Entergy Corporation

Greenhouse Gas Verification Report

2009 Greenhouse Gas Inventory

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Prepared for
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1. Verification Summary

Based on its review of Entergy's 2009 GHG emissions inventory, ICF International (ICF), in cooperation with Cventure LLC, has verified the information submitted by Entergy as being consistent with its emissions methodology and reporting guidance. This guidance is contained in the Entergy Corporation Greenhouse Gas Inventory Management Plan (IMP), the latest version dated August 2009. ICF found that the 2009 inventory conforms to generally accepted greenhouse gas (GHG) accounting standards, in particular the WRI/WBCSD GHG Protocol, Corporate Accounting and Reporting Standard (2004). The emission estimates were calculated in a consistent and transparent manner and were found to be a fair and accurate representation of Entergy Corporation's actual emissions and were free from material misstatement. ICF identified several minor, immaterial discrepancies in Entergy's greenhouse gas inventory which were corrected by Entergy during the course of the verification. ICF has verified a total of 42,866,756 metric tons of CO_2 equivalent (CO_2e) emissions.

2. Emissions Inventory

Entity Name: Entergy Corporation

Company address: 639 Loyola Avenue, New Orleans, Louisiana 70113

Entity Contact and Inventory Preparer: Rick Johnson

Verification Statement Prepared by: Craig Ebert and Khalid Husain, ICF International; Kevin Johnson, Cventure LLC.

This verification statement pertains to the greenhouse gas emissions inventory prepared by Entergy Corporation for calendar year 2009 (January 1st, 2009 – December 31st, 2009). This emissions inventory uses an equity share approach to establishing boundaries and includes the following emissions sources:

Scope 1**:** Stationary combustion in electric generating units and small sources at company facilities; mobile combustion in company fleet vehicles, fugitive methane from natural gas transmission systems, fugitive SF_6 from electric power transmission and distribution systems, and fugitive HFCs from building HVAC systems, district cooling operations, and vehicle air conditioning systems.

Scope 2: Indirect emissions associated with both contract and spot market purchased electricity.

Scope 3: Purchased electricity for resale to end-users.

Emissions associated with electricity used in Entergy facilities are accounted for within stationary combustion emissions. Emissions associated with line losses in electric power transmission and distribution systems are included within the stationary combustion and purchased electricity emissions.

The inventory includes the following greenhouse gases: CO_2, CH_4, N_2O, SF_6, and HFCs.

All electricity consumed in the operation of generating plants and consumed in Entergy's various administrative and commercial buildings and operations are accounted for in Entergy's direct emissions for stationary combustion. The GHG emissions resulting from the full life cycle of the various fuel sources are not included in the inventory.

3. Greenhouse Gas Management Plan and Inventory Methodology

This verification draws upon the Entergy document *Greenhouse Gas Inventory Management Plan (IMP)*, originally developed by Entergy in July 2005 with input and review from EPA Climate Leaders and most recently updated in August 2009.

4. Verification Level of Effort

This is a Tier II verification. A Tier II-level verification is appropriate for basic reporting, and those voluntary efforts and public commitments for which there are no imminent requirements for compliance obligations or emissions trading. It is intended to establish the basis for baseline

protection, support claims for credit for early action, and enable assessments of performance of various GHG reduction initiatives by Entergy Corporation towards its voluntary targets. Given the status of Entergy Corporation's GHG emissions inventory and management system, a Tier II-level verification was appropriate for this project.

The 2009 GHG inventory verification focused primarily on direct emissions from large fossil fuel usage at generating facilities using CEMS data as well as purchased power. Entergy noted in its GHG Inventory Management Plan and also indicated to ICF and Cventure LLC that the other categories that comprised Entergy's 2008 GHG inventory would carry forward to 2009 due to their *de minimus* nature. As such, our verification efforts have not focused significantly on these carry-forward emissions from previous years, as they were already reviewed in prior year verifications.

5. Verification Approach

This Tier II verification effort involved the review of the logic and procedures used to compile the emission estimates, determine completeness and accuracy in calculations, and to assess the validity of the inventory design itself. It also focused on a review of the procedures in place and identified any missing or incorrectly calculated values. Emissions data were reviewed at a high level to detect internal inconsistencies, identify outliers and find potential errors in reporting, and included boundaries' completeness checks. Data in supporting spreadsheets and from the corporate databases were also examined under this Tier II review.

