Smoke and Mirrors:
Debunking the Doctored Numbers on Long Phu-1 Greenhouse Gas Emissions

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INTRODUCTION AND SUMMARY

Vietnam Electricity (EVN) has proposed a 4,400 MW coal-fired power plant complex in the Long Phu District of Soc Trang province, Vietnam. This project is contemplated to be constructed in three phases. The first phase of the proposed project consists of two 600 MW coal-fired units identified by Petro Vietnam (PVN), the sponsor of the project, as Long Phu 1. This proposal was the subject of a feasibility study and environmental impact assessment published in 2009. Construction of this project reportedly commenced in 2015[1], but PVN is now seeking financing from a mix of export credit agencies (ECAs). PVN and HSBC (as lead lender) retained ERM Vietnam (ERM) to conduct a due diligence review to evaluate whether relevant Vietnamese statutes and lender policies with respect to financing new coal-fired power plants were met. The referenced policies include the International Finance Corporation (IFC) Performance Standards (PSs) and Environmental, Health and Safety (EHS) Guidelines; World Bank Safeguard Policies (Operational Policies); OECD Council's Recommendation on Common Approaches for Officially Supported Export Credits and Environmental and Social Due Diligence[2]; and the environmental and social policies of ECAs. In December 2016, ERM Vietnam published a report of its review (ERM Report) that documented a number of issues requiring resolution and asserted compliance with applicable policies and regulations in other areas.

Friends of the Earth U.S. has requested a review of the PVN Feasibility Study, the ERM Report, and other available documents concerning two narrowly focused issues: (1) whether the Long Phu 1 project would be eligible for funding under the OECD's coal-fired power plant sector understanding[3], which restricts most OECD member countries' ECA financing for certain coal plants and (2) any relevant issues with respect to the proposed air pollution controls and air quality modeling.

According to the OECD Sector Understanding on Export Credits for Coal-Fired Electricity Generation Projects (OECD Sector Understanding), coal-fired power plant units of more than 500 MW that meet a definition of ultra-supercritical (USC) are eligible for financing provided other conditions are met. However, the materials available to date[4] do not substantiate that the proposed (and under construction) project will meet the OECD Sector Understanding's criteria for a USC power plant. The OECD Sector Understanding sets out alternative criteria; one using operating pressure and temperature, another using g CO_2/kWh. The minimum specified operating temperatures are below those set out in the OECD Sector Understanding for USC plants. Based on these operating parameters and the relatively warm water that will be used for cooling the plant, it is highly unlikely that this plant can meet the OECD alternate criterion of a CO_2 emission rate less than 750g CO_2/kWh. The engineering firm Fichtner Viet Nam (Fichtner), the project manager consulting firm for the project, estimates emissions at 800g CO_2/kWh. This estimate is reasonable and consistent with descriptions of the project by General Electric, the turbine supplier and an estimate of emissions by the United States Export-Import Bank.[5] As explained below, ERM's subsequent counter-estimate is inconsistent with the engineering specifications for the turbine, not supported by any publicly available information, and merely reports, in a different format, an undocumented and self-serving claim by PVN.

The environmental and policy due diligence reviews are being conducted too late in the process to allow for meaningful consideration. According to the documents provided, contracts for major components have been signed and onsite work has commenced, with the project construction more than 14 percent[6] complete. The underlying efficiency of large units such as those under construction at Long Phu 1 is dependent on the extent to which highly specialized and very expensive materials are used in very large

1 See, ERM, Environmental and Social Due Diligence – Long Phu 1 Thermal Power Plant, December 9, 2016 (ESDD) at page 1.
2 The applicable policy is respecting coal plant efficiency requirements is the OECD Sector Understanding on Export Credits for Coal-Fired Electricity Gene ation Projects.
3 OECD, Sector Understanding on Export Credits for Coal-Fired Electricity Generation Projects, Chapter II, Table 1, November 27, 2015, http://www.oecd.org/officialdocuments/publicdisplaydocumentpdf/?cote=TAD/PG(2015)9/FINAL&docLanguage=En.
4 The materials principally relied on for this report are cited herein. Documentation that ERM used in calculating the annual emission rate and efficiency, Fichtner's rebuttal to ERM's assessment, Long Phu I contract provisions, and any information provided "from the client" that ERM references in the report have been requested from the U.S. Export-Import Bank, but not yet provided.
5 http://www.exim.gov/policies/ex-im-bank-and-the-environment/pending-transactions; listing the Long Phu 1 project at 806g CO_{2e} per kWh.
6 See, ESDD, supra at p 25.

