

SERVICE QUOTATIONCustomer PO/Ref No:
6119

Sales Quotation: 20004068

Despatch Date: 09-Jul-2024

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Customer DetailsTo:
VIRIDIS MINING AND MINERALS LIMITED
LEVEL 50, 108 ST GEORGE TERRACE
PERTH WA 6000**ANSTO Details**Contact:
ROBERT RING
Name: ANSTO Minerals
Phone: +61 2 9717 3224
Email:

Project entitled "Colossus Project -
Process Development and Optimisation
(Rev 1)" as described in proposal dated
24th May 2024 to be carried out under
ANSTO Minerals Standard Terms and
Conditions of Business.

Contact: Rafael Moreno

TOTAL

126,600.00

12,660.00

139,260.00

Quote valid from: 09.07.2024

Quote valid to: 26.09.2024

Signed for and on behalf of ANSTO

Signatory

Print Name Sateesha Tirumali Seetharam

Authority delegated by project leader or business manager

Agreement

As an authorised representative of the Customer, I accept this Quotation and agree to the provision of the services described in this Quotation by ANSTO to the Customer on the terms and conditions set out in the accompanying Terms of Business.

Signatory

Print Name Rafael Moreno

Authorised to accept on behalf of customer

Date :

Minerals Terms of Business

1. DEFINITIONS

"Agreement" includes the Particulars and these Terms of Business. To the extent of any inconsistency, the Particulars will prevail followed by these Terms of Business.

"ANSTO" means Australian Nuclear Science and Technology Organisation, its successors and assigns.

"Client" means the person or company named in the Agreement, its successors and permitted assigns.

"Fees" means the fees and charges for the Services and Products as described in, or to be calculated in accordance with, the Particulars.

"Intellectual Property Rights" means any and all existing and future rights throughout the world conferred by statute, common law, equity or any corresponding law in or in relation to copyright, trademarks, designs, patents, circuit layouts, plant varieties, and any other results of intellectual activity in the industrial, commercial, scientific, literary or artistic fields whether or not registrable, registered or patentable.

"Know-How" means all technical, product, process and method information not in the public domain including (but not limited to) inventions, process, methods, discoveries, trade secrets, concepts, data, formulae, specifications, procedures, results for experiments and tests, experimentation and testing, results of research and development (including but not limited to laboratory records, clinical trial data, case reports), data analysis and summaries, and information in submissions to and information from regulatory bodies.

"Loss" means any loss, damage, liability, compensation, or expense (including any legal cost and expense), however it arises.

"Particulars" means a document entitled *Quotation or ANSTO Agreement for Services* from ANSTO (and documents referred to in Quotation or Agreement or Services) which set out details pertaining to particular Services and/or products and this Agreement and which refers to or attaches these Terms of Business.

"Product" means the tangible product or result (if any) to be delivered as part of the Services as identified in the Particulars.

"Reimbursable" means any amount payable to third parties which is described as a reimbursable in the Particulars.

"Services" means the services to be provided by ANSTO to the Client as described in the Particulars.

2. FEES

- (a) The Client agrees to pay to ANSTO the Fees in consideration for the performance of the Services and in accordance with this clause 2.
- (b) To the extent that an estimate of, or formula for, the Fees is set out in the Particulars, the Fees will be determined by applying the formula or methodology for determination of the Fees as set out in the Particulars. In this case, any estimated fees set out in the Particulars have been calculated on the basis set out in the Particulars and ANSTO's actual Fees may differ from this estimate. ANSTO will advise the Client promptly if it's actual Fees are likely to exceed the estimate.
- (c) The Client agrees to pay Reimbursables. The methods for payment is that these will be either billed directly to the Client by the third party, or charged by the third party to ANSTO and on-charged by ANSTO to the Client. Unless otherwise agreed in the Particulars, Reimbursables will be on-charged by ANSTO at cost plus 10% handling cost. Reimbursables are not included in the Fees or any estimate of Fees.
- (d) The Client is liable for and agrees to pay all taxes and duties due under or in relation to the Agreement, including but not limited to any consumption tax, value added tax, stamp duty or customs duty, or similar taxes or duties levied in respect of the Services, the Fees or the Reimbursables.
- (e) If GST is imposed on any supply made under the Agreement and the consideration for that supply was GST exclusive, then the recipient agrees to pay to the supplier an amount equal to GST payable on the supply at the same time as payment for the supply is required to be made. For the purposes of this clause, "GST",

"supply", "supplier" and "recipient" have the meaning given to those expressions in A New Tax System (Goods Tax) Act 1999 (Cth) as amended, and any successor legislation.

- (f) Unless a different method of payment is set out in the Particulars, Fees and Reimbursables will be payable within thirty (30) days of the date of invoice. Unless a contrary method of invoicing is set out in the Particulars, ANSTO will render invoices monthly.
- (g) Any outstanding payment under the Agreement will attract interest at an annual rate equal to 2% over Commonwealth Bank of Australia's CommSec Variable Rate from time to time charged to commercial borrowers who borrow more than \$100,000, accruing daily, from their due date to their receipt in full, without need for further invoice.

3. PROVISION OF SERVICES

ANSTO will perform the Services in a diligent and professional manner, and with the necessary skill and care required to perform the Services.

