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Report to Associação Unidos em Defesa de Covas do Barroso (UDCB) on air quality considerations relating to the proposed lithium mine near Covas do Barroso.

Introduction:

This report is a review of documents provided by *Slipstream Resources Portugal Lda.* regarding their proposed lithium mine near Covas do Barroso. My review is focussed on understanding possible air quality effects of the proposed mine.

The documents available to me are listed in the attached bibliography. All documents reviewed are in Portuguese, and I acknowledge that I have only rudimentary ability in that language. In order to minimize the volume of material to be read, I review only extracts dealing with air quality from the full documents. UDCB provided guidance on the relevant extracts.

The review covers the various documents sequentially, and provides an overall conclusion with suggestions for further action by UDCB. I structure my report in six sections, each dealing with the contents of the six documents.

Section 1: (Document 1)

Caracterização da Qualidade do Ar Ambiente

SLIPSTREAM RESOURCES PORTUGAL, LDA. – Projeto de ampliação da Mina do Barroso (dated 2018.10.31).

This is a consultant report prepared for the mine proponents by CENTRO TECNOLOGICO DA CERAMICA E DO VIDRO, a consulting company providing technical services to the ceramic, cement and glass materials industry. The company has no apparent expertise in ambient meteorological and air quality monitoring. The stated objective of the report is:

"….. to provide a preliminary assessment of the baseline situation for ambient air quality by carrying out a 14-day monitoring campaign for suspended particulate matter (PM10 fraction) at a sensitive point in the vicinity of the Barroso Mine."

The report details the operation of a suite of standard meteorological instruments, and a PM_{10} monitor at a single location in the outskirts of Covas do Barroso. Judging by the topographic map and site photographs (provided in the report) The instruments are located in an agricultural/rural setting, and are surrounded by trees and buildings. The broader region is one of fairly complex (rolling) topography. The instruments were mounted on a roughly 3 m tall mast, just below the height of surrounding vegetation.

The instruments were operated, and delivered data for 14 days (15th to 28th August, 2018). The data were subjected to simple descriptive statistical analysis, which included wind- and pollution-roses.

The report concludes with a brief discussion of natural versus anthropogenic sources of PM_{10} in this region.

Overall Comments:

1) No attempt is made to argue that the monitoring location was chosen so as to be regionally representative. Judging by the location details, the meteorological data are likely to be only of very local relevance.
2) The monitoring period was so short, as to make the data relevant only for the meteorological conditions at the dates of measurement (likely a period of summertime anticyclonic weather). The data are not of any value in providing information about baseline ambient air quality as a proper baseline analysis must cover both seasonal and inter-annual variability.

3) The report promises “additional analyses” of PM_{10} (mineral) content, but no such analyses were provided. The report mentions tin, tungsten, niobium and tantalum as possible metals in the ore to be mined. If these metals are in concentrations of concern, their toxicity on human, plant, wildlife and livestock will be a matter of concern.
4) It is clear that the report fails dismally to provide a useful air quality baseline as context for mine development.

Section 2: (Document 2)

AVALIAÇÃO DE IMPACTE AMBIENTAL MINA DO BARROSO (dated April 2021)

Savannah Lithium. – Projeto de ampliação da Mina do Barroso.

This is an overall environmental impact statement, apparently prepared by the mine proponent. I have reviewed sections specifically referring to air quality.

Section I ,1.7: (lines I.113 to I.121)

Regarding air quality, the EIS places measurement of PM_{10} air quality in the context of air quality standards set by the Portuguese Environmental Agency, and also in relation to measured air quality at the Douro Norte (Lamas de Olo) air quality monitoring station.

Air quality at the proposed mine site is characterized by direct reference to the measurement program reported in Document 1. As noted in my review of Document 1, the air quality measurement program undertaken in the vicinity of Covas do Barroso was so limited as to have no useful value in characterizing baseline ambient air quality.

Section II, 1.7: (lines II.52 to II.67)

This section uses established emissions modelling approaches (emissions factors) to estimate PM_{10} emissions from mining activities at the proposed lithium mine. The analysis concludes that PM_{10} emissions from wind erosion of deforested surfaces results in a vast majority (197 t/yr) of the total emissions (240 t/yr).

Dispersion of these emissions amounts are then modelled over a domain of unspecified extent using 900 receptors on a 10 x 90 m grid. The modelling was conducted using 2014 meteorological data. The dispersion model was not specified, and while the use of 2014 annual meteorological data is mentioned, it appears these data were used only to provide emissions estimates, and not to drive meteorological dispersion. The figures purporting to represent ambient PM_{10} concentration fields show remarkably flat distributions. There is no indication that turbulent dispersion by wind fields is at the basis of the model.

