Submission No. 18

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[redacted]

Committee Secretary
Standing Committee on Industry and Resources
House of Representatives
Parliament House
CANBERRA ACT 2600
AUSTRALIA

Dear Sir,

Submission
Inquiry into developing Australia's non-fossil fuel energy industry

Please accept this letter as a submission to your Inquiry of into developing Australia's non-fossil fuel energy industry.

I make this submission on behalf of Eaglefield Holdings Pty Ltd (Eaglefield), a privately owned mineral exploration and development company that has been operating in WA since 1988.

Eaglefield is the owner of major multi-metal mineral resource located in WA named the Mulga Rock Deposit (MRD). The MRD are part of a larger resources project named the Narnoo Project. Principal commodities within the MRD are nickel, cobalt, scandium, and uranium. Only the uranium content of the MRD has been evaluated (by the previous owner) and was estimated at over 40,000 t U3O8 (the age of this resource estimation renders it non-JORC compliant).

However, more importantly, work that we have subsequently completed indicates that the MRD may also be the largest known exploitable resource of scandium in the world, and therefore of considerable national and international strategic importance. Scandium is a very rare material used in the manufacture of premium aluminium alloys, and more recently is being evaluated as an additive to significantly increase the performance of Solid Oxide Fuel Cells.

The Narnoo Project also contains a very large resource of oily-lignite that may yield over one billion barrels of oil if amenable to processing via emerging coal to oil conversion technology. The location of such a massive energy resource in the Goldfields region also affords other mineral processing or water supply possibilities.

The development of the MRD will have major strategic importance to WA, Australia, and the world. Therefore, this submission is addressed towards the term of reference:

Strategic importance of Australia's uranium resources and any relevant industry developments.

In summary, the potentially significant strategic aspects of the MRD, inclusive of its possible development are:

1. The return of ownership of a potentially world-class mineral resource from totally foreign ownership to local ownership
2. Establishment of a long-term revenue source for Local and State Governments and other bodies from a resource project with a mullti-billion dollar insitu value.
3. Installation of access and communications infrastructure into a presently remote, but mineral-, energy- and water-rich area of the North-eastern Goldfields region of WA.
4. Provide a mechanism for the supply of potable water to the City of Kalgoorlie-Boulder and the Perth area, sourced from aquifers in the Gunbarrel Basin.
5. Increase sales of WA's massive LNG resource to major trading partners by linking the sale of this globally abundant commodity with supply of the much scarcer yellowcake. All of WA's major trading partners consume both LNG and yellowcake.
6. Develop a globally dominant, and internationally significant scandium product supply industry based in Australia, generating potentially hundreds of millions of dollars of economic activity, and a new, in Australia. Other, presently uneconomic, scandium-rich mineral resources in Australia (e.g., Nickel Laterite deposits in NSW and QLD) may also subsequently be developed via the monetising of their presently valueless scandium component, producing major economic activities in those states.
7. Provide the major financial and infrastructure resources prerequisite for the evaluation and possible development the massive oily-lignite resource within the project area, with a synthetic oil production facility located in the Kalgoorlie-Boulder region. This facility may subsequently render economic other known lignite resources in the Eastern and southern Goldfields regions. Collectively, these resources are so massive as to be potentially able to supply all of WA and much of Australia's oil requirements for many decades.
   An aluminium smelter may also be associated with this project.

An overview of the MRD and associated resources, and the potential strategic outcomes from their developments are described in detail below.

THE PROJECT

The Narnoo Project is located about 240 km ENE of Kalgoorlie-Boulder on the western margin of the Great Victoria Desert. The project area covers much of a small sedimentary basin named the Narnoo Basin, which is adjacent to the much larger Gunbarrel Basin (previously known as the Officer Basin).

The project is sited on vacant crown land, with the nearest inhabited settlements (Pastoral Leases) over 150 km away. The terrain is typically sand dunes and Spinifex, and the climate very arid.

THE RESOURCES

The Narnoo Project contains multiple known mineral and energy resources. The most important of these are described below.

