NUCLEAR FUEL CYCLE ROYAL COMMISSION TENTATIVE FINDINGS RESPONSE

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The Commission's Tentative findings overview begins by stating that the publication reflects "the Commission's current thinking on the issues it considers to be important and the most cogent evidence relevant to them."

While I do not doubt the accuracy of this statement, it does raise the question "how does the Commission determine what it considers to be important?"

With this question in mind, I seek to draw attention by my submission to matters related to occupational health and safety for existing and future nuclear industrial workers in South Australia. I hope that the Commission considers this important, and the evidence base for it reputable.

I will also briefly address matters of risk to human health and the environment associated with the operation of nuclear facilities- including the operation of uranium mines and mills, further processing and nuclear accidents.

I sincerely hope that the health and wellbeing of South Australia's workforce, its citizenry and its environment are considered sufficiently important topics for this Commission to elaborate on the matters raised here ahead of its final report to Parliament in May.

Note: This submission does not address matters related to the storage and transport of nuclear waste in South Australia. I am confident that these issues will be the core focus of many other persons and organisations' submissions. In my initial submission to this Commission, I raised matters related to nuclear weapons proliferation which I will not repeat in this submission. I would encourage the Commission to revisit my prior submission, as I believe its contents to be sound, and the sources of relevant information clearly expressed.

KEY TENTATIVE FINDINGS – BRIEF RESPONSES

The Commission's opening tentative finding states that "South Australia can safely increase its participation in nuclear activities, and by doing so, significantly improve the economic welfare of the South Australian community."

The evidence base for adopting such a confident and conclusive statement is questionable. In the case of nuclear industrial activities which have established links with health conditions including cancer and associated heart, lung and liver conditions and potential genetic harm, the safety or otherwise of an activity or regulatory regime can only be proven by epidemiological studies spanning a timeframe of decades.

For example, little is known about the fates of worker cohorts from existing and past uranium mining and milling activity in South Australia. I raised this matter with the Commissioner and his Chief of Staff during a public session in Port Pirie in May 2015. I also raised it in my first written submission to this Commission. The Commission has had time to consider this matter, but appears to have not deemed it sufficiently important. I would argue that the health and safety of South Australians engaged in the uranium industry should be of immediate importance.

The only relevant epidemiological studies that I am aware of conducted in South Australia were published circa 1990, and demonstrated that incidence of lung cancer among Radium Hill workers was greater than that of the wider South Australian population or the South Australian Department of Mines had anticipated.

Despite operating as an underground mine since the 1980s, and having a far deeper, longer network of underground workings than those at Radium Hill in the 1950s and 1960s, no epidemiological studies of workers from Olympic Dam has ever been undertaken. Without such studies, absolute assurances of safety cannot be honestly made. The South Australian historical record provides the basis for this position.

I wish to make a case for the prioritisation of epidemiological studies of past and present South Australian uranium worker cohorts as a matter of the utmost importance. The results of such studies could provide an empirical basis for future commentary regarding the safety or otherwise of the industry as it has existed until now. I will respond to this matter in more detail in responses to findings 10-22.

Similarly, the Commission's "key finding" that "An expansion of uranium mining has the potential to be economically beneficial. However, it is not the most significant opportunity" neglects to consider the potential costs associated with class action or individual law suits, should workers from Radium Hill, Wild Dog mine (Myponga), Port Pirie and Thebarton treatment works and persons employed at contemporary uranium mines and mills seek compensation in the future for cancer, lung, heart and liver conditions attributable to occupational exposure. If compensation is sought, and cause demonstrated, who will bear the cost? The threat of such law suits and class actions in the USA led to the eventual enacting of the Radiation Exposure Compensation Act in 1990. Compensation has now been paid out to 8,215 workers engaged in the mining, milling and transportation of uranium ore.

How can the Commission be so confident that *future* safety can be assured, when the health implications of exposure in *existing and past* nuclear worker cohorts in South Australia are so poorly understood?

If the allowable doses and working conditions have changed notably between the days of Radium Hill and Olympic Dam, I would assert that this Royal Commission might consider it important to detail what progress has been made. Have allowable dose limits changed? How have monitoring systems and workplace practises improved? Are workers better informed about the risks they face in today's workplace than those of the past?

Ultimately, I ask the Commission: can it demonstrate that uranium mining and milling have *ever* been "safe" in South Australia? Does the Commission have any epidemiological evidence upon which to base their assurances of safety?