core components. Retrofitting these components at some later date is not feasible. Therefore, compliance with policies requiring mitigation of greenhouse gas emissions by, for example, reconstructing or retrofitting an actual supercritical power plant as a USC power plant, is impossible as a practical matter. Additionally, in derogation of IFC Performance Standard 1.8, the environmental assessment of the project is segmented – looking at each of the three proposed plants as if cumulative impacts of the other two plants are not contemplated[7]. ERM notes this deficiency, but does not specifically address remedial action to correct it.

A comprehensive review, including air quality monitoring and modeling and thermal discharge modeling of the entire proposed project to determine whether unacceptable degradation of air and water resources is inevitable, should be conducted in advance of commencement of construction, not as the various stages of construction commence. Further, the evaluations to date do not provide useful information about the most harmful of the air pollutants emitted by these plants - fine particulate matter ($PM_{2.5}$) and ozone.

COMPLIANCE WITH OECD SECTOR UNDERSTANDING ON EXPORT CREDITS FOR COAL-FIRED ELECTRICITY GENERATION PROJECTS (OECD SECTOR UNDERSTANDING)

According to the OECD Sector Understanding, the ECA considering financing a coal plant bears the burden of notifying other ECAs that the potential client is following the relevant policies. Accordingly, if PVN and the ECA cannot demonstrate that the Long Phu 1 power plant is USC, it is not eligible for financing. Several years ago there was not a "bright line" test to distinguish claims that a unit was subcritical, SC, USC or advanced USC (AUSC). For purposes of the OECD Sector Understanding, alternate "bright lines" are now provided. In order to be eligible for funding, a unit that is greater than 500 MW of gross installed capacity must either (1) operate at steam pressures greater than 240 bar and at a steam temperature greater than or equal to 593°C or (2) emit CO_2 at a rate less than 750gCO_2/kWh[8]. ERM concedes that the units are SC, not USC designs and does not dispute that these units are not designed to operate at the required temperature.

Coal Efficiency Technology and Designation

Each of the proposed Long Phu units has a gross installed capacity greater than 500 MW. Accordingly, pursuant to the OECD Sector Understanding, supercritical coal-fired generation projects larger than 500 MW are "ineligible" for ECA funding.[9]

The Long Phu units are described as "supercritical" units in the initial feasibility study, Fichtner's 2015 Greenhouse Gas Emission Study,[10] the ERM Report[11] and in public disclosures relating to the project by Black and Veatch, which provided design and management services for the project, and by General Electric (GE), the supplier of the steam turbines and generators for the project.[12] According to GE:

> Long Phu 1 is one of the first coal-fired power plants in Vietnam to use **supercritical** technology for higher efficiency, more environmentally friendly power generation as compared to conventional subcritical boiler technology. The plant is one of three power

7 IFC Performance Standard 1.8 states: "[c]umulative impacts that result from the incremental impact, on areas or resources used or directly impacted by the project, from other existing, planned or reasonably defined developments at the time the risks and impacts identification process is conducted".

8 Under the OECD Sector Understanding, an exception, not applicable here, allows for funding of SC units in the least developed countries.

9 See, OECD Sector Understanding On Export Credits for Coal-fired Electricity Generation Projects, TAD/PG(2015)9/FINAL 27-Nov-2015, Section 2, Table 1, supra, and OECD Council's Recommendation of the Council on Common Approaches for Officially Supported Export Credits and Environmental and Social Due Diligence (referred to as "the Common Approaches") including the updated ANNEX VI related to the coal-fired power plants valid as of 1st January 2017 TAD/PG(2017)1, accessed at http://www.oecd.org/officialdocuments/publicdisplaydocumentpdf/?doclanguage=en&cote=tad/pg(2017)1

10 See, Feasibility Study and EIA at Section 1.5 PROJECT DESCRIPTION. The 2015 Fichtner GHG Emission Study was not available, but was referenced in the ERM study at C-53. "1.5.1 Technology of the plant "Long Phu 1 power plant project is designed with capacity of 1.200MW, including 2 units (2x600MW). a) Boiler type: pulverized-coal-fired boiler technology; b) Steam parameters: pressure super critical 250bar - 285bar, temperature high pressure / return baking gas at 540-600OC/560-620OC". (emphasis provided)

11 ERM Report, supra, at p. 20 "2.4.1 Technology Selection for the Project The Project uses supercritical pressure (258 bar), coal-fired steam power generation technology", LP1 applied the supercritical technology, which results in higher turbine efficiency and better heat rate, which ultimately leads to lower fuel consumption and reduced emissions of CO2 and other pollutants for the same amount of power generated. Id. at 56.

