RESUMED **[10.00 AM]**

COMMISSIONER: We will reconvene and welcome back. We are on topic eight, Adding Value to South Australian Radioactive Minerals and we welcome Dr Voss. Counsel.

MR HANDSHIN: James Voss holds qualifications in nuclear engineering from the University of Arizona. He has worked in a number of countries in areas including radioactive waste management, nuclear fuel storage, renewable energy and environmental sectors. Mr Voss lectures at multiple universities and has held leadership roles wit a number of organisations concerned with the management of nuclear material, including Golder Associates and Geo Resources Pty Ltd and a potential business that would be involved in fuel leasing called Resources Solutions Australia.

COMMISSIONER: Mr Voss, thank you very much for joining us. We are particularly interested in this section of our discussions in adding value and for you, with your background and experience; I would like to explore fuel leasing. So perhaps we could start with your notion of what fuel leasing is and why you think that adds particular value. And I know you have some knowledge about South Australia, so perhaps you could provide some context as you go through your explanation?

MR VOSS: Thank you. The notion of fuel leasing that we have is to own the – that is some entity would be formed that would own the Australian produced uranium. It would establish contracts with nuclear utilities. Those contracts would require that the uranium be made in to fuel for those companies. After the fuel was used and sufficiently pooled, it would be returned to Australia for management. That management would be, in my mind, long-term storage while a decision is made either to recycle the residual material, or to dispose of it. So that comprises the technical facets of it, the activity facets. There are some who believe that the added value is in what is referred to as the front end of the nuclear fuel cycle. That is converting the yellowcake in to UF6 then enriching it, then making it in to fuel. We look at the numbers – there are two reasons we don't think that this is a particularly attractive notion of adding value. The first is that it is a relatively minor part financially of the total beneficiation process involved with nuclear fuel, where the majority of it is actually on the back end.

The second reason is that there is an oversupply of all of those front-end functions in the world. Consequently, if Australia were to say – some entity were to say let's construct these facilities in Australia and do the beneficiation on the front end, what they would be facing is a global marketplace with an oversupply and pricing – downward pricing pressure. The ability to raise debt or equity to construct those facilities, the billion of dollars needed would be a significant challenge. Our view is that the scarce commodity right now, in the global marketplace, is the back end management of nuclear fuel. Our view is

that there is sufficient demand amongst significant customers in the world for the services that the entire Australian uranium supply could be allocated within a leasing structure through a – and the fuel would be properly managed and it would be remunerative and beneficial to the Australian people.

COMMISSIONER: Can I interrupt there Mr Voss? Unpack a little of the worldwide supply of conversion enrichment fuel fabrication. Can we just walk through who the major players are and also where you see demand going in to the sort of medium term, the next 10 to 15 years?

MR VOSS: Right.

COMMISSIONER: Perhaps start with conversion?

MR VOSS: Look I am not going to hold out that I can quote each of the companies involved. In doing our research, what I have done is gone to the literature to find what the literature says on this matter and then gone to experts and asked them the same questions. Clearly, and everybody is repeating the same conclusion to me. And I mean clearly an organisation like Urenco is a dominant enricher in the world, the Russians offer various aspects of this, in each aspect of this. There are US suppliers, European suppliers. I am not going to attempt to defend who they are, or suggest who they are. The question of the nuclear demand in the next 10 to 15 years is actually pretty straightforward. Recognising that nuclear power plants take a decade or so to be built and come on line, the demand in the next 10 to 15 years, in my view, is going to come in from India, from China. There will be a – there may be a growth in the Middle East. We have heard lots of things from Saudi Arabia but haven't actually seen particular actions.

