April 29, 2013

MEMORANDUM TO: Ryan Whited, Branch Chief
Environmental Technical Support Branch
Division of Site Safety and Environmental Analysis
Office of New Reactors

FROM: Stacey F. Imboden, Senior Project Manager ***/RA/***
Environmental Technical Support Branch
Division of Site Safety and Environmental Analysis
Office of New Reactors

SUBJECT: STAFF GUIDANCE TO SUPPORT ISG-026 ATTACHMENT 1 REGARDING GREENHOUSE GAS AND CLIMATE CHANGE IMPACTS FOR NEW REACTOR ENVIRONMENTAL IMPACT STATEMENTS

Enclosed is supplemental guidance for consideration of greenhouse gas emissions and treatment of climate change in the review of applications for new reactors and developing the staff's environmental impact statement. This guidance serves to support the Interim Staff Guidance (ISG-026 Attachment 1) regarding Greenhouse Gas and Climate Change Impacts for New Reactor Environmental Impact Statements. Changes from the previous guidance memo (ML110380369) include a revised generic carbon dioxide equivalent footprint for emissions from a reference nuclear power plant, revised template language, and an expanded discussion of climate change.

Enclosure: Staff Guidance to Support ISG-026 Attachment 1 Regarding Greenhouse Gas and Climate Change Impacts for New Reactor Environmental Impact Statements

CONTACT: Stacey Imboden, NRO/DSEA/RENV
301-415-2462

April 29, 2013

MEMORANDUM TO: Ryan Whited, Branch Chief
Environmental Technical Support Branch
Division of Site Safety and Environmental Analysis
Office of New Reactors

FROM: Stacey F. Imboden, Senior Project Manager ***/RA/***
Environmental Technical Support Branch
Division of Site Safety and Environmental Analysis
Office of New Reactors

SUBJECT: STAFF GUIDANCE TO SUPPORT ISG-026 ATTACHMENT 1 REGARDING GREENHOUSE GAS AND CLIMATE CHANGE IMPACTS FOR NEW REACTOR ENVIRONMENTAL IMPACT STATEMENTS

Enclosed is supplemental guidance for consideration of greenhouse gas emissions and treatment of climate change in the review of applications for new reactors and developing the staff's environmental impact statement. This guidance serves to support the Interim Staff Guidance (ISG-026 Attachment 1) regarding Greenhouse Gas and Climate Change Impacts for New Reactor Environmental Impact Statements. Changes from the previous guidance memo (ML110380369) include a revised generic carbon dioxide equivalent footprint for emissions from a reference nuclear power plant, revised template language, and an expanded discussion of climate change.

Enclosure: Staff Guidance to Support ISG-026 Attachment 1 Regarding Greenhouse Gas and Climate Change Impacts for New Reactor Environmental Impact Statements

CONTACT: Stacey Imboden, NRO/DSEA/RENV
301-415-2462

DISTRIBUTION:

JCushing	AKugler	MNotich
BHarvey	MWong	NMartinez
DLogan	RidsNroDsea	RidsOgcMailCenter
RidsNroDnrlEpb1 Distribution	RidsNroDnrlEpb2 Distribution	RidsNroDseaRenv Distribution

ADAMS ACCESSION NUMBER: ML12356A500 *** via email** **NRO-002**

OFFICE	PM/RENV/DSEA:NRO	LA/DNRL/NRO	RHMB/DSEA/NRO	OGC*	RENV/DSEA/NRO
NAME	SImboden	MBrown	BHarvey	JMartin	RWhited
DATE	4/29/2013	01/14/2013	1/25/2013	4/8/2013	4/11/2013

OFFICIAL RECORD COPY

Staff Guidance to Support ISG-026 Attachment 1 Regarding Greenhouse Gas and Climate Change Impacts for New Reactor Environmental Impact Statements

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 (EIS) for new reactor reviews (e.g., construction permits and operating licenses under 10 CFR Part 50; combined licenses, early site permits, and limited work authorizations under 10 CFR Part 52). A National Environmental Policy Act (NEPA) analysis is an 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 2009, two U.S. Nuclear Regulatory Commission (NRC or Commission) Atomic Safety Licensing Boards 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 (NRC 2009), the Commission provided guidance to the staff on addressing GHG issues in environmental reviews. The staff outlined its general plan for implementing the Commission's guidance in a memorandum from Mr. Michael R. Johnson, Director of the Office of New Reactors, to R. W. Borchardt, Executive Director for Operations, on January 15, 2010 (NRC 2010). The principal purpose of this supplemental guidance document for new reactor application reviews is to provide (1) the detailed analytical framework for consideration of GHG emissions and climate change 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 staff's general plan.

Additional information is provided in Attachment 1 of this memorandum to highlight 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.

GUIDANCE

Consideration of GHG emissions and climate change are not to be considered "new" components of the NEPA review for new reactor applications, but rather as important factors to be considered within the existing NEPA framework. While it may be appealing to draw specific attention to this 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.

With the purpose of informing decision-making, the Council on Environmental Quality (CEQ) proposed in its 2010 "Draft NEPA Guidance on Consideration of the Effects of Climate Change and Greenhouse Gas Emissions," 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 (CEQ 2010). CEQ recommends that GHG emissions can be used as a "proxy" for assessing climate change impacts. While the CEQ guidance is still in draft form, the NRC staff finds the proposed approach reasonable for assessing GHG emissions and climate change impacts in new reactor environmental reviews. Consequently, for new reactor licensing actions where an EIS is being prepared to fulfill its responsibilities under NEPA, the NRC staff should consider (1) the potential impacts of the proposed action on the environment due to GHG emissions 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 other words, consider the impact of the proposed action on the climate (through greenhouse gas emissions), and consider the changing climate's impact on the proposed action (through sea level rise, drought, etc.) In addition to the direct effects of the action, the NRC staff considers the indirect and cumulative effects of the proposed action. In considering the effects of climate change for new reactor applications, the NRC staff should consider changes in climate that may occur during the period of the proposed action on susceptible environmental resources such as air, water, and ecological resources, as well as human health issues.

In its February 18, 2010, guidance memo, CEQ suggests an indicator of 25,000 metric tons carbon dioxide (CO_2) equivalent annual emissions as the point at which Federal agencies should consider effects of these emissions in NEPA documents. The reference point of 25,000 metric tons CO_2 equivalent annual emissions may be a useful indicator, rather than an absolute standard of insignificant effects, for agencies' evaluation of GHG emissions in NEPA documents (CEQ 2010). The reference point 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, the 25,000 metric tons CO_2 equivalent annual emissions reference point is similar to the concept used in the "tailoring" rule (75 FR 31514), which requires new facilities with GHG emissions of 100,000 tons per year CO_2 equivalent and existing facilities making modifications that increase GHG emissions by 75,000 tons per year CO_2 equivalent to obtain a Prevention of Significant Deterioration permit.

The emissions of CO_2 equivalent resulting from the operation of a new reference 1000-MW(e) 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 10,000 metric tons annually (see Appendix A to Attachment 1 of ISG-026). Consequently, the issues do not require detailed atmospheric transport modeling, but can be expressed in terms of total emissions to the atmosphere and placed in context with other emission sources and statewide, national, or global emissions. 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. If the proposed reactor differs significantly from the reference 1000-MW(e) reactor discussed in Appendix A to Attachment 1 of ISG-026, a reviewer should consider whether a different analysis is needed.

