PMBelCOL PEmails

From: Mallecia Hood
Sent: Wednesday, November 19, 2008 9:52 AM
To: PMBelCOL PEmails
Subject: FW: Letter to NRC dated November 18, 2008
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From: Creek, Carolyn P [mailto:cpcreek@tva.gov]
Sent: Tuesday, November 18, 2008 4:30 PM
To: Slays, Kim; Neil Haggerty; Mallecia Hood; Spink, Thomas E; Ray, Phillip M
Cc: Sterdis, Andrea Lynn; Bhatnagar, Ashok S
Subject: Letter to NRC dated November 18, 2008

<<RAI-LTR-041 Rev..pdf>>

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November 18, 2008

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Washington, D.C. 20555

In the Matter of	)	Docket Numbers	52-014 and 52-015
Tennessee Valley Authority	)		

BELLEFONTE COMBINED LICENSE APPLICATION – ADDITIONAL INFORMATION REGARDING COST ESTIMATES FOR CONSTRUCTION OF NEW NUCLEAR, COAL- AND GAS-FIRED ELECTRICITY GENERATING UNITS

Reference: 1.) Letter from Mr. Ashok S. Bhatnagar (TVA) to Mr. R. William Borchardt, NRC, "Application for Combined License for Bellefonte Units 3 and 4," dated October 30, 2007 [ML073110527].

2.) Letter from Andrea L. Sterdis (TVA) to NRC Document Control Desk, Bellefonte Combined License Application – Additional Information Regarding Cost Estimates for Construction of New Nuclear, Coal- and Gas-Fired Electricity Generating Units," dated November 5, 2008 [ML083120274].

This letter updates the estimated values of the cost of constructing and operating nuclear, coal-fired, and gas-fired electricity-generating power plants, as presented in Chapters 9 and 10 of the Environmental Report (ER) for Bellefonte Nuclear Plant, Units 3 and 4 (BLN) Combined License Application (COLA), which was submitted to the NRC by Reference 1. This letter supersedes the TVA letter dated November 5, 2008 (Reference 2).

TVA has developed changes that will be made in a future revision to the BLN COLA. The marked-up text presented in the enclosure to this letter addresses the updated ranges of cost estimates, based on recent publications and regulatory filings.

In Part 1 of the BLN COLA, TVA submitted as proprietary information BLN-specific cost estimates that are based on preliminary cost estimates provided by the supplier of the AP1000 plant. TVA sought confidential treatment of that information because disclosure of that financial information "would place TVA at a distinct disadvantage in conducting business as competitors could then seek to analyze the data to identify strengths and weaknesses and then seek to capitalize on those perceived strengths and weaknesses." This BLN-specific cost estimate in COLA Part 1 is bracketed by the updated ranges of cost estimates presented in the enclosure to this letter.

To promote the use of consistent information sources, TVA has also provided updated cost estimates for coal-and gas-fired electricity generation and combinations of alternatives, based on the same updated publications and regulatory filings. These updated cost estimates are also reflected in the ER changes provided in the enclosure to this letter.

If you should have any questions, please contact Thomas Spink at 1101 Market Street, LP5A, Chattanooga, Tennessee 37402-2801, by telephone at (423) 751-7062, or via email at tespink@tva.gov.

I declare under penalty of perjury that the foregoing is true and correct.

Executed on this 18th day of Nov, 2008.

Andrea L. Sterdis
Manager, New Nuclear Licensing and Industry Affairs
Nuclear Generation Development & Construction

Enclosure: Revised Cost Estimates for Nuclear and Coal- and Gas-Fired Generation
cc: See page 3

cc (Enclosure):
M. A. Hood, NRC/HQ
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Revised Cost Estimates for Nuclear and Coal- and Gas-Fired Generation

This enclosure provides changes to the Bellefonte Nuclear Plant, Units 3 and 4 (BLN) Applicant's Environmental Report – Combined License Stage (ER), Revision 1, to reflect information available in recent publications and public utility commission filings regarding the cost of constructing and operating nuclear power plants, as well as coal- and gas-fired electricity generating power plants.

1. Change COLA Part 3, ER Chapter 2, Section 2.5.2.3, 9th (last) paragraph, as follows:

   The TVA book value for Alabama is subject to changes that affect the amount of tax-equivalent payments. The book value currently includes a book valuation of $3.1 billion for the existing facilities at the BLN site, which are in the process of being depreciated. The current book value of Bellefonte Units 1 and 2 is likely to be entirely or largely depreciated by the time BLN (i.e., Units 3 and 4) is operational. However, the book value for the new units compensates for this loss: for FY 2007, if the proposed Units 3 and 4 had been completed, and the current book valuation of Bellefonte Units 1 and 2 had been completely written off, the total payout to Jackson County would have been almost ~~$13.6~~ $15.6 million, which is almost ~~$3.2~~ $5.2 million more than the actual FY 2007 payout of $10.4 million. However, this estimate does not take into account a number of other likely future events. For example, completion of Watts Bar Nuclear Unit 2 would increase the TVA book value in Tennessee relative to the total, thereby somewhat decreasing the Alabama share of the total TVA book value, and therefore, the Alabama share of TVA payments. Other future events could also affect the payment to Jackson County, including fluctuation or growth in revenue from power sales, plant retirements and additions, and future depreciation of assets. The amount of the distribution is not based on operation of the units. The construction costs associated with BLN will be a factor in determining the tax distribution base when they are incurred.

2. Change COLA Part 3, ER Chapter 5, Subsection 5.8.2.2.1, 3rd paragraph, as follows:

   Based on the tax calculation procedures described in Subsection 2.5.2.3 and the property value of BLN (i.e., Units 3 and 4), tax-equivalent payments to Jackson County from the State of Alabama are estimated at ~~$13.6~~ $15.6 million, an increase of ~~$3.2~~ $5.2 million over FY 2007 estimates. This includes the assumption that tax-equivalent payments based on Bellefonte Units 1 and 2 will no longer be made by the time that BLN (i.e., Units 3 and 4) is operational. Based on DOE/EIS-0288 data, 40 percent of the annual allocation to Jackson County, approximately ~~$5.4~~ $6.2 million, is paid to the city and county school systems, while the remaining 60 percent, approximately ~~$8.2~~ $9.4 million, funds public services within the county (Reference 18).

3. Change COLA Part 3, ER Chapter 9, Subsection 9.2.2.1, 6th paragraph, 3rd sentence, as follows:

   Wind power costs have declined to as little as $0.03 per kilowatt-hours (kWh) to ~~$0.05/kWh~~ $0.06/kWh, after installation costs of $1000/kW to $2000/kW.