The Commission states that "policies must be based on evidence, not opinion or emotion." The same rule should apply to statements made by the Commission. To be considered credible, they must be supported by material evidence. The absence of evidence is not evidence of absence. *Harm can neither be proven, nor safety assured without relevant epidemiological studies.*

This was known to South Australia's Department of Mines in 1956, when Dr. B. S. Hanson wrote in *The Health of Workers in the Uranium Industry* (pg. 16):

"It is only by long-term health examinations that the validity of our present speculative exposure limits may be tested."

This document is currently available on SARIG, the South Australian government's resources industry geoserver:

https://sarigbasis.pir.sa.gov.au/WebtopEw/ws/samref/sarig1/image/DDD/RB4200080.pdf

EXPLORATION, EXTRACTION & MILLING

Finding #10

"Where drilling occurs, if properly applied, the current administrative and regulatory processes are sufficient to manage the environmental and other risks. There are always risks of non-compliance with license requirements and these have occurred in the past."

Given that the statement made above refers to mineral exploration drilling generally, it would be appropriate for the Commission to acknowledge *the evidence which I have previously supplied*, which detailed non-compliant mineral exploration activity in South Australia. The example provided as an attachment to my previous written submission (*Compliance Audit Report – Eyre Iron's Exploration Activities, Lower Eyre Peninsula*) was provided to make several points. Firstly, non-compliant drilling in recent history has been discovered after widespread harm had been caused. It was discovered and reported not by the drillers themselves or regulators during field visits- but by concerned landholders and community members. Furthermore, once the audit was finally conducted and non-compliance proven, the report was not made publicly available. It was only obtained after the document was sought by making requests under the *Freedom of Information Act 1991*.

It is worth mentioning here that I have previously expressed my criticism that this, and indeed all Royal Commissions conducted in South Australia are exempt from the *Freedom of Information Act 1991*. This is fundamentally undemocratic, and contradicts claims made by the Commissioner on many occasions of his commitment to openness and transparency.

Returning to the subject of exploration drilling, I would suggest that there is another factor confounding the efficacy of exploration drilling regulation in South Australia- namely regulatory capture. This is accompanied by a tendency to withhold information regarding non-compliance and regulatory failure. The resulting impression can be one of false assurance. For example, by citing *Marathon Resources Rectification Plan 2008* in its Tentative Findings, while neglecting to list the Eyre Iron compliance audit report which it also received, the Commission is misleading the reader. A reader would be forgiven for assuming that Marathon's non-compliance was an isolated example, when clearly, this is not the case. The compliance audit report is found as Appendix A attached to my submission below.

http://nuclearrc.sa.gov.au/app/uploads/2016/03/Dan-Monceaux-10-08-2015.pdf

Finding #11

"Mining and milling activities for all minerals pose risks to human health and the environment, which need to be managed. If expanded, uranium mining and milling activities in South Australia would create similar risks to those arising from current uranium mining activities."

"b) the handling of ores containing radioactive minerals, both extracted uranium and its waste products- human exposure is controlled through ventilation, automated processes, protective equipment, engineered barriers and employee monitoring."
"c) the generation of dust – monitored and controlled by the use of filtration systems and wetting dry surfaces"

Points b) and c) describe management responses to risk of occupational exposure for uranium

workers, but the potential consequences of human exposure are not described. I do not believe it is responsible for the Commission to identify a "risk" and not describe the potential consequences of that risk in terms of possible human health impacts. What happens when ventilation is inadequate in underground mines where radon gas is found? What of the deposition of radon daughter products in the lungs of workers exposed to radon gas and its progeny? What of the ingestion of particulates which can occur when miners don't wash their hands and eat while underground?

The Government of South Australia has on its own record admissions of its institutional knowledge of lung cancer risk to uranium workers in underground mines. The evidence base dates back to the early experiences of miners at Joachimstahl in Czechoslovakia, from whose high incidence of lung cancer the first precautionary safety standards were subsequently set in other jurisdictions. The risk was understood in the 1920s as evidenced by publications of the South Australian Department of Mines from the mid 1950s, namely:

Possible health hazards in uranium mining – Armstrong, A.T., Department of Mines (1955)
https://sarigbasis.pir.sa.gov.au/WebtopEw/ws/samref/sarig1/image/DDD/RB00429.pdf

The health consequences of workers in the uranium industry – Dr. B. S. Hanson (1956)
https://sarigbasis.pir.sa.gov.au/WebtopEw/ws/samref/sarig1/image/DDD/RB4200080.pdf

They are found in the results of Radium Hill worker cohort studies published in peer-reviewed medical journals. The epidemiological studies of the 1980s, published circa 1990 proved, with epidemiological evidence of elevated cancer incidence, that confidence expressed in the safety of working conditions at the Radium Hill mine in the 1950s and 1960s was ill-founded.

