San Francisco Peninsula Long-term Preferred Option

Stakeholder Study Group Phase 2 Study
July 26, 2005

The ISO has determined there is a Reliability need for San Francisco beginning in 2012 following the completion of the Action Plan components.

- What is the objective?
  - Assuming the successful completion of the ISO's Revised Action Plan, assess and identify the preferred transmission alternative to provide reliable, long-term (through 2018) load serving capability for the San Francisco Peninsula Area

- How was this to be accomplished?
  - As appropriate, evaluate practical alternatives through technical analysis and certain economic assessment to determine their viability in meeting the Phase 2 objective

- Alternatives assessed?
  - The alternatives assessed are discussed in detail in Attachment 1

- Two key issues to help resolve some differences:
  - Should the next transmission line into the San Francisco Peninsula Area come from the south (Tesla – Potrero) or from across the San Francisco Bay (Moraga – Potrero/Trans-Bay Cable)?
  - Electrically, is there a preference between Moraga and Pittsburg?

- ISO annual economic analysis detail in Attachment 2

- Stakeholder positions on the alternatives
  - Comments received at the June 2005 SFSSG meeting in Attachment 3

- Reconductoring of Existing Facilities – this alternative is not recommended for the following reasons:
  - Difficult to implement and provides less operational flexibility and could place PG&E customer load at unnecessary risk (ISO concern: clearance for Newark-Ravenswood & Ravenswood-Shrdr Jct Reconductoring)
  - Two new cable projects in San Francisco are needed for this option (one before 2018 & another shortly after 2018) – Cost of second cable is not included in $114 million estimate for this option. Routing & permitting uncertainty associated with new cable implementation.

- Increased reliance on power across SF Peninsula & Martin substation.
- Existing facilities will be loaded more heavily – adverse impact on life span of the existing facilities.
- Use of series reactors also possible to control flow, but this is not considered an acceptable long-term solution.

- Moraga – Potrero Transmission Line – this alternative meets the long-term load serving capability objective and also improves supply diversity. However, it is not recommended for the following reasons:
  - Ability to permit and construct this option in a timely manner is uncertain
  - Capital cost is $274 million but could be much higher due to permitting uncertainty

- Tesla – Potrero Transmission Line – this alternative is not recommended for the following reasons:
  - Includes the notable difficulty of building a major new transmission line and new supporting towers above San Francisco Bay
  - Includes construction of new transmission infrastructure that parallels existing transmission through the San Francisco peninsula corridor that already accommodates numerous 115kV and 230kV lines, including the Jefferson – Martin Project. Siting another transmission project through this area would be extremely difficult considering the recent siting of the Jefferson – Martin 230kV line in this same area.
  - Ability to permit and construct this option in a timely manner is uncertain
  - Capital cost is $457 million. This cost could be much higher due to permitting uncertainty
  - Doesn't provide supply diversity – feeds San Francisco from the south

- Trans-Bay Cable Project – this is the preferred alternative for the following reasons:
  - Ability to permit & construct this option is far more certain than the competing 230 kV alternatives
  - It provides supply diversity – feeds San Francisco from the north
  - DC technology provides operational flexibility
  - It is the only new transmission option that can be implemented prior to the Reliability need in 2012.
  - It can be operational by January 2009, which will help offset some of the SF Locational Capacity as soon as the project is placed in-service in 2009

ISO conclusion is that the Trans-Bay Project is preferred:

- This alternative is the preferred option and fully meets the objective of establishing long-term reliable load serving capability by adding 400 MW of load serving capability upon its initial operation. This option will increase the diversity of power import route through controllable transmission capacity from PG&E's Pittsburg Substation in the East Bay to its Potrero Substation in San Francisco. This option provides for significant savings by reducing power losses within the parallel AC transmission system, deferral of new 115 kV cables within San Francisco as well as facilitates a more economic generation dispatch pattern within the Greater Bay Area. This project is estimated to cost $300 million including Interconnection costs. Economic savings associated with the Trans-Bay Cable are estimated to be as much as $10 million per year as attributed to transmission system loss savings, improved economic dispatch of generation and reduction in Reliability Must-Run costs. The ability to permit and build this project in a timely manner requires about half the lead-time (three years) as either the Moraga to Potrero or Tesla to Potrero 230 kV Projects. In addition, development of an Environmental Impact Report is well underway as has preliminary approval with the Federal Energy Regulatory Agency for rate recovery.

