Exhibit 5.18

April 8, 2010

MEMORANDUM TO: H. Brent Clayton, Branch Chief
Environmental and Technical Support Branch
Divison of Site and Environmental Reviews
Office of New Reactor

FROM: Barry Zalcman, Senior Project Manager ***/RA/***
Environmental and Technical Support Branch
Divison of Site and Environmental Reviews
Office of New Reactor

SUBJECT: Supplemental Staff Guidance to NUREG 1555, "Environmental Standard Review Plan," (ESRP) for Consideration of the Effects of Greenhouse Gases and of Climate Change

Enclosed is supplemental guidance for consideration of greenhouse gas (GHG) emissions and treatment of climate change in the review of applications for new reactors and developing the staff's environmental impact statement (EIS). Of primary importance in developing EISs, GHG emissions will be considered in a manner analogous to other air emissions under the existing air quality sections. The guidance differentiates among the several aspects of climate change, namely:

(1) *the direct and indirect consequences of GHG emissions on the human environment*; the U.S. Environmental Protection Agency (EPA), has determined that GHG emissions are linked to changes in climate that could adversely affect public health and welfare;

(2) *the affected environment is dynamic*; during the period covered by the proposed action, resource abundance and impacts on resources may be affected by a changing climate; and

(3) *the change in climate may affect safe design or operation of a facility*; this aspect should be treated as part of the safety review, not the environmental review.

The guidance references the staff's plan to consider GHG emissions in response to direction from the Commission in CLI-09-21. The staff is informed by the recent draft guidance issued by the Council on Environmental Quality; that guidance is available for public comment.

Enclosure:
As stated

CONTACT: Barry Zalcman, NRO/DSER
301-415-2419

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Exhibit 5.18

H. B. Clayton

Memorandum to H. Brent Clayton from Barry Zalcman dated April 8, 2010

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Exhibit 5.18

Supplemental Staff Guidance to NUREG 1555, "Environmental Standard Review Plan," (ESRP) for Consideration of the Effects of Greenhouse Gases and of Climate Change

PURPOSE

The purpose of this guidance is to clarify the consideration of greenhouse gas (GHG) emissions and the treatment of climate change in developing draft environmental impact statements (EISs) for new reactor reviews. This complex contemporary issue has gained prominence worldwide and it is important that decision makers consider the full suite of environmental impacts of proposed actions before acting. A National Environmental Policy Act (NEPA) analysis is the appropriate forum to consider the interface and potential consequences of new projects and the environment. In addition to disclosing the benefits and risks associated with proposed actions, NEPA provides the opportunity for public involvement to provide additional insights and inform decision makers.

In recent licensing actions, NRC's Atomic Safety Licensing Board Panels have referred rulings on GHG emissions and climate change to the Commission suggesting that it may want to consider the "… potential generic significance of the issue …" In CLI-09-21 (Attachment 1, ML093070690), the Commission provided additional guidance to the staff. The staff outlined its general plan for implementing the Commission's guidance in a memorandum from M. Johnson to R. Borchardt on January 15, 2010 (Attachment 2, ML093520734). The principal purpose of this supplemental guidance document for new reactor application reviews is to provide (1) the detailed analytical framework for consideration of and (2) the format and content to present the NRC Staff's evaluation of GHG emissions and climate change in a manner that implements the Commission's direction and is consistent with the general plan.

Additional information is provided in the following Background section to highlight allied issues related to the types of major Federal actions that are more common in the Executive Branch. As an independent executive agency, the NRC is informed by the requirements and findings of other Federal agencies and guidance that is developed to assist them in fulfilling their responsibilities.

BACKGROUND

PROPOSED ACTION

The NRC's proposed action related to issuing combined licenses (COLs) is to authorize construction (as defined in 10 CFR 51.4) for an undefined period of time and to authorize operation for a period not to exceed 40 years. Pursuant to 10 CFR 51.20(b)(2), the issuance of

a COL requires the preparation of an EIS. Other new reactor application reviews, early site permits and limited work authorizations [10 CFR 51.20(b)(1)], also require the preparation of an EIS. The ESRP directs the staff's assessment of potential impacts of the proposed action on the environment. In addition to the direct effects of the action, the Staff considers the indirect and cumulative effects of the proposed action. Finally, insofar as the staff recognizes that the affected environment is a changing environment, the staff should now consider changes in climate that may occur during the period of the proposed action on susceptible environmental resources; the staff considers air and water resources, ecological resources, and human health issues as the areas to consider the effects of a changing climate.

For most of the new reactor license applications, the U.S. Army Corps of Engineers (Corps) will participate with the NRC as a cooperating agency (10 CFR 51.14) because it has jurisdiction by law over certain portions of the applicant's activities and it has special expertise with respect to environmental impacts of the applicants' proposals. The regulatory authority of the NRC is under the Atomic Energy Act; the regulatory authority of the Corps is under the Rivers and Harbor Act and the Federal Water Pollution Control Act (also known as the Clean Water Act). The applicant's undertaking may differ in some respects between the proposed actions of the NRC and the Corps because each agency's authorities differ.

COMMISSION GUIDANCE AND STAFF PLANS

In its Memorandum and Order of November 3, 2009, related to CLI-09-21, the Commission provided the following guidance to the NRC Staff:

> *We expect the Staff to include consideration of carbon dioxide and other greenhouse gas emissions in its environmental reviews for major licensing actions under the National Environmental Policy Act. The Staff's analysis for reactor applications should encompass emissions from the uranium fuel cycle as well as from construction and operation of the facility to be licensed. The Staff should ensure that these issues are addressed consistently in agency NEPA evaluations and, as appropriate, update Staff guidance documents to address greenhouse gas emissions.*

The Staff outlined its general plan to implement the Commission's guidance in its Memorandum dated January 15, 2010:

> *After gaining experience on the initial set of pending combined license (COL) reviews and other agency licensing actions, the staff will update the regulatory guidance contained in its environmental standard review plans (i.e., NUREG-1555, "Standard Review Plans for Environmental Reviews for Nuclear Power Plants," and NUREG-1748, "Environmental Review Guidance for Licensing Actions Associated with NMSS Programs") and in other guidance documents as appropriate.*

The staff's efforts will be informed by the work of other key stakeholders such as Federal agencies charged with the responsibility to assess and report on the science of climate change, the Council on Environmental Quality, and the practices of other Federal agencies. For example, the staff has reviewed the U.S. Global Change Research Program report, June 2009, "Global Climate Change Impacts in the United States" (http://downloads.globalchange.gov/usimpacts/pdfs/climate-impacts-report.pdf). The staff is already using insights from the report to provide the context for the discussion of GHG emissions in upcoming draft EISs for COL reviews.

Additionally, the staff recognizes that the issue of GHG emissions will continue to gain additional attention with the evolution of public policy and science. The staff will remain vigilant for and be informed by insights from all stakeholders.

Until final updates are made to NRC's ESRP, this supplemental guidance provides the regulatory framework to address GHG emissions and the effects of climate change.

EPA ENDANGERMENT FINDING

On December 15, 2009, the Administrator of the U.S. Environmental Protection Agency (EPA) issued (74 FR 66496) her determination that:

… greenhouse gases in the atmosphere may reasonably be anticipated both to endanger public health and to endanger public welfare…. The Administrator reached her determination by considering both observed and projected effects of greenhouse gases in the atmosphere, their effect on climate, and the public health and welfare risks and impacts associated with such climate change.

The NRC has no statutory requirement for such a finding under its organic Acts or under NEPA; the EPA finding is made under the Clean Air Act. In addition to the finding itself, the bases for the finding provide insights on the extensive efforts within the Federal government to weigh and balance science and public policy issues when considering GHG emissions and the effects of climate change. In the following, the excerpted text from EPA's determination is considered relevant by the NRC staff in shaping its consideration of GHG emissions and the effects of climate change as part of its NEPA reviews of new reactor applications and its preparation of draft EISs:

The Administrator recognizes that human-induced climate change has the potential to be far-reaching and multidimensional, and in light of existing knowledge, that not all risks and potential impacts can be quantified or characterized with uniform metrics.

The Administrator has considered how elevated concentrations of the well-mixed greenhouse gases and associated climate change affect public health by evaluating the risks associated with changes in air quality, increases in temperatures, changes in

extreme weather events, increases in food- and water-borne pathogens, and changes in aeroallergens.

The Administrator has considered how elevated concentrations of the well-mixed greenhouse gases and associated climate change affect public welfare by evaluating numerous and far-ranging risks to food production and agriculture, forestry, water resources, sea level rise and coastal areas, energy, infrastructure, and settlements, and ecosystems and wildlife.

The Administrator is defining the air pollutant that contributes to climate change as the aggregate group of the well-mixed greenhouse gases. The definition of air pollutant used by the Administrator is based on the similar attributes of these substances. These attributes include the fact that they are sufficiently long-lived to be well mixed globally in the atmosphere, that they are directly emitted, and that they exert a climate warming effect by trapping outgoing, infrared heat that would otherwise escape to space, and that they are the focus of climate change science and policy.

The release of the U.S. Global Climate Research Program (USGCRP) [formerly the Climate Change Science Program (CCSP)] report on impacts of climate change in the United States in June 2009 … synthesized information contained in prior CCSP reports and other synthesis reports, many of which had already been published … [and undergo a rigorous and exacting standard of peer review by the expert community, as well as rigorous levels of U.S. government review and acceptance.… The review processes … provide EPA with strong assurance that this material has been well vetted by both the climate change research community and by the U.S. government.]. These assessments therefore essentially represent the U.S. government's view of the state of knowledge on greenhouse gases and climate change. For example, with regard to government acceptance and approval of IPCC [Intergovernmental Panel on Climate Change] assessment reports, the USGCRP Web site states that: ''When governments accept the IPCC reports and approve their Summary for Policymakers, they acknowledge the legitimacy of their scientific content.'' It is the Administrator's view that such review and acceptance by the U.S. Government lends further support for placing primary weight on these major assessments.

EPA has no reason to believe that the assessment reports do not represent the best source material to determine the state of science and the consensus view of the world's scientific experts on the issues central to making an endangerment decision with respect to greenhouse gases. EPA also has no reason to believe that putting this significant body of work aside and attempting to develop a new and separate assessment would provide any better basis for making the endangerment decision, especially because any such new assessment by EPA would still have to give proper weight to these same consensus assessment reports.

These statements support the NRC Staff's view that assessments such as the June 2009 USGCRP report on impacts of climate change in the United States represent appropriate source material to be used for framing resource issues associated with climate change. The NRC Staff is responsible for the reliability of all information used in developing its EISs (10 FR 51.70); at this time, the Staff finds that the information in the USGCRP report is of high quality and that the report is a reliable source for information regarding climate change in the U.S. As discussed below, the Staff notes that the Council on Environmental Quality (CEQ) also relies on the USGCRP report in its proposed guidance. The Staff will continue to monitor the development of EPA and CEQ positions and their reliance on the USGCRP report.