4. LIABILITY OF ANSTO

- (a) Except for the representations and warranties expressly made in the Agreement, all conditions, warranties, undertakings or representations, express or implied, arising by statute, general law or otherwise are expressly excluded to the extent permitted by law.
- (b) In the case of a breach by ANSTO of any condition or warranty implied by Schedule 2 of the Competition and Consumer Act 2010 (Cth) (or equivalent applicable legislation), ANSTO's liability is limited to either a refund of the Fees and Reimbursables paid by the Client under the Agreement or supply of the Services by ANSTO again, at ANSTO's election.
- (c) To the extent permitted by law, the liability of ANSTO under or in connection with the Agreement or the Services, whether in contract, tort (including negligence and breach of statutory duty) is limited to the Fees.
- (d) Clause 4(c) does not apply to liability under clause 5 or if ANSTO's liability is for negligence causing personal injury.
- (e) To the extent permitted by law, ANSTO is not liable under or in connection with the Agreement or the Services or Product, to compensate the Client for any lost revenue, lost profits or lost business, or any special, indirect or consequential Loss or damage of any nature.
- (f) The Client acknowledges that it relies upon its independent assessment and enquiries as to:
 - (i) whether the Product and/or the provision of the Services is of commercial value to the Client and suitable for the Client's purposes;
 - (ii) whether the Product may be owned, held, or used or disposed of by the Client;
 - (iii) the manner in which the Client uses or disposes of the Product; and
 - (iv) whether the use or exploitation of the Product and/or the disclosure of any information in connection with the Product and/or the provision of the Services breaches any obligation or infringes any Intellectual Property Rights of third parties.
- (g) The Client acknowledges and agrees that ANSTO is not liable under or in connection with this Agreement (and is released from any liability) for any of the matters set out in clause 4(f). The Client shall indemnify ANSTO from and against any Loss in respect of any claim which may be brought or commenced against ANSTO by a third party in relation to the matters set out in clause 4(f).

5. CONFIDENTIALITY

- (a) Each party will maintain the confidentiality of information and material of the other party which is identified as confidential (**Confidential Information**). The receiving party can only disclose Confidential Information to employees, directors and

officers of the receiving party or for whom the disclosing party has provided consent in writing. The receiving party can only use Confidential Information for the purposes of the provision of the Services, and in the case of the Client, to use the Product for its internally-focused business operations. This clause does not apply to information already known to the receiving party, information lawfully received from third parties or determined by the receiving party from its own endeavours, information in the public domain or information which the receiving party is compelled to disclose under an applicable law (or in the case of ANSTO, under a request from an officer of the Commonwealth or a regulatory government body).

- (b) To the extent the Client and ANSTO have entered into a confidentiality agreement or non-disclosure agreement (or similar) which remains in force in relation to the provision of the Services (**Confidentiality Agreement**), then that Confidentiality Agreement will apply in addition to this Agreement. To the extent of any inconsistency, the Confidentiality Agreement prevails.

6. CLIENT WARRANTIES AND UNDERTAKINGS

- (a) The Client warrants that it is entitled to provide all information and other materials provided to ANSTO, and that the use by ANSTO of such information and materials for the purpose of this Agreement does not breach any obligation or undertaking to, or any intellectual property rights of, any third party. The Client indemnifies ANSTO against any Loss suffered by ANSTO in connection with a claim by a third party that such use breaches any obligation or undertaking to, or any Intellectual Property Rights of, any third party.
- (b) The Client agrees that it may not disclose any draft report or other draft Product to a third party without the prior written consent of ANSTO, and must ensure that all copies of such drafts are clearly marked "DRAFT". The Client should not use any draft report or other draft Product except for the purposes of the completion of the Services by ANSTO.
- (c) The Client undertakes to obtain all necessary licences or permits, and comply with all legislation, delegated legislation and directives of any competent authority or body to enable it to own, hold, use and dispose of the Product. The Client undertakes to provide evidence of such licences, permits and compliance on request by ANSTO.
- (d) The Client agrees to promptly furnish to ANSTO, and so to not delay the delivery of the Services, all information, drawings, data, descriptions, forecasts and the like reasonably required by ANSTO. The Client acknowledges that delay in the provision of such information or other materials may result in a delay to the delivery of the Services.
- (e) The Client agrees that ANSTO and other persons engaged by ANSTO may, where reasonably necessary, access the Client's premises for the provision of the Services, after reasonable notice and with the Client's consent, such consent not to be unreasonably withheld.

7. INTELLECTUAL PROPERTY IN PRODUCT AND AS TO SERVICES

7.1 Ownership

- (a) The Client owns the copyright in the reports and data provided by ANSTO to the Client (the **Copyright**). The Client acknowledges however that a report provided by ANSTO may contain confidential information of ANSTO and/or disclose ANSTO IP subject to clause 5 and this clause 7.1.
- (b) As between the parties, ANSTO owns all ANSTO IP. *ANSTO IP* means Intellectual Property and Know How:
- (i) owned, or licensed from a third party, by ANSTO as at the commencement of the Agreement;
 - (ii) acquired, or licensed from a third party, by ANSTO during the term of the Services but not in connection with the Services;
 - (iii) in improvements and developments to the Intellectual Property Rights or Know How under paragraphs (i) and (ii).
- (c) As between the parties, the Client owns all Client IP. *Client IP* means Intellectual Property and Know How:
- (i) owned, or licensed from a third party, by the Client as at the commencement of the Agreement;

- (ii) acquired, or licensed from a third party, by the Client during the term of the Services but not in connection with the Services;
- (iii) in improvements and developments to the Intellectual Property Rights or Know How under paragraphs (i) and (ii).

- (d) Patent Rights in New Patentable Inventions will be owned by the party or parties so designated in the Particulars, and if no party is designated, then ANSTO. *New Patentable Inventions* means inventions, discoveries and innovations created in the course of or arising in connection with the Services excluding ANSTO IP and Client IP. *Patent Rights* means rights with respect to patents (including any divisions, continuations, continuations in part, renewals, reissues, extensions, supplementary protection certificates, utility models and foreign equivalents of any such patents) and rights with respect to existing and future patent applications and patentable inventions, including the right to apply for registration of any such rights, anywhere in the world
- (e) As between the parties, ANSTO will own all New Know How. *New Know How* means Know How and Intellectual Property Rights in such Know How created in the course of or arising in connection with the Services and Product excluding all Copyright, ANSTO IP, Client IP and Patent Rights in New Patentable Inventions.
- (f) Each party assigns to the other party by the Agreement absolutely and as beneficial owner such right, title and interest in Intellectual Property Rights as is required to give effect to this clause 7.1.
- (g) The Client acknowledges that ANSTO has not undertaken and is not required to undertake any freedom to operate or prior art searches, or otherwise determined the rights of third parties, in relation to the Product or Services.