As outlined in the NRC staff plan for implementing the Commission's guidance for considering GHG emissions and climate change (NRC 2010), the NRC Staff's review of impacts due to climate change will rely principally on the U.S. Global Change Research Program (GCRP) report (GCRP 2009). This report synthesizes the work of the Federal Government on climate change. The GCRP reports and peer-reviewed assessments from GCRP, such as *Global Climate Change Impacts in the United States* (http://www.globalchange.gov/publications/reports/scientific-assessments/us-impacts), were suggested as sources of the best scientific information available on the reasonably foreseeable climate change impacts in the 2010 CEQ Draft NEPA Guidance.

The GCRP 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 the GCRP report, the NRC staff should review such changes and determine if they warrant a change in regulatory guidance. Reviewers should also consider sources of climate change information on a local level in the project area. For example, a university may have performed climate change research at a regional or State level. The regional or State climate change trends could then be combined with the global or regional outlook in the GCRP or the Intergovernmental Panel on Climate Change (IPCC) reports. The staff should consider public comments received during the scoping and Draft EIS comment periods that may provide new sources of information on this subject.

The draft guidance from CEQ suggests 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). For NRC purposes, impacts of climate change on the safe design or safe operation of a new reactor are outside the scope of 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. Impacts of severe weather as a result of climate change (for example, flooding) are addressed in the safety review for the new reactor application according to Title 10 of the Code of Federal Regulations (CFR), Part 100 and General Design Criterion (GDC) 2 in Appendix A to 10 CFR Part 50. GDC 2, *"Design Bases for Protection Against Natural Phenomena,"* states that structures, systems, and components important to safety shall be designed to withstand the effects of natural phenomena such as earthquakes, tornadoes,

hurricanes, floods, tsunami, and seiches without loss of capability to perform their safety functions. 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 influence 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.

1.0 AFFECTED ENVIRONMENT

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 or "project period" [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 the discussion of affected environment and cumulative impacts. The affected environment discussion should focus on the project period and the cumulative effects discussion should focus on past, present and reasonably foreseeable future conditions. Past conditions would include historical trends in the project area.

Under the current organization of EISs for new reactor application reviews, the initial discussion of climate change effects is based on the historical record for the area being considered. Following this discussion, climate change in the affected environment section should cover the project period and resources that are likely to be impacted by climate change during this period. The project period should cover the planning horizon for the project, the project construction/preconstruction period, startup and operation.

The reviewer should recognize the uncertainty with predicting climate change effects in the short-term. The basis for projecting the changes from the existing environment to the reasonably foreseeable affected environment should be clear, including what would happen to cause the change in the future affected environment and the probability or likelihood of this occurring (CEQ 2010). Reviewers should also consider the particular impacts of climate change on vulnerable communities (CEQ 2010) (75 FR 8046). This could include Tribal and Alaska Native communities, communities using subsistence farming or fishing practices, or projects located in coastal areas that could be impacted by sea level rise.

Information regarding the estimated changes in climate conditions on a regional basis is provided in the GCRP report. A convenient source for this information is the Regional Climate Information tab from the GCRP 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 during the period of the proposed action. The EIS discussion of reasonably foreseeable future conditions should be commensurate in scope and depth with the discussion of current climate conditions.

Under the current organization of EISs for new reactor application reviews, the discussion of the past (historical trends), present and reasonably foreseeable future 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 length of time addressed in the cumulative impacts analysis may be out to the time of available scientific data on climate change as presented in the GCRP report. This timeframe could be longer than that discussed in the affected environment section.

Due to the uncertainty in linking a specific change in climate with a given year, it may not be possible for the cumulative impacts discussion to define a specific year as an endpoint for analysis.

When assessing the effects of climate change on a proposed action, an agency typically starts with an identification of the reasonably foreseeable future condition of the affected environment for the "no action" alternative based on available climate change information (CEQ 2010). The NRC staff finds this to be a logical approach that should be incorporated into new reactor environmental reviews. 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. Information regarding the estimated changes in climate conditions on a sector basis is provided in the GCRP report. A convenient source for this information is the Sectoral Climate Information tab from the GCRP home page (www.globalchange.gov); 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.

2.0 ENVIRONMENTAL CONSEQUENCES

2.1 Carbon Dioxide and Other Greenhouse Gas Emissions

The NRC staff already 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. This approach is 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 the following method to meet the purposes of its NEPA analysis.

In its periodic reports on the inventory of GHG emissions and sinks in the United States (U.S.), the U.S. Environmental Protection Agency (EPA) provides context for the contribution of GHG to "global warming potential" (GWP); these reports are available at www.epa.gov/climatechange/emissions. The GWP concept is a method developed by the IPCC to compare the ability of each greenhouse gas to trap heat in the atmosphere relative to another gas (EPA 2012a). Not all GHG species have an equal role in contributing to potential

environmental effects. The main GHG emissions associated with the combustion of fossil fuels in stationary combustion sources are carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O). The 100-year time horizon GWP for carbon dioxide is 1, for methane it is 21, and for nitrous oxide it is 310 (EPA 2012a). The GWP is much greater for most 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.

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. Water produced as a byproduct of combustion at low altitudes has a negligible contribution to climate change. The residence time of water vapor is very short (days) and the water content of the air in the long term is a function of temperature and partial pressure, with emissions playing a minimal role. Additionally, the radiative forcing of a given mass of water at low altitudes is much less than the same mass of carbon dioxide (74 FR 66496).

The largest source of U.S. GHG emissions, CO_2, from fossil fuel combustion has accounted for more than 78 percent of GWP-weighted emissions since 1990 and at an increasing pace, and transportation activities accounted for more than 30 percent of this total. In its 2010 inventory report (EPA 2012a), the 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 transport 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 the EPA's Mandatory Reporting of Greenhouse Gases rule (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)]. The EPA indicated that "… accurate and timely information on GHG emissions is essential for informing many future climate change policy decisions." Notably, one of the types of fuel combustion sources at an operating nuclear power plant, the emergency generator, is exempt from reporting requirements because "… the reporting of GHG emissions is unreasonable given the cost of monitoring and the relative level of GHG emissions." 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 is adopting the EPA practice of calculating "CO_2 equivalent

emissions." The EPA maintains a Greenhouse Gas Equivalencies Calculator and updates it periodically based on the inventories of GHG emissions and sinks discussed above. This is a useful tool where reviewers enter the quantity of GHG emissions, and the calculator converts the emissions to CO_2 equivalents. 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 equivalent factor changes based on updates of the inventories as the higher valued GWP GHG emissions are reduced.

2.2 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:

- the direct and indirect impacts of building the nuclear power plant, but not to the extent of considering the manufacturing of components;
- the direct and indirect impacts of operating the nuclear power plant;
- the indirect impacts of fuel cycle activities;
- the direct and indirect impacts of decommissioning the nuclear power plant;
- the incremental impacts of the proposed project within the analysis of cumulative impacts of other past, present and reasonably foreseeable activities;
- the comparison of the proposed project impacts at the proposed site to alternative energy source impacts that meet the purpose and need of the proposed action (i.e., baseload power generation); and
- 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.

