STATE OF INDIANA

INDIANA UTILITY REGULATORY COMMISSION

VERIFIED PETITION OF DUKE ENERGY INDIANA, INC. SEEKING (1) APPROVAL OF AN ONGOING REVIEW PROGRESS REPORT PURSUANT TO IND. CODE §§8-1-8.5 AND 8-1-8.7; (2) AUTHORITY TO REFLECT COSTS INCURRED FOR THE EDWARDSPORT INTEGRATED GASIFICATION COMBINED CYCLE GENERATING FACILITY ("IGCC PROJECT") PROPERTY UNDER CONSTRUCTION IN ITS RATES AND AUTHORITY TO RECOVER APPLICABLE RELATED COSTS THROUGH ITS INTEGRATED COAL GASIFICATION COMBINED CYCLE GENERATING FACILITY COST RECOVERY ADJUSTMENT, STANDARD CONTRACT RIDER NO. 61 PURSUANT TO IND. CODE §§8-1-8.8-11 AND -12; AND (3) ESTABLISHMENT OF A SUBDOCKET PROCEEDING TO REVIEW THE COST ESTIMATE FOR THE IGCC PROJECT	**)**	**CAUSE NO. 43114 IGCC 4S**

DIRECT TESTIMONY OF DAVID A. SCHLISSEL
ON BEHALF OF THE
CITIZENS ACTION COALITION OF INDIANA
SAVE THE VALLEY
VALLEY WATCH
SIERRA CLUB
July 30, 2010

REDACTED (PUBLIC) VERSION

Introduction and Qualifications

Q. Please state your name and business address.

A. My name is David A. Schlissel. I am the President of Schlissel Technical Consulting, Inc., 45 Horace Road, Belmont, MA 02478.

Q. Please summarize your educational background and recent work experience.

A. I graduated from the Massachusetts Institute of Technology in 1968 with a Bachelor of Science Degree in Engineering. In 1969, I received a Master of Science Degree in Engineering from Stanford University. In 1973, I received a Law Degree from Stanford University. In addition, I studied nuclear engineering at the Massachusetts Institute of Technology during the years 1983-1986.

Since 1983 I have been retained by governmental bodies, publicly-owned utilities, and private organizations in 28 states to prepare expert testimony and analyses on engineering and economic issues related to electric utilities. My recent clients have included the New Mexico Public Regulation Commission, the U.S. Department of Justice, the Attorney General and the Governor of the State of New York, state consumer advocates, and national and local environmental organizations.

I have testified before state regulatory commissions in Arizona, New Jersey, California, Connecticut, Kansas, Texas, New Mexico, New York, Vermont, North Carolina, South Carolina, Maine, Illinois, Indiana, Ohio, Massachusetts, Missouri, Rhode Island, Wisconsin, Iowa, South Dakota, Georgia, Minnesota, Michigan, Florida, North Dakota and Mississippi and before an Atomic Safety & Licensing Board of the U.S. Nuclear Regulatory Commission.

A copy of my current resume is attached as Exhibit DAS-1. Additional information about my work is available at www.schlissel-technical.com.

Q. On whose behalf are you testifying in this case?

A. I am testifying on behalf of the Citizens Action Coalition of Indiana, Valley Watch, Save the Valley and the Sierra Club.

Q. Have you testified previously before this Commission?

A. Yes. I have submitted testimony in Causes Nos. 28045, 38702-FAC-40-S1, 43114 and 43114 IGCC-1.

Q. What is the purpose of your testimony?

A. I was retained to review Duke Energy Indiana's ("Duke," "DEI" or "the Company") new cost estimate for the Edwardsport Integrated Gasification Combined Cycle Facility ("IGCC Project") and to evaluate whether the Company has appropriated evaluated the cost of continuing the IGCC Project against other technically and economically viable alternatives. This testimony presents the results of my evaluation of these issues.

Q. Please summarize your primary conclusions.

A. My primary conclusion is that the economic analyses presented by DEI's witnesses reflect a number of flawed assumptions that bias their results in favor of the completion of the IGCC Project. These flawed assumptions include:

1. Despites having severely understated the estimated cost of the IGCC Project in its earlier analyses, DEI failed to model any new scenarios with a construction cost higher than the Company's current $2.88 billion estimate.

2. DEI claims that the capability to capture carbon is a major benefit of an IGCC plant. However, the Company's new economic analyses fail to include either (a) the capital or operating costs for carbon capture or (b) the reduced net output and the higher heat rate which would result from adding carbon capture technology.

3. DEI uses only a single set of CO_2 prices in its new modeling analyses and thus does not adequately reflect the potential range of economic risks that federal regulation of greenhouse gas regulation poses for the IGCC Project and, consequently, for DEI and its ratepayers.

4. DEI uses high natural gas prices that bias the analyses against the scenario that assumes the conversion of the Project to an NGCC plant.

5. DEI adds very expensive nuclear units approximately four years earlier in the two scenarios that do not include completion of the IGCC Project. This increases their NPV costs relative to the Complete as IGCC scenario.

Despite these biased assumptions, as shown in the testimony of DEI witness Hager, the Complete as IGCC option is the highest cost alternative of the three plans examined by Duke in both the Base Case and the High Energy Efficiency scenarios.[1]

Q. Please summarize you primary recommendations.

A. The Commission should not approve the Company's decision to complete the IGCC Project or modify the CPCN at the new cost estimate that Duke Energy Indiana has presented in this proceeding.

Q. When did the Company first realize that it would be unable to complete the Edwardsport Project for the $2.35 billion cost approved by the IURC?

A. The Company has said that it first recognized in mid-October 2009 that it would be unable to complete the Edwardsport Project for the Commission approved $2.35 billion cost.[2]

[1] Direct Testimony of Janice D. Hager, at page 13, lines 6-21.

[2] DEI Revised and Supplemental 7/7/10 Response to Data Request DEI-IG 5.13.

Q. Did DEI undertake any resource planning analyses during 2009 in which it considered the cancellation of the Edwardsport Project or its conversion to a natural gas-fired unit?

A. No.[3] The Company did not re-examine the economics of completing the IGCC Project at any time in 2009 even after it realized in October 2009 that the cost of completing the Project would be significantly higher than it had previously estimated.

Q. Was this prudent?

A. No. Prudence requires that a company re-examine its commitment to a project in light of significantly changed circumstances. Starting at least in early 2009, Duke knew that its schedule was slipping for the IGCC Project and that its costs were rising. By mid-October of the year, the Company knew that it would exceed its Commission approved cost estimate.[4] Under these circumstances, the Company should have immediately re-evaluated the economics of completing the IGCC Project.

However, Duke did not re-analyze the economics of the Project until early 2010 and did not submit new resource planning analyses to the Commission until early April. At the same time, the Company has failed to suspend construction. The additional spending on the project made by DEI during the fall of 2009 and the winter and spring of 2010 have improved the relative economics of completing Edwardsport as an IGCC plant. This spending also has increased the sunk costs that ratepayers may have to pay if the Edwardsport Project is cancelled or is completed as an NGCC unit.