This section is wholly inadequate. The science of pollutant dispersion modelling is well-established, and there are widely used industry standard dispersion models that would have been used by competent professionals.

The monitoring plan is completely inadequate. It specifies monitoring of PM_{10} , but gives no details as to number and spatial distribution of monitoring stations. Neither does the report specify reporting of monitoring results and compliance statistics. These details are all commonly used in such projects.

Overall Comments:

1. The emissions estimates are probably reasonable representations of emissions effects of the proposed mine.
2. The analysis does not consider precipitation effects in depositing emitted particulates to ground. This is a strange omission.
3. The modelled PM_{10} fields are simply far too flat to be reasonable. From this I infer that the modelling is unrealistic. At very least, one would expect the concentration fields (even as an annual average) to have a spatial structure that at least partially reflects wind channelling in the complex topography of this region.
4. The dispersion modelling is simply inadequate. No explanation is provided about the model details. This is astounding, given the rich and well-known field of dispersion modelling. In the field of impact assessment, there is a set of accepted air pollution dispersion models that have been accorded regulatory approval, and are generally required of regulators, and thus widely used by consultants and project proponents.
5. I am surprised that the responsible Portuguese Environmental Agency did not require the use of any one of the many commonly used atmospheric dispersion models.
6. In the application of any air pollution dispersion model, it is standard practise to compare the modelled pollution concentrations with measurements of the modelled pollutant at one or more measuring stations within the modelling domain. This process is called model evaluation. As noted above, PM_{10} air quality is measured at the nearby Douro Norte (Lamas de Olo) air quality monitoring station. The opportunity therefore exists to perform an evaluation of the modelled PM_{10} plotted in Figures II.14 to I.21. It is unclear why this was not done.
7. Given the weaknesses of the dispersion modelling, the resulting air quality impacts on plants, human health and livestock are unknown. The discussion about “minimization measures” is therefore without a quantitative basis.

Section 3: (Document 3)

PARECER DA COMISSÃO DE AVALIAÇÃO
“Ampliação da Mina do Barroso” (AIA 3353) (June 2022)

This is the opinion prepared by the formally established evaluation committee on the environmental impact statement regarding the “Expansion of the Barroso Mine”. The primary concerns expressed by the evaluation committee are with regard the treatment of hydrologic, ecosystems and socio-economic impacts of the proposed mine. The evaluation committee was also concerned by possible landscape changes and their impact on the UNESCO classification of World Agricultural Heritage attributed to the Barroso Area.

A notable omission by the evaluation committee is a critical examination of the proponent’s assessment of air quality impacts of the proposed mine.
Regarding air quality impacts, the evaluation committee concludes:

“*Regarding Air quality, The project presented merits a favourable evaluation/ opinion. The study is well made both in terms of the baseline profiling, identifying expected impacts and mitigation measures.*” (translated from the original Portuguese).

I have reviewed sections specifically referring to air quality, and given the quoted conclusion, I make the following observations:

1. Given my negative comments on the baseline measurements reported in Chapter 1, I cannot agree with the conclusion that the “baseline profiling” of air quality in the area of the proposed mine expansion is “well made”.
2. Given my negative comments on the modelling of air pollutant dispersion reported in Chapter 2, I cannot agree with the conclusion that the “identifying expected impacts’ of air quality in the area of the proposed mine expansion is “well made”.
3. As I argue in my overall comments to Chapter 2, if air quality baseline is unknown, and modelling of ambient air pollutant concentration is inadequate, it is not possible to rationally discuss mitigation (“minimization”) measures.
4. Given these three concerns, It is my opinion that the conclusion of an overall “favourable evaluation” regarding air quality impacts is unsupportable.

Section 4: (Document 4)

AVALIAÇÃO DO PROJETO REFORMULADO NO ÂMBITO DO ARTIGO 16o DO RJAIA

This document is a revision, and expansion of Document 2 (Baseline and impact assessment).

Regarding air quality, the revision is specifically targeted at three objectives:

1. Establishing ambient air quality standards for the protection of human health that will be applicable to the proposed mining activities;

Table 9.15 (page 206) of the revised impact assessment is a listing of criteria pollutants and ambient concentration limits designed to protect human health. The table is drawn from applicable Portuguese law (Directive 102/2010). These values are in turn based on applicable E.U. ambient standards, which are in turn based on W.H.O. recommendations. Given this pedigree, the limit values reflect current research and are appropriate for the intended purpose.