<u>The MRD</u>
The MRD comprise three discrete mineral resources spread along a linear trend about 25 km long. They are a globally unique form of sediment-hosted, poly-metallic mineral deposit formed within a small sedimentary basin.

The mineralisation that comprises the deposits is typically developed in the upper interval of a seam of oily-lignite. The thickness of the ore ranges from 0.5 m to over 5m and depths of 35 m to 50 m. The average uranium content varies from about 1 kg/t to 2 kg/t U3O8. Nickel, cobalt, scandium and other metals are also present, but the average grades of these constituents have not yet been determined.

The MRD was discovered, and initially evaluated by PNC Exploration Australia Pty Ltd (PNC) during the period 1979 to 1997. PNC was an entity owned by the Japanese Government with a charter to pursue uranium exploration in Australia. They divest the deposit in 2000, following closer of the parent department by the Japanese Government. Eaglefield acquired tenure to the resource, with tenement grant in February 2003.

Because PNC was a private entity, little information on the MRD passed into the public domain. However, we have determined that PNC evaluated only the uranium content of the MRD, and the total estimated resource determined by internal studies by them, or by Robertson Research (PNC's consultants) was about **43 Mt at 1.1 kg/t U_3O_8 for a total 46,000 t U_3O_8.** This resource is non-JORC compliant. The present-day insitu value of the U_3O_8 alone (at US$25/lb, A$=0.77) is about **$3.3 Billion.** However, many analysts forecast that the uranium price will increase towards US$40 /lb over the next five years, greatly increasing the value of the resource.

Although the quantity, and therefore, value of the associated nickel, cobalt, scandium and other mineral metals are not yet known, it is possible that their combined value may equal or exceed that of the uranium. This will be largely dependent on the final value of the scandium.

However, given the significant minimum value of the resource, it is likely that when developed, the MRD will pay total Local and State Government royalties and taxes of over $500 million, and more in Federal income tax.

<u>Oily Lignite</u>
The lignite seam that hosts the MRD also extends over a much larger area of the Narnoo Basin, and the thickness locally increase to over 30 m. The size of the resource has not been determined to JORC compliance, but the two largest thick seam (i.e. >10 m) deposits found to date cover an aggregate area of many square kilometres, and therefore, could hold over 250 Mt.

Preliminary analytical test work that we have completed indicates that the lignite contains over 100 litres per tonne (L/t) of high quality oil that can be recovered by simple pyrolysis (roasting). However, international experts of more sophisticated solid to liquid conversion technology (i.e. solvent extraction with hydrogen donor) have reviewed the preliminary chemical analysis of the lignite, and advised that it may be well suited to processing by this method, in which case an oil yield of up to 600 L/t (i.e. about 4 barrels per tonne) could be achieved.

There is also an additional huge amount of oily-lignite in the basin where the seam less than 10 m thick, including all the material that is host to the MRD. Therefore, the total amount of oily lignite in the Narnoo Basin is very large, and this may convert to over one billion barrels of oil.

PROPOSED RESOURCE DEVELOPMENT MODEL

It is proposed that the development of the MRD and associated resources will proceed in an incremental manner, along the lines of the following.

1. A Feasibility Study to confirm the size of the MRD, and mining and ore processing methods.
2. Installation of access, accommodation and communications infrastructure at the MRD.
3. Commissioning of an open pit mining operation. This may produce 900 – 1,000 tpa Yellowcake, over 200 tpa Sc-oxide, and an amount of nickel and cobalt. This Yellowcake represents less than 10% of Australia's present production, but would be less than 5% after the proposed expansion of the Olympic Dam Mine.
4. A proposed second phase of ore processing (to recover gold and remaining nickel and cobalt) will require combustion of the lignitic ore, releasing much surplus energy. If converted to electricity, the energy could be utilised to distil (if necessary) and pump potable water from the Gunbarrel Basin to Kalgoorlie-Boulder, and possibly the metropolitan area via reversing the flow of the Goldfields pipeline.
5. Laboratory scale testing of conversion methods for the lignite would proceed concurrent with the establishment of the mining operation. If a suitable process were developed, then a Pilot Plant would be constructed, probably near Kalgoorlie-Boulder.
6. If conversion of lignite to oil were proved economic, a plant would be constructed at a site closer to Kalgoorlie-Boulder, and the lignite ore pumped as slurry from the Narnoo Basin. The plant would produce many millions of barrels of oil per year for many decades. This plant could also produce much of the sulphur now imported to region for use in several of the existing and proposed Nickel Laterite plants.
   A power station integrated with the oil plant could also sustain an aluminium smelter, with alumina feedstock source from the southwest region of WA.

