

**ENTERPRISE RISK MANAGEMENT**  
**RISK REVIEW**

The Enterprise Risk Management (ERM) program identifies and manages the most significant risks facing PG&E. The Executive Management Committee (EMC) approved a portfolio of ten Enterprise Risks in November 2008 (listed below). Cyber-security was added to the list in April 2010. These risks are being evaluated by multidisciplinary work teams overseen by officer “risk owners.” Upon approval of the Chief Risk and Audit Officer, the evaluations are presented to senior management before being presented to the Finance Committee of the Boards of Directors.

The attached reports summarize the work completed to date on one of the “top” enterprise risks: the risk of a “system safety” event. This is a re-analysis of work presented to the Enterprise Risk Management Committee in January 2007, and to the Board Finance Committee in September 2007.

Risk summaries for other enterprise risks will be presented at future EMC meetings. Questions about the ERM program should be directed to Anil Suri. Questions about specific risks should be directed to the associated Risk Owner.

<b><u>Enterprise Risk</u></b>	<b><u>Risk Owner</u></b>	<b><u>Officer Presentation</u></b>
Business Continuity Plan Failure	Dinyar Mistry	April 2010
Cyber Security	Pat Lawicki	
Diablo Canyon Shutdown	John Conway	May 2010
Energy Procurement	Fong Wan	January 2010
Environmental	Des Bell	
Greenhouse Gas Regulation	Steve Kline	(AB 32 Committee)
Liquidity	Kent Harvey	July 2009
Political and Regulatory Environment	Greg Pruett	
Seismic	Ed Salas	July 2009
System Safety	Ed Salas	July 2010
Urban Fire	Ed Salas	January 2010



# Enterprise Risk Management – System Safety

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Date: June 22, 2010  
Officer Overview

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## Objective

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- Advance Officer Awareness of ERM System Safety
- Explain
  - Approach
  - Definition & Scope
  - Changes, Assumptions, Impact
  - Conclusion
  - Next Steps
- Provide Clarity, Answer Questions

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## ERM - Portfolio of Risks

Enterprise Risks	Owner	Other Significant Business Risks	Owner
Business Continuity	Suri	Dynamic Pricing	Bottorff/Burt
Cyber Security	Lawicki	SmartMeter™	Burt
DCPP Shutdown	Conway	Revenue Stream Continuity	Burt
Energy Procurement	Wan	Customer Loss	Burt/Pruett
Environmental	Bell	Hydro Operations Safety	Conway
Liquidity	Harvey	Reliability	Salas
Political/Regulatory	Pruett	Qualified Workforce	Simon
Regulation of Greenhouse Gas	Kline	Cover-up/Fraud	Suri
Seismic	Salas	Pandemic	Suri
<b>System Safety</b>	<b>Salas</b>	Rogue Trader	Suri
Urban Wildland Fire	Salas	Terrorism/Physical Security	Suri
		Renewables	Wan

\*Anil Suri, Chief Risk Officer, oversees this ERM - Portfolio of Risks

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## Approach

- Created a cross functional analysis team comprised from T&D, Law, Chief Risk Officer organizations
- Used a “bottom’s-up” approach to identify key risks
- Leveraged a “top-down” approach to confirm and prioritize key risks
- Assessed risks as high, medium, low, based on catastrophic impact
- Evaluated mitigation as strong, acceptable, weak, based on effectiveness
- Proposed remediation activities when residual risk is assessed as unacceptable without further corrective action

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## Definition & Scope

- Defined as
  - A single significant event occurring in a high density area (HDA), or
  - Multiple recurring significant events within a short-medium term period independent of geography.
  - These are extraordinary events resulting in fatalities and/or severe injuries.
    - *HDA refers to specific locations within PG&E's service territory that have high population density.*
    - *Using a threshold of 1,000 persons per square mile, the defined HDA includes 6 counties: Alameda, Contra Costa, Santa Clara, San Mateo, San Francisco, and Sacramento.*
    - *These 6 HDA counties account for 75% of the population density within PG&E's service territory.*
- Scoped as
  - System safety events (as defined above) that occur in locations where high population densities intersect with particular types of transmission/distribution equipment that are capable of explosion and fire.

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## Examples of Events

- In-Scope events include:
  - Explosion or fire caused by
    - PG&E at-fault dig-in to a high pressure transmission or distribution line
    - Over pressurization due to unmaintained high pressure gas regulators
    - Underground equipment, such as transformers, in vaults with manholes
    - Energized oil-filled equipment or ceramic bushings located in outdoor substations
  - Multiple explosions or fires caused by
    - Pipeline leaks
    - Aged equipment failure that PG&E had not taken timely action to replace
    - Faulty equipment for which the supplier had previously notified PG&E of its defects but the company took no action to replace it
- Out-of-Scope events include:
  - Reliability events such as outages, which are managed through the reliability program
  - Seismic events, which are addressed in the ERM seismic risk
  - Urban wildland fire events, which are addressed in the ERM urban fire risk
  - Nuclear and generation events, which are addressed ERM Diablo Canyon and Hydro Operations Safety risks
  - Environmental events, which are addressed by ERM environmental risk
  - Other natural hazard events, such as facility failure caused by flooding

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## Changes, Assumptions, Impact

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- Changes
  - Prior assessment
    - Definition was too broad; it included any system condition to cause a safety hazard event.
    - Scope was too generic; it included any risks associated with day-to-day activities in gas and electric.
  - Current assessment
    - Definition and scope focuses on catastrophic events that pose extraordinary risk.
    - Ordinary system safety risk is excluded as its mitigated via the core processes, compliance activity and daily operations of T&D systems.
- Critical Assumptions
  - In-scope system safety scenarios are events that pose highest risk of catastrophic consequences.
  - Single significant events outside defined HDA do not pose catastrophic risk.
- Impact
  - Financial: \$100 to \$500 million
  - Image/Reputation: National media attention
  - Environment & Safety: Significant

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## Conclusion

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- Concluded that PG&E already has significant mitigation efforts in place to address potentially catastrophic system safety events. These include:
  - Design Standards
  - Methods and Work Procedures
  - Operational and Technical Trainings
  - Operator Qualification
  - Root Cause Analysis of Events Process
  - Work Error Identification and Corrective Action Processes
  - Line Patrols and Inspections Program
  - Equipment Inspection and Testing Programs
  - Maintenance and Construction Programs
  - Repair and Replacement Programs
  - Pipeline Integrity Management Programs
  - Pipeline Damage Prevention
  - Mark and Locate Program
  - Quality Assurance
  - Compliance Programs (e.g., FERC, NERC, DOT, CPUC)

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## Next Steps

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- Proposed additional remediation efforts to further mitigate risks; these include
  - Gas Distribution: to develop a new Probabilistic Risk Model that
    - uses a quantitative risk analysis method,
    - includes dollar amounts for consequence, and
    - encompasses high consequence very low probability threats.
  - Electric Distribution: to provide list of high risk equipment along with a work plan for replacement based on age and risk exposure.
  - Transmission & Distribution: to develop quantitative methods to enhance measurement of system safety risk and mitigation effectiveness.
- Scheduled meetings with Officers
  - Share results with Anil Suri (CRO) and key stakeholder officers, who include:
    - Jack Keenan (COO)
    - Des Bell (Shared Services)
    - Pat Lawicki (ISTS)
    - Geisha Williams (ED)
    - Greg Kiraly and Bill Hayes (EM&C and GM&C)
    - Sara Cherry (Finance)
  - Provide final results to the Executive Management Committee and Peter Darbee

## **ENTERPRISE RISK MANAGEMENT** **SYSTEM SAFETY RISK REVIEW – 2009/2010**

### **Introduction**

In 2009, Transmission & Distribution (T&D) updated its ERM system safety risk—its definition, scope, and mitigation activities, originally developed in 2006. Its ERM risk manager created a cross functional analysis team with over a dozen subject matter experts (SMEs) throughout gas and electric along with leads from Law and Chief Risk Officer organizations.