In addition to vetting the USGCRP report, the EPA finding also included insights on the geographic and temporal scope of impacts. These attributes are particularly important in the NRC Staff's analysis of the direct and indirect impacts of the proposed action as well as cumulative impacts of the proposed action when combined with other past, present, and reasonably foreseeable impacts. Regarding the geographic and temporal scope of GHG emissions and climate change, EPA stated:

> *It is the Administrator's view that the primary focus of the vulnerability, risk, and impact assessment is the United States. As described in Section IV of these Findings, the Administrator gives some consideration to climate change effects in world regions outside of the United States. Given the global nature of climate change, [the Administrator] has also examined potential impacts in other regions of the world. Greenhouse gases, once emitted, become well mixed in the atmosphere, meaning U.S. emissions can affect not only the U.S. population and environment, but other regions of the world as well. Likewise, emissions in other countries can affect the United States.*
>
> *The timeframe over which vulnerabilities, risks, and impacts are considered should be consistent with the timeframe over which greenhouse gases, once emitted, have an effect on climate. Thus the relevant time frame is decades to centuries for the primary greenhouse gases of concern. Therefore, in addition to reviewing recent observations, the underlying science upon which the Administrator is basing her findings generally considers the next several decades—the time period out to around 2100, and for certain impacts, the time period beyond 2100.*

Unlike many major Federal actions of natural resource, land management, and facility management agencies of the Federal government whose activities may result in GHG emissions, the NRC is a regulatory agency. NRC's major Federal actions are usually associated with a grant of permission to perform specific activities associated with the use of nuclear materials in private facilities on private lands for a fixed period of time. The issuance of a permit, a license, or an authorization is the NRC's major Federal action; amendments to a permit, license, or authorization are separate actions and may not be of such significance to warrant the preparation of an EIS.

For the purposes of developing EISs for new reactor license reviews, the NRC Staff is informed by the EPA finding that the current effects of GHG emissions nationwide on climate change is detectable and endangers public health and welfare. For the purposes of evaluating the cumulative impacts of the proposed action, the NRC Staff is informed by the EPA finding that the effects may be far-reaching geographically and long-lived temporally.

FEDERAL GUIDANCE ON GHG EMISSIONS AND CLIMATE CHANGE

On February 23, 2010, the CEQ issued (75 FR 8046) draft guidance for public comment on "Consideration of the Effects of Climate Change and Greenhouse Gas Emissions." The CEQ draft guidance was published for a 90-day public comment period; given the public interest in this complex, contemporary, and controversial topic, an extraordinary number of public comments are anticipated. It may take some time to consider, weigh and disposition public comments before any guidance is finalized. The Staff has considered the information in the draft CEQ guidance in developing this supplemental guidance for considering GHG emissions. The CEQ guidance has not been finalized; consequently, the Staff will remain vigilant as the CEQ guidance matures to determine if changes to this supplemental guidance are needed.

Consistent with CEQ's objectives of advising Federal agencies on NEPA implementation issues, the CEQ states that:

> *This draft guidance affirms the requirements of the statute and regulations and their applicability to GHGs and climate change impacts. CEQ proposes to advise Federal agencies that they should consider opportunities to reduce GHG emissions caused by proposed Federal actions and adapt their actions to climate change impacts throughout the NEPA process and to address these issues in their agency NEPA procedures.*

Clearly, the CEQ guidance is directed at Executive Branch agencies; however, it can be useful to independent executive agencies when developing their NEPA procedures. In the following, the excerpted text from the CEQ's draft guidance are considered relevant by the NRC staff in shaping its consideration of GHG emissions and the effects of climate change as part of its NEPA reviews of new reactor applications and its preparation of draft EISs:

> *Because climate change is a global problem that results from global GHG emissions, there are more sources and actions emitting GHGs (in terms of both absolute numbers and types) than are typically encountered when evaluating the emissions of other pollutants. From a quantitative perspective, there are no dominating sources and fewer sources that would even be close to dominating total GHG emissions. The global climate change problem is much more the result of numerous and varied sources, each of which might seem to make a relatively small addition to global atmospheric GHG concentrations. CEQ proposes to recommend that environmental documents reflect this global context and be realistic in focusing on ensuring that useful information is provided*

to decision makers for those actions that the agency finds are a significant source of GHGs.

Under this proposed guidance, agencies should use the scoping process to set reasonable spatial and temporal boundaries for this assessment and focus on aspects of climate change that may lead to changes in the impacts, sustainability, vulnerability and design of the proposed action and alternative courses of action. At the same time, agencies should recognize the scientific limits of their ability to accurately predict climate change effects, especially of a short-term nature, and not devote effort to analyzing wholly speculative effects.

In the agency's analysis of direct effects, it would be appropriate to: (1) quantify cumulative emissions over the life of the project; (2) discuss measures to reduce GHG emissions, including consideration of reasonable alternatives; and (3) qualitatively discuss the link between such GHG emissions and climate change. However, it is not currently useful for the NEPA analysis to attempt to link specific climatological changes, or the environmental impacts thereof, to the particular project or emissions, as such direct linkage is difficult to isolate and to understand. The estimated level of GHG emissions can serve as a reasonable proxy for assessing potential climate change impacts, and provide decision makers and the public with useful information for a reasoned choice among alternatives.

Insofar as consideration of alternatives, cumulative impacts, and depth of analysis, CEQ provided the following discussion:

For proposed actions evaluated in an EIS, Federal agencies typically describe their consideration of the energy requirements of a proposed action and the conservation potential of its alternatives. … Within this description of energy requirements and conservation opportunities, agencies should evaluate GHG emissions associated with energy use and mitigation opportunities and use this as a point of comparison between reasonable alternatives. For proposals normally evaluated in an EA, agencies may consider the GHG emissions as a factor in discussing alternative uses of available resources. … CEQ proposes that this analysis should also consider applicable Federal, State or local goals for energy conservation and alternatives for reducing energy demand or GHG emissions associated with energy production.

Where an agency concludes that a discussion of cumulative effects of GHG emissions related to a proposed action is warranted to inform decision-making, CEQ recommends that the agency do so in a manner that meaningfully informs decision makers and the public regarding the potentially significant effects in the context of the proposal for agency action. This would most appropriately focus on an assessment of annual and cumulative emissions of the proposed action and the difference in emissions associated

with alternative actions. Agencies may incorporate USGCRP studies and reports by reference in any discussion of GHG emissions and their effects.

Agencies apply the rule of reason to ensure that their discussion pertains to the issues that deserve study and deemphasizes issues that are less useful to the decision regarding the proposal, its alternatives, and mitigation options. … In addressing GHG emissions, consistent with this proposed guidance, CEQ expects agencies to ensure that such description is commensurate with the importance of the GHG emissions of the proposed action, avoiding useless bulk and boilerplate documentation, so that the NEPA document may concentrate attention on important issues. … Using NEPA's "rule of reason" governing the level of detail in any environmental effects analysis, agencies should ensure that they keep in proportion the extent to which they document their assessment of the effects of climate change. The focus of this analysis should be on the aspects of the environment that are affected by the proposed action and the significance of climate change for those aspects of the affected environment. Agencies should consider the specific effects of the proposed action (including the proposed action's effect on the vulnerability of affected ecosystems), the nexus of those effects with projected climate change effects on the same aspects of our environment, and the implications for the environment to adapt to the projected effects of climate change. The level of detail in the analysis and NEPA documentation of these effects will vary among affected resource values. For example, if a proposed project requires the use of significant quantities of water, changes in water availability associated with climate change may need to be discussed in greater detail than other consequences of climate change. In some cases, discussion of climate change effects in an EA or EIS may warrant a separate section, while in others such discussion may be integrated into the broader discussion of the affected environment.

CEQ suggests that each agency has discretion in determining which climate change impacts should be considered:

CEQ proposes that agencies should determine which climate change impacts warrant consideration in their EAs and EISs because of their impact on the analysis of the environmental effects of a proposed agency action. … As with analysis of any other present or future environment or resource condition, the observed and projected effects of climate change that warrant consideration are most appropriately described as part of the current and future state of the proposed action's "affected environment." … Based on that description of climate change effects that warrant consideration, the agency may assess the extent that the effects of the proposal for agency action or its alternatives will add to, modify, or mitigate those effects. Such effects may include, but are not limited to, effects on the environment, on public health and safety, and on vulnerable populations who are more likely to be adversely affected by climate change. The final analysis documents an agency assessment of the effects of the actions considered, including alternatives, on the affected environment.

For some Federal agencies, it may be entirely appropriate for their EISs to consider "public health and safety." As a regulatory agency with its organic statute principally focused on public health and safety, the NRC's responsibilities under the Atomic Energy Act already include consideration of natural phenomena on the safe design and operation of reactors. Public health is considered as part of the NRC's NEPA review as well, but public safety is considered in the NRC's safety evaluation reports (SERs) developed concomitant with its EIS for the regulatory action.

Finally, as for scientific resources that may be used and the manner in which they may be invoked, CEQ recommends using the work of the USGCRP:

> *For sources of the best scientific information available on the reasonably foreseeable climate change impacts, Federal agencies may summarize and incorporate by reference the Synthesis and Assessment Products of the U.S. Global Change Research Program (USGCRP), and other major peer-reviewed assessments from USGCRP. Particularly relevant is the report on climate change impacts on water resources, ecosystems, agriculture and forestry, health, coastlines and arctic regions in the United States: Global Climate Change Impacts in the United States. Research on climate change impacts is an emerging and rapidly evolving area of science. In accordance with NEPA's rule of reason and standards for obtaining information regarding reasonably foreseeable significant adverse effects on the human environment, action agencies need not undertake exorbitant research or analysis of projected climate change impacts in the project area or on the project itself, but may instead summarize and incorporate by reference the relevant scientific literature.*

The CEQ guidance concludes with:

> *With the purpose of informing decision-making, CEQ proposes that the NEPA process should incorporate consideration of both the impact of an agency action on the environment through the mechanism of GHG emissions and the impact of changing climate on that agency action. This is not intended as a "new" component of NEPA analysis, but rather as a potentially important factor to be considered within the existing NEPA framework. Where an agency determines that an assessment of climate issues is appropriate, the agency should identity alternative actions that are both adapted to anticipated climate change impacts and mitigate the GHG emissions that cause climate change. As noted above, NEPA analysis of climate change issues necessarily will evolve to reflect the scientific information available and the legal and policy context of decisions that the NEPA process is intended to inform. Therefore, once this guidance is issued in final form, CEQ intends to revise it as warranted to reflect developments in the law, policy, and science regarding climate change.*

GUIDANCE

Consideration of greenhouse gas (GHG) emissions and climate change are not to be considered "new" components of the National Environmental Policy Act (NEPA) review for new reactor applications, but rather as important factors to be considered within the existing NEPA framework. While it may appear to be appealing to draw specific attention to the contemporary topic, GHG emissions and climate change should be given the appropriate consideration commensurate with the importance of the issues related to the proposed action; the NRC Staff is to avoid providing useless bulk and boilerplate documentation, so that the NEPA document may concentrate attention on important issues.

The EPA and CEQ are attempting to establish a discriminator to help guide Federal agencies in determining which activities requiring the development of EISs could result in potentially important contributions to atmospheric loading of GHGs and, by extension, potential effects on climate change. The discriminator is not a threshold value or "bright line" marker, but it informs Federal agencies in deciding which issues are important and, consequently, which issues should be assessed in greater detail; as applied to GHG control requirements, this threshold can be related to the "tailoring" rule. In testimony before the Senate Appropriations Subcommittee on Interior and Related Agencies, the Administrator introduced a higher level of carbon dioxide (CO_2) emissions than contemplated earlier to be applied to new or modified stationary sources. For the purposes of this supplemental guidance, the direct emissions of GHGs for major stationary sources of importance is in the range of 25,000 to 75,000 metric tons per year of CO_2 emissions; direct emissions above that range may warrant more detailed examination. CO_2 serves as a surrogate for a variety of GHGs. The emissions of CO_2 (or CO_2 equivalent) resulting from the operation of a new reactor (and its attendant infrastructure, including the indirect effects of worker transportation), accounting for the infrequent use of GHG emitting equipment, is expected to be less than 5000 metric tons per year. Consequently, the issues do not require detailed atmospheric transport modeling, but can be expressed in terms of atmospheric loading and placed in context with other emission sources and society as a whole. This is consistent with CEQ's recommendation that GHG emissions can be used as a "proxy" for assessing climate change impacts and to provide decision makers and the public with useful information.