Radon daughter exposures at the Radium Hill uranium mine and lung cancer rates among former workers, 1952-1987 - Alistair Woodward, David Roder, Anthony J. McMichael, Philip Crouch and Arul Mylvaganam (1991)
http://www.jstor.org/stable/3553403

At least in 1956, Dr. B. H. Hansen was honest about describing known and unknown risks. For example, genetic harm was discussed as a matter of unknown risk, as was the dose below which there would be no perceptible evidence of adverse effects.

"There is less certainty, however, about the genetic effect of these [ionizing] rays, for this may be proved only after several generations, perhaps several centuries... it seems prudent to accept only the lowest practicable exposure in persons of reproductive age... the safe rule, then, is "as little as practicable." (Pg. 1)

Similarly:

"What is not yet known is how high a level of natural radioactivity may be regarded as normal and how much radioactive material may be taken into the body without harmful effects. These materials are cumulative in their effects whether they are stored in the body or exert their action by irradiating the body tissues before being excreted or destroyed by natural decay, but it is not known over how long a period a minute quantity of any given radioactive material may be safely absorbed." (pg.3)

Internal exposure through the inhalation of radon gas and the deposition of its daughter products in the lung was identified as the most significant risk. The management of ventilation and dust mobilisation in the mine were considered priority actions, and were openly expressed as such. If

provisions were made to this effect, epidemiological study has shown those provisions to have been inadequate to provide a safe working environment, at least with respect to the development of lung cancer.

“What is far harder [than ingestion] is to prevent inhalation of them, for radon gas is intimately mixed with the air, and its daughter products deposit readily on dust particles and thus may enter the respiratory tract.” (Hanson, Pg. 6)

By comparison, the Olympic Dam mine's radiological safety measures and records remain protected by special secrecy provisions established under the *Roxby Downs (Indenture Ratification) Act 1982*. Secrecy during the time of the Radium Hill mine was a matter of protecting Commonwealth secrets during the Cold War. The secrecy provisions of the *Roxby Downs Indenture (Ratification) Act 1982*, were according to Ian Gilfillan of the Australian Democrats, at least in part to protect the project from attack by environmental groups. The Indenture Act was revised in 2011, and forfeited the ideal opportunity to repeal Cold War-style exemptions as a sign of good faith to the people of South Australia and movement towards open government.

The available evidence suggests that contemporary publications of South Australian Government departments fail to adequately communicate occupational exposure risk to their readers. The perfect example of this is the Uranium fact sheet published by the Department of State Development in 2015, during the proceedings of this Commission.

The “Fact Sheet” poses the question “Is uranium safe?” then neglects to answer the question. Instead, it provides the graphic reproduced from http://www.statedevelopment.sa.gov.au/upload/uranium/uranium%C2%ADthe-facts-final.pdf?t=1458534521755 below:

Compare this to Hanson and Armstrongs statement from 1956, in documents held by the same South Australian government, written 60 years earlier:

“Hazards associated with uranium ore are of two kinds, those due to radioactivity, including

external radiation as well as internal radiation; and those due to uranium metal poisoning. Radon gas and its solid daughter products would appear to offer the greatest potential danger. They can be inhaled and the solid products so lodged in the body." (Armstrong, pg. 18)

"The individual employed in a mine or mill risks damage by external or internal radiation, and as to the latter the radioactive particles which form a danger are either ingested or inhaled." (Hanson pg. 7)

"The daughter products are insoluble, but together with the dust to which they adhere some are engulfed by the reticulo-endothelial cells of the lung surface and there theoretically give a high intensity of alpha radiation to those very surface cells which form the type seen in the usual cancer of the lung." (Hanson pg. 9)

"The inhalation of active deposit on dust particles, is so much the most important one that most of our [Department of Mines'] effort should be directed towards overcoming it." (Hanson pg.10)

"In my opinion, dusty clothes inevitably mean an inhalation risk as well as an ingestion risk." (Hanson pg.14)

"Almost without exception this report deals with the real or probable dangers of radioactivity." (Hanson pg. 19)

The disparity between the messages of 1955 and 1956 (Department of Mines) and 2015 (Department of State Development) is alarming and deeply concerning.

Lessons can also be learned from experiences in other jurisdictions.