Attachment 1

ATTRIBUTES FOR COMPARING OPTIONS

The following are the major attributes for comparing the pros and cons of each option:

Long-Term Reliable Load Serving Capability – Does the option allow the ISO to reliably serve load at least until 2018?

Capital Cost – How much will this option cost? How does it compare with the cost of other alternatives and is there a risk of significant cost escalation?

Economic Benefits - Does this option decrease or increase power losses and does it promote more economic generation dispatch? What related savings to ratepayers are projected?

Import Security – Will the option improve the overall security of the transmission system through which power is imported into San Francisco and the Peninsula?

Ability to permit and construct – Are there significant uncertainties associated with the ability to permit and construct the project when needed?

PROPOSED LONG-TERM OPTION DESCRIPTIONS

Option 1 – Do Nothing - Do nothing beyond utilizing the transmission facilities planned to exist once the Revised Action Plan for San Francisco is fully implemented by the end of 2007. Full implementation of the Action Plan is expected to increase load serving capability to the San Francisco Peninsula Area, which is expected to be sufficient only until the summer of 2011 based on current load growth projections. Estimated implementation cost: $0.

Option 2 –Rely on Load Management/Distributed/Renewable Generation to serve SF Peninsula load beyond 2011 – In addition to the load management programs already captured within PG&E's annual load forecasting process, this option assumes that new load management and distributed generation programs will be implemented to serve the San Francisco Peninsula load beyond 2011. It is hard to estimate if these programs will be effective in meeting the long term load serving capability goal. Also, it is hard to estimate the implementation cost of this option.

Option 3 – Upgrade & Replace Existing Facilities - Upgrade & Replace Existing Facilities - Replace, reconductor, and/or rerate existing transmission infrastructure and implement operating solutions as needed to mitigate overloads and increase load serving capability for facilities serving the Greater Bay Area. This option is expected to provide additional load serving capability to the San Francisco Peninsula, which should be sufficient through Year 2018 based on current load growth projections. Estimated implementation cost: $114 million.

Option 4 – Trans-Bay Cable Project - Install a new ±400kV, 400 MW High Voltage Direct Current (HVDC) submarine DC cable proposed by an independent developer

(Babcock & Brown) between Pittsburg Substation in the East Bay area and Potrero Substation in San Francisco. This option is estimated to provide additional load serving capability to the San Francisco Peninsula, which should be sufficient through atleast Year 2018 based on current load growth projections. Estimated implementation cost: $295 million.

Option 5 – **Moraga-Potrero 230 kV Line -** Install a new 230 kV AC line from Moraga Substation in the East Bay area to Potrero Substation in San Francisco. This new line would be a combination of overhead and underground conductors running from Moraga to the San Francisco Bay and then run beneath San Francisco Bay to Potrero. It is anticipated that PG&E would permit and build this line. With about 275 MW flowing into San Francisco through this new line, this option is expected to provide additional load serving capability to the San Francisco Peninsula, which should be sufficient through atleast Year 2018 based on current load growth projections. Estimated implementation cost: $274 million.

Option 6 – Tesla-Potrero 230 kV Line - Install a new 230 kV AC line from Tesla Substation to Potrero Substation. This option will either utilize or convert existing transmission facilties leading into and through the Peninsula and San Francisco areas from Tesla to Potrero. New line construction across and above San Francisco Bay will be installed. With about 200 MW flow on the new line, this option is expected to provide additional load serving capability to the San Francisco Peninsula, which should be sufficient through atleast Year 2018 based on current load growth projections. Estimated implementation cost: $457 million.