On the other hand, the Emirates are very active with their five-reactor programme and are considering more beyond that. There is the Eastern European block that is moving steadily in to new reactors. Now beyond that, the US is certainly not a growth sector, given the price of natural gas in this country. Canada, I can't comment on; currently Canada is not a particular marketplace for Australian uranium. The Koreans seem to be moving toward an expansion, although I think they have some internal struggles to get past. Japan is clearly not going to expand their nuclear power programme in the next little while and that brings us back to Western Europe. We know that England will move some steps to building, Germany will not. France has announced a higher push on renewables, non-nuclear renewables. So when I look at that total picture, where I see the market opportunities for Australian sourced material, in a bigger sense is the Emirates, possibly the Sauds, Korea, India. China is a possibility with some complexities. Beyond that, the Japanese, as they restart their programmes, I do not know what their long-term contract commitments are for their reactor fleet. Whether that is a marketplace or not,

can't comment.

COMMISSIONER: All right. If that's the market as you see it and a mixed view about the future of the industry in terms of its growth path, can you just take us through how you would establish the path towards a long-term storage site? What would you have in mind in terms of time frames and processes?

MR VOSS: Let me call it a two-pronged business discussion. The first prong is the contracts, the supply side. I would focus my attention right now in Korea, the Emirates and in India to establish long-term supply arrangements. In terms of the domestic programs, clearly there's a massive amount of contract work, treaty work, multilateral and bilateral treaty arrangements that have to be structured as well as contract work to get all of that front end established credibly. There would need to be a storage facility for spent fuel, a receiving and storage facility in Australia. There are many, many models of it around the world, in Germany, smaller versions in the United States. In our submission we've given you some pictures but these are very well established engineering facilities.

There would have to be a consent-based siting program that went on in Australia to come up with a site for this facility. Clearly, that site has to either be near a port or has to have very good transportation lines from a port. There is a massive industrial infrastructure that has to evolve also. The development of a shipping fleet is needed for this. We have submitted information on our view of what that fleet looks like but if we model it after the organisation in Britain known as PNTL, the model is a series of five to six thousand tonne vessels that have to be constructed, purpose built, for this application. There also needs to be an infrastructure for the construction of shipping casks or flasks, referred to interchangeably. These are massive steel products and they have to be – as has been discussed right now in the Australian discussion of submarines, there are people who have the designs and the rights to these products. We would want them, however, manufactured in Australia.

As this industrial infrastructure and nuclear infrastructure evolves, there also then has to be a long-term program undertaken to develop a disposal site for material. This is, in my opinion, a decades-long process. Too many programs have walked out and driven a stake in the ground and say, "This is the place and then we'll defend it." I don't think that's productive and it would be counterproductive. So that program has to go on at the same time. It's a complex undertaking with many, many failure paths but to undertake it could have some significant benefits to world securing of the nuclear material in the world. It could have massive complements to help having Australia reduce the carbon emissions in the world, far more so that it can domestically, far more so.

So it's simply an opportunity that, if there is consensus and support for that opportunity, we think the capital and the manpower and the staffing can be undertaken to get it right and make some massive contributions to the world but also to deliver some benefit to Australia.

MR HANDSHIN: Mr Voss, in the course of that answer you made reference to this being a complex undertaking. Amongst other things you said that there are many failure paths, some of which might be implicit in what you've just told us but I wonder if we might get you to illustrate what you contemplate as being some of the difficulties in getting a concept like this into an operational phase.

MR VOSS: The principal failure path is the perception that such a program would breach the social contract that exists within Australia and its citizens. If the Australians believe this breaches the social contract it will not get off the ground. For those who know the history of Pangea, for example, there is a case in point where the concept, albeit not proposed by the government but proposed by a private entity, was viewed by very many as a breach of the social contract. But not just in Australia. I've been doing some research on siting efforts in the last 40 years in democracies for these facilities. The landscape is littered with failures and the failures all are driven, with a couple of exceptions – they're almost entirely driven by breach of the social contract. If you don't have the political support, the public support, for one of these you're not moving forward.

Now, there are always technical things that have to be exactly right. Australia is blessed with the best geology on earth for managing nuclear materials. That doesn't mean that every site is qualified but what it means is that there are many, many options within the nation where this could be done. If you will, there are political failure modes, there are technical failure modes which we believe are manageable, and of course there are financial failure modes. Whether the business is a government public-private partnership, a corporate endeavour, whatever the structure, it still has to make fiscal sense. So there's that failure mode. I'm sure there are others but in the broad categorisation of things that's how I would put it.