A detailed technical review of the methodologies, approaches, and calculations used in Entergy Corporation's inventory estimates was conducted in this verification effort. This was combined with a sampling of some of the data sources used during the compilation of the GHG emissions inventory by Entergy. Documentation was examined, including reviews of some disaggregated data, and the audit trail followed below the business entity level to raw data sources for several Entergy power generation units and power purchase agreements. The section that follows outlines the approaches used to review the main sources of the 2009 GHG inventory.

Stationary Combustion: Fossil Fuel Usage at Generating Facilities

For Tier II verifications in general, material business units and/or source types which collectively contribute on the order of 40 to 50 percent of the overall GHG emissions inventory are typically reviewed. For this verification, the inventory was reviewed in its entirety and a sample of data was reviewed in greater detail. Generation units were selected for detailed audit trail or desktop reviews based on relative contribution to the 2009 corporate GHG emissions inventory, access to granular data and supporting documentation, and also to account for some overlap with last year's samples (to test for any changes) as well as a selection of new samples. The ten (10) generation units selected for this desktop review included the following 5 coal and 5 gas/oil units:

<u>Coal</u>

- Independence 1
- Independence 2
- RS Nelson 6
- White Bluff 1
- White Bluff 2

Gas / Oil

- Baxter Wilson 1
- Little Gypsy 3
- Michoud 3
- Ninemile Point 4
- Sabine 4

The following information was received from Entergy and reviewed in relation to the above samples:

- Quarterly (1st through 4th quarter 2009) electronic data reports (EDRs) for each of the selected 10 units;
- Annual CO2 / flow monitors relative accuracy test audits (RATAs) for the 5 selected coal units;
- Quarterly CO2 CEM linearity checks for the 5 selected coal units;
- Monthly data on electricity generation (MWh) and heat input (total Btu)/fuel flow (scf) for Ninemile 4, Michoud 3, Little Gypsy 3 and Baxter Wilson 1; and
- Fuel flow meter (natural gas/oil) accuracy checks for Ninemile 4, Michoud 3, Little Gypsy 3, Baxter Wilson 1, and Sabine 4

The units above which were reviewed in greater detail represented over 60% of Entergy's total direct CO2 emissions from power generation units, and approximately 40% of Entergy's total corporate GHG emissions, in 2009. They also represented approximately 10% of Entergy's total number of units in its 2009 generation fleet, and about 20% of those units which had significant 2009 operations.

Organizational boundaries were verified using information contained in Entergy's SEC 10-K report for 2009, Entergy's inventory list of generation assets, and U.S. EPA's Clean Air Markets database. As described in Entergy's IMP, Entergy GHG emissions inventory boundaries are determined on an equity share basis (i.e. the percent equity share of those facilities which Entergy owns jointly with other companies) which was used to calculate the GHG emissions in the inventory database for this category. These equity share values in the GHG inventory were crosschecked against the data provided in the IMP, Entergy's statistical reports, and Entergy's SEC 10-K report, and successfully verified.

CEMS reports supplied by Entergy were checked against both the GHG emissions data in their GHG inventory spreadsheet database, and the EPA Clean Air Markets emissions reporting and tracking database, for the ten (10) above selected units. Monthly and annual CO2 CEMS reports generated by queries of the EPA Clean Air Markets database were checked and confirmed against the data reported in Entergy's GHG emissions inventory spreadsheets. Also, a sampling of Entergy's monthly CEMS electronic data reports (EDRs) were verified against the EPA Clean Air Markets emissions monitoring reports, and Entergy-supplied electricity generation (MW-hr) and heat input (MMBtu) data for the ten (10) units reviewed.

Associated CEM system and gas/oil fuel flow meter QA/QC supporting documentation (including relative accuracy test audits, linearity checks, and CEMS EDRs' calibration results) was also reviewed for a sample of two (2) generating units. These documentary evidence verification checks were performed and confirmed that the reported emissions data and emissions/fuel flow monitoring

measurements and monitoring calibrations were accurate and the associated measurements data reported correctly in the Entergy GHG inventory.