SELECTION OF THE PREFERRED LONG-TERM OPTION

The preferred long-term option should meet the principal objective of the 'San Francisco Peninsula Phase 2 Long-Term Electric Transmission Planning Study' by providing reliable long-term load-serving capability in the most economic and environmentally sensitive manner while also being deemed 'constructible' by factoring into account the option-specific right-of-way, permitting, regulatory and other development requirements.

'Reliable long-term load-serving capability' measures should include: (i) whether or not the amount of incremental load-serving capability attributed to the option is good through atleast Year 2018; (ii) whether or not all applicable NERC, WECC, Cal-ISO and PG&E reliability standards are achieved; and (iii) positive impacts on PG&E system performance by minimizing reliance on the peninsula transmission corridor.

'Economic' measures should include the 'benefits' of improved generation dispatch, system loss reduction and other deferred transmission system or resource investment weighed against capital and operating 'costs', including required system upgrades, as quantified on a Net Present Value or annualized basis.

Environmental' measures should include the option-specific CEQA requirements for rights-of-way, visual aesthetics, electric and magnetic filed effects, construction and other impacts.

'Constructability' measures should include an assessment on whether an option is deemed to be able to acquire the necessary land and right-of-way and be successful in securing the necessary permits and regulatory approvals.

Another way of comparing Long-Term Options is below and may be preferred or not to the descriptions above.

A. Load-serving capability
    1. Lead-time vs. need load growth: time required for siting (e.g., routing through congested areas vs. through existing right of way), permitting, construction clearances, etc.
    2. Location of increased capability (San Francisco, Peninsula, Greater Bay Area, etc.)
B. Reliability
    1. Infrastructure diversity, redundancy, size of largest contingency, etc.
    2. System stability, controllability, and need for related operational controls (e.g., DC runback, RAS)
    3. Operational complexity
C. Environmental effects (emissions, visual effects, etc.)
    4. Type and magnitude of environmental effects
    5. Location of environmental effects (environmental justice, concentration or dispersion of effects, etc.)
D. Cost, including effect on ratepayers, expressed as net present value
    6. Capital Cost of construction including ability to construct given permitting requirements, construction clearances, etc.,
    7. Financial effects of postponed/accelerated construction start dates.
    8. Operational costs
        a. System power losses
        b. Effect on economic generation dispatch
        c. Frequency, duration, and cost of expected maintenance

The following Tables are composed of lists of advantages and disadvantages of each long-term option being considered followed by a decision matrix supporting the preferred option chosen.

The Table below lists the advantages and disadvantages of each long-term option being considered.

Alternatives	Advantages	Disadvantages	Stakeholder Comments
<u>Option 1</u> – Do Nothing	• Deferred transmission investment • Option value of future load serving technologies/projects • No adverse environmental impacts	• Does not meet the goal of establishing a Long-Term (10 Year) Reliable Load Serving Capability. • Continues reliance on importing power on transmission lines only through the SF Peninsula corridor. Therefore, would expose load to unreliable load serving conditions as load exceeds the capability of the transmission system through which power is imported. • Will increase system losses as compared to Options 3, 4, 5, and 6, as existing lines load more heavily in serving increased load. • Installing future transmission projects may be more difficult with time.	•
Alternatives	**Advantages**	**Disadvantages**	**Stakeholder Comments**
<u>Option 2</u> – Rely on Load Management/Distributed/ Renewable Generation to serve SF Peninsula load beyond 2011 **Cost: Unknown** **LSC improvement: Unknown**	• Deferred transmission investment • Option value of future load serving technologies/projects • Environmental benefits as compared to continued use of diminishing supplies of natural gas.	• It is uncertain that new load management initiatives will be effectively identified and implemented in a timely manner. • Lack of visibility of new load management initiatives makes it difficult to estimate that even if new load management programs are established, till what year will these be enough to meet San Francisco Peninsula's load serving capability needs.	