Not only have uranium mining and processing cost human health including thousands of lives in the USA alone, special legislation was enacted there to minimize damages borne by law suits from former uranium workers seeking compensation. The *Radiation Exposure Compensation Act* became law in 1990, and as of 16 March 2016 its records show that 6,214 uranium miners, 1,673 uranium mill workers and 328 uranium ore transportation workers have been compensated, resulting in over US$800,000,000 being dispensed to sick workers or their surviving relatives.

https://www.justice.gov/civil/common/reca

To qualify for compensation, an affected US worker must have developed lung cancer, fibrosis of the lung, pulmonary fibrosis, cor pulmonale related to fibrosis of the lung, silicosis or pneumoconiosis following employment. For uranium mill workers and ore transport workers renal cancer and chronic renal disease are also compensable. The date range for eligible employment spanned 1947 to 1971.

The tasks these workers fulfilled were comparable to those held by South Australians during the same time period. The Radium Hill mine, Wild Dog mine (Myponga), Port Pirie Treatment Works and Thebarton Pilot Plant all operated during this period, when South Australian standards for mine and plant safety were informed by American standards.

It is in my opinion, irresponsible for this Commission to make forward-looking statements regarding safety, without appropriately analysing its own operational and medical records, and considering the historical records of similar facilities in other jurisdictions under comparable

management regimes.

Finding #13

"The lessons that have emerged from the state-owned uranium mine at Radium Hill, which closed in 1961, and the associated treatment works at Port Pirie have been incorporated into current regulatory frameworks..."

This finding should also explain how the discovery of increased incidence of lung cancer among the workers employed at Radium Hill has informed improved regulation of the industry in contemporary uranium mines, most notably at Olympic Dam, its closest analog. The omission of this important "lesson learned" from the tentative finding could be read to suggest that the Commission does not consider the health of workers in underground uranium mines to be important.

Radon daughter exposures at the Radium Hill uranium mine and lung cancer rates among former workers, 1952-1987 - Alistair Woodward, David Roder, Anthony J. McMichael, Philip Crouch and Arul Mylvaganam (1991)

http://www.jstor.org/stable/3553403

FURTHER PROCESSING & MANUFACTURE

Finding #25

"If inhaled or ingested, airborne low-level radioactive materials also present health risks to workers in further processing facilities. These risks are managed by using protective clothing for workers, monitoring and containment and ventilation and air filtering."

It is inconsistent for the Commission to acknowledge that this risk exists in the further processing of uranium and manufacture of nuclear fuel, while failing to acknowledge that similar risks exist in the mining and milling of uranium. The absence of adequate description of the potential human health consequences of internal contamination by radioactive particulates in publicly available South Australian publications related to uranium mining in South Australia is irresponsible and in need of correction.

Please refer to references included in my reponse to Finding #11 for supporting evidence.

Findings #32 & #33

"Proximity of uranium mining would not, by itself, present a competitive advantage for conducting processing activities... However, the concept of fuel leasing, which links uranium processing with its eventual return for disposal... may present competitive advantages."

This statement (which bridges findings 32 and 33) infers that South Australia may have a "competitive advantage" if it were to begin with a nuclear fuel leasing scheme, and then expand into processing to complete the nuclear fuel chain. This is essentially suggesting a future pathway for future fuel cycle development in South Australia, which has not been clearly or adequately expressed in media releases or during press conferences.

REPROCESSING

Finding #34

"Reprocessing has proven to be a risky technology to introduce, with two overseas facilities experiencing significant operational difficulties."

This statement is very vague and requires extrapolation. What were these operational difficulties? South Australians should be plainly informed and supplied with adequate detail on this matter, given the possible scenario whereby nuclear fuel leasing and nuclear waste storage developments eventually leads to spent fuel reprocessing. It is worth noting that the separation of plutonium from spent nuclear fuel represents a nuclear weapons proliferation risk. Plutonium's importance in reprocessing is only mentioned in the list of references related to this Finding. Given the sensitivity of the material and its implications for nuclear weapons proliferation, I believe this should be acknowledged upfront, not obscured in appendices or reference lists.

Reprocessing spent fuel also has a unique pollution profile. One pollutant of note is the noble gas Krypton-85, which is released to the atmosphere. Naturally occurring Krypton-85 in the atmosphere retains equilibrium at 0.09 Pbq and is produced by the interaction of cosmic rays with stable Krypton-84.

Year	**Atmospheric Kr-85 inventory**
Pre-WWII	0.09 Pbq (estimate based on naturally occurring Kr-85 production by cosmic rays)
1973	1961 PBq
2000	4800 PBq
2009	5500 PBq

In 2009, the global inventory represented 61,111 times the naturally occurring background concentration. Clearly there is a case for investigating the consequences of such an increase, resulting almost exclusively from nuclear fuel reprocessing.