SUBMISSION

The MRD is one of Australia's most strategically important uranium resources; not so much for the contained uranium, but rather the other unique nationally and internationally significant resource and industrial developments that it could deliver. These include:

<u>1) Local Ownership of a Strategic Resource</u>
Eaglefield's acquisition of the MRD has achieved the return of ownership of a strategically important resource from a foreign entity to a local one. This is a very significant outcome when realising that the majority of Australia's uranium resources are owned or controlled by foreign entities.

It is our intention to strive to ensure majority ownership and control remain with Australians, but this is dependent on local institutional and retail investors making capital available when such funds are required for further project evaluation and development. The investing habits of Australians are very much driven by market sentiment towards a commodity, and this in turn is influenced by government policy.

Generally, the ambivalent or negative policies of Governments in Australia to uranium projects generates a major disincentive for Australians to invest, at the predevelopment stage, in any resource project containing uranium.

If Australian individuals and financial institutions are not prepared to make capital available, when required, on commensurate terms to project value when these funds are required (a situation that exists now), then it is very likely that majority ownership, and possible control of the MRD will again pass to foreign entities who are prepared to recognise the project's value.

2) Long Term Revenue Source

If developed, the MRD and possible associated oil production facility would be very long-life, high revenue projects. These projects would deliver a steady and substantial stream of royalties and other taxes to the Local and State Governments; income that would help reduce the tax burden that is instead imposed on the people of WA.

It is worth noting that there is probably well over 150,000 tonnes of yellow cake in the five substantial known uranium deposits in WA. According to international experts, this will very soon be worth over $10,000 M. If developed at the previously nominated output levels by the respective owners (totalling about 6,000 tonnes per year yellowcake), they would deliver royalties of probably over $30 M per year directly to the State Government, plus generate other economic activity.

It is reported that uranium mining in South Australia from just two operations employs (directly and indirectly) about 5,000 people. Similar employment and economic activity could be expected from WA's resources. A Government should be mindful of the enormous value and income potential of these recourses to the people of the state if considering policies that seek to sterilise them.

3) Installation Of Access And Communications Infrastructure

The Narnoo Project is located in a mineral-, energy- and water-rich area of the North-eastern Goldfields region of WA that is presently almost devoid of all access, accommodation and communications infrastructure. Installation of this infrastructure could only be as a consequence of the development of a major resources project, and the MRD is the only pending project of sufficient size to warrant the cost.

However, once such regional development has commenced, other lower value developments can follow.

4) Supply Of Potable Water to the Goldfields

The long term supply of an increased volume of potable and process water to the Goldfields region is one of the most important regional development issues that must be resolved by the State Government in the near future. It is known that a huge resource of potable water exists in the remote Gunbarrel Basin (also known as the Officer Basin), but development of this resource is uneconomic (compared, for example, to sea water distillation) due to the lack of energy and infrastructure in the basin.

Development of the MRD, and subsequent processing of the ore should produce the require infrastructure and energy to permit the cost-effective collection of water from the adjacent Gunbarrel Basin, and pumping to Kalgoorlie-Boulder, with a possibly of additional supply to the metropolitan area via reversing the flow of the Goldfields pipeline. This development would require construction of water gathering network in the Gunbarrel Basin, plus a pipeline to Kalgoorlie-Boulder. Such a project could only be viable if integrated with development of the MRD.

Once in place, the water gathering and transport system could be progressively expanded until it comprise a major part of the supply to regional and urban WA.