[3] DEI Response to Data Request CACI 1.12.

[4] DEI Response to Steel Dynamics Inc. Data Request Set No. 2, Request SDI 2.21.

Q. But didn't Duke need to wait to re-examine the economics of completing the Project until it knew what the new cost estimate would be?

A. No. The Company could and should have undertaken new modeling analyses by the fall of 2009 when it became aware that it would exceed its Commission approved cost estimate. These new modeling analyses could have assumed a range of revised estimated costs for the Project (e.g., +10 percent to +20 percent) and need not have awaited the development of the new detailed $2.88 billion cost estimate.

Modeled Project Construction Costs

Q. Has DEI presented any modeling analyses that assume further increases in the cost of constructing the Edwardsport IGCC Project?

A. No. Despite the dramatic increases in the Project's estimated cost experienced since late 2007, DEI's modeling analyses assume that the Project's cost will not increase any more.

Q. Is that reasonable?

A. No. Given the dramatic cost increases experienced on the Project since 2007, it is reasonable, indeed prudent, to expect that the cost of building the IGCC plant will rise further if construction continues.

Q. Why is it reasonable to anticipate that the cost of the Edwardsport Project will continue to rise?

A. There are a number of reasons why it is reasonable to expect that the cost of the Project will continue to rise above Duke's current $2.88 billion estimate:

a. As noted by several DEI witnesses, Edwardsport remains the first-of-a-kind commercial power plant of its size using the chosen IGCC

technology.[5] This could lead to further construction cost increases, schedule delays and start-up technical problems.

b. The project is only 40 percent complete.[6]

c. DEI witness Womack has acknowledged that the Project is 5 months behind schedule in the key area of piping and there is no proof that the Company will be able to make up any of this delay despite its claim that it will make up 2 months of the delay by shortening the planned time for testing and startup.[7] As noted above, the fact that Edwardsport is the first project of its commercial size using the chosen IGCC technology would suggest that a significant number of problems (perhaps some serious) may be experienced during start-up testing that would prevent DEI from shortening the duration of the startup and testing period, at all, let alone by the two months that Duke Energy Indiana claims it will be shortened.

d. According to Petitioner's Confidential Exhibit B-1, the Ernst & Young *Evaluation of the Estimate at Final Completion*:

> Bechtel's projections of potential piping productivity predict a [**X**] to **[X]** month delay to completion of piping. While, typically, a delay to the completion, of piping would translate directly to a project delay, Duke anticipates being able to prevent a day-for-day delay by shortening the start-up and testing phase and making up approximately **[X]** months due to re-planned concurrent activities. This plan would result in a net delay of **[X]** to **[X]** months.[8]

Thus, Ernst & Young currently expects that the IGCC Project could be as much as 6 months behind schedule – and even this 6 month delay depends on the Company's claimed ability to shorten the start-up and testing phase by 3 months.

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5 For example, see the Direct Testimony of Richard W. Haviland, at page 8, lines 20-21, and DEI's response to Data Request SDI 2.19.

6 Weekly Construction Progress Report #44, Week Ending June 25th, 2010. Provided as Confidential Attachment DEI-IG 6.1-D, at page 7 of 49.

7 Direct Testimony of W. Michael Womack, at page 33, lines 18-23.

8 At page 17.

e. The Weekly Construction Progress Report for the Week Ending June 25th, 2010, reports that the Project continues to experience **[XXX]** than anticipated construction progress in a significant number of key areas and that the gap between the plan and "actual [progress] for all commodities, except for concrete, has been **[XXX]** every week."[9]

f. DEI acknowledges that one of the factors that have led to the increased cost of building the Edwardsport Project is a dramatic growth in the quantities of key construction commodities (concrete, piping, etc).[10] A comparison between the April 2010 Ernst & Young *Evaluation of the Estimate at Final Completion* and the Weekly Construction Progress Report for the Week Ending June 25th, 2010 suggests that this growth in the quantities of key construction commodities continues.

Q. Should the Commission accept DEI's claim that there is only a 15 percent chance that the cost of building the Edwardsport Project will rise above the Company's current $2.88 billion estimate?

A. No. DEI really doesn't provide any concrete evidence supporting its claimed 85 percent confidence level in the current $2.88 cost estimate. After all, as Mr. Turner testifies, the Company has previously expressed "a high degree of confidence" in the reasonableness of the now surpassed $2.35 billion estimated cost.[11] Indeed, even Company witness Womack admits that "it is possible that the confidence level is not as high as we assume."[12]

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9 Weekly Construction Progress Report #44, Week Ending June 25th, 2010. Provided as Confidential Attachment DEI-IG 6.1-D, at page 4 of 49.

10 For example, see the Direct Testimony of W. Michael Womack, at pages 6 and 7.

11 Direct Testimony of James L. Turner, at page 5, lines 14-17.

12 Direct Testimony of W. Michael Womack, at page 21, line 14.

Q. DEI witness Turner has testified that there is only a 15 percent chance that the cost of the Edwardsport Project will exceed $2.88 billion. Is DEI willing to agree not to seek recovery in the future for any cost in excess of its current cost estimate?

A. No.[13] Duke has said that it is unwilling to agree to any cap on the recovery of the cost of the Edwardsport Project.[14]

Q. Does this demonstrate a lack of confidence in the reasonableness of the current $2.88 billion Project cost estimate?

A. Yes. The Company's refusal to accept a cost cap shows that it must be aware of the potential for further cost increases and does not want to expose shareholders to those risks.

Q. Has DEI recovered or will it seek to recover any increased project costs from GE, Bechtel or any other contractor on the Edwardsport Project?

A. No. According to DEI, the Company has not recovered any costs at this time from its contractors and will continue to evaluate whether to seek to recover any such costs in the future.[15]

Q. Have you previously warned about the potential for increases in the construction cost of the IGCC Project?

A. Yes. As I have testified in Causes Nos. 43114 and 43114 IGCC-1, Duke should have anticipated that the cost of the Edwardsport Project would exceed its cost estimates in 2007 and 2008. Unfortunately, Duke chose to dispute rather than heed those warnings.

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13 See DEI Response to Data Request SDI 2.8.

14 See DEI Response to Data Request SDI 2.1.

15 See DEI Response to Data Request CAC 1.10.

Q. Is it your recommendation that the IURC require DEI to either recover increased project costs from its contractors on the Edwardsport Project or to demonstrate that the failure to do so was prudent?

A. Yes. Before it allows DEI to recover any of the cost of the Edwardsport Project, I believe the IURC should require DEI to demonstrate that (1) its management of the Edwardsport Project has been prudent and (2) that the management and work of its subcontractors on the Project have been prudent. Such prudence reviews were common in the 1980s and 1990s as the construction costs of nuclear power plants soared far above initial estimates.[16]

Q. What is your conclusion regarding Duke's failure to model any further increases in the cost of building the Edwardsport Project?

