
# Evaluation of the 2018 Environmental Impact Assessment (EIA) Report

# For the Vung Ang II Thermal Power Plant Project

By

Mark Chernaik, Ph.D.
Heidi W. Weiskel, Ph.D.
Staff Scientists
Environmental Law Alliance Worldwide

April 2020

*Summary: In September of 2018, the Vung Ang II Thermal Power Joint Stock Company (VAPCO) issued an updated Environmental Impact Assessment Report for the Vung Ang II Thermal Power Plant Project (EIA Report).*[1] *Dr. Mark Chernaik has more than twenty years of experience evaluating the adequacy of EIAs for thermal power projects. Dr. Heidi Weiskel, is an experienced marine ecologist. Our opinions were requested about whether the 2018 EIA Report fulfills basic requirements of internationally-accepted best practices for informing decision-makers and stakeholders about the potential environmental impacts of the proposed project. We conclude that the 2018 EIA Report:*

- *Failed to examine alternatives that prevent or minimize adverse environmental impacts of the proposed thermal power plant;*
- *Used the wrong choice of an air pollutant dispersion model that renders meaningless predictions of air quality impacts;*
- *Applied weaker emission standards for the project than those used internationally;*
- *Allowed continued wet handling of ash contrary to international guidelines;*
- *Allowed discharge of thermal effluent in excess of international guidelines; and*
- *Erroneously dismissed potentially significant impacts to marine species.*

*Below, we address each of these issues in detail.*

## 1. The EIA Report lacks an assessment of project alternatives

EIAs are a critical planning tool for any project. A central purpose of the process is to identify alternatives for meeting the purpose of a project in a manner that minimizes its environmental and social impacts. The basic purpose of a thermal power plant project is to provide electrical energy. Therefore, consideration of alternative means of providing the electrical energy, including renewable energy sources such as utility-scale solar or wind projects, must be part of an EIA for a proposed thermal power plant. This concept is enshrined in guidelines that apply to this project. According to the Japan Bank for International Cooperation (JBIC):

> "1. Environmental and Social Considerations Required for Funded Projects
>
> In principle, appropriate environmental and social considerations shall be undertaken,

[1] Japan Bank for International Cooperation. 2018. Environmental Impact Assessment Report for the Vung Ang II Thermal Power Plant Project (2018 EIA Report). https://www.jbic.go.jp/en/business-areas/environment/projects/page.html?ID=61715&lang=en

according to the nature of the project, based on the following:

(1) Underlying Principles

- Environmental impact which may be caused by a project must be assessed and examined from the earliest planning stage possible. **Alternative proposals or mitigation measures to prevent or minimize adverse impact must be examined**, and the findings of such examinations shall be incorporated into the project plan:

[…]

(2) Examination of Measures

> ***Multiple alternative proposals must be examined to prevent or minimize adverse impact and to choose a better project option in terms of environmental and social considerations. In examination of measures priority is to be given to the prevention of environmental impact, and when this is not possible, minimizing and mitigating impact must be considered next***."[2]

The Vung Ang II Thermal Power Plant Project has a rated capacity of 1320 MW (2 x 660MW) and as such **can be expected to emit more than 10 million metric tons per year of carbon dioxide**, a greenhouse gas. The requirement for an assessment of renewable energy generation alternatives, (*e.g.*, utility-scale solar and wind projects) is heightened because such projects emit copious quantities of greenhouse gases, the negative environmental and social impacts of which are well-documented. According to International Finance Corporation (IFC) Performance Standard 3 (Resource Efficiency and Pollution Prevention), the following principles apply:

> *Greenhouse Gases*
>
> "7. In addition to the resource efficiency measures . . ., the client will consider alternatives and implement technically and financially feasible and cost-effective options to reduce project-related GHG emissions during the design and operation of the project. **These options may include, but are not limited to, alternative project locations, adoption of renewable or low carbon energy sources**, sustainable agricultural, forestry and livestock management practices, the reduction of fugitive emissions and the reduction of gas flaring."[3]

---

[2] Japan Bank for International Cooperation Guidelines for Confirmation of Environmental and Social Considerations (January 2015) pp. 18-19 (emphasis added).
https://www.jbic.go.jp/wp-content/uploads/page/2013/08/36442/Environemtal_Guidelines2015.pdf

[3]International Finance Corporation (IFC). 2012. Performance Standard 3: Resource Efficiency and Pollution Prevention. 5 pp. pp. 1-2 (emphasis added)

In violation of JBIC Guidelines for Confirmation of Environmental and Social Considerations and IFC Performance Standard 3, an assessment of renewable energy generation alternatives **is absent** from the 2018 EIA Report for the Vung Ang II Thermal Power Plant Project.

This failure is a fatal flaw of the 2018 EIA Report because a transformation is changing electricity markets in Vietnam, with solar and wind projects rapidly providing ***inexpensive and clean electricity generation*** in a manner that is filling energy demand with minimal environmental and social impacts.

A report published in March of 2020 by the Carbon Tracker Initiative (CTI) finds that **new renewables are cheaper than new coal in all major markets today.** According to CTI:

> "In *Powering Down Coal: Navigating the economic and financial risks in the last years of coal power* published in 2018, we found that declining renewable energy costs and existing carbon and air pollution regulations were already undermining coal as the least-cost option for power generation. Due to price deflation of renewable energy, we concluded that coal generation would become uneconomic in both absolute and relative terms. Regarding the latter, we anticipated that by 2025 at the latest, investments in new renewables would beat new coal investments in all markets. ***Using updated data from publicly available sources, we now believe these conclusions are too conservative. Our analysis finds that the LCOE [levelized cost of electricity] of renewable energy is cheaper than the LCOE of coal in all major markets today.***"[4]

To illustrate its finding, the CTI report shows how today in 2020 new wind projects in Vietnam have an levelized cost of electricity (LCOE) of $58 per megawatt-hour ($/MWh), substantially below the LCOE of $69/MWh for new coal-fired plants. According to section 1.4.8 of the 2018 EIA Report, the total budget for the Vung Ang II Thermal Power Plant Project is about $2 billion. Under circumstances in which the LCOE of new solar and wind energy generation *is less expensive than the LCOE for a new coal-fired plant*, it should be presumed that utility-scale solar and wind projects in Vietnam will meet the basic purpose of a new coal-fired power plant with far less environmental and social impact and fewer economic risks.

These are basic facts that VAPCO should have known prior to its issuance of the EIA Report for the Vung Ang II Thermal Power Plant Project in 2018. In June of 2018, the Green Innovation and Development Centre (Green ID) published a report showing that the LCOE of both ground-mounted solar installations and wind turbines in Vietnam would be at or below the LCOE of

---

https://www.ifc.org/wps/wcm/connect/1f9c590b-a09f-42e9-968c-c050d0f00fc9/PS3_English_2012.pdf?MOD=AJPERES&CVID=jiVQIwF

[4] Carbon Tracker Initiative. 2020. How to waste over half a trillion dollars: The economic implications of deflationary renewable energy for coal power investments (emphasis added). https://carbontracker.org/reports/how-to-waste-over-half-a-trillion-dollars

ultra-supercritical coal-fired power plants by the year 2020.[5] Later in 2018, the CTI published a report concluding that in Vietnam by 2020:

> "… it will be cheaper to invest in new solar PV than new coal and 2022 for onshore wind. This represents the first inflection point when new investments in coal capacity become economically uncompetitive relative to new investments in renewable energy. These changing cost dynamics call into question over 30 GW or $40 bn of planned coal investments in Vietnam and the long-term role of the existing fleet to deliver an economic return to investors."[6]

The EIA process should have included an assessment of alternatives that incorporated this critical information.

## 2. The wrong model is used to predict air quality impacts

Coal-fired power plants emit large quantities of air pollutants, including particulate matter (PM), sulfur dioxide ($SO_2$) and nitrogen oxides ($NO_x$). In the 2018 EIA Report, VAPCO estimates that the proposed Vung Ang II Thermal Power Plant would emit 56.9 grams per second of PM, 227 grams per second of $SO_2$, and 478 grams per second of $NO_x$. At full operation of 8760 hours per year, this equates to emissions of 1794 metric tons per year of PM; 7177 metric tons per year of $SO_2$; and 15074 metric tons per year of $NO_x$.