MR HANDSHIN: What do you see as some of the options from a funding perspective?

MR VOSS: The front end is going to entirely be done with what I would call equity. There's an enormous risk of failure at the front end. I think it's just going to take corporate investors who are willing to put money in. Obviously they're going to want to see a path for remuneration with that investment. Once that investment has been made and the front end is successful, it's my view that, yes, maybe some additional equity is needed but the substantial part

of this will be handled through advance payments from customers, possibly debt facilities to take advantage of the bankable nature of the contracts.

MR HANDSHIN: Can you just perhaps clarify for us so that we all know what the parameters of the discussion are what your understanding or what you're meaning to convey by "front end" in this context?

MR VOSS: The dominant success goal would be the ability to enter into contracts with utilities for leasing. In order to do that there are a number of things that have to be accomplished. There has to be the treaty infrastructure between nations. The analogy that I would use is the Basel Convention on the Safe Management of Hazardous Wastes. So this a framework under which the nations agree hazardous material can move between boundaries and can be managed. There are then protocols under it for implementation. So there is no such framework in the world right now for this activity. The Basel convention is a great model but it excludes explicitly nuclear wastes.

There clearly has to be a siting undertaking – siting of facility for storage. Within that, there has to be a broad set of agreements with the host – with South Australia, using that – within the context of these discussions. This might be an equivalency to the indenture agreement between Olympic Dam and the state. But this would have to be in place. Those pieces are what I refer to as the front-end. There are many other things that have to be done that are second tier in that but if you – when I am speaking of the front-end, what I'm thinking of is, I am now presenting a contract to a customer. For that customer to enter in to the contract, there has to be a broad set of things done before that customer can do so.

MR HANDSHIN: Can we just develop the idea of advance payments a little bit? You referred to that a moment ago. Can you tell us how you would see that working and how that fits in with the way that the nuclear fuel cycle currently operates?

MR VOSS: The nuclear fuel cycle – the nuclear economy is quite accustomed to paying in advance for long-term management of nuclear materials. In most situations the nuclear plants are required to – nuclear utilities are required to pay in advance for two items. One is waste management and the other is for decommissioning. So there is an entire infrastructure in place within the rate structuring, the tax structuring, financial management of nuclear power plants, for these payments to be made on the basis of electricity rates. The notion of then saying to a customer, okay we are going to lease you nuclear material and we are going to take it back for management, it would be perfectly reasonable for that customer to say, yes, I understand, I will start making progress payments, or advance payments along the way, much as they would for any of these opportunities.

COMMISSIONER: Can I perhaps change the direction of the discussion and understand the facility that you are proposing?

MR VOSS: Yes.

COMMISSIONER: You have talked about storage, as opposed to disposal?

MR VOSS: Initially, yes.

COMMISSIONER: So can you explain in a little more detail, how you envisage, should we decide that that is an economic and safe process - - -

MR VOSS: Yes.

COMMISSIONER: Talk about safety in a minute but just give us some idea of how you see that site evolving over time?

MR VOSS: Right. Let me start by saying that there are broadly two ways you store spent fuel. You store it in water, or you store it in dry. Without looking at what exactly these facilities would look like, I will lead you down the path, down both paths.

COMMISSIONER: Okay.

MR VOSS: Spent fuel would be transported in very large casks to a facility in Australia. At that facility, the casks would be opened and the nuclear material taken out. Now this is done in one of two ways. It is done in either a – what is referred to as a hot cell, a large concrete facility that is in – everything is contained within that facility. So you would open it up, take the nuclear material out and if you were doing that, you may put – you may go directly in to then a dry storage cask. This is one way to do it, or you might move it directly in to a dry storage vault. A centralised facility that would – in which you would store it, a warehouse. If you put it in to a storage cask, this cask might be a concrete steel composite and you would put that – you could either put it inside of a facility; a model of this is in Aarhaus in central Germany, or you might put it out on to concrete pads outside of the facility, just open to the environment. These casks are extraordinarily robust, they are certified for every terrorist threat, every – certainly every natural disaster, crashing a plane in to them, these sorts of things. All of these facilities fall within that category.