7.2 Licence

Without limiting any other provision of the Agreement, ANSTO grants to the Client a non-exclusive, worldwide, royalty-free, licence to use ANSTO IP embodied within the Product as part of the use of the Product, New Know How and, if owned by ANSTO, New Patentable Inventions, for the purposes of the Client's internal-focused business operations.

8. TITLE AND RISK

Subject to clause 7, title and ownership, and risk of damage or destruction, in the Product passes to the Client at the time of delivery of the Product to the Client.

9. DISPUTE RESOLUTION

- (a) If a dispute arises out of or in relation to the Agreement (including any dispute as to breach or termination of the Agreement or as to any claim in tort, in equity or pursuant to any statute) (a **Dispute**), a party may not commence any court or arbitration proceedings relating to the Dispute unless it has:
- (i) complied with this clause 9; and
 - (ii) the Dispute has not been resolved within 50 days after the receipt of the Dispute Notice under clause 9(b),
- except if the party seeks urgent (or interlocutory) relief by way of injunction or temporary restraining order.
- (b) A party claiming that a Dispute has arisen in relation to the Agreement shall give written notice to the other party specifying the nature of the Dispute (a **Dispute Notice**).
- (c) If the parties have not resolved the Dispute within 30 days after the receipt of a Dispute Notice, ANSTO and the Client shall ensure their respective Chief Executive Officers (or equivalent) of the parties shall meet in person, by telephone or videoconference to endeavour to resolve the Dispute expeditiously by negotiation.
- (d) If the parties have not resolved the Dispute under clause 9(c) within 30 days after the receipt of a Dispute Notice, then the parties shall refer the Dispute to the Law Society of New South Wales, Australia as the mediator.
- (e) The parties agree that in relation to any mediation under this clause 9:
- (i) The mediation shall be conducted in accordance with the Mediation Rules of the Law Society of New South Wales, Australia. The mediation shall be conducted in Sydney, Australia. The mediation shall be attended by an executive from each party with sufficient authority to resolve the Dispute.
 - (ii) The costs of the mediation will be born equally by each party.

10. GENERAL

- (a) The provisions of the United Nations Convention on Contracts for the International Sale of Goods (Vienna Convention) and all associated enacting legislative instruments shall not apply to this Agreement.
- (b) If:
- (i) ANSTO provided a *Quotation or Agreement for Services or Purchase Order* which referred to or attached these Terms of Business in relation to the Services; and
 - (ii) the Client provided a purchase order in relation to, or otherwise agreed to proceed with (but without signing), such *Quotation or Agreement for Services or Purchase Order or Services*,
- then the Agreement is as defined in these Terms of Business and any terms or conditions referred to or included with the purchase order from the Client are agreed by the parties not to apply unless otherwise expressly stated in the *Quotation or Agreement for Services or Purchase Order* from ANSTO.
- (c) This Agreement may be terminated by either party on 21 days' written notice.
- (d) If the Client terminates this Agreement, then the Client agrees to pay to ANSTO, without set-off or counter claim:
- (i) internal and third party costs incurred by ANSTO in the provision of the Services (as at the date of the notice of termination) and/or as a result of the termination; and
 - (ii) ANSTO's lost profits which ANSTO would have recovered by the Fees had the Services been completed (as substantiated by an independent auditor).
- Such amount must be paid within 30 days of ANSTO's delivery of an invoice for payment. This clause 10(g) does not apply to termination by the Client for a material breach of this Agreement by ANSTO.
- (e) Clauses 4, 5, 6(a), 6(b), 7, 8, 9, and 10 survive the termination or expiry of this Agreement.
- (f) This Agreement (and any Confidentiality Agreement) constitutes the entire agreement of the parties in relation to the Services and the Products.
- (g) A variation of any term of this Agreement must be in writing signed by authorised representatives of the parties.
- (h) A waiver of any breach of this Agreement must be in writing and signed by the party granting the waiver.
- (i) All notices under the Agreement must be in writing and provided to the contact details set out in the Particulars, or if no details, to the Legal Counsel of the party at the registered address for the party.
- (j) This Agreement shall be governed by the laws of the State of New South Wales. Each party irrevocably submits to the jurisdiction of the Courts of New South Wales, and Courts of appeal there from, and waives all objections to the venue of any such action or proceedings or any claim that any such action or proceedings has been brought in an inconvenient forum.
- (k) If any part of this Agreement is void, voidable or unenforceable, it is to be severed from this Agreement, without affecting the validity or enforceability of the remainder of it.
- (l) This Agreement can be concluded by the signature on behalf of the Client of the *Quotation or Agreement for Services or Purchase Order* of ANSTO. The Agreement may be executed in counterparts, including signed counterparts of the Particulars or Purchase Order exchanged as attachments to email (the receipt of which emails has been acknowledged), which counterparts taken together shall constitute the one binding agreement. The Agreement will also be agreed to by the Client if, after ANSTO has provided the Agreement (as set out in clause 1 and 10(b)), the Client has provided a purchase order in relation to, or otherwise agreed to proceed with (but without signing), such *Quotation or Agreement for Services or Purchase Order or Services*.
- (m) Rights under this Agreement may not be assigned or transferred to a third party except with the prior written consent of the other party.
- (n) Each party agrees that any form of electronic signature, whether digital or encrypted, of a party included in this Agreement, including in the Particulars or Purchase Orders, shall be considered as an original signature for all purposes and shall have the same force and effect as an original signature. Without limitation, "electronic signature" includes facsimile or electronically scanned and transmitted versions of an original signature.