4. Change COLA Part 3, ER Chapter 9, Subsection 9.2.2.7, by deleting the 2nd paragraph, as follows:

   ~~Comparing costs in dollars per MWh ($/MWh) (dollars per million Btu [$/MBtu]) (September 2006), coal was $0.50/MWh ($1.72/MBtu), natural gas was $1.82/MWh ($6.22/MBtu), and petroleum liquids were $2.39/MWh ($8.14/MBtu).~~

5. Change COLA Part 3, ER Chapter 9, Subsection 9.2.2.9, 8th paragraph, as follows:

Recent estimates indicate that capital costs for conventional pulverized- coal-fired power plants range from ~~$1094/kW to $1350/kW~~ $1600/kW to $2300/kW. The levelized cost of electricity produced from pulverized coal-fired power plants is ~~$0.033/kWh to $0.041/kWh~~ $0.059/kWh to $0.087/kWh, excluding carbon capture and sequestration systems.

6. Change COLA Part 3, ER Chapter 9, Subsection 9.2.2.10, 4th paragraph, as follows:

Overall, experience with IGCC still shows generation costs more expensive than comparably sized pulverized coal plants, due in part to the coal gasifier and other specialized equipment. Recent data indicate that capital costs for coal-fired IGCC power plants are ~~near $1200/kW~~ between $2600/kW and $3800/kW, and have production costs of electricity ~~near $0.043/kWh~~ between $0.09/kWh and $0.116/kWh.

7. Change COLA Part 3, ER Chapter 9, Subsection 9.2.2.11, 1st and 2nd paragraphs, as follows:

Natural-gas-fired generation using combined-cycle turbines is a technology that is available and economical. Current estimates indicate that capital costs for natural-gas-fired power plants average ~~$575/kW~~ $575/kW to $1550/kW.

8. Change COLA Part 3, ER Chapter 9, Subsection 9.2.3.3.3, 1st and 3rd paragraphs, as follows:

For the combination alternative to pass an economic comparison, the cost of the generation using all generation pairing levels of the combination are considered. That is, 100 percent wind power, or 100 percent coal power, or 90 percent wind and 10 percent coal, etc., ~~must be shown to cost less to generate electricity as compared~~ are considered for comparison to the BLN project. Also in consideration is the fact that coal or other plants cost more per MW to operate when not running at 100 percent capacity, because the capital and fixed operating costs are loaded across fewer MWh, increasing the cost per MWh.

Various studies (Subsection 10.4.2.1.1) show a wide range of electricity generation costs for varying power sources. The levelized cost of electricity generation calculated by these studies is based on various factors, such as choices for discount rate, construction duration, plant lifespan, capacity factor, cost of debt and equity and the split between debt and equity financing, depreciation time, tax rates, and premium for uncertainty (Subsection 10.4.2.1.2). One reason for the difference in reported generation costs between the various studies is the choice of which combinations of these factors are included in their calculations. In some instances, this results in calculated nuclear generation costs that are within the range of costs associated with natural gas and coal-fired plants.

The “internal” or monetary costs associated with construction and operation of the plant may be presented as overnight cost, construction cost, and levelized cost. Because levelized costs reflect construction and operating costs, as well as financing and other economic factors, it is considered a more accurate measure of economic competitiveness, and is used in this economic comparison. The levelized cost estimates, including owners’ costs, from five recently published studies are presented below. These five studies provide adequate

breadth and depth of analyses to provide a reasonably accurate and complete baseline of internal capital costs and a recent basis for estimating costs.

	Levelized Cost, Escalated to 2008 Dollars ($/MWh)[a]		
Study	Nuclear	Coal-Fired	Gas-Fired
NEI, 2008	$66.5 – $78.3[b] $100.1 – $122.7[d]	$74.2[c] $72.9 – $116.0[d,e]	-- $72.7 – $101.6[d]
CBO, 2008	$77.00 - $92.00	$59.00 - $137.00	$61.00 - $92.00
Brattle Group, 2008	$83.40	$86.50 - $141.90	$76.00 - $103.10
Keystone, 2007	$86.00 - $115.00	Not estimated	Not estimated
NETL, 2007	Not estimated	$73.00 - $133.00	$73.00 - $106.00

a. More details are provided in Tables 10.4-X1 (nuclear plants), 10.4-X2 (coal-fired plants), and 10.4-X3 (gas-fired plants).

b. Based on an 80 percent debt/20 percent equity capital structure, supported by a federal loan guarantee.

c. Based on an 80 percent debt/20 percent equity capital structure.

d. Based on a 50 percent debt/50 percent equity capital structure, typical of a regulated electric company, and assuming the company is permitted to recover the cost of capital during construction (CWIP).

e. Lower-end cost ($72.9/MWh) is based on supercritical pulverized coal (SCPC), and higher-end cost ($116.0/MWH) is based on integrated gasification combined cycle.

~~The 2005 Organization for Economic Co-operation and Development (OECD) study of projected electricity generating costs (Reference 9), reported a levelized cost of nuclear generation between $0.021 and $0.031/kWh at the 5 percent discount rate, while costs for coal and natural gas plants ranged from $0.025 to $0.050/kWh and $0.037 to $0.060/kWh, respectively. A 2004 National Institute of Nuclear Investigations study of the overall costs of generating electricity (Reference 10) provided costs of $0.0227/kWh for nuclear, $0.0328/kWh for coal, and $0.0353/kWh for natural gas at a 5 percent discount rate. A 2004 University of Chicago study (Reference 11) lists a range for nuclear generation costs of $0.047 to $0.071/kWh, compared to $0.033 to $0.041/kWh and $0.035 to $0.045/kWh for coal and natural gas plants, respectively.~~ Solar ranges from $0.09/kWh to $0.23/kWh, and wind from $0.03/kWh to ~~$0.05/kWh~~ $0.06/kWh, although as discussed in Subsection 9.2.2.1, the wind generation capability within the overall TVA region is low, and there is not enough wind in the TVA region of interest to reliably generate output equal to that generated by the BLN project. ~~To support timely decision making, TVA updates such information as there are changes in market conditions or technological costs.~~ Considering the above information, ~~a range of $0.036 to $0.083/kWh~~ $0.066 to $0.123/kWh has been selected as a reasonable ~~and conservative~~ estimate of the range of levelized cost of generation for the BLN project, as discussed in Subsection 10.4.2.1.2. The costs of a combination of alternatives will largely be driven by the costs of coal or gas-fired plants. For example, even if all of the available wind resources in the region of interest were developed as discussed in Subsection 9.2.2.1, only a small fraction of the energy needed by the combination would be obtained from wind. Considering the above, a range of $0.055 to $0.100/kWh is considered

reasonable for a combination of alternatives using wind power (which is less expensive than combinations using solar power).