A “bottom’s-up” approach was used to identify key risks. This process entailed having several facilitated structured meetings to solicit input from the analysis team, who roundtabled system safety scenarios to pin point catastrophic inherent risk (risk assuming no controls in place) and to shape definition and scope. A “top-down” approach was then used with various officers and directors to confirm and prioritize key risks. Taking this holistic approach allowed focus to be placed on those distinct system safety risks that fall outside of T&D’s day-to-day processes, due to the potential of these risks yielding catastrophic impact yet low likelihood events.

The analysis team went about working with SMEs in their larger business areas, identifying applicable key programs that mitigate the risk drivers, and evaluating the effectiveness of controls in order to reduce residual risk (risk with controls in place) to acceptable levels. This process took about 3 months to complete and results were reviewed by business areas officers/directors, along with the ERM risk manager and risk owner officer.

Given that existing asset management databases are not capable of providing geographic/spatial level analysis, as a result this risk assessment has leveraged predominantly qualitative methods to derive results. Risks are assessed as high, medium, low, based on catastrophic impact. Mitigation is assessed as strong, acceptable, weak, based on its level of controls effectiveness (preventive, detective, and administrative). Proposed remediation activities are a result of residual risk assessed as unacceptable without further corrective action.

### **Risk Definition**

The risk of a single significant event occurring in a high density area, or of multiple recurring significant events within a short-medium term period independent of geography, resulting in fatalities and/or severe injuries.

“Significant event” refers to a system condition; specific examples of these are listed in the in-scope section.

“Multiple recurring events” refers to a system condition where its significance is compounded by its repeated occurrence within a short-medium term period; specific examples of these are listed in the in-scope section.

“System condition” refers to a condition that PG&E knew about or should have known about, associated with gas or electric transmission and distribution facilities, that poses a catastrophic threat to the safety of employees, contractors, or the public.

“High density area” (HDA) refers to specific locations within PG&E’s service territory that have high population density. Using the 2005 California Population Density by County, [http://www.counties.org/images/public/CA\\_Counties/Pop%20density%20by%20county.pdf](http://www.counties.org/images/public/CA_Counties/Pop%20density%20by%20county.pdf), which uses a threshold of 1,000 persons per square mile, the defined HDA includes 6 counties: Alameda, Contra Costa, Santa Clara, San Mateo, San Francisco, and Sacramento. These 6 HDA counties account for 75% of the population density within PG&E’s service territory.

Attachment A provides California County Population Density details and GIS pictures of PG&E’s service territory with focus on Transmission assets. Distribution assets are excluded from map overlay due asset data by location being not readily available; remediation to improve risk management of these assets is included with Additional Proposed Activities to Mitigate System Safety Risk.

## **Scope**

The scope of this risk is limited to system events that occur in the HDA, or multiple recurring events independent of geography, that intersect with particular types of transmission and distribution equipment that have the capability of explosion and fire, resulting in fatalities and/or severe injuries.

## **Examples of In-Scope Events:**

- For gas transmission and distribution system, events include:
  - Explosion or fire caused by over pressurization due to unmaintained high pressure regulators (or where there is a lack of redundant mitigation for these regulators).
  - Explosion or fire caused by a PG&E at-fault dig-in to a high pressure transmission line or distribution line.
  - Multiple explosions or fires caused by pipeline leaks.
  
- For electric transmission and distribution system, events include:
  - Explosion or fire caused by underground equipment (such as transformers or splices) in vaults with manholes.
  - Explosion or fire caused by energized oil-filled equipment or ceramic bushings located in outdoor substations.
  - Multiple explosions or fires caused by faulty equipment for which the supplier had previously notified PG&E of its defects but the company took no action to replace it.
  - Multiple explosions or fires caused by aged equipment failure that PG&E had not taken timely action to replace.
  
- System safety events (as described above) exacerbated by PG&E’s failure to adequately respond to an emergency.

### **Events Out of Scope include:**

- Other events relating to electric and gas transmission and distribution system that are omitted from the system safety scope include:
  - Reliability events, such as outages and the indirect impact to customers, which are managed through the reliability program.
  - Seismic events, such as third party damage, which are addressed in the ERM seismic risk.
  - Urban wild land fire events, which are addressed in the ERM urban fire risk.
  - Nuclear and generation events, which are addressed ERM Diablo Canyon and Hydro Operations Safety risks
  - Environmental events, which are addressed by ERM environmental risk.
  - Other natural hazard events, such as facility failure caused by flooding.

### **Changes to Definition/Scope from 2006 to 2009 for the ERM System Safety Assessment**

- The prior definition was very broad; it included any system condition that could cause a hazardous event (i.e., significant safety risk) that PG&E knew or should have known about but failed to take expeditious or sufficient action to mitigate.
- The prior scope included risks associated with day-to-day activities in gas and electric transmission and distribution (G&E T&D systems) and the potential system safety risks that relate to these activities; the 2009 ERM effort has sought to redefine the scope to focus more narrowly on those events that pose a potentially catastrophic risk to PG&E.
- During the 2009 ERM effort, the risk definition and scope were periodically reviewed and refined to ensure that the risk analysis addressed the areas of the transmission and distribution system that posed extraordinary risk for a catastrophic event, without unduly narrowing the boundaries of the scope.
- A team of subject matter experts from G&E T&D systems assessed various system safety events and scenarios and recommended only those identified events listed in the in-scope section to be included.

### **Critical Assumptions**

- In-scope system safety scenarios are events that pose the highest risk of catastrophic consequences.
- Single significant events outside the defined HDA do not pose catastrophic risk.

