TRANSCRIPT

LEGISLATIVE COUNCIL ENVIRONMENT AND PLANNING COMMITTEE

Inquiry into Nuclear Energy Prohibition

Melbourne—Thursday, 25 June 2020

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WITNESSES

Mr Jeremiah Josey, Founder and Chief Executive Officer,

Dr Dragos Petrescu, Chief Operating Officer, and

Dr Dian Kemp, Nuclear Chemical Engineer, The Thorium Network *(all via videoconference).*

The CHAIR: I declare open the Environment and Planning public hearing for the Inquiry into Nuclear Prohibition. Please ensure that mobile phones have been switched to silent and that background noise is minimised. I would like to acknowledge my colleagues participating today and thank those who actually provided apologies.

I would also like to warmly welcome our witnesses for this afternoon, Mr Jeremiah Josey, Dr Dragos Petrescu and Dr Dian Kemp as a nuclear chemical engineer from The Thorium Network. Gentlemen, thank you for your time. We are looking forward to your evidence this afternoon. All evidence taken at this hearing is protected by parliamentary privilege, as provided by the *Constitution Act 1975,* and further subject to the provision of the Legislative Council's standing orders. Therefore the information you provide during the hearing is protected by law; however, any comment repeated outside this hearing is not to be protected or may not be protected. Any deliberately false evidence or misleading of the committee may be considered a contempt of Parliament. All evidence is being recorded. You will be provided with a proof version of the transcript following this hearing, and the transcript will ultimately be made public and posted on the committee's website.

We have allowed around 5 to 10 minutes for an opening statement. We do have your submission, which members have read, so you do not need to take us through the whole submission, but if you would like to take us through a summary, that would be excellent. Who would like to lead the presentation from your end? Put your hand up and I will call you. Jeremiah, Mr Josey, we are all ears.

Mr JOSEY: Thank you, Cesar. It is a pleasure to be here today. Thank you for the opportunity. I suppose just getting into the feel of this whole event I did have something prepared. From our perspective—and we are focusing on thorium for the reasons we have already outlined in the document—I will just point out something which ties in to the previous session you have had with the Minerals Council, and that is from a document they produced in September 2017. They produced a nice little graphic comparing the effects of the open nuclear technology approach that Canada has as opposed to what is happening in Australia. I am just looking at the numbers now, and for Canada they are quoting 60 000 jobs and a value of CAD$5 billion—per year, I imagine. That is the industry they have in Canada. In Australia, comparing that, we have 3000 jobs and only $600 million a year. Most of that is just exporting the material.

So, I mean, our whole thrust is about bringing technology into the country. The ban prohibits research because there is no outcome; there is no point of doing it. And one of the tenets of our project worldwide is to advance the research and development of thorium molten salt technology because of our particular views on the benefits of that technology. So that is our point. I suppose you guys have been going all day. I think we are the last ones, is that correct?

The CHAIR: That is correct.

Mr JOSEY: So you have got a head full of the pros and cons. We are coming in with a particular, very niche angle on one particular technology type—thorium molten salt. We are focusing on the thorium. We are talking with CSIRO about how to get more thorium out of monazite sands in Australia. We are talking to the IDC in South Africa for funding for research we want to do in that country. So there is a lot going on in the world, and the opportunity for Victoria is to relax the laws there so you guys can get involved.

I heard before a quote that said it might be 10 years before there is nuclear energy in Victoria. That may be the case, but you have to start now. I will finish my little introduction with a quote: 'The best time to plant a tree was 20 years ago, and the next best time to plant a tree is today'. That is my introduction. Thank you.

The CHAIR: Thank you. I will kick off the first question in layman's terms—non-engineer, know nothing about the industry, as an example. What is the difference between thorium and the other minerals we are now getting off the ground for nuclear uranium, for example? What is the difference between the two? Is there a big difference?

Mr JOSEY: Well, it is kind of like comparing a jet engine and an internal combustion engine—an engine in a car. Uranium systems tend to be very complex because of their safety requirements, whereas if you use thorium, the safety requirements are much less. You are using an atmospheric pressure vessel running at high temperature—we are talking about a molten salt system—so you are able to get more energy from much, much less fuel. We have calculated that the entire energy requirement for Australia would be 100 tons of thorium per year. That is comparing the coal industry in Australia, which is 500 million tonnes per year. So our project is not an industrial one; it is more of an environmental one, because with 100 tonnes a year you can supply the entire energy demands of Australia from thorium alone. It is also a radioactive material paired with uranium and has a half-life equivalent to the life of the universe—about 14 billion years or something like that. I would like to pass over to Dian, to Dr Kemp, if you wouldn't mind, so he can go into detail on the difference between thorium and other elements.