2. Characterizing and quantifying atmospheric emissions of air pollutants from the proposed mine;

The revised assessment elaborates on the preceding assessment of Document 2, and provides a wider assessment of the significance of effects. Estimated (modelled) emissions strengths of PM_{10} from various mine activities remain unchanged from those in document 2.

3. Characterizing ambient air quality in municipalities surrounding the study area.

This analysis is based on the values measured at the Air Quality Network Station of the Portuguese Environment Agency at Douro Norte (Lamas de Olo). It is claimed that ambient air quality at this station is representative of the study area, and therefore of the community of Covas do Barroso and surrounding communities and agricultural lands. No arguments are presented to support this claim. The accepted way of establishing the equivalence is to compare data from a short term study at the location of interest (Covas do Barroso) with data from the long-term or reference station (Lamas de Olo). This comparison was not attempted, and, given the inadequacy of the baseline data (see analysis of document 1), would likely have been meaningless.

Air quality impacts of the proposed mine are considered for three phases: Construction; Operation/Extraction and Closure phases. Without a clear understanding of pre-construction baseline air quality in the potentially impacted communities, it is not possible to assess incremental ambient air quality changes driven by proposed mining activity. I am therefore doubtful of the veracity of the conclusions presented for the various phases.

Air pollution impacts during the three phases are classified according to the dimensions: negative or positive; direct or indirect; local, regional or global; reversible or irreversible; likely or unlikely; permanent or temporary; immediate or delayed; according to magnitude, and significance. while these dimensions are wide-ranging and thorough, the actual classifications must remain speculative for air quality until substantive data and analysis are available.

Monitoring of air quality effects of the proposed mine during the four phases is planned for the single site used for the baseline monitoring discussed in

document 1. No consideration is given to the suitability of this site as a location for monitoring pollutant dispersion under the variety of weather conditions (specifically wind direction) likely to be experienced on a long term basis. Furthermore, it would be extremely unlikely if only one monitoring station were sufficient to capture pollutant dispersion under varying meteorological conditions.

The proposed monitoring plan to monitor for a minimum of 14 days and only expand to annual monitoring if the "legal limit" is exceeded is blatantly inadequate. If weather conditions on the chosen 14 (or more) days were such that mine emissions were highly diluted, or even advected away from the (single) monitor, the decision about monitoring frequency will be of no utility at all. The only monitoring plan that would adequately protect human, plant and livestock health would involve multiple monitoring stations, and would be conducted continuously for the full duration of all four phases.

There appears to be no plan to mitigate air quality effects of the proposed mine. It is industry standard practise to have in place a Fugitive Dust Management Plan in place when open-pit mines are located near communities.

Section 5: (Document 5)

PARECER DA COMISSÃO DE AVALIAÇÃO
"Ampliação da Mina do Barroso" (AIA 3353) (May 2023)

This is the opinion prepared by the formally established evaluation committee on the environmental impact statement regarding the "Expansion of the Barroso Mine". Unlike Document 3, this report evaluates the modified EIS (Document 4).

The report assumes available local air quality data and their analysis (Document 1) give a fair assessment of baseline air quality. As I note, the data are inadequate in extent (number of stations) and duration to provide a reliable baseline assessment. Since all considerations and conclusions in the committee report are based on the veracity of the baseline, I believe the conclusions are unsupportable.

The committee conclude that operations resulting from the Barroso Mine will be responsible for the occurrence of negative impacts on air quality. In my opinion, this conclusion is unsupportable, and should not form the basis of a decision.

The committee does recommend that baseline air quality surrounding the proposed mine area should be monitored so as to give greater precision than presently available. Furthermore, the committee points out that the ambient air quality measurement carried out as part of the Barroso Mine expansion project did not take into account the legally mandated duration of monitoring campaigns, meaning that the results obtained in this assessment cannot be compared with the legally mandated values, thus limiting any determination of potential air quality impacts of the proposed mine. This statement by the committee

undermines their own conclusions. It is thus clear that the committee is concerned with the quality of baseline air quality data, in agreement with my concerns.

Regarding air quality, the committee makes an overall conclusion that the project, as specified in the modified EIS

"deserves a favourable opinion" and that "*the study is well-rounded both in terms of the baseline situation and in terms of identifying expected impacts and their respective mitigation measures"*

This is, in essence, the same conclusion reached on the initial EIS. I believe this conclusion is unsupported by the available data and analyses (Documents 1 and 2).

Section 6: (Document 6)

Environmental Declaration for the modified EIA and conditions imposed by regulator.

Decision statement by Portuguese environmental agency. Dated 2023.05.31.