## **Ownership and Responsibility**

Risk Owner	Ed Salas
Supporting Officers	Jack Keenan, Des Bell, Pat Lawicki, Geisha Williams, Bob Howard, Mark Johnson, and P.J. Martinez
Risk Manager	Ken Wells
ERM Resource Support	Josh Fleischer
Analysis Team	Electric Distribution Engineering: Trish Lynch Electric Operations: Ben Almario, Angie Gibson Electric System Engineering: Steven Ng Electric Substation Engineering: Dan De La Cruz Electric Transmission Engineering: Raymond Thierry Engineering & Operations: Ferhaan Jawed Gas Engineering: Glen Carter, Bob Fassett, Bill Manegold Gas Operations: Gary Chrisco Geosciences: Kent Ferre Law: Lise Jordan, Steve Garber System Reliability & Support: Tom Swierk Vegetation Management: Pete Dominguez

## **Process**

- Significant risks were identified and consolidated into risk families to pinpoint key drivers
- Existing mitigation activities were evaluated against identified risks
- Potential gaps were identified
- Potential gaps were further evaluated, and discussed with business line management
- Proposals for eliminating gaps were developed with action plans
- Risk definition and scope were revisited to ensure that the assessment risk captured extraordinary risk events without inappropriately narrowing the geographic areas of the risk

## **Impact Analysis**

Financial	▪ \$100 to \$500 million
Image/Reputation	▪ National media attention
Environment & Safety	▪ Significant

### Financial

- 3rd party damages (property and injury) due to system safety event: potentially more than \$500 million
- PG&E damages (property and injury) due to system safety event: potentially up to \$100 million
- Loss of PG&E revenue due to utility service downtime: potentially up to \$100 million

### Image/Reputation

- Impact to businesses from utility service disruption following a system safety event
- Perception of not meeting state and local regulatory and safety requirements
- Litigation and other third party actions would result in sustained news coverage

### Safety

- Impact to employee and public safety due to a high potential for fatalities or severe injuries, along with direct damage to equipment and loss of service at critical facilities
- Health and safety impact to the public that may be attributed to lack of utility service

### **Interrelated Risks**

- Business Continuity
- Political/Regulatory
- Seismic
- Urban Wild land Fire

### **Risk Drivers**

The risk drivers discussed below are applicable to the system safety in-scope events and characterize the risk of what can potentially fail (rather than a characterization of what is failing).

- Relating to the electric transmission and distribution system:
  - External
    - Third party damages equipment (dig-in)
    - Third party equipment is inadequate (fuel tank/protective barrier)
  - People
    - Improper operation or design
    - Failure to perform quality inspections or workmanship
  - Process
    - Improperly maintained equipment (i.e., due to inadequate asset records and maps)
    - Failure to replace aging equipment
  - Technology
    - Faulty equipment (i.e., due to failure to act on manufacturer product alerts)

- Relating to the gas transmission and distribution system:
  - External
    - Animals cause damage (fill equipment boxes with dirt)
    - Third party construction volume contributes to untimely response (or less qualified employee to respond)
  - People
    - Improper operation or design
    - Improper access to equipment causes damage
    - Inadequate staffing/resources
  - Process
    - Unmapped/improperly mapped facilities contribute to dig-ins
    - Inadequate design/construction/maintenance standards and procedures
  - Technology
    - Lack of distribution SCADA data delays timely response
    - Potential inaccuracy of locating tools used for facilities
    - Potential for error due to facilities having varying types of signals used to locate equipment
  
- Relating to emergency response:
  - External
    - Restricted or delayed access to event location
  - People
    - Lack of trained employees
    - Inadequate staffing
  - Process
    - Lack of (or inadequate) procedures and training
  - Technology
    - Unable to operate/monitor system due to equipment and communication failures

### **Current Mitigation Activities**

- Attachment A contains tables that list risk drivers (in columns), existing mitigation measures (in rows) and an evaluation of mitigation effectiveness with respect to the risk driver (in each cell). Depending on effectiveness, mitigation is rated as strength, acceptable, or weak.
  - Mitigation activities for electric transmission and distribution system include:
    - Standards, work procedures and related trainings for asset management
    - Equipment maintenance and replacement programs, including patrols and inspections
    - System automation and technology, such as SCADA
    - Quality assurance and control

- Mitigation activities for gas transmission and distribution system include:
  - Standards, work procedures and related trainings for pipeline management
  - Integrity management and damage prevention programs
  - System automation and technology, such as gas shut off devices
  - Quality assurance and control
  
- Mitigation activities relating to emergency response (ER) and incident command (IC) for G&E T&D systems include:
  - ER and IC operating plans and procedures
  - ER and IC training and preparedness
  - Design of system infrastructure, SCADA, gas shut off devices
  - Design of communication equipment, radio, phone, etc.

### **Summary Conclusion**

The 2006 ERM system safety risk assessment identified several measures to mitigate the risk of such events from occurring. The status of those measures is discussed in the Prior Remediation Commitments Section. The 2009 ERM system safety risk assessment took an iterative approach and redefined the scope to focus more narrowly on those events that pose a potentially catastrophic risk to PG&E, evaluated the narrower risk and concluded that PG&E already has significant mitigation efforts in place to address potentially catastrophic system safety events. The additional efforts that are expected to further mitigate risks are discussed in the Additional Proposed Activities to Confirm Scope and Mitigate System Safety Risk Section.

**Additional Proposed Activities to Mitigate System Safety Risk**

Proposed remediation activities pending officer approval

<b>Gap</b>	<b>Proposed Activities</b>	<b>Who Is Accountable?</b>	<b>Target Date</b>
Potentially unmaintained high pressure regulators (HPRs).	Identify and map in GIS the location of non-district regulator station HPRs in the HDA.	Gas Engineering, Bob Howard & Glen Carter	12/31/10
	Develop and implement an atmospheric inspection/remediation program for HPRs in the HDA.		6/30/11
	As appropriate based on risk, apply this new atmospheric inspection/remediation program for HPRs to service locations outside the HDA.		12/31/12
Integrity management over gas distribution pipelines needs improvement.	Develop new Probabilistic Risk Model that <ul style="list-style-type: none"> <li>• Uses quantitative risk analysis method</li> <li>• Uses historical event rate of occurrence (i.e 1/1000, 1/10,000 etc.)</li> <li>• Uses dollar amounts for consequence</li> <li>• Does not exclude high consequence very low probability threats (i.e. major earth quakes, land slides etc.)</li> </ul>	Gas Engineering, Bob Howard & Glen Carter	In phases from 2010 to 2013
Management over electric asset strategy for aging distribution equipment needs improvement.	Prepare a list of high risk equipment.	Electric Distribution Engineering, P.J. Martinez & Greg Disse	12/31/10
	Create a work plan to replace high risk aging equipment and pilot efforts in San Francisco.		3/31/11
	Revise work plan, as needed, and apply efforts to HDA areas along with other service locations outside the HDA as appropriate based on risk.		12/31/12
	Review and modify, as needed, failure analysis process and preventive maintenance practices for equipment.		3/31/12
Status and control metrics to measure system safety risk and mitigation effectiveness, useful for decision-making.	Assist G&E T&D systems to develop quantitative methods to enhance measurement of system safety risk and mitigation effectiveness.	System Reliability & Support, Ken Wells	6/30/11

**Prior Remediation Commitments to Mitigate System Safety Risk**

The following commitments were made in previous review cycles. Work efforts are either complete and on-going, or they have been initiated; however, successful completion is dependent on successful regulatory outcomes.