A. As I have noted in my previous testimony regarding the Edwardsport Project, DEI should model a range of plant construction costs that allows for further cost increases. Given the dramatic increases experienced in less than three years, DEI should model scenarios that evaluate the relative economics of completing the Project assuming at least an additional 10 percent to 20 percent construction cost increase.

Q. Is a natural gas fired alternative subject to the same cost uncertainty as the IGCC plant?

A. No. There is no evidence that the cost of building NGCC units has increased significantly in the past few years.

[16] For example, see the Illinois Commerce Commission's Order in Dockets Nos. 83-0537 and 84-0555 and the Public Utility Commission of Texas' Order in Docket No. 6668.

Duke's Failure to Model the Cost and Impact of Adding Carbon Capture Technology

Q. Is an IGCC coal plant a low-carbon energy resource?

A. No. There is much confusion on this point. Many people assume that IGCC coal has significantly lower carbon dioxide emissions than a pulverized coal plant either because it has significantly better efficiency or because they believe that IGCC coal has carbon capture equipment. The reality is that carbon dioxide emissions from IGCC and pulverized coal plants are very similar. Take for example, the results of the study cited by Mr. Turner in his direct testimony – *EPRI – Updated Cost and Performance Estimates for Clean Coal Technologies Including CO_2 Capture*. According to this study, the CO_2 emissions rate for a supercritical pulverized coal plant is 1771 – 1743 lbs per MWh and 1835 – 1860 lbs. per MWh for an IGCC coal plant. The bottom line is that there is no CO_2 emissions benefit from building an IGCC coal plant over a pulverized coal plant unless carbon capture equipment is added to the IGCC unit and is actually used to capture CO_2 that would otherwise be emitted into the atmosphere.

Q. Are IGCC coal plants cheaper than pulverized coal plants?

A. No. It is commonly accepted that IGCC plants are more expensive than pulverized coal plants. One need not look any further than the Duke Energy system for evidence of this. According to Duke Energy's website, the Company is constructing the 825 MW Cliffside pulverized coal plant in North Carolina at a cost of $1.8 billion. This is far less than the current cost estimate of $2.88 billion for the 625 MW Edwardsport IGCC project.

Q. So why would Duke Energy Indiana or any other utility choose to build an IGCC plant over a pulverized coal plant?

A. Because, as Mr. Turner testifies, it appears to be more cost-effective to capture carbon dioxide from an IGCC plant than from a pulverized coal plant. If one's objective is to build a coal plant, the cost-effectiveness of carbon dioxide capture

at an IGCC plant over a pulverized coal plant is the sole reason to consider IGCC.[17]

Q. Does Duke Energy Indiana propose to construct the Edwardsport IGCC plant with carbon capture?

A. No. However, Mr. Turner's testimony would suggest that DEI believes the passage of federal legislation requiring the reduction of CO_2 emissions on its system will make the addition of carbon capture equipment to the Edwardsport plant cost-effective at some point in the future.[18]

Q. Has Duke assumed any carbon capture costs in its new modeling analyses?

A. No.

Q. Is this reasonable?

A. No. Duke has proposed building an IGCC unit because that would allow the capture and sequestration of CO_2. However, the Company's modeling does not reflect the costs of adding and operating the technology that would allow for the capture and sequestration of the CO_2 that would otherwise be emitted by the unit. Instead, the Company essentially models a more complicated and more expensive pulverized coal plant without any reduction in its CO_2 emissions. One cannot claim that an IGCC plant with CCS is a cost-effective way to capture and sequester CO_2 emissions without accounting for the costs of capture.

If an IGCC plant with CO_2 capture is truly a cost-effective carbon reduction measure, it must be evaluated against other potential measures such as a natural gas plant, energy efficiency, wind energy, etc. And it can only be *properly* evaluated if the *full* cost of building the plant, including the cost of capturing the CO_2, is included in DEI's resource planning analyses.

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[17] Direct Testimony of James L. Turner, at page 10, lines 15-17.

[18] Id, at page 10.

Q. But isn't the Company now evaluating what it will cost to capture some of the CO2 that would be emitted by the Edwardsport Project?

A. Yes. However, the Company does not have to wait until its current detailed study is completed before making some assumptions about potential costs of capturing CO_2 from the plant.

Q. Have you seen any estimates of the capital costs of adding equipment to capture the CO_2 from the Edwardsport Project?

A. Yes. There have been a number of studies that have provided generic cost figures for how much it would cost to add CO_2 capture equipment to both pulverized and IGCC coal plants.[19] More specifically, EPRI prepared a report for Duke Energy Indiana in November 2008 titled *An Analysis of Carbon Capture Retrofit Options for the Duke Edwardsport IGCC Plant*. Unfortunately, the results of this report have been kept from the public.

In this report, EPRI estimated that the cost of adding equipment to capture 29 percent of the CO_2 that would be emitted by the Edwardsport Plant would be approximately $**[XX]** million.[20] EPRI's estimated cost of adding equipment to capture 59 percent of the CO_2 from the plant was approximately $**[XXX]** million.[21] The estimated cost of adding equipment to capture 90 percent of the CO_2 was approximately $**[XXX]** million. Even if these estimated costs were not the product of a rigorous and complete analysis, they should have been included as proxies in the Company's new modeling analyses. In fact, given the dramatic cost escalation experienced at Edwardsport, it is quite likely that the estimated costs of capturing CO_2 estimated by EPRI in November 2008 are now far too low and should be higher. Nevertheless, these or other generic cost estimates should

[19] For example, see *Cost and Performance Baseline for Fossil Energy Plants, Final Results*, the August 2007 Report of the U.S. Department of Energy's National Energy Technology Laboratory.

[20] Confidential Attachment CAC 2.11-A, at page vii.

[21] Id.

have been used by Duke in the modeling analyses discussed by Ms. Hager and Mr. Turner.

Q. Are there generic estimates for the operating costs for capturing CO_2 that DEI could have used in its new modeling analyses?

A. Yes. The EPRI report cited by DEI witness Turner in his Direct Testimony presented O&M costs for a generic GE IGCC plant.[22] An August 2007 report by the National Energy Technology Laboratory of the U.S. Department of Energy, *Cost and Performance Baseline for Fossil Energy Plants, Final Results, Revised August 2007,* also provided operating costs for a generic GE IGCC plant.[23] DEI could have used either of these estimates in its recent modeling analyses.

Q. What are the projected net output and expected heat rate of the Edwardsport IGCC Plant?

A. According to DEI witness Womack, the net output of the plant is now expected to be approximately 617.7 MW and the heat rate has increased to 9313 btu/kwh.[24]

Q. Do the changes in the expected net output and heat rate for the Edwardsport plant reflect the addition and operation of equipment to capture CO_2?