5) Increased Sales Of LNG From WA

Development of the MRD (and other uranium deposits in WA) would provide a long-term supply of an internationally significant amount yellowcake from WA. There is a ready and willing market for this uranium among WA's key trading partners (e.g., Japan, South Korea, Taiwan, China and the USA), as all have major, or pending, nuclear power facilities, but little indigenous supplies of uranium. These nations are also major, or emerging markets for LNG, a commodity also in abundance in WA. However, there are many new, and lower cost LNG facilities being constructed around the world, hence WA operations may find it increasingly difficult to compete in a market where cost, rather than reliability of supply, is becoming the more important factor determining sales.

It is notable that the North West Shelf operation recently failed in bid to supply about 1.5 million tonnes of LNG to South Korea. At the same time, the South Korean Government were searching the world for a reliable, long-term supply of uranium for their expanding nuclear power industry.

It is arguable that the State or Federal Governments could leverage additional sales of WA LNG (and other commodities) to trading nations via agreements to also guarantee supply uranium.

6) Develop A Scandium Product Supply Industry

The MRD is probably the largest exploitable scandium resource known in the world today. When operational, the deposit will produce 99% of the world's scandium for some time. The development of the MRD represents the first opportunity ever for the supply of a commercially significant amount of scandium products to the industrialised world.

The scandium content of the MRD is not yet proven, but preliminary data suggests it will be 15% to 20% of the uranium content (i.e. many thousands of tonnes of Sc-oxide). Metallurgical testing that we have completed indicates that the scandium is easily recovered in conjunction with the uranium, nickel and cobalt.

Recognising that the Committee (or any other Australian based body) will have little knowledge of the scandium industry, the follow information, based on our research, is provided. An informative source of information on scandium-aluminium alloys can also be found at reference (1).

1. Scandium supply is presently only about 5 tpa Sc-oxide. Worse is that only about 2 tpa is a by-product of from mine production, with the balance drawn from a small stockpile in Russia left over from the Soviet era (sourced from a few, now closed uranium mines), when scandium-aluminium alloys were a critical part of their military aerospace systems. The extreme scarcity of scandium is due to a peculiar chemistry that prevents incorporation into ore-forming minerals.
2. Most Sc-oxide consumed is processed into Scandium Master Alloy (Sc_2O_3 is converted to $ScAl_3$), for use in aluminium alloys, at an ancient and very inefficient facility located in Russia. This plant can only process about 10 tpa Sc-oxide. China also produces some Master Alloy.
3. Many high-value consumer goods are presently being manufacture from scandium-aluminium alloys, including bicycle frames and baseball and other bats. The most substantial potential market is commercial aerospace.

4. A new Master Alloy plant would have to be constructed somewhere in the world to process MRD Sc-oxide. It is logical that this should be in Australia if the MRD is developed with local ownership.
   The CSIRO in Melbourne have conducted R&D on scandium-aluminium alloys, and have knowledge that may assist in inventing new technology for Master Alloy manufacture. .
5. Researchers and consumers of premium aluminium alloys, and Solid Oxide Fuel Cells (described-below) are seeking a large, reliable and reasonable priced supply of Sc-oxide. They are aware of the present precarious supply situation, and this is greatly restricting research and product development.
6. Large-scale adoption of scandium in any products will only occur if a guaranteed critical mass of production can be demonstrated achievable from one or more sources. The collective "best guess" of this critical mass is about 150 tpa Sc-oxide supply. However, market analysis we have completed indicates that demand for 400-500 tpa Sc-oxide could emerge over the medium term once the critical mass was reached.
7. Scandium modified products are so dramatically different (but better) to those that they would replace, major retooling would be required to manufacture the new products. This retooling would be very expensive and take time. Therefore, demand growth for Sc-oxide will be slow, mainly because it is coming off a very low base (e.g., even at growth of 100% pa, it would take about 5 years for demand to reach 150 t Sc-oxide).
8. Scandium rich zones have been discovered in low-grade Nickel Laterite type deposits in Qld and NSW. However, these resources cannot be contemplated for development at present owing to a Pressure Acid Leach metallurgical process being required for extraction. These plants have very high Capex and Opex, so would not gain debt funding until a large and secure market is established. Similar deposits may be found in WA with a concerted exploration effort.