Table S-3 did not consider CO_2 explicitly; however, 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 in Appendix A to Attachment 1 of ISG-026. Just as the NRC Staff includes Table S-3 in its EIS for a new reactor application, the NRC staff should reference the results of its generic analysis in an EIS for a new reactor application. The EIS should discuss why the generic analysis is appropriate for the proposed reactor design. If the applicant proposes a novel or unique reactor design, then it may be necessary to perform a different analysis.

To account for two units, for example, certain values, such as those for construction/preconstruction-related activities, should be doubled. To account for a higher power level or a different assumption regarding capacity factor, an appropriate multiplier should be used 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.

If an applicant provides its own GHG emission estimates in the ER, the reviewer should discuss both the applicant's GHG emissions estimates and the staff's GHG emission estimates scaled from the generic analysis in Appendix A to Attachment 1 of ISG-026, and discuss any uncertainty with regards to both estimates. Both the applicant's GHG emission estimates and the staff's GHG emission estimates will most likely conclude that the GHG emissions from building and operating the new unit(s) will be a small percentage of projected GHG emissions for the corresponding state and the United States.

2.3 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 Appendix A to Attachment 1 of ISG-026 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 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 with 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.). Table values, either reported or computed, and citations from applicant or other source documents are to reflect appropriate information consistent with the proposal.

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) for early site permits, a set of design 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 design 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.

If the project circumstances differ significantly from the assumptions made in Appendix A to Attachment 1 of ISG-026 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.

(a) Building Related Impacts

The recommended format and content should be similar to the following:

4.7 Meteorological and Air Quality Impacts

…

4.7.1 Construction and Preconstruction Activities

Development activities at the [site name] would result in temporary impacts on local air quality. Activities including earthmoving, concrete batch plant operation, and vehicular traffic generate fugitive dust (such as PM_{10} and $PM_{2.5}$). In addition, emissions from these activities would contain carbon monoxide, oxides of nitrogen, oxides of sulfur, and volatile organic compounds. As discussed in Section 2.9.2, [county name] County is an attainment area for all criteria pollutants for which National Ambient Air Quality Standards have been established (40 CFR Part 81). As a result, a conformity determination for direct and indirect emissions is not required (40 CFR Part 93). [Ensure that the region is in attainment and not a maintenance or non-attainment area; otherwise, refer to conformity guidance].

The State of [state name] regulates air quality through [regulation citation]. The applicant must obtain appropriate State permits for air emissions that will be generated during construction and preconstruction activities. Prior to beginning construction and preconstruction activities, [applicant name] stated that it would develop a [plan name] that implements requirements of [regulation]. This plan would describe the management controls and measures that [applicant name] 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 [site name] 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 [unit number(s)].

The [plan name] would also identify specific mitigation measures to control fugitive dust and other emissions in accordance with all applicable State and Federal permits and regulations. Section [section number] 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. Construction and preconstruction activities, such as operation of on-road construction vehicles, commuter vehicles, non-road construction equipment, marine engines, and locomotive engines would also result in greenhouse gas emissions, principally carbon dioxide (CO_2). Assuming a 7-yr period for construction and preconstruction activities and typical construction practices, the review team estimates that the total construction/preconstruction equipment GHG emission footprint for building [number] nuclear power plant(s) at the [site name] site would be of the order of [the total preconstruction/construction equipment value of 39,000 MT CO_2 equivalent from column 2 in Table A-1 of Appendix A to Attachment 1 of ISG-026 multiplied by the number of units to be built at the applicant's site; these emissions are more likely to be related to the amount of required terrain modification than to the size of a reactor] metric tons (an emission rate of about [previous value divided by 7 years] metric tons annually, averaged over the period of construction/preconstruction), as compared to a total [name of state] annual CO_2 emission rate of [latest estimate] (citation) and a total United States annual CO_2 emission rate of [latest estimate] (EPA citation). Appendix A to Attachment 1 of ISG-026 provides the details of the review team estimate for a reference 1000-MW(e) nuclear power plant. [If an applicant provides its own GHG emission estimates in the ER, the reviewer should discuss both the applicant's GHG emissions estimates and the staff's GHG emission estimates scaled from Appendix A to Attachment 1 of ISG-026.]

Based on its assessment of the relatively small construction equipment GHG footprint as compared to total [name of state] and 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 [applicant name] and its stated intent to conduct [for example: "all site preparation and construction/preconstruction activities in accordance with Federal, State, and local regulations [or in accordance with [list specific State agency regulation if one exists (if one does exist then you can list it and say that the "State of [state name] requires the Applicant" to perform these activities)]]"], the review team concludes that the impacts from [site name] Units [unit number(s)] construction and preconstruction activities on air quality would not be noticeable because appropriate mitigation measures would be adopted. [If applicable, state that the conclusion that impacts will not be noticeable is based on the use of best industry practices for reducing emissions.]

4.7.2 Transportation

In the ER, [applicant name] (citation) estimates the maximum workforce for proposed Units [unit number(s)] would be about [number of workers] workers and would exceed [number of workers] workers for about a [number of years]-yr period. Many of these workers would be doing shift work. [Applicant name] estimates that about [value] percent of the workforce would be in the first (day) shift, [value] percent would be in the second (swing), and the remaining [value] percent would be in the third (graveyard) shift (citation). The workforce needed to build Units [unit number(s)] [if at an existing site, "combined with the workforce needed for [plant name] Units [unit number(s)] (including during outage activities),"] would have a minimal impact on air quality from criteria pollutants.

The current primary access road to the [site name] site is a [type of road] 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. [Applicant name] (citation) has stated that a [name of traffic plan] traffic plan would be developed before building activities begin. [if at an existing site, "Among other things, the [name of traffic plan] traffic plan would specify separate plant entrances for the operations workforce for [site name] Units [unit number(s)] and the construction/preconstruction workforce for proposed Units [unit number(s)"]]. The [name of traffic plan] 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/preconstruction workers"].

Workforce transportation would also result in greenhouse gas emissions, principally carbon dioxide (CO_2). Assuming a 7-yr period for construction and preconstruction activities and a typical workforce, the review team estimates that the total workforce GHG emission footprint for building [number of units] nuclear power plant(s) at the [site name] site would be of the order of [the total preconstruction/construction workforce value of 43,000 MT CO_2 equivalent from column 2 in Table A-2 of Appendix A to Attachment 1 of ISG-026 multiplied by the number of units to be built at the applicant's site] metric tons (an emission rate of about [previous value divided by 7 years] metric tons annually, averaged over the period of construction/preconstruction); again this is compared to a total [name of state] annual CO_2 emission rate of [latest estimate] (citation) and a total United States annual CO_2 emission rate of [latest estimate] (U.S. EPA citation). Appendix A to Attachment 1 of ISG-026 provides the details of the review team estimate for a reference 1000-MW(e) nuclear power reactor. [If an applicant provides its own GHG emission estimates in the ER, the reviewer should discuss both the applicant's GHG emissions estimates and the staff's GHG emission estimates scaled from Appendix A to Attachment 1 of ISG-026.]

Based on its assessment of the relatively small construction and preconstruction workforce GHG footprint as compared to the [name of state] and United States annual CO_2 emissions, the review team concludes that the atmospheric impacts of greenhouse gases from workforce

transportation would not be noticeable and additional mitigation would not be warranted. Based on [applicant's] stated intent to develop a [plan name] 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 be minimal if the applicant's proposed mitigation measures are adopted.