A. No. The decrease in the plant's expected net output and the increase in its expected heat rate that are discussed by DEI witness Womack do not reflect the addition and operation of any equipment for carbon capture.

Q. Is it reasonable to expect that adding CO_2 capture technology will affect the heat rate and the net output of the Edwardsport plant?

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22 *Updated Cost and Performance Estimates for Clean Coal Technologies Including CO2 Capture – 2006*, Table 7-7, at page 7-13.

23 At page 22.

24 Direct Testimony of W. Michael Womack, at page 36, lines 12-15.

A. Yes. It is reasonable to expect that adding CO_2 capture technology will have a significant impact on the heat rate and the net output of the Edwardsport IGCC plant.

For example, the EPRI report cited by Mr. Turner, *Updated Cost and Performance Estimates for Clean Coal Technologies Including CO2 Capture – 2006*, estimated that CO_2 capture would increase the heat rate of an IGCC plant of the same relative size as Edwardsport from approximately 8,800 btu/kwh to approximately 10,500 btu/kwh and decrease its net output by about 80 MW.[25] It is reasonable to expect that these effects would have a significant impact on the results of the modeling analyses discussed by Ms. Hager.

Q. Have you seen any plant-specific estimates of the impacts that adding CO_2 capture technology would have on the net output and heat rate of the Edwardsport IGCC plant?

A. Yes. The November 2008 EPRI report, *An Analysis of Carbon Capture Retrofit Options for the Duke Edwardsport IGCC Plant*, provided estimates of the impacts that adding CO_2 capture technology would have on the net output and heat rate of the Edwardsport plant. These results are presented in Confidential Table 1 below:

Confidential Table 1: Impact of CO_2 Capture on Plant Output and Heat Rate

	No CO_2 Capture	29% CO_2 Capture	59% CO_2 Capture	90% CO_2 Capture
Net Plant Power (MW)	635 MW	618 MW	592 MW	563 MW
Net Plant Heat Rate (btu/kwh)	8,920 btu/kwh	9,250 btu/kwh	9,950 btu/kwh	10,614 btu/kwh

These impacts can and should have been included by Duke Energy Indiana in its modeling analyses of the economics of completing the Edwardsport Project given the current $2.88 billion cost estimate.

[25] Table 7-5, at page 7-11.

CO_2 Prices

Q. What CO_2 prices did DEI use in the new modeling analyses presented by Ms. Hager and Mr. Turner?

A. DEI assumed what it termed a single set of future CO_2 prices that starts with a price of $25.03 per ton in 2015 and escalates to $81.35 per ton in 2036, all of which are in 2009 dollars.[26]

Q. Is it reasonable to assume a single set of future CO_2 prices instead of looking at a range of potential CO_2 prices?

A. No. DEI also should have examined a wide range of possible CO_2 prices in its modeling analyses given the uncertainties associated with the timing, stringency and design of federal or state regulation of greenhouse gas emissions.

Q. Has DEI acknowledged this uncertainty concerning future greenhouse gas regulations?

A. Yes. For example, in its response to CAC 2.6.d, Duke noted that:

> Duke Energy Indiana is unable to determine the potential cost of complying with unspecified and unknowable future GHG legislation or any indirect costs that might result, however, such costs could be significant. Duke Energy Indiana's cost of complying with any legislatively-mandated federal GHG emissions regulations will depend upon the design details of the program, and upon the future levels of Duke Energy Indiana's GHG emissions that might be regulated under the program. If potential future federal GHG legislation mandates a cap-and-trade approach, for example, the design elements of such a program that will have the greatest influence on Duke Energy Indiana's compliance costs include (i) the level of the emissions cap over time, (ii) the GHG emissions sources covered under the cap, (iii) the number of allowances that Duke Energy Indiana might be allocated at no cost on a year-to-year basis, (iv) the type and effectiveness of any cost containment measures that may be included in the program, (v) the role of emissions offsets in the program, (vi) the availability and cost of technologies that will be available for Duke Energy Indiana

[26] Attachment CAC 1.2-A.

to deploy to lower its emissions over time, and (vii) the price of allowances and emissions offsets. Although Duke Energy Indiana believes that it is likely that Congress will adopt mandatory GHG emission reduction legislation at some point, the timing and design details of any such legislation are highly uncertain at this time.

Given all of these uncertainties, it is prudent to examine a range of potential CO_2 prices – not to assume that a single set of future CO_2 prices will be correct.

Q. Have you reviewed any recent resource planning analyses presented by an affiliate of Duke Energy Indiana that also have assumed future CO_2 prices?

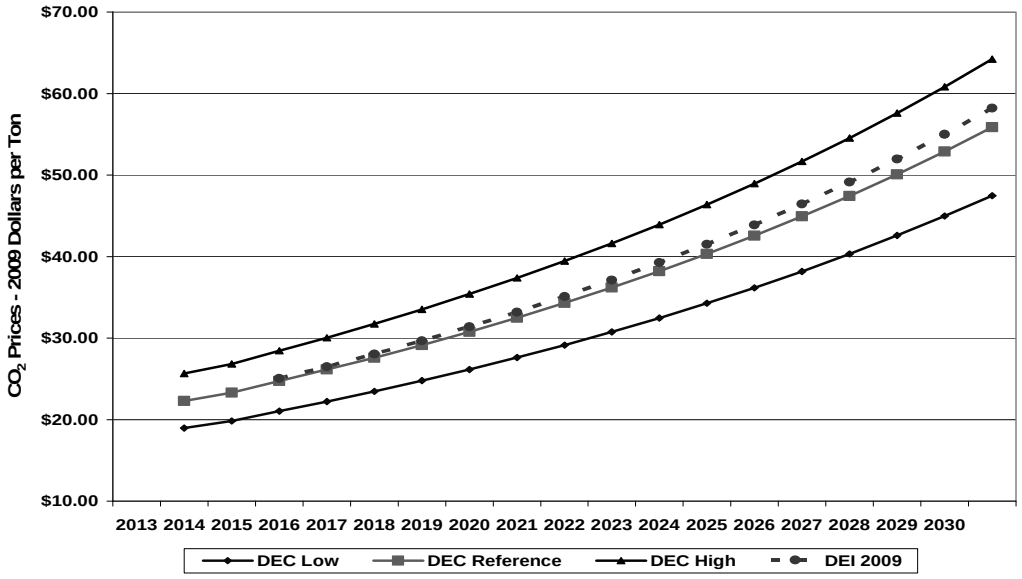
A. Yes. In February and March of this year I reviewed the updated IRP analyses submitted by Duke Energy Carolinas to the North Carolina Utilities Commission in January 2010. I am also in the process of reviewing the recent IRP filed by Duke Energy Ohio at the Public Utility Commission of Ohio.

Q. How do the CO_2 prices that DEI has used in its new modeling analyses compare to the prices that Duke Energy Carolinas used in its recent resource planning analyses?