For new reactor licensing actions where an EIS is being prepared to fulfill its responsibilities under NEPA, the NRC Staff should consider certain aspects of climate change. These aspects include (1) the potential impacts of the proposed action on the environment and (2) the changes in significant resource areas that may occur during the lifetime of the proposed action as a result of a changing climate. In addition to the direct effects of the action, the Staff considers the indirect and cumulative effects of the proposed action and alternatives (sites and energy sources) to the proposed action. The Staff should now consider changes in climate that may occur during the period of the proposed action on susceptible environmental resources; the Staff should consider air and water resources, ecological resources, and human health issues as the areas to consider the effects of climate change for new reactor applications.

Notwithstanding the draft guidance from CEQ suggesting consideration should be given to matters related to the change in climate that may affect public safety (for NRC purposes, the safe design or operation of a new reactor), such issues are outside the environmental review but may be considered by the NRC Staff if it is important to the safety determination that it makes under the Atomic Energy Act. Apart from any NRC Staff safety evaluation during initial licensing, there is a continuing obligation of a nuclear power plant license holder to ensure that its plant stays within the licensing basis. If it becomes evident that long-term climate changes influences the most severe of natural phenomena reported in the site vicinity, then a license holder may need to take action to ensure the licensing basis is preserved. Therefore, while CEQ included the public safety aspect of climate change in its draft guidance, NRC Staff considers this aspect separately for new reactor applications.

As outlined in the NRC Staff plan for implementing the Commission's guidance for considering GHG emissions and climate change, the NRC Staff will rely principally on the State of Knowledge report produced by the U.S. Climate Change Research Program. This report synthesizes the work of the Federal Government on climate change.

The report is not intended to dissuade meaningful research into the topic, but to provide the Federal Government and the general public with a basis for making informed decisions regarding the complex scientific and public policy issues related to climate change. As updates are made to this report, the NRC Staff should review such changes and determine if they warrant a change in regulatory guidance.

AFFECTED ENVIRONMENT

As a rule, the discussion of the affected environment in an EIS addresses the baseline condition in all resource areas in the site region. For the purposes of recognizing that the climate may change during the period of the proposed action [taken to be of the order of a half century for new reactor proposals (with or without early site permits), which is the sum of the period required by the proponent to build the plant and, if the approval is granted, the period to operate the plant that is authorized by the NRC], climate change effects are to be addressed in two ways.

First, under the current organization of EISs for new reactor application reviews, the initial discussion is to be provided in Chapter 2 for the proposed site location following the discussion of climatic conditions based on the historical record. Information regarding the estimated changes in climate conditions on a regional basis is provided in the USGCRP report. A convenient source for this information is the Regional Climate Information tab from the USGCRP home page (www.globalchange.gov); this site disaggregates the report by region and allows for ease of access. It is appropriate to consider the anticipated changes in precipitation, temperature, frequency and severity of storms, sea level, floods and droughts. The EIS discussion should be commensurate in scope and depth with the discussion of current climate conditions.

Second, under the current organization of EISs for new reactor application reviews, the discussion of the reasonably foreseeable effects of climate change on specific resource areas during the period of the proposed action is to be provided in the cumulative impacts sections of Chapter 7 for the proposed site location and in Chapter 9 for each of the alternative sites. The Staff considers air and water resources, ecological resources, and human health issues as the resource areas to consider the effects of a changing climate for new reactor applications. While there are other resource areas that can be affected by a changing climate, the NRC Staff has determined that the geographic and temporal extent of such effects related to the proposed action do not warrant further examination. Information regarding the estimated changes in climate conditions on a sector basis is provided in the USGCRP report. A convenient source for this information is the Sectoral Climate Information tab from the USGCRP home page; this site disaggregates the report by resource area and allows for ease of access. The EIS discussion should be commensurate in scope and depth with the importance of the issue for the resource area.

ENVIRONMENTAL CONSEQUENCES

Carbon Dioxide and Other Greenhouse Gas Emissions

The NRC Staff evaluates air quality conditions (i.e., status with regard to National Ambient Air Quality Standards) and potential emissions from sources and activities associated with building and operating a new nuclear power plant. In addition to consideration of the traditional criteria pollutants, conformity reviews, visibility impairment in Prevention of Significant Deterioration Class I areas, etc., the NRC Staff considers the emergence of CO_2 and other GHGs as an important air quality issue consistent with CEQ's draft guidance; i.e., "[T]his is not intended as a 'new' component of NEPA analysis, but rather as a potentially important factor to be considered within the existing NEPA framework." Consequently, discussions related to the consequences of CO_2 and other GHG emissions should be included within the context of air quality issues in EISs for new reactor application reviews.

While CO_2 is often used as a surrogate for GHGs, other gases with similar potential to implicate greenhouse behavior may be emitted at the same time as CO_2; this could result in a slight underestimation of the total potential GHG emissions and the effects resulting from them if the Staff only considered CO_2. To ensure that the NRC Staff meets the Commission's expectation that it consider both CO_2 and other GHG emissions for new reactor applications, the Staff considered methods that would meet the purposes of its NEPA analysis.

In EPA's periodic reports on the inventory of GHG emissions and sinks in the U.S., EPA provides context for the contribution of GHG to "global warming potential" (GWP); these reports are available at www.epa.gov/climatechange/emissions. EPA described the GWP concept, as developed by the Intergovernmental Panel on Climate Change (IPCC), as a means "… to compare the ability of each greenhouse gas to trap heat in the atmosphere relative to another gas." Consequently, not all GHG species have an equal role in contributing to potential environmental effects. Although water vapor has the potential to contribute to global warming, it has not been targeted by the IPCC or the EPA as in need of control. The GWP for CO_2 is 1, for methane it is 21, and for nitrous oxide it is 310; the GWP is much greater for yet other GHGs, but the more exotic GHGs are not related to the activities associated with building and operating a new nuclear power plant in appreciable quantities. In addition, the proportional presence of individual GHG species in the atmosphere and the species' life cycle (short-lived *v*. long-lived) add to the complexity of the scientific analysis. The largest source of U.S. GHG emissions, CO_2, from fossil fuel combustion has accounted for more than 75% of GWP-weighted emissions since 1990 and at an increasing pace, and transportation activities accounted for more than 30%. In its 2007 inventory report, EPA reported that "… [C]hanges in CO_2 emissions from fossil fuel combustion are influenced by many long-term and short-term factors, including population and economic growth, energy price fluctuations, technological changes, and seasonal temperatures." Furthermore, "[U]ncertainties in the emission estimates … also result from the data used to allocate CO_2 emissions from the transportation end-use sector to individual vehicle types and transportation modes." By these accounts, maintaining the inventory of sources and

sinks has been a challenging undertaking by EPA and translation of the relationship between emissions and effects requires synthesis and has some uncertainty.

In a recent rule promulgated by EPA (74 FR 56260), certain categories of sources of emissions are now required to report annual GHG emissions. The suite of GHGs, which are the same as those listed by the IPCC, include carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), sulfur hexafluoride (SF_6), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and other fluorinated gases [e.g., nitrogen trifluoride (NF_3) and hydrofluorinated ethers (HFEs)]. EPA indicated that "… accurate and timely information on GHG emissions is essential for informing many future climate change policy decisions." This reporting requirement is placed on certain classes of pollution sources, is forward looking, and will inform future decision-making with improved technical bases and refined analytical methods. Of the specific GHGs that are required to be reported, detailed methods for calculating GHG emissions were provided in Subpart C—General Stationary Fuel Combustion Sources of the rule. Notably, one of the types of fuel combustion sources at an operating nuclear power plant, the emergency generator, is exempt because "… the reporting of GHG emissions is unreasonable given the cost of monitoring and the relative level of GHG emissions." This is instructive; however, while the operator of an emergency generator may be exempt from reporting, the generator, however infrequent it may be used, would still be an emitter of GHGs and should be considered in the NEPA analysis of new reactor applications.

Accounting for the complexity and uncertainty in attempting to estimate CO_2 and other GHG emissions, the NRC Staff principally focused on the use of the information for sound NEPA decision-making and the development of information commensurate with the importance of the impact. Consequently, to account for the Commission's direction to consider "other greenhouse gases," the NRC Staff is adopting the EPA practice of calculating "CO_2-equivalent emissions."

EPA maintains a GHG Equivalencies Calculator and updates it periodically based on the inventories of GHG emissions and sinks discussed above. Carbon dioxide equivalent is "… a metric measure to compare the emissions from various greenhouse gases based upon their global warming potential (GWP). … The carbon dioxide equivalent for a gas is derived by multiplying the tons of the gas by the associated GWP." The ratio of carbon dioxide emissions to total emissions (including carbon dioxide, methane, and nitrous oxide, all expressed as carbon dioxide equivalents) is a convenient scaling factor to express emissions as a *CO_2 equivalent* to ensure that the GWP and, therefore, climate change effects are not under reported. The NRC Staff will consider "… carbon dioxide and other greenhouse gas emissions in its environmental reviews for major licensing actions under the National Environmental Policy Act …" for new reactor application reviews in the context of *CO_2 equivalent* emissions. The equivalent factor does change based on updates of the inventories as the higher valued GWP GHG emissions are reduced. For example, the NRC Staff analysis of vehicle emissions is based on a factor of .971 (i.e., 97.1% of emissions were CO_2 with a GWP of only 1); while the factor was updated to a value of .977, the lower value used by the NRC Staff is bounding because it assumes a higher proportion of other (high-value GWP) GHGs to CO_2.

Environmental Consequence Analyses

The Commission directed that the NRC Staff's NEPA analysis for reactor applications should "… encompass emissions from the uranium fuel cycle as well as from construction and operation of the facility to be licensed." For new reactor EISs, the NRC Staff encompasses the direction outlined by the Commission and considers CO_2 and the other GHG as *CO_2 equivalent* emissions in the following air quality analyses:

> (1) the direct and indirect impacts of building the nuclear power plant, but not to the extent of considering the manufacturing of components;
> (2) the direct and indirect impacts of operating the nuclear power plant;
> (3) the indirect impacts of fuel cycle activities;
> (4) the direct and indirect impacts of decommissioning the nuclear power plant;
> (5) the incremental impacts of the proposed project within the analysis of cumulative impacts of other past, present and reasonably foreseeable activities;
> (6) the comparison of the proposed project impacts at the proposed site to alternative energy source impacts that meet the purpose and need (i.e., baseload generation); and
> (7) the comparison of the proposed project impacts at the proposed site to potential impacts at alternative sites in the context of cumulative impacts.

