of a Failure (COF) shall be defined as the sum of the following Consequences Categories: Impact on Population (IOP), Impact on the Environment (IOE), and Impact on Reliability (IOR). Each of the consequence categories shall be weighted in proportion to the perceived impact of a failure.

IOP shall be weighted 50%, IOE shall be weighted 10%, and IOR shall be weighted 40%.

$$[COF = 0.50(IOP) + 0.10(IOE) + 0.40(IOR)] \qquad \text{Equation 3}$$

The weightings on each of the consequence categories will be reviewed and approved annually by the Consequence Steering Committee. The Consequence Steering Committee will also review and approve the factors, points and weightings used to derive the consequence ranking. For each factor, a percentage weighting will be established to identify the factor's relative significance in determining the COF. Points will be established based on criteria that the committee feels is significant to determining the COF due to each factor. Generally, the summation of the percentage weightings for all of the factors within each impact category will be 100%. Points will be scored to the consequences as follows:

4.4.1 Impact on Population (IOP) shall be calculated per the direction of the Consequence Steering Committee. The committee has determined that the factors in A through C of this section are significant for determining the Population Impact of a gas pipeline failure. The IOP contribution to COF shall be the summation of assigned points times the assigned weighting for the following factors:

A) Population Density in Proximity to Pipeline (35% Weighting): Points will be awarded as follows:

Criteria	Points	Contrib
Class 1	10	3.5
Class 2	40	14
Class 3	70	24.5
Class 4	100	35
Unknown	40	14

B) Pipeline proximity¹ to a potential area of population concentration (45% Weighting): Points are *additive* and will be awarded as follows:

Criteria	Points	Contrib.
Commercial / Industrial Property	50	22.5
Apartments / Church Universities, and Public Assembly Areas ²	70	31.5
Structures Required by Integrity Management Program: Hospitals, Schools, Childcare Centers, Retirement Communities, Prisons, California Youth Authority Facilities, and Health Treatment Facilities	100	50
HCA Structures within 660'	30	13.5
Railroad	30	13.5
Urban, State or National Park	30	13.5
Highway ³	40	18
Stadiums or Commercial Airports	50	22.5

- ¹ Within 100 Yards or 1.5(IZ), (where IZ = 0.685(OD)(√MOP) (in feet)), of Pipeline centerline, whichever is greater and unless otherwise noted.
- ² Park or other identified public assembly area having a capacity of 20 or more people
- ³ Highways are Class 1, 2, and 3 roads in GIS

C) Pipe Impact Zone¹ (Ft.) (20% Weighting): Points will be awarded as follows:

Criteria	Points	Contrib.
< 100 Ft.	10	2
100 to 199 Ft.	20	4
200 to 299 Ft.	40	8
300 to 449 Ft.	60	12
450 to 660 Ft.	80	16
> 660 Ft.	100	20

¹ Impact Zone (IZ) = 0.685(OD)(√MOP) (in feet)

4.4.2 Impact on Environment (IOE) shall be calculated per the direction of the Consequence Steering Committee. The committee has determined that the factors in A and B of this section are significant for determining the environmental impact of a gas pipeline failure. The IOE contribution to COF shall be the summation of the assigned points times the assigned weighting for the following factors:

A) Presence of a Water Crossing (20% Weighting): Points will be awarded as follows:

Criteria	Points	Contrib.
Presence of Water Crossing	100	20
No Water Crossing	0	0

B) Passing through or adjacent* to an Environmentally Sensitive Area (80% Weighting): Points will be awarded as follows:

Criteria	Points	Contrib.
State or National Park	70	56
Wildlife Preserve	70	56
Navigable Waterway	90	72
Other Protected Area	70	56

* Within 100 meters of Pipeline centerline.

4.4.3 Impact on Reliability (IOR) shall be calculated per the direction of the Consequence Steering Committee. The committee has determined that the factors in A through D of this section are significant for determining the reliability impact of a gas pipeline failure. The IOR contribution to COF shall be the summation of the assigned points times the assigned weighting for the following factors:

A) Reliability Impact on Customers served by CGT in the event of a pipe failure (35% Weighting): Points will be awarded for gas load* as follows:

Criteria	Points	Contrib.
0 MCF/Day to 50 MCF/Day	10	3.5
> 50 MCF/Day to 2500 MCF/Day	20	7
> 2500 MCF/Day to 10,000 MCF/Day	40	14
> 10,000 MCF/Day to 50,000 MCF/Day	60	21
> 50,000 MCF/Day	100	35
Unknown (Default)	20	7

* Gas Load is the higher of a Average Summer Day (ASD) or a Average Winter Day (AWD) as provided by Transmission System Planning. It does not include an Abnormal Peak Day (APD).