On the other path, if you chose to do a wet storage, then you would have a very large pool in which the material is stored within the pool. There are – and so you would bring the cask in from the ship and actually put it under water and open it under water. So these are the two concepts. I couldn't – wouldn't want

to speculate how it would be best to do it. My own view is I would rather store it dry but that is a narrow engineering perspective that may not be supported in the end. So this storage facility, if it was at a port, might – gosh, I would have to think about the size, hundred hectares would be sort of the maximum I could wrap my head around. But I wouldn't want to argue for that.

COMMISSIONER: Yes.

MR VOSS: But most of that is actually just buffer zone and security zones. The facilities themselves are not that large. The car parks on which you put these flasks for storage are not that large. Nor are the pools. So that is the front end, that is the storage aspect of this. After an appropriate period of time, there will be a decision made about whether to recycle the nuclear material that is inside – that is contained within the fuel, or to dispose of it. It is a monumental decision. My own view is that it probably would be – would not make economic sense for a very long period of time to recycle it. Hence I would personally be moving toward finding a disposal solution in the long term. But that is – that can go either way. But even if you opt for recycling, you still need the disposal solution. And this is the example that ANSTO is facing in the return of the HIFAR fuel to Australia. You still have to dispose of the residuals.

MR HANDSHIN: Can I ask Mr Voss, in relation to the first stage, the storage, what sort of - - -

MR VOSS: Yes.

MR HANDSHIN: - - - timeframe is involved in that first stage?

MR VOSS: I'm not quite sure which timeframe you are referring to?

MR HANDSHIN: Sorry. The initial stage of storage, be it wet or dry. How long do you need to store the material like that for?

MR VOSS: I would – I am going to answer a slightly different question. You don't need to store it for any period of time in an engineering, scientific, health and safety sense, but when you move it off a reactor site it has probably been out of the reactor for five years or so. You want that degree of radioactive decay to have occurred. If you choose to reprocess it then or dispose of it then, you could. So the need, in my opinion, is - there is no need to store it longer. The need, in my opinion, is driven more by the question of how long will it take to get an acceptable disposal path in place.

Turning the question a little bit differently is how long can you store it, and the answer to that is many, many decades, many, many decades, 100 years if that's

what you chose to do. Here in the United States we're working with specific parties right now where we are anticipating that spent nuclear fuel will be in storage for at least 100 years, and none of these are particularly challenging from health and safety environmental protection standpoint. The fuel is very, very robust. The containers in which you put it are an added layer of safety and protection, and then of course the storage casks themselves are yet another.

MR HANDSHIN: With the long-terms solutions for disposal, can that be both artificial and natural disposal facilities?

MR VOSS: I'm not sure what you mean by an artificial disposal facility.

MR HANDSHIN: An engineered facility?

MR VOSS: This gets into a philosophy of confidence, actually. Spent fuel has to be contained for a very long period of time to be inert or move past an acute hazard level. My view is that that time needs to match up where the material in disposal begins to look like a uranium deposit, because we have those all around and we know that those are like. Now, that containment period is hundreds of thousands of years. So I have two choices. My preference is to go into a piece of geology where I can prove that the geology has been static for millions of years and rely upon the natural stability of that structure to contain it. If something has been stable for 5 million years and I need to 200,000 more years of stability, unless there's some evidence of some mechanism that's going to overturn that, then you start with a geosphere that it inherently safe.

Now, there are others who believe that you need to then add to that what is referred to as engineered barriers. In Sweden, for example, where they don't have that geologic stability in place, they're going to an extremely expensive multilayer engineered barrier disposal facility. Whether or not that is needed in that environment, they believe they need to do this. I personally have a bit of a problem with this. If I have a geosphere that is extraordinarily robust, then are you kidding yourself when you say, "I'm going to build something that will also last 100,000 years?