While a nuclear power plant may not combust hydrocarbons to produce electrical energy, the electrical energy that is used to produce and manage the nuclear fuel is highly likely to require the combustion of fossil fuels; this is considered in the analysis of the indirect CO_2 and GHG emissions associated with a nuclear power plant. The NRC has established a framework for assessing the contribution of the environmental effects of uranium mining and milling, the production of uranium hexafluoride, isotopic enrichment, fuel fabrication, reprocessing of irradiated fuel, transportation of radioactive materials and management of low-level wastes and high-level wastes related to uranium fuel cycle activities to the environmental costs of licensing the nuclear power plant. The environmental data for this framework is presented in Table S—3, Table of Uranium Fuel Cycle Environmental Data, in 10 CFR 51.51. Among the analyses that were performed to support these requirements, is the assessment of electrical energy needed by the fuel cycle to produce and manage the fuel so that it could be used to generate electrical energy. This framework is reported as a reference power level [i.e., reference reactor year of 1000 MW(e)] and the environmental costs would be scaled proportionately to the reference; e.g., a 500 MW(e) facility would have half of the environmental costs as the reference reactor.

The NRC Staff reported its analysis of carbon monoxide (CO) emissions in Table S—3; it did not consider CO_2 explicitly. Relying upon the convenient structure of Table S—3, i.e., environmental data scaled to a 1000 MW(e) reference model, the NRC Staff has developed a generic analysis of CO_2 and other GHG emissions, reported as CO_2 equivalent emissions, scaled to a 1000 MW(e) reference unit. Just as the NRC Staff includes Table S—3 in its EIS for a new reactor application, the NRC Staff should include the results of its generic analysis as an

Appendix in an EIS for a new reactor application; the Appendix is provided in Attachment 3. To account for two units, for example, certain values, such as those for construction-related activities, should be doubled, etc. To account for a higher power level or a different assumption regarding capacity factor, an appropriate multiplier should be use to scale the values up or down. The analysis is to be made unique to the project using project-specific adjustment factors without departure from the underlying generic analysis; therefore, this approach is analogous to the use of Table S—3.

EIS Format and Content for CO_2 and GHG Discussions

In the following discussion, this supplemental guidance provides the level of detail and the manner of presentation of the 7 areas of analysis and their results, relying upon the information in Attachment 3 to be scaled by activity, number of units, power level, capacity factor, etc. considered to be appropriate for the NEPA review of the proposed action relative to CO_2 and GHG emissions and impacts. The affected sections, principally synthesized with the other air quality aspects of the review, are highlighted. In the section-by-section texts, there need not be a repetitive referral to CO_2 equivalent emission, however, the term CO_2 "footprint" is, in fact, the CO_2 equivalent as outlined in Attachment 3.

Prior to each of the discussions is the admonition that the NRC Staff can rely upon the generic analysis as a starting point; however, the unique aspects of each proposal must be reflected in the material included in the air quality sections of the EIS. For example, the discussions provided reflect a proposal of two new units at an existing site with two units in an area of attainment of the National Ambient Air Quality Standards with cumulative impacts involving a nearby power project that has not been completed (and, thus, not within the baseline). For "greenfield" sites, a different mix of major emitters, different cooling systems, different numbers of units proposed, etc., the unique attributes of the proposal (at times reflected in bracketed text) are to be reflected in the discussion of effects at the appropriate life-cycle stage (building the plant, operating the plant, decommissioning the plant, the fuel cycle impacts for the plant, etc.).

The discussions also include material that is not affected by consideration of CO_2 and other GHG emissions and is presented solely for the purposes of illustrating the location of affected text. Table values, either reported or computed, and citations from applicant or other source documents are to reflect appropriate information consistent with the proposal.

(1) Building related impacts

Generic guidance and generic analysis is useful to ensure that the depth of analysis is appropriate for the importance of the issue and the documentation provides consistent meaning when repeated. Every new reactor application is to be considered (1) a unique request for one or more particular reactors (and attendant infrastructure) of a specific design to be located at a particular location on a specific site and is planned to be operated in a specific manner or (2) a set of plant parameters with attributes associated with building and operating a plant at a particular location on a specific site. Certain analyses related to this aspect of CO_2 and other GHG emissions effects are to be adjusted to account for the reactor type, number of units, power level and the capacity factor, or for a set of plant parameters, and for schedule and types of activities to be undertaken as part of the project, the baseline environmental setting (affected area) in the site region, and other activities that may affect the air quality resources that may take place during this phase of the project.

In the format and content presented below, the highlighted text reflects an acceptable example; however, in performing the analysis and reporting conclusions, the reviewer is required to account for the unique circumstances of the project. If the project circumstances differ significantly from the assumptions made in the Appendix and are outside the bounds of the generic analysis and the scaling adjustments are not adequate to analyze environmental effects, then the reviewer is expected to provide an alternative analysis and the technical bases in the EIS.

The recommended format and content should be similar to:

4.7 Meteorological and Air Quality Impacts

…

4.7.1 Construction and Preconstruction Activities

Development activities at the ZZZZZZZZ site would result in temporary impacts on local air quality. Activities including earthmoving, concrete batch plant operation and vehicular traffic generate fugitive dust. In addition, emissions from these activities would contain carbon monoxide, oxides of nitrogen, and volatile organic compounds. As discussed in Section 2.9.2, FFFF County is an attainment area for all criteria pollutants for which National Ambient Air Quality Standards have been established (40 CFR citation). As a result, a conformity analysis for direct and indirect emissions is not required (40 CFR citation). [ENSURE THAT THE REGION IS IN ATTAINMENT AND NOT A MAINTENANCE OR NON-ATTAINMENT AREA; OTHERWISE, REFER TO CONFORMITY GUIDANCE].

Prior to beginning construction and preconstruction activities, AAAAAAAA stated that it would develop a "GGGG Plan" that implements HHHH requirements. This plan would describe the management controls and measures that AAAAAAAA intends to implement to minimize impacts of these activities on air quality. The plan would provide for site inspections and environmental inspection reports that document the results of the inspections (citation). Current policies and procedures at the ZZZZZZZZ site address requirements of regulations and permits. These policies and procedures may need to be supplemented to address specific measures to mitigate air quality impacts of proposed Units JJJJ and KKKK.

The GGGG Plan would also identify specific mitigation measures to control fugitive dust and other emissions. Section LLLL of the ER lists mitigation measures specifically related to dust control that could be used. These measures include [ENSURE THAT THIS LIST IS SITE-SPECIFIC AND COMPREHENSIVE]:

- Limiting speed on unpaved roads
- Watering unpaved roads
- Using soil adhesives to stabilize loose dirt surfaces
- Covering haul trucks when loaded or unloaded
- Ceasing grading and excavation during high winds and air pollution episodes
- Phasing grading to minimize areas of disturbed soil, and
- Revegetating road medians and slopes.

Finally, the plan would include control strategies to minimize daily emissions by phasing the project and performing construction vehicle maintenance. Preoperational activities would also result in greenhouse gas emissions, principally carbon dioxide (CO_2). Assuming a 7-yr construction period and typical construction practices, the review team estimates that the total construction equipment CO_2 emission footprint for building two nuclear power plants at the ZZZZ site would be of the order of 70,000 metric tons, as compared to a total United States annual CO_2 emission rate of 6,000,000,000 metric tons (EPA citation). Appendix YYYY provides the details of the review team estimate for a reference 1000 MW(e) nuclear power plant. Based on its assessment of the relatively small construction equipment carbon footprint as compared to the United States annual CO_2 emissions, the review team concludes that the atmospheric impacts of greenhouse gases from construction and preconstruction activities would not be noticeable and additional mitigation would not be warranted.

In general, emissions from construction and preconstruction activities (including greenhouse gas emissions) would vary based on the level and duration of a specific activity, but the overall impact is expected to be temporary and limited in magnitude. Considering the information provided by AAAAAAAA and its commitment to conduct [FOR EXAMPLE: "all site preparation and construction activities in accordance with Federal, State, and local regulations"], the review team concludes that the impacts from ZZZZZZZZ Unit MMMM and NNNN construction and preconstruction activities on air quality would not be noticeable because appropriate mitigation measures would be adopted.

4.7.2 Traffic

In the ER, AAAAAAAA (citation) estimates the maximum workforce for proposed Units MMMM and NNNN would be about PPPP workers and would exceed QQQQ for about a RRRR-yr period. Many of these workers would be doing shift work. AAAAAAAA estimates that about SSSS percent of the workforce would be in the first (day) shift, TTTT percent would be in the second (swing), and the remaining UUUU percent would be in the third (graveyard) shift (citation). The workforce needed to build Units MMMM and NNNN [IF AT AN EXISTING SITE ", combined with the workforce needed for ZZZZZZZZ Units VVVV and WWWW (including during outage activities),"] would have a minimal impact on air quality from criteria pollutants.

The current primary access road to the ZZZZZZZZ site is a [TYPE] road that would be likely to experience a significant increase in traffic during shift changes that could lead to periods of congestion and decreased air quality. However, the overall impact caused by increased traffic volume and congestion would be localized and temporary. AAAAAAAA (citation) has stated that a XXXX traffic plan would be developed before building activities begin. [IF AT AN EXISTING SITE "Among other things, the XXXX traffic plan would specify separate plant entrances for the operations workforce for ZZZZZZZZ Units VVVV and WWWW and the construction workforce for proposed Units MMMM and NNNN.] The XXXX traffic plan would address traffic mitigation measures that would reduce the impact of increased traffic on air quality. Mitigation measures that are typically used to reduce traffic include encouraging car pools, [and] establishing central parking and shuttling services to and from the site [IF AT AN EXISTING SITE ", and staggering shift changes for operating personnel, outage workers, and construction workers"].

Construction workforce transportation would also result in greenhouse gas emissions, principally carbon dioxide (CO_2). Assuming a 7-yr construction period and a typical workforce, the review team estimates that the total construction workforce CO_2 emission footprint for building [two] nuclear power units at the ZZZZZZZZ site would be of the order of 300,000 metric tons; again this is compared to a total United States annual CO_2 emission rate of 6,000,000,000 metric tons (EPA citation). Appendix YYYY provides the details of the review team estimate for a reference 1000 MW(e) nuclear power reactor.

Based on its assessment of the relatively small construction workforce carbon footprint as compared to the United States annual CO_2 emissions, the review team concludes that the atmospheric impacts of greenhouse gases from construction workforce transportation would not be noticeable and additional mitigation would not be warranted. Based on AAAAAAAA's commitment to develop a GGGG plan and the potential mitigation measures listed in the ER, the review team concludes that the impact on the local air quality (including the effects of greenhouse gas emissions) from the increase in vehicular traffic related to construction and preconstruction activities would be temporary and would not be noticeable because appropriate mitigation measures would be adopted.

4.7.3 Summary

The review team evaluated potential impacts on air quality associated with criteria pollutants and greenhouse gas emissions during ZZZZZZZZ site development activities. The review team determined that the impacts would be minimal. On this basis, the review team concludes that the impacts of ZZZZZZZZ site development on air quality from emissions of criteria pollutants and CO_2 emissions are SMALL and that no further mitigation is warranted. Because NRC-authorized construction activities represent only a portion of the analyzed activities, the NRC staff concludes that the air quality impacts of NRC-authorized construction activities would also be SMALL; the NRC staff also concludes that no further mitigation, beyond the applicant's commitments, would be warranted.

