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Mr Peter Jansen
KASA Consulting
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RE: Rare Earths Processing Facility, Kalgoorlie WA
Independent Peer Review of the Radiation Impact Assessment (RIA)

Dear Mr Jansen,

Lynas Kalgoorlie Pty Ltd, a wholly owned subsidiary of Lynas Corporation are in the process of preparing a proposal to establish a Rare Earths Processing Facility (REPF) near Kalgoorlie. KASA Consulting (as the lead approvals coordinator on behalf of Lynas) concurs with the company's intention to seek an independent technical review of the draft radiation related documentation that was prepared internally.

Three key deliverables are:

1. Radiation Impact Assessment,
2. Radiation Management Plan,
3. Radioactive Waste Management Plan; and
4. Update to Transport Management Plan.

Calytrix Consulting Pty Ltd (Calytrix Consulting) was selected for the independent technical review of the above documentation. As discussed and agreed in early April 2020, the first of the documents listed above, the Radiation Impact Assessment (RIA) was reviewed in the period May – June 2020. Five versions of the document were reviewed and comments and suggestions were communicated in writing to KASA Consulting and Lynas Corporation after each review.

Calytrix Consulting understands that the RIA is a key supporting document to imminent referrals to the Commonwealth Department of Agriculture, Water and the Environment (DAWE) and WA Environmental Protection Authority (EPA) for assessment of the REPF.

The review of the Radiation Impact Assessment, versions 1 – 5

The review of the first version of the RIA, on the 4th of May 2020, contained 52 comments and suggestions. Out of these comments:

- 29 were of general nature for the improvement of the text, including the correction of typographical errors,
- 4 provided additional explanation of the applicability of different regulatory documents,
- 16 were of technical nature, in regards to:
    - Compatibility of values measured at a similar plant in Malaysia (LAMP),
    - Minimum detection limits for different laboratory analyses and monitoring methods,
    - Insufficient data from the processing plant in Malaysia, such as levels of gamma radiation, concentrations of radon in different areas, the time workers spend in different areas of LAMP, etc., and
- 3 contained a suggestion for the improvement in the assessment of the radiological impact on the non-human biota.

All calculations of doses and impacts were carried out correctly and only minor technical clarifications were requested.

Most of the comments and suggestions were taken into account in the subsequent version of the RIA that was reviewed on the 20th of May 2020. Only fifteen comments were made on the second version of the RIA:

- Clarification of 2 terms not used previously was requested,
- 2 suggestions were made to ensure that the processing sequence is more easily understood,
- 6 minor grammatical changes were made, and
- 5 technical points were highlighted as requiring additional interpretation.

All calculations of doses and impacts were made correctly.

The review of the third version of the RIA was carried out on the 23rd of June 2020:

- The assessment of radiation exposures was carried out correctly, but six comments were made in regards to the degree of conservatism used in adopting some of the factors in calculations. It was suggested that internal radiation exposures of workers may have been *over*-estimated and the actual exposures are likely to be lower than assessed in the RIA. No changes to the document were suggested, but it was noted that confirmatory monitoring would be required in the future, when the plant will be operational.
- In several other comments the questions were posed in regards to the use of the monitoring data obtained at LAMP in Malaysia for the prospective assessment at the future plant near Kalgoorlie. As above, no changes to the document were suggested, but it was noted that the actual monitoring in the future is likely to show that the radiation exposures of workers to both gamma radiation and the inhalation of dust at LAMP may have been *over*-estimated.
- It was suggested to clearly state that the possible dose to the members of the general public due to all potentially applicable pathways of radiation exposure is expected to be indistinguishable from the natural background. The only possible exposure may occur due to the inhalation of radon (^{222}Rn) and thoron (^{220}Rn) and was calculated to be above zero mostly because the background concentrations were not taken into account.
- The suggestions for an improvement in the assessment of risk to non-human biota were again made in this review.

Additionally, in regards to the air dispersion modelling (that was only included in full in the third version of the document), it was suggested that not only outputs of the model are provided, but also some of the relevant inputs, without which the assessment of the accuracy of the modelling cannot be adequately estimated.

In reply to this request two reports by Environmental Technologies and Analytics were provided by KASA Consulting on 28th of June (*Kalgoorlie Rare Earths Processing Plant – Air Quality Impact Assessment* and *Proposed Kalgoorlie Rare Earths Processing Plant – Deposition*). It is concluded that these documents provide adequate data for the purposes of the Radiation Impact Assessment.

The fourth version of the RIA was received on the 30th of June 2020 and reviewed on the same day. 15 comments and suggestions were made, out of which:

- 14 were the suggestion for the editorial corrections in the text, and
- 1 was the request for clarification of one of the radiation monitoring methods that is used at the LAMP in Malaysia, mostly in regards to the differences between applicable Australian Standards and guidelines and similar monitoring guidelines applicable in Malaysia.