These large quantities of emissions have the potential to increase concentrations of pollutants in ambient air to an extent that adversely impacts human health. For this reason, it is international best practice to quantitatively predict how pollutant emissions from a proposed thermal power plant might impact ambient air quality. According to the United States Environmental Protection Agency:

> "In evaluating the potential impacts of a power generation or transmission project on ambient air quality, prediction should be made to determine the extent to which ambient air quality standards may be compromised. The predictions should assess the likelihood of air pollution from the plant, dumps, and materials storage and handling facilities, identify the areas of maximum impact, and assess the extent of the impacts at these sites. Although analytical approaches can be used, international experience indicates that numeric modeling is the most appropriate method to evaluate the impacts of a power generation or transmission project on air resources. Quantitative

[5] GreenID. 2018. "A blueprint for Vietnam's Clean Energy Future." http://en.greenidvietnam.org.vn//app/webroot/upload/admin/files/Khuyen%20nghi%20chinh%20sach%20Eng_compressed(1).pdf

[6] Carbon Tracker Initiative. 2018. Economic and financial risks of coal power in Indonesia, Vietnam and the Philippines. https://carbontracker.org/reports/economic-and-financial-risks-of-coal-power-in-indonesia-vietnam-and-the-philippines/

models can be used to calculate contaminants in air and to compare the results to numerical air quality standards.

At the facility level, impacts should be estimated through qualitative or quantitative assessments by the use of baseline air quality assessments and atmospheric dispersion models to assess potential ground level concentrations. Local atmospheric, climatic and air quality data should be applied when modeling dispersion."[7]

Similarly, according to the IFC:

"At facility level, impacts should be estimated through qualitative or quantitative assessments by the use of baseline air quality assessments and atmospheric dispersion models to assess potential ground level concentrations. Local atmospheric, climatic, and air quality data should be applied when modeling dispersion, protection against atmospheric downwash, wakes, or eddy effects of the source, nearby13 structures, and terrain features. The dispersion model applied should be internationally recognized, or comparable. Examples of acceptable emission estimation and dispersion modeling approaches for point and fugitive sources are included in Annex 1.1.1. These approaches include screening models for single source evaluations (SCREEN3 or AIRSCREEN), as well as more complex and refined models (AERMOD OR ADMS). Model selection is dependent on the complexity and geomorphology of the project site (e.g. mountainous terrain, urban or rural area)."[8]

As detailed below, the 2018 EIA Report for the proposed Vung Ang II Thermal Power Plant fails to accurately assess potential ground level concentrations because of its wrong choice of an atmospheric dispersion model. Pages 156 and page 209 of the 2018 EIA Report state that VAPCO used a Japanese air pollutant dispersion model (Ministry of Economy, Trade and Industry Low Rise Industrial Source Dispersion Model METI-LIS Model Ver. 2.02) for predicting air quality impacts of the proposed Vung Ang II Thermal Power Plant: Pages 156 states:

"Dự báo phát thải bụi và khí thải qua ống khói được sử dụng mô hình Metilis với các thông số đầu vào về khí tượng thuỷ văn, địa hình, yếu tố ảnh hưởng đến khí quẩn, và không gian lưới tiếp nhận được mô tả như sau: …

**Địa hình**

[7] United States Environmental Protection Agency. 2011. EIA Technical Review Guidelines: Energy Generation and Transmission, Volume I, CAFTA-DR, USEPA, USAID, EPA/315R11001. https://www.epa.gov/sites/production/files/2014-04/documents/energyvol1.pdf

[8] International Finance Corporation. 2007. Environmental, Health, and Safety Guidelines: General EHS Guidelines: Environmental Air Emissions and Ambient Air Quality. 17 pp. p. 4. https://www.ifc.org/wps/wcm/connect/4e01e089-ad1a-4986-b955-e19e1f305ff0/1-1%2BAir%2BEmissions%2Band%2BAmbient%2BAir%2BQuality.pdf?MOD=AJPERES&CVID=ls0KF2J

Địa hình xung quanh có thể tác động đáng kể đến mức độ phân tán của khói. Cao độ của địa hình vượt 10% cần phải được bao gồm trong mô hình và trong biên chiều cao của của địa hình đồi. Do đặc trưng địa hình đồi núi khu vực xung quanh, số liệu về địa hình được tính đến trong mô hình phân tán.

Có thể thấy rằng khu vực xung quanh vị trí dự kiến của nhà máy có cao độ đáng kể, trên 360m về phía bắc của thôn Tây Yên và phía nam của nhà máy và dao động trong khoảng 240m đến 310m về phía tây nam của nhà máy (Hình 3.3). Dữ liệu chi tiết về địa hình sử dụng cho mô hình được trình bày trong Phụ lục 3.6.

Vì nhà máy được đặt tại bờ biển và dưới 50% diện tích khu vực trong bán kính 3km của ống khói được dùng làm khu thương mại, khu dân cư và sản xuất công nghiệp, do đó, các tham số tính toán được đặt trong mô hình ở điều kiện khu vực nông thôn.

**Khí quẩn từ các khu nhà**

Những khu nhà xung quanh có thể ảnh hưởng đến việc phân tán khói thông qua hiện tượng gọi là khí quẩn. Bất cứ tòa nhà nào có chiều cao nhiều hơn một phần ba của nguồn thải đều có khả năng ảnh hưởng đến sự phân tán khói thải. Chiều cao ống khói theo tiêu chuẩn kỹ thuật là chiều cao của ống khói tại đó khói thải sẽ không bị ảnh hưởng bởi khí quẩn từ các khu nhà.

Với chiều cao ống khói khoảng 210m, chiều cao ống khói theo tiêu chuẩn kỹ thuật, được tính bởi mô hình và dựa trên hướng của các khu nhà xung quanh, không nhỏ hơn chiều cao thật của ống khói, do đó, các khu nhà sẽ không ảnh hưởng đến nồng độ phát thải tại mặt đất."

ENGLISH TRANSLATION

"The METI–LIS model is used to forecast dust and exhaust gas emissions from smoke-stacks with the input parameters on meteorology and hydrology, topography, factors affecting the trapped air and receiving grid spaces as follows: …

**Topography**

The surrounding terrain may have significant impacts on the dispersion of smoke. Terrain elevation of over 10% must be included in the model and in the height boundary of the hilly terrain. Considering the hilly terrain in the surrounding area, topographical data are taken into account in the dispersion model.

It can be seen that the area around the proposed location of VA2 Plant has significant elevation of over 360 meters to the north of Tay Yen Village and to

the south of the Plant. The elevations range from 240 meters to 310 meters to the southwest of the plant. (Figure 3.3). Detailed data on the terrain used for the model are presented in Appendix 3.6.

The Plant is situated on the coast and less than half of the area of no more than 3 kilometers of the smoke-stacks is for commercial, residential and industrial production purposes so the calculation parameters are set in the model applied for rural areas.

**Trapped air in residential clusters**

Surrounding residential clusters may affect the dispersion of smoke, causing the phenomenon known as trapped air. Any buildings that are higher than a third of the height of emission sources can possibly affect the dispersion of exhaust smoke. The height of smoke-stacks compliant with technical regulations ensures that exhaust smoke is not influenced by the air trapped in residential clusters.

The height of the Plant's smoke-stacks is 210 meters which complies with technical regulations. It is calculated based on a model and directions of surrounding residential clusters. Therefore, the clusters will have no impacts on ground-level emission concentrations."[9]

Page 209 of the 2018 EIA report states:

"Mô hình METI_LIS: Trong dự báo lan truyền ô nhiễm không khí, báo cáo đã sử dụng mô hình METI-LIS được xây dựng bởi Bộ Kinh tế-Thương mại và Công nghiệp Nhật Bản (Ministry of Economy, Trade and Industry - METI) từ năm 1996. Mô hình lan truyền METI-LIS là mô hình dạng Gauss (Gaussian dispersion model) được hình thành trên cơ sở mô hình Industrial Sources Complex ISC của Ủy ban Bảo vệ Môi trường Mỹ (Environmental Protection Agency- EPA). ISC là mô hình mang tính pháp quy ở Mỹ và được sử dụng rộng dãi trên thế giới.

METI đã phát triển, đưa vào sử dụng mô hình METI-LIS, khi vấn đề nhiễm bẩn không khí được đưa vào Đạo luật Ngăn ngừa Ô nhiễm Không khí (Air Pollution Prevention Act ) tại Nhật Bản. Hàng lọat các thực nghiệm trong ống khí động và trên hiện trường với mô hình đã được tiến hành dưới sự bảo trợ của METI, phiên bản pilot METI-LIS đã được đưa ra năm 2001. Phiên bản 2 của METI-LIS 2.02 năm 2005 - với nhiều cải thiện trong trong phần mềm cả về nội dung lẫn hình thức, với nhiều công cụ thân thiện hơn cho người sử dụng.