(2) Operations related impacts

Generic guidance and generic analysis is useful to ensure that the depth of analysis is appropriate for the importance of the issue and the documentation provides consistent meaning when repeated. Every new reactor application is to be considered (1) a unique request for one or more particular reactors (and attendant infrastructure) of a specific design to be located at a particular location on a specific site and is planned to be operated in a specific manner or (2) a set of plant parameters with attributes associated with building and operating a plant at a particular location on a specific site. Certain analyses related to this aspect of CO_2 and other GHG emissions effects are to be adjusted to account for the reactor type, number of units, power level and the capacity factor, or for a set of plant parameters, and for schedule and types of activities to be undertaken as part of the project, the baseline environmental setting (affected area) in the site region, and other activities that may affect the air quality resources that may take place during this phase of the project.

In the format and content presented below, the highlighted text reflects an acceptable example; however, in performing the analysis and reporting conclusions, the reviewer is required to account for the unique circumstances of the project. If the project circumstances differ significantly from the assumptions made in the Appendix and are outside the bounds of the generic analysis and the scaling adjustments are not adequate to analyze environmental effects, then the reviewer is expected to provide an alternative analysis and the technical bases in the EIS.

The recommended format and content should be similar to:

5.7 Meteorological and Air Quality Impacts

…

5.7.1 Air Quality Impacts

Proposed Units MMMM and NNNN at the ZZZZZZZZ site would each have [PROJECT SPECIFIC NUMBER OF] standby diesel generators and [PROJECT SPECIFIC NUMBER OF] combustion turbine generators. These generators, each of which would be operated about 4 hours per month, [PROJECT SPECIFIC COOLING SYSTEM EMITTER, FOR EXAMPLE, “and the UHS cooling towers] would be the largest stationary sources of emission that could affect air quality. Table 5-IIII lists the expected annual emissions from these sources. There would be other minor emission sources onsite [FOR EXAMPLE, “such as diesel-driven fire water pumps”], but their impact on air quality would be negligible because of infrequent use. There would also be auxiliary boilers onsite. These boilers would not impact air quality because they would be electric [ENSURE THAT THIS IS APPROPRIATE FOR THE PROJECT]. AAAAAAAA has

stated that air emissions sources would be managed in accordance with Federal, HHHH, and local air quality control laws and regulations. (citation)

In its ER, AAAAAAAA briefly addresses fugitive dust during plant operations. AAAAAAAA states that fugitive dust generated by the commuting work force would be minimized by [FOR EXAMPLE] properly maintaining hard-surfaced access roads and setting appropriate speed limits (citation).

Table 5-IIII Anticipated Atmospheric Emissions Associated With Operation of Proposed Units MMMM and NNNN

	Diesel Generators (lb/yr)[(a)]	**Combustion Turbine (lb/yr)[(a)]**	**UHS Cooling Towers (lb/yr)[(b)(c)]**
Particulates			
Sulfur Oxides			---
Carbon Monoxide			---
Hydrocarbons			---
Nitrogen Oxides			---

(a) AAAAAAAA citation
(b) Review team estimate based on cooling tower flow and drift rate assuming that drift is salt particles.
(c) citation.

As noted in Section 2.9, the ZZZZZZZZ site is in FFFF County which is in attainment for all criteria pollutants defined in the National Ambient Air Quality Standards. Further, the closest Class I Federal Area is more than 100 mi from the ZZZZZZZZ site [ENSURE THIS IS CORRECT].

Impacts of existing transmission lines on air quality are addressed in NUREG-1437 (NRC 1996). Small amounts of ozone and smaller amounts of NO_X are produced by transmission lines. The production of these gases was found to be insignificant for 745-kV transmission lines (the largest lines in operation) and for a prototype 1200-kV transmission line [ENSURE THAT THIS IS CONSISTENT WITH THE PROJECT]. In addition, it was determined that potential mitigation measures, such as burying transmission lines, would be very costly and would not be warranted. The components needed to complete an interface between proposed Units MMMM and NNNN and [IF AT AN EXISTING SITE ZZZZZZZZ "Units VVVV and WWWW and ties to"] the regional power grid would be well within the range of transmission lines provided in NUREG-1437, and the review team therefore concludes that air quality impacts from transmission lines would not be noticeable.

Finally, the operation of a nuclear power plant involves the emission of some greenhouse gases, primarily carbon dioxide (CO_2). The review team has estimated that the total carbon footprint for actual plant operations of Units MMMM and NNNN for 40 years is on the order of 280,000 metric tons of CO_2 equivalent, as compared to a total United States annual CO_2 emissions rate of 6,000,000,000 metric tons (EPA 2009). Workforce transportation accounts for

about 90 percent of the total. Periodic testing of diesel generators accounts for most of the rest. These estimates are based on carbon footprint estimates in Appendix YYYY and emissions data contained in the ER (citation). Based on its assessment of the relatively small plant operations carbon footprint as compared to the United States annual CO_2 emissions, the review team concludes that the atmospheric impacts of greenhouse gases from plant operations would not be noticeable and additional mitigation would not be warranted.

The review team has considered the timing and magnitude of atmospheric releases related to operation of proposed Units MMMM and NNNN, the existing air quality at the ZZZZZZZZ site and the distance to the closest Class I Federal Area, and the AAAAAAAA commitment to manage and mitigate emissions in accordance with applicable regulations. On these bases, the review team concludes that the air quality impacts of operation of proposed Units MMMM and NNNN would not be noticeable. Based on its assessment of the carbon footprint of plant operations, the review team concludes that the atmospheric impacts of greenhouse gases from plant operations would not be noticeable.

5.7.3 Summary

The review team evaluated potential impacts on air quality associated with criteria pollutants and greenhouse gas emissions from operating proposed Units MMMM and NNNN. The review team also evaluated potential impacts of cooling system emissions and transmission lines. In each case, the review team determined that the impacts would be minimal. On this basis, the review team concludes that the impacts of operation of proposed Units 3 and 4 on air quality from emissions of criteria pollutants, CO_2 emissions, and cooling system emissions are SMALL and that no further mitigation is warranted.

(3) Fuel cycle related impacts

Generic guidance and generic analysis is useful to ensure that the depth of analysis is appropriate for the importance of the issue and the documentation provides consistent meaning when repeated. Every new reactor application is to be considered (1) a unique request for one or more particular reactors (and attendant infrastructure) of a specific design to be located at a particular location on a specific site and is planned to be operated in a specific manner or (2) a set of plant parameters with attributes associated with building and operating a plant at a particular location on a specific site. Certain analyses related to this aspect of CO_2 and other GHG emissions effects are to be adjusted to account for the reactor type, number of units, power level and the capacity factor, or for a set of plant parameters, and for schedule and types of activities to be undertaken as part of the project, the baseline environmental setting (affected area) in the site region, and other activities that may affect the air quality resources that may take place during this phase of the project.

In the format and content presented below, the highlighted text reflects an acceptable example; however, in performing the analysis and reporting conclusions, the reviewer is required to account for the unique circumstances of the project. If the project circumstances differ significantly from the assumptions made in the Appendix and are outside the bounds of the generic analysis and the scaling adjustments are not adequate to analyze environmental effects, then the reviewer is expected to provide an alternative analysis and the technical bases in the EIS.

The recommended format and content should be similar to:

[KEEP IN MIND THAT THE FUEL CYCLE IMPACTS ARE UNLIKELY TO OCCUR IN THE SITE REGION; CONSEQUENTLY, THE IMPACTS ARE INDIRECT IMPACTS OF THE PROPOSED ACTION]

6.1 Fuel Cycle Impacts and Solid Waste Management

…

6.1.3 Fossil Fuel Impacts

Electric energy and process heat are required during various phases of the fuel cycle process. Electric energy is usually produced by the combustion of fossil fuel at conventional power plants. Electric energy associated with the fuel cycle represents about 5 percent of the annual electric power production of the reference 1000-MW(e) LWR. Process heat is primarily generated by the combustion of natural gas. This gas consumption, if used to generate electricity, would be less than 0.4 percent of the electrical output from the model plant.

The largest source of carbon dioxide (CO_2) emissions associated with nuclear power is from the fuel cycle, not the operation of the plant, as indicated above and in Table S–3. The CO_2 emissions from the fuel cycle are about 5 percent of the CO_2 emissions from an equivalent fossil fuel-fired plant.

The largest use of electricity in the fuel cycle comes from the enrichment process. It appears that gas centrifuge (GC) technology is likely to eventually replace gaseous diffusion (GD) technology for uranium enrichment in the United States. The same amount of enrichment from a GC facility uses less electricity and therefore results in lower amounts of air emissions such as carbon dioxide than a GD facility. Therefore, the NRC staff concludes that the values for electricity use and air emissions in Table S-3 continue to be appropriately bounding values. In Appendix YYYY, the NRC staff estimates that the carbon footprint of the fuel cycle to support a reference 1000 MW(e) LWR for a 40-year plant life is on the order of 14,000,000 metric tons of CO_2 including a small contribution from other greenhouse gases. Scaling this footprint to the power level and capacity factor of ZZZZZZZZ Units MMMM and NNNN, the NRC staff estimates the carbon footprint for 40 years of fuel cycle emissions to be 45,000,000 [ENSURE SCALING FACTOR IS APPROPRIATE FOR PROJECT] metric tons of CO_2, as compared to a total United States annual CO_2 emissions rate of 6,000,000,000 metric tons (EPA 2009).

On this basis, the NRC staff concludes that the fossil fuel impacts, including greenhouse gas emissions, from the direct and indirect consumption of electric energy for fuel cycle operations would be SMALL.

(4) Decommissioning related impacts

Generic guidance and generic analysis is useful to ensure that the depth of analysis is appropriate for the importance of the issue and the documentation provides consistent meaning when repeated. Every new reactor application is to be considered (1) a unique request for one or more particular reactors (and attendant infrastructure) of a specific design to be located at a particular location on a specific site and is planned to be operated in a specific manner or (2) a set of plant parameters with attributes associated with building and operating a plant at a particular location on a specific site. Certain analyses related to this aspect of CO_2 and other GHG emissions effects are to be adjusted to account for the reactor type, number of units, power level and the capacity factor, or for a set of plant parameters, and for schedule and types of activities to be undertaken as part of the project, the baseline environmental setting (affected area) in the site region, and other activities that may affect the air quality resources that may take place during this phase of the project.

In the format and content presented below, the highlighted text reflects an acceptable example; however, in performing the analysis and reporting conclusions, the reviewer is required to account for the unique circumstances of the project. If the project circumstances differ significantly from the assumptions made in the Appendix and are outside the bounds of the generic analysis and the scaling adjustments are not adequate to analyze environmental effects, then the reviewer is expected to provide an alternative analysis and the technical bases in the EIS.

The recommended format and content should be similar to:

6.3 Decommissioning Impacts

At the end of the operating life of a power reactor, NRC regulations require that the facility undergo decommissioning. Decommissioning is the safe removal of a facility from service and the reduction of residual radioactivity to a level that permits termination of the NRC license. The regulations governing decommissioning of power reactors are found in 10 CFR 50.75.

An applicant for a COL is required to certify that sufficient funds will be available to assure radiological decommissioning at the end of power operations. As part of its COL application for the proposed Units MMMM and NNNN on the ZZZZZZZZ site, AAAAAAAA included a Decommissioning Funding Assurance Report (citation). AAAAAAAA would establish an external sinking funds account to accumulate funds for decommissioning.