The ~~project~~ range of costs associated with electricity generation at BLN are anticipated to ~~fall within~~ be similar to, and within, the range ~~that makes it economically competitive with~~ of costs associated with a combination of other viable forms of electricity generation.

9. Change COLA Part 3, ER Chapter 9, Subsection 9.2.3.3.4, as follows:

9.2.3.3.4 Summary

Although other combinations of the various alternatives are not discussed here, the lower capacity factors, higher environmental impacts, immature technologies, and a lack of cost competitiveness have not been found to assemble into a viable, competitive alternative combination that is either environmentally equivalent or preferable.

Wind and solar generation in combination with fossil-fuel-fired facilities could be used to generate baseload power and would serve the equivalent purpose of the proposed project. However, wind and solar generation in combination with fossil-fuel-fired facilities would have equivalent or greater environmental impacts as compared to a new nuclear facility at the BLN site. The electrical generating costs associated with wind ~~Also, wind and solar~~ generation in combination with fossil-fuel-fired facilities would ~~have higher electrical generating costs as compared~~ be comparable to a new nuclear facility at the BLN site. However, the environmental impacts ~~of proposed project are smaller than those~~ related to the combinations of alternatives are equal to or greater than the environmental impacts of BLN. Therefore, wind and solar generation in combination with fossil-fuel-fired facilities are not environmentally preferable to the proposed project. Accordingly, it is reasonable to proceed with and license the proposed BLN Units 3 and 4.

10. Change COLA Part 3, ER Chapter 9, Subsection 9.2.4, as follows:

As shown in detail in Table 9.2-6, based on environmental impacts, the analyses demonstrate that either a coal-fired or a natural-gas-fired plant would entail ~~a~~ an appreciably greater environmental impact on air quality than would the proposed project. Furthermore, each of these types of plants would entail a significantly greater relative environmental impact on air quality than would the proposed project. In addition, a combination of either of these two types of generation with renewable sources of energy such as wind or solar is possible, but to achieve a smaller impact on the air qualify, a moderate to large impact on land would be required.

Therefore, TVA concludes that neither a coal-fired, nor natural-gas-fired plant, nor a combination of alternatives would be environmentally preferable to the proposed project. ~~Also, these alternatives would have higher economic costs, and therefore are not economically preferable to the proposed project.~~

11. Change COLA Part 3, ER Chapter 9, Subsection 9.2.5, by deleting current References 13 through 15, and adding new References 13 through 17, as follows:

13. ~~Nuclear Energy Agency, Organization for Economic Co-operation and Development (OECD), and International Energy Agency, Projected Costs of Generating Electricity: 2005 Update, Website, http://213.253.134.43/oecd/pdfs/browseit/6605011E.PDF~~

~~(Note: electronic version cannot be printed; paper version is available for purchase), accessed June 5, 2007.~~
Nuclear Energy Institute (NEI), *The Cost of New Generating Capacity in Perspective*, August 2008.

14. ~~National Institute of Nuclear Investigations, Mexico, Palacios & others, "Levelized Costs for Nuclear, Gas and Coal for Electricity, Under the Mexican Scenario," 2004.~~ Congressional Budget Office, *Nuclear Power's Role in Generating Electricity*, May 2008.

15. ~~The University of Chicago, The Economic Future of Nuclear Power: A Study Conducted at The University of Chicago, August 2004, Website, http://nuclear.energy.gov/np2010/reports/NuclIndustryStudy-Summary.pdf, accessed June 5, 2007.~~
The Brattle Group, *Integrated Resource Plan for Connecticut*, January 1, 2008.

16. The Keystone Center, *Nuclear Power Joint Fact-Finding*, June 2007.

17. National Energy Technology Laboratory (NETL), *Cost and Performance Baseline for Fossil Energy Plants, Volume 1: Bituminous Coal and Natural Gas to Electricity*, DOE/NETL-2007/1281, Revision 1, August 2007.

12. Change COLA Part 3, ER Chapter 10, Subsection 10.4.2.1.1, as follows:

~~The following~~This subsection describes projected internal monetary costs related to construction of BLN based upon published literature. There are many ~~cost~~ studies that estimate the cost of constructing and operating new nuclear power plants available in the literature, providing ~~with~~ a wide range of cost estimates. The following documents were considered in estimating the appropriate range for BLN internal costs:

~~Due to the depth of their analyses and the fact that other studies tend to be based on them, the following four studies are among the most authoritative sources:~~

- ~~Organization for Economic Co-operation and Development (OECD) study of projected electricity generating costs (Reference 6).~~
- ~~Massachusetts Institute of Technology (MIT) study on the future of nuclear power (Reference 7).~~
- ~~University of Chicago (UC) study on the economic future of nuclear power (Reference 5).~~
- Energy Information Administration (EIA) annual energy outlook (Reference 8).
- The Brattle Group's Integrated Resource Plan for Connecticut (Reference 6).
- The Nuclear Energy Institute (NEI) white paper on the cost of new generating capacity (Reference 12).
- The Keystone Center fact-finding study of the issues related to reemergence of nuclear power in the United States (Reference 14).

The CBO and Keystone studies are based on costs for plants recently constructed overseas and use input from the U.S. Energy Information Administration (EIA). It is difficult to compare study results due to differing assumptions and analytical approaches. In addition, studies do not always identify inputs that would facilitate explanation of the reason for differing results.

However, as discussed in the NEI white paper, the uncertainty about the capital cost of new nuclear generating capacity is lessening, as recent filings with the state Public Utility Commissions (PUCs), and negotiations on engineering, procurement, and construction (EPC) contracts are beginning to narrow the range and present a more accurate picture of these costs. Filings by Progress Energy Florida in March 2008 (Reference 17), South Carolina Electric and Gas (SCE&G) in May 2008 (Reference 18), and Southern Company in 2008 (Reference 19), provide more precise, informed estimates of new nuclear generating construction based on EPC contracts.