12 https://www.bv.com/news/black-veatch-wins-power-project-in-vietnam; https://www.genewsroom.com/press-releases/ge-high-efficiency-steam-turbines-selected-petrovietnam%E2%80%99s-new-coal-fired-power-plant

stations planned for the Long Phu Power Center. The facility will use two GE D850 steam turbines, configured to enhance the construction timeline with pre-assembled sections and installation features that shorten erection time while maintaining GE-tested quality standards. (emphasis provided)

* * *

'Power development in Vietnam remains highly dependent on coal,' said Ramesh Singaram, president of Power Generation, Asia Pacific, GE Power & Water. 'By using GE's **supercritical** steam turbine technology, Long Phu 1 will demonstrate how efficiently coal can be used as part of an environmentally sound energy mix.' (emphasis provided)

It should be noted that GE also markets USC units and is more than willing to apply the USC label to its products when appropriate. For comparison, see the references below for GE's RDK 8 project.[13] The GE ST- 850 steam turbine that GE states is employed in the Long Phu project is rated at up to 245 bar and 585°C[14] and thus is not suitable for USC applications. GE also markets its GE ST-1050 turbine series, which is designed and rated for USC conditions, and provides 54 percent steam turbine efficiency[15], substantially greater than the 49 percent steam turbine efficiency claimed for the 850 series.

Errors in ERM's Emission Calculations

The Fichtner Group estimated that the CO_2 emission rate for the Long Phu units would be 800g/kWh and that "[t]he total carbon intensity level of LP1 is in compliance with *IFC EHS Guidelines for Thermal Power Plants* (coal fuel, **supercritical**) and OECD's common approaches guidelines." (emphasis provided)[16]

ERM discounts the engineering data used by Fichtner, asserting that there were limited details available about the coal that would be used and that "it is unclear if the formula used for the calculation of annual CO_2 production from coal was accurate." Without access to the underlying Fichtner calculation, ERMs' criticism cannot be evaluated fully, but it should be understood that the differences in treatment of unburned carbon discussed by ERM are likely to be far smaller than the overall difference in emission rate between the Fichtner estimate and the ERM prediction. Fichtner's range of coal properties is consistent with specifications for international steam coal suitable for use in SC units and, at this time, the properties of the coal that will be used are not further specified. Further, Fichtner's resulting CO_2 emission rate of 800g/kWh is consistent with the design information provided and the documented emission rate of similar units.

"An emission rate of 698g CO2/kWh (gross) is among the lowest emission rates, if not the lowest emission rate, for any USC coal-fired power plant in operation anywhere in the world today"

The design emission rate, in grams of CO_2 per kilowatt hour of electricity, forms the basis of the lending constraint and, along with an estimate of the amount of electricity produced, the basis of a calculation of annual emissions. ERM does not demonstrate that the Fichtner calculation is incorrect or even that it *may* be incorrect, asserting only that it finds Fichtner's calculation "unclear".[17] However, this claim provides a false rationale for ERM to substitute an emission rate estimate that would allow ECA support for the project.

Rather than documenting whether and, if so, why it believes Fichtner's 800 g/kWh estimate is wrong, ERM "backs" into its compliant number by accepting

13 http://www.gereports.com/supercritical-thinking-this-coal-power-plant-applies-bullet-like-pressures-to-steam-to-achieve-worlds-best-performance/; https://www.gepower.com/steam/customer-outcomes/rdk8.html

14 https://www.gepower.com/content/dam/gepower-pw/global/en_US/documents/alstom/gea31876-steam-power-systems-29-10-15.pdf

15 "Steam turbine efficiency" refers to the efficiency of the conversion of the energy of the high pressure steam to the mechanical work associated with rotating the turbine and is a component of the overall efficiency of the steam-electric generating unit.