Environmental impacts from the activities associated with the decommissioning of any reactor before or at the end of an initial or renewed license are evaluated in the *Generic Environmental Impact Statement on Decommissioning of Nuclear Facilities: Supplement I, Regarding the*

Decommissioning of Nuclear Power Reactors (GEIS-DECOM), NUREG-0586 Supplement 1 (NRC 2002) [IF THE PROJECT INVOLVES REACTOR TYPES NOT COVERED BY THE GEIS-DECOM OR PRACTICES SUBSTANTIALLY DIFFERENT FROM THOSE ADDRESSED IN THE GEIS-DECOM, THEN ALTERNATIVE LANGUAGE SHOULD BE PROVIDED]. Environmental impacts of the DECON, SAFSTOR, and ENTOMB decommissioning methods are evaluated in the GEIS-DECOM. A COL applicant is not required to identify a decommissioning method at the time of the COL application. The NRC staff's evaluation of the environmental impacts of decommissioning presented in the GEIS-DECOM, identifies a range of impacts for each environmental issue for a range of different reactor designs. The NRC staff concludes that the construction methods that would be used for the LLLL[REACTOR TYPE] are not sufficiently different from the construction methods used for the current plants to significantly affect the impacts evaluated in the GEIS-DECOM. Therefore, the NRC staff concludes that the impacts discussed in the GEIS-DECOM remain bounding for reactors deployed after 2002, including the LLLL[REACTOR TYPE].

The GEIS-DECOM does not specifically address the carbon footprint of decommissioning activities. However, it does list the decommissioning activities and states that the decommissioning workforce would be expected to be smaller than the operational workforce and that the decontamination and demolition activities could take up to 10 years to complete. Finally, it discusses SAFSTOR, in which decontamination and dismantlement are delayed for a number of years. Given this information, the NRC staff estimated the CO_2 footprint of decommissioning to be of the order of 63,000 metric tons without SAFSTOR. This footprint is about equally split between decommissioning workforce transportation and equipment usage. The details of the NRC staff's estimate are presented in Appendix YYYY. A 40-yr SAFSTOR period would increase the footprint of decommissioning by about 40 percent. These CO_2 footprints are roughly three orders of magnitude lower than the CO_2 footprint presented in Section 6.1.3 for the uranium fuel cycle.

The NRC staff relies upon the bases established in the GEIS-DECOM and concludes the following:

1. Doses to the public would be well below applicable regulatory standards regardless of which decommissioning method considered in GEIS-DECOM is used.

2. Occupational doses would be well below applicable regulatory standards during the license term.

3. The quantities of Class C or greater than Class C wastes generated would be comparable or less than the amounts of solid waste generated by reactors licensed before 2002.

4. Air quality impacts of decommissioning are expected to be negligible at the end of the operating term.

5. Measures are readily available to avoid potential significant water quality impacts from erosion or spills. The liquid radioactive waste system design includes features to limit release of radioactive material to the environment, such as pipe chases and tank collection basins. These features will minimize the amount of radioactive material in spills and leakage that would have to be addressed at decommissioning.

6. Ecological impacts of decommissioning are expected to be negligible.

7. Socioeconomic impacts would be short-term and could be offset by decreases in population and economic diversification.

On the basis of the GEIS-DECOM and the evaluation of air quality impacts from greenhouse gas emissions above, the NRC staff concludes that, as long as the regulatory requirements on decommissioning activities to limit the impacts of decommissioning are met, the decommissioning activities would result in a SMALL impact.

(5) Cumulative impacts

Generic guidance and generic analysis is useful to ensure that the depth of analysis is appropriate for the importance of the issue and the documentation provides consistent meaning when repeated. Every new reactor application is to be considered (1) a unique request for one or more particular reactors (and attendant infrastructure) of a specific design to be located at a particular location on a specific site and is planned to be operated in a specific manner or (2) a set of plant parameters with attributes associated with building and operating a plant at a particular location on a specific site. Certain analyses related to this aspect of CO_2 and other GHG emissions effects are to be adjusted to account for the reactor type, number of units, power level and the capacity factor, or for a set of plant parameters, and for schedule and types of activities to be undertaken as part of the project, the baseline environmental setting (affected area) in the site region, and other activities that may affect the air quality resources that may take place during this phase of the project.

In the format and content presented below, the highlighted text reflects an acceptable example; however, in performing the analysis and reporting conclusions, the reviewer is required to account for the unique circumstances of the project. If the project circumstances differ significantly from the assumptions made in the Appendix and are outside the bounds of the generic analysis and the scaling adjustments are not adequate to analyze environmental effects, then the reviewer is expected to provide an alternative analysis and the technical bases in the EIS.

The recommended format and content should be similar to:

7.6 Air Quality

…

7.6.1 Criteria Pollutants

…

7.6.2 Greenhouse Gas Emissions

As discussed in the state of the science report issued by the GCRP, it is the "… production and use of energy that is the primary cause of global warming, and in turn, climate change will eventually affect our production and use of energy. The vast majority of U.S. greenhouse gas emissions, about 87 percent, come from energy production and use…" Approximately one third of the greenhouse gas emissions are the result of generating electricity and heat (Karl et al. 2009). This assessment is focused on greenhouse gas emissions.

Greenhouse gas emissions associated with building, operating, and decommissioning a nuclear power plant are addressed in Sections 4.7, 5.7.1, 6.1.3, and 6.3. The review team concluded that the atmospheric impacts of the emissions associated of each aspect of building, operating and decommissioning a single plant are minimal. The review team also concludes that the impacts of the combined emissions for the full plant life cycle are minimal.

The cumulative impacts of a single source or combination of greenhouse gas emission sources must be placed in geographic context:

- The environmental impact is global rather than local or regional
- The effect is not particularly sensitive to the location of the release point
- The magnitude of individual greenhouse gas sources related to human activity, no matter how large compared to other sources, are small when compared to the total mass of greenhouse gases resident in the atmosphere, and
- The total number and variety of greenhouse gas emission sources is extremely large and are ubiquitous.

These points are illustrated in Table 7-2.

Table 7-JJJJ. Comparison of Annual Carbon Dioxide Emission Rates

Source	Metric Tons per Year
Global Emissions	28,000,000,000[a]
United States	6,000,000,000[a]
1000 MW Nuclear Power Plant (including fuel cycle, 90 percent capacity factor)	400,000[b]
1000 MW Nuclear Power Plant (operations only, 90 percent capacity factor)	5000[b]
Average U. S. Passenger Vehicle[c]	5

(a) Source: EPA 2009g
(b) Source: Appendix YYYY
(c) Source: FHWA 2006

Evaluation of cumulative impacts of greenhouse gas emissions requires the use of a global climate model. The GCRP report referenced above provides a synthesis of the results of numerous climate modeling studies. The review team concludes that the cumulative impacts of greenhouse emissions around the world as presented in the report are the appropriate basis for its evaluation of cumulative impacts. Based on the impacts set forth in the GCRP report, the review team concludes that the national and worldwide cumulative impacts of greenhouse gas emissions are noticeable but not destabilizing. The review team further concludes that the

cumulative impacts would be noticeable but not destabilizing, with or without the greenhouse gas emissions of the proposed project.

Consequently, the review team recognizes that greenhouse gas emissions, including carbon dioxide, from individual stationary sources and, cumulatively, from multiple sources can contribute to climate change and that the carbon footprint is a relevant factor in evaluating energy alternatives. Section 9.2.5 contains a comparison of carbon footprints of the viable energy alternatives.

7.6.3 Summary

Cumulative impacts to air quality resources are estimated based on the information provided by AAAAAAAA and on the review team's independent evaluation. Other past, present and reasonably foreseeable activities exist in the geographic areas of interest (local for criteria pollutants and global for greenhouse gas emissions) that could affect air quality resources. The cumulative impacts on criteria pollutants from emissions of effluents from the ZZZZZZZZ site [and other projects OR other projects, and the NAME(s) OF THE MAJOR EMITTER(s) OF GHGs] would be noticeable but not destabilizing [IF THERE ARE MAJOR EMITTER(s), principally as a result of the contribution of THE MAJOR EMITTER(s)]. ZZZZZZZZ and other projects listed in Table 7-1 would have de minimis impacts. The national and worldwide cumulative impacts of greenhouse gas emissions are noticeable but not destabilizing. The review team concludes that the cumulative impacts would be noticeable but not destabilizing, with or without the greenhouse gas emissions from the ZZZZZZZZ site. The review team concludes that cumulative impacts from other past, present, and reasonably foreseeable future actions on air quality resources in the geographic areas of interest would be MODERATE [THIS IS A NATIONWIDE CONCLUSION BASED ON THE EPA'S ENDANGERMENT FINDING]. The incremental contribution of impacts on air quality resources from building and operating proposed Units MMMM and NNNN would be SMALL. The incremental contribution of impacts on air quality resources from the NRC-authorized activities would also be SMALL.

(6) Alternative Energy Sources

Generic guidance and generic analysis is useful to ensure that the depth of analysis is appropriate for the importance of the issue and the documentation provides consistent meaning when repeated. Every new reactor application is to be considered (1) a unique request for one or more particular reactors (and attendant infrastructure) of a specific design to be located at a particular location on a specific site and is planned to be operated in a specific manner or (2) a set of plant parameters with attributes associated with building and operating a plant at a particular location on a specific site. Certain analyses related to this aspect of CO_2 and other GHG emissions effects are to be adjusted to account for the reactor type, number of units, power level and the capacity factor, or for a set of plant parameters, and for schedule and types of activities to be undertaken as part of the project, the baseline environmental setting (affected area) in the site region, and other activities that may affect the air quality resources that may take place during this phase of the project.

In the format and content presented below, the highlighted text reflects an acceptable example; however, in performing the analysis and reporting conclusions, the reviewer is required to account for the unique circumstances of the project. If the project circumstances differ significantly from the assumptions made in the Appendix and are outside the bounds of the generic analysis and the scaling adjustments are not adequate to analyze environmental effects, then the reviewer is expected to provide an alternative analysis and the technical bases in the EIS.

The recommended format and content should be similar to:

9.2 Energy Alternatives

…

9.2.2 Alternatives Requiring New Generating Capacity

…

9.2.2.1 Coal-Fired Generation

…

Air Quality

The impacts on air quality from coal-fired generation would vary considerably from those of nuclear generation because of emissions of SO_2, nitrogen oxides (NO_X), carbon monoxide (CO), particulate matter (PM), volatile organic compounds (VOCs), and hazardous air pollutants such as mercury and lead. In its environmental report (ER), AAAAAAAA assumed a coal-fired plant design that would minimize air emissions through a combination of boiler technology and post combustion pollutant removal. AAAAAAAA estimated that annual emissions for a supercritical pulverized coal-fired generation alternative using sub-bituminous coal would be approximately as follows (citation):

- SO_2 – 2900 tons/yr
- NO_X – 2000 tons/yr
- CO – 2800 tons/yr
- PM_{10} – 50 tons/yr
- $PM_{2.5}$ – 13 tons/yr
- Mercury – 0.46 tons/yr.

PM_{10} is particulate matter with a diameter equal to or less than 10 microns (40 CFR 50.6). $PM_{2.5}$ is particulate matter with a diameter equal to or less than 2.5 microns (40 CFR 50.7).