<b>Commitment Activity</b>	<b>Status</b>	<b>Who Is Accountable?</b>
Implement effective asset registry system	G&E T&D use SAP and other systems to manage its asset records. Efforts to improve the accuracy and completeness of these asset records are progressive year to year, and will continue. Compliance efforts, along with other asset maintenance efforts relating to electric relays and poles, gas pipe leak surveys have contributed to asset management improvements. In addition, a work management system (WMS) is being implemented for maintenance activities. WMS will bring efficiency and accountability and monitor workload and performance.	Electric Engineering, P.J Martinez and Gas Engineering, Bob Howard
Improve tracking of programs mitigating incidents/equipment failures	G&E T&D enhanced its tracking of incidents and equipment failures by centralizing the recording of events to improve analysis and reporting, and by creating root cause analysis processes within the business areas to enhance analysis of high risk events. In addition, other processes to manage the quality of material and equipment have been implemented/enhanced, such as material problem reporting and supplier notification for product changes.	Electric Engineering, P.J Martinez and Gas Engineering, Bob Howard
Enhance local agency coordination	Electric Operations (EO) improved its emergency response program through increased arrangements and relations with local water agencies, fire departments, and county offices of emergency services.	Electric Operations, Mark Johnson & Kris Buchholz
Changes to personnel deployment to enhance coverage in emergency response areas	EO improved its emergency response program by increasing its staffing, by improving its efforts for better mobilization and communication, by improving its operations coordination center (OCC) for crew/equipment/tools readiness and availability, by strengthening its coordination with customer care and account services, by increasing its communications with its OCC and resource management centers, and by implementing an incident command system (ICS).	Electric Operations, Mark Johnson & Kris Buchholz
Changes to personnel deployment to enhance coverage in emergency response areas	Gas Operations improved its emergency response program by implementing the ICS system along with additional training, by increasing the number of personnel filling ICS roles in the gas restoration center, and by leading gas emergency exercises at division and district levels for transmission, distribution, and customer field service.	Gas Engineering, Bob Howard & Glen Carter

<b>Commitment Activity</b>	<b>Status</b>	<b>Who Is Accountable?</b>
Enhance analysis of key information sources – more rigorous data analysis and streamlined data collection	<p>G&amp;E T&amp;D enhanced its analysis, use, and communication of key information sources by increasing the effectiveness of its quality assurance program and methods and procedures / work procedure errors programs by centralizing and streamlining them, by improving its outage reporting to provide better visibility and more accountability to its business areas, and by dedicating its Compliance Champion to manage risk and compliance activities to sustain communications with management regarding status of issues and non-compliance.</p> <p>Law communicates operational/system risks identified through litigation, CPUC action, or the claims process to the appropriate operating groups and works with these groups to mitigate those risks.</p>	System Reliability and Support, Ken Wells
Implement a gas distribution integrity management program to integrate pipeline replacement, meter protection, and copper service replacement.	<p>Gas Engineering implemented a gas distribution integrity management program, and continues to enhance it as new regulations and/or technology becomes available. This program includes threat identification, risk evaluation/ ranking of threats, recommended remediation to manage risks, and mitigation performance and results monitoring.</p>	<p>Law, Stephen Schirle</p> <p>Gas Engineering, Bob Howard &amp; Glen Carter</p>

## **Exhibits for System Safety Scope**

Attachment A provides California County Population Density details and GIS pictures of PG&E's service territory with focus on Gas Transmission (GT) pipelines, Electric Transmission (ET) lines, and Substations. [As previously mentioned, Distribution assets are excluded from map overlay due asset data by location not being readily available; remediation to improve risk management of these assets is included with Additional Proposed Activities to Mitigate System Safety Risk.]

Located below are statistics to provide context and perspective on risk exposure, and to demonstrate that

1. High population concentrations per square mile are located in the HDA, thus lessening risk exposure elsewhere in PG&E's service territory.
2. High risk assets related GT, ET and Substation located in the HDA have a low concentration rate, thus lessening risk exposure in these highly populated areas.

PG&E's service territory contains

- 6 HDA counties of 1,000 or more persons per square mile (e.g., Alameda, Contra Costa, Santa Clara, San Mateo, San Francisco, and Sacramento), which accounts for 75% of the population density.
- 1 county of 500 to 999 persons per square mile (e.g., Santa Cruz with less than 600)
- 40 counties of less than 500 persons per square mile

GT pipelines

- ~1,000 miles (13%) located within the HDA counties, of which 50% are considered Gas High Consequence Area (HCA) locations
- ~6,400 miles (87%) located outside the HDA counties yet within the service territory, of which 18% are considered Gas HCA locations

ET lines

- ~3,300 miles (17%) located within for the HDA counties
- ~15,900 miles (83%) located outside the HDA counties yet within the service territory