B) Number of Customers* to experience a gas service outage (55% Weighting): Points will be awarded as follows:

Criteria	Points	Contrib.
None to 1,000	10	5.5
>1,000 to 10,000	20	11
> 10,000 to 50,000	60	33
> 50,000	100	55
Unknown (Default)	20	11

* The number of customer outages is provided by Transmission System Planning.

C) Proximity of Critical Facilities (10% Weighting): Points will be awarded as follows:

Criteria	Points	Contrib.
Liquid Fuel Pipelines ¹	100	10
Other Gas Pipelines ²	80	8
Electric Transmission Lines ³	80	8

¹ Within 30 Meters of Gas Pipeline.

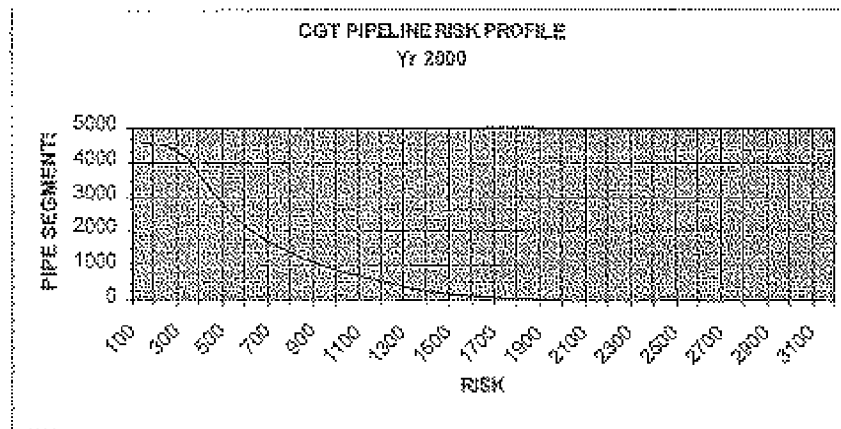
² Within 10 Meters of Gas Pipeline.

³ The distances in footnotes 1 and 2 shown above may be adjusted as appropriate to reflect conditions verified in the field such as precise location and cover.

5.0 RISK MITIGATION

5.1 RISK REVIEW AND ESTABLISHMENT OF TARGET RISK THRESHOLDS

After calculating risk for all pipeline segments, a review of the risk profile is performed with a focus on high-risk pipeline facilities. A target risk threshold is established based on the risk profile and the comparative level of risk necessary to obtain confidence in the structural integrity of CGT's pipeline system. (Below is a risk profile for 2000.)



Once the threshold is established, high-risk segments are reviewed for factors that are significant risk drivers. From these, pipelines are selected for investigation, and mitigation efforts are then proposed to address the significant risk drivers. Because any pipeline failure, regardless of the consequences, is highly undesirable, it may also be prudent to select a certain number of pipelines for investigation based on a high LOF. Consideration as to the number and selection of pipelines to investigate would include the relative LOF, threat type, past risk mitigation efforts, and confidence in COF values.

Depending on the risk driver, mitigation efforts could include one or more of the following:

- Inspections or tests to verify assumptions made in the risk calculation.
- Reduced operating pressure.
- Recoating
- Modification, alteration, or replacement of pipe or protective features.
- Additional Public Education as part of the PSIP Program discussed in Section 5.5 of this procedure or by additional line markers.
- Verification or modification of the consequences of a failure.

Risk values are reported out in a couple of different venues. They are reported to the Manager of System Integrity in an annual report and are provided in the budgeting process to evaluate the risk benefit of performing competing projects, and summary reports are provided to regulatory agencies for their review.

5.2 INSPECTION/TESTING

An effective tool in risk management is inspections and testing. Due to the serious consequences of a pipeline failure, conservative assumptions are necessarily made as to the status of a pipeline when conditions are not known. It is very common to perform an inspection and test and verify that the condition of a pipeline is much better than assumed. The type of inspection or test specified is dependant on the threat.

5.3 PROJECT PLANNING

RMP involvement in the Budget Planning Process also provides opportunities to reduce risk. Therefore, for each proposed project in the annual budget, a risk reduction calculation is performed so that an evaluation can be made as to the risk reduction benefits of the project. Often times, a project benefiting the operating capacity or operating efficiency will also reduce risk and based on a combined benefit will be the most cost effective project.