Table 10.4-X1 provides a summary of the estimated nuclear plant costs from these studies and PUC filings. Commonly used terminology cited in Table 10.4-X1 and subsequent tables includes the following:

- Overnight cost – Sometimes called "overnight capital cost," this is a convention for expressing the cost of construction as if the plant could be built overnight. The cost is expressed as an absolute dollar value or a dollar value per unit of net (exclusive on-site use) electrical generation capacity, such as dollars per kilowatt or dollars per megawatt. The cost does not include escalation or interest costs during construction or during the time between estimate and assumed start of construction. The data is useful for comparing costs of alternative nuclear technologies and becomes the basis for broader cost estimates. Variables affecting interpretation of published information include whether the basis is recent construction history or materials and labor costs buildup; inclusion of owner's costs (e.g., licensing, land, site preparation, cooling system, electrical switchyard and transmission interconnection facilities, project management, and contingencies); economies of scale due to number of units to be built at the site; and dollar-year of estimate.
- Construction cost – Sometimes called "all-in cost," this adds to overnight cost escalation and interest during construction and during the time between a cost estimate and the start of construction. It is expressed in the same units as overnight cost and is useful for identifying the total cost of construction and for determining the effects of construction delays. Variables affecting the interpretation of published information include completeness of overnight cost estimate; assumptions on escalation and interest rates, debt/equity ratio, length of construction period, and contingencies; and dollar-year of estimate.
- Levelized cost – Sometimes called "levelized annual cost" or "breakeven cost," this is the constant real wholesale price needed to recover financing, construction, and operating costs of the plant. The cost is expressed as cent or dollar value per amount of net electrical generation over time, such as cents per kW-hour. Levelized cost is useful for comparing cost-competitiveness between alternative generation technologies (e.g., nuclear versus coal). Variables affecting interpretation of published information include completeness of intermediary cost estimates (overnight and construction); assumptions about plant capacity factor and levelization period; and dollar-year of estimate.

The studies report cost estimates for different years. In order to compare estimates from different studies, these estimates were escalated to 2008 dollars, using an assumed escalation rate of 3.3 percent.

Overnight Cost

The overnight cost estimates in Table 10.4-X1 do not incorporate the cost of land or the cost of network transmission facilities. TVA does not consider the cost of its nuclear plant sites to

be irretrievable, because the land would be available for resale after decommissioning. Therefore, the land cost could not go into a benefit/cost equation accurately except on both sides of the equation, in which case it is not a differentiator useful to a decision-maker. The Table 10.4-X1 overnight cost information does not include the cost of transmission facilities.

Table 10.4-X1 shows overnight cost estimates ranging from $2516 to $4649 per kW in 2008 dollars, with more recent costs generally being in the higher end of the range. The Keystone study (Reference 14) indicates today's costs reflect an increase that is consistent with a sharp rise in construction cost indices since 2003. For a plant such as BLN, with a two-unit capacity of 2234 MWe net (Subsection 8.4), this data gives an overnight cost range of approximately $5.6 billion to $10.4 billion. TVA has concluded that this range would bracket BLN overnight costs.

Construction Cost

As Table 10.4-X1 indicates, each of the four utilities that have filed applications with their state PUCs (i.e., SCE&G, Southern Company, Progress, and FP&L) have included construction cost estimates with their filings. Although additional literature with projections of new nuclear plant costs has been published (e.g., The Keystone Center study), the cost estimates provided with the PUC filings are considered the most accurate, because they are both current and are often based on signed engineering, procurement, and construction (EPC) contracts (such as the SCE&G and Southern Company filings). Construction estimates that are supported by EPC contracts have limited uncertainties, based on a projection of indices as specified in the contracts that have been negotiated with the reactor vendors.

The construction costs presented in the PUC filings are inclusive of owners' costs (except network transmission expenses). The total construction cost estimates, escalated to 2008 dollars, range from $4374 to $7829 per kWe net. Applying this range to BLN would give a total construction cost estimate range of $9.8 billion to $17.5 billion. Similar to overnight costs, TVA has concluded that the construction cost estimates presented by these four utilities would bracket BLN construction costs. TVA expects that the BLN construction costs would fall within the lower half of this range, due in part to work already completed on the Bellefonte site. However, the conclusions in this report are valid if the costs were to fall anywhere within the range presented in Table 10.4-X1.

Levelized Cost

The NEI, Brattle Group, CBO and Keystone studies reported estimates of levelized costs, escalated to 2008 dollars, ranging from 6.6 to 12.3 cents per kWh. Generally, the higher-end estimates assume longer construction times (6 to 7 years) and lower capacity factors (75 to 85 percent). TVA has concluded that the BLN levelized cost is bracketed by these costs. TVA expects that its actual costs will be within the lower half of this range. However, the conclusions in this report are valid if the costs were to fall anywhere within the range presented in Table 10.4-X1.

Internal Costs for Coal- and Gas-Fired Generation

As described in Subsection 9.2.3, TVA has concluded that coal- and natural gas-fired generation are reasonable alternatives to the proposed action. These technologies also figure into most published studies that compare the cost of new nuclear plants to the cost of generation alternatives. For several reasons, comparisons between these alternatives are

difficult. Coal- and gas-fired plants cost less to build than nuclear plants, but their operating costs are higher. This means that only comparisons of levelized costs reflect a true assessment of competitiveness. Recent domestic experience in building coal- and gas-fired plants means that there is less need for contingency and risk planning than for new nuclear plants. The volatility of the natural gas market makes predicting gas-fired generation operating costs difficult. However, the most significant complicating factor is the potential impact of federal legislation on greenhouse gas emissions.

There are numerous studies available that estimate the cost of constructing and operating new coal- and gas-fired plants. The following studies that evaluated the cost of constructing and operating new coal- and gas-fired plants under various greenhouse gas control scenarios were reviewed in detail to estimate TVA internal costs.

- Congressional Budget Office (CBO) study on the role of nuclear power in generating electricity (Reference 15).
- National Energy Technology Laboratory (NETL) report on the cost and performance baseline for fossil energy plants converting coal and natural gas to electricity (Reference 20).
- The Brattle Group's Integrated Resource Plan for Connecticut (Reference 6).

The studies report cost estimates for different years. In order to compare estimates from different studies, the estimates were escalated to 2008 dollars, using an assumed escalation rate of 3.3 percent. TVA also added an estimate of owner's costs to the results of the National Energy Technology Laboratory (NETL) study. Tables 10.4-X2 and 10.4-X3 provide summaries of the estimated coal- and gas-fired plant costs from these studies, as well as specific information for American Electric Power Company's Mountaineer IGCC plant, which includes carbon capture and sequestration (CCS) technology, and received approval from the West Virginia Public Service Commission in March 2008.