Dr KEMP: Thank you for giving me the opportunity to be here today. On the difference between thorium and uranium, let me start very simply. You have got two types of naturally occurring isotopes or materials that you can use in a nuclear reactor: one is thorium; one is uranium. With uranium, we have got what we call natural uranium, which contains U-238 and U-235. U-238 grabs a neutron and produces plutonium. What happens with thorium, which is known as thorium-232, is it grabs a neutron and transmutes—or transforms, to keep it in simple terms—into U-233. Now, U-235, U-233 and Pu-239 all can be used in a nuclear reactor in order to produce energy. However, the difference comes in how we use it for a very long term. If you were to use uranium-235 and you were to put it in something like a thorium molten salt, your breeding ratio—your ability to generate new fuel—is severely dampened.

If you put plutonium in a fast reactor, then you do have the ability to make it higher in breeding, but the thorium has the advantage of using what we call a thermal reactor, which is what every other reactor in the world pretty much is, which works on a different spectrum—I am trying to keep it as simple as possible for you. You can breed it, and it means that you put it in 100 tonnes of thorium, and it builds up its own uranium. Your supply means you can utilise the fuel much more effectively. To give you just an interesting number: if you were to use uranium in a PWR reactor, you use approximately 0.5 per cent of the fuel, whereas if you use TMS, you get somewhere in the region of 20 per cent of the fuel utilisation. So with further research we can actually push this upwards of 90 to 100 per cent. I hope that answers your question.

The CHAIR: Yes. Has that technology ever been deployed anywhere in the world? Has it been used, or is it still in the development stage?

Dr KEMP: The answer is yes, it has been deployed. Thorium has been used. If you look back in history, the original molten salt reactor that was used initially was uranium-235, and it then became the first reactor to use the transmuted version of thorium known as U-233. There was a German reactor called the AVR. Do not ask me to give you the name in German; I do not know. That used a pebble-bed type system and it used thorium, as well as the thorium high temperature reactor. There is also currently thorium being worked in a reactor I think in Norway. Jeremiah, I think you know the name. I think it is called Halden.

Mr JOSEY: Yes.

Dr KEMP: And we also know that a number of countries are looking at utilising thorium in their reactor schemes, most notably India, China and I believe Russia as well.

Mr LIMBRICK: Thank you so much for appearing here today. Thorium molten salt technology is fascinating technology—what I have read about it—and I am very interested in a couple of things. But, firstly, you mentioned during your presentation that it is an environmental benefit. Could you please describe what are some of the environmental benefits that you might see from a thorium molten salt reactor as compared to other electricity production technologies?

Mr JOSEY: Sure. Dr Dragos, would you like to answer that, or would you like me to carry on?

Dr PETRESCU: Yes. I want to thank the committee for having me today. The environmental benefits will be the fact that the technology is clean and green. There are no CO_2 emissions, or at least the CO_2 emissions are on par with the wind and solar. The other one would be the nuclear waste or the waste management. My colleague Jeremiah mentioned previously that for a year Australia needs something under 100 million tonnes of thorium in a molten salt reactor. Out of 100 million tonnes—

Mr JOSEY: I am sorry, Dragos: only 100 tonnes.

Dr PETRESCU: One hundred tonnes—apologies. We jumped with the numbers too high—100 tonnes. Out of this 100 tonnes we only have half a tonne—500 kilograms—of waste. You think that from the whole of Australia 500 kilograms—that would be a chest or container with the size of 35 x 35 x 35 centimetres, a bit over a cubic foot. So it is something that is very easy to manage, and its life to be managed is not thousands of years; it is about 300 years—and that in comparison with a plastic bag that degrades in the environment for about 1000 years.