		• Continues reliance on importing power on transmission lines only through the SF Peninsula corridor. Therefore, could expose load to unreliable load serving conditions if load exceeds the capability of the transmission system through which power is imported. • Installing future transmission projects may be more difficult with time • Does not improve economic generation dispatch and therefore does not generate associated economic benefits.	
Alternatives	**Advantages**	**Disadvantages**	**Stakeholder Comments**
<u>Option 3</u> – Upgrade & Replace Existing Facilities. **Cost: $114 million** **LSC improvement: until 2018**	• Least capital cost option that meets the goal of providing long term load serving capability. • For most part, implementation of this option will need less lead time as compared to that for Options 4, 5, & 6.	• This option is dependent on the timely identification, permitting and construction of many transmission system upgrades, including building up to two new 115 kV cables within San Francisco and therefore incur related routing and permitting uncertainty. • Increased reliance on importing power across the SF Peninsula corridor and Martin substation. This option doesn't improve supply diversity, as done so by Options 4, 5, and 6. • As the load grows, existing facilities will experience loadings closer to their operating capabilities. This could potentially have an adverse impact on life of	

		facilities, and will lead to higher system losses as compared to Options 4, 5, and 6. • The improved load serving capability provided by this option will be good until Year 2018. Additional project(s) in San Francisco will be needed soon after 2018. • Environmental permitting and regulatory approval process not yet initiated. • This option reduces real-time operational flexibility, because of the added need of taking clearances of several existing facilities to implement the projects outlined for this option. • Installing future projects may be more difficult with time.	
Alternatives	**Advantages**	**Disadvantages**	**Stakeholder Comments**
<u>Option 4</u> – Trans-Bay Cable Project Cost: $295 million LSC improvement: atleast until 2018	• Provides fully controllable bi-directional power delivery up to 400 MW, thus brings in the flexibility of supplying a "desired" amount of power into San Francisco as needed in real time, with flexibility of developing a Runback scheme • This option improves supply diversity by providing a new route of delivering power to San Francisco. • The ability to permit and build this project in a timely	• Potential for extended repair time for forced outages compared with overhead line options. • Several non-traditional, but standard, engineering studies required to integrate the DC converters into the AC system. • New largest contingency loss of source to the San Francisco Peninsula (i.e. loss of 400 MW HVDC line) • Having to build and operate the converter stations adds new complexity to operating the	•

	manner requires about three years lead-time as compared to six years for Options 5 and 6. • • EIR has been started with no adverse comments received to date. • DC connection inherently improves angular stability • Doesn't require increased risk of load dropping due to clearance requirements • Increases System Stability and Security (i.e. support of weak AC system in case of contingencies)	transmission system within the SF Greater Bay Area.	
Alternatives	**Advantages**	**Disadvantages**	**Stakeholder Comments**
<u>Option 5</u> – Moraga-Potrero 230 kV Line Cost: $274 million LSC improvement: atleast until 2018	• For a portion of the line, existing rights of ways and corridors will be utilized. • This option improves supply diversity by providing a new route of delivering power to San Francisco. • This option can be enhanced to provide 230 kV service to Oakland area. However, other alternatives for Oakland are concurrently being pursued.	• Environmental permitting and regulatory approval process not yet initiated. • May require up to six years lead-time as compared to three years for Option 4. • Requires series reactors to assist in control of power delivery.	

Alternatives	Advantages	Disadvantages	Stakeholder Comments
<u>Option 6</u> – Tesla-Potrero 230 kV Line **Cost: $457 million** **LSC improvement: atleast until 2018**	• For a portion of the line, existing rights of ways and corridors will be utilized. • This option improves supply diversity by providing a new route of delivering power to San Francisco.	• While this option involves importing power across San Francisco Bay as compared to all imported power now being routed through the San Francisco Peninsula, this option would include the significant difficulty of building a major new transmission line and new supporting towers above San Francisco Bay. • May require up to six years lead-time as compared to three years for Option 4 • Requires series reactors to assist in control of power delivery. • A portion of this line would be within the existing SF Peninsula corridor between San Mateo and Potrero Substations. • Environmental permitting and regulatory approval process not yet initiated.	