Substations

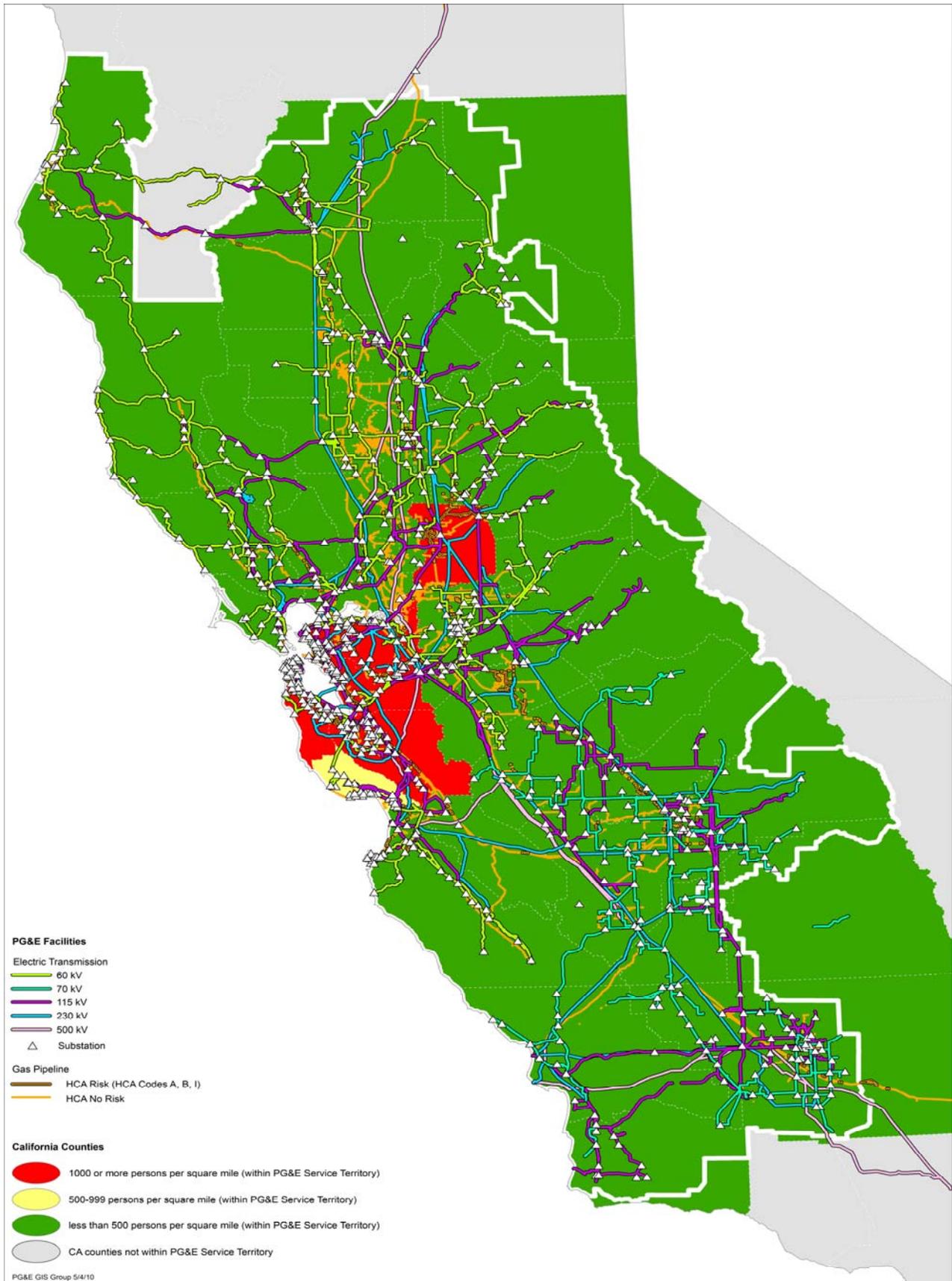
- ~250 stations (28%) located within the HDA counties, of which 10% are indoor (within enclosed structures) and 90% are outdoor
- ~630 stations (72%) located outside the HDA counties yet within the service territory, of which 99% are outdoor

*Note:*

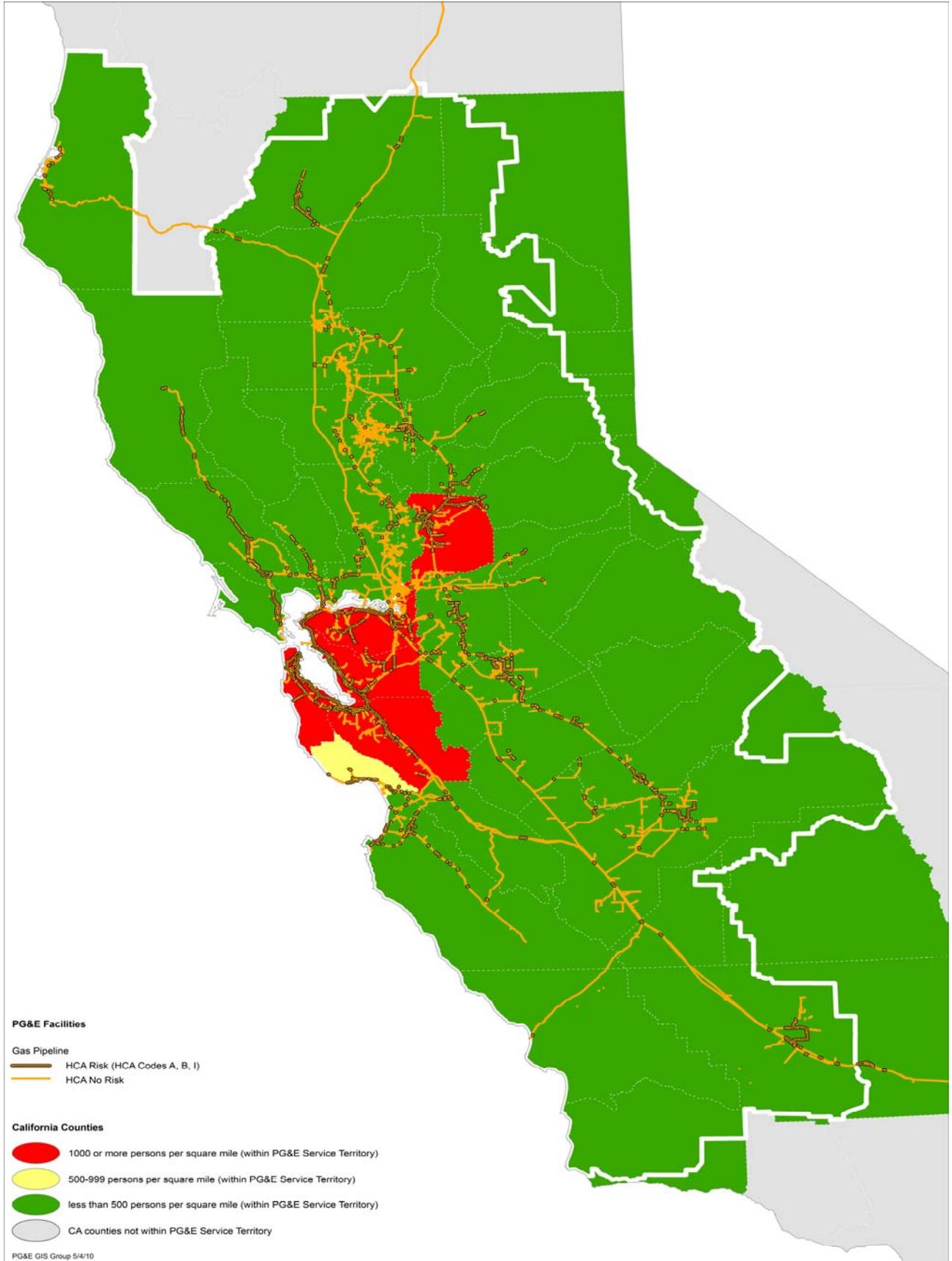
- *The core processes, compliance activity and operations of G&E T&D systems mitigate ordinary system safety risk. The focus of this ERM system safety assessment is on catastrophic events that pose extraordinary risk.*
- *Transmission and substation assets are subject to strict management standards by regulators, including the Department of Transportation for Pipelines and the North*

*American Electric Reliability Corporation (NERC). As such, risk exposure is lessened by T&D's Gas Transmission Integrity Management Program and its NERC compliance program, which provide focused oversight on these high risk assets.*