16 ERM Annex F at F-5.

17 It may be that ERM has missed the distinction between percentage of unburned carbon in the fly ash and the percent of the carbon in the fuel that is not combusted.

without support the client's estimate of how much coal would be consumed and how much electricity would be produced. Starting with its estimate of 800g CO_2/kWh number Fichtner had calculated that annual coal consumption would be 3,280 million tons if the plant used coal with a Gross Calorific Value of 4,963 kcal/kg and operated at full load for 6500 hours. ERM assumes generic (Tier 1) emission factors for CO_2 emissions per unit of coal consumed[18] and a coal consumption number provided by the client of 2,888 million tons for the same amount of electricity and from that number calculates a lower emission rate. But where does the figure of 2,888 million tons of coal consumption come from? ERM does not identify the basis for assuming such a large reduction in coal consumption from the Fichtner figure. The client may have new information from a vendor that the design has changed, or the client could simply have figured out what efficiency they would need to use to meet the ECA funding requirements.[19] Based on the "client" data on coal consumption (and apparently not on any engineering analysis on its part) ERM completes a rudimentary calculation[20] and asserts that these SC units emit at less than 750g CO2/kWh and therefore are eligible for financing under the OECD Sector Understanding.[21]

"No design changes have been identified that would offset these increases or otherwise provide a basis for the lower CO2 emission rate suggested by ERM"

ERM goes on to make an inexplicable estimate of Long Phu 1 gross carbon intensity:

> Based on a calculation by ERM (see *Annex F*), the carbon intensity level of the Project calculated using the IPCC method is 698 g CO2/kWh, which is less than the typical value of 774 gCO2/kWh for such a thermal power plant (supercritical, coal fired) stated in the *IFC EHS Guidelines for Thermal Power Plants*. Moreover, though LP1 uses supercritical technology, it is expected that the carbon intensity of LP1 reaches the expected carbon intensity level of ultra-supercritical thermal power plants (<750 g CO2/kWh) as referred to in Chapter II, Annex VI of the UECD common approaches.[22]
>
> The **gross** carbon intensity level of the Project is estimated to be 698 gCO2/kWh, which is lower than the estimate by Fichtner GHG emission study report (i.e. 805.61 gCO2/kWh). The carbon intensity level of the Project estimated by ERM is within the limit for such a thermal power plant stated in the *IFC EHS Guidelines for Thermal Power Plants* (**% Gross,** LHV - coal fuel, supercritical) and OECD's common approaches guidelines. (emphasis provided)[23]

The difference between the 774g CO_2/kWh rate for a "typical" supercritical plant and the 698g CO_2/kWh assumed by ERM for the Long Phu units is huge, unexplained and unsupported by any engineering analysis. Indeed, an emission rate of 698g CO_2/kWh (gross) is among the lowest emission rates, if not the lowest emission rate, for any USC coal-fired power plant in operation anywhere in the world today. For example, the Isogo USC power plant (Japan) claims an emission rate of 802g CO_2/kWh (net)[24], which converts to approximately 710 g CO_2 / kWh (gross). The Nordylland USC plant (Denmark), which for many years claimed to have the highest efficiency in the world partially due to its access to extremely cold cooling water, claims an emission intensity of 790g CO_{2eq}/kWh (net).[25] This rate is approximately equivalent to 699 g CO_{2eq}/kWh (gross).

18 ERM does not provide a specific alternative calculation for unburned carbon.
19 Indeed, since one must know the emission rate or unit efficiency to determine an annual emission rate in the first instance, ERM or the client may simply have "assumed" a "compliant" CO_2 emission rate that then leads it to an estimate of 2,888 million tons/year of CO_2.
20 Using default emission factors ERM concludes that the reduced coal consumption cuts CO2 emissions from 6.235 million tons/year to 5.447 million tons year. ERM Report, Annex F at F-9, F-10.
21 Determined based on the stated coal consumption of 2,888,836 tons/year, coal heat content of 4,640 kCal/kg and generation of 7,800,000 kWh. *Id.*
22 ERM Report, *supra,* at 56. See also, ERM Report, Annex F.
23 ERM Report, Annex F at F-11
24 See, http://spectrum.ieee.org/green-tech/clean-coal/japans-isogo-power-plant-burnishes-clean-coals-credentials
25 See, https://pire.soe.ucsc.edu/sites/default/files/Nordjylland%20Power%20Station%20-%20Carbon%20Footprint%20Study%20of%20Biomass%20CHP.pdf

