

**PG&E's Approximate Unit Costs for Generation Interconnection Projects**

**General Notes and Clarifications:**

1. The following estimated costs are based on past experiences and are intended to provide an order-of-magnitude of the total project cost when all the pieces are added together. Since conditions do vary, and under the same category final detailed scope components do vary depending on site condition, these costs can only be a guide until the project scope is well developed and some engineering has been done.
2. For substation estimated costs below, the accuracy is expected to be in the +/- 25% range based on past and up-coming projects. It does not mean that the estimate has a 25% contingency included or added to it.
3. Some categories have no costs entered because either they are rarely installed or for lack of good cost data. For these categories, costs estimates will be provided after some engineering or investigation has been completed.
4. The equipment or installation categories below are what have been more commonly experienced in PG&E's service territory.
5. Installations at 500kV are rare for generation interconnection projects in PG&E's service area and good cost data are not available. Costs will have to be estimated on a case-by-case basis after some engineering work.
6. The estimated costs here do not include any applicable ITCC tax
7. April 1, 2009 update: added item numbers for easier reference and revised Items 6, 15, 16, and 21.
8. Feb. 12, 2010 update: some substation costs revised for Year 2010.
9. Dec. 23, 2010 update: some substation costs revised for Year 2011. Also Transmission line costs are updated for Year 2011

Equipment or Installation Categories	Per Unit	60/70kV	115kV	230kV	Notes/Comments
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Item #	New installations @ PG&E Substation Facilities				
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1	Build a new switching station complete with two BAAH (breaker-and-a-half) bays and an MPAC building or control house (Engineer, Design and Build)	per unit	x	\$12,000,000	\$14,000,000	Total installed cost including control building but excluding land, land rights, permitting, incoming T-lines, and relay modification or upgrade work at remote stations. Also Note: new stations are typically required to be designed to be expandable). This new station and cost do not include the Generation Developer's switchyard should it be interconnected to PG&E's main buses, nor do they include AC station service power that needs be obtained from PG&E Distribution through a separate application process
2	New switching station complete with with three BAAH bays and an MPAC or control building	per unit	x	\$15,000,000	\$18,000,000	ditto
3	Install a complete new switching station with four BAAH bays, complete with MPAC or control building	per unit	x	\$18,000,000	\$22,000,000	ditto plus added note for ring bus configuration: PG&E's design criteria is a ring must be arranged such that it is expandable to an ultimate 6-breaker ring and land must be acquired to support such future expansion
4	New switching station with 4-breaker ring bus, complete with MPAC or control building	per unit	\$8,500,000	\$10,500,000	\$13,000,000	ditto plus added note for ring bus configuration: PG&E's design criteria is a ring must be arranged such that it is expandable to an ultimate 6-breaker ring and land must be acquired to support such future expansion
5	New switching station with 5 breaker ring bus, complete with MPAC or control building	per unit	\$9,500,000	\$12,000,000	\$15,000,000	ditto plus added note for ring bus configuration: PG&E's design criteria is a ring must be arranged such that it is expandable to an ultimate 6-breaker ring and land must be acquired to support such future expansion

6	PG&E support for a new PG&E-owned switching station that will be designed and built by the generation developer and deeded back to PG&E. PG&E support includes: Preparation of PG&E specification and requirements. Engineering review and approval of design. PG&E Civil, Electrical and Mechanical site inspectors during construction, Project Management, and other support activities	per unit	\$900,000	\$900,000	\$900,000	This cost does not include work that needs be done at PG&E's remote stations
7	Add one line breaker position to existing substation with DBSB (Double-Bus-Single-Breaker) bus configuration	per unit	\$1,500,000	\$2,000,000	\$2,500,000	includes foundations, breaker, switches, structures, CVT's or PT's and line relays and protection inside existing control building. Assumes a spare bay is available. Cost does not include bus extension if needed
8	Add one bus sectionalizing breaker to existing substation	per unit	\$1,500,000	\$2,000,000	\$2,500,000	ditto. Includes also removal cost for bus disconnect sw, etc. Assumes space is available. Cost does not include relocating one or more existing line positions if needed to make space
9	Add one pair of bus sectionalizing breakers to existing substation on the main buses	per unit	x	\$4,000,000	\$5,000,000	ditto. Includes also removal cost for bus disconnect sw, etc. Assumes space is available. Cost does not include relocating one or more existing line positions if needed to make space
10	Add one bus parallel or substitute breaker to existing DBSB substation	per unit	x	\$2,000,000	\$2,500,000	ditto. Includes also removal cost for bus disconnect sw, etc. Assumes space is available. Cost does not include relocating one or more existing line positions if needed to make space