A. As can be seen in Figure 1 below, the CO_2 prices that Duke Energy Carolinas ("DEC") used in its January 2010 updated IRP analyses differed in a key respect from the prices that Duke Energy Indiana has used in the modeling analyses presented by its witnesses in this proceeding.[27] Unlike DEI, Duke Energy Carolinas assumed a range of CO_2 prices with the high and low price trajectories $\pm$ 15 percent above and below the reference case forecast.

[27] Duke Energy Carolinas *Integrated Resource Plan (Annual Report) Rev 1*, January 11, 2010.

Figure 2: Duke Energy Indiana vs Recent Duke Energy Carolinas CO_2 Prices



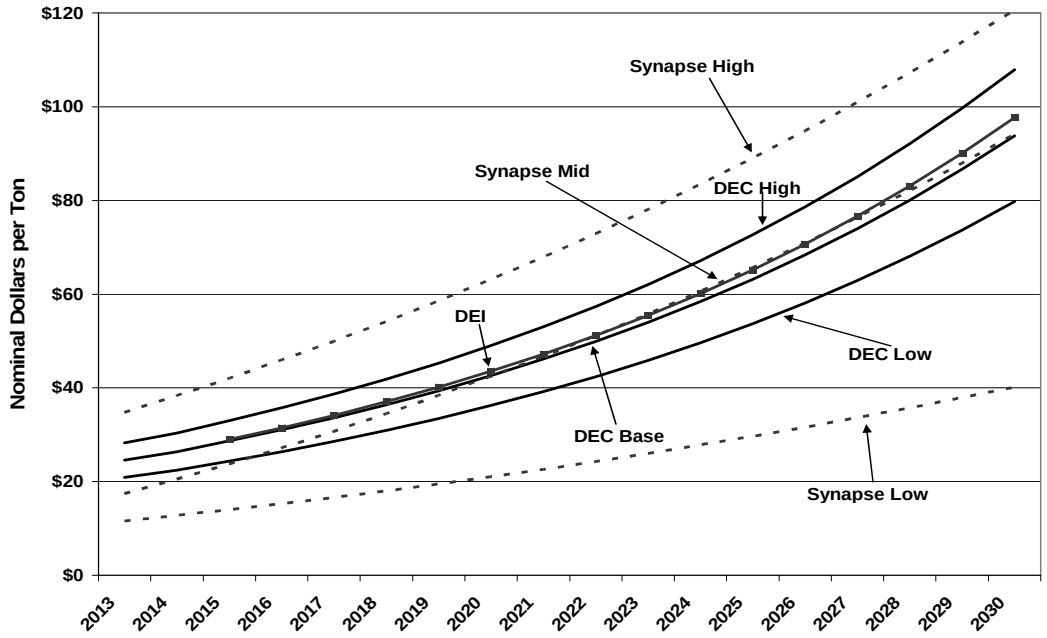
Q. Were the CO_2 prices that Duke Energy Carolinas used in its January 2010 IRP planning analyses reasonable?

A. In general, yes. However, I believe that Duke Energy Carolinas should have used a wider range of scenarios than only ± 15 percent around its Base case set of CO_2 prices. It is important and prudent to consider such a wider range of possible CO_2 prices given the uncertainties associated with the timing, stringency and design of federal regulation of greenhouse gas emissions.

Figure 2, below, compares the annual CO_2 prices used by DEI and Duke Energy Carolinas in their recent resource planning analyses with the CO_2 price projections that I helped developed in 2008 when I was with Synapse Energy Economics, Inc.[28]

[28] The derivation of the Synapse 2008 CO_2 price forecasts is available at http://schlissel-technical.com/docs/reports_34.pdf.

Figure 2: Duke Energy Indiana, Duke Energy Carolinas and Synapse CO_2 Prices



As can be seen in Figure 2, the DEI, Duke Energy Carolinas and the Synapse Mid CO_2 price trajectories are very close. However, the Synapse forecasts allow for greater uncertainty than the DEI and the Duke Energy Carolinas forecasts because they encompass a wider range of possible future CO_2 prices.

Q. How do the CO_2 prices that DEI has used compare to other projections of future CO_2 prices?

A. Figure 3, below, compares the CO_2 emissions prices that DEI has used in this proceeding and that Duke Energy Carolinas used in its January 2010 IRP analyses with the current Synapse CO_2 price forecasts and the results of the independent modeling of the legislation that has been introduced in the U.S. Congress in recent years. These modeling analyses include:

- The U.S. Department of Energy's Energy Information Administration's ("EIA") assessment of the *Energy Market and Economic Impacts of S. 280, the Climate Stewardship and Innovation Act of 2007* (July 2007).[29]
- The EIA's October 2007 Supplement to the *Energy Market and Economic Impacts of S. 280, the Climate Stewardship and Innovation Act of 2007*.[30]
- The EIA's assessment of the *Energy Market and Economic Impacts of S. 1766, the Low Carbon Economy Act of 2007* (January 2008).[31]
- The EIA's assessment of the *Energy Market and Economic Impacts of S. 2191, the Lieberman-Warner Climate Security Act of 2007* (April 2008).[32]
- The EIA's assessment of the *Energy Market and Economic Impacts of H.R. 2454, the American Clean Energy and Security Act of 2009* (August 2009).[33]
- The U.S. Environmental Protection Agency's ("EPA")' *Analysis of the Climate Stewardship and Innovation Act of 2007 – S. 280 in 110th Congress* (July 2007).[34]
- The EPA's *Analysis of the Low Carbon Economy Act of 2007 – S. 1766 in 110th Congress* (January 2008).[35]
- The EPA's *Analysis of the Lieberman-Warner Climate Security Act of 2008 – S. 2191 in 110th Congress* (March 2008).[36]
- The EPA's *Analysis of the American Clean Energy and Security Act of 2009, H.R. 2454 in the 111th Congress* (June 2009)[37]
- *Assessment of U.S. Cap-and-Trade Proposals* by the Joint Program at the Massachusetts Institute of Technology ("MIT") on the Science and Policy of Global Change (April 2007).[38]

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29 Available at http://www.eia.doe.gov/oiaf/servicerpt/csia/pdf/sroiaf(2007)04.pdf.