4.7.3 Summary

The review team evaluated potential impacts on air quality associated with criteria pollutants and greenhouse gas emissions during [site name] site construction and preconstruction activities. The review team determined that the impacts would be minimal. On this basis, the review team concludes that the impacts of [site name] site development on air quality from emissions of criteria pollutants and GHG emissions during construction and preconstruction 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 [applicant name]'s commitments, would be warranted.

(b) Operations Related Impacts

The recommended format and content should be similar to the following:

5.7 Meteorological and Air Quality Impacts

5.7.1 Cooling System Impacts

…

5.7.2 Air Quality Impacts

5.7.2.1 Criteria Pollutants

Proposed Units [unit number(s)] at the [site name] 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 proposed cooling system natural draft cooling tower (NDCT) and the ultimate heat sink (UHS) mechanical draft cooling towers (MDCTs)"] would be the largest stationary sources of emissions that could affect air quality. Table 5-[Table Number] 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]. [Applicant name] has stated that air emissions sources would be managed in accordance with Federal, [state name], and local air quality control laws and regulations. (citation)

In its ER, [applicant name] briefly addresses fugitive dust during plant operations. [Applicant name] 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-[Table Number]. Anticipated Atmospheric Emissions Associated With Operation of [Site Name] Proposed Units [Unit Number(s)]

Source Category	Annual Emissions (tons/yr)					
	PM[(a)]	SO_X[(b)]	CO[(c)]	VOC[(d)]	NO_X[(e)]	CO_2[(f)]
[number] Standby diesel generators[(g)]	[value]	[value]	[value]	[value]	[value]	[value]
[number] Combustion turbine generators[(g)]	[value]	[value]	[value]	[value]	[value]	[value]
NDCT[(h)]	[value]	0	0	0	0	0
MDCT[(h)]	[value]	0	0	0	0	0

Source: [applicant citation]
(a) PM = particulate matter
(b) SO_X = oxides of sulfur
(c) CO = carbon monoxide
(d) VOC = volatile organic compounds
(e) NO_x = oxides of nitrogen
(f) CO_2 = carbon dioxide
(g) [list assumptions used; for example, "assumes 4 hours per month operation"]
(h) [list assumptions used; for example, "it was conservatively assumed that the NDCT and one of the two MDCTs would continuously operate for the entire year at the maximum water flow rate"]

As noted in Section 2.9, the [site name] site is in [county name] 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 [site name] site [ensure this is correct].

5.7.2.2 Greenhouse Gases

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 GHG footprint for actual plant operations of [plant name] Units [unit number(s)] for 40 years is on the order of [from Table A-3 of Appendix A to Attachment 1 of ISG-026, the plant operations value of 181,000 MT CO_2 equivalent plus the plant operations workforce value of 136,000 MT CO_2 equivalent, the sum of which is multiplied by the number of units] metric tons of CO_2 equivalent (an emission rate of about [previous value divided by 40 years] metric tons annually, averaged over the period of operation), as compared to a total [state name] annual CO_2 emission rate of [latest estimate] and a total United States annual CO_2 emissions rate of [latest estimate] (U.S. EPA citation). Periodic testing of [list highest contributor, for example, "diesel generators"] and workforce transportation account for about [value] percent of the total operational emissions. These estimates are based on GHG footprint estimates in Appendix A to Attachment 1 of ISG-026 and emissions data contained in the ER (citation). [If an applicant provides its own GHG emission estimates in the ER, the reviewer should discuss both the applicant's GHG emissions

estimates and the staff's GHG emission estimates scaled from Appendix A to Attachment 1 of ISG-026.]

The EPA promulgated the Prevention of Significant Deterioration (PSD) requirements and the Title V GHG Tailoring Rule on June 3, 2010 (75 FR 31514). This rule states that, among other items, new and existing sources not already subject to a Title V permit, or that have the potential to emit at least 100,000 tons/yr (or 75,000 tons/yr for modifications at existing facilities) CO_2 equivalent, will become subject to the PSD and Title V requirements effective July 1, 2011. The rule also states that sources with a potential to emit (PTE) below 50,000 tons/yr CO_2 equivalent will not be subject to PSD or Title V permitting before April 30, 2016. Note that using the emission factors presented in [application name] and assuming the standby diesel generators, auxiliary diesel generators, and fire pumps operate [500 or appropriate value] hr/yr each and the auxiliary boiler operates 8760 hr/yr, a combined CO_2 PTE of about [value] tons/yr was estimated. However, [site name] could be exempted from GHG-related PSD or a Title V permit if it is eligible and chooses to be considered a "synthetic minor" source, which could significantly reduce the PTE.

Based on its assessment of the relatively small plant operations GHG footprint as compared to the [state name] and 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.

5.7.3 Transmission Line Impacts

…

5.7.4 Summary of Meteorological and Air Quality Impacts

The review team evaluated potential impacts on air quality associated with criteria pollutants and greenhouse gas emissions from operating proposed [site name] Units [unit number(s)]. 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 [site name] Units [unit number(s)] on air quality from emissions of criteria pollutants, greenhouse gas emissions, cooling system emissions, and transmission-line impacts would be SMALL and no further mitigation would be warranted.

(c) Fuel cycle related impacts

The recommended format and content should be similar to the following:

[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

As indicated in Appendix A to Attachment 1 of ISG-026, the largest source of greenhouse gas emissions associated with nuclear power is from the fuel cycle, not operation of the plant. The largest source of greenhouse gases in the fuel cycle is production of electric energy and process heat from the combustion of fossil fuel in conventional power plants. This energy is used to power components of the fuel cycle such as the enrichment process.

Table S-3 in 10 CFR 51.51 presents data for evaluating the environmental effects of a reference 1000-MW(e) light-water-cooled nuclear power reactor resulting from the uranium fuel cycle. Table S-3 does not provide an estimate of GHG emissions associated with the uranium fuel cycle, but does state that 323,000 MW-hour is the assumed annual electric energy use associated with the uranium fuel cycle for the reference 1000-MW(e) nuclear power plant and this 323,000 MW-hour of annual electric energy is assumed to be generated by a 45-MW(e) coal-fired power plant burning 118,000 MT of coal. Table S-3 also assumes approximately 135,000,000 standard cubic feet (scf) of natural gas is also required per year to generate process heat for certain portions of the uranium fuel cycle.

The NRC used these fossil fuel use assumptions presented in Table S-3 to estimate that the GHG footprint of the fuel cycle to support a reference 1000-MW(e) LWR with an 80 percent capacity factor for a 40-year operational period is on the order of 10,100,000 metric tons of CO_2 equivalent . Scaling this footprint to the power level and capacity factor of [site name] Units [unit number(s)], the review team estimates the GHG footprint for 40 years of fuel cycle emissions to be [10,100,000 metric tons of CO_2 equivalent from Table A-3 of Appendix A to Attachment 1 of ISG-026 multiplied by the scaling factor] [ensure scaling factor is appropriate for project] metric tons of CO_2 equivalent. This rate of GHG production equals [previous value divided by 40 years] MT of CO_2 equivalent per year, less than [annual value divided by state annual value multiplied by 100] percent of [state's] annual CO_2 emissions rate and [annual value divided by U.S annual value multiplied by 100] percent of the total United States annual CO_2 emissions rate of [latest estimate] (EPA citation).