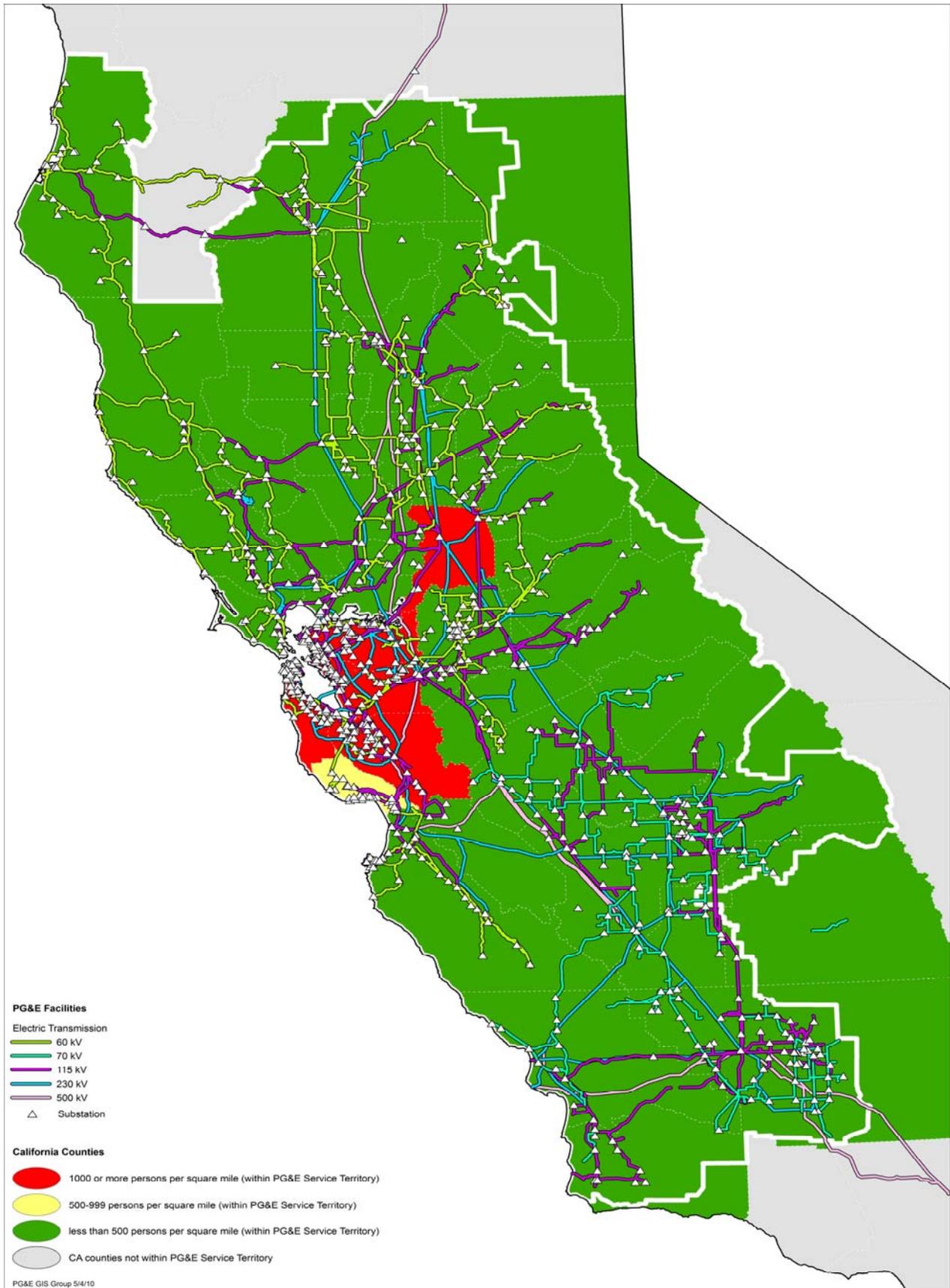
# Attachment A1: Gas Transmission Pipelines, Electric Transmission Lines, and Substations



# Attachment A2: Gas Transmission Pipelines



# Attachment A3: Electric Transmission Lines and Substations



## Attachment A4: California County Population Density

County	Population by square mile (2005 estimates)*	County	Population by square mile (2005 estimates)*
San Francisco	8,714	San Bernardino	97
<i>Orange**</i>	3,882	El Dorado	96
<i>Los Angeles**</i>	2,492	Kern	93
Alameda	1,818	Tulare	85
San Mateo	1,355	San Luis Obispo	79
Sacramento	1,347	Madera	66
Santa Clara	1,332	Amador	63
Contra Costa	1,277	Lake	48
<i>San Diego**</i>	710	Shasta	47
Santa Cruz	592	Calaveras	44
Solano	482	San Benito	41
San Joaquin	456	Humboldt	37
<i>Ventura**</i>	435	<i>Imperial**</i>	35
Marin	428	<i>Del Norte</i>	29
Stanislaus	332	Mendocino	26
Sonoma	299	Tuolumne	25
<i>Riverside**</i>	261	Glenn	21
Placer	205	Tehama	20
Yolo	181	Colusa	18
Napa	167	Mariposa	12
Santa Barbara	152	Plumas	8
Fresno	147	Lassen	8
Sutter	147	Siskiyou	7
Butte	129	<i>Mono**</i>	4
Monterey	127	Trinity	4
Merced	120	Sierra	4
Yuba	105	Modoc	2
Kings	101	<i>Inyo**</i>	2
Nevada	100	Alpine	2

\*According to population estimates from the California Department of Finance, and square mileage numbers from the California State Controller's Office

\*\*Counties in italics without shade are located outside PG&E's service territory