[9] VAPCO. 2018. Vung Ang II Thermal Power Plant Project Environmental Impact Assessment (2018 EIA Report). Chapter 3: Evaluation and Forecast of the Environmental Impacts of the Project. 130 pp. for Chapter 3. pp. 157-158.

> METI-LIS là phần mềm được sử dụng rộng rãi để nghiên cứu, đánh giá lan truyền chất ô nhiễm từ các NMNĐ ở Nhật Bản (Phụ lục 3.7)."

ENGLISH TRANSLATION:

> "METI_LIS model: In the forecast of air pollution dispersion, the report used the METI-LIS model developed by the Ministry of Economy, Trade and Industry (Ministry of Economy, Trade and Industry - METI). since 1996. The METI-LIS propagation model is a Gaussian dispersion model formed on the basis of the Industrial Sources Complex ISC model of the US Environmental Protection Agency (EPA). ISC is a legal model in the US and widely used in the world.
>
> METI has developed and put into use the METI-LIS model, when air pollution is introduced into the Air Pollution Prevention Act in Japan. A series of aerodynamic and field experiments with models were conducted under the auspices of METI, a pilot version of METI-LIS was launched in 2001. Version 2 of METI-LIS 2.02 in 2005 - with many improvements in software both in content and appearance, with more user-friendly tools.
>
> METI-LIS is a widely used software to study and assess the spread of pollutants from thermal power plants in Japan (Appendix 3.7)."

Contrary to the claim made in the 2018 EIA Report**, METI-LIS <u>is not</u> a preferred or recommended air pollutant dispersion model of the U.S. EPA for predicting air quality impacts from a proposed industrial facility**. The only two preferred or recommended air pollutant dispersion models for land-based polluting facilities are the AERMOD Modeling System and the Complex Terrain Dispersion Model Plus Algorithms for Unstable Situations (CTDMPLUS).[10]

More importantly, METI-LIS was the wrong choice of a pollutant dispersion model because of the complex terrain in which the proposed Vung Ang II Thermal Power Plant is situated. The proposed location of the facility is on the shoreline within a few hundred meters of hills that rise to more than 300 meters (see Google Earth satellite image below dated 20 April 2019). This topography is highly likely to trap air pollutants emitted from the proposed power plant, especially when winds are calm and shortly after sunrise when cooler sea and land surfaces reduce the height of mixing layer into which pollution plumes from a stack can disperse.

[10] U.S. EPA Support Center for Regulatory Atmospheric Modeling, Air Quality Dispersion Modeling - Preferred and Recommended Models.
https://www.epa.gov/scram/air-quality-dispersion-modeling-preferred-and-recommended-models


The height of the proposed combined stacks that emit pollutants from the Vung Ang II Thermal Power Plant is 210 meters, *which is lower than the height of the nearby hills*. When a polluting facility is located near to hills higher than its stack, then the facility is located in what air pollution modeling experts call *complex terrain*. According to the published operation manual for METI-LIS, this air pollutant dispersion model should NOT be used for facilities located in complex terrain, but only for facilities in simple terrain.[11]

F. Terrain Considerations

With certain restrictions, METI-LIS Ver. 2 can take into account terrain effects based on the USEPA ISC3 model. Note the following restrictions on the handling of terrain effects by METI-LIS Ver. 2.

- Buildings are not included
- Simple terrains

"Simple terrains" means:

A = the elevation of the calculation point

is less than

B = stack elevation + actual stack height

i.e., A < B.

[11] Research Center for Chemical Risk Management National Institute of Advanced Industrial Science and Technology. 2005. Japanese Ministry of Economy, Trade and Industry Low Rise Industrial Source Dispersion Model METI-LIS Model Ver. 2.02 Operation Manual. 87 pp. p. 87. https://www.aist-riss.jp/projects/METI-LIS/20050630METI-LIS%20Operation%20Manual.pdf

Therefore, the use of METI-LIS in non-simple terrain, such as when elevation of land surrounding a polluting facility is higher than the facility's stack, is beyond the scope of how METI-LIS can be used. VAPCO's wrong choice of a pollutant dispersion model is the reason why predicted air pollutant concentrations presented in the 2018 EIA Report do not reflect the well-known effect of how nearby higher elevations trap air pollution plumes emitted by stacks. See, for example, Figure 3.5 of the 2018 EIA Report (below), which shows the absence of any impact of the nearby higher elevations on predicted annual levels of $PM_{10}$.[12]

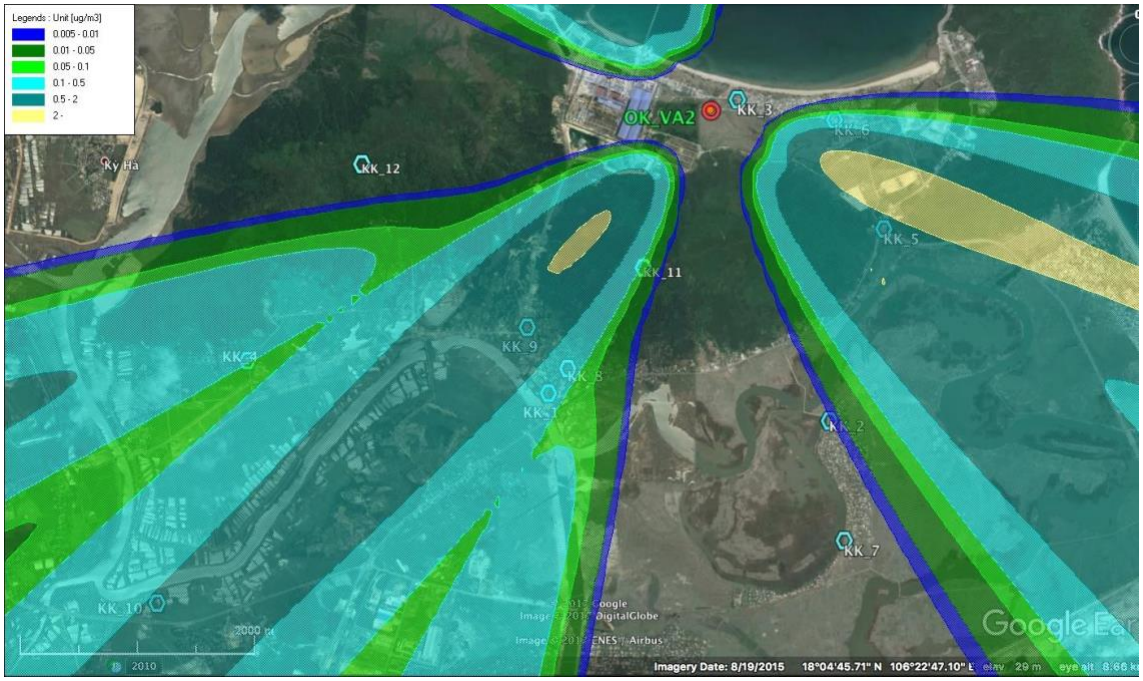



**Figure 3. 5- Annual $PM_{10}$ concentrations in the scenario of normal operation of VA2 Plant.**

In our opinion, it is implausible that nearby higher elevations would have no impact on levels of $PM_{10}$. The wrong choice of METI-LIS as a model renders meaningless the predictions of air quality impacts presented in the EIA. In our opinion, the wrong choice of an air pollutant dispersion model in this instance substantially underestimates pollutant levels during periods of time when winds are calm, and shortly after sunrise when cooler sea and land surfaces reduce the height of mixing layer into which pollution plumes from a stack can disperse.

## 3. Emission standards for the project are significantly weaker than equivalent international ones

According to the 2018 EIA Report at page 148, the proposed Vung Ang II Thermal Power Plant would comply with the following Vietnamese emissions standards: a limit of 50 mg/$Nm^3$ for emissions of $PM_{10}$; a limit of 200 mg/$Nm^3$ for emissions of $SO_2$; and a limit of 455 mg/$Nm^3$ for emissions of $NO_x$.