Proposal to Viridis Mining and Minerals

on

Colossus Project – Process Development and Optimisation (Rev1)

1. Introduction

Viridis Mining and Minerals (Viridis) has recently acquired an Ionic Clay Rare Earth Element (REE) project (Colossus Project) in the Minas Gerais State of Brazil.¹ The Colossus Project is located in the Poços de Caldas Intrusive. The Poços de Caldas area has a long and continuous history of clay mining for bricks and subsequently refractory clays, along with a more recent history (from the 1950s) of mining activities focused on bauxite for aluminium and uranium by the Brazilian Nuclear Industry.

Recent drilling by Viridis has identified the following four different geographical prospects:

- Cupim South;
- Fazenda (northern concession);
- Capao Da Onca; and
- Ribeirao.

ANSTO Minerals (ANSTO) has recently completed an initial testing program focused on samples from the Cupim South, Fazenda and Capao Da Onca prospects, with promising REE recoveries under mild desorption conditions confirming the deposit is an ionic clay containing significant desorbable REE content. ANSTO is about to undertake a second program of desorption tests on an additional 23 composite samples from the Caminho Das Pedras and Capao Da Onca Concessions.

In addition to the desorption testing of interval samples by ANSTO, Viridis has also conducted in-country desorption testing of bulk composites produced from the Northern Concessions, Cupim South, Capao Da Onca and Ribeirao. All samples were shown to contain a high percentage of desorbable REEs.

Viridis has recently appointed Hatch to deliver a Scoping Study for the Colossus Project and general Engineering Support. Metallurgical flow sheet development will be supported by the ongoing ANSTO test work program. This scoping study will be based on clay from the Northern Concessions.

Rafael Moreno, CEO Viridis, has now requested that ANSTO expand its work program to confirm and optimise conditions for a process to produce a mixed rare earth carbonate (MREC) product from a clay composite from the Northern Concessions (Process Development Program - PD Stage 2). Validation of the process would most likely require continuous mini-plant testing in the future.

¹ ASX Announcement, 13th September 2023.

The preferred process conditions identified in this work will also be used to produce a “bulk” quantity of MREC for marketing purposes and to generate sufficient quantities of IR solids and MREC for detailed analysis and determination of S/L separation characteristics. The S/L separation characteristics of the desorption clay are being determined in a separate project (PD Stage 1). The bulk MREC work will be undertaken as a separate work program (PD Stage 3).

This proposal is in response to the request from Viridis to investigate and optimise process conditions (PD Stage 2).

2. ANSTO Minerals’ Background in Rare Earth Minerals

ANSTO has extensive experience in rare earth process development with several rare earth experts in our team having ~ 30 years of experience, dating back to early work on the Mt Weld deposit (monazite mineralogy) in the early 1990s. Over the last 10 to 15 years, we have worked on numerous rare earth projects both in terms of process development, piloting (Peak Resources, Arafura Resources, ASM, Northern Minerals, Hastings Rare Metals, Mkango Resources, Iluka Resources, VHM) and providing expert advice.

ANSTO has experience in the processing of monazite (beach sand and weathered), bastnaesite, xenotime, apatite, parasite and synchysite, as well as from less frequently exploited rare earth sources such as ionic clays, clay-hosted rare earths, phosphogypsum and complex ores containing zirconium / niobium silicates. Process development work has been undertaken for projects in Australia and across the globe.

Our work has included all facets of rare earth process flowsheets, including acid leaching, sulfation baking, caustic conversion, alkaline roasting, selective precipitation, impurity removal, solvent extraction, ion exchange, process water treatment (softening) and chemical concentrate production. We are experts in the deportment and the management of radioactivity in rare earth process flowsheets.

Over the last 5 years, ANSTO expertise has been applied to an increasing number of ionic adsorption and clay-hosted REE projects (>15 currently in progress), including the more advanced projects of Aclara (Chile), Serra Verde (Brazil), Ionic Rare Earths (Uganda), Australian Rare Earths (South Australia) and Caldeira (Brazil). Work on these projects has included leaching/desorption, solid/liquid separation, impurity removal and rare earth precipitation, mineralogy, radionuclide deportment and removal, process modelling and mini-plant circuit operations. Although U and Th concentrations in clay deposits are perceived to be low, radioactivity (in the form of U and Th decay chain progeny) reporting to specific intermediate streams and the REE product is often an issue, which ANSTO has specifically addressed on a number of projects.

ANSTO has produced a range of separated light rare earth oxide (La, Ce, Nd, Nd/Pr) and mixed middle and heavy rare earth concentrates using solvent extraction. Product purities ranging from 99% (2N) to 99.9% (3N) have been achieved for several projects. A comprehensive modelling capability for these circuits, something which is unique in the industry, has also been developed. This knowledge has been applied to several scoping and higher level engineering studies, including SX circuit design (number of stages, circuit configurations, reagent consumptions), and techno-economic evaluation of processing options.

3. Process Development for Northern Concession Composite Sample

The approach proposed for process definition on a composite sample can be divided into a number of stages as follows:

1. The composite will be subjected to a diagnostic leach test under conditions (4 wt% solids, pulverised sample) that ANSTO uses to characterise ionic clay samples. A few additional diagnostic tests will also be undertaken to assess how the sample responds to key variables such as time and reagent strength. These tests are designed to determine the maximum extraction that can be achieved under the conditions used, without impacts of re-adsorption, co-precipitation and poor wash efficiency;
2. “Optimise” conditions for desorption, considering target REE recovery, reagent type and consumption, impurity dissolution, and potential impacts of conditions on effectiveness of impurity removal efficiency and product quality. This work would compare ammonium sulfate and magnesium sulfate in desorption. Desorption variables would include pH, duration, reagent strength and slurry density. The maximum practical slurry density that could be used will be determined in the PD1 program;
3. Determine appropriate conditions for the impurity removal (IR) stage with the aim of minimising REE losses, while still rejecting impurities to the required levels. IR variables would include reagent, pH and duration (possibly 2-stage precipitation and effect of temperature). S/L separation for IR precipitate is not included, but would be addressed in PD3;
4. Determine appropriate conditions for rare earth carbonate precipitation from IR liquor and quality of MREC produced. The precipitant used (e.g. ammonium bicarbonate, MgO) would depend on the optimised conditions for the previous steps. S/L separation for MREC precipitate and radionuclide analysis² are not included, but will be addressed in PD3.