Developments in Aluminium Alloys

Despite the issues surrounding scandium supply, research and evaluation of scandium-aluminium alloys continued by many groups around the world, and some results have been published during the past few years. Examples include:

1. The Airbus Group have announced that commercial aircraft made from scandium-aluminium alloys would be about 15% lighter, and 15% cheaper to build than present aircraft (2). The dramatic difference is due to the ability to weld (using lasers) the aircraft components together, replacing the riveting method used at present. Components would also require less anti-corrosion treatments. However, a switch to welded structures would incur very high retooling and retraining costs, hence could only be contemplated if a substantial and price-stable supply of scandium-aluminium alloys were available.
2. NASA has competed a long-term test of a commercial scandium-aluminium alloy for use in spacecraft and other aerospace (3). Despite the crudeness of the alloy tested (named C557, and developed by Alcoa for baseball bats), the results were very positive. Further R&D of this type of alloy will result in major improvements.
3. The Saudi Government is sponsoring R&D of corrosion-resistant scandium-aluminium alloys for use in seawater distillation plants and for boat hulls (4). The development of scandium-aluminium alloys for naval use could have significant commercial ramifications for boat building companies, particularly those who could gain preferential access to these alloys.
4. The CSIRO are evaluating various aspects of scandium-aluminium alloys as part of their Flagship Light Metal project.

5. The Smith and Wesson group have released a range of handguns made almost entirely from scandium-aluminium alloy, including the barrels (5). These products may be the precursor to a massive market in military applications, provided a secure supply of scandium is established.

Many other groups are conducting R&D of scandium-aluminium alloys, and links to these can be found at reference (1).

Solid Oxide Fuel Cells (SOFC)

SOFC are devises that convert the chemical energy contained in a gaseous, hydrogen-rich fuel (e.g., natural gas or hydrogen) directly to electricity with some by-product heat (6). A massive R&D effort is proceeding globally to refine this technology as a precursor to the transition to a Hydrogen Economy.

The crucial component of SOFC is a ceramic electrolyte in which the core reactions take place. Electrolyte is presently made of Yttria Stabilised Zirconia or YSZ (i.e. zirconium oxide produced from zircon mineral sand of the type mined in WA, plus 5%-10% yttrium oxide). Although YSZ performs the required job, it must operate at temperatures of 900-1,000° C to be electrically efficient. However, at this temperature, very expensive metals must be used to both house the SOFC, and for the other internal conducting components. The electrolyte is also subject to destructive thermal shocks due to the high temperature range during operation.

One of the most significant discoveries of recent times has been the finding that replacing the yttria with scandia (i.e. Sc-oxide) to produce Scandia Stabilised Zirconia (ScSZ) produced a three to five times improvement in the efficiency of the electrolyte, and therefore, permits a lowering of operating temperature to 750-800° C. At this temperature, simple low cost metals (i.e. stainless steel) can be used throughout the product, producing a major manufacturing cost saving. ScSZ is also stronger, and less prone to thermal erosion or decay. Therefore, the electrolyte can be thinner, saving both weigh and cost.

A company named Ceramic Fuel Cells Ltd have recently listed on the ASX to commercialise SOFC technology developed by the CSIRO (7).

On the basis of the information above, the following conclusions can be made regarding the scandium industry and the MRD:

1. A significant potential industry exists for the supply of scandium products to the aluminium alloy and fuel cell industries.
2. The scandium market is presently very small. Furthermore, significant market growth will be slow (many years), as much retooling and retraining will be required in the major consuming industries.
3. The MRD is geologically unique in that it contains a high concentration of easily recovered scandium, plus sufficient concentrations of other valuable commodities that can defray operating costs until full Sc-oxide sales are achieved. It has no known analogues anywhere in the world. As a consequence, the MRD is the most significant exploitable scandium resource known in the world today. It contains thousands of tonnes of Sc-oxide, which could be produced at the quantity, high reliability and modest cost required for its adoption across all applications.
4. It is uncertain if the MRD could economically produce Sc-oxide without some revenue from associated uranium-oxide.

5. Laterite-type nickel-cobalt-scandium deposits at other locations in Australia could be economically developed in the future, but only after production from the MRD has established a substantial market and known price for Sc-oxide.