For the coal-fired alternative, assuming no carbon emission (greenhouse gas) controls, Table 10.4-X2 shows overnight cost estimates in 2008 dollars ranging from $1600 to $3822 per kW. When carbon emission control is considered, Table 10.4-X2 indicates that overnight costs could be as high as $4037 per kW in 2008 dollars. For a coal-fired plant having a capacity of 2120 MWe net (Subsection 9.2.3.1), this data gives an overnight cost range of approximately $3.4 billion to $8.6 billion.

For the gas-fired alternative, assuming no carbon emission control, Table 10.4-X3 shows overnight cost estimates in 2008 dollars ranging from $572 to $869 per kW. When carbon emission control is considered, Table 10.4-X3 indicates that overnight costs could be as high as $1558 per kW in 2008 dollars. For a gas-fired plant having a capacity of 2120 MWe net (Subsection 9.2.3.1), this data gives an overnight cost range of approximately $1.2 billion to $3.3 billion.

~~"Overnight capital cost," is a term commonly used in describing the monetary cost of constructing large capital projects such as a power plant. Capital costs are those incurred during construction when actual outlays for equipment, construction, and engineering (including construction of any new transmission lines) are expended. Overnight costs are exclusive of interest and include engineering, procurement and construction costs, owner's costs, and contingencies.~~

~~In these studies, estimates of overnight capital costs for constructing a nuclear reactor range from $1100 per kilowatt to $2500 per kilowatt, with $1500 to $2000 per kilowatt (in 2002~~

~~dollars) being the most representative range. Many factors account for the range in values; the specific technology and assumptions about the number of like-units built, allocation of first-of-a-kind costs, site location and parity adjustments to allow comparison between countries, and allowances for contingencies are some examples.~~

~~These cost estimates are not based on nuclear plant construction experience in the U.S., which is more than 20 years old. Actual construction costs overseas have been less than the most recent domestic construction, suggesting that the industry has learned how to reduce costs. An assumption in these studies is that the overseas' experience can be applied domestically (Reference 5).~~

~~The selected studies tend to support $2000 per kilowatt as a reasonable high-end overnight capital cost estimate. The $2500 value is based on construction in Japan. While no explanation is offered as to why this amount is so high, it is reasonable to suggest that contributing factors are the high cost of living in Japan (labor accounts for more than 20 percent of costs) and difficulties associated with construction on a relatively small island. These costs do not reflect the fully loaded costs that include various utility owners' costs. Owner's costs typically include site work and preparation, cooling water intake structures and cooling towers, import duties on components, insurance, spare parts, development costs, project management costs, owner's engineering, state and local permitting, legal fees, and operations staffing and training. Also, with the recent trends in commodity and labor pricing, the $2000 per kilowatt value may not be conservative. For the purposes of analysis and to avoid understating the cost, a range of $2850 to $3200 per kilowatt is chosen. This estimated range more closely reflects full plant costs which include such additional items as interest during construction, escalation to the year in which the dollars are spent, contingencies, and additional investment in the transmission infrastructure. Together with a combined installed capacity of 2234 MWe, the construction cost for the two units ranges from $6.4 to $7.1 billion.~~

13. Change COLA Part 3, ER Chapter 10, Subsection 10.4.2.1.2, as follows:

Operational costs for power plants is frequently expressed as the levelized cost of electricity, which is the price at the busbar needed to cover operating costs (including transmission line maintenance) and annualized capital costs. Overnight capital costs account for approximately one-third of the levelized cost, and interest costs on the overnight costs account for another 25 percent. The ~~University of Chicago~~ NEI study states that, in ~~2003~~ 2007 dollars, the cost of nuclear fuel is listed as ~~$4.35~~ $7.50 per megawatt hour (Reference 12). Variable operation and maintenance costs are approximately $2~~.00~~per megawatt hour and nuclear waste fees are $1 per megawatt hour (Reference 5).

The ~~four~~ studies described above show a wide disparity in the range of operational cost estimates. Levelized cost estimates range from ~~$36 and $83~~ $66 and $123 per MWe hour (~~3.6 to 8.3~~ 6.6 to 12.3 cents per kilowatt hour). Factors affecting this range include: choices for discount rate, construction duration, plant lifespan, capacity factor, cost of debt and equity and the split between debt and equity financing, depreciation time, tax rates, and premium for uncertainty. These estimates also include decommissioning but, due to the effect of discounting a cost that occurs as much as 40 years into the future, decommissioning costs have relatively little effect on the levelized cost.

A more recent study, published by the Nuclear Energy Institute (NEI) in August 2008 (Reference 12), provides the following conclusion regarding comparative studies of electricity generation costs:

> "Analysis by generating companies, the academic community, and financial experts shows that even at capital costs in the $4,000/kWe to $6,000/kWe range, the electricity generated from nuclear power can be competitive with other new sources of baseload power, including coal and natural gas. These results are absent any restrictions on carbon dioxide emissions. With regional or national programs that put a significant price on carbon emissions, nuclear power becomes even more competitive."

NEI's cost study provides a comprehensive assessment of the costs of constructing and operating nuclear plants, based not only on international construction experience, but also on recent filings with state Public Utility Commissions (PUCs), and negotiations on engineering, procurement, and construction (EPC) contracts.

~~The four previously cited studies also provide coal- and gas-fired generation costs for comparison with nuclear generation costs. One study (Reference 6) showed nuclear costs competitive with those of natural gas and coal. The other studies showed nuclear costs exceeding cost estimates for gas and coal. One study (Reference 7) indicated that new nuclear power is not economically competitive but suggested steps for the government to take to improve nuclear economic viability. Since the study was published, the government has undertaken these steps as follows:~~

- ~~The U.S. government has endorsed nuclear energy as a viable carbon-free generation option.~~
- ~~The Energy Policy Act of 2005 instituted a production tax credit for the first advanced reactors brought on line in the U.S.~~
- ~~U.S. Department of Energy provides financial support to plants engaged in testing the NRC licensing processes for early site permits and combined operating licenses.~~

~~Consequently, the recent government steps and incentives have negated the MIT study's conclusion that new nuclear power is not economically competitive.~~

14. Change COLA Part 3, ER Chapter 10, Subsection 10.4.3, 2nd paragraph, last sentence, as follows:

~~The BLN units were found preferable to each of these alternatives.~~ None of the alternatives was found to be environmentally preferable to BLN.