4. Objectives and Scope

The main objective of the work program is:

- To carry out laboratory tests to define preferred conditions for a low-acid, low-cost, simple desorption process, followed by a 2-stage precipitation process, that can be applied to produce a “marketable” MREC.

The specific tasks in the scope are:

- Sample preparation on ~ 50 kg composite sample to produce sub-samples for head assay, and diagnostic and slurry leach tests;
- Assay of composite head sample by XRF (in-house) and fusion digest/MS, in triplicate (ALS Brisbane);
- Carry out 7 diagnostic leach tests to assess key leach variables;
- Carry out 11 slurry leach tests on clay crushed to < 600 µm to define “optimum” conditions;

² Requires 20-30 g of MREC.

- Carry out a 4-stage slurry desorption test on clay crushed to < 600 µm;
- Wash efficiency tests on the desorption slurry;
- Carry out 8 batch IR tests to “optimise” conditions on fresh desorption liquor produced from slurry leach tests;
- Carry out 4 RE carbonate precipitation tests on fresh IR liquor to determine optimum operating conditions;
- Prepare a comprehensive final report which presents all results and findings, including recommendations for the next stages of work.

Excluded from the scope are:

- Any continuous test work; and
- Test work by vendors.

5. Work Program

5.1 Sample

5.1.1 Sample Shipment

The client will send ~ 50 kg of a composite sample from the Northern Concession. If the sample is subjected to drying, it should have been dried at low temperature (~50 °C).

It is recommended that all samples sent to ANSTO come from a depth greater than 2 m. If samples are above 2 m, they will need to be irradiated for quarantine, which will incur a cost and a delay. Viridis will need to make a declaration regarding the samples in this regard. ANSTO will provide assistance in regard to the requirements for Australian Customs.

The samples are to be provided in containers suitable for transport. A GHS compliant Safety Data Sheet (SDS) for the samples is to be sent as a hard copy, if available, along with any other required documentation.

The delivery address is:

ANSTO
New Illawarra Road
Lucas Heights NSW 2234
AUSTRALIA
c/o Suzanne Burling
Minerals Bldg 39C
Phone: +612 9717 7437; 0439 730 597
Email: sbu@ansto.gov.au

5.1.2 Sample Preparation³

The 50 kg composite will be dried at 50 °C. The as-received 50 kg sample will be control crushed to < 600 µm. The crushed sample will then be split as follows:

³ The costs for sample prep and head assay have been reduced to account for costs included in the slurry settling and filtration project, which involved sample prep on only 10 kg and one head assay.

- 10 kg for use in the PD1 work (slurry settling/filtration);
- 25 kg for use in PD3 work (bulk MREC precipitation);
- 15 kg for optimisation work (PD2, this study):
 - ~ 1.2 kg of the < 600 μm clay will be split out and pulverised to produce samples for head assay (in triplicate), mineralogy and diagnostic leach tests. The assay sample will be dried at 105 °C and the mass loss determined;
 - 5 kg of < 600 μm clay will be split into 300-500 g lots for slurry leach tests;
 - Remaining clay will be kept aside for larger scale (1-2 kg) desorption tests.

5.2 Sample Characterisation

5.2.1 Elemental Analysis

The composite will be analysed by XRF at ANSTO for major gangue elements (Al, Ca, Cu, Fe, K, Mg, Mn, Na, Ni, P, Si, Sr, Zn) and a range of minor elements. The REEs along with Y, U, Th and Sc in the samples will be analysed in triplicate by tetraborate fusion digest/ICP-MS (lithium tetraborate method) at ALS Geochemistry Laboratory, Brisbane.

5.3 Diagnostic Leach Tests

Diagnostic tests will be done under a standard desorption condition using 80 g of pulverised sample at a high L/S ratio (4 wt%) to eliminate the impacts of adsorption, co-precipitation reactions and wash efficiency. The tests will provide the maximum REE extraction obtainable for the conditions.

The tests will make an initial assessment of the impact of key leaching conditions, e.g. ammonium sulfate (AS) concentration, pH and residence time. Allowance has been included to also assess the use of magnesium sulfate as an alternative lixiviant. The proposed tests are outlined in **Table 1**. Tests 1-6 will be carried out on the same day to minimise the project timeline. The aim of these tests is to define a window of operation, to be further narrowed in the slurry leach tests.

All tests will be conducted in a 2 L baffled leach vessel equipped with an overhead stirrer. 1 M H_2SO_4 will be utilised to maintain the test pH for the duration of the test, if necessary. At the completion of each test, a thief sample will be taken for liquor analysis only. The bulk final slurry will be discarded.

Table 1
Diagnostic Leach Tests on Composite Sample

Test No.	AS Concentration	pH	Duration (h)	Sampling
1	0.5 M	4	0.5	0.5 h
2	0.3 M	4	0.5	0.5 h
3	0.3 M	4.5	1	0.5, 1 h
4	0.1 M	4.5	1	0.5, 1 h
5	0.3 M MgSO_4	4	0.5	0.5 h
6	0.3 M MgSO_4	4.5	1	0.5, 1 h
7	Spare			

The final leach liquor filtrates will be analysed as follows:

- ICP-MS for Ce, Dy, Er, Eu, Gd, Ho, La, Lu, Nd, Pr, Sc, Sm, Tb, Th, Tm, U, Y, Yb (ALS);
- ICP-OES for Al, Ca, Fe, K, Mg, Mn, Na, Si (in-house)⁴.