The underlying calculation assumes that the units have a far greater efficiency than thus far documented. To understand the nature of the error, one must consider the concepts of "net" and "gross" generation. Gross generation refers to the amount of electricity produced by the generator in the system. However, not all of this electricity leaves the facility. This is because the unit requires a substantial amount of electricity to operate – large fans to bring in and exhaust gases, mills to grind the coal to a fine powder, pumps to cycle water, as well as pollution and operational controls. The amount of electricity "produced" by a plant and sent offsite for use by the public is ordinarily referred to as "net" generation.[26]

ERM acknowledges that as designed the proposed plant would achieve a minimum ***gross*** efficiency (on a HHV basis) of approximately 42.14 percent and that the EPC contractor has committed to achieve no more than 42.22 percent ***gross*** efficiency on a HHV basis. To achieve a GHG emission rate of less than 750 g CO_2/kWh (gross) the plant would have to operate at a ***net*** efficiency of approximately 44 percent. The difference between net and gross efficiency is that the former takes into account the energy needed to run the pumps, fans, pollution controls, and other auxiliary equipment at the plant. A gross efficiency of 42 percent is roughly equivalent to a net efficiency of 38 percent with the difference representing the energy needed to operate the plant.[27] These data lend further support to the notion that the plant is not designed as a USC plant.

However, with no technical support or rationale, ERM now assumes that the plant will achieve an efficiency of 44 percent net. The Gap Analysis Table (Annex 3 of ERM's report) states:

> ERM's estimate of **net** energy efficiency, based on the capacity of the plant and the net calorific values of coal and oil (i.e. the two main fuels used) is approximately 44%. This is higher than the normal energy efficiency for such thermal power plant (supercritical, coal fired), stated as 40% in IFC EHS Guidelines for Thermal Power Plans and similar to the European Industrial Emission Directive (2010/75/EU) of 44% for thermal power plant using hard coal.[28] (emphasis provided).

Since the initial feasibility study, two developments have occurred that may increase the internal electric demands and thereby increase the CO_2 emission rate above the 806 g CO_2/kWh design rate used by Fichtner. Initially, the units were designed to operate without post-combustion emission controls for NOx. However, subsequent government regulation now apparently requires the installation of a selective catalytic reduction (SCR) NOx control system, though the degree of implementation of the SCR is not specified. In addition, ERM has concluded that the SO_2 control system (flue gas desulfurization or FGD) system is undersized given the range of sulfur content of proposed fuels. The effect of these changes is to reduce overall system efficiency and increase the net CO_2 emission rate above the initial design rate. No design changes have been identified that would offset these increases or otherwise provide a basis for the lower CO_2 emission rate suggested by ERM.

"ERM has asserted efficiency gains that have not been demonstrated elsewhere in the world"

At the upper levels, energy efficiency gains of a tenth of a percent are very difficult to achieve. Therefore, an assertion that somehow this plant has gone from 38 percent net efficiency to 44 percent net efficiency should be well documented and carefully scrutinized. ERM does not identify any upgrades to the unit, such as multiple reheat cycles, that would alter the initial estimate, nor is there any suggestion that the GE ST- 850 steam turbines have been upgraded to GE ST-1050 series.

26 Efficiency reporting is also complicated by different practices in reporting the heat content of the coal employed. In the U.S., use of the "higher heating value" (HHV) is common, while elsewhere, the "lower heating value" (LHV) is used. The difference is in the treatment of the hydrogen and water content of the fuel, which is present, but not useful for generating steam. See, https://www.iea.org/ciab/papers/power_generation_from_coal.pdf, for a general discussion of efficiency measuring and reporting issues.