11	Add one line position to a BAAH scheme with one breaker (one bus-side breaker)	per unit	x	\$1,700,000	\$2,000,000	Assumes that existing bus configuration is already set-up for expansion this way with two existing breakers in the BAAH bay, and space is available. Also these are typical incremental costs only.
12	Add one line position to a ring bus with one breaker	per unit	\$1,500,000	\$2,000,000	\$2,500,000	Assumes that existing bus configuration already set-up for expansion this way and space is available. Also these are typical incremental costs only.
13	Add one 3-phase transformer, 420 MVA, includes one breaker on high side and one on low side. Typical 230kV/115kV, 230kV/60 or 70kV	per unit	x	x	\$10,000,000	includes transformer, foundations, breakers, switches, structures, CVT's and line relays and protection inside existing control building
14	Add one 3-phase transformer, 200 MVA, includes one breaker on high side and one on low side. Typical 230kV/115kV, 230kV/60 or 70kV, 115kV/60 or 70kV	per unit	x	\$7,000,000	\$8,000,000	includes transformer, foundations, breaker, switches, structures, CVT's and line relays and protection inside existing control building
15	Add shunt capacitor banks, 4 steps 75 MVAR each step	per unit	x	x	\$10,000,000	Assumes space is readily available. Includes 5 breakers plus four cap banks each 75 MVAR
16	Add SVC (Static Var Compensator)	per unit	x	\$20,000,000	\$30,000,000	Assumes space is readily available
17	Add Current Limiting Reactors on Main Double-Bus, 8 ohms	per unit	x	x	\$10,000,000	Assumes space is readily available. Does not include relocating line positions to make space if needed
18	Add DTT (Direct Transfer Trip scheme) without upgrading relays. Each terminal only	per unit	\$250,000	\$250,000	\$250,000	Cost is for one terminal only. Does not include costs for matching equipment at other terminal or terminals. Does not include cost of leased line which is typically the responsibility of the generation developer. Cost of DTT receivers at generation facility is typically lower.

19	Add SPS (Special Protection Scheme) at one terminal only	per unit	x	x	x	Costs of SPS's have a wide range depending on scope. It could be from \$300K to well over a million or much more.
20	Replace one overstressed breaker with new relays	per unit	\$1,000,000	\$1,200,000	\$1,500,000	Includes adding or pulling new CT wires, modifying breaker foundation, replacing CVT's or PT's, etc. May include replacing existing breaker disconnect switches.
21	Replace one overstressed breaker without relay upgrade	per unit	\$750,000	\$900,000	\$1,200,000	Includes adding or pulling new CT wires, modifying breaker foundation, replacing CVT's or PT's, etc. May include replacing existing breaker disconnect switches.
22	Replace or upgrade relays on one line position	per unit	\$500,000	\$600,000	\$600,000	Assumes panel space is available on existing switchboard and existing line relays do not share the same panel with another line position. Cost does not include cost of new communication circuits between two or three stations when fiber is required for line current differential protection schemes. This communication cost has to be determined on a case-by-case basis and can be substantial
23	Converting an existing bus configuration to a ring bus or a breaker-and-a-half scheme	per unit	x	x	x	Conversion costs vary and depend on size of existing station and site condition. Costs will have to be determined on a case-by-case basis