7) Provide Infrastructure For a Major Synthetic Oil Production Facility

The Narnoo Project contains a massive inferred resource of oily-lignite that may be utilised to establish an intergraded oil, power and possibly aluminium smelting facility in the Goldfields region.

The size of the resource has not been determined to JORC compliance, but the two largest thick seam (i.e. >10 m) deposits found to date cover an aggregate area of many square kilometres, and therefore, could hold over 250 Mt. Preliminary analytical testwork that we have completed (modified Fischer Assay) has returned oil yields of 100 – 120 litres per tonne (L/t). However, international experts of more sophisticated solid to liquid conversion technology named "Solvent Extraction With Hydrogen Donor" have reviewed the preliminary chemical analysis of the lignite, and advised that it may be well suited to processing by this method, in which case an oil yield of up to 600 L/t (i.e. about 4 barrels per tonne) could be achieved. Much more work will be required to confirm this assesment.

There is also an additional huge amount of oily-lignite in the basin where the seam less than 10 m thick, including all the material that is host to the MRD. Therefore, the total amount of oily lignite in the Narnoo Basin is very large, and the contained oil may exceed one billion barrels.

Appraisal and possible development of the resource will take many years of expensive research, and a huge investment in plant and infrastructure. In reality, such a development could probably only be achieved in conjunction with an existing project that was both profitable, and established significant transport and mining infrastructure near the lignite resource.

Development of the oil resource would initially require laboratory scale testing of conversion methods for the lignite. This would proceed concurrent with the establishment of the mining operation at the MRD. If a suitable process were developed, then a Pilot Plant would be constructed, probably near Kalgoorlie-Boulder.

The mining of lignite feed for a Pilot Plant would be very expensive (prohibitively?) if sourced from a dedicated pit. However, a large amount of unmineralised oily-lignite would also be mined as waste from the MRD open pit (i.e. at very little cost), and this could be trucked as back-freight to the Pilot Plant.

If conversion of lignite to oil were proved economic, then full project would require a massive investment in additional infrastructure, creating spectacular growth in the Goldfields region.

We envisage that ore from the Narnoo Basin would be pumped as slurry to a site closer to Kalgoorlie-Boulder. Here, the excess water could be captured for use in the region, and the residue processed to recover the oil. Production of many millions of barrels of oil per year would follow for many decades. This plant could also produce much of the sulphur now imported to region for use in several of the existing and proposed Nickel Laterite plants.

Over time, the other oily-lignite resources that have been discovered in the Goldfields region could be developed, and provide supplemental feed to the plant, increasing the amount of oil and other commodities produced.

It is also possible that the plant would have the capacity to produce significant, low-cost electricity. This could be harnessed to power an aluminium smelter, to be fed by some of the great amount of alumina that is now exported from WA to be refined at other location in Australia and around the world, at great economic cost to the people of WA.

The lignite processing facility described above would be a major emitter of green house gases. These would be offset at a global level by the construction of nuclear power stations in other countries (but fuelled by MRD uranium) that replace existing fossil fuel power stations.

Yours sincerely

Mike Fewster
Manager

References cited:

1) http://home.no/al-sc/
2) http://lu.fme.vutbr.cz/icas2002/PAPERS/4101.PDF
3) http://techreports.larc.nasa.gov/ltrs/PDF/2002/tm/NASA-2002-tm211633.pdf
4) http://www.sciencedirect.com/science?_ob=ArticleURL&_udi=B6TWS-42SXG3G-3&_user=10&_coverDate=07%2F31%2F2001&_rdoc=3&_fmt=summary&_orig=browse&_srch=%23toc%235570%232001%23999569992%23243276!&_cdi=5570&_sort=d&_docanchor=&_acct=C000050221&_version=1&_urlVersion=0&_userid=10&md5=9ff91cd006d9de9e2353fb97e238d202
5) http://firearms.smith-wesson.com/contentbuilder/layout.php3?contentPath=content/00/01/32/32/75/userdirectory50.content
6) http://www.cfcl.com.au/html/technology.htm
7) www.cfcl.com.au