Another way to illustrate comparing long-term Options is illustrated in the following Tables and may be preferable to using the Tables above.

	Option 1 Do Nothing	Option 2 Load Management	Option 3 Upgrade & Replace Existing Facilities	Option 4 Trans-Bay Cable Project	Option 5 Moraga-Potrero 230 kV line	Option 6 Tesla-Potrero 230 kV line
A. Increase in load-serving capability	0 MW.	__ MW decrease in projected load.	__ MW.	___ MW (about 400 MW flow).	___ MW (about 275 MW flow).	___ MW (about 200 MW flow).
A.1 Lead time vs. load growth	Installing future transmission projects may be more difficult with time. Does not meet projected load growth after 2011.	Installing future transmission projects may be more difficult with time. Load reduction may not materialize.	Installing future transmission projects may be more difficult with time. For a portion of the line, existing rights of way and corridors will be utilized. Requires timely identification, permitting and construction of transmission system upgrades within San Francisco.	Projected to become operational about three years from project approval. Site Control of HVDC terminal location has been established. Preliminary environmental work started about 1 year ago. EIR commenced: no adverse comments received on notice of preparation by responsible agency.	Projected to become operational up to six years after project initiation. For a portion of the line, existing rights of way and corridors will be utilized. EIR process has not been initiated.	Projected to become operational up to six years after project initiation. For a portion of the line, existing rights of way and corridors will be utilized. This option would include a major new transmission line and new supporting towers above San Francisco Bay.
A.2 Location of increased load-serving capability					This option can be enhanced to provide 230 kV service to the Oakland area.	
B. Reliability		Could expose load to unreliable load serving conditions (details?).		Provides fully controllable bi-directional power delivery up to 400 MW, with flexibility of developing a Runback scheme.		

	Option 1 Do Nothing	Option 2 Load Management	Option 3 Upgrade & Replace Existing Facilities	Option 4 Trans-Bay Cable Project	Option 5 Moraga-Potrero 230 kV line	Option 6 Tesla-Potrero 230 kV line
B.1 Infrastructure diversity, redundancy, etc.	Continues reliance on transmission lines only through the SF Peninsula corridor.	Continues reliance on transmission lines only through the SF Peninsula corridor.	Continues reliance on transmission lines only through the SF Peninsula corridor.	This option improves diversity by providing a new transmission route to San Francisco. New largest contingency loss of source to the San Francisco Peninsula (i.e. loss of 400 MW HVDC line).	This option improves diversity by providing a new transmission route to San Francisco.	This option improves diversity by providing a new transmission route to San Francisco.
B.2 Stability, controllability, etc.	Will expose load to unreliable load serving conditions (details?).			DC connection inherently improves angular stability.	Requires series reactors to assist in control of power delivery.	Requires series reactors to assist in control of power delivery.
B.3 Operational complexity				Doesn't require increased risk of load dropping due to clearance requirements. Converter stations add new complexity to operating the transmission system.		
C. Environmental effects				EIR commenced: no adverse comments received on notice of preparation by responsible agency.		
C.1 Type and magnitude of environmental effects						
C.2 Location of environmental effects						
D Cost						
D.1 Construction cost	$0	Capital cost is hard to estimate at this time.	$114 million	$295 million Several non-	$274 million	$457 million