Mr LIMBRICK: It is quite incredible really to think that Australia's entire electricity production—the waste from it—could be such a tiny, tiny amount. I know that—and you mentioned this in your submission—the other countries are doing research into this. One of my concerns with having this prohibition is that Victoria and Australia are being left behind. I notice that Indonesia has signed a memorandum of understanding to build a test thorium molten salt reactor. What is happening in Indonesia at the moment? Could you maybe comment on what they are doing and what sort of advances Indonesia is making with this?

Mr JOSEY: I can take this question. Dragos, I will do this one. Indonesia is a very interesting case. It is more than a test that is certainly there. They have signed an MOU for a 500-megawatt thorium molten salt burner based on the same principles that were developed by Oak Ridge back in the 1950s and 60s. The last I saw was Indonesia is requiring a prototype to be running by 2022 in Indonesia, and I give credit to ThorCon for holding that project together. We want to be talking to them by the end of this year—where are we now, yes—about how we can accelerate their adoption plans for that.

From the perspective of—we are not close to the Indonesian government, we are not close to ThorCon, so we read the same information you are reading about what their progress is. My feeling is that they need a kickstart. Indonesia does not have a nuclear industry per se, which is a little bit different to Australia and also South Africa—I will add that as well. That is why we are busy there. If Indonesia had a government-supported nuclear research program, then they would be going much faster than they are with ThorCon, which is a private company. That is what I would say on that.

Mr LIMBRICK: And you mentioned then about Indonesia not having a nuclear industry, but Australia does, effectively. It is small scale.

Mr JOSEY: Yes.

Mr LIMBRICK: Could the skills, knowledge and regulatory frameworks that Australia already has for our reactor at Lucas Heights and other activities that we do undertake—could those skills and regulatory bodies be used to undertake research and maybe prototype production and things like this with thorium molten salt technology?

Mr JOSEY: Certainly, absolutely. I want to say one thing about that: thorium molten salt was developed—in 1947 they first started looking at this. In the 50s and 60s they spent billions and there were millions of man-hours invested. One project alone had 14 000 people to develop the prototype that ran for 96 hours, so the numbers are staggering when you dig into the data. I saw a report, probably one of the last reports that came out of the program from August 1978. At the back of the report it has a list of who is going to get this report, with actual document numbers, and it went up to 192, I think. So in 1978, 192 people got this report. There was no media, there was no internet, there was no YouTube, and that is where that technology has remained, basically in the dark.

What I am saying in answer to your question is in Australia we are smart people. I am from Australia. Dragos is living in Melbourne. Dian is South African, which is almost Australian. We are very smart, and to pick up that technology, to pick up the research that has been done, I am talking billions of dollars and millions of man-hours—literally millions of man-hours—and to bring it up to speed is very, very within our capability. The Chinese learned very well from that. They went to Oak Ridge National Laboratory in, I think, 2015, and they went away with container loads of copies of documents from that research program. China, by the way, has committed over $3 billion to develop thorium molten salt. So, yes, I very much do believe that if the prohibition was not in place, then Australia would definitely be able to catch up. We used to be number one in space research back in the 1950s, so we have got a lot of firsts in the country, and this prohibition prohibits the advancing in this particular area where many other countries in the world—I used that example of Canada at the start—are moving quite rapidly.

Ms TAYLOR: Thank you for your comments. I can see you are passionate on thorium. I guess where I am coming from, my concerns are where we are here and now, real jobs here and now, focusing on climate change here and now, because it is urgent and not something reasonably into the future. So the three key concerns that I have: it is not cost effective; we are not at that point where they are cost effective, if they ever will get to that point; the waste is still a serious issue; and the by-product uranium-233 is useful in the creation of nuclear weapons. So there is nothing to say that a country—it could be Australia as well—that is producing it for energy would not also turn its mind to other avenues. These are my main concerns.

The CHAIR: Do you want to make any comments on that, or we will just take it as a comment?

Mr JOSEY: Okay, so you are asking for a comment on that?

Ms TAYLOR: Oh, yes, I meant to phrase it as a question. I am sorry. I am just saying—how do you respond to that? That is how I should have said it. I was not trying to just blab at you. I am saying: how do you respond?

Mr JOSEY: No problem. So you have got three points: not cost effective—you said dangerous waste?

Ms TAYLOR: Yes. Well, there is no solution for waste so far. All they want to do is bury it; that is the only solution. Even if it is reprocessed, it still needs to be buried for centuries.