The largest use of electricity in the fuel cycle comes from the enrichment process. The development of Table S-3 assumed that gaseous diffusion process is used to enrich uranium. Recent applications for new uranium enrichment facilities indicate that gas centrifuge and laser separation technologies are likely to eventually replace gaseous diffusion technology for uranium enrichment in the United States. The same amount of enrichment from gas centrifuge and laser separation facilities is likely to use significantly less electricity and therefore result in lower amounts of air emissions such as carbon dioxide than a gaseous diffusion facility. In addition, U.S. electric utilities have begun to switch from coal to cheaper, cleaner- burning natural gas, therefore the Table S-3 assumption that a 45-MW(e) coal-fired plant is used to generate the 323,000 MW-hour of annual electric energy for the uranium fuel cycle also results in conservative air emission estimates. Therefore, the NRC staff concludes that the values for electricity use and air emissions in Table S-3 continue to be appropriately bounding values.

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.

6.2 Transportation Impacts

…

6.3 Decommissioning Impacts

….

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 [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 [reactor type].

The GEIS-DECOM does not specifically address the GHG 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 greenhouse gas footprint of decommissioning to be of the order of [27,000 MT CO_2 equivalent (sum of the decommissioning equipment and decommissioning workforce emissions presented in Table A-3 of Appendix A to Attachment 1 of ISG-026) multiplied by the ratio of reactor output /1000-MW(e) reference reactor and the number of units] metric tons CO_2 equivalent without SAFSTOR. The contributions to this footprint are about one third from decommissioning workforce transportation and two thirds from equipment usage. The details of the NRC staff's estimate are presented in Appendix A to Attachment 1 of ISG-026. A 40-yr SAFSTOR period would increase the GHG footprint of decommissioning by about 40 percent. These greenhouse gas footprints are roughly almost three orders of magnitude lower than the greenhouse gas 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:

….

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

…

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.

(d) Cumulative Impacts

The recommended format and content should be similar to the following:

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 U.S. Global Change Research Program (GCRP) (2009), 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 (GCRP 2009).

Greenhouse gas emissions associated with building, operating, and decommissioning a nuclear power plant is addressed in Sections 4.7, 5.7, 6.1.3, and 6.3. The review team has concluded that the atmospheric impacts of the emissions associated of each aspect of building, operating and decommissioning a single plant would be minimal. The review team also concluded that the impacts of the combined emissions for the full plant life cycle would be minimal.

It is difficult to evaluate cumulative impacts of a single source or combination of GHG emission sources because:

- The impact is global rather than local or regional;
- The impact 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-[Table Number].

Table 7-[Table Number]. Comparison of Annual Carbon Dioxide Emission Rates

Source	Metric Tons per Year[(a)]
Global Emissions from Fossil Fuel Combustion (2009)[(b)]	30,300,000,000
United States Emissions from Fossil Fuel Combustion (2010)[(c)]	5,400,000,000
[State where action occurs] Emissions from Power Production (2010) [(d)]	[value]
1000-MW(e) Nuclear Power Plant (including fuel cycle, 80 percent capacity factor)[(e)][author may want to scale value to higher capacity factor, if so, note in footnote]	260,000
1000-MW(e) Nuclear Power Plant (operations only)[(e)]	4,500
Average U.S. Home[(f)]	12
Average U.S. Passenger Vehicle[(f)]	5

(a) Nuclear power emissions estimates are in units of MT CO_2 equivalent whereas the other energy alternatives emissions estimates are in units of MT CO_2. If nuclear power emissions were represented in MT CO_2, the value would be slightly less, as other GHG emissions would not be included.
(b) Source: (EPA 2012a), Chapter 3, expressed in metric tons per year of CO_2
(c) Source: (EPA 2012a), Table 3-1, expressed in metric tons per year of CO_2
(d) Source: EPA's GHG Reporting Program, expressed in metric tons per year of CO_2-eq
(e) Source: Appendix A to Attachment 1 of ISG-026, expressed in metric tons per year of CO_2-eq
(f) Source: (EPA 2012b), expressed in metric tons per year of CO_2

[Discuss GHG emissions and sinks in U.S. – reference the latest EPA report on U.S. Inventory of GHG Emissions and Sinks]

[Discuss GHG emissions and sinks in state where action will occur- use EPA'S GHG Reporting Program (GHGRP) website to access this information (http://ghgdata.epa.gov/ghgp/main.do). According to the EPA, GHGRP collects annual GHG data from facilities that directly emit large amounts of GHGS and from suppliers of certain fossil fuels and industrial gases.]

[Discuss impacts on GHG emissions from preconstruction, construction, operation, and decommissioning of proposed new reactor.]

In summary, over the lifespan of preconstruction, construction, operation, and decommissioning of the proposed [nuclear plant], the uranium fuel cycle phase was projected to generate the highest emissions (see Appendix A to Attachment 1 of ISG-026). These direct emissions would be about [value] percent of [state where action will occur] GHG emissions in [year of most

recent data for state] and [value] percent of U.S. GHG emissions in [year] (the most recent publicly reviewed data).

The applicant should consider measures that would reduce GHG emissions. These could include, but would not necessarily be limited to, energy-efficient design features and features to reduce space heating and air conditioning energy requirements, use of renewable energy sources, use of low-GHG-emitting vehicles, and other policies to reduce GHG emissions from vehicle use, such as anti-idling policies and van- or carpooling.

Evaluation of cumulative impacts of greenhouse gas emissions requires the use of a global climate model. The GCRP report referenced above (GCRP 2009) 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 primarily on the scientific assessments of the GCRP and National Research Council, the EPA Administrator issued a determination in 2009 (74 FR 66496) that greenhouse gases in the atmosphere may reasonably be anticipated to endanger public health and welfare, based on observed and projected effects of GHGs, their impact on climate change, and the public health and welfare risks and impacts associated with such climate change. Based on the impacts set forth in the GCRP report, and the CO_2 emissions criteria in the final EPA CO_2 Tailoring Rule (75 FR 31514), the review team concludes that the national and worldwide cumulative impacts of greenhouse gas emissions are noticeable but not destabilizing. The review team found that major attributes of the environment may be noticeably affected by GHG emissions, but not destabilized, based on the tailored approach to addressing CO_2 emissions in the EPA Tailoring Rule and the EPA Administrator's determination, neither of which call for immediate action such as closure of GHG-emitting facilities. Therefore, national and worldwide cumulative impacts of GHG emissions reflect conditions within the MODERATE impact level for air quality related to GHG emissions, 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. Section 9.2.5 contains a comparison of carbon footprints of the viable energy alternatives.

7.6.3 Summary of Air Quality Impacts

Cumulative impacts to air quality resources are estimated based on the information provided by [applicant name] and on the review team's independent evaluation. Other past, present and reasonably foreseeable activities exist in the geographic areas of interest (local and regional for criteria pollutants and global for GHG emissions) that could affect air quality resources. The cumulative impacts on criteria pollutants from emissions of effluents from the [site name] 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)"]. [Site name] and other projects listed in Table 7-[Table Number] would have minimal impact. 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 [site name] 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 for criteria pollutants and MODERATE for GHGs [this is a nationwide conclusion based on the U.S. EPA's endangerment finding]. The incremental contribution of impacts on air quality resources from building and operating proposed Units [unit number(s)] would be SMALL. The incremental contribution of impacts on air quality resources from the NRC-authorized activities would also be SMALL.