All results will be presented as a data pack, with a brief progress note (PN1) summarising the key results.

5.4 Slurry Leach Tests

Slurry leach tests will be carried out on the composite crushed to < 600 µm to “optimise” desorption conditions. It should be noted that optimum conditions are not only defined by REE extraction, but also by the concentration of impurities in solution and the ease (and cost) by which these impurities are removed in impurity removal, and the potential extent of build-up in recycled lixiviant. Consequently, the optimisation tests to be undertaken are only the first step, where subsequent integrated test work would further refine the best conditions. Initial desorption conditions will be based on results of the diagnostic leach tests.

A key variable to be assessed will be the slurry density. As desorption is an ion exchange process, the slurry density⁵ will impact desorption, with a lower slurry density potentially better in terms of desorption efficiency. However, this increase in extraction needs to be considered in terms of solution tenor, size of equipment and additional RE recovery in filter cake washing. Procedures and sampling/analyses for the slurry leach tests will be as described in **Section 5.3**.

It is envisaged that each test will be carried out on a ~1 L scale using 300 g of clay (dry weight, dried at 50 °C), crushed to < 600 µm. All tests will be carried out at ambient temperature (~ 22 °C). Proposed tests conditions are as presented in **Table 2**, with all conditions to be reviewed when results of the diagnostic tests are available. It is anticipated that a block of 5 tests (1-3 and 6-7) would be undertaken in 1-2 days, with conditions for subsequent tests determined when liquor assays were available, about 1 week later.

The ammonium sulfate condition will be set at the start of the tests and not adjusted. pH will be maintained at the target by addition of sulfuric acid. The ammonium concentration will be measured at the completion of selected tests.

At the completion of all tests, the whole slurry will be filtered and the primary filtrate analysed as follows:

ICP-OES - Al, Ca, Co, Cu, Fe, K, Mg, Mn, Na, Ni, P, Pb, Si, Sr, Zn

ICP-MS - Ce, Dy, Er, Eu, Gd, Ho, La, Lu, Nd, Pr, Sc, Sm, Tb, Th, Tm, U, Y, Yb

Final liquors from selected tests (2) will be analysed for an extended range of gangue elements.

⁴ Minor elements in solution will not be analysed because of the high dilution, and as the purpose of the tests is to assess RE extraction variability. The dissolution of the major gangue elements will give an indication of relative acid consumption.

⁵ The maximum slurry density tested will be selected on the basis of the PD1 work on S/L separation and viscosity measurements.

For the 2 h test, thief samples will be taken as indicated (0.5 and 1 h). The liquors only from these samples will be analysed by ICP-OES and ICP-MS for the standard suites of elements.

Table 2
Slurry Leach Tests on Composite Sample

Test No.	Lixiviant Concentration	Slurry Density (wt%)	pH	Duration (h)	Sampling
1	0.5 M AS	35	4	0.5	0.5 h
2	0.3 M AS	35	4	0.5	0.5 h
3	0.3 M AS	35	4.5	0.5	0.5 h
4	0.3 M AS	40	4 or 4.5	0.5	0.5 h
5	0.15 M AS	35 or 40	4 or 4.5	0.5	0.5 h
6	0.5 M MgSO ₄	35	4	0.5	0.5 h
7	0.5 M MgSO ₄	35	4.5	0.5	0.5 h
8	0.3 M MgSO ₄	35	4 or 4.5	0.5	0.5 h
9	? M MgSO ₄	TBC	TBC	0.5	0.5 h
10 [#]	Preferred conditions for AS			2 h	0.5, 1, 2 h
11	Spare				

The purpose of this test will be to assess any changes in REE extraction over an extended period, which would occur in a filter feed tank and/or a thickener.

The final solids filter cake will be washed on the filter with two displacement washes of 450 mL each of lixiviant, followed by a 300 mL water wash. All of the final washed filter cake will be pulverised, and a sub-sample taken for drying at 105 °C. This sub-sample will be analysed by ALS by fusion digest/MS for the following elements:

Ce, Dy, Er, Eu, Gd, Ho, La, Lu, Nd, Pr, Sc, Sm, Tb, Th, Tm, U, Y, Yb

The final leach solids will not be analysed for gangue/minor elements as dissolution of these elements will be low, and extractions can be estimated from the head and liquor assays.

The 2 wash liquors (combined lixiviant and water wash) will be analysed as for the final leach liquor.

The RE extractions will be calculated based on the head assay and both the final solids assay, and the assays and volumes of the final filtrate, the combined lixiviant washes and the water wash.

All results will be presented as a data pack, with a brief progress note (PN2) summarising the key results. On the basis of the results, preferred desorption conditions will be selected for use in generating liquors for the downstream test work.

5.4.1 4-Stage Desorption

A 4-stage desorption process is an option for S/L separation in a CCD circuit where the clay would be washed counter-currently with lixiviant (slightly diluted). With this arrangement, it may be possible to operate at a lower lixiviant concentration than would be applied to a single stage desorption, followed by washing on a filter (likely to be inefficient) In this approach, a

desorption test under preferred conditions will be undertaken. The solid will be recovered (thoroughly water washed) and subjected to a second desorption test under the same conditions, but using fresh lixiviant solution. The solid from the second desorption would be similarly treated another 2 times.

Only ammonium sulfate will be tested in this manner, with the AS concentration selected (e.g. 0.05-0.1 M) when slurry leach results are available. Residence time of each desorption step would be 0.5 h.