30 Available at http://www.eia.doe.gov/oiaf/servicerpt/biv/pdf/s280_1007.pdf

31 Available at http://www.eia.doe.gov/oiaf/servicerpt/lcea/pdf/sroiaf(2007)06.pdf

32 Available at http://www.eia.doe.gov/oiaf/servicerpt/s2191/pdf/sroiaf(2008)01.pdf.

33 Available at http://www.eia.doe.gov/oiaf/servicerpt/hr2454/index.html.

34 Available at http://www.epa.gov/climatechange/economics/economicanalyses.html.

35 Available at http://www.epa.gov/climatechange/economics/economicanalyses.html.

36 Available at http://www.epa.gov/climatechange/economics/economicanalyses.html.

37 Available at http://www.epa.gov/climatechange/economics/pdfs/HR2454_Analysis.pdf.

38 Available at http://web.mit.edu/globalchange/www/MITJPSPGC_Rpt146.pdf.

- *Analysis of the Cap and Trade Features of the Lieberman-Warner Climate Security Act – S. 2191* by the Joint Program at MIT on the Science and Policy of Global Change (April 2008).[39]

- *The Lieberman-Warner America's Climate Security Act: A Preliminary Assessment of Potential Economic Impacts,* prepared by the Nicholas Institute for Environmental Policy Solutions, Duke University and RTI International (October 2007)[40]

- *U.S. Technology Choices, Costs and Opportunities under the Lieberman-Warner Climate Security Act: Assessing Compliance Pathways,* prepared by the International Resources Group for the Natural Resources Defense Council (May 2008*).*[41]

- *The Lieberman-Warner Climate Security Act – S. 2191, Modeling Results from the National Energy Modeling System – Preliminary Results,* Clean Air Task Force (January 2008).[42]

- *Economic Analysis of the Lieberman-Warner Climate Security Act of 2007 Using CRA's MRN-NEEM Model,* CRA International, April 2008.[43]

- *Analysis of the Lieberman-Warner Climate Security Act (S. 2191) using the National Energy Modeling System (NEMS/ACCF/NAM),* a report by the American Council for Capital Formation and the National Association of Manufacturers, March 2008.[44]

In total, these modeling analyses examined more than 85 different scenarios. These scenarios reflected a wide range of assumptions concerning important inputs such as: the "business-as-usual" emissions forecasts; the reduction targets in each proposal; whether complementary policies such as aggressive investments in energy efficiency and renewable energy are implemented, independent of the emissions allowance market; the policy implementation timeline; program flexibility regarding emissions offsets (perhaps international) and allowance banking; assumptions about technological progress and the cost of alternatives; and the presence or absence of a "safety valve" price.

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39 Available at http://mit.edu/globalchange/www/MITJPSPGC_Rpt146_AppendixD.pdf.

40 Available at http://www.nicholas.duke.edu/institute/econsummary.pdf.

41 Available at http://docs.nrdc.org/globalwarming/glo_08051401A.pdf.

42 Available at http://lieberman.senate.gov/documents/catflwcsa.pdf.

43 Available at http://www.nma.org/pdf/040808_crai_presentation.pdf.

44 Available at http://www.accf.org/pdf/NAM/fullstudy031208.pdf.

In Figure 3:

- S.280 refers to the McCain-Lieberman bill introduced in 2007 in the 110th U.S. Congress
- S.1766 refers to the Bingaman-Specter bill introduced in 2007 in the 110th U.S. Congress
- S. 2191 refers to the Lieberman-Warner bill introduced in 2007 in the 110th U.S. Congress
- HR. 2454 refers to the Waxman-Markey bill introduced in 2009 in the current 111th U.S. Congress

Figure 3: Levelized Duke Energy Indiana, Duke Energy Carolinas and Synapse 2008 CO_2 Prices Compared to Results of Modeling of Proposed Federal Legislation

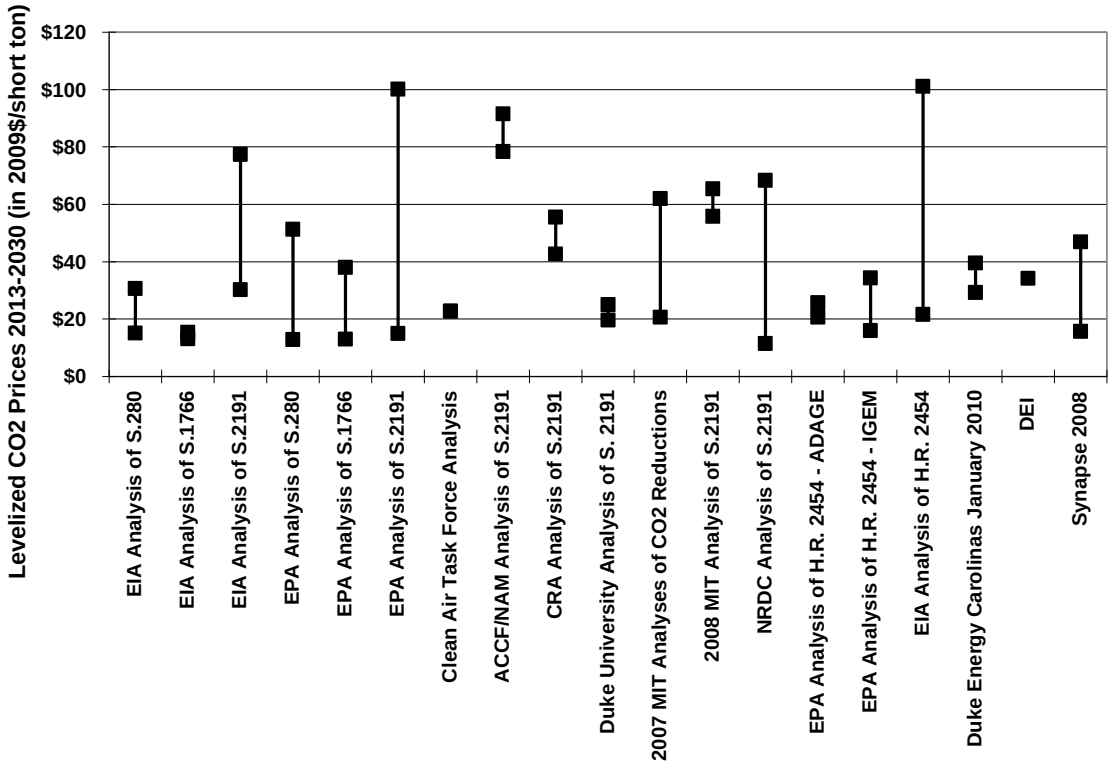


Figure 3 confirms that the CO_2 prices used by Duke Energy Indiana do not adequately reflect the potential uncertainties associated with the design and stringency of future federal regulation of greenhouse gas emissions.