[12] 2018 EIA Report, Chapter 3, p. 163.

| *Nồng độ chất thải (mg Nm$^{-3}$)* [a] | |
|---|---|
| $NO_x$ [e] | 455 |
| $PM_{10}$ | 50 |
| $SO_2$ | 200 |

These emissions standards are substantially weaker than those required internationally, including by the European Union, which require adherence to the following limits for new coal-fired power plants larger than 300 MW: a limit of no more than 5 mg/Nm$^3$ for emissions of $PM_{10}$; a limit of no more than 75 mg/Nm$^3$ for emissions of $SO_2$; and a limit of no more than 85 mg/Nm$^3$ for emissions of $NO_x$ on a yearly average basis.[13]

**Table 10.3: BAT-associated emission levels (BAT-AELs) for $NO_X$ emissions to air from the combustion of coal and/or lignite**

| Combustion plant total rated thermal input ($MW_{th}$) | BAT-AELs (mg/Nm$^3$) | | | |
|---|---|---|---|---|
| | Yearly average | | Daily average or average over the sampling period | |
| | New plant | Existing plant (1) | New plant | Existing plant (2) (3) |
| < 100 | 100–150 | 100–270 | 155–200 | 165–330 |
| 100–300 | 50–100 | 100–180 | 80–130 | 155–210 |
| ≥ 300, FBC boiler combusting coal and/or lignite and lignite-fired PC boiler | 50–85 | < 85–150 (4)(5) | 80–125 | 140–165 (4) |
| ≥ 300, coal-fired PC boiler | 65–85 | 65–150 | 80–125 | < 85–165 (5) |

**Table 10.4: BAT-associated emission levels (BAT-AELs) for $SO_2$ emissions to air from th combustion of coal and/or lignite**

| Combustion plant total rated thermal input ($MW_{th}$) | BAT-AELs (mg/Nm$^3$) | | | |
|---|---|---|---|---|
| | Yearly average | | Daily average | Daily average or average over the sampling period |
| | New plant | Existing plant (1) | New plant | Existing plant (2) |
| < 100 | 150–200 | 150–360 | 170–220 | 170–400 |
| 100–300 | 80–150 | 95–200 | 135–200 | 135–220 (3) |
| ≥ 300, PC boiler | 10–75 | 10–130 (4) | 25–110 | 25–165 (5) |
| ≥ 300, Fluidised bed boiler (6) | 20–75 | 20–180 | 25–110 | 50–220 |

**Table 10.6: BAT-associated emission levels (BAT-AELs) for dust emissions to air from the combustion of coal and/or lignite**

| Combustion plant total rated thermal input ($MW_{th}$) | BAT-AELs (mg/Nm$^3$) | | | |
|---|---|---|---|---|
| | Yearly average | | Daily average or average over the sampling period | |
| | New plant | Existing plant (1) | New plant | Existing plant (2) |
| < 100 | 2–5 | 2–18 | 4–16 | 4–22 (3) |
| 100–300 | 2–5 | 2–14 | 3–15 | 4–22 (4) |
| 300–1 000 | 2–5 | 2–10 (5) | 3–10 | 3–11 (6) |
| ≥ 1 000 | 2–5 | 2–8 | 3–10 | 3–11 (7) |

[13] Directive 2010/75/EU of the European Parliament and of the Council of 24 November 2010 on industrial emissions (integrated pollution prevention and control) https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32010L0075&from=EN

## 4. The proposed manner of handling coal combustion residuals violates IFC guidelines

The wet disposal of coal combustion residuals (fly ash and bottom ash) vastly increases the environmental footprint of a coal-fired power plant. Wet disposal of ash: 1) wastes water; 2) creates potential fugitive sources of particulate matter from portions of the ash disposal site that dry out; 3) creates the potential for groundwater and surface water contamination by contaminants that can leach from the ash disposal site; and 4) creates a risk to public safety if the ash disposal site containment fails or is flooded.

Google Earth satellite images of the Vung Ang I power plant reveals a wet ash disposal site with a considerable environmental footprint, covering an area of more than 20 hectares.


For this reason, international best practice dictates that wet handling of ash be avoided. According to the IFC:

> "Recommended water treatment and wastewater conservation methods are discussed in Sections 1.3 and 1.4, respectively, of the **General EHS Guidelines**. In addition, recommended measures to prevent, minimize, and control wastewater effluents from thermal power plants include:
>
> […]
>
> - "Collection of fly ash in dry form and bottom ash in drag chain conveyor systems in new coal-fired power plants; …."[14]

[14] International Finance Corporation. 2008. Environmental, Health, and Safety Guidelines for Thermal Power Plants. 33pp. p. 11. https://www.ifc.org/wps/wcm/connect/f82a5f06-f3f7-4033-8ea6-b767523cda8e/FINAL_Thermal%2BPower.pdf?MOD=AJPERES&CVID=jqeD9Eg&id=1323162579734

In violation of this international best practice, VAPCO is proposing continuation of wet ash handling for the proposed Vung Ang II Thermal Power Plant. Page 33 of the 2018 EIA report states:

> "Bãi chứa xỉ có diện tích 49,4 ha - Tro xỉ thải tại nhà máy nhiệt điện sẽ được chở bằng xe tải hoặc qua đường ống thải tro (tùy chọn) đến bãi tro xỉ nằm dưới chân núi Ngà Voi và núi Cao Vọng, phía bắc sông Quyền, cách Dự án khoảng 3 km về phía tây nam. Bãi chứa xỉ sẽ được trải hai lớp đất sét và một lớp vải địa kỹ thuật ở giữa nhằm tránh việc rò rỉ nước thải gây ô nhiễm nước ngầm."

ENGLISH TRANSLATION

> "The ash pond covers an area of 49.4 hectares. The plant's ash and slag is transported by trucks or designated pipelines (optional) to the ash pond at the foot of Nga Voi and Cao Vong mountains in the north of Quyen River and about 3 km from the southwest of the Project area. The pond is lined with two clay layers and a geotechnical cloth layer in the middle to prevent wastewater leakage that may contaminate ground water."[15]

To comply with international best practice, the proposed Vung Ang II Thermal Power Plant must adopt a system of dry handling of ash that maximizes the potential for the beneficial reuse of this high volume of waste.

## 5. The proposed discharge of thermal effluent is a violation of IFC guidelines

According to the IFC:

> "38. […] thermal power plants with steam power generators and once-through cooling systems use significant volumes of cooling water for condensing steam turbine exhaust and cooling auxiliary equipment. The heated cooling water is normally returned to the source water (*i.e.*, river, lake, estuary or the ocean) or the nearest surface water body.
>
> 39. Due to the biological sensitivity of many aquatic organisms to water temperature, temperature increases caused by power plant discharges may have multiple impacts on aquatic ecosystems. The effects of thermal discharges on the water environment can be sub-divided into direct effects (those organisms directly affected by changes in the temperature regime) and indirect effects (those arising in the ecosystem as a result of the changes in the organisms directly affected).
>
> 40. The direct effects of thermal discharges on the water environment include: change to the temperature regime of the water column and, in some cases, the sediment; lethal (temperatures above the critical thermal maximum create uninhabitable conditions)

[15] 2018 EIA Report. Chapter 1: Description of the Project. 42 pp. for Chapter 1. p. 33.

and sub-lethal (inhibited biological processes and stress) responses of water body organisms to the change in temperature regime; stimulation in productivity in a range of organisms resulting in increased respiration rates; reduction in the dissolved oxygen. The indirect effects of thermal discharges on the water environment include: changes in the distribution, composition and growth rates of communities of water body organisms including fish and macroinvertebrates; impacts on the distribution of bird populations reliant on these organisms; and altered nutrient and carbon cycling.

41. In general, thermal discharge should be designed to ensure that discharge water temperature does not result in exceeding relevant ambient water temperature standards outside a scientifically established mixing zone. The mixing zone is typically defined as the zone where initial dilution of a discharge takes place within which relevant water quality temperature standards are allowed to exceed and takes into account cumulative impact of seasonal variations, ambient water quality, receiving water use, potential receptors and assimilative capacity among other considerations. Establishment of such a mixing zone is project specific and may be established by local regulatory agencies and confirmed or updated through the project's EA process. Thermal discharges should be designed to prevent negative impacts to the receiving water taking into account the following criteria:

- The elevated temperature region caused by thermal discharge from the project should not impair the integrity of the water body as a whole or endanger sensitive areas (such as recreational areas, breeding grounds, or areas with sensitive biota);

- There should be no lethality or significant impact to breeding and feeding habits of organisms passing through the elevated temperature areas; and

- There should be no significant risk to human health or the environment due to the elevated temperature or residual levels of water treatment chemicals."[16]

In summary:

> "The effluent should result in a temperature change of no more than 3°C at the edge of a scientifically established mixing zone which takes into account ambient water quality, receiving water use, potential receptors, and assimilative capacity. The EA for a specific project may specify a more stringent temperature change guideline."[17]

In violation of this standard, the 2018 EIA Report shows that thermal discharges from the proposed Vung Ang II Thermal Power Plant would raise ambient water temperatures by more

[16] International Finance Corporation (IFC). 2017. Environmental, Health, and Safety Guidelines for Thermal Power Plants: Draft for Second Public Consultation. 61 pp. pp. 17-19 (internal footnotes omitted). https://www.ifc.org/wps/wcm/connect/9ec08f40-9bc9-4c6b-9445-b3aed5c9afad/Thermal+Power+Guideline+2017+clean.pdf?MOD=AJPERES&CVID=lNwcJZX

[17] IFC 2017, p. 31.

than 3°C in the dry season (November)**,** over an elliptical area with a length of more than 500 meters, far exceeding the size of a scientifically established mixing zone. See Figure 3-19 of the 2018 EIA Report below.