(e) Alternative Energy Sources

The recommended format and content should be similar to the following:

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), [applicant name] assumed a coal-fired plant design that would minimize air emissions through a combination of boiler technology and post combustion pollutant removal. [Applicant name] estimated that annual emissions for a supercritical pulverized coal-fired generation alternative using sub-bituminous coal would be approximately as follows (citation) [obtain the following estimates from the applicant's ER]:

- SO_2 – [value] tons/yr
- NO_X – [value] tons/yr
- CO – [value] tons/yr
- PM_{10} – [value] tons/yr
- $PM_{2.5}$ – [value] tons/yr
- Mercury – [value] tons/yr.

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

The review team determined the preceding emission estimates are reasonable [insert basis for conclusion, such as "because emissions are comparable to typical coal-fired power plant emissions"]. A new coal-fired plant at the [site name] site would also have approximately [value] tons/yr of carbon dioxide emissions (citation) that could affect climate change [obtain this estimate from the applicant's ER].

The acid rain requirements of the Clean Air Act capped the nation's SO_2 emissions from power plants. [Applicant name] 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 [site name] site would qualify as a new major source of criteria pollutants and would therefore need a prevention of significant deterioration (PSD) permit and an operating permit from the [state permitting authority]. A new coal-fired generation plant would also be subject to the new source performance standards for such plants in 40 CFR 60, Subpart Da. These regulations establish emission limits for particulates, opacity, SO_2, NO_X, and mercury. The [site name] site is in an area designated as in attainment or unclassified for criteria pollutants (40 CFR 81). [Confirm status of site attainment designations.] Fugitive dust emissions from construction activities would be mitigated using best management practices (BMPs); such emissions would be temporary (citation). The U.S. 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. [Discuss recent regulatory actions that could impact coal fired power plants, such as EPA proposed limits on CO_2 emissions or the Clean Air Interstate Rule.]

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. The closest mandatory Class I Federal areas to the [site name] site are [list areas with distances and discuss possible impacts].

Historically, CO_2, an unavoidable byproduct of combustion of carbonaceous fuels, has not been regulated as a pollutant. However, regulations are now under development for CO_2 and other GHGs. In response to the Consolidated Appropriations Act of 2008 (Public Law 110-161), the U.S. EPA promulgated final mandatory GHG reporting regulations in October 2009, effective in December 2009 (74 FR 56260). The rules are applicable to major sources of CO_2 (those emitting greater than 25,000 tons/yr). New utility-scale coal-fired power plants would be subject to those regulations.

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 [unit number(s)]. Such emissions would be temporary. A new coal-fired generation plant would qualify as a major generator of GHGs under the "Tailoring Rule" recently promulgated by the U.S. EPA (75 FR 31514). Beginning January 2, 2011, operating permits issued to major sources of GHG under the PSD or Title V Federal permit programs must contain provisions

requiring the use of best available control technology (BACT) to limit the emissions of GHGs if those sources would be subject to PSD or Title V permitting requirements because of their non-GHG pollutant emission potentials and if their estimated GHG emissions are at least 75,000 tons/yr of CO_2 equivalent. The amount of CO_2 released per unit of power produced would depend on the quality of the fuel and the firing conditions and overall firing efficiency of the boiler. Meeting permit limitations for GHG emissions may require installation of carbon capture and sequestration (CCS) devices on any new coal-fired power plant, which could add substantial power penalties. However, the review team recognizes that the environmental impacts of air emissions from the coal-fired plant would be significantly greater than those from [site name], even after application of any new GHG emissions standards.

The GEIS for license renewal considers global warming from 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 [site name] 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. In its environmental report (ER), [applicant name] estimated that a natural gas-fired plant equipped with pollution control technology to meet emission limits would have approximately the following emissions [obtain the following estimates from the applicant's ER]:

- SO_2 – [value] tons/yr
- NO_x – [value] tons/yr
- CO – [value] tons/yr
- PM_{10} – [value] tons/yr
- $PM_{2.5}$ – [value] tons/yr

The review team determined the preceding emission estimates are reasonable [insert basis for conclusion, such as "because emissions are comparable to typical natural gas-fired power plant emissions"]. A natural gas-fired power plant would also have approximately [value] tons/yr of carbon dioxide emissions that could affect climate change (citation) [obtain this estimate from the applicant's ER].

A new natural gas-fired power generation plant at the [site name] would likely qualify as a new major source of criteria pollutants and would therefore need a PSD permit and an operating permit from the [state regulatory authority]. A new natural gas-fired combined-cycle plant would also be subject to the new source performance standards for such plants in 40 CFR 60, Subparts Da and GG. These regulations establish emission limits for particulates, opacity, SO_2, and NO_X. The [site name] site is in an area designated as in attainment or unclassified for criteria pollutants (40 CFR 81) [confirm status of site attainment designations]. 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 combustion turbine portion of the combined-cycle plant would be subject to the U.S. 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)).

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. The closest mandatory Class I Federal areas to the [site name] site are [list areas with distances and discuss possible impacts].

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 [unit number(s)]. Such emissions would be temporary.

Historically, CO_2, an unavoidable byproduct of combustion of carbonaceous fuels, has not been regulated as a pollutant. However, regulations are now under development for CO_2 and other GHGs. In response to the Consolidated Appropriations Act of 2008 (Public Law 110-161), the U.S. EPA promulgated final mandatory GHG reporting regulations in October 2009, effective in December 2009 (74 FR 56260). The rules are applicable to major sources of CO_2 (those emitting greater than 25,000 tons/yr). New utility-scale natural gas-fired power plants would be subject to those regulations.

A new natural gas-fired generation plant would qualify as a major generator of GHGs under the "Tailoring Rule" recently promulgated by the U.S. EPA (75 FR 31514). Beginning January 2, 2011, operating permits issued to major sources of GHG under the PSD or Title V Federal permit programs must contain provisions requiring the use of BACT to limit the emissions of

GHGs if those sources would be subject to PSD or Title V permitting requirements because of their non-GHG pollutant emission potentials and if their estimated GHG emissions are at least 75,000 tons/yr of CO_2 equivalent. Meeting permit limitations for GHG emissions may require installation of CCS devices on any new natural gas-fired power plant, which could reduce power output. However, the review team recognizes that the environmental impacts of air emissions from the natural gas-fired plant would be significantly greater than those from [site name], even after application of any new GHG emissions standards.

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 [site name] site would be SMALL to MODERATE.

9.2.3 Other Alternatives

…

9.2.4 Combination of Alternatives

…

9.2.5 Summary Comparison of Alternatives

The GHG emissions for the proposed action and energy generation alternatives are discussed in Sections 5.7.2, 9.2.2.1, 9.2.2.2, and 9.2.4. Table 9-[Table Number] 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 [if the proposed project considers the use of small modular reactors, this table may need to be expanded to include estimates for CO_2 emissions from other energy sources that may be considered to be viable, such as wind, solar, and hydropower]. 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. [This statement may need to be modified if renewable energy sources, such as wind, solar, and hydropower, are also considered to be 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 [from Appendix A to Attachment 1 of ISG-026, sum of operations plus operations workforce emissions multiplied by number of units, plus fuel cycle emissions multiplied by scaling factor]. This number is still significantly lower than the emissions for the other viable alternatives. [Again, this statement may need to be modified if renewable energy sources, such as wind, solar, and hydropower, are also considered to be viable energy generation alternatives.]