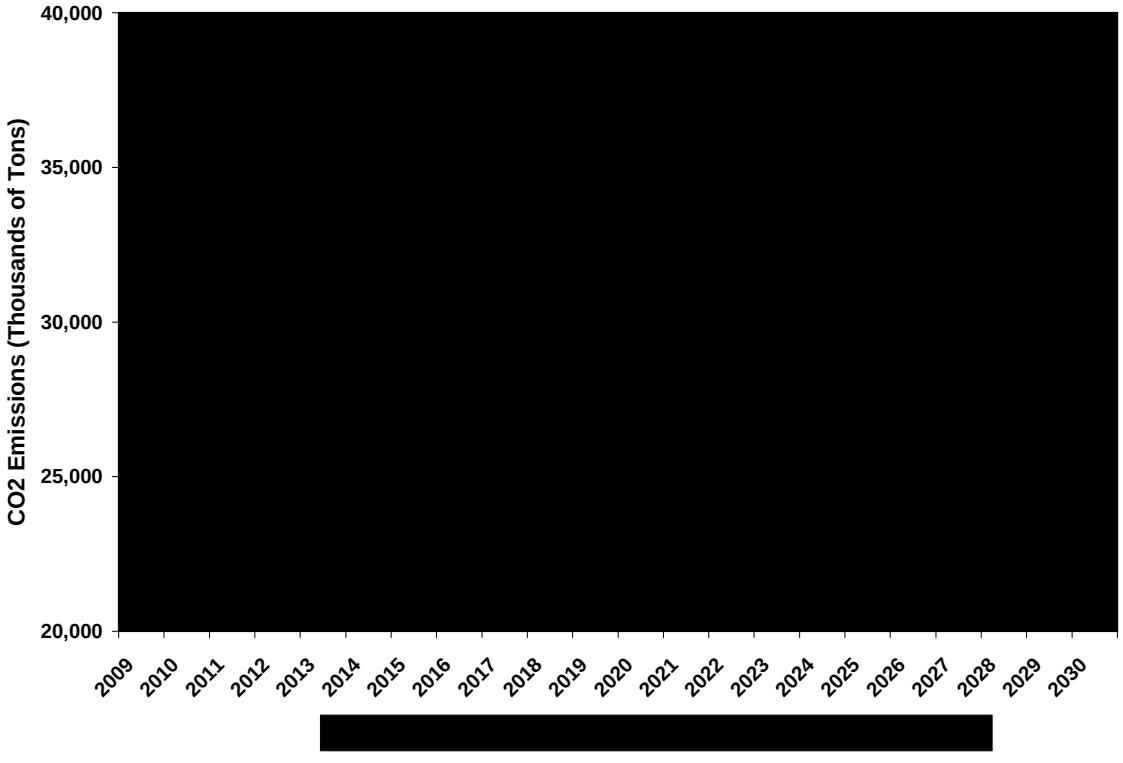
Q. Does Figure 3 include the modeling of the Waxman-Markey bill that has been passed by the U.S. House of Representatives?

A. Yes. The fourth through sixth bars from the right in Figure 3 provide the ranges of levelized CO_2 prices from the modeling of the Waxman-Markey bill by the EIA and the EPA. However, it is not certain that whatever bill is ultimately passed by the U.S. Congress actually will reflect the terms of that legislation. This is the reason why the results of the modeling of the other legislation that has been introduced in previous U.S. Congresses remain relevant.

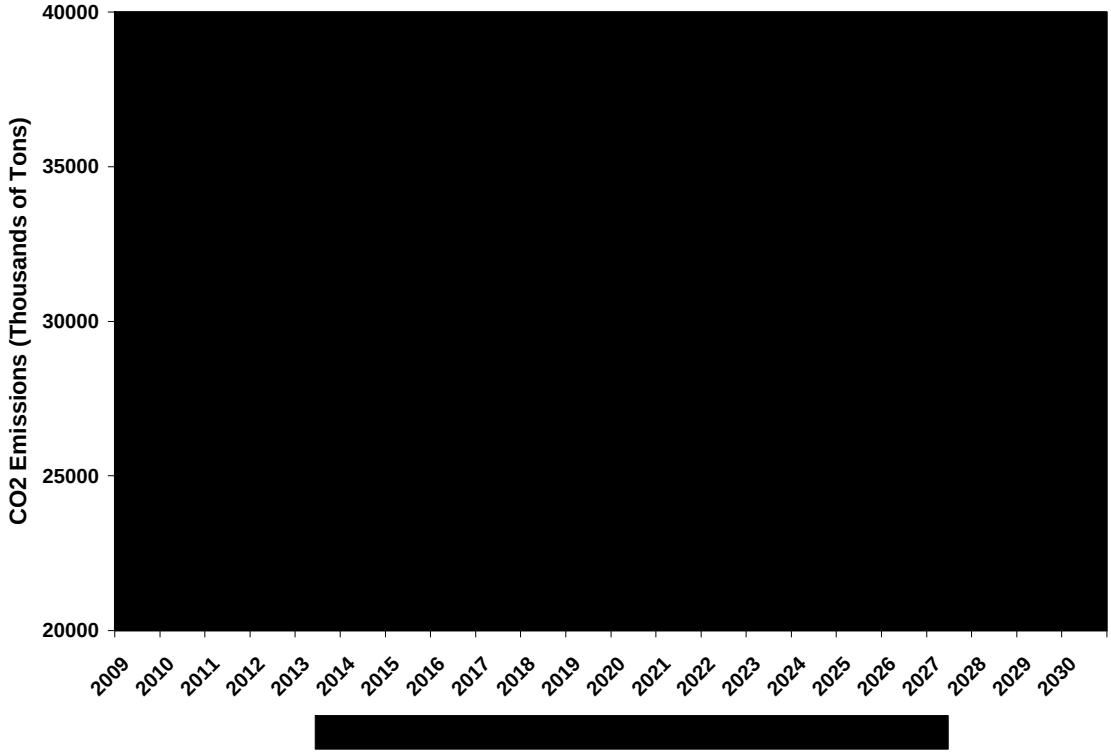
Q. Which of the three alternatives examined by DEI in its recent modeling analyses has the highest CO_2 emissions?

A. As can be seen from Confidential Figures 4 and 5, below, the scenario in which Edwardsport is completed as an IGCC unit has the highest CO_2 emissions.

Confidential Figure 4: Annual DEI CO_2 Emissions Base EE Case



Confidential Figure 5: Annual DEI CO_2 Emissions High EE Case



Natural Gas Prices

Q. What natural gas prices did DEI assume in the modeling analyses presented by Ms. Hager and Mr. Turner?

A. The natural gas prices used by DEI in its most recent modeling of the Edwardsport IGCC Project are presented in Confidential Figure 6, below.

Confidential Figure 6: Natural Gas Prices

Q. Are the natural gas prices used by DEI in its recent modeling of the IGCC Project consistent with the Company's most recent forecast of natural gas prices?

A. No. As can be seen in Confidential Figure 6, the natural gas prices that the Company used in its recent modeling analyses are significantly higher than its most recent long-term gas price forecast.[45] Some of this difference, though not all, may be explained by the fact that the prices that Duke used in the modeling analyses reflected the as-delivered prices at each of its power plants while the long-term forecasts represent Henry Hub prices without delivery costs. However,

[45] Provided by DEI in Confidential Attachment CAC 1.5-A to its Response to Data Request CAC 1.5.

it seems unreasonable to expect that the entire gulf between DEI's most recent forecast and the prices it used in the modeling analyses represents delivery costs.

Q. Are the natural gas prices used by DEI in its recent modeling of the IGCC Project consistent with the most recent DOE Annual Energy Outlook ("AEO 2010") forecast and with recent NYMEX futures prices?