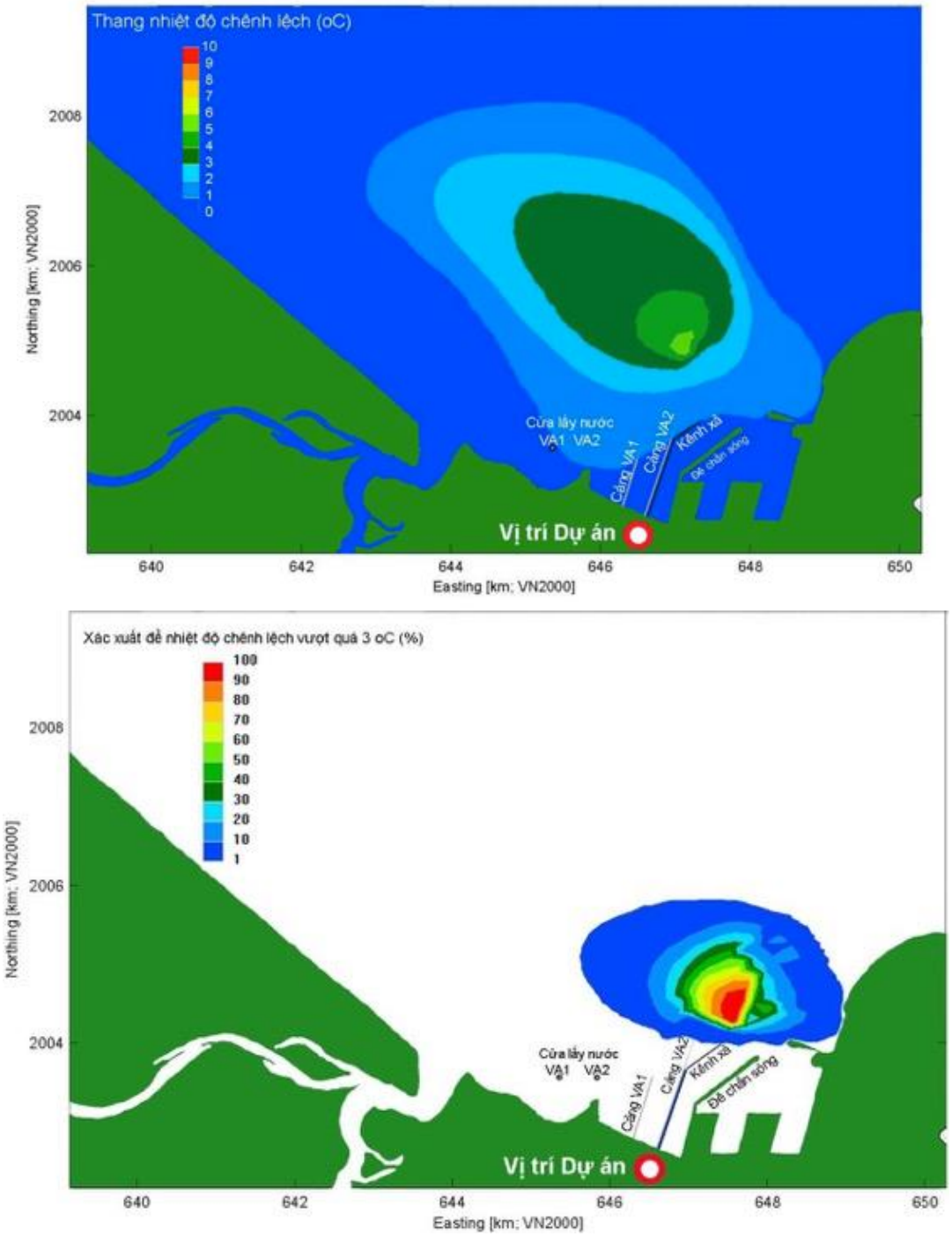



**Figure 3. 19- Simulation of heat transfer scenario (in November) and the probability of over 3 °C temperature difference[18]**

[18] 2018 EIA Report, Chapter 3, p. 185.

The 2018 EIA Report discusses these temperature increases as follows:

> "Đồ thị biểu diễn đường đồng mức cho mùa khô (tháng 11) cho thấy khối nước nóng tiến sát về phía đông nam của cảng/đê chắn sóng và bờ biển. Nước nóng không đi vào bờ (Hình 3.19). Một phần nhiệt lượng sẽ quay trở lại điểm lấy nước làm mát. Trong suốt mùa khô, nhiệt độ tăng thêm trung bình tại điểm lấy nước khoảng 0,45°C, biên dao động trong khoảng từ 0 đến 1,33°C.
>
> Hai kịch bản trên được tóm tắt trong phần thống kê theo dạng hình lan truyền nhiệt (Hình 3.18 và Hình 3.19) trong khoảng thời gian mô phỏng là 30 ngày. Những giá trị thống kê cho thấy tỉ lệ phần trăm số lần nhiệt độ vượt giá trị được quy định trong suốt thời gian mô hình hóa. Trong mùa mưa, vùng hoà trộn có nhiệt độ gia tăng lớn hơn 3 °C là lớn hơn hướng dẫn của IFC (IFC quy định khoảng cách là 100m), với khoảng cách vùng có lưỡi nhiệt gia tăng lớn hơn 3 °C là 560m với xác suất xuất hiện là 90%. Trong mùa khô, giá trị tương ứng là 360m
>
> Theo hướng dẫn của IFC cho phép vùng hòa trộn lớn hơn 100m trên danh nghĩa nếu "không có hệ sinh thái nhạy cảm trong nước" hiện hữu trong vùng hòa trộn. Cần lưu ý rằng thiết kế của cống xả là tăng khả năng xả nước nóng vào môi trường bằng cách nâng nhiệt độ bề mặt và do đó, nhiệt độ chênh lệch sẽ khuếch tán vào không khí. Hơn nữa, khối nước nóng có khuynh hướng phân tầng, điều này cho phép những sinh vật đáy có thể tồn tại bên dưới khối nước nóng. Khu vực chịu tác động của nước thải làm mát từ Dự án phần lớn nằm trong khu vực tuyến luồng và khu nước trước bến của Cảng nhập than, có mục đích sử dụng công nghiệp do vậy sẽ không gây tác động đáng kể đến môi trường.
>
> Khu vực nhận nước thải làm mát từ NMNĐ Vũng Áng II không có những nguồn tiếp nhận nhạy cảm là vùng sinh thái nhạy cảm, hữu ích và cũng không có các khu vui chơi, giải trí thể thao dưới nước trong khu vực gần, kế cận với điểm xả thải đề xuất và trong phạm vi khoảng cách này trong vịnh Vũng Áng. Dự báo không có sự vi phạm trong cả mùa khô lẫn mùa mưa và nhiệt độ xả thải sẽ có ảnh hưởng đáng kể đến hệ sinh thái và nước biển trong vùng hoà trộn. Để giảm thiểu sự ảnh hưởng của nhiệt độ xả thải đối với vùng nước xung quanh, dòng thải nhiệt tương đối lớn có thể giảm xuống bằng cách giảm lưu lượng xả hoặc đưa điểm xả xuống sâu hơn và xa hơn ngoài khơi để tăng mức độ trộn lẫn và pha loãng."

ENGLISH TRANSLATION

> "The chart of temperature contour lines in dry season (in November) reveals that the mass of heated water approached close to the southeast of the port or the breakwater and the coast. The mass does not reach the shore (Figure 3.19). Part of the heat volume will be returned to the cooling water intake point. The average temperature rise in the water intake point in dry season is about 0.45 °C with a fluctuation range of 0 to 1.33 °C.