The overall conclusion regarding air quality is that the Barroso Mine's operations will cause minor negative impacts, and that the limits established by current legislation will be met.

As reported above, the evaluation committee is quite explicit that the available data do not allow comparison with established air quality standards. I am in agreement with the evaluation committee on this. It is therefore my opinion that the conclusion of the environmental agency is premature.

The Agency does recommend air quality and meteorological monitoring, and specifies multiple monitoring locations, and minimum monitoring periods.

The additional monitoring locations are located in nearby towns. While this is appropriate, the monitoring should be conducted so as to capture the full range of air quality impacts on the total environment, not just as air quality as it affects human health.

The Agency recommends monitoring on a minimum of 52 days, without specifying the general weather conditions under which monitoring should take place. Given the strong annual variation of weather in this mediterranean climate zone (cool rainy winters, warm, dry summers), the outcome of the monitoring could be highly dependent on prevailing weather. There is no logical argument for anything but (at least) a full year of air quality and meteorological monitoring.

In an overall conclusion, the Agency states (Italics indicate translations from Portuguese).:

"The methodology used to characterize air quality was deemed insufficient, consisting of a PM10 pollutant measurement campaign between August 15, 2018, and August 28, 2018. This corresponds to 3.8% of the legally required period (1 year). Only one receiver was analyzed in Covas do Barroso, where the towns of Dornelas, Antigo, and Vila Grande are aligned with the prevailing winds in the area."

I am in full agreement with the Agency analysis in this matter, as I have repeatedly stated in this report, the baseline air quality analysis is insufficient.

"The results of the simulations mentioned in the EIA were also not presented."

This too was a concern of mine. Simulations were not explained at all.

"The only mitigation measure presented (dust reduction through the installation of tree barriers and sprinklers) was insufficient."

This is correct. I have noted that absence of a Fugitive Dust Management Plan, which would include these mitigation measures and be linked to a comprehensive monitoring scheme.

It is worth noting that dust generated by mining can pose risks of exposure to contaminants, causing harm to public health and affecting habitats and ecosystems.

I will deal with this matter in my discussion of Omissions.

Given the concerns about air quality expressed by the responsible government agency, I am surprised by the overall positive assessment given the proposed mine expansion.

Omissions:

The proposal and EIS raise a number of air quality concerns that have not been addressed.

1) The proposed monitoring plan is inadequate. I do not know if the agency recommendations are binding, but am of the opinion that they represent a bare minimum plan for protection of human plant and livestock health.
2) As repeatedly noted, the absence of a transparent explanation of the dispersion model used to understand the spatial (and temporal) distribution of emitted pollutants is a serious omission.
3) The air quality plan focusses on PM_{10}. This is appropriate, but misses completely the possibility that the PM_{10} particles may contain heavy metals that are part of the geologic makeup of the material being mined. Many heavy metals are highly toxic to humans, plants and livestock. A comprehensive analysis of heavy metal content of the materials to be mined must be made, and monitoring plans adjusted accordingly.
4) It is important to include $PM_{2.5}$ in the assessment of air quality effects of an open pit mine. All such mines are dusty, and depending on mining techniques and ore processing technology (if the ore is processed on site) both PM_{10} and $PM_{2.5}$ could be emitted. It is well known that $PM_{2.5}$ has far greater human health effects than PM_{10}.
5) One of the dust mitigation plans is to water roads as a dust suppression mechanism. This region is notoriously water deficient, especially in summer. The matter cannot be ignored. The potential for severe dust pollution is high.
6) The absence of a well-designed and operated Fugitive Dust Management Plan, preferably with an adaptive management approach is a significant omission in the EIS.

BIBLIOGRAPHY

Document 1: Original EIA - Annex IV - Air quality report by consultant (entire document)

Document 2: Original EIA - Baseline and impact assessment (baseline - I.113; impact assessment – II.52 to II.67; cumulative impacts – II.327; alternatives – II.342; mitigation measures – general at II.353 and specific at II.359; monitoring plan – III.11).

Document 3: Original EIA - Evaluation committee's report (p. 75 to p.78)

Document 4: Modified EIA – Baseline and impact assessment (baseline – section 9.3, from p. 206 to p. 215; impact assessment – section 10.4, from p.404 to p.410; monitoring plan – section 14.4, pages 671 and 672; mitigation measures – general at section 11, without specific measures on the air quality in subsection).

Document 5: Modified EIA - Evaluation committee's report (section 5.5 - p. 94 to p. 97)

Document 6: Favourable Environmental Declaration for the modified EIA and conditions imposed by regulator – specific references to air quality in pages 17, 60, 76 and 81.