The only other anthropogenic sources of Krypton-85 in the atmosphere are the testing of nuclear weapons, or nuclear accidents such as Three Mile Island, Chernobyl and Fukushima. Contributions from such events are small and occasional when compared to the emissions resulting from the ongoing reprocessing of spent nuclear fuel.

Krypton-85 is radioactive, and has a half-life of 10.8 years. It has the potential to alter the electrical conductivity of the atmosphere, and while not a greenhouse gas in the conventional sense, has a poorly understood potential to alter weather. Research into the implications of increasing presence of Krypton-85 in the Earth's atmosphere is lacking and in my opinion, is deserving of investigation.

Krypton-85 inventory data sources and references are available at:
https://en.wikipedia.org/wiki/Krypton-85

Finding #35

"Without nuclear power generation, a used fuel reprocessing facility would not be needed in South

Australia, nor would it be commercially viable. On that view, it is not necessary to address its specific environmental and health risks."

This finding assumes that nuclear fuel reprocessing would not be needed on the bases of existing means of uranium supply and demand. This appears to be a very short-term view, given that economically recoverable supplies of uranium are finite. As uranium deposits become increasingly expensive to exploit, due to dropping ore grades, diminishing deposit sizes and deeper or otherwise more challenging geology, a point is likely to be reached at which reprocessing of spent fuel becomes economically more attractive than mining. By such a time, should the Government of South Australia have decided to establish a nuclear waste repository for the receipt of spent nuclear fuel, South Australia would find itself in possession of a significant resource, fit for reprocessing and resale.

If the Commission's considerations are going so far as to imagine the safe storage of nuclear waste in terms of centuries or millenia, it would be inconsistent to not consider that while future reprocessing technologies may develop, the chemical composition of the spent fuel is already known and can be accurately predicted (as its constituent isotopes decay over time).

It is therefore, in my opinion, imperative that the Commission shares its findings regarding the environmental and human health risks associated with existing a theoretical reprocessing of spent nuclear fuel.

Such considerations should include: the radiological and chemical exposure potential for workers engaged at such facilities, the human health consequences of over-exposure and the environmental consequences of liquid and gaseous effluent discharges.

It is worth noting another compensation program offered by the US Government under the Energy Employees Occupational Illness Compensation Program Act (EEOICPA). This program "compensates current or former employees (or their survivors) of the Department of Energy (DOE), its predecessor agencies, and certain of its vendors, contractors and subcontractors, who were diagnosed with a radiogenic cancer, chronic beryllium disease, beryllium sensitivity, or chronic silicosis, as a result of exposure to radiation, beryllium, or silica while employed at covered facilities."

Some of these workers would have been exposed to hazardous substances which are also handled at nuclear fuel reprocessing facilities. The program has paid out claims and medical bills in excess of US$12.3 billion since it commenced in 2001. The risks of human health impacts by workers engaged with nuclear fuel cycle activities are real, and could carry substantial human health and economic costs in the future, should Australia progress down this path.

http://www.dol.gov/owcp/energy/

ELECTRICITY GENERATION

Finding #38

"Nuclear power plants are very complex systems, designed and operated by humans, who can make mistakes."

I wish to express my agreement with this statement.

Finding #40

In this statement I wish to recommend that two statements be extrapolated upon. Firstly, in reference to the Three Mile Island accident, the statement "very small amounts of radioactivity were released externally" should be replaced by quantitative data. These are available.

In reference to the Chernobyl disaster, describing the "chemical explosion that caused the death of two workers and caused the release of a significant amount of radioactive material into the environment" is problematic. By specifying the deaths of these two workers, a reader could be mistakenly led to believe that the death toll of this incident was two. This is incorrect by a magnitude of thousands. The term "significant amount" should also be quantified. Given the manufactured nature of the isotopes emitted during the accident, one could argue that any amount of such material (including isotopes of Caesium and Strontium) is significant when compared to background levels (ie. none).

The failure to detail the consequences of the Chernobyl disaster in this section is misleading, given that the Finding is listed under the subheading "What are the risks?" It would be reasonable and appropriate to detail the extent of the contamination and its consequences, including an acknowledgment that various accounts of the human health implications of the disaster exist, which range in scope from thousands to tens or even hundreds of thousands.

I would encourage the Commission to consider the following reports, for comparison with UNSCEAR and WHO reports:

http://www.ratical.org/radiation/Chernobyl/HEofC25yrsAC.html

http://www.chernobylreport.org/?p=summary

Finding #41

Similar to my criticism of Finding #40, this finding should detail the known extent of the consequences of the Fukushima disaster to date. This finding neglects to mention the number of people evacuated, the area of land evacuated, the inability for existing technology to resist the heat and radiation emitting from the molten reactor cores, the ongoing discharges of contaminated water to the sea, the deaths of citizens including suicides resulting from displacement from their homes, and the increase of childhood thyroid abnormalities, including cancers. These are grave omissions, and I interpret them as an attempt to paint an artificially favorable picture of the event and its consequences.