The scenarios are summarized in the heat transfer model statistics (Figures 3.18 and 3.19) over a 30-day simulation period. Statistical data show the percentage of times when the temperature exceed the designated values during the modeling process. In rainy season, the interleaved region records a temperature increase of more than 3 °C, higher than the IFC guidelines. IFC specifies a distance of 100 meters for temperature increase while the distance of the area with more than 3 °C increase is 560 meters and the chance of temperature increase is 90%. The distance is 360 meters in dry season.

According to the IFC guidelines, the distance from the interleaved region is 100 meters in principle if "no sensitive ecosystems in the water" present in the interleaved region. It should be noted that the drain is designed to enhance the discharge capacity of heated water into the environment by increasing the temperature of surface water so that the temperature difference will enable heat dispersal into the air. In the meantime, masses of heated water tends to be stratified so benthos can survive beneath the masses. The area affected by the Project's cooling waste water is largely located in the streams and water area in front of the coal import port. It is for industrial purposes and will not have significant environmental impacts.

The area that receives cooling waste water from VA2 Plant does not have any sensitive receiving sources which are sensitive, significant ecological areas. There are also no underwater playgrounds, recreational and sports areas near or close to the proposed discharge points and within the scope of distance in Vung Ang Bay. No violations of the national technical regulation are expected in both dry and rainy seasons. Temperature of discharge water will have a major impact on the ecosystems and seawater in the interleaved region. To mitigate the impacts of temperature on surrounding water areas, the relatively high temperatures of discharge flows can be brought down by reducing the discharge flow rate or bringing the discharge point to a lower and further offshore in order to increase the mixing and diluting levels."[19]

However, the IFC Guidelines do not offer a relaxation of the standard even for areas deemed to be for industrial purposes. Moreover, the 2018 EIA Report contains water quality data that contradict the claim that the area that would be impacted by thermal discharges should be characterized as industrial. The 2018 EIA Report states:

"***2.1.4.4. Chất lượng nước biển***
Các mẫu nước biển ven bờđược lấy tại các vị trí có thể bịảnh hưởng trực tiếp do quá trình xây nhà máy, vận chuyển nguyên vật liệu từ cảng Vũng Áng. Các mẫu sẽđược dùng để làm cơ sở so sánh chất lượng nước biển ven bờ trước, trong quá trình xây dựng nhà máy và sau khi dự án vận hành. Chất lượng nước biển ven bờđược thể hiện ở bảng 2.12.

[…]

[19] 2018 EIA Report, Chapter 3, pp. 182-183.

Nhận xét:
Qua kết quả phân tích, so sánh QCVN 10-MT:2015/BTNMT và qua quan sát thực tế thấy rằng chất lượng nước biển gần bờ tại khu vực dự án chưa có dấu hiệu ô nhiễm do các hoạt động công nghiệp, chất lượng nước đạt tiêu chuẩn cho các mục đích sử dụng khác nhau (không bao gồm các mục đích bảo tồn, du lịch và hoạt động thể thao)."

ENGLISH TRANSLATION

"***2.1.4.4. Seawater quality***

Coastal seawater samples were collected at locations that may be directly affected by the plant construction and material transportation from Vung Ang Port. They are used as the basis to evaluate the seawater quality before and during the plant construction as well as following the operation of the plant. Table 2.12 shows the quality coastal seawater.

**Table 2. 12- Analysis results of coastal seawater samples**

| **Parameters** | **Unit** | **Result** | | | | **QCVN 10-MT:2015/ BTNMT (Coastal)** |
|---|---|---|---|---|---|---|
| | | NB1 | NB2 | NB3 | NB4 | |
| **pH** | - | 8.1 | 8 | 8.1 | 8.1 | 6.5-8.5 |
| **Temperature** | oC | 21 | 22 | 21 | 21 | - |
| **TSS** | mg/l | 26 | 18 | 18 | 24 | - |
| **Salinity** | % | 22 | 22.5 | 22.4 | 22.2 | - |
| **Turbidity** | NTU | 16 | 12 | 18 | 14 | - |
| **DO** | mg/l | 6.8 | 7 | 7.2 | 6.8 | - |
| **COD** | mg/l | 14.6 | 14.2 | 11.8 | 13.2 | - |
| **BOD5** | mg/l | 6.2 | 7.4 | 5.8 | 6.2 | - |
| **Ammonia** | mg/l | <0,02 | <0,02 | <0,02 | <0,02 | 0.5 |
| **Hg** | mg/l | <0.001 | <0.001 | <0.001 | <0.001 | 0.005 |
| **Pb** | mg/l | <0,002 | <0,002 | <0,002 | <0,002 | 0.1 |
| **As** | mg/l | 0.008 | 0.012 | 0.013 | 0.014 | 0.05 |
| **Fe** | mg/l | <0,2 | <0,2 | <0,2 | <0,2 | 0.5 |
| **Zn** | mg/l | <0,01 | <0,01 | <0,01 | <0,01 | 2 |

| | | | | | | |
|---|---|---|---|---|---|---|
| **Cu** | mg/l | <0,01 | <0,01 | <0,01 | <0,01 | 1 |
| **Cd** | mg/l | <0,002 | <0,002 | <0,002 | <0,002 | 0.01 |
| **Cr (6)** | mg/l | <0,01 | <0,01 | <0,01 | <0,01 | 0.05 |
| **Total N** | mg/l | 1.6 | 1.4 | 1.6 | 2.8 | - |
| **Total P** | mg/l | 0.6 | 0.5 | 0.4 | 0.5 | - |
| **Coliform** | MPN/100ml | 220 | 160 | 160 | 140 | 1000 |
| **Oil and grease** | mg/l | 0.08 | 0.03 | 0.1 | 0.05 | 0.5 |

Source: CEMM, 2017

**Remarks**:

- (-) means non-regulated;
- *NB1:* Coastal and offshore areas near Vung Ang Perth (N18°06'30,3"; E106°23'17,3");
- *NB2:* Designated cooling water intake area for VA2 Plant (on the right of the headland) (N18°06'17,9"; E106°22'56,3");
- *NB3:* Sea waters to the west and north of the cooling water intake area (N18°06'36"; E106°22'12");
- *NB4:* Sea waters near O Ton Mountain (N18°07'5,45"; Y E106°24'26");

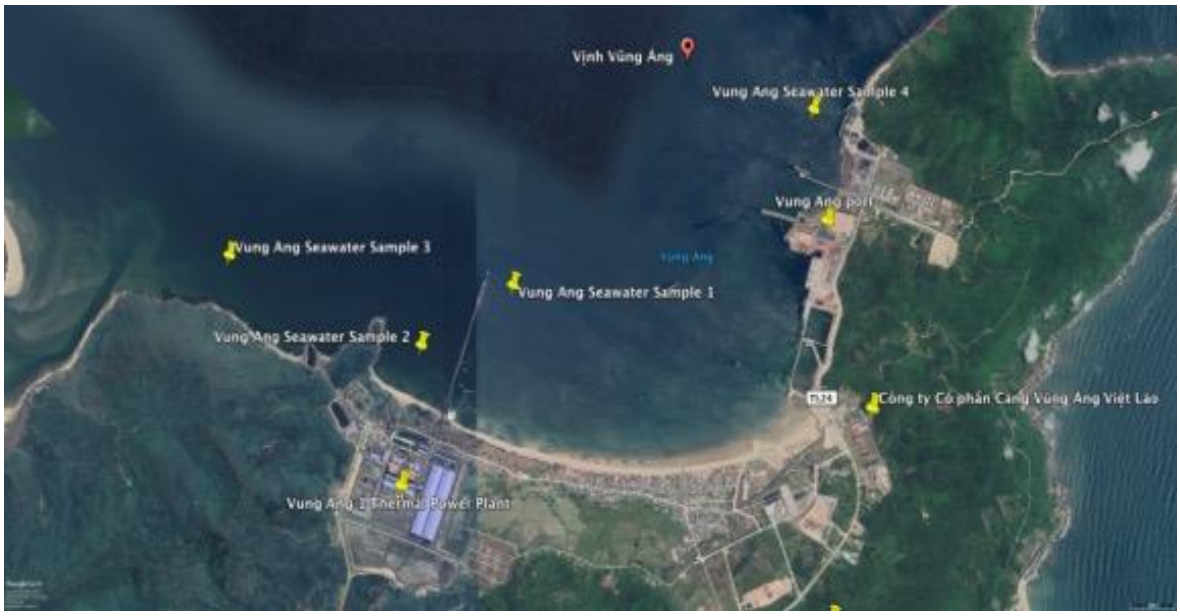
Assessment:

Analysis and comparison results with regulation QCVN 10-MT:2015/BTNMT reveal that coastal seawater quality of the Project area shows no signs of pollution connected to industrial activities.