27 See, Table 4 of the IFC Guidelines for Thermal Power Plants, http://www.ifc.org/wps/wcm/connect/dfb6a60048855a21852cd76a6515bb18/FINAL_Themal%2BPower.pdf?MOD=AJPERES&id=1323162579734

28 Annex C at C-53, See Also Annex F at F-11

ERM's Reliance on Supposed Forthcoming Efficiency Improvements

Apparently, Fichtner does not agree with ERM's calculation and has responded to ERM's comments. See, Attachment 1, below. ERM responds with assertions that Fichtner's calculations are based on pre-construction design-based assumptions and that a final determination of the actual design efficiency of the units should be completed six months prior to operation of the unit. This is far too late in the process to determine whether the actual design efficiency has been increased to the point of meeting USC emission performance. ERM further suggests that if the calculation of GHG emission is greater than 774g CO_2/kWh, "mitigation measures" will need to be undertaken to reduce GHG emission intensity. This suggestion is clearly untenable for several reasons.

1. The ECA funding guidelines specify a bright line of 750 g CO_2/kWh for USC, not the "typical value of 774 g CO2/kWh for such a thermal power plant (supercritical, coal fired) stated in the IFC EHS Guidelines for Thermal Power Plants."

2. Funding decisions need to be made in advance, based on the best objective information concerning the design of the plant. Here, the vendor is claiming an efficiency of 42.22 percent (gross). This information constitutes the best objective information available for decision making at this time.

3. The underlying efficiency of large units such as those under construction at Long Phu 1 is dependent on the extent to which highly specialized and very expensive materials are used in very large core components. Retrofitting these components later is not feasible.

4. The OECD Sector Understanding does not provide for offsets in lieu of meeting the design criteria at the outset. Even if they did, the ERM report notes that "LP1 has not provided reporting for any specific actions taken to avoid, minimise and/or offset CO2 emissions."[29] Even if greenhouse gas offsets were allowed, they would be too large and costly to be feasible, and no proven offsets at reasonable costs have been identified. . Further, these units will operate for 50 years or more and there is no mechanism to enforce any "offset" obligation after the period of the loan tenor. Further, this approach, if adopted, would be unbounded.

5. The suggested approach undercuts the credibility of export credit agency claims of compliance with loan policies by allowing unverified and self-serving claims to control the decision making process until it is too late to require compliance with the relevant policies.

AIR POLLUTION CONTROLS AND AIR QUALITY MODELING

Viet Nam's air pollution regulations are among the least protective in the world. Ambient air quality in the region currently exceeds WHO guidelines.[30] While the procurement specifications apparently now require the installation and use of basic control devices (FGD, SCR and ESP) to limit emissions of SO_2, NOx and PM, the specified operational levels are less than technically achievable with full application of these controls.[31] No analysis has been conducted to evaluate or explain why full application of these technologies -- SO_2 removal at or above 95 percent, PM_{10} removal of 99 - 99.5 percent, and NO_x removal of 90 percent – should not be employed. Further, given the use of surrounding area full consideration of the impacts of mercury (Hg) deposition and available Hg controls should have been conducted.

The available materials do not show that a credible analysis of the impacts of the most potent air pollutants – $PM_{2.5}$ and ozone – has been conducted. ERM has noted significant deficiencies and departures from IFC requirements, including but not limited to, the failure to consider cumulative impacts from

29 ERM Report, Annex F, at F11

30 Compare WHO guidelines, http://apps.who.int/iris/bitstream/10665/69477/1/WHO_SDE_PHE_OEH_06.02_eng.pdf, with ambient air quality backgroun data for Long Phu District, shown at *Feasibility Study, supra,* p 3-1

31 Indeed, there is no specified operational level for the SCR, other than to meet the applicable regulatory limit.

the proposed Long Phu 2 and 3 plants, the failure to measure PM10 and PM2.5, and a lack of long-term meteorological data. Additionally, the air quality modeling is proposed to be conducted based on unenforceable "estimates" of emission rates rather than the enforceable limits, which ordinarily form the basis for air quality modeling. In an effort to meet the funding requirements of this ongoing project, ERM and the lenders have suggested that only one year of meteorological data be accepted. This is an extremely risky approach as year-over-year variation in weather conditions may result in greater adverse impacts than shown in a single year. Here, the risk is exacerbated as ERM's subsequent short term modeling with all three plants operating the predicted 1 hour concentration of NOx (194.08 $\mu g/m^3$) that is quite close to IFC and Vietnamese standards (200$\mu g/m^3$).[32] These results strongly suggest that if five years of meteorological data are considered, exceedances of Vietnam and IFC ambient air quality limits will be demonstrated. Particular attention should also be given to consideration of short-term (one hour) SO_2 emissions.