5.4 REHABILITATION

The RMP Project will propose such projects, as are necessary to establish and maintain an acceptable risk profile. In addition, the RMP will also support and propose other projects that will reduce risk where there are opportunities to justify projects based on reducing risk and reducing maintenance or operation costs.

5.5 PUBLIC SAFETY INFORMATION PROGRAM (PSIP)

The RMP will work in partnership with the Corporate PSIP Program to the extent necessary to ensure compliance with 49 CFR, 192.616 (Public Education) and 49CFR 192.615 (Emergency Plans).

49 CFR, 192.616 states "Each operator shall establish a continuing educational program to enable customers, the public, appropriate government organizations, and persons engaged in excavation related activities to recognize a gas pipeline

emergency for the purpose of reporting it to the operator or the appropriate public officials."

49 CFR 192.615 requires establishing and maintaining adequate means of communication with appropriate fire, police, and other public officials and training of appropriate operating personnel to assure that they are knowledgeable of the emergency procedures and verify that the training is effective. Each operator shall establish and maintain liaison with appropriate fire, police, and other public officials to: (1) learn the responsibility and resources of each government organization that may respond to a gas pipeline emergency; (2) Acquaint the officials with the operator's ability in responding to a gas pipeline emergency; (3) Identify the types of gas pipeline emergencies of which the operator notifies the officials; and (4) Plan how the operator and officials can engage in mutual assistance to minimize hazards to life or property."

6.0 RMP MAINTENANCE

6.1 FACILITY UPDATE

In general, the source of information used to calculate risk shall be obtained from PG&E's Geographical Information System (GIS). Exceptions are noted within the applicable procedures. There are also special cases where updated information is made available from other sources (such as from pipeline engineers, In-Line-Inspection (ILI) reports, or Corrosion Engineers).

Changes in facility properties shall be incorporated into the Risk Calculations at least annually. Examples of facility properties include location, material properties, coating, operating status, cover, pipe specification, and structures near the facility.

6.2 HAZARD UPDATE

RMP will monitor industry experience, as well as PG&E experience to identify trends in threat prediction, mitigation effectiveness, and advances in inspection and risk management technology and adapt the program to new information as necessary to keep the program current and robust.

Data bases necessary for making accurate risk evaluations will be maintained and updated as necessary to ensure hazard information is current. Information necessary to accurately determine and track risk will also be updated as follows:

Threat	Update Interval
Third Party Dig-Ins	Weekly into GIS, Annually – Into Risk Calculations
Leak Reports (EC, DM)	Weekly into GIS, Annually, into Risk Calculations
Seismic (Fault Crossings)	5 years (Per Procedure RMP-04)
Seismic (Vertical or Horizontal Ground Acceleration)	5 years (Per Procedure RMP-04)
Slope Stability	5 years (Per Procedure RMP-04)
Liquefaction	5 years (Per Procedure RMP-04)
Water Crossing	10 years

6.3 CONSEQUENCE UPDATE

RMP will monitor industry experience, as well as PG&E experience to identify trends in consequence prediction and mitigation effectiveness and adapt the program to new information to keep the program current and robust.

Data bases necessary for making accurate risk evaluations will be maintained and updated as necessary to ensure consequence information is current. The following Geographic information will also be updated as follows:

Consequence	Update Interval
Electric Transmission	10 years
Highways	5 Years
Other Pipelines	5 Years
Airports	10 Years
Water Crossing	10 Years
Land Base*	5 years

Land Base information includes Highways, water crossings, park, schools, hospitals, etc.

6.4 ALGORITHM REVIEW

The RMP will annually review the threat and consequence algorithms with the appropriate steering committees and make changes as necessary to reflect regulatory requirements and best industry practices. Additionally, and to the extent practicable, the RMP will also solicit feedback from knowledgeable individuals and organizations in Planning, Pipeline Engineering, Station Engineering, Maintenance and System Integrity.

6.5 REVISION TO RISK CALCULATIONS

Risk calculations shall be reviewed annually and recalculated as necessary to reflect changes to facility, threat, or consequence data, and/or changes to the threat or consequence algorithms.

7.0 INTEGRITY MANAGEMENT

The RMP will develop a plan to implement the expected OPS Gas Pipeline Integrity Rule and integrate it into CGT's RMP. Requirements for execution of the integrity management rule will be per Procedure RMP-08.