15. Change COLA Part 3, ER Chapter 10, Subsection 10.4.3, 5th paragraph, last sentence, as follows:

On the basis of the assessments summarized in this environmental report, ~~statement that~~ the construction and operation of BLN, with no modifications, is ~~are~~ needed by the service area in the time frame projected, and the accrued benefits outweigh the economic, environmental, and social costs. Further, the overall benefit-cost balance does not substantively improve by the selection of an alternative site or by use of an alternative generating system.

16. Change COLA Part 3, ER Chapter 10, Subsection 10.4.4, by replacing Reference 6 and adding new References 12 through 20, as follows:

6. The Brattle Group, *Integrated Resource Plan for Connecticut*, January 1, 2008. ~~OECD 2005, Nuclear Energy Agency, Organization for Economic Co-operation and Development, and International Energy Agency, Projected Costs of Generating Electricity; 2005 Update, available on OECD website at http://www.oecdbookshop.org/oecd/display.asp?K=5LH1VDKBQCTB&tag=XNJB98XX4X488918XKCJS5&lang=EN&sort=sort_date/d&sf1=Title&st1=electricity&sf3=SubjectCode&st3=34&st4=not+E4+or+E5+or+5&sf4=SubVersionCode&ds=electricity%3B+Energy%3B+&m=17&dc=58&plang=en (Note: electronic version cannot be printed, Paper version available for purchase), accessed June 5, 2007.~~

12. Nuclear Energy Institute (NEI), *The Cost of New Generating Capacity in Perspective*, August 2008.

13. American Electric Power (AEP), "*AEP receives approval to build IGCC plant from WV PSC,"* March 2008, *Website,* http://www.aep.com/newsroom/newsreleases/?id=1440, accessed October 16, 2008.

14. The Keystone Center, *Nuclear Power Joint Fact-Finding,* June 2007.

15. Congressional Budget Office, *Nuclear Power's Role in Generating Electricity*, May 2008.

16. Florida Power and Light, *Before the Florida Public Service Commission Florida Power & Light Company's Petition to Determine Need for Turkey Point Nuclear Units 6 and 7 Electrical Power Plant, Direct Testimony & Exhibits of Steven D Scroggs,* FPSC Document No. 09467-07 Docket No. 070650, October 16, 2007.

17. Progress Energy Florida, *Petition for Determination of Need for Levy Units 1 and 2 Nuclear Power Plants on Behalf of Progress Energy Florida,* Docket No. 080148-EI, March 11, 2008.

18. South Carolina Electric & Gas Company (SCE&G), *COMBINED APPLICATION for Certification of Environmental Compatibility, Public Convenience and Necessity And For a Base Load Review Order, Public Service Commission of South Carolina,* Docket No. 2008-196-E, Public Version, May 2008.

19. Southern Company, *The Georgia Power's Application for The Certification of Units 3 and 4 At Plant Vogtle and Updated Integrated Resource Plan,* Docket No. 27800-U, Public Disclosure, undated.

20. National Energy Technology Laboratory (NETL), *Cost and Performance Baseline for Fossil Energy Plants, Volume 1: Bituminous Coal and Natural Gas to Electricity,* DOE/NETL-2007/1281, Revision 1, August 2007.

21. MIT 2006, Massachusetts Institute of Technology, P. L. Joskow, *Prospects for Nuclear Power A U.S. Perspective*, May 19, 2006.

11. Change COLA Part 3, ER Chapter 10, Table 10.4-2, by changing the costs associated with the Capital and Operating Costs, as follows:

TABLE 10.4-2 (Sheet 1 of 4)
SUMMARY OF PRINCIPAL BENEFITS AND COSTS
FOR CONSTRUCTING AND OPERATING
BELLEFONTE NUCLEAR PLANT, UNITS 3 AND 4

Attribute	Benefits	Costs
Capital and Operating Costs	Obtain a relatively clean and abundant form of baseload electricity that is relatively cost-competitive with fossil fuels.	Overnight Capital Costs are estimated to range between ~~$2850 to $3200 per KW~~ $2516 and $4649 per kW for a combined construction cost (two units) of ~~$6.4 and $7.1~~ $5.6 to $10.4 billion. Levelized (two units) costs are estimated to range between ~~$36 and $83~~ $66 and $123 per MWh.

12. Change COLA Part 3, ER Chapter 10, Table 10.4-3, by changing the first two rows of information, as follows:

TABLE 10.4-3 (Sheet 1 of 2)
INTERNAL AND EXTERNAL COSTS OF
BELLEFONTE NUCLEAR PLANT, UNITS 3 AND 4

Cost Category	Cost
	Internal Costs
Overnight Capital Costs	~~$2850 to $3200 per KW~~ $2516 to $4649 per kW
Construction costs (two units)	~~$6.4 to $7.1~~ $9.9 to $17.5 billion

Table 10.4-X1
Nuclear Plant Monetary Costs[a]

Study	Overnight Cost[b] per kW (year)	Overnight Cost per kW Escalated to 2008 Dollars[c]	Construction Cost[d] per kW (year)	Construction Cost per kW Escalated to 2008 Dollars[c]	Levelized Cost[e] per kWh (year)	Levelized Cost per kWh Escalated to 2008 Dollars[c]
NEI, August 2008 (Reference 12)	$3500 - $4500 (2007) Two units, including owner's costs (assumed).	$3616 - $4649	$5071 - $6378 (2007) Excluding transmission cost (assumed).[f] $4351 - $5473 (2007) Excluding transmission cost (assumed).[g]	$5238 - $6588 $4495 - $5654	6.4¢ - 7.6¢ (2007)[f] 9.7¢ - 11.9¢ (2007)[g] 4-year construction period, 6-month start-up, 90% capacity factor, and 40-year plant life.	6.6¢ – 7.9¢ 10.0¢ - 12.3¢
SCE&G, 2008 (Reference 18)	Not provided	Not provided	$4596 (2008) Two units, excluding transmission costs, year spent dollars.	$4596	Not provided	Not provided
Southern Co, 2008 (Reference 19)	Not provided	Not provided	$4436 - $6314 (2008) Two units, based on Georgia Power ownership share (45.7%)[h]	$4436 - $6314	Not provided	Not provided
CBO, May 2008 (Reference 15)	$2358 (2006) Single unit, including owner's costs (assumed)[i]	$2516	Not estimated	Not estimated	7.2¢ (2006) with 6-year construction period, 90% capacity factor, and 40-year plant life	7.7¢
Progress, 2008 (Reference 17)	$4260 (2007) Two units, does not include transmission upgrades.	$4401	$6267 (Year spent dollars), includes 3.0% escalation.	$6267	Not provided	Not provided
Brattle Group, 2008 (Reference 6)	$4038 (2008)	$4038	Not estimated	Not estimated	8.3¢ (2008) with 90% capacity factor and 40-year plant life.	8.3¢
FPL, Oct 2007 (Reference 16)	$2910 - $4298 (2007)[j]. Two units, including owner's costs	$3006 - $4441	$5079 - $7579 (2007)[k] with 6-year construction period	$5247 - $7829	Not estimated	Not estimated
Keystone Jun 2007 (Reference 14)	$2130[l] (2002) Single unit, including all owner's costs (presumed)[m]	$2588	$3600 with 5-year construction period and no escalation - $4000 with 6-year construction period and 3.3% real escalation (2007)	$4374 - $4860	8.3¢ with 90% capacity factor and 40-year levelization period 11.1¢ with 75% capacity factor and 30-year levelization period (2007)	8.6¢ - 11.5¢