	Option 1 Do Nothing	Option 2 Load Management	Option 3 Upgrade & Replace Existing Facilities	Option 4 Trans-Bay Cable Project	Option 5 Moraga-Potrero 230 kV line	Option 6 Tesla-Potrero 230 kV line
				traditional engineering studies required to integrate the DC converters into the AC system.		
D.2 Change in construction cost	Deferred transmission investment. Installing future transmission projects may be more difficult with time.	Deferred transmission investment. Installing future transmission projects may be more difficult with time.	Deferred transmission investment. Installing future transmission projects may be more difficult with time.			
D.3 Operational cost						
D.3.a System power loss	Increased line losses.		Will increase system power losses.			
D.3.b Economic dispatch			Cost of economic dispatch.			
D.3.c Maintenance cost				Extended repair time for forced outages compared with overhead line options.		
Miscellaneous	Option value of future load serving technologies / projects.	Option value of future load serving technologies / projects.	This option reduces real-time operational flexibility during construction, because of the need for clearances of existing facilities.			

Attachment 2

Annual Economic Benefits

- Economic benefits in 2008
  - $ 4 to 6 million (7/7/05 Meeting)
  - $ 10 million (7/26/05 Meeting)
  - Modifications include:
    - Double-line outages
    - Transmission line maintenance
    - Variable O&M differential
    - CO2 emission cost

Assumed Capital Costs for Pittsburg-Potrero HVDC

- 2008 Online Date
  - PV Capital Costs -- $ 281 million
  - PV Revenue Req. -- $ 475 million
- 2011 Online Date
  - PV Capital Costs -- $ 245 million
  - PV Revenue Req. -- $ 414 million

2008 vs. 2011 Online Date

Parameter	2008 Online Date	2011 Online Date	Difference
PV of capital costs	$281	$245	$36
PV of rev. req.	$475	$414	$60
PV of 2008-2010 econ. ben.	$27	$0	$27
NPV of capital costs	$254	$245	$9
NPV of rev. req.	$448	$414	$33
Capital cost risk premium			**4%**
Revenue req. risk premium			**8%**

Conclusion Regarding 2008 vs. 2011 Online Date

- Relatively small risk premium provides significant benefits, such as:
  - Reduced risk of project delay and cost overrun
  - Additional SF reliability protection for 2008-2010 2010:
    - Providing an additional transmission cooridor
    - Higher-than-expected SF load growth
  - Reduced SF generation and associated emissions for 2008-2010

Attachment 3

SF STAKEHOLDER POSITIONS
JUNE 2005 MEETING

Barry Flynn:	Have this discussion only after economic studies are done. Don't have next meeting if economic analysis not done. Spend time to review economic studies rather than debating now. Hybrid options should be covered through economic assessment
Francisco DeCosta:	Quality of life issues. CCSF CTs should not be built.
Dave Parquet:	If a project fails one week before commercial operation, ratepayers will not pay even a dime.
	Moraga/Tesla-Potrero options red flags – routing/ permitting issues (probably impossible to permit)
	Option 2 should be pushed forward as much as possible.
	Reinforcement option would be the option to pursue if you delay other major options.
	Across 23rd street, near Potrero substation near DHL.
City of Pittsburg:	Adding our support to DC project, looking forward to 23rd meeting for economic analysis.
PG&E (Bhaskar):	PG&E has been neutral so far. My observation are that:
	Options 4 and 5 better.
	No generation alternatives have been evaluated. Lack of generation puts more burden on 500 kV system.
	Look forward to economic analysis.
CPUC:	Supports ISO's study efforts.
	Looking forward to economic analysis
	Several questions, Larry said to please send an email.
Seabreeze:	Mentioned another DC alternative from Moraga-Potrero.
Barry Flynn:	We should look at this new alternative.

Steven Moss:	With all these energy efficiency programs going forward, why are we still building so much transmission? Residential rates keep going up.
Laura Douglass:	My purpose is reducing RMR costs.
	Looking forward to next part of overall GBA study to reduce RMR costs.
John Carney:	More power may be needed than projected. Lots of new housing development.
Stan Nishioka:	Neutral stand.
	Options 3, 4, 5, and 6 serve purpose of meeting reliability criteria.
	Without economic analysis can't tell what is better than the other.