On June 3, 2010, the EPA issued a rule tailoring the applicability criteria that determines which stationary sources and modifications to existing projects become subject to permitting requirements for greenhouse gas (GHG) emissions under the Prevention of Significant Deterioration (PSD) and Title V programs of the Clean Air Act (75 FR 31514). According to

source permitting program if the source (1) is otherwise subject to PSD (for another regulated NSR pollutant) and (2) has a GHG potential to emit equal to or greater than 75,000 tons per year of CO_2 equivalent, such sources would be subject to best available control technology (BACT). The use of BACT has the potential to reduce the amount of GHGs emitted from stationary source facilities. The implementation of this rule could reduce the amount of GHGs from the values indicated in Table 9-[table number] for coal and natural gas, as well as from other alternative energy sources that would otherwise have appreciable uncontrolled GHG emissions. The GHG emissions from the production of electricity from a nuclear power source are primarily from the fuel cycle and such emissions could be reduced further if the electricity from the assumed fossil fuel source powering the fuel cycle is subject to BACT controls.

The emission of GHGs from the production of electrical energy from a nuclear power source is orders of magnitude less than those of the reasonable alternative energy sources. Accordingly, the comparative relationship between the energy sources listed in Table 9-[table number] would not change meaningfully, even if possible reductions to the GHG emissions from the nuclear fuel cycle are ignored, because GHG emissions from the other energy source alternatives would not be sufficiently reduced to make them environmentally preferable to the proposed project. [This paragraph may need to be modified if renewable energy sources, such as wind, solar, and hydropower, are also considered to be viable energy generation alternatives.]

Although several of the renewable energy generation alternatives discussed in Section 9.2.3, such as wind power, solar power, hydropower, geothermal energy, biomass-derived fuels, and fuel cells, were determined not to meet the purpose and need for the proposed action, the review team compared the GHG emissions from energy generation technologies powered by renewable resources with those powered by nuclear power and fossil fuel-based resources in order to provide a comprehensive comparison of GHG emissions. The IPCC released a special report on renewable energy sources and climate change mitigation in 2012 (IPCC 2011). Annex II of the IPCC report includes a synopsis of previously published works on lifecycle assessments (LCAs) of GHG emissions from various electric generation technologies, including nuclear power, fossil fuels, and renewable energy. The IPCC report included in its assessment only studies that passed certain screening criteria for quality and relevance and reported its finding in terms of GHG emissions normalized per unit of electrical output (g CO_2 equivalent per kWh). Numerous estimates of LCAs of GHG emissions were reported for each energy generation technology, many of which represented multiple scenarios that in several cases ranged at least one order of magnitude. The 50^{th} percentile value for each energy generation technology is presented in Table 9-[Table Number]. Lifecycle GHG emissions from technologies powered by renewable resources were generally found to be considerably less than those powered by fossil fuel-based resources and similar to nuclear power.

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) [this sentence may need to be modified if renewable energy sources, such as wind, solar, and hydropower, are also considered to be viable energy generation alternatives]. Consequently, the review team concludes that the proposed action

results in the lowest level of emissions of greenhouse gases among the viable alternatives [this sentence may also need to be modified if renewable energy sources, such as wind, solar, and hydropower, are also considered to be viable energy generation alternatives].

Table 9-[Table Number]. Comparison of Direct Carbon Dioxide Emissions for Energy Alternatives [only include alternatives that meet project purpose and need]

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

(a) Nuclear power emissions estimates are in units of MT CO_2 equivalent whereas the other energy alternatives emissions estimates are in units of MT CO_2. If nuclear power emissions were represented in MT CO_2, the value would be slightly less, as other GHG emissions would not be included.
(b) From Section 5.7.2 [operations value (not including operations workforce) multiplied by number of units]
(c) From Section 9.2.2.1
(d) From Section 9.2.2.2
(e) From Section 9.2.4 (assuming only natural gas generation has significant CO_2 emissions)

Table 9-[Table Number] Lifecycle Assessment of GHG Emissions from Electricity Generation Technologies[(a)]

Energy Source	LCA (g CO_2eq/kWh) 50th percentile
Biopower	18
Coal (without CCS)	1001
Coal (with CCS)[(b)]	247
Geothermal	45
Hydropower	4
Natural Gas (without CCS)	469
Natural Gas (with CCS)[(b)]	155
Nuclear [(c)]	16
Solar (photovoltaic)	46
Solar (concentrating solar power)	22
Wind	12

(a) Source: (IPCC 2011), Table A.II.4.

(b) The listed CCS values for coal and natural gas are the mean values between the minimum CCS value and maximum CCS value.

(c) For comparison, the review team derived a LCA value of 37.5 g CO_2 equivalent per kWh for nuclear energy as described in Appendix A to Attachment 1 of ISG-026.

(f) Alternative Sites

The recommended format and content should be similar to the following:

9.3 Alternative Sites

…

9.3.1 Alternative Site [Site Name] [Repeated as often as needed and peculiarized for the Alternative Site circumstances]

…

9.3.3.1 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-[Table Number]. The geographic area of interest for the [alternative site name] site is [county name] County, which is in the [air quality control region name] Air Quality Control Region (40 CFR citation).

The emissions related to building and operating a nuclear power plant at the [alternative site name] alternative site would be similar to those at the [applicant's site name] site. The air quality attainment status for [county name] County, as set forth in 40 CFR 81, reflects the effects of past and present emissions from all pollutant sources in the region. [County name] County is not out of attainment of any National Ambient Air Quality Standard. [Confirm status of site attainment designations.]

The atmospheric emissions related to building and operating a nuclear power plant at the [applicant's site name] site in [county name] 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 [applicant's site name] site were evaluated and also determined to be ["SMALL" if no other major emitters or "MODERATE 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-[Table Number], the most significant are [name(s) of significant projects where, for illustrative purposes, the first project listed is assumed to be a coal-fired plant and the second project listed is assumed to be a natural gas-fired plant]. Effluents from power plants such as these are typically released through stacks and with significant vertical velocity. Other industrial projects listed in Table 9-[Table Number] 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 [alternative site name] 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 [alternative site name] site, result in degradation of air quality in the region. Releases from operation of [number of units] units at the [alternative site name] would be intermittent and made at low levels with little or no vertical velocity. The air quality impacts of the [name of first significant emissions-contributing project] are included in the baseline air quality status. The air quality impacts of the [name of second significant emissions-contributing project] 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 [alternative site name] site and the aforementioned sources could be noticeable but not destabilizing.

The cumulative impacts of GHG emissions related to nuclear power are discussed in Section 7.6. The impacts of the emissions are not sensitive to location of the source. Consequently, the discussion in Section 7.6 is applicable to a nuclear power plant located at the [alternative site name] 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 GHG emissions of the project at the [alternative site name] site.

Cumulative impacts to air quality resources are estimated based in the information provided by [applicant name] 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 [alternative site name] site, other projects, and the [name of first significant project] and the [name of second significant project] could be noticeable but not destabilizing, principally as a result of the contribution of these two sources.