Finding #42

"While the consequences are severe... The risk of nuclear accident should not of itself preclude consideration of nuclear power as a future electricity generation option."

This statement would appear to be questionably bullish, were the greater consequences of the Chernobyl and Fukushima disasters discussed in the prior two Findings. In my opinion, it is unreasonable for the Commission to make such a statement while simultaneously depriving its audience of known details regarding the greater extent of the impact of these two incidents.

Finding #45

"The generating capacities of SMRs would be attractive to integration in smaller markets such as South Australia and in off-grid applications."

It is my understanding that the commission is aware of the nature of projects likely to consider future deployment of SMRs. They include remote mining and defense facilities. It would be worth the Commission extrapolating on this point to avoid confusion related to the use of the term "off grid" which is more often used in reference to residential power supply (for example, using solar panels and battery storage).

Finding #50

"While the expected downward trend in the cost of renewable technologies to 2030 has been factored into assessments in estimating the changing mixture of generation in the National Electricity Market (NEM), the cost of nuclear is assumed to remain unchanged."

This statement reminds me of my own criticisms of the scope of this commission's inquiry. Given the downward trend in costs of renewable energy generation, I believe that this Commission could have potentially delivered a greater and more immediately beneficial return on investment had it directed its energies into analysing means to advance or accellerate renewable energy deployment in South Australia, including the approximately 3 GW of generating capacity in prospective wind farms planned for South Australia, and means to finance building or enhancing infrastructure to allow South Australia to become an effective energy exporter to Victoria and New South Wales. All of the currently proposed wind projects were realised, South Australia would have approximately 4.5 GW of wind generation capacity at its disposal, and could import energy via interconnectors during period in which wind conditions were not favourable, or make stored energy available via battery banks or prospective pumped hydro-electric power, which could be implemented in the Upper Spencer Gulf region.

FUEL LEASING

Finding #97

"Ownership of the fuel is maintained by one entity. It removes for the utility the significant operating cost of storing and managing used fuel over the long term. It might also help secure contracts for the storage and disposal of used fuel."

If ownership of the fuel is to be maintained by one entity, who or what is that likely to be? If the Commission can extrapolate on this it would be beneficial to readers. It would also pay to explain how such a scheme might secure contracts for spent fuel storage and disposal.

Finding #98

"The fuel leasing concept is not new."

Rather than making this ambiguous statement, it would pay for the Commission to describe the origin of nuclear fuel leasing, and explain where it has been trialed, developed or conceived. The concept of nuclear fuel leasing is not familiar to many people (myself included), and it would pay for the Commission to provide more detail on this topic generally in its findings.

Finding #99

"Fuel leasing based on an operating storage and disposal facility might resolve some of the significant economic barriers to new entrants seeking to provide global conversion, enrichment and fabrication services."

This statement deserves further extrapolation. How exactly will it perform this function?

Finding #100

This finding reads to me like the cornerstone of the Commission's findings in general. In its three proposed steps, it lays out the staged development of 1) storage and waste disposal facilities, 2) sale of uranium with agreement to dispose of spent fuel (utilising external conversion, enrichment and fuel fabrication facilities) then 3) the establishment of such facilities within South Australia. If this is indeed the Commission's overarching recommendation for nuclear industrial progress in the state, it would be more appropriate to express this in the document's "key findings" rather than on page 20.

SOCIAL AND COMMUNITY CONSENT

Finding #104

"Social consent and an associated process of public engagement would be necessary for... the repeal or amendment of laws which prohibit the establishment of types of nuclear facilities in South Australia."

On the topic of social consent, it must be asked how this will be *measured*. This question was asked of Commissioner Scarce by another attendee at the public session held on the evening of the release of Tentative Findings. The Commissioner did not provide a direct answer. As I understand it, a bill to amend legislation which fits this description and repeals certain prohibitions has already been drafted, and I have seen no evidence that there is any demonstrable "social consent" for the process of repealing or amending existing laws.

Finding #110

"The impact of atomic weapons testing at Maralinga in the 1950s and 1960s remains very significant to many people. Those tests, and the subsequent actions of successive governments, have left many Aboriginal people in particular with a deep scepticism about the ability of government to ensure that any new nuclear activities would be undertaken safely."