Sample and assays will be as follows:

Desorption 1 : leach liquor by ICP/OES/MS, thief solids by digest/MS

Desorption 2 : leach liquor by ICP/OES/MS, thief solids by digest/MS

Desorption 3 : leach liquor by ICP/OES/MS, thief solids by digest/MS

Desorption 4 : leach liquor by ICP/OES/MS, thief solids by digest/MS, final bulk solids (washed per standard procedure) by digest/MS

Solids and liquor would be assayed as per procedures for slurry tests.

5.4.2 Desorption Slurry Viscosity

Slurry viscosity will be measured as part of the PD1 work program.

5.5 Solid/Liquid Separation and Washing

Filtration/settling rates for the desorption slurry are key criteria impacting the size and cost of S/L separation equipment. Solid/liquid separation tests will be measured as part of the PD1 work program.

5.5.1 Washing Tests

In practice, the clay will be washed following the desorption process with recycled lixiviant solution to recover entrained leach liquor. Typically the clay would be washed with a weak lixiviant solution, followed by a water wash to remove lixiviant from the final filter cake before disposal. The first (and perhaps second) displacement washes would be combined with the primary filtrate and sent to the impurity removal (IR) step. Subsequent washes can be recycled to the desorption step (after lixiviant concentration adjustment) and/or treated by RO to recover lixiviant and clean water for the clay water wash step. The options for recycling/treatment of wash liquors are a key part of the process.

The work proposed here will assess wash efficiency using lixiviant solution (at a concentration of 50% of the lixiviant) and water, and provide input to future flowsheet modelling.

A desorption test (at least 1 L) will be carried out under the preferred conditions. Only a final thief slurry sample will be taken for liquor and solids analyses as per the procedures used in **Section 5.4**. The final slurry will be vacuum filtered and the volume of filtrate collected in order to estimate the volume of liquor retained by the cake.

The cake will then be subjected to five displacement washes with lixiviant solution. The volume of each wash will equal the volume of liquor retained in the initial filtration. The wash volume collected (for each wash) will be measured and a sample taken for ICP/OES/MS analysis. After 5 washes and collection of 5 separate samples, one of each spent wash, the filter cake will be

similarly subjected to 3 displacement water washes. Each wash will be analysed by ICP/OES/MS.

The final washed residue will be analysed by ALS by fusion digest/MS for the standard suite of elements.

Ideally, a sample of solids should be taken after each wash, but this would involve carrying out five separate filtrations on the same slurry. ANSTO has tested this approach in previous work and found that assessing wash efficiencies by comparing solids assays was somewhat problematic. In the proposed approach, the wash efficiency can be estimated from the concentration of REs in the final leach liquor and the wash liquors.

5.6 Impurity Removal (IR) Tests

IR is a critical step as certain impurities must be removed by pH adjustment, with addition of ammonium bicarbonate (base case), prior to RE carbonate precipitation. The key factors are extent of impurity removal (particularly Al, Fe, Si Th and U) and the loss of REs with the precipitate.

Tests will be undertaken on liquors produced under the preferred desorption conditions for the composite. A number of desorption tests will be undertaken as part of this program to generate fresh desorption liquor. The plan will be to carry out the IR tests on the same day as the desorption tests. Note that to ensure precipitation of iron as ferric, hydrogen peroxide may be added to the desorption liquors before IR treatment.

5.6.1 pH Profile Tests

Two initial tests on a ~300 mL scale will be carried out over 1.5 h, where the pH is increased by addition of ammonium bicarbonate and MgO. Samples will be taken at pH intervals of ~ 0.3 over the target range from 4.5 – 6.4. At least 15 minutes will be allowed for the pH to stabilise before taking a 10 mL sample. Each liquor sample will be analysed by ICP-OES (extended suite of elements) and ICP-MS (by ALS).

5.6.2 IR Optimisation

5.6.2.1 Optimise pH

On completion of the above scoping tests, a further 6 tests (2 target pHs⁶ for both reagent and two spares⁷) will be undertaken on a ~ 1 L scale. Each test will be of 60 minutes duration, with the pH controlled at the selected targets for the duration of the test. Liquor samples will be taken at 15⁸, 30 and 60 minutes⁹ and analysed by ICP-OES (extended element suite) and ICP-MS. Tests at this scale should generate just sufficient solids for assay. Solids from all tests will be analysed by XRF and acid/digest ICP-MS (at ANSTO). Reagent additions will be

⁶ Two target pHs will be selected for each reagent as it is likely that the profile tests will show that there is a trade-off between Al rejection and REE losses over a narrow pH (~0.4 units) range.

⁷ The spare tests could examine a 2-stage precipitation, or a higher temperature to optimise results.

⁸ The liquor sample at 15 minutes will be subject to a more complete assay including a wider range of elements.

⁹ The preferred residence time for IR has been shown to be ~ 15 minutes (or less). However, as IR liquor may not be filtered immediately, an extended duration will be used to assess whether continued precipitation of gangue/REs occurs.

measured and the weight of solids generated will be determined (after washing with pH 5 water).

Several desorption tests will be required to generate test feed liquor for the IR tests, with some tests conducted in parallel.

5.7 Rare Earth Carbonate (MREC) Precipitation Tests

Optimum conditions for rare earth carbonate precipitation should be almost independent of the composition of the feed liquor (within a target window). Main variables will be target pH, residence time and washing required. Ammonium bicarbonate and magnesium bicarbonate will be used as the precipitating agents in this work.

All MREC precipitations will be undertaken on fresh liquor produced from IR tests. Whenever possible, the time between feed liquor production and the MREC precipitation tests will be minimised to reduce ageing effects (on-going precipitation of impurities and REs) on the feed liquor.

5.7.1 pH Profile Test

Initial tests on a ~300 mL scale will be carried out over 1.5 h using each reagent, where the pH is increased by addition of ammonium bicarbonate and magnesium bicarbonate. Samples will be taken at pH intervals of ~ 0.3 over the target range from 6.5 – 8.0. At least 15 minutes will be allowed for the pH to stabilise before taking a 10 mL sample. Each liquor sample will be analysed by ICP-OES and ICP-MS (by ANSTO).