For each of the units sampled, various error checking tests were performed on the sampled data to assess the information collected, including some examples such as record counts, missing data, limits and reasonableness, consistency, re-computation, and other cross-checks. For each of the selected units, some aggregation calculation checks, and source type and equity share checks, were made and compared against database outputs/reports. Also, for each of the ten (10) selected units, a sampling of CO2 emissions values were checked using an alternative quantification methodology, based on activity data (e.g., fuel heat input values) and emissions factors.

Purchased Power

The key emissions factors, sources, and calculations that Entergy used for its Purchased Power (comprising Controllable Power Purchases and Non-Controllable Power Purchases) in the 2009 inventory database were checked. Together the data from these two sources correspond to approximately 30% of the total Entergy Corporate GHG emissions in 2009. A monthly breakdown of total purchased power was obtained from Entergy for review purposes and cross-checked against the 2009 SEC 10-K report for boundary and equity share purposes. In addition, raw data showing controllable purchased power for 2009 was received from System Planning and Operations (SPO) and was cross-checked against the inventory spreadsheet database. In order to double-check this raw data for redundancy and accuracy purposes, ICF requested from Entergy raw purchased power data from 8 plants (comprising 66% of total controllable power purchases).

Statistical-based data sampling plans, detailed statistical analyses, and quantitative uncertainty analyses were not performed under this Tier II effort. Preliminary trends analyses, performance benchmarks, and assessments of internal GHG reduction projects and location-specific energy efficiency initiatives were beyond the scope of this verification effort.

As noted earlier, all other GHG emissions sources were taken to be the same as last year due to their de minimus nature and as noted in the GHG IMP. These sources include small stationary combustion, mobile source combustion, fugitive CH_4 emissions from natural gas transmission and distribution operations, fugitive SF_6 emissions from electricity transmission and distribution operations, and fugitive HFCs from building HVAC systems, district cooling operations, and vehicle air conditioning systems.

6. Inventory Boundaries & Dates

The boundaries for Entergy Corporation's GHG inventory were developed through an equity share approach, consistent with the EPA Climate Leaders and WRI Protocols. These boundary determinations were executed by Entergy in a manner generally consistent with accepted GHG accounting practices. Reviews of the 2009 SEC Form 10-K statement, Entergy's inventory list of fossil generating assets, and EPA's Clean Air Markets database indicated that the Entergy Corporation GHG inventory included all material business entities and associated facilities under their financial control, including:

- Entergy Corporation
- Entergy Arkansas, Inc.
- Entergy Gulf States Louisiana, L.L.C.
- Entergy Louisiana, LLC

- Entergy Mississippi, Inc.
- Entergy New Orleans, Inc.
- Entergy Texas, Inc.
- System Energy Resources, Inc.
- Entergy Power, Inc.
- Entergy Asset Management

The inventory review covers year 2009 (January 1, 2009 – December 31, 2009), and was the subject of this verification effort.

The 2000 base year and 2009 emissions inventories provide a performance benchmark against which Entergy Corporation will measure year-on-year progress towards its emissions reductions goals.

7. Key Findings: Data Calculations, Methodology, and Monitoring

In general, practices followed in collecting, monitoring, storing, and calculating activity data were largely in accordance with procedures described in Entergy's *Greenhouse Gas Inventory Management Plan (IMP)* and in accordance with generally accepted GHG accounting principles. There were however a number of corrections made in the inventory as listed in the sub-sections that follow.

Stationary Combustion: Fossil Fuel Usage at Generating Facilities

For direct emissions from electricity generation units, the ICF verification team performed a series of checks of several different data sources. In one of these checks the verification team reviewed the calculated Entergy share of CO_2 emissions from owned and partially-owned generating units. While the FERC Form 1 submission for Entergy Mississippi, and the SEC 10-K report for 2009, both show a 39.37% ownership share of Independence Unit 2, statistical reports shows a 39% ownership share and the GHG Inventory shows a 39.4% ownership share. These differences were reconciled to clarify the correct value. With 39.37% ownership being the correct value, Entergy was initially over-reporting its emissions by approximately 2,034 short tons of CO_2. This immaterial error was corrected in the final GHG emissions inventory verified herein.