The water quality meets requirements for different using purposes (excluding conservation, tourism, and sport purposes)."[20]

The proponents appear to be arguing both sides of this debate. The final statement in the EIA Report quoted above suggests that the water does not meet the standards for conservation of marine species or bathing (tourism and sport purposes), yet it shows no sign of industrial pollution, a claim largely borne out by the data presented. Below are the sampling locations for the seawater quality data.

[20] 2018 EIA Report, Chapter 2: Natural, Environmental and Socioeconomic Conditions of the Project Area. 64 pp for Chapter 2. pp. 76-78.




In essence, the water is either polluted by industrial activities or it is not. If the coastal seawater quality data from the project area show no signs of pollution connected to industrial activities—what the proponents claim and the data confirm—then it is especially imperative that IFC limits on thermal discharges be adhered to.

Further, there is strong scientific evidence that significant biological impacts occur when temperatures are elevated even fewer than 3°C.[21] One paper that examined the impact of elevated temperatures on plankton near a power station in Malaysia concluded that:

> "Tolerant small crustaceans, salps and larvaceans likely benefited from elevated temperature, reduced pH and shift to a more significant microbial loop exacerbated by eutrophication, while large crustaceans were more vulnerable to such changes. It is predicted that any further rise in SST will remove more large-bodied crustacean zooplankton, the preferred food for fish larvae and other meroplankton, with grave consequences to fishery production."[22]

In addition to this conclusion, this paper puts the research that has been done on the impacts of power stations into helpful context, stating:

> "Power plants that abstract seawater to cool down its superheated power turbines generating electricity have the reputation of not only directly causing massive mortality of marine organisms by impingement and entrainment (Lewis and Seegert, 2000; Greenwood, 2008; Azila and Chong, 2010), but also indirectly killing or undermining

[21] Chew, L. L., V. C. Chong, R. C. S. Wong, P. Lehette, C. C. Ng, and K. H. Loh. 2015. Three decades of sea water abstraction by Kapar power plant (Malaysia): What impacts on tropical zooplankton community? Marine Pollution Bulletin 101(1): 69-84.
[22] Chew *et al*. 2015, p. 69.

organisms via thermal discharges that increase temperature, acidification and chemical pollution of the receiving waters (Bamber and Spencer, 1984; Poornima *et al*., 2005; Ferry-Graham *et al*., 2008; Chuang *et al*., 2009; Coulter *et al*., 2014). A single once-through cooled (OTC) power plant can withdraw millions of cubic meters of cooling-water daily before discharging the heated water including chemical biocides into the sea. Impingement mortality at the intake screens is highly variable, ranging from annual fish deaths of about 13,000 in a 930 MW power plant in USA to 214 million in a 5706 MW power plant in France (see Azila and Chong, 2010). Small nekton and plankton are however subject to entrainment into the power plant's heat-cooling system. The annual entrainment mortality of larval fish is usually very high ranging from 132 million fish eggs and larvae (or 23% of the total ichthyoplankton) through a single small direct-cooled power plant such as at the Wabash River, USA (Lewis and Seegert, 2000) to an estimated 1014 fish larvae in north European waters where 45 large power plants were located (Henderson, 2015).

Discharged thermal waters are 2–12 °C warmer than intake temperatures in temperate regions (Bamber, 1995; Hoffmeyer *et al*., 2005; Coulter *et al*., 2014), 8–12 °C in a subtropical region (Chuang *et al*., 2009), while differences of 7–10 °C are reported in tropical regions (Anton, 1990; Poornima *et al*., 2005; Pokale, 2012). Phytoplankton biomass especially during spring was significantly greater in the intake region than in the outlet region of a nuclear power plant in subtropical Taiwan (Chuang *et al*., 2009). Warmed water seems to limit the growth of more nutritious and palatable large diatom species, but favors the less palatable and small diatom species, cyanobacteria and harmful algae (Hutchins *et al*., 2007). Mortality of copepods, cirriped and crab larvae was higher at the water discharge outlets compared to intake points (Hoffmeyer *et al*., 2005; Choi *et al*., 2012), with increased thermal sensitivity in the presence of chlorine (Choi *et al*., 2012). Warm water also induces high productivity of heterotrophic bacteria in themicrobial loop of marine food webs (Berglund *et al*., 2007; Sarmento *et al*., 2010), which may alter the zooplankton community in such a way that species (for instance, large-sized copepods) that rely on large nutritious diatoms are eliminated from the system, whereas species (small-sized ones) that rely on heterotrophic microbes and small plankton become dominant in the system (Richardson, 2008). Richardson (2008) concluded that the replacement of large-sized copepods by small-sized ones (as well as the blooming of jellyfish and ctenophores) is the likely consequence of sea warming. Striking phenological changes due to sea warming have been documented in temperate waters including for dinoflagellates, diatoms, holozooplankton and meroplanktonic larvae where their seasonal peaks advanced by 23 days, 22 days, 10 days and 27 days, respectively, indicating asynchronous responses to ocean warming that could lead to trophic mismatches in the marine food web (Edwards and Richardson, 2004)."[23]

In summary, the elevated temperatures from the Vung Ang II thermal power plant could negatively impact the entire food web of Vung Ang Bay, including the number of different kinds

[23] Chew *et al*. 2015, pp. 69-70.

of species (richness), the number of individuals of each species (abundance), and the identity of the species (composition).

## 6. The 2018 EIA Report erroneously dismisses the project's impacts on marine species

There are several important flaws related to the EIA Report's assessment of impacts on marine species.

### A. STRATIFIED ELEVATED TEMPERATURE DISCHARGE HARMS THE UPPER WATER LAYER WHERE THE MAJORITY OF PLANKTON ARE FOUND

The 2018 EIA Report states:

> "Theo hướng dẫn của IFC cho phép vùng hòa trộn lớn hơn 100m trên danh nghĩa nếu "không có hệ sinh thái nhạy cảm trong nước" hiện hữu trong vùng hòa trộn. Cần lưu ý rằng thiết kế của cống xả là tăng khả năng xả nước nóng vào môi trường bằng cách nâng nhiệt độ bề mặt và do đó, nhiệt độ chênh lệch sẽ khuếch tán vào không khí. Hơn nữa, khối nước nóng có khuynh hướng phân tầng, điều này cho phép những sinh vật đáy có thể tồn tại bên dưới khối nước nóng. Khu vực chịu tác động của nước thải làm mát từ Dự án phần lớn nằm trong khu vực tuyến luồng và khu nước trước bến của Cảng nhập than, có mục đích sử dụng công nghiệp do vậy sẽ không gây tác động đáng kể đến môi trường."

ENGLISH TRANSLATION

> "According to the IFC guidelines, the distance from the interleaved region is 100 meters in principle if "no sensitive ecosystems in the water" present in the interleaved region. It should be noted that the drain is designed to enhance the discharge capacity of heated water into the environment by increasing the temperature of surface water so that the temperature difference will enable heat dispersal into the air. In the meantime, masses of heated water tends to be stratified so benthos can survive beneath the masses. The area affected by the Project's cooling waste water is largely located in the streams and water area in front of the coal import port. It is for industrial purposes and will not have significant environmental impacts."[24]

First, the 2018 EIA Report appears to have included a blanket statement about no significant impacts without any study or analysis to back the claim, which is a critical failure of the document.

Second, in this system, it appears that the opposite of that claim may be true. Data from Appendix 2.6 of the 2018 EIA Report conducted by the Institute of Ecology and Biological Resources, suggest both that the top layer is where the majority of the plankton in the system

[24] 2018 EIA Report, Chapter 3, p. 183.

are found, and that coastal areas have the richest plankton biodiversity. It is possible that the benthic species (*e.g*., crabs, sponges, corals) may be able to survive in the colder water refuge afforded by the stratified water or—in the case of motile species—move out of the thermally polluted area. But what of the phyto- and zooplankton that make up the foundation of the food web? Appendix 2.6 of the 2018 EIA Report states:

> "Mật độ cao nhất ở tầng 5 - 0 m, thấp ở tầng nước sâu hơn, cao ở thời kỳ chân triều, thấp hơn ở thời kỳ đỉnh triều.
>
> […]
>
> Kết quả phân tích về số lượng động vật phù du ở vùng biển Hà Tĩnh cho thấy thường dao động từ 2200- 2400 con/$m^3$ ở tầng mặt và từ 200-1850 con/$m^3$."