The final, fifth version of the RIA was received on the 1st of July 2020 and reviewed on the same day. It is considered that this version is satisfactory for the submission to Appropriate Authorities, the conclusions and recommendations are presented below.

Conclusions

It is concluded that the Radiation Impact Assessment (RIA, version 5, 1-July-2020) provides reliable data on potential radiological impacts of the future rare earth plant near Kalgoorlie.

Further technical details are expected to be available in the Radiation Management Plan and the Radioactive Waste Management Plan, but on the basis of the data provided in the RIA it is concluded that:

1. The assessments of:
    a. All pathways of radiation exposure for the workers and members of the public and
    b. Potential radiological impacts on the environment

   were carried out correctly.

2. The radiological impact of the Project is likely to be low, very low or negligible and proposed management controls (to be further detailed in the future management plans) are considered to be adequate.

Recommendations

1. The Radiation Management Plan (RMP) and the Radioactive Waste Management Plan (RWMP)

RMP and RWMP for the Project are to be prepared and submitted for approval to the relevant regulatory bodies in Western Australia – DMIRS and the Radiological Council. The documents will need to be progressively updated, as actual radiation monitoring data will become available.

Due to the character of mineral processing it is considered essential to carry out a full radionuclide balance for the site for all relevant radionuclides (^{238}U, ^{234}U, ^{230}Th, ^{226}Ra, ^{210}Pb, ^{210}Po, ^{232}Th, ^{228}Ra and ^{228}Th) to ensure that there is no accumulation of any of these 'long-lived' radionuclides in any processing vessels and/or pipe work. The obtained data should be compared with the values measured at the LAMP facility in Malaysia to check that the deportment of radionuclides at the Kalgoorlie site is the same as at the LAMP, thus confirming all other assumptions, including those relevant to radiation protection.

2. Authorisations

Authorisations for the Project will need to be obtained for the different stages of the Project, in accordance with ARPANSA Code of Practice RPS-9, specifically Authorisation to Construct (§3.7.2) and Authorisation to Operate (§3.7.3). Additionally, the provisions for the possible Temporary Cessation of Operation (§3.7.4(a)) should also be considered and submitted for approval by the appropriate authorities, preferably as a part of a conceptual Closure Plan.

3. Residue deposition/disposal

The most important long-term radiological impact associated with the Project is expected to be the proposed deposition of some of the process residues at the Project site, specifically "iron phosphate" that will be classified as radioactive material.

It is very important to note that the material cannot be currently classified as "waste", as future use for it is foreseen – especially for the quantity of the material that may be deposited at the Project site and not transported back to the Mount Weld site. It is noted that some of the residues may be disposed of in other areas, such as Lynas Mount Weld site, and there is also a potential for the re-use of the material for different purposes.

It is the requirement of the WA Mines Safety and Inspection Regulation 16.35(2) that,
Each responsible person at a mine must ensure that, so far as is practicable, radioactive waste is diluted with other mined material before it is finally disposed of in order to ensure that in the long term the use of the disposal site is not restricted.

Additionally, the blending of NORM residues and wastes prior to their re-use or disposal is considered to be best practice internationally:
Dilution as a means of increasing the amounts of NORM residues that can be used as by-products should not only be permitted in terms of the national approach, but should actually be encouraged. (IAEA TECDOC-1712, 2013, the reviewer is one of the co-authors of this document).
Additional information containing more references:
N Tsurikov, "Is blending of radioactive waste before disposal acceptable?", Disposal of Large Volume of Radioactive Waste workshop, IAEA, Vienna, 2013
https://gnssn.iaea.org/RTWS/general/Shared%20Documents/Waste%20Management/Waste%20Management%20after%20Emergency/Nov%202013%20NE%27s%20TM%20on%20the%20Disposal%20of%20large%20volume%20of%20radioactive%20waste/Wednesday/NTsurikov%20presenation%201_AUS.pdf
N Tsurikov, "The management of NORM residues: practical aspects", NORM-VIII Symposium, Rio de Janeiro, 2016. Presentation: https://nucleus.iaea.org/sites/orpnet/resources/Shared%20Documents/Tsurikov-NORM-Management-Australia.pdf Paper: https://www.iaea.org/publications/13402/naturally-occurring-radioactive-material-norm-viii, pp.78-90

It is recommended that both current WA Regulations and the International best practice be taken into account by Lynas in the process of planning, construction, operation and closure of the Project to minimise a possibility of the creation of a "radiologically contaminated site" in close vicinity of Kalgoorlie.

Kind regards
Nick Tsurikov
1-July-2020