The EPA Administrator issued a determination in 2009 (74 FR 66496) that greenhouse gases in the atmosphere may reasonably be anticipated to endanger public health and welfare, based on observed and projected effects of GHGs, the impact on climate change, and the public health and welfare risks and impacts associated with such climate change. Therefore, national and worldwide cumulative impacts of GHG emissions reflect conditions within the MODERATE impact level for air quality related to GHG emissions, 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 [alternative site name] 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 [number of units] units at the [alternative site name] site would be insignificant for both criteria pollutants and greenhouse gas emissions.

REFERENCES

10 CFR Part 50. Code of Federal Regulations, Title 10, *Energy,* Part 50, "Domestic Licensing of Production and Utilization Facilities."

10 CFR Part 51. Code of Federal Regulations, Title 10, *Energy,* Part 51, "Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions."

10 CFR Part 100. Code of Federal Regulations, Title 10, *Energy*, Part 100, "Reactor Site Criteria."

40 CFR Part 50. Code of Federal Regulations, Title 40, *Protection of Environment*, Part 50, "National Primary and Secondary Ambient Air Quality Standards."

40 CFR Part 51. Code of Federal Regulations, Title 40, *Protection of Environment*, Part 51, "Requirements for Preparation, Adoption, and Submittal of Implementation Plans."

40 CFR Part 60. Code of Federal Regulations, Title 40, *Protection of Environment*, Part 60, "Standards of Performance for New Stationary Sources."

40 CFR Part 63. Code of Federal Regulations, Title 40, *Protection of Environment*, Part 63, "National Emission Standards for Hazardous Air Pollutants for Source Categories."

40 CFR Part 81. Code of Federal Regulations, Title 40, *Protection of Environment*, Part 81, "Designation of Areas for Air Quality Planning Purposes."

40 CFR Part 93. Code of Federal Regulations, Title 40, *Protection of Environment*, Part 93, "Determining Conformity of Federal Actions to State or Federal Implementation Plans."

74 FR 56260. October 30, 2009. "Mandatory Reporting of Greenhouse Gases." *Federal Register*. U.S. Environmental Protection Agency.

74 FR 66496. December 15, 2009. "Endangerment and Cause or Contribute Findings for Greenhouse Gases Under Section 202(a) of the Clean Air Act." *Federal Register*. U.S. Environmental Protection Agency.

75 FR 31514. June 3, 2010. "Prevention of Significant Deterioration and Title V Greenhouse Gas Tailoring Rule." *Federal Register*. U.S. Environmental Protection Agency.

Clean Air Act. 42 USC 7401, *et seq*.

Council on Environmental Quality (CEQ). 2010. Draft NEPA Guidance on Consideration of the Effects of Climate Change and Greenhouse Gas Emissions. February 18, 2010. Accession No. ML12333A340.

HYPERLINK "http://www.epa.gov/climatechange/Downloads/ghgemissions/US-GHG-Inventory-2012-Upfront.pdf" U.S. Environmental Protection Agency (EPA). 2012a . *Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2010.* EPA 430-R-12-001.

HYPERLINK "https://adamsxt.nrc.gov/WorkplaceXT/IBMgetContent?vsId=%7b26DB19E6-1E69-481F-9DBC-3CF7B425573E%7d&objectType=document&id=%7b03A8E0D1-BF40-4E44-8712-99CA6ED6E5D4%7d&objectStoreName=Main.__.Library" U.S. Environmental Protection Agency (EPA). 2012b. Calculations and References. *Clean Energy.* Accessed October 10, 2012 at http://www.epa.gov/cleanenergy/energy-resources/refs.html. Accession No. ML12292A648.

HYPERLINK "http://globalchange.gov/publications/reports/scientific-assessments/us-impacts/full-report" U.S. Global Change Research Program (GCRP). 2009 . *Global Climate Change Impacts in the United States.* T. R. Karl, J. M. Melillo, and T. C. Peterson, eds. Cambridge University Press, New York, New York. Available at http://downloads.globalchange.gov/usimpacts/pdfs/climate-impacts-report.pdf.

HYPERLINK "http://srren.ipcc-wg3.de/report" Intergovernmental Panel on Climate Change (IPCC). 2011 . *IPCC Special Report on Renewable Energy Sources and Climate Change Mitigation.* Prepared by Working Group III of the Intergovernmental Panel on Climate Change. Cambridge, United Kingdom and New York, NY, USA : Cambridge University Press. p. 1075 pp.

HYPERLINK "http://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr1437/" U. S. Nuclear Regulatory Commission (NRC). 1996 . *Generic Environmental Impact Statement for License Renewal of Nuclear Plants.* NUREG-1437, Washington, D.C.

HYPERLINK "http://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr0586/" U. S. Nuclear Regulatory Commission (NRC). 2002. *Generic Environmental Impact Statement on Decommissioning of Nuclear Facilities.* NUREG-0586, Supplement 1, Washington, D.C.

HYPERLINK "https://adamsxt.nrc.gov/WorkplaceXT/IBMgetContent?vsId=%7b490F396F-B941-42C9-B0FA-CC36CC86D68C%7d&objectStoreName=Main.__.Library&objectType=document&id=%7b6C95C627-747B-4179-8B9D-EB4A33480531%7d" U.S. Nuclear Regulatory Commission (NRC). 2009: U.S. Nuclear Regulatory Commission (NRC), Memorandum and Order (CLI-09-21) In the Matter of Duke Energy Carolinas, LLC, and Tennessee Valley Authority. (Combined License Application for Williams States Lee III Nuclear Station, Units 1 and 2 and Bellefonte Nuclear Power Plant, Units 3 and 4), November 3, 2009. Docket Nos. 52-014-COL, 52-015-COL, 52-018-COL, 52-019-COL. Accession No. ML093070689.

HYPERLINK "https://adamsxt.nrc.gov/WorkplaceXT/IBMgetContent?vsId=%7b0F96F573-2388-4698-8C11-E8F81131BE39%7d&objectStoreName=Main.__.Library&objectType=document&id=%7b13BBE0CD-3681-4B34-B102-F8DFDCFDA4CE%7d" U.S. Nuclear Regulatory Commission (NRC). 2010: Memorandum from Michael Johnson to R.W. Borchardt. Subject: “Consideration of

Certain Environmental Impacts Relevant to Greenhouse Gas Emissions." January 15, 2010. Accession No. ML093520734.

Attachment 1

Additional Background Information

PROPOSED ACTION

The U.S. Nuclear Regulatory Commission's (NRC or Commission) 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 Title 10 of the *Code of Federal Regulations* (CFR), Part 51.20(b)(2), the issuance of an operating license or COL requires the preparation of an environmental impact statement (EIS). Other new reactor application reviews such as construction permits, early site permits and limited work authorizations [10 CFR 51.20(b)(1)], also require the preparation of an EIS. The Environmental Standard Review Plan (ESRP) (NUREG-1555) 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 (NRC 2009), 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 [National Environmental Policy Act] 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 a memorandum from M. Johnson to R. Borchardt on January 15, 2010 (NRC 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 [greenhouse gas] 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 greenhouse gas (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 her Endangerment and Cause or Contribute Findings for Greenhouse Gases Under Section 202(a) of the Clean Air Act (74 FR 66496):

> *… 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 the National Environmental Policy Act (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" (CEQ, 2010). 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.*

The 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.*