ENGLISH TRANSLATION

> "The density is the highest in the 5-0m layer, low in deeper layers, high in the intertidal period, and lower in the tidal peak. Coastal sea waters have higher zooplankton density than offshore ones.
>
> […]
>
> According to analysis of zooplankton population in Ha Tinh sea, their density ranges from 2,200 to 2,400 creatures/$m^3$ in surface layer and averages 200-1,850 creatures/$m^3$."[25]

The proponents must provide some analysis to support their claim of no significant impacts given that the facts in Appendix 2.6 of the 2018 EIA Report run counter to their assertion.

Further, the mitigation measures proposed to address the impacts from the cooling water are largely not sufficient. The 2018 EIA Report states:

> "*For thermal impacts at the outlet:* The average temperature of cooling water at the intake point into the condenser is about 30°C. The difference between the temperatures of the cooling water at the intake and outlet of the condenser is 8°C. After getting out of the condenser, the cooling wastewater system registers the highest temperature of about 38°C. The water goes through a dedicated disposal system before being pouring into the sea. This means the temperature of the cooling wastewater at the disposal point is lower than the permissible limit of 40°C (QCVN 40 :2011/BTMT). The thermal impacts are minimal and the temperature difference in the treatment

[25] 2018 EIA Report, Appendix 2.6: Survey Report on Coastal and Marine Ecosystems in Vung Ang II Thermal Power Plant Project Area (2018 EIA Report, Appendix 2.6). 18pp. p. 12.

process is small so creatures are able to adapt to the new living conditions. However, constant monitoring is necessary for the big volume of the plant's wastewater.
Where the temperature of cooling seawater > 31°C, turbines/power generators will operate in the time-like convergence condition (TCC) with the following parameters:

- Cooling water temperature °C 31
- Ratio of supplemented water % 3
- Other conditions similar to the rated output (RO).

Where the temperature of cooling seawater is higher, the plant will cut down its output to curb the temperature of discharged cooling water at ≤ 40 °C to comply with regulations."[26]

The one measure that may be effective is the agreement to cut output if the discharging water temperature is too high. Cutting the output means shutting down the plant, which would be a responsible and serious step to take in order to protect the local marine ecosystem. Enforcement of this commitment will be challenging.

**B. INTAKE PIPE PROPOSED IN LIKELY HIGH DIVERSITY AREA FOR FISHES**

The 2018 EIA Report states that:

> "Đối với NMNĐ Vũng Áng II, lưu lượng nước làm mát là khoảng 50 $m^3$/s và được lấy vùng nước biển trong Vịnh Vũng Áng là vùng biển có mục đích sử dụng trong công nghiệp, nên tác động của việc lấy nước làm mát sẽ không có ảnh hưởng đáng kể đến nguồn lợi thuỷ sản ở vùng biển cấp nước làm mát."

ENGLISH TRANSLATION

> "VA2 Plant has a cooling water flow rate of about 50 m3/s. The water is taken from the seawater area in Vung Ang Bay, which is used for industrial purposes. For this reason, the impacts of cooling water intake on aquatic resources in the cooling water supply area are minimal."[27]

Asserting that water is used for industrial purposes says nothing about the quality of the water or what it contains, and therefore cannot address project impacts.

Appendix 2.6. of the 2018 EIA Report states the following about the fishes in the project area:

> "- Nhóm cá nước lợ: Nhóm này có số loài khá nhiều, thành phần phức tạp, nhưng sống chủ yếu trong vùng nước gần bờ độ muối thấp ( thường < 15‰), trong các bãi triều và cửa sông . Đại diện cho nhóm này có các loài: cá lẹp hàm ngắn (*Thirissa dussumieri*), cá

[26] 2018 EIA Report, Chapter 4: Measures to Prevent and Mitigate Negative Impacts. 69 pp for Chapter 4. p. 239-240.
[27] 2018 EIA Report, Chapter 3, p. 192.

lẹp hàm dài (*T. setirostis*) cá đối mục (*Mugil cephalus*), cá đối vây trước (*M. affinis*), cá dìa (*S. ganuscramin*), cá bống thâm, cá bống vây nhỏ (*Oxyurichthys papuensis*).

- Nhóm cá vùng triều: Nhóm cá này đặc trưng là các loài cá kích thước không lớn như cá bống bớp (*Bostrichthis sinensis*), cá nhệch, cá lác *Boleophthalmus pectinirostris*... , tuy nhiên một số loài như cá bống bớp lại đang rất có giá trị cho xuất khẩu."

ENGLISH TRANSLATION

"- Brackish fish: The population of brackish fish is quite big. They have complicated composition of species and do best in water with low salinity (< 15‰). They originate from the foreshore areas or areas in which freshwater meets saltwater. Typical species of this group include: the shortjaw thryssa (*Thirissa dussumieri*), the longjaw thryssa (*T. setirostis*), the flathead grey mullet (*Mugil cephalus*), the mugilidae (*M. affinis*), the siganus (*S. ganuscramin*), goby, and frogface goby (*Oxyurichthys papuensis*);

- Intertidal fish: They are characterized by small-sized fish such as the four-eyed sleeper (*Bostrichthis sinensis*), the snake-eel (*Pisodonophis boro*), the great blue spotted mudskipper (*Boleophthalmus pectinirostris*), etc. Some of them such as the four-eyed sleeper are of high export value."[28]

Using these habitat descriptions, it is extremely likely that the fishes that are brackish and intertidal will be found in the area where the intake pipe has been proposed, based on the location information provided by the EIA. Given that these fishes are both numerous and commercially valuable, it would follow that the proponents should provide some information that would specifically address potential impacts.

Assessing these impacts is not beyond the bounds of scientific research. One study in England studied the entrainment of fishes on the screens of a single power plant for two years and found that:

"*3.1. Catch composition*

A total of 35,559 fish weighing 229.6 kg were collected from approx. 5.58 x $10^6$ $m^3$ of cooling water in 1999 and 101,977 fish weighing 494.5 kg were collected from approx. 5.82 x $10^6$ $m^3$ of cooling water in 2000 (Appendix). There were 40 species or genera identified during sampling. Fish ranged in size from a plaice of 22 mm TL (0.1 g) to a European eel (*Anguilla anguilla*) of 670 mm TL (428.5 g). Median fish size was 85 mm (3.4 g) (5th percentile: 58 mm [0.8 g]; 95th percentile: 140 mm [18.5 g]).

*3.2. Estimates of total numbers and mass of fish killed, January 1999–December 2000*

[28] 2018 EIA Report, Appendix 2.6, p. 14.

> Almost 1.25 x $10^7$ (95% c.i.: 7.10 x $10^6$–2.21 x $10^7$) fish weighing 74.0 t (43.0–127.8 t) were estimated to have been killed on the Longannet intake screens in 1999 (Table 1). Estimates of numbers killed in 2000 were more than threefold higher at 4.41 x $10^7$ (2.30–8.50 x $10^7$), weighing approximately 184.4 t (100.2–340.1 t)."[29]

Interestingly, one of the other conclusions from the study was that:

> "The results from the present study confirm that fish mortality is quite predictable in terms of annual abundance and species richness given knowledge of power station pumping capacity and geographic location (Henderson and Seaby, 2000)."[30]

In other words, the proponents for the Vung Ang II power plant could have conducted this research to assess the potential for real harm to marine species in the area. They chose not to, even though suggesting there will be no impacts without providing data to bolster that claim weakens the credibility of the EIA Report.

Further, they should have provided strong mitigation measures to protect against any negative impact on marine species. But their mitigation is as follows:

> "*For impacts at the intake areas*: The cooling water system is equipped with coarse and fine trash screens that block trash and prevent fish and other creatures from being sucked into the system. According to the design, the speed of water collection at the intake can minimize erosion risks in the area."[31]

*Based on our review of the project documents and the reasons stated herein, we recommend that the 2018 EIA Report for the Vung Ang II power plant be rejected.*

[29] Greenwood, M. F. D. 2008. Fish mortality by impingement on the cooling-water intake screens of Britain's largest direct-cooled power station. Marine Pollution Bulletin 56: 723–739.
[30] Greenwood 2008, p. 731.
[31] 2018 EIA Report, Chapter 4, p. 239.