5.7.2 MREC Precipitation Optimisation

5.7.2.1 pH Optimisation

Rare earth carbonate precipitation tests will be undertaken on liquor produced from ~ 1 L IR tests. Each test will be of 1.5 h (TBC) duration, with the pH controlled at the target for the duration of the test by addition of ammonium bicarbonate (150 g/L concentration) and magnesium bicarbonate. At this stage, it is planned to test two target pHs, to be selected on the basis of the profile tests for each reagent.

In each test, samples will be taken after 0.5, 1 h and on completion of the test. Thief and final liquor samples will be taken for ICP-OES and ICP-MS analysis. The final slurry will then be centrifuged, filtered, the solids washed¹⁰ (repulped twice in DI water, 15 mL/g wet cake, and the resultant slurry filtered and the solids subjected to 1 displacement wash with DI water), weighed and dried at 55 °C¹¹ for assay by XRF and acid digest followed by ICP-OES and ICP-MS assay (extended element lists). Radionuclide analysis would not be undertaken due to insufficient sample produced.

6. Samples and Waste

All analytical samples generated in the course of this project will be kept for a period of two (2) months following submission of the draft final report to the client. Analytical and bulk liquor

¹⁰ In one test, for ammonium bicarbonate, the 3 wash liquors will be analysed by ICP/OES and ICP/MS.

¹¹ Moisture content will be determined.

samples will then be treated by neutralisation and will be disposed of by ANSTO. The costs associated with all liquid waste treatment and disposal are included in the project price.

The tailings solids arising from the process along with the remaining head samples will be disposed of by ANSTO (cost included).

A storage fee¹² will be applied if the samples are required to be retained for more than six (6) months after project completion, unless other arrangements have been made.

7. Reporting and Timing

It is anticipated sample preparation can commence within 1 week of sample delivery, provided at least 2 weeks of notice for delivery is given.

The diagnostic desorption tests will require ~2 weeks to complete (including assay of leach liquor samples), with all diagnostic tests done on the same day.

The single stage desorption slurry tests will take ~5-6 weeks to complete, with this timing dependent on the turnaround time of leach residue assays¹³ and ANSTO piloting commitments.

The washing tests will be done in parallel with the slurry leach tests. The 4-stage desorption test will be undertaken towards the end of the test work program at a time which does not impact other tasks in the program.

Impurity removal and MREC precipitation tests will take a further ~5-6 weeks to complete following determination of the optimum desorption conditions.

Data files for the various test programs on the composite will be set-up and results provided when available, with a brief on-going summary of key results. Progress notes would be written on completion of the various tasks, with reference to the data files, as follows:

Progress Note 1	Results of Diagnostic Leach Tests and Data Pack
Progress Note 2	Completion of Slurry Leach Tests and Residue Washing Tests and Data Pack
Progress Note 3	Results of Impurity Removal Test Work and Data Pack

A detailed draft final report in electronic form presenting all key results, plus discussion, and a recommended flowsheet will be prepared within ~4 weeks of completion of all test work. The final report will be issued within 3 weeks of receiving comments from the client. If no comments are received within 4 weeks, the final report will be issued.

8. Health Safety and Environment (HSE)

ANSTO operates an Occupational Health, Safety and Environmental Management (OHSE) system designed to ensure the safety of its employees, partners and members of the public. The basic requirements of ANSTO's OHSE management system are: hazard identification, risk assessments and identification and implementation of control measures. Safe Work Method

¹² A storage fee of \$250/month/pallet (1 m²) will be applied if the samples are stored more than six (6) months after project completion.

¹³ A rapid turnaround on residue assay will be requested at an additional cost.

and Environmental Statements (SWMES) are incorporated in the planning of all experimental work undertaken by ANSTO.

ANSTO asserts its commitment towards the protection of the environment through its ongoing certification to the international standard for Environmental Management Systems, ISO 14001:2004. Our Minerals Business Unit is also ISO 9001 certified.

The Minerals Business Unit maintains a licence for an Ore Processing and Operations Facility (OPOF) from the Australian Radiation Protection and Nuclear Safety Agency (ARPANSA) to store, handle and process naturally occurring radioactive samples for the purposes of metallurgical testing. This licence is mandated under the Australian Radiation Protection and Nuclear Safety Act 1998 (Cth) (ARPANS Act).

9. Meetings/Liaison/Advice

No allowance has been included for project personnel to attend formal meetings with the client over the course of the project. Any costs of travel and accommodation for meetings outside Sydney on behalf of the client (if required) shall be borne by the client and are not included in this proposal. If required these costs will be charged as a disbursement.

An allowance has been included for project personnel to participate in teleconferences/Teams meetings, provide email updates on results, and general advice on RE processing, as appropriate.

The client is welcome to visit ANSTO any time during the work program.

10. Project Personnel

Suzanne Burling will be the Project Leader for this work. Suzanne will be the primary contact and be responsible for data assessment, email updates and reporting. Suzanne has over 15 years of hydrometallurgy experience and has worked on projects relating to rare earth, uranium and lithium recovery.

Bob Ring will be the Project Manager. Bob will have ultimate responsibility for project delivery. Bob will provide a review and assessment of results, participate in any teleconferences/meetings. Bob has ~ 40 years' experience in hydrometallurgical process development, with particular emphasis on leaching, including rare earths, and radionuclide deployment.

11. Price of Work Program

12. Terms and Conditions

All work will be carried out under the ANSTO Minerals Standard Terms and Conditions of Business (**Terms of Business**). Work will not commence until the client has signed to accept the quotation or provided a company purchase order referencing the quotation, this proposal and the associated terms and conditions.

Bob Ring, Suzanne Burling
ANSTO Minerals
24th May 2024