This Finding points to a cultural problem which is not adequately described in this short statement. The skepticism referred to here is based on harm caused, including impacts to health, land and culture. Justice has not been served to the displaced people of the Maralinga lands, nor for the Australian atomic veterans who were exposed to fallout and were effectively used as guinea pigs in British Cold War military experiments.

It is worth noting that other major nuclear weapons testing nations have admitted some degree of culpability for harm caused, but not the British. The USA, France and Russia have each compensated veterans of nuclear weapons tests to varying degrees.

https://en.wikipedia.org/wiki/Nuclear_weapons_testing#Compensation_for_victims

It is my opinion that aboriginal and post-colonial Australians alike are entitled to be skeptical about nuclear industrial development. The on the ground experience of exposed and displaced aboriginal Australians, occupationally exposed atomic veterans who tended to the Maralinga and Emu Field weapons tests, the Radium Hill miners who died of lung cancer and workers at related facilities who may have died prematurely due to occupational exposure tell a grim story of disregard for culture, health and human life which has been repeated across the nuclear industry's known faces. For people to expect better, would be to betray the lessons learned from the harshest of experiences.

It is worth noting that as of 16 March 2016 under the *Radiation Exposure Compensation Act* in the USA (RECA), 19,555 "downwinders" (persons who were unwittingly exposed to fallout from nuclear weapons tests) and 3,963 onsite participants have received compensation payments. The British, who were responsible for the weapons test program conducted in Australia have no similar compensation scheme, and continue to fight against atomic veterans who are seeking justice through the court system.

https://en.wikipedia.org/wiki/Radiation_Exposure_Compensation_Act

Finding #111

On the topic of community engagement, the Findings state that "it is essential that benefits are not oversold and risks are not underestimated."

By my assessment, the Commission has already demonstrated a clear bias in favour of selling benefits and diminishing risks. The trail of documentation produced by the Commission to date, the selection of witnesses to appear before it, and the consistent lack of detail provided when discussing risks to human health in particular provide the evidence base for my position. I hope that this can be remedied to some extent by the synthesis of information I have provided in this response document, along with its supporting references.

RISKS & CHALLENGES

Finding #118

"Any new nuclear facilities in South Australia would need to be designed and operated in a way that ensures the regulatory limits are not exceeded and that any human exposure is as low as reasonably achievable."

While this statement is sound in principle, I wish to reiterate the need for contemporary epidemiological studies. Without these, the adequacy of regulation cannot be proven. The principle of ALARA as expressed here is entirely appropriate- as is testing and verifying existing standards by comparing known worker exposure doses with epidemiological study results.

Finding #119

"Data from modern nuclear fuel cycle facilities demonstrates that they operate well within the applicable regulatory limits for worker, the public and the environment."

While this may be so, assurance can only be given with confidence pending the results of long term health studies. A recent decision to discontinue a long term investigation into the health of Americans living near nuclear facilities in the USA is deserving of question. Why was the study terminated prematurely? Surely if people had nothing to worry about, having evidence to support this position would have been welcome news to the nuclear industry. What can be said of the probability that the news was, in step with past claims and predictions, that assurances of safety were prematurely confident and overstated?

http://www.southernstudies.org/2015/09/feds-cancel-nuclear-health-study-leaving-questions.html

We will never know, unless the study is resumed. However, other studies of the health of people living in proximity to nuclear power plants have been conducted in other jurisdictions and by other organisations. Some of these have encouraged further research after detecting elevated incidence of childhood leukemia. Examples below:

France: http://www.sortirdunucleaire.org/IMG/pdf/Childhood-leukemia.pdf
Germany: https://www.nirs.org/radiation/radhealth/kikkcommentary0709ijoeh.pdf

Finding #121

"In Australia in 2014, the average annual dose (in addition to background radiation) received by a uranium mine worker was less than 15 mSv, or just below the level of average annual background radiation."

This finding neglects to mention the uncertainties surrounding the impact of internal emitters, absorbed into the body by inhalation or ingestion. "Personal dosimeters attached to clothing" are unable to estimate internal exposure, and once a hot particle is lodged in human tissue, it will irradiate the surrounding tissue until the particle eventually decays into stable lead (in the case of radon daughter products).

It would be pertinent for the Commission to detail, in reference to miner mortality in other regions

(and at Radium Hill) how, quantitatively, regulation was tightened following the demonstration of harm caused prior to 1971 in the USA, as evidenced by the results of the Radiation Exposure Compensation Act and its thousands of successful claimants since it was enacted in 1990.

As a researcher I find it very frustrating that in referencing its findings, this Commission has chosen in most instances to associate a long list of references with a heading, in this case “Radiation Risks” without supplying in-line citations. This makes it impossible for a reader to verify the statement made in the Finding, without reading all of the references associated with a particular heading.