Red shade = 1,000 or more persons per square mile with PG&E service territory

Amber shade = 500 to 999 persons per square mile with PG&E service territory

Green shade = less than 500 persons per square mile with PG&E service territory

## Attachment A5 - Emergency Response - Mitigation Matrix

Legend: H – High M – Medium L – Low  S – Strong A – Acceptable W – Weak	Risk Driver Family	System safety and urban wildland fire events exacerbated by gas transmission and distribution facilities, or PG&E's failure to adequately respond to an emergency. <i>This risk evaluation only considers system safety and urban wildland fire event impact rather than other types of events such as earthquakes, which are addressed in ERM seismic risk.</i>														
	Category	External			People				Process			Technology				
	Risk driver	Restricted or delayed access to event location		Lack of trained employees				Inadequate staffing	Lack of (or inadequate) procedures and training			Unable to operate/monitor system due to equipment and communication failures				
	High Consequence Events (Examples)	Government agencies limit access or its response isn't timely/coordinated	Environment limits access	Lack of qualified electric personnel	Lack of qualified gas personnel	Lack of qualified ISTS personnel	Personnel error	Inability to respond	Regulatory fines, 3rd party litigation	Death/severe injury to employee/contractor/ or the public	Lack of / inadequate PG&E response & coordination	Critical system failure (SCADA, operational data network, outage information system)	Critical equipment failure (gas shut-off valves, substation banks)	Limited radio coverage/usage	Cell/satellite / lan line failure	
<b>Key Mitigation Efforts</b>	<b>Inherent Risk</b>	M	H	M	M	M	M	M	H	H	M	H	H	M	M	
Emergency Response Activities	Management emergency response resource and operating plans							A	A	A	A	A	A			
	Operating procedures - emergency response (technology down, business continuity and work around)			A	A	A	A	A	A	A	A	A	A	A	A	
	Training - first responder			A	A	A	A		A	A	A	A	A	A	A	
	Training - emergency response skills (includes incident command system and leadership coordination)			A	A	A	A		A	A	A	A	A	A	A	
	Training - operations (operator qualification)			A	A	A	A		A	A	A	A	A	A	A	
	Training - emergency response exercise (faux drill)	A		A	A	A	A		A	A	A	A	A	A	A	
	Design of communication devices used to sustain response efforts														W	A
	Design of infrastructure systems/equipment used to sustain operations		A									A	A			
	External coordination with local agencies	A							A	A						
	External coordination with customers & media	A							A	A						
	Internal coordination within PG&E	A							A	A						
	Regulatory oversight by CPUC, CAISO, etc (such as GO 166 requires PG&E to sustain emergency response program)			A	A		A	A	A	A	A					
Emergency response post incident evaluation (evaluates how well mitigation addressed risk drivers)	A	A	A	A	A	A	A	A	A	A	A	A	A	A		
<b>Residual Risk</b>	M	H	L	L	L	L	M	M	M	L	M	M	M	L		
<b>Remediation Underway</b>																
<i>The first two efforts are addressed with ERM seismic risk along with the latter effort that is part of day-to-day operational improvements. These are noted below as they will further reduce future risk exposure.</i>																
	T&D to develop/implement emergency response playbook for gas & electric to address (a) making the system safe, (b) system resilience and restoration, and (c) preparedness/ coordination/communication for internal/external needs.															
	T&D & ISTS to implement "Radio Refresh" to have all company wide radios on same frequency to facilitate emergency response and restoration activities.															
	T&D to implement Automated Mapping/Facility Management (AM/FM) GIS project. The implementation of an Enterprise GIS system will allow better access to our facilities data and will help establish the framework for future technologies throughout the company.															
<b>Residual Risk</b>	M	H	L	L	L	L	M	M	M	L	M	M	M	L		

## Attachment A6 - System Safety - Electric Transmission - Mitigation Matrix

Legend:  H – High M – Medium L – Low  S – Strong A – Acceptable W – Weak		Risk Driver Family		Events include explosion or fire caused by underground equipment (such as transformers or splices) in vaults with manholes, or multiple explosions or fires caused by faulty equipment for which the supplier had previously notified PG&E of its defects but the company took no action to replace it, or multiple explosions or fires caused by aged equipment failure that PG&E had not taken timely action to replace.				
		Category	External	People		Process		Technology
		Risk driver	3rd party damages equipment (dig-in)	Improper operation or design	Failure to perform quality inspections or workmanship	Improperly maintained equipment	Failure to replace aging equipment	Faulty equipment
<b>Key Mitigation Efforts</b>		<b>Inherent Risk</b>	L	M	M	M	L	M
Primary Electric Transmission Activities	Apprenticeship program			A	A	A		
	Automatic protection schemes			W				
	Cable replacement						W	
	Clearance process			S	S			
	Design standards			A	A			
	Maintenance management and execution standards				A	A	A	
	Manufacturer evaluation							S
	New product testing							A
	Operating procedures			A				
	Patrol & inspection				A	A	A	
	SCADA			A				
	Station inspection				A	A	A	
	Supplier equipment inspection and acceptance testing							A
	Training (initial & periodic)				A	A		
	Utility operations standards/guidelines/bulletins/procedures				A	A		
	Underground service alert		A					
Secondary Electric Transmission Activities	Cable replacement							W
	Construction standards / feedback loop			A				
	CPUC/CAISO inspection reports				A	A		
	Electric maintenance notification process					A		
	Failure analysis				W		W	W
	Infrared inspection				A			
	Institutional knowledge				A	S		
	Manhole cover replacement							A
	Manufacturer problem notifications							W
	Material problem reports						W	W
	NERC/FERC requirements & assessments					A		
	New product testing							A
	Quality assurance				W	A		
	Safety health & claims near miss reports				W	W		
	Oversight during excavation		A					
Supplier equipment acceptance and inspection testing							A	
		<b>Residual Risk</b>	L	L	L	L	L	L
<b>Related Remediation</b>								
<i>These efforts are part of operational improvements and are included as they further reduce risk exposure.</i>								
As part of the San Francisco re-cable project, sections of the cable were removed for laboratory testing and analysis; results showed cable condition was favorable, which increases confidence in reliability of other cables throughout the system.							A	
As part of a project to replace pressurization equipment, we are installing lower pressure 'trip' systems that with automatically protect the cable. On cables without pumping plants (high pressure gas filled) low pressure protection will be installed over the next several years.				A		A	A	
		<b>Residual Risk</b>	L	L	L	L	L	L

## Attachment A7 - System Safety - Electric Distribution - Mitigation Matrix

Legend: H – High M – Medium L – Low  S – Strong A – Acceptable W – Weak		Risk Driver Family		Events include explosion or fire caused by underground equipment (such as transformers or splices) in vaults with manholes, or multiple explosions or fires caused by faulty equipment for which the supplier had previously notified PG&E of its defects but the company took no action to replace it, or multiple explosions or fires caused by aged equipment failure that PG&E had not taken timely action to replace.				
		Category	External	People		Process		Technology
		Risk driver	3rd party damages equipment (dig-in)	Improper operation or design	Failure to perform quality inspections or workmanship	Improperly maintained equipment	Failure to replace aging equipment	Faulty equipment
<b>Key Mitigation Efforts</b>		<b>Inherent Risk</b>	L	M	H	H	H	M
Primary Electric Distribution Activities	Equipment inspections & testing program (line equipment)			A	A			
	Equipment inspection & testing program (network transformers)			S	S			
	Patrol & inspection program (includes infrared)			A	A			
	Electric corrective maintenance notification work				A	A		
	Electric direct current elimination program					A		
	Equipment replacement programs					A (network, underground) W (Cable)	W (Cable)	
	Apprenticeship program		A		A			
	Training (initial & periodic)			A	A			
	Design standards		A					
	Failure analysis			A			W	W
	Maintenance & construction work procedures		A	A				
	Maintenance management & execution standards			A	A		W	
	Quality assurance		A	A	W			
	Supervisor in the field			W	W			
Utility operations standards/guidelines/bulletins/procedures			S	S				
Secondary Electric Distribution Activities	Clearance process		A					
	Construction standards / feedback loop		A					
	CPUC/CAISO inspection reports				A			
	Institutional knowledge			A	A			
	Manhole cover replacement						A	
	Manufacturer evaluation						A	
	Manufacturer problem notifications						W	
	Material problem reports						W	
	Operating procedures		A					
	Outage review process				W	W		
	Program management			A	A	W		
	Quality control			W	W			
	SCADA						A	
	Safety health & claims near miss reports			W	W			
Oversight during excavation		A						
<b>Residual Risk</b>		<b>L</b>	<b>M</b>	<b>M</b>	<b>M (line equip) L (network)</b>	<b>H</b>	<b>M</b>	
<b>Additional Proposed Remediation</b>								
Prepare list of high risk equipment; create a work plan to replace; pilot effort then apply to other high risk urban areas.						A		
Review/modify failure analysis process and preventive maintenance practices for equipment located in high risk urban areas.						A		
Implement project to improve underground cable testing & proactive cable replacement; pilot to occur in San Francisco in 2010.						A		
Implement project to improve decision making process for underground cable management; pilot underway in San Jose in conjunction with Equipment Requiring Repair program.						A		