<b>"DA" or Direct Assignment Costs at Generation Site</b>						
24	Provide engineering and protection review for gen site for conformance to Interconnection Handbook requirements		\$40,000	\$40,000	\$40,000	This cost assumes a medium size generation project or medium complexity
25	Provide Pre-parallel inspection and witness testing at gen site		\$15,000	\$15,000	\$15,000	This task is typically performed by PG&E Station Test Group
26	Provide PG&E revenue meter at gen site and pull secondary wires for one circuit		\$25,000	\$25,000	\$25,000	This task is typically performed by PG&E Metering Department
27	Maintenance and Operation (switching, etc)		\$15,000	\$15,000	\$15,000	
28	Pro-rated PG&E project management for gen site		\$30,000	\$40,000	\$40,000	
29	Install "PG&E RTU" for EMS telemetry at generation site and provide Telecom Support		\$100,000	\$100,000	\$100,000	Mounting space, DC and AC power, wires and and raceway, etc., to be provided by gen developer and not included here. This part is performed mainly by PG&E ISTS Department.
30	SCADA and EMS support work at PG&E's TOC		\$75,000	\$75,000	\$75,000	This part is performed mainly by PG&E ISTS Department.
<b>ACRONYMS and TERMS for Substation Work</b>						
<p><b>MPAC_Modular Protection, Automation and Control.</b> An MPAC building is similar to a control building containing all the equipment and devices for substation protection, automation and control. This building is built in the factory by a PG&amp;E-approved supplier and shipped to the job site for final interface with outdoor installation and for commissioning testing.</p> <p><b>BAAH_Breaker-And-A-Half bus scheme or bus configuration</b></p> <p><b>DBSB_Double Bus Single Breaker bus configuration</b></p> <p><b>ITCC Tax_ITCC is Income Tax Component of Contribution.</b> A tax (for exmaple, 34%) that has not been added to the estimates here.</p> <p><b>PG&amp;E RTU_Generation Developer is required to install EMS telemetry /SCADA at their facility to provide information to PG&amp;E per PG&amp;E Transmission Interconnection Handbook for visibility.</b> Often part of this is done by PG&amp;E by installing a "PG&amp;E RTU" at the Gen. Site to satisfy the requirements.</p>						

	<b>SPS_Special Protection Scheme</b>
	<b>DTT_Direct Transfer Trip Scheme (usually using the RFL Gard 8000 teleprotection unit for Year 2010 and subsequent years until further notice)</b>
	<b>DA_Direct Assignment. This term may be obsolete by now but is here for illustration only since some of us are familiar with this term for what it meant.</b>
	<b>Interconnection Facility Cost_ As the name says. As opposed to Network Upgrade Cost.</b>

Transmission Line Work						
	<b>New Transmission Line</b>	Unit	60/70kV	115kV	230kV	Unit cost per mile shown is based on flat land/rural setting, engineering and construction costs only. Environmental, Permitting, and Right of way Acquisition costs are not included.
30	Double Circuit, Strung on both sides, Lattice Tower	per mile	\$1,420,000	\$1,420,000	\$1,680,000	Additional factors applied for hilly (1.2X), mountainous (1.3X), and forested (1.5X) terrain. Factors also apply for suburban (1.2X) or urban (1.5X) population density. Line length <10 miles (2X), line length 10 to 20 miles (1.5X). Costs for 60/70kV are same as for 115kV due to same 115kV standards used for new installation or design
31	Double Circuit, Strung on one side, sides, Lattice Tower	per mile	\$1,110,000	\$1,110,000	\$1,320,000	
32	Double Circuit, Strung on both sides, Tubular Steel Pole	per mile	\$1,590,000	\$1,590,000	\$1,890,000	
33	Double Circuit, Strung on one side, sides, Tubular Steel Pole	per mile	\$1,320,000	\$1,320,000	\$1,560,000	
34	Single Circuit, Tubular Steel Pole	per mile	\$990,000	\$990,000	\$1,160,000	
<b>Removal of Transmission Line (Complete Tear Down)</b>						
35	Double Circuit	per mile	\$264,000	\$264,000	\$420,000	Cost of removal only, assume any rebuild would use "new transmission line" from section above. Will include similar factors as new transmission line
36	Single Circuit	per mile	\$160,000	\$160,000	\$290,000	