Based on data from previous NRC EIS documents, the review team determined the preceding emission estimates are reasonable. A new coal-fired plant at the ZZZZZZZZ site would also have approximately 27,000,000 tons/yr of unregulated carbon dioxide emissions (citation) that could affect climate change. [ENSURE THAT THIS ESTIMATE AND THE ONES ABOVE ARE ADJUSTED APPROPRIATELY FOR THE PROJECT]

The acid rain requirements of the Clean Air Act capped the nation's SO_2 emissions from power plants. AAAAAAAA would need to obtain sufficient pollution credits either from a set-aside pool or purchases on the open market to cover annual emissions from the plant.

A new coal-fired generation plant at the ZZZZZZZZ site would likely need a prevention of significant deterioration (PSD) permit and an operating permit from the HHHH. The plant would need to comply with the new source performance standards for such plants in 40 CFR 60, Subpart Da. The standards establish emission limits for PM and opacity (40 CFR 60.42Da), SO_2 (40 CFR 60.43Da), NO_X (40 CFR 60.44Da), and mercury (40 CFR 60.45Da). Fugitive dust emissions from construction activities would be mitigated using best management practices (BMPs); such emissions would be temporary (citation).

The U.S. Environmental Protection Agency (EPA) has various regulatory requirements for visibility protection in 40 CFR Part 51, Subpart P, including a specific requirement for review of any new major stationary source in areas designated as in attainment or unclassified under the Clean Air Act. The ZZZZZZZZ site is in an area designated as in attainment or unclassified for criteria pollutants (40 CFR citation).

Section 169A of the Clean Air Act (42 USC 7491) establishes a national goal of preventing future impairment of visibility and remedying existing impairment in mandatory Class I Federal areas when impairment is from air pollution caused by human activities. In addition, the EPA regulations provide that for each mandatory Class I Federal area located within a State, the State must establish goals that provide for reasonable progress toward achieving natural visibility conditions. The reasonable progress goals must provide for an improvement in visibility for the most impaired days over the period of the implementation plan and confirm no degradation in visibility for the least-impaired days over the same period [40 CFR 51.308(d)(1)]. If a new coal-fired power plant were located close to a mandatory Class I area, additional air

pollution control requirements could be imposed. No mandatory Class I Federal areas are within 50 mi of the ZZZZZZZZ site.

The GEIS for license renewal considers global warming from unregulated carbon dioxide emissions and acid rain from sulfur oxides and nitrogen oxide emissions as a potential impact (NRC 1996). Adverse human health effects, such as cancer and emphysema, have been associated with the byproducts of coal combustion. Overall, the review team concludes that air quality impacts from new coal-fired power generation at the ZZZZZZZZ site would be MODERATE. The impacts would be clearly noticeable but would not destabilize air quality.

9.2.2.2 Natural Gas-Fired Generation

…

Air Quality

Natural gas is a relatively clean-burning fuel. When compared to a coal-fired plant, a natural gas-fired plant would release similar types of emissions but in lower quantities. A new natural gas-fired power generation plant would likely need a PSD permit and an operating permit from the TCEQ. A new natural gas-fired combined-cycle plant would also be subject to the new source performance standards in 40 CFR 60, Subparts Da and GG. These regulations establish emission limits for particulates, opacity, SO_2, and NO_X. The EPA has various regulatory requirements for visibility protection in 40 CFR 51, Subpart P, including a specific requirement for review of any new major stationary source in areas designated as in attainment or unclassified under the Clean Air Act. The ZZZZZZZZ site is in an area designated as in attainment or unclassified for criteria pollutants (40 CFR citation).

Section 169A of the Clean Air Act (42 USC 7491) establishes a national goal of preventing future impairment of visibility and remedying existing impairment in mandatory Class I Federal areas when impairment is from air pollution caused by human activities. In addition, the EPA regulations provide that for each mandatory Class I Federal area located within a State, the State must establish goals that provide for reasonable progress toward achieving natural visibility conditions. The reasonable progress goals must provide for an improvement in visibility for the most impaired days over the period of the implementation plan and ensure no degradation in visibility for the least-impaired days over the same period (40 CFR 51.308(d)(1)). If a new natural gas-fired power plant were located close to a mandatory Class I area, additional air pollution control requirements could be imposed. No mandatory Class I Federal areas are within 50 mi of the ZZZZZZZZ site.

AAAAAAAA estimated that a natural gas-fired plant equipped with pollution control technology to meet emission limits would have approximately the following emissions (citation):

- SO_2 – 41 tons/yr
- NO_x – 680 tons/yr
- CO – 141 tons/yr
- $PM_{2.5}$ – 119 tons/yr.

A natural gas-fired power plant would also have approximately 6,900,000 tons/yr of unregulated carbon dioxide emissions that could affect climate change (citation). [ENSURE THAT THIS ESTIMATE AND THE ONES ABOVE ARE ADJUSTED APPROPRIATELY FOR THE PROJECT]

The combustion turbine portion of the combined-cycle plant would be subject to EPA's National Emission Standards for Hazardous Air Pollutants for Stationary Combustion Turbines (40 CFR 63) if the site is a major source of hazardous air pollutants. Major sources have the potential to emit 10 tons/yr or more of any single hazardous air pollutant or 25 tons/yr or more of any combination of hazardous air pollutants (40 CFR 63.6085(b)).

The review team assumes fugitive dust emissions from construction activities would be mitigated using BMPs, similar to mitigation discussed in Chapter 4 for proposed Units MMMM and NNNN. Such emissions would be temporary.

The impacts of emissions from a natural gas-fired power generation plant would be clearly noticeable, but would not be sufficient to destabilize air resources. Overall, the review team concludes that air quality impacts resulting from construction and operation of new natural gas-fired power generation at the ZZZZZZZZ site would be SMALL to MODERATE.

9.2.3 Other Alternatives

…

9.2.4 Combination of Alternatives

…

9.2.5 Summary Comparison of Alternatives

Table 9-4 provides a summary of the review team's environmental impact characterizations for constructing and operating new nuclear, coal-fired, and natural gas-fired combined-cycle generating units at the ZZZZZZZZ site. The combination of alternatives shown in Table 9-4 assumes siting of natural gas combined-cycle generating units at the ZZZZZZZZ site and siting of other generating units within AAAAAAAA's ROI.

The review team reviewed the available information on the environmental impacts of power generation alternatives compared to the building new nuclear units at the ZZZZZZZZ site. Based on this review, the review team concludes that, from an environmental perspective, none of the viable energy alternatives are clearly preferable to building a new baseload nuclear power generation plant at the ZZZZZZZZ site.

It is appropriate to specifically discuss the differences among the alternative energy sources regarding carbon dioxide (CO_2) emissions. The CO_2 emissions for the proposed action and energy generation alternatives are discussed in Sections 5.7.1, 9.2.2.1, 9.2.2.2, and 9.2.4. Table 9-5 summarizes the CO_2 emission estimates for a 40-year period for the alternatives considered by the review team to be viable for baseload power generation. These estimates are limited to the emissions from power generation and do not include CO_2 emissions for workforce transportation, building fuel-cycle, or decommissioning. Among the viable energy

generation alternatives, the CO_2 emissions for nuclear power are a small fraction of the emissions of the other viable energy generation alternatives. Even adding in the transportation emissions for the nuclear plant workforce and fuel cycle emissions would only increase the emissions for plant operation over a 40-year period to about 45,000,000 metric tons. This number is still significantly lower than the emissions for the other viable alternatives.

The CO_2 emissions associated with generation alternatives such as wind power, solar power, and hydropower would be associated with workforce transportation, construction, and decommissioning of the facilities. Because these generation alternatives do not involve combustion, the review team considers the emissions to be minor and concludes that the emissions would have a minimal cumulative impact. Other energy generation alternatives involving combustion of oil, wood waste, municipal solid waste, or biomass-derived fuels would have CO_2 emissions from combustion as well as from workforce transportation, plant construction, and plant decommissioning. It is likely that the CO_2 emissions from the combustion process for these alternatives would dominate the other CO_2 emissions associated with the generation alternative. It is also likely that the CO_2 emissions from these alternatives would be the same order of magnitude as the emissions for the fossil-fuel alternatives considered in Sections 9.2.2.1, 9.2.2.2, and 9.2.4. However, because the review team determined that these alternatives do not meet the need for baseload power generation, the review team has not evaluated the CO_2 emissions quantitatively.

As discussed in Chapter 8, the review team concludes that the need for additional baseload power generation has been demonstrated. Also, as discussed earlier in this chapter, the review team concludes that the viable alternatives to the proposed action all would involve the use of fossil fuels (coal or natural gas). Consequently, the review team concludes that the proposed action results in the lowest level of emissions of greenhouse gases among the viable alternatives.

Table 9-KKKK. Summary of Environmental Impacts of Construction and Operation of New Nuclear, Coal-Fired, and Natural Gas-Fired Generating Units, and a Combination of Alternatives

Resource Area	Nuclear	Coal	Natural Gas	Combination of Alternatives
Land use				
Air quality (criteria pollutants)				
Water use and quality				
Ecology				
Waste management				
Socioeconomics				
Human health				
Historic and cultural resources				
Environmental justice				

Table 9-LLLL. Comparison of Carbon Dioxide Emissions for Energy Alternatives

Generation Type	Years	CO_2 Emission (metric tons)
Nuclear Power[(a)]	40	
Coal-Fired Generation[(b)]	40	
Natural Gas-Fired Generation[(c)]	40	
Combination of Alternatives[(d)]	40	

(a) From Appendix YYYY
(b) From Section 9.2.2.1
(c) From Section 9.2.2.2
(d) From Section 9.2.4 (assuming only natural gas generation has significant CO_2 emissions)

(7) Alternative Sites

Generic guidance and generic analysis is useful to ensure that the depth of analysis is appropriate for the importance of the issue and the documentation provides consistent meaning when repeated. Every new reactor application is to be considered (1) a unique request for one or more particular reactors (and attendant infrastructure) of a specific design to be located at a particular location on a specific site and is planned to be operated in a specific manner or (2) a set of plant parameters with attributes associated with building and operating a plant at a particular location on a specific site. Certain analyses related to this aspect of CO_2 and other GHG emissions effects are to be adjusted to account for the reactor type, number of units, power level and the capacity factor, or for a set of plant parameters, and for schedule and types of activities to be undertaken as part of the project, the baseline environmental setting (affected area) in the site region, and other activities that may affect the air quality resources that may take place during this phase of the project.

In the format and content presented below, the highlighted text reflects an acceptable example; however, in performing the analysis and reporting conclusions, the reviewer is required to account for the unique circumstances of the project. If the project circumstances differ significantly from the assumptions made in the Appendix and are outside the bounds of the generic analysis and the scaling adjustments are not adequate to analyze environmental effects, then the reviewer is expected to provide an alternative analysis and the technical bases in the EIS.

The recommended format and content should be similar to:

9.3 Alternative Sites

…

9.3.BBBB Alternative Site BBBB-1 (Repeated as often as needed and peculiarized for the Alternative Site circumstances)

…

9.1.1.1 Air Quality

The following impact analysis includes impacts from building activities and operations. The analysis also considers other past, present, and reasonably foreseeable future actions that impact air quality, including other Federal and non-Federal projects listed in Table 9-CCCC. The geographic area of interest for the BBBB-1 site is DDDD County, which is in the EEEE Air Quality Control Region (40 CFR citation).

The emissions related to building and operating a nuclear power plant at the BBBB-1 alternative site would be similar to those at the ZZZZZZZZ site. The air quality attainment status for DDDD County, as set forth in 40 CFR (citation), reflects the effects of past and present emissions from all pollutant sources in the region. DDDD County is not out of attainment of any National Ambient Air Quality Standard.