A. No. As shown in Confidential Figure 6, the natural gas prices that the Company used in its recent modeling analyses are significantly higher than the DOE AEO 2010 forecasts and recent NYMEX futures prices.

Q. What impact would using lower natural gas prices have on the results of the modeling analyses presented by DEI?

A. Using lower natural gas prices would adversely impact the relative economics of the Complete as IGCC scenario and improve the relative economics of the Complete as NGCC alternative.

Fuel Mix

Q. DEI witness Hager warns about the Company's increased natural gas usage if the Edwardsport Project were completed as an NGCC unit.[46] Should the Commission be concerned that the Company would be over-reliant on natural gas if Edwardsport were a natural gas-fired unit?

A. No. Fuel diversity is an important consideration. However, Duke's system-wide annual natural gas usage would only be 8% to 14% if Edwardsport were completed as an NGCC unit.[47] That is hardly a significant, let alone an unreasonable, reliance on natural gas.

The IURC, instead, should be concerned about Duke's over-reliance on coal given all of the uncertainties and risks that coal-fired generation faces in the coming years such as increasingly stringent air emissions requirements, federal

[46] Direct Testimony of Janice D. Hager, at page 16, line 1, to page 17, line 2.

[47] Id, at page 16, lines 18-19.

regulation of coal combustion wastes and federal regulation of greenhouse gas emissions. In fact, Ms. Hager's own testimony suggests that the Company will continue for the foreseeable future to rely on coal for 90 percent or more of its generation. This is an unreasonable over-reliance on a single fuel. Given these circumstances, it would be prudent to diversify DEI's fuel mix to include more gas and renewable resources, as well as more energy efficiency.

DEI's Modeling Methodology

Q. Does Duke Energy Indiana provide evidence that the resources added in the Complete as NGCC option represent a cost-effective, low risk portfolio?

A. No. Duke witness Hager explained that the Company ran the System Optimizer model to determine a cost-effective mix of resources for the No IGCC option. However, it does not appear that the Company similarly ran the System Optimizer model or any other capacity expansion model to determine the lowest cost mix of resources that would be added to the Duke system if Edwardsport were completed as a Natural Gas-Fired Combined Cycle unit.

Q. Why is this important?

A. Quite simply, there may be even lower cost, lower risk resource portfolios that DEI can and should pursue if Edwardsport is completed as an NGCC than the Company has studied in this proceeding.

Q. Doesn't Duke Energy Indiana merely substitute an NGCC Edwardsport for an IGCC Edwardsport in the Complete as NGCC option?

A. No. As Duke witness Hager explains, the Complete as NGCC option (1) changes the timing of renewable resource additions, (2) includes fewer MWs of new combustion turbines, and, perhaps, most significantly, adds 1,050 MW of new nuclear capacity between 2021 and 2030 where the Complete as IGCC option has

only 700 MW of new nuclear capacity between 2025 and 2029.[48] Even though Ms. Hager describes this as an "optimal" resource plan that includes the conversion of the Edwardsport Project to an NGCC, there is no evidence that this claim is in fact accurate.

Q. Are there any aspects of the Company's modeling of the Complete as NGCC option that should concern the IURC?

A. Yes. The main concern is that there might be lower cost portfolios of alternatives (including natural gas, additional renewables and additional spending on energy efficiency) that Duke Energy Indiana could and should pursue if Edwardsport is converted to an NGCC. In addition, I am concerned that the Company first advances the in-service dates for two expensive new 350 MW nuclear plants from the years 2025 and 2029 in the Complete as IGCC option to 2021 and 2025 in the Complete as NGCC option. Duke Energy Indiana then adds a third expensive 350 MW nuclear unit in 2030 in the Complete as NGCC option. The earlier nuclear unit in-service dates (and the addition of the third nuclear unit) affect the NPV cost of the Complete as NGCC option because of the nuclear units' very high capital costs.

The significant changes in nuclear plant in-service dates that the Company makes in the Complete as NGCC are very perplexing given that the net output of the Edwardsport NGCC unit would be only about 125 MW less than the projected output of the Edwardsport IGCC unit. This difference in net output between an NGCC unit and an IGCC unit would be even smaller if it reflected the additional parasitic loads from CO_2 capture equipment that would reduce the net output of an Edwardsport IGCC plant, as I have discussed above.

A. What model has Duke Energy Indiana used in this Cause to compare the three options: Complete as IGCC, Complete as NGCC and No IGGC?

[48] Direct Testimony of Janice D. Hager, at page 10, line 17, to page 11, line 9.

A. The modeling analyses sponsored by Ms. Hager were performed using the modeling software MULTISYM. MULTISYM is a dispatch model, meaning it cannot select what type of electric capacity ought to be built based on cost. It simply dispatches a set portfolio of resources to show which would run in order to achieve least cost dispatch.

Q. Has Duke Energy Indiana previously used a dispatch model in this Cause?

A. No, it has not. Up until this latest cost increase, DEI has used a capacity expansion model.

Q. What is a capacity expansion model?

A. A capacity expansion model evaluates potential portfolios of possible resource options on the basis of cost given constraints such as availability, reliability, demand, capital costs and fuel prices.

Q. What is the significance, if any, of Duke Energy Indiana's switch from a capacity expansion to a dispatch model?

A. A capacity expansion model is designed to assist in choosing where and when to invest capital. That is, how much of a particular resource results in a "least-cost" portfolio. The capacity expansion model reflects both the capital and the operating costs and performance of existing and new supply and demand side alternatives. A dispatch model simply gives the order of least-cost dispatch based on plant operating characteristics and costs. The Company then adds on to the results of the dispatch model the capital costs from its pre-determined set of new resources. Based only on this approach, DEI cannot say with confidence that completing Edwardsport as an IGCC plant is the more cost-effective alternative.

Q. Would a capacity expansion model help to resolve any other anomalies of the modeling?

A. Yes. In the years 2020 to 2030, DEI projects that its peak load will increase by 0.4 to 1.7 percent, depending on the year. The average is 1.2 percent.[49] If DEI were to continue to achieve 2 percent annual efficiency savings (per the IURC's order in Cause No. 42693) after 2020 it should need little to no additional capacity let alone two to three new nuclear power plants during that period. In fact, the results of DEI's MULTISYM modeling suggest that the Company assumes that it will not achieve any additional incremental energy efficiency savings after 2020. Apart from the issue of whether this interpretation is consistent with the IURC's Order in Cause No. 42693,[50] this assumption in the MULTISYM model prevents a comparison of adding DSM resources instead of the very expensive nuclear plants that the model selects in the period 2020 to 2030.

Q. Does this conclude your testimony?

A. Yes.

[49] See response to CAC 3.9-A.

[50] See pages 30 and 31 of the IURC Order in Cause No. 42693.

CERTIFICATE OF SERVICE

The undersigned hereby certifies that the foregoing was served by electronic mail or U.S. Mail, first class postage prepaid, this 30th day of July, 2010, to the following:

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