## Attachment A7 - System Safety - Electric Distribution - Mitigation Matrix

<b>Legend:</b> H – High M – Medium L – Low  S – Strong A – Acceptable W – Weak	<b>Risk Driver Family</b> Events include explosion or fire caused by underground equipment (such as transformers or splices) in vaults with manholes, or multiple explosions or fires caused by faulty equipment for which the supplier had previously notified PG&E of its defects but the company took no action to replace it, or multiple explosions or fires caused by aged equipment failure that PG&E had not taken timely action to replace.							
	<b>Category</b>	<b>External</b>	<b>People</b>		<b>Process</b>		<b>Technology</b>	
	<b>Risk driver</b>	3rd party damages equipment (dig-in)	Improper operation or design	Failure to perform quality inspections or workmanship	Improperly maintained equipment	Failure to replace aging equipment	Faulty equipment	
<b>Key Mitigation Efforts</b>	<b>Inherent Risk</b>	L	M	H	H	H	M	
	<b>Residual Risk</b>	L	M	M	M (line equip) L (network)	M	M	

## Attachment A8 - System Safety - Substation - Mitigation Matrix

Legend: H – High M – Medium L – Low  S – Strong A – Acceptable W – Weak		Risk Driver Family		Events include explosion or fire caused by energized oil-filled equipment or ceramic bushings located in outdoor substations.				
		Category		External	People		Process	Technology
		Risk driver		3rd party equipment is inadequate (fuel tank/protective barrier)	Improper operation or design	Failure to perform quality inspections or workmanship	Improperly maintained equipment	Failure to replace aging equipment
<b>Key Mitigation Efforts</b>		<b>Inherent Risk</b>	L	L	M	M	M	L
Primary Substation Activities	Apprenticeship program		A	A	A			
	Design standards	S	A					
	Equipment inspections & testing			S	A	A	A	A
	Failure analysis			A	A	A	A	A
	Infrared Inspection				A	A	A	A
	Material problem reports			A	A	A	A	A
	Operations maintenance & construction work procedures		A	A	S	A	A	A
	Replacement program (transformers/circuit breakers/switches)					A		
	Training (initial & periodic)		A	A	A			
	Utility operations standards/guidelines/procedures/bulletins	S	A	A	A			
Secondary Substation Activities	Applied technology services	A						
	Automatic protection schemes		A					A
	CPUC/CAISO inspection reports				A			
	Manufacturer evaluation							A
	Manufacturer problem notifications							A
	NERC/FERC requirements & assessments				A			
	New product testing							A
	Quality assurance				A			
	Supplier equipment acceptance and inspection testing							A
<b>Residual Risk</b>			L	L	L	L	L	L

**Attachment A9 - Gas Transmission and Distribution - Mitigation Matrix**

Legend: H – High M – Medium L – Low  S – Strong A – Acceptable W – Weak	Risk Driver Family	Events include explosion or fire caused by over pressurization due to unmaintained high pressure regulators (or where there is a lack of redundant mitigation for these regulators).							Events include explosion or fire caused by a PG&E at-fault dig-in to a high pressure transmission line or distribution line, or multiple explosions or fires caused by pipeline leaks.							
	Category	External	People		Process		Technology	External	People		Process		Technology			
	Risk driver	Animals cause damage (fill equipment boxes with dirt)	Improper operation or design	Improper access to equipment causes damage	Unmapped/improperly mapped facilities contribute to dig-ins	Inadequate design standards	Inadequate maint procedures (or lack of)	Lack of distribution SCADA data delays timely response	3rd party construction volume contributes to untimely response (or less qualified employee to respond)	Improper operation or design	Inadequate staffing/resources	Unmapped/improperly mapped facilities contribute to dig-ins	Inadequate construction standards	Inadequate construction procedures	Potential inaccuracy of locating tools used for facilities	Potential for error due to facilities having varying types of signals used to locate equipment
<b>Key Mitigation Efforts</b>	<b>Inherent Risk</b>	L	M	L	M	M	M	M	M	H	L	H	M	L	L	L
Primary Gas Transmission & Distribution Activities	Appropriate funding/resources										A					
	Atmospheric corrosion inspection program	W						W								
	Damage prevention program					A									A	A
	Design standardization/standard units					S										
	Design standards (current industry standards)					S		A							A	A
	Design standards (prior industry standards)					A		A								
	Gas distribution integrity management program											A	W	A		
	Gas distribution internal gas incident review		A				W			A			W			
	Gas transmission risk management program (supplementary)											A	W			
	Geographic information system/mapping				A							A				
	Near miss reports		A	W						A	W					
	Odorization					A	A									
	Operator qualification program		A							A						
	Pipeline public information program													A		
	Oversight during excavation								A	S		A	A			
Training		W						A	S		A	A				
Underground service alert (includes mark&locate)								A			A					
Secondary Gas Transmission & Distribution Activities	Gas leak form		A							A						
	Design/standard exception process					A										
	Failure analysis reports					A										
	First responder training program					W										
	Gas transmission integrity management program (baseline)					A										
	Gas transmission incident reports					W							W			
	Gas service representative response to customer leak notification response			S												
	Gas service representative/meter reader observations			W												
	Quality assurance												W			
	Leak and incident reports			W												
	Maintenance management/execution (includes leak survey)															
	Regulator station maintenance		W													
	Gas safety program		W							A						
<b>Residual Risk</b>		L	L	L	M	L	M	L	L	M	L	M	L	L	L	L
<b>Additional Proposed Remediation</b>																
Identify/map in GIS the location of all non-district regulator station HPRs; develop/implement an atmospheric inspection and remediation program for these HPRs.		A			A		A									
Improve integrity management over distribution pipelines by developing a new Probabilistic Risk Model that uses quantitative risk analysis methods along with dollar amounts for consequence and includes high consequence very low probability threats.																
<b>Related Remediation</b> <i>These efforts are part of operational improvements and are included as they further reduce risk exposure.</i>																
Trained leak surveyors to perform atmospheric corrosion inspection while performing the leak survey.		A					A									
Improved Operator Qualification program as part of the Operational & Human Performance Initiative			A						A							
Enhanced Damage Prevention program by well-defined processes, metrics, quality control, and assigned process owners.						A								A	A	
Developed Gas Event reporting and review process, which is transitioning to System Reliability & Support to better align root cause analysis and enhance work procedure error focus.			A			A			A			A				
<b>Residual Risk</b>		L	L	L	M	L	M	L	L	M	L	M	L	L	L	L