The atmospheric emissions related to building and operating a nuclear power plant at the ZZZZZZZZ site in FFFF County, are described in Chapters 4 and 5. The criteria pollutants were found to have a SMALL impact. In Chapter 7, the cumulative impacts of the criteria pollutants at the ZZZZZZZZ site were evaluated and also determined to be [SMALL (IF NO OTHER MAJOR EMITTERS) OR MODERATE principally because of a nearby major source (IF THERE IS A MAJOR EMITTER; absent that source, the cumulative impacts would be SMALL)].

Reflecting on the projects listed in Table 9-CCCC, the most significant are the GGGG and the HHHH. Effluents from power plants such these are typically released through stacks and with significant vertical velocity. Other industrial projects listed in Table 9-CCCC would have de minimis impacts. Given that these projects would be subject to institutional controls, it is unlikely that the air quality in the region would degrade to the extent that the region is in nonattainment of National Ambient Air Quality Standards.

The air quality impact of BBBB-1 site development would be local and temporary. The distance from building activities to the site boundary would be sufficient to generally avoid significant air quality impacts. There are no land uses or projects, including the aforementioned sources, that would have emissions during site development that would, in combination with emissions from the BBBB-1 site, result in degradation of air quality in the region.

Releases from operation of two units at the BBBB-1 site would be intermittent and made at low levels with little or no vertical velocity. The air quality impacts of the GGGG are included in the baseline air quality status. The air quality impacts of the HHHH would be similar to the air quality impacts discussed in Section 9.2.2.2, which could be noticeable but not destabilizing. The cumulative impacts from emissions of effluents from the BBBB-1 site and the aforementioned sources could be noticeable but not destabilizing.

The cumulative impacts of greenhouse gas emissions related to nuclear power are discussed in Section 7.5. The impacts of the emissions are not sensitive to location of the source. Consequently, the discussion in Section 7.5 is applicable to a nuclear power plant located at the BBBB-1 site. The review team concludes that the national and worldwide cumulative impacts of greenhouse gas emissions are noticeable but not destabilizing. The review team further concludes that the cumulative impacts would be noticeable but not destabilizing, with or without the greenhouse gas emissions of the project at the BBBB-1 site.

Cumulative impacts to air quality resources are estimated based in the information provided by AAAAAAAA and the review team's independent evaluation. Other past, present and reasonably foreseeable future activities exist in the geographic areas of interest (local for criteria pollutants

and global for greenhouse gas emissions) that could affect air quality resources. The cumulative impacts on criteria pollutants from emissions of effluents from the BBBB-1 site, other projects, and the GGGG and the HHHH could be noticeable but not destabilizing, principally as a result of the contribution of these two sources. The national and worldwide cumulative impacts of greenhouse gas emissions are noticeable but not destabilizing. The review team concludes that the cumulative impacts would be noticeable but not destabilizing, with or without the greenhouse gas emissions from the BBBB-1 site. The review team concludes that cumulative impacts from other past, present, and reasonably foreseeable future actions on air quality resources in the geographic areas of interest would be SMALL to MODERATE [IF THERE WILL BE A NEW MAJOR EMITTER] for criteria pollutants and MODERATE for greenhouse gas emissions. The incremental contribution of impacts on air quality resources from building and operating two units at the BBBB-1 site would be insignificant for both criteria pollutants and greenhouse gas emissions.

Attachment1

CLI-09-21
MEMORANDUM AND ORDER
(ML093070690)

Attachment 2

MEMORANDUM DATED JANUARY 15, 2010
FROM M. JOHNSON to R. BORCHARDT
(ML093520734)

Attachment 3

APPENDIX YYYY

Carbon Dioxide Footprint Estimates for a Reference 1000-MW(e) Reactor

Exhibit 5.18

Appendix YYYY

Carbon Dioxide Footprint Estimates for a Reference 1000-MW(e) Reactor

The review team has estimated the carbon dioxide (CO_2) footprint of various activities associated with nuclear power plants. These activities include building, operating, and decommissioning a plant. The estimates include direct emission from the nuclear facility and indirect emissions from workforce transportation and the fuel cycle.

Construction equipment estimates listed in Table YYYY-1 are based on hours of equipment use estimated for a single nuclear power plant at a site requiring a moderate amount of terrain modification. Equipment usage for a multiple unit facility would be larger, but it is likely that it would not be a factor of 2 larger. A reasonable set of emission factors used to convert the hours of equipment use to CO_2 emissions are based on carbon monoxide emissions (UniStar 2007) scaled to CO_2 using a scaling factor of 165 tons of CO_2 per ton of CO. The scaling factor is based on emissions factors in Table 3.3-1 of AP-42 (EPA 1995). Equipment emissions estimates for decommissioning are one half of those for construction.

Table YYYY-1. Construction Equipment CO_2 Emissions (metric tons equivalent)

Equipment	Construction Total[(a)]	Decommissioning Total[(b)]
Earthwork and Dewatering	1.1×10^4	5.4×10^3
Batch Plant Operations	3.3×10^3	1.6×10^3
Concrete	4.0×10^3	2.0×10^3
Lifting and Rigging	5.4×10^3	2.7×10^3
Shop Fabrication	9.2×10^2	4.6×10^2
Warehouse Operations	1.4×10^3	6.8×10^2
Equipment Maintenance	9.6×10^3	4.8×10^3
Total[(c)]	3.5×10^4	1.8×10^4

(a) Based on hours of equipment usage over 7-year period
(b) Based on equipment usage over 10-year period
(c) Total not equal to the sum due to rounding

Workforce estimates are typical workforce numbers for new plant construction and operation based on estimates in various (COL) applications, and decommissioning workforce emissions estimates are based on decommissioning workforce estimates in NUREG-0586 S1, *Generic Environmental Impact Statement on Decommissioning of Nuclear Facilities, Supplement 1 Regarding the Decommissioning of Nuclear Power Reactors* (NRC 2002). A typical construction workforce averages about 2500 for a 7-year period with a peak workforce of about

4000. A typical operations workforce for the 40-year life of the plant is assumed to be about 400, and the decommissioning workforce during a decontamination and dismantling period of 10 years is assumed to be 200 to 400. In all cases, the daily commute is assumed to involve a 100-mi round trip with two individuals per vehicle. Considering shifts, holidays, and vacations, 1250 round trips per day are assumed each day of the year during construction; 200 round trips per day are assumed each day during operations; and 150 round trips per day are assumed 250 days per year for the decontamination and dismantling portion of decommissioning. If the SAFSTOR decommissioning option is included in decommissioning, 20 round trips each day of the year are assumed for the caretaker workforce.

Table YYYY-2 lists the review team's estimates of the carbon dioxide equivalent emissions associated with workforce transport. The table lists the assumptions used to estimate total miles traveled by each workforce and the factors used to convert total miles to metric tons CO_2 equivalent. CO_2 equivalent accounts for other greenhouse gases, such as methane and nitrous oxide, which are emitted by internal combustion engines. The workers are assumed to travel in gasoline power passenger vehicles (cars, trucks, vans, and sport utility vehicles) that get an average of 19.7 mi per gallon of gas (FHWA 2006). Conversion from gallons of gasoline burned to CO_2 equivalent is based on Environmental Protection Agency (EPA) emissions factors (EPA 2007a; 2007b).

Table YYYY-2. Workforce CO_2 Footprint Estimates

	Construction Workforce	Operational Workforce	Decommissioning Workforce	SAFSTOR Workforce
Round trips per day	1250	200	150	20
Miles per round trip	100	100	100	100
Days per year	365	365	250	365
Years	7	40	10	40
Miles Traveled	3.2×10^8	2.9×10^8	3.8×10^7	2.92×10^7
Miles per gallon[(a)]	19.7	19.7	19.7	19.7
Gallons fuel burned	1.6×10^7	1.5×10^7	1.9×10^6	1.58×10^6
Metric tons CO_2 per gallon[(b)]	8.81×10^{-3}	8.81×10^{-3}	8.81×10^{-3}	8.81×10^{-3}
Metric tons CO_2	1.4×10^5	1.3×10^5	1.7×10^4	1.3×10^4
CO_2 equivalent factor[(c)]	0.971	0.971	0.971	0.971
Metric tons CO_2 equivalent	1.5×10^5	1.3×10^5	1.7×10^4	1.3×10^4

(a) FHWA 2006
(b) EPA 2007b
(c) EPA 2007a

Published estimates of uranium fuel cycle CO_2 emissions required to support a nuclear power plant range from about 1 percent to about 5 percent of the CO_2 emissions from a comparably sized coal-fired plant (Sovacool 2008). A coal-fired power plant emits about 1 metric ton of CO_2 for each megawatt hour generated (Miller and Van Atten 2004). Therefore, for consistency with Table S-3 of 10 CFR 51.51, the NRC staff estimated the uranium fuel cycle CO_2 emissions as

0.05 metric tons of CO_2 per MWh generated and assumed an 80 percent capacity factor. Finally, the review team estimated the CO_2 emissions directly related to plant operations from the typical usage of various diesel generators onsite using EPA emissions factors (EPA 1995). The review team assumed an average of 600 hrs of emergency diesel generator operation per year (for a total of 4 generators) and 200 hrs of station blackout diesel generator operation per year (total for 2 generators).

Given the various sources of CO_2 emissions discussed above, the review team estimates the total life CO_2 footprint for a reference 1000 MW(e) nuclear power plant to be about 18,000,000 metric tons. The components of the footprint are summarized in Table YYYY-3. The uranium fuel cycle component of the footprint dominates all other components. It is directly related to power generated. As a result, it is reasonable to use reactor power to scale the footprint to larger reactors.

In closing, the review team considers the footprint estimated in Table YYYY-3 to be appropriately conservative. The CO_2 emissions estimates for the dominant component (uranium fuel cycle) are based on 30 year old enrichment technology assuming that the energy required for enrichment is provided by coal-fired generation. Different assumptions related to the source of energy used for enrichment or the enrichment technology that would be just as reasonable could lead to a significantly reduced footprint.

Table YYYY-3. Nuclear Power Plant Lifetime Carbon Dioxide Footprint

Source	Activity Duration (yr)	Total Emissions (metric tons)
Construction Equipment	7	3.5×10^4
Construction Workforce	7	1.5×10^5
Plant Operations	40	1.9×10^5
Operations Workforce	40	1.3×10^5
Uranium Fuel Cycle	40	1.7×10^7
Decommissioning Equipment	10	1.8×10^4
Decommissioning Workforce	10	1.7×10^4
SAFSTOR Workforce	40	1.3×10^4
TOTAL		1.8×10^7

Emissions estimates presented in the body of this EIS have been scaled to values that are appropriate for the proposed project. The uranium fuel cycle emissions have been scaled by reactor power using the scaling factor determined in Chapter 6 and by the number of reactors to be built. Plant operations emissions have been adjusted to represent the number of large CO_2 emissions sources (diesel generators, boilers, etc.) associated with the project. The workforce emissions estimates have been scaled to account for differences in workforce numbers and commuting distance. Finally, equipment emissions estimates have been scaled by estimated equipment usage. As can be seen in Table YYYY-3, only the scaling of the uranium fuel-cycle emissions estimates makes a significant difference in the total carbon footprint of the project.

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