For the ten (10) units identified as targets for audit sampling in Section 5 above, monthly/annual CEMS data from EPA's Clean Air Markets emissions reporting database were reviewed. These results were verified against the direct emissions reported in Entergy's GHG emissions inventory spreadsheets. No material errors or omissions were identified.

In addition to those independent data source and aggregation checks, a re-calculation of the CO_2 emissions at the ten (10) audit data sampled units were made, based on fuel heat input data. The results of this alternative quantification methodology comparison showed a calculated total CO_2 output within +/- 2% of the reported value from the CEMS units for each of the gas-fired units, and within +/- 4% of the CEMS values for each of the coal-fired units. This degree of agreement between two alternative emissions quantification methodologies represents an acceptable margin of error for a Tier II level verification program, particularly considering that compliance-based CEMS measurements are generally more accurate than emission factor-based quantification approaches.

Therefore, the alternative quantification methodology provides additional verification confirmation of the CEM systems measurement approach and results.

Purchased Power

For power purchase agreements, the ICF verification team reviewed each individual controllable power purchase agreement GHG emissions estimate included in the Entergy inventory, representing thirty-four (34) total units. Hourly-level granularity power purchase data (i.e., in MW-hr units of measure) were provided by Entergy's System Planning and Operations (SPO) department for all of Entergy's 2009 controllable power purchases. GHG inventory activity data verification against the SPO database query of raw outputs, and unit-specific GHG emissions calculation checks, which were performed on the individual power purchase agreement units contained in Entergy's GHG emissions inventory, identified no calculation or methodology material errors or misstatements. While summation totals in the raw data for controllable purchases was incorrect for approximately 1/3 of such purchases, the correct total had been entered into the GHG inventory spreadsheet. A redundancy check was carried out by obtaining power purchase data on eight (8) specific units to ensure that no transposition or summation errors were made; this check confirmed no such mistakes had been made

Electricity emissions factors (lbs CO2/MWh) that the GHG inventory applied for each plant were verified against the plant-specific factors in eGRID's 2005 database. All but 3 of the emissions factors were correct. The three that have been corrected (either because the wrong EF was used, or a plant-specific factor was available to replace the regional factor previously used) concerned the following plants:

- Formosa Plastics,
- Duke Power – Hot Springs, and
- Tractabel – Hot Springs

A monthly breakdown of the total purchased power was also reviewed. This revealed a slight discrepancy in the total purchased power number between the number previously present in the GHG inventory and the newly calculated number. The latter number included all purchases while subtracting the relevant EPI (or EAM) share to avoid double-counting in other parts of the inventory. The relevant units that were subtracted include:

- Independence 2 (14.37% EPI ownership);
- RS Cogen (50% EAM ownership);
- Harrison County (60.9% EAM ownership)

The correct ownership shares for the above were subtracted from total EPI and EAM purchases to avoid double-counting. This led to a revised total purchased power number, as well as an uncontrollable power purchase number with the latter having associated emissions of just under 7 million short tons of CO2e.

8. Suggestions for Future Improvement

The following are suggestions for future improvement of Entergy's GHG inventory process:

- Manual data collection, transfer, and entry steps should be targets for elimination where feasible. Standardized data collection procedures across facilities, source, and emissions types, and streamlined data collection templates should be implemented. Increasingly automated data

collection and handling approaches including web-based data collection and entry tools (e.g., electronic forms/templates); electronic data transfer; and robust data management and accessible database reporting systems all could be areas for consideration by Entergy going forward. Implementation of such an increasingly automated and electronic GHG data transfer effort across the corporation will continue to decrease the occurrence of manual errors, and improve overall GHG inventory data quality and reliability, as well as enhance analytics opportunities and performance tracking activities.

- Some of the oxidation rates and emissions factors were slightly outdated. These have been pointed out to Entergy with correct values indicated as per the EPA Climate Leaders Protocol (revised versions from 2008). These should be reflected in the 2010 inventory and in subsequent ones.