AFUDC = Allowance for funds used during construction (interest incurred during construction period)

Table 10.4-X1 -- Nuclear Plant Monetary Costs

Notes

a. Costs summarized in this table do not include transmission and distribution costs.

b. "Overnight Cost" is a convention for expressing the cost of construction as if the plant could be built overnight and therefore does not include escalation or interest costs during construction. Engineering, procurement, and construction costs are included. Some studies include owner's costs, others do not.

c. Escalated at an assumed rate of 3.3% per year.

d. "Construction Cost" equals overnight cost plus escalation and interest during construction period and during period until construction starts. Sometimes referred to as "all-in cost."

e. "Levelized Cost" is the constant real wholesale price needed to recover construction and operating costs over lifetime of plant.

f. Project finance based on an 80 percent debt/20 percent equity capital structure, supported by a federal loan guarantee. Assumes 48-month construction, 6-month start-up; owners cost of $286/kWe and 10% contingency; 6.5% interest rate on commercial debt for unregulated entities, 6.0% interest rate on commercial debt for regulated entities, 4.5% interest rate on government-guaranteed debt, 15% return on equity; 5% loan guarantee cost; 90% capacity factor; O&M cost of $9.50/MWh and fuel cost of $7.50/MWh.

g. Based on a 50 percent debt/50 percent equity capital structure, typical of a regulated electric company, and assuming the company is permitted to recover the cost of capital during construction (CWIP); 90% capacity factor; O&M cost of $9.50/MWh and fuel cost of $7.50/MWh.

h. Georgia Power (Reference 19) total in-service cost of $4,512 billion if construction work in progress (CWIP) is approved and $6.447 billion if CWIP request is denied. Georgia Power ownership share (45.7%) projected to full cost.

i. CBO May 2008 (Reference 15) indicates that it relied on the EIA most recent projections. The EIA has indicated that its 2007 projection is an average of construction costs incurred in completed advanced reactor builds in Asia. It is reasonable to conclude that construction costs for completed reactors would include owner's costs and that, therefore, EIA and CBO May 2008 projections include owner's costs.

j. FPL (Reference 16) total overnight costs ($3108-$4540) included transmission costs, which have been subtracted here.

k. FPL (Reference 16) construction costs ($5426 - $8005) included transmission costs, which have been subtracted here. In addition, portions of escalation and AFUDC costs attributable to transmission costs have also been subtracted here.

l. The study presents a construction cost estimate of $2950 per kW, but this value appears to be incorrect. The study indicates that the estimate is an escalation of the average cost of recently constructed units ($2130 per kW) from 2002 to 2007 dollars at 3.3% real and that the estimate is reasonable and consistent with the $2500 per kW value used by Paul Joskow in recent presentations (see MIT 2006 – Reference 21). Joskow was the source of costs for recently constructed units and was a contributor to the MIT 2003 study (Reference 7). An estimate of $2950 does not appear to be consistent with a $2500 value. TVA's calculation, escalating $2130 at 3.3% real results in a 2007 dollar value of $2505, which is consistent with a $2500 value.

m. Assumed because study indicates that estimate is based on cost for units already constructed, so owner's costs would have already been incurred.

Table 10.4-X2
Coal-Fired Plant Monetary Costs[a]

Study	Overnight Cost[b] per kW (year)	Overnight Cost per kW Escalated to 2008 Dollars[c]	Construction Cost[d] per kW (year)	Construction Cost per kW Escalated to 2008 Dollars[c]	Levelized Cost[e] per kWh (year)	Levelized Cost per kWh Escalated to 2008 Dollars[c]
NEI 2008 (Reference 12)	$2250 (2007) SCPC, Including owner's costs (assumed)[f] $3700 (2007) IGCC, Including owner's costs (assumed)[f]	$2324 (SCPC) $3822 (IGCC)	SCPC: $2424 (2007) IGCC: $4164 (2007)[g] $4855 (2007)[h] Does not assume any restrictions on CO_2 emissions.	SCPC: $2504 IGCC: $4301[g] $5015[h] Does not assume any restrictions on CO_2 emissions	SCPC: 7.1¢ (2007) IGCC: 11.2¢ (2007)[g] 7.2¢ (2007)[h] Does not assume any restrictions on CO_2 emissions.	SCPC: 7.3¢ IGCC: 11.6¢[g] 7.4¢[h] Does not assume any restrictions on CO_2 emissions
CBO 2008 (Reference 15)	$1499 (2006) Including owner's costs (assumed)[f]	$1600	Not estimated	Not estimated	No CO_2 Emissions Cap: 5.5¢ CO_2 Emissions Capped at 2008 Level:[j] 8.0¢ CO_2 Emissions Capped at 85% Below 2008 Level by 2050: 12.8¢[k] (2006) with 4-year construction period, 85% capacity factor, and 40-year plant life	No CO_2 Emissions Cap: 5.9¢ CO_2 Emissions Capped at 2008 Level: 8.5¢ CO_2 Emissions Capped at 85% Below 2008 Level by 2050: 13.7¢
AEP 2008 (Reference 13)	$3545 (2007) Including escalation, not including AFUDC	$3783 with CCS	Not estimated	Not estimated	Not estimated	Not estimated
Brattle Group, 2008 (Reference 6)	$2214 - $4037 SCC $2567 - $3387 IGCC (2008) Including owner's cost (assumed)[f]	SCC: $2214 without CCS $4037 with SCC IGCC: $2567 without CCS $3387 with CCS[l]	Not estimated	Not estimated	SCC: 8.7¢ without CCS 14.2¢ with CCS IGCC: 9.2¢ without CCS 12.5¢ with CCS[l]	SCC: 8.7¢ without CCS 14.2¢ with CCS IGCC: 9.2¢ without CCS 12.5¢ with CCS[l]
NETL 2007 (Reference 20)	$1575 without CCS and $2870 with CCS (2007)[m]	Without Owner's Costs: $1627 without CCS and $2965 with CCS With Owner's Costs Added: $1952 without CCS and $3558 with CCS[n]	Not estimated	Not estimated	Without Owner's Costs: 6.3¢ without CCS and 11.5¢ with CCS With Owner's Costs Added: 7.0¢ without CCS and 12.8¢ with CCS 85% capacity factor, 20-year levelization period	Without Owner's Costs: 6.5¢ without CCS and 11.9¢ with CCS With Owner's Costs Added: 7.3¢ without CCS and 13.3¢ with CCS