Furthermore, it would be appropriate for the Commission seek republication rights so that all relevant, referenced information cited by the Commission in this document and in its final report are made available to the public in perpetuity. In the case of this heading, approximately 27 references are provided, while few of them are hyperlinked.

Finding #123

This finding relies exclusively on the work of UNSCEAR and the World Health Organisation to synthesize its findings regarding the consequences of the Chernobyl disaster. The notes focus on acute radiation syndrome, which was suffered by 134 people, 28 of which died as a direct result. The Commission should quantify incidence of thyroid cancer if possible, and presumably it is, given that a “signifcant” finding is acknowledged by these sources.

It would be worthwhile for the Commission to, in its final report, acknowledge the vastly different views regarding the impact of the Chernobyl disaster, including: the extent and persistence of exclusion zones and the rationale for these, projections of cancer incidence and genetic damage, incidence of abortions and suicides related to stress caused by the incident and its consequences.

I would encourage the Commission to consider the following reports, for comparison with UNSCEAR and WHO reports:

http://www.ratical.org/radiation/Chernobyl/HEofC25yrsAC.html

http://www.chernobylreport.org/?p=summary

Finding #124

“There may be an increased risk of thyroid cancer in more vulnerable groups in Fukushima (the most exposed workers, and infants and children in the evacuation zone)... to date the most important health impact has been on psychological well-being.”

The Commission's conclusions reached in this Finding regarding the Fukushima disaster are based exclusively on UNSCEAR's conclusions, which no longer represent the best available data. In October 2015, 137 children from the Fukushima Prefecture were described as either being diagnosed with or showing signs of developing thyroid cancer. The study's lead author Toshihide Tsuda from Okayama University has stated that the increased detection could not be accounted for by attributing it to the screening effect. He described the screening results to be "20 times to 50 times what would be normally expected."

https://en.wikipedia.org/wiki/Fukushima_Daiichi_nuclear_disaster#Thyroid_screening_program

Another statistic worth the Commission including in its final report is the number of cases of suicide linked to the Fukushima disaster. As of November 2015, these totaled 154 according to the Japanese Cabinet Office. At that time, 24,000 people in Iwate and about 55,000 in Miyagi were still living in temporary housing away from their homes while in Fukushima, the number was approximately 103,000. The humanitarian impact caused by the evacuation zone and resulting in approximately 182,000 disaster refugees is a substantial risk deserving of detailing in the Commission's findings.

http://ajw.asahi.com/article/0311disaster/fukushima/AJ201512280026

It is also worth noting that the Commission has neglected to mention the uncertain fate of the molten reactor cores, and the inability for existing technology to be deployed to assess their status, due to the heat and radiation they continue to emit.

http://phys.org/news/2015-03-fuel-fukushima-reactor-tepco.html

Japan is relying on future technological developments in order to recover the corium from the crippled reactors, and is yet to observe the location and condition of it. Periodic news updates from the Japanese Atomic Energy Agency provide the most recent status of developments, though they do not describe the fate of robots used previously, which have not survived the conditions within the reactor building.

http://fukushima.jaea.go.jp/english/topics/pdf/topics-fukushima070e.pdf

http://fukushima.jaea.go.jp/english/topics/pdf/topics-fukushima071e.pdf

The most important information for the Commission to responsibly convey is that the full extent of Fukushima disaster's consequences are unlikely to ever be known. Radioactive cooling water continues to be discharged to the sea, bags of contaminated soil and vessels of cooling water continue to accumulate within the exclusion zone. The human health impacts of initial air-borne emissions will take decades to manifest, and will be difficult to link definitively to exposure.

Information regarding the Fukushima nuclear disaster, synthesized from an extensive number of references can be found on Wikipedia, in the following articles:

https://en.wikipedia.org/wiki/Fukushima_disaster_cleanup

https://en.wikipedia.org/wiki/Fukushima_Daiichi_nuclear_disaster

The economic cost estimates associated with the Fukushima nuclear disaster are significant, and the Commission should acknowledge these. In July 2015, the Japanese government confirmed that compensation exceeding US$57 billion was expected to be paid out. These costs are expected to rise as further lawsuits are mounted.

http://phys.org/news/2015-07-tepco-fukushima-compensation-bn.html

Estimates of the wider economic costs of the disaster range from US$105 billion to US$500 billion. Sources for such estimates are listed below.

https://www.rt.com/news/183052-japan-fukushima-costs-study/

http://www.psr.org/environment-and-health/environmental-health-policy-institute/responses/costs-and-consequences-of-fukushima.html