- Estimates of all fugitive emissions – CH4, SF6, and HFCs – and emissions associated with mobile combustion sources have been deemed to be de minimus, as together they represent less than 1% of Entergy's total GHG emissions. As such, they were calculated in accordance with methodologies outlined in the EPA's Climate Leaders Protocol. Emissions from these sources were conservatively calculated in 2004 and the results have been carried forward into Entergy's 2009 inventory. Going forward, Entergy may want to calculate these for 2010 as these numbers will start to get outdated.

- The GHG inventory does not calculate emissions of CH4 or N2O from mobile combustion fuels other than gasoline or diesel. However, this is a very minor source and does not constitute a material omission but could be an area for inclusion in future inventories.

- Several low capacity factor/activity data fossil generation stations and units, those without CEM systems, were excluded from Entergy's GHG emissions inventory. These immaterial exclusions from the organizational boundaries are to be addressed in 2010 by Entergy Fossil Operations to provide complete GHG accounting for some of these reserve and peaking units.

- The Entergy greenhouse gas inventory management plan (IMP) identifies the need for procedures for handling changes in the corporate boundaries resulting from mergers, acquisitions, and divestitures (MADs), as well as reporting changes and management responsibilities. While this is a good start, the IMP could be enhanced going forward with additional discussions on the details of baseline adjustments associated with MADs (including organic growth, and decline, impacts). Possible improvements include expanding the existing discussion with some specifics on facility/source identification/labeling, date stamping/reporting time allocation, emissions re-stating impacts (base year and subsequent years), etc. In addition, further details could be provided on data or methodology change management procedures (e.g., de minimus change thresholds, "sunset" or look-back time periods, and documentation and recordkeeping requirements).

- As part of its GHG inventory development process, Entergy performs a significant array of various data quality assurance and quality control (QA / QC) activities. Some examples of these include consistency checks with prior year's data, and with similar facilities and source types; data normalization checks (including facility-level, year-on-year emissions intensity); and various data "cleansing" reviews with data coordinators and data collection team leaders/data suppliers. While there is a section in the IMP on auditing, verification and management responsibilities, Entergy could benefit from elaborating in more depth in the IMP the overall QA / QC approach that it employs and the various procedures that it undertakes at different steps of the inventory process and for each major segment for the inventory. This could be useful to Entergy for replicability, transparency and institutional memory purposes.

- In addition to their GHG inventory QC activities, Entergy conducts a QA/QC program for its generating plant CEM systems, according to 40 CFR Part 75, Appendix B procedures (for Acid Rain reporting units). Elements of Entergy's CEMS QA/QC program include a formal QA/QC plan, CEMS calibration and maintenance procedures, maintenance and testing logs, electronic data reports, relative accuracy test audits, linearity checks, and EPA feedback reports. As part of Entergy's internal safety, health, and environmental (SH&E) program, periodic internal audits are conducted of generation facilities CEMS procedures and their implementation. Of the ten (10) facilities selected for more detailed GHG inventory review, the Michoud station was subjected to a SH&E audit in 2009. Its air quality audit results showed that the CEM systems were generally in compliance with all Part 75 Appendix B requirements and procedures. The only findings of note were incomplete entries and lack of detail in the maintenance logbooks, and some elements of the QA/QC plan were not representative of current emissions monitoring operations. The recommended corrective action was for refresher QA/QC training courses to be given to the CEMS maintenance personnel at Michoud.
- In 2010, Entergy will be conducting a CEMS program audit for Fossil Operations as a part of their overall SH&E Audit Program. The results of that audit, as well as those from their ongoing internal SH&E site level audits, will be utilized as part of the 2010 GHG emissions inventory verification analyses, to be conducted in early 2011. These results will also be used as part of the 2010 GHG emissions inventory desktop audit site selections.

9. Conclusion

ICF identified some minor discrepancies in Entergy's greenhouse gas inventory that were corrected during the course of the verification. ICF believes that Entergy's overall inventory meets Entergy's goal of accurately calculating and reporting its corporate GHG emissions for 2009 in accordance with the WRI/WBCSD GHG Protocol, Corporate Accounting and Reporting Standard (2004).

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