Mr JOSEY: I am going to let my colleagues come in as well. I am going to talk about number two, the waste, because I like that one, and the other ones, cost effectiveness and weapons, I would like to pass to Dian and Dragos. Let me go through waste first. A hundred kilograms is three 40-foot containers. So when you see a truck going down the road and you have got a 40-foot container, like a big container on that truck, when it is full of thorium, and you have got three of those trucks in a line, that is all of the fuel we need in Australia per year running on thorium. So that is the input. As Dr Kemp pointed out, we can convert that into energy and have, luckily, half a tonne or 500 kilograms, which is half the size of a VW, of waste.

Now, the thorium process is different, because it basically burns up all of the actinides and you are left with products that decay in only 500 years. So you have got a 500-kilogram block of waste—I made a mistake, not 500 years, 300 years—and you have got a 300-year period where you have got to hold that material until it decays to background radiation, to dirt.

As opposed to the uranium solid fuel process, and I will say solid fuel process in general, you have got in that solid fuel matrix locked up material you have to store for more than 100 000 years—I saw one report which says 200 000 years—which is incomprehensible in the minds of humans, who say, 'Well, we don't even have a culture or humanity which is more than 200 000 years old'. But 300 years, yes, I can go to Amsterdam or Brussels and I can see buildings with '1658' or even '1522' on them and say, 'Okay. It looks like it's going to fall over, but that building is still standing, it's still livable, after a considerable amount of time. When I look at the thorium process, particularly thorium molten salt, that is the benefit—that there is no waste. I can say that.

If I compare that to a coal-fired power station—now, that is just a crazy comparison because the waste, the tailings dam that holds the ash coming out of that facility, is huge. It devastates an environment for centuries, makes it unlivable and we are talking about hectares of land. It is also radioactive. Our research has shown that studies say it is more radioactive than what you are getting from a conventional nuclear power station. So comparing apples with apples, we have really got the Rolls Royce for waste management, and that is what I would like to end on with the waste. Dragos or Dian, do you want to go on with the other ones, cost effectiveness or weapons?

Dr PETRESCU: In addition to what you said, Jeremiah, is the fact that the management of the waste from the thorium molten salt technology is being patented by a Melbourne company from Dandenong. They develop operations in the UK, France and the US, but we do have the company still here with the patented technology actually for the three patents—

Mr LIMBRICK: Which company is that, Dr Petrescu?

Dr PETRESCU: Sabre Energy.

The CHAIR: Any further before I move on to the next question?

Dr KEMP: Yes. May I add, you were talking about the weapons of U-233, if I may comment on that. Ms Taylor, you are correct in the sense that U-233 can be used with nuclear weapons. Because of the way fission works, yes, you can use it. However, with that being said, they actually have gone and done a number of tests in the US called the Teapot experiments many years ago. What was found was that, number one, in order to build a U-233 bomb it is very difficult, it is very expensive and it is very difficult to manage. The reason for that is that even if you have just a tiny little bit of one of its daughter products called U-232, it has a very high gamma emitter which essentially fries the electronics in the bomb. So I am not going to go into too much detail, but one of the main reasons why somebody would probably not want to go into using U-233 to build a bomb is because you can build a bomb using other nuclear materials far cheaper, far easier with far less hassle. So using it, yes, you can use it, but it becomes more difficult the more you go.

The second problem is this U-232 is very dangerous. If you were to just a put part per billion into a sample, it becomes a problem already. So you need to have it very, very pure in order to get it to become a bomb. That again makes it very difficult, because your enrichment—you are talking about enriching from U-233 to U-232; that is one neutron mass difference. If we were to look at something like regular uranium enrichment, you are going from Uranium-235 to U-238; that is three neutrons. So it requires three times as much energy, which needs to be used. Overall, it just becomes so much more difficult to do it. Now, back to what I said, yes, it is possible, but a third problem with it is that the yield from a U-233 bomb is significantly lower from a U-235 bomb or even a plutonium bomb. So a government would go off and say, 'We'd like to go off and spend less money, less complexity building a uranium bomb, which we can effectively dig out of the ground and build a bomb, or do we want to go through this whole problem of making thorium: making U-233, using that U-233, using an enormous amount of energy, an enormous amount of technical prowess in order to get the material to make the bomb, with ultimately a bomb not working to the level that we require?'. That is my comment on that.