But having said that, the key part of this is again the social contract. Every successful nuclear endeavour is successful in part because there is a regulatory infrastructure in place that the public trusts, and this would be equivalent to food safety or anything else. If that regulatory infrastructure in Australia said, "You must have engineered barriers in addition to your geosphere," then that's fine. That's what the regulator is demanding and that's what's needed. It doesn't mean I personally think it's the right thing to do, but so be it.

COMMISSIONER: Can I perhaps move off into - you've done some very

broad analysis of the opportunities if the nation agreed to store spent fuel.

MR VOSS: Yes.

COMMISSIONER: Can you just broadly outline what you see as those opportunities and how much modelling work you've actually conducted to get to those conclusions?

MR VOSS: In our submission, we delivered some work that was done 18, 19 years ago, and those have been updated in some work that I did, I believe, two years ago. When I look at the uranium export in Australia and then I look at the economic opportunity, rather than turn to my own speculation of pricing I found citations in the literature, and I believe the citation that was attached in our submission was an OECD NEA document which looked at the estimated financial commitment by nuclear utilities for waste management. Using that number as a financial opportunity led to the very specific projections that were made within our submission.

There are two major presumptions in that: one is that the marketplace is there, people would actually sign into contracts; and the second presumption is that the OECD NEA projection of commitments for nuclear fuel management are accurate. Our own view is that those projections are accurate based on, you know, sort of rules of thumb from other data sources. I'm not going to throw numbers at you, because I don't have them at my fingertips here, but again, they're in the submission you're looking at right now.

COMMISSIONER: As I see just briefly going through it, you thought that it could lead to a direct increase of 8,000 permanent jobs.

MR VOSS: That's correct.

COMMISSIONER: That was the sort of ballpark figure that you were working from.

MR VOSS: Yes. In my past in Pangea, commissioned work from Access Economics in Canberra to examine the macro-economic impacts of these sorts of functions and activities and those numbers were updated in some research that I did two years ago and submitted in the (indistinct) submission. But, yes, it's many thousands of permanent jobs and of course they're during the construction phases of these facilities. There's obviously increases in the construction side. Most of these jobs are driven by this industrial infrastructure that I mentioned, the ship building, cask building, and most of those jobs end up being blue collar, union jobs of highly skilled men and women to construct these facilities and ships. There is obviously a white-collar component of employment that comes out of the business safety – the entire corporate

structure that is around this. Our crystal ball isn't quite strong enough for me to tell you it's - of the 8,000 it is 1,500 white collar and 6,500 – I can't look that deeply in to the matter.

COMMISSIONER: No, that is the ballpark figure that I was seeking to establish. One of the concerns for the community and one of the concerns that we must address is the safety of the operation.

MR VOSS: Yes.

COMMISSIONER: Can you work through why you are confident and why you are confident in your submission that the safety aspects of managing spent fuel for hundreds of thousands of years, can be managed?

MR VOSS: There are – let me break this in to two pieces. The piece prior to – everything prior to actually putting spent fuel in to the ground and then once it's in the ground. Now I have referred to the point of the geosphere and the isolation that that geosphere provides once it is in the ground. I believe a regulator should establish an extremely aggressive or restrictive risk standard and that nothing should be put in to the ground until that risk standard is unarguably met. That it is demonstrated and that is the safety that is in disposal. I believe it can be met because of the extraordinarily robust geosphere that exists in many parts of Australia. Now that – if I can really leave that assertion apart for a moment, then you get in to the front end of this. There is an extraordinarily robust safety record for the handling and management of spent fuel worldwide. This is taken with great seriousness. There must be, from day one, a culture of safety that starts at the chairman's office and goes through the entire operation but that is what does exist in the nuclear industry.