Table 10.4-X2
Coal-Fired Plant Monetary Costs[a]

CC = Combined cycle
CCS = Carbon capture and sequestration
CO_2 = Carbon dioxide
IGCC = Integrated gasification combined cycle
SCC = Supercritical coal
SCPC = Supercritical pulverized coal

a. Costs summarized in this table do not include transmission and distribution costs.

b. "Overnight Cost" is a convention for expressing the cost of construction as if the plant could be built overnight and therefore does not include escalation or interest costs during construction. Engineering, procurement, and construction costs are included. Some studies include owner's costs, other do not.

c. Escalated at an assumed rate of 3.3% per year.

d. "Construction Cost" equals overnight cost plus escalation and interest during construction period and during period until construction starts. Sometimes referred to as "all-in cost."

e. "Levelized Cost" is the constant real wholesale price needed to recover financing, construction, and operating costs over the lifetime of the plant.

f. The capital cost estimates for supercritical pulverized coal (SCPC) and integrated gasification combined cycle (IGCC) are from recent regulatory filings for projects.

g. Project finance based on a 50 percent debt/50 percent equity capital structure, typical of a regulated electric company, and assuming the company is permitted to recover the cost of capital during construction (CWIP).

h. Project finance based on an 80 percent debt/20 percent equity capital structure.

i. Assumed that CBO May 2008 overnight costs include owner's costs so that costs are comparable across different technologies (see Table 9.2-7, footnote f.

j. Includes charge of $19 per metric ton of CO_2 in 2015 (CBO May 2008) (Reference 15).

k. Includes charge of $55 per metric ton of CO_2 in 2015 (CBO May 2008) (Reference 15).

l. Lower-end Combined cycle (CC) and Integrated gasification combined cycle (IGCC) cost values are without CCS; Higher-end CC and IGCC cost values are with CCS.

m. Information for supercritical pulverized coal technology.

n. Assuming owner's costs add 20%.

Table 10.4-X3

Gas-Fired Plant Monetary Costs[a]

Study	Overnight Cost[b] per kW (year)	Overnight Cost per kW Escalated to 2008 Dollars[c]	Construction Cost[d] per kW (year)	Construction Cost per kW Escalated to 2008 Dollars[c]	Levelized Cost[e] per kWh (year)	Levelized Cost per kWh Escalated to 2008 Dollars[c]
NEI 2008 (Reference 12)	$1000	$1033	$1195 - $1218	$1234 - $1258	No CO_2 Emissions Cap: 7.0¢ - 9.8¢ (2007)[f]	No CO_2 Emissions Cap: 7.2¢ - 10.2¢[f]
CBO May 2008 (Reference 15)	$685 (2006)[g] Including owner's costs (assumed)[h]	$731	Not estimated	Not estimated	No CO_2 Emissions Cap: 5.7¢ CO_2 Emissions Capped at 2008 Level:[i] 6.7¢ CO_2 Emissions Capped at 85% Below 2008 Level by 2050: 8.6¢[i] (2006) with 4-year construction period, 85% capacity factor, and 40-year plant life	No CO_2 Emissions Cap: 6.1¢ CO_2 Emissions Capped at 2008 Level: 7.1¢ CO_2 Emissions Capped at 85% Below 2008 Level by 2050: 9.2¢
Brattle Group, 2008 (Reference 6)	$869 CC without CCS (2008) $1558 CC with CCS (2008)	$869 - $1558	Not estimated	Not estimated	Advanced combined cycle without CCS: 7.6¢ Advanced combined cycle with CCS: 10.3¢ (2008) 4-year construction period, 85% capacity factor	Advanced combined cycle without CCS: 7.6¢ Advanced combined cycle with CCS: 10.3¢
NETL Aug 2007 (Reference 20)	$554 without CCS and $1172 with CCS (2007)[k] Excluding owner's costs	Without Owner's Costs: $572 without CCS and $1211 with CCS With Owner's Costs Added: $687 without CCS and $1453 with CCS[l]	Not estimated		Without Owner's Costs: 6.8¢ without CCS and 9.7¢ with CCS With Owner's Costs Added: 7.1¢ without CCS and 10.3¢ with CCS 85% capacity factor, 20-year levelization period	Without Owner's Costs: 7.0¢ without CCS and 10.0¢ with CCS With Owner's Costs Added: 7.3¢ without CCS and 10.6¢ with CCS

CCS = Carbon capture and sequestration
CO_2 – Carbon dioxide

a. Costs summarized in this table do not include transmission and distribution costs.

b. "Overnight Cost" is a convention for expressing the cost of construction as if the plant could be built overnight and therefore does not include escalation or interest costs during construction. Engineering, procurement, and construction costs are included. Some studies include owner's costs, other do not.

Table 10.4-X3

Gas-Fired Plant Monetary Costs[a]

c. Escalated at an assumed rate of 3.3% per year.

d. "Construction Cost" equals overnight cost plus escalation and interest during construction period and during period until construction starts. Sometimes referred to as "all-in cost."

e. "Levelized Cost" is the constant real wholesale price needed to recover financing, construction, and operating costs over the lifetime of the plant.

f. Low-end cost assumes fuel costs of $6.00/mmBtu; high-end cost assumes fuel cost of $10.00/mmBtu. Assumed plant capacity is 400 MWe.

g. Assumed that CBO May 2008 (Reference 15) overnight costs include owner's costs so that costs are comparable across different technologies (see Table 10.4-X1, footnote f).

h. Information for conventional technology using combined cycle turbines.

i. Includes charge of $19 per metric ton of CO_2 in 2015 (CBO May 2008) (Reference 15).

j. Includes charge of $55 per metric ton of CO_2 in 2015 (CBO May 2008) (Reference 15).

k. Information for combined cycle F-class technology.

l. Assuming owner's costs add 20%.