Mrs McARTHUR: Thank you, gentlemen, for this fascinating presentation. I am excited because I think the mineral sands where you might find thorium are in my electorate, and the hydrogen research that is being done in Warrnambool is also in my electorate. So what is not to love about thorium is all I can say. Have we got sufficient supply to keep us going if we go down this path? Who could not love the idea of—what have we got?—100 tonnes to supply the whole of Australia for the entire time? Goodness me! Have we got enough to keep us going?

Mr JOSEY: No, we have only got about 1000 years, unfortunately.

Mrs McARTHUR: Not beyond my lifetime, so that is no good. But, anyway, can you just expand on the use of thorium, converting it to hydrogen energy?

Mr JOSEY: Well, one of the great things about thorium and fission in general—I am going to go a little bit into science, and Dr Kemp and Dr Petrescu can correct me if I am wrong.

Mrs McARTHUR: And we are politicians, so apart from Melina we are not too hot on science.

Mr JOSEY: No problem. So the basic idea is that thorium, as we have already discussed and we described it in our document, is much more efficient. It is just better. We always promote thorium molten salt. So you are burning thorium in a molten salt burner. Now, molten salt is running between 650 and 750 degrees Centigrade. So it is running at the same temperature as the inside of your car, in where the spark plugs are doing their thing, and that is a high temperature element all by itself. Hydrogen production needs high temperature. So basically you can couple the two together: you have got thorium production generating high heat. You can use that for hydrogen production and you can use and you can use it for electrical production as well. So it is a very, very good form of industrial heat to apply to many industrial processes.

The CHAIR: Commercialisation of thorium versus uranium, what is the cost? Is it more costly to use thorium technology or raw material versus uranium? The reason I am asking that is because, obviously, it has not been taken up to a large scale at this stage. Do you mind taking me through that : what is the cost between the two, and why it has not been taken up?

Mr JOSEY: Yes, sure. I do not know if we listed it in the document, but there have been numerous studies done on the material—

The CHAIR: I am happy for you to take it on notice if you want to get back to us. I will appreciate it if you want to do that as well; that is another option. But please go ahead.

Mr JOSEY: No problem. I have got some numbers—I can rattle them off for you—some ranges anyway. Just keep in mind thorium molten salt runs at a high temperature but it runs at atmospheric pressure. It does not use cooling water to control the temperature, so basically you have got—I will not quite say an open vessel, but there is no pressure, so the wall thickness is thin and it is more of a chemical system than a nuclear system. All of the costs associated with trying to contain high-pressure water in the traditional system do not exist. You end up with a very, very low cost, and some at this stage are showing between $1 million and $2 million per megawatt installed. That is comparable to everything else you have got. I concede prices for solar are now much less than that in the Middle East, but there are some different economic drivers on that. Comparing that to uranium solid fuel systems, which are going above $7 million per megawatt installed—so just because of the simpler technology required to contain the thorium while it is doing its stuff, it ends up being cheaper.

The CHAIR: Again why hasn't there been a high take-up then, if that is the case?

Mr JOSEY: You cannot make weapons from it. The path to manufacture weapons back in—this is all documented; there is lots of material on it. There was one guy, Dr Alvin Weinberg, who was actually the inventor of the pressurised water reactor at Oak Ridge. He discovered how to make energy this way. They put it in submarines. He was part of the Manhattan Project where they just wanted to make plutonium, or whatever they wanted to do, to make weapons. Thorium is not a weapon. It is very difficult, as Dr Kemp said, to make weapons—it is just really painful—but it is really excellent to make energy. But back then they were not interested in energy—lots of oil, lots of coal and they did not have any weapons, so they wanted weapons. The entire direction of the US nuclear development went down the weapons path, and thorium only lasted as long as it was pushed—until 1972 when Alvin Weinberg was retired or sacked from Oak Ridge.

Mrs McARTHUR: I wonder if you can tell us where in the world are the largest deposits of the mineral sands from which thorium can be extracted?

Mr JOSEY: Australia, Brazil and India.

Mrs McARTHUR: Thank you. So we could lead the world?

Mr JOSEY: Yes.