But beyond that, every part of the safety culture presumes that you are going to have an accident and it presumes that if that accident occurs, that you know exactly how you are going to contain the nuclear material and how you are going to clean it up and how you are going to recover and how you are going to repackage things. You know there are many thousands of nuclear packages shipped every day worldwide, pharmaceuticals, radioactive waste, an enormous amount of stuff. In the area of spent fuel, there are no accidents from that. This material is handled as if it were gold and is handled with great seriousness. I have complete confidence in the infrastructure and the experience and the facilities and the people to do that but for the public to have confidence of that, what we would – a) as a I said a moment ago, we would need a very aggressive and tight regulator to give the public confidence that we are regulating and managing it correctly but that culture of safety has to start on the first day and be carried through forever.

MR HANDSHIN: Can I just raise one safety related matter generally, and that concerns the topic of non-proliferation? How do you see - - -

MR VOSS: Yes.

MR HANDSHIN: - - - fuel leasing arrangement interacting with non-proliferation concerns?

MR VOSS: I think it's a great complement to the non-proliferation objectives. If Australia owns the nuclear material that is being used in a reactor and – okay, it can't go over by force and actually recover it but there are many other entanglements that become very significant. If somebody is taking Australian fuel and decides to break in to it and try to recover nuclear material out of it, well Australia is actually holding the fuel that is needed for them to generate power. This is a very significant lever tool in controlling this material. So I think it fits absolutely perfectly with the non-proliferation objectives that every nation must have.

MR HANDSHIN: I just have two more questions Mr Voss if I may? The first is whether the concept of fuel leasing, as you have described it to us, has ever been employed anywhere in the world in the past?

MR VOSS: No.

MR HANDSHIN: And that might - - -

MR VOSS: I am sorry. Let me back up – let me back off that a little bit. Just to be clear, it is a little bit difficult for me to say the Russians do undertake or the Russians do not undertake it. There have been arrangements with some of the reactors that the Soviet Union deployed in the former Soviet countries. There are discussions that under the Rosatom agreements with Vietnam and Turkey and those that they are proposing in Argentina, that they will take material back as well. Now that goes well past however, and I am strictly speaking here about what the trade press is reporting, this goes well past fuel leasing as we are presenting it to you. Because in those cases, the Russians actually own the nuclear power plants and operate them. So the Russians are sort of taking – appear to be taking the view that this is not leasing the fuel per se, but this is Russia building a plant in another country and running it and taking the material back. So that is, to answer your question, the closest that we are aware of.

MR HANDSHIN: Is there any reason that you can see why the concept of fuel leasing, as you have described it to us, hasn't been used in the past?

MR VOSS: Yes. Because no country would put their hand up and say, we'll

take the material back.

MR HANDSHIN: So that goes back to that foundation or social contract issue that you have spoken about?

MR VOSS: That's correct. By the same token, the – using the Emirates as an example and the Swiss, both have provisions with international law that say we will allow our nuclear fuel to go elsewhere for management, however it must meet a certain set of very restricted conditions.

MR HANDSHIN: So compliance with those conditions would be a precondition to any fuel leasing arrangement with those countries?

MR VOSS: Exactly.

MR HANDSHIN: The only other question I had Mr Voss was whether it is possible to give us some idea of the cost that might be involved in setting up the fuel leasing arrangement, as you have described it to us?

MR VOSS: My opinion is there would probably be about 100 million on the front end. And I am not going to argue whether those are AUS dollars or US dollars. There is an enormous amount of front-end work that has to be done before the first contract is entered in to. From an investment standpoint, you know you would have structured this thing as a series of gates and you would ask for equity to get through the first gate and if you did, then equity to get through the second gate and so forth.

MR HANDSHIN: So that figure is just a ballpark figure?

MR VOSS: Absolutely. There is no science to that figure whatsoever.

MR HANDSHIN: Thank you.

COMMISSIONER: Mr Voss, thank you very much for your evidence this morning. We very much appreciate you taking the time to talk to us.

MR VOSS: I am grateful for the opportunity. Thank you.

COMMISSIONER: Thank you. We will adjourn now until 11.15.

ADJOURNED **[10.50 AM]**