CONCLUSION AND RECOMMENDATIONS

Based on the design information available at this time, the Long Phu 1 units are supercritical units greater than 500MW and, therefore, are ineligible for ECA funding under the OECD Sector Understanding. The emission calculation by Fichtner is consistent with GE's identification of the use of GE ST-850 turbines and the design constraints imposed by that choice. ERM has asserted efficiency gains that have not been demonstrated elsewhere in the world and has not come forward with any credible technical data to support its assertion that the efficiency of the unit will be 44 percent (net) as opposed to the 42.21 (gross) efficiency set out in the contract. This prediction is even less plausible when considering additional pollution control equipment that will apparently be required, the effect of which is to reduce overall system efficiency and increase the net CO_2 emission rate above the initial design rate. The suggestion of a late determination of compliance (six months before operation) coupled with a vague and unenforceable "offset" obligation would provide many opportunities for abuse and substantially undercut the effectiveness of the ECA lending policies by allowing sunk costs to affect the decision making process of the ECAs. Accordingly, it is recommended that a determination be made in the near future that this project is not compliant with relevant ECA policies, including the OECD Sector Understanding, and will not be funded by ECAs.[33]

"...the Long Phu 1 units are supercritical units greater than 500MW and, therefore, are ineligible for ECA funding under the OECD Sector Understanding"

Any further evaluation of the issues discussed herein should include public disclosure of the Fichtner calculation of the CO_2 emission rate of the proposed units, the ERM counter-calculation, including but not limited to the technical basis for any assumptions used in that calculation and the Fichtner comments and/or rebuttal to the ERM estimate. Further, the timing of the assessments *yet to be conducted*, even as construction is underway, raises concerns about the objectiveness of the review process. For the review process to function effectively, compliance with critical policy objectives must be determined while there remains a realistic opportunity to revise the proposed project rather than simply papering over outstanding but irresolvable issues. Here, construction is well underway, long before critical air and water quality measurement and modeling have been completed. This again raises the prospect that sunk costs, rather than the merits of the project, will drive decision making.

32 ERM, *Long Phu 1 Thermal Power Plant – Supplemental Environmental and Social Document Review_ Final Report*, December 2, 2016 page 4, *et. seq.*

33 It should also be noted that pursuant to the World Bank's Criteria for Screening Coal Projects Under the Strategic Framework for Development and Climate Change, "Coal projects will be designed to use the best , appropriate available technology to allow for high efficiency and therefore lower GHG emission intensity." http://siteresources.worldbank.org/EXTENERGY2/Resources/CGN_20100331.pdf at page 2. There has been no claim or demonstration that the true USC technology could not have been employed in this project.

ATTACHMENT 1. SUPPLEMENTAL ESA, ANNEX H, PAGE 42

REVIEW RESULT

Fitchtner's responses to ERM comments on the calculation of Greenhouse Gas Emission Study Report are well noted. However, ERM recommends to keep this action for the following reasons:

At this stage, the Project's data (i.e. annual coal consumption, heating values) have not been verified and confirmed. Current calculation of GHG emission intensity was based on information of design coal type and associated default emission factors for technology used. Fitchtner's calculation was also based on plant's performance data with lots of assumption at current stage (e.g. annual coal consumption, coal contents, etc.) Therefore, when Project's data is verified and confirmed, calculation of GHG intensity using 2006 IPCC Guidelines Tier 2 or Tier 3 approaches is needed for greater accuracy in reflecting the reality of GHG intensity in relation to the coal as opposed to the Tier 1 general approach. Note that Tier 2 and 3 require for details of data, e.g. Fuel combustion information (i.e. coal quality, efficiency), together with specific emission factors, where possible, etc.

If the calculation of GHG emission intensity using verified and confirmed data found greater than typical value of 774 g CO2/kWh for such a thermal power plant (supercritical, coal fired) stated in the IFC EHS Guidelines for Thermal Power Plants, mitigation measures need to be undertaken to reduce GHG emission intensity. Thus, this action will be conducted when the Project's data (i.e. annual coal consumption, heating values) are verified and confirmed.

RECOMMENDATION FOR ESAP UPDATE

Action remains. It is opinion of ERM that the Project data (i.e. annual coal consumption, heating values) should be verified and confirmed approximately 6 months prior to operation.

Therefore ERM recommends LP1 to complete this action 6 months prior to operation.