Dr PETRESCU: If I may add, we can lead the world in both thorium and hydrogen production—the green hydrogen. As Jeremiah said previously, through the heat that we can transfer from the thorium production we can anode through the catalytic thermolysis, we can generate enormous quantities of green hydrogen, which we can export, which can be used in energy hungry industries like steel, paper, plastics, aluminium and cement production, with very high efficiency. We could bring the cost of hydrogen below A$1.50 or even $1 per kilogram of hydrogen, which is fantastic. [Zoom dropout] energy attracting to the hydrogen. Also, besides the cost, the technology is safe. The uranium 233 left in the thorium molten salt is there if you leave it in there. You can extract it only then and introduce it into the chemical mix of [Zoom dropout].

The CHAIR: Well, thank you very much. I really appreciate your time. It has been—

Ms BATH: Can I ask a question, please, Chair?

The CHAIR: Yes, why not. We can squeeze a last one in.

Ms BATH: I have not asked one yet. I have been waiting patiently and learning as much as I can about thorium as we go.

The CHAIR: Did I leave you out?

Ms BATH: I have a couple of questions. That is okay, Chair. You made me first earlier on, so I am happy to wait. Thank you.

You were talking about hydrogen production involving thorium. Just to help me clarify that, you are using the heat from the thorium molten salt to create water and to create hydrogen, or is it part of the process of the molten hydrogen that you create that? Just explain that a little bit for me please.

Mr JOSEY: The former—there is no hydrogen produced in the thorium molten salt process. We are just using the heat coming out of that.

Ms BATH: The heat. Thank you. I appreciate that. That is what I thought. I just wanted clarity.

Dr PETRESCU: And that is why—because you do not have hydrogen being produced in the thorium molten salt—it is safe, because a hydrogen build-up would mean an explosion. It is one of the [Zoom dropout]. This does not happen in the thorium molten salt. Hydrogen production is separate.

Ms BATH: So you are using this as an energy source to split water to create hydrogen, which is again inert, until it becomes hydrogen.

The other question I had, I guess, relates to that we as MPs always try and have a local hat on and a jobs hat on. Part of our issue is around energy production for the state and a proper mix of that, but also it is about jobs. I am interested in: if a thorium molten production could occur in X time, what would the physical footprint be on the earth—what would the physical footprint of a plant be? And, in your opinion so far, what would be the matrix of employment there? What sorts of professionals and skilled engineers et cetera, electricians—what would we need, or is that a 'How long is a piece of string' question?

Mr JOSEY: No. I want to use the numbers from Canada as a specific comparator. These are numbers that were published in September 2017. I will just go back to it—60 000 jobs in Canada and a $5 billion per year industry. That is what I said before. You can expect similar. In Canada they have a full spectrum of nuclear. They are also doing thorium molten salt as well. You can expect similar ramifications in Australia. Canada and Australia are very similar in size, logistics and things like that. So you can start there and then your imagination can go anywhere if you start to add in alternative industries. The thing about thorium molten salt is it produces a great deal of heat, which is excellent for industry. I mean, you do not have to convert it into electricity or transport it like you do in coal; transport it 500 kilometres and then turn it into a heat source, say, at an aluminium smelter. You can couple these things together [Zoom dropout] until you get that enhanced speculation. You can just sort of speculate on how much it would be.

But, like I said, this is a process you have got to start now. I heard the comment before: let us just wait until the rest of the world does it, and then we will just buy them in. Great! Buy them in. You employ a couple of procurement officers and a few logistics people and a few maintenance people to look after it. If you do not do any development, you are going to be left behind by the rest of the world. Physically the rest of the world is very, very active in this. Donald Trump signed a law in October 2018, I think. I am not sure of the actual date. They called it a new [Zoom dropout]. In that new law they repealed the restriction they had on liquid fuel research since the 1970s—part of the conspiracy stuff that we will not go into. I do not know if Trump knew what he was doing—I am sure he did—but that basically opened up the US to legitimate research into nuclear energy, which had been closed for many, many years. Now there is, like—I do not know—20 startups in America all trying to catch up on this thing. Australia—we are smart guys. We know what to do. We put rockets into space first. We have done a lot of things first. And then we export it. So this is a great opportunity to bring it back just by dropping the law off a little bit.

The CHAIR: Okay. Well, it has been an excellent session. Thank you very much for your thoughts. Gentlemen, thank you. A copy of the transcript will be sent to you shortly, so if any corrections need to be made, please make the corrections and send it back. On that note, we adjourn now.

Committee adjourned.