COMMISSIONER: Good morning. I welcome you back to topic, workshop on estimating the costs and benefits of nuclear activities. The Commission's terms of reference is required to express a view about the conditions under which a range of nuclear fuel activities would be viable. Today's public session is concerned with how the Commission plans to approach an assessment of the potential economic or commercial viability of further processing of radioactive materials, nuclear power generation, radioactive waste storage and disposal activities in South Australia. The Commission has engaged experts in relevant fields to undertake estimation studies of a range of hypothetical scenarios. The scenarios represent some of the activities that the Commission needs to consider under its terms of reference.

The scenarios themselves, as will be explained, are defined in very broad terms. They do not assume a particular site on which a facility might be developed, nor do they cost a specific facility or project such as would be necessary if assessing whether a particular activity or project oughtn't proceed. Instead, what is to be estimated is intended to be indicative of the range of potential viability of the activity and, therefore, to assist the Commission to take a view on the conditions under which the activity broadly might be viable in South Australia. The nature of the estimation work in the broadest terms has been disclosed in the statements of work available through the links on the Commission's website.

The purpose of today's public session is to inform those interested of the nature of the inputs and methodology of the estimation exercises being undertaken. It will also disclose the types of outputs those estimation exercises would produce once they're complete. The estimation work will be undertaken in the coming months. Those that are interested may, if they wish, comment on the inputs and the methodology as explained today by writing to the Commission at the email address found on the flyer for today's session. Such comments need to be provided by the end of next week. Comments directed to the inputs, methodology and the kinds of outputs will be considered by the Commission and those undertaking the estimation work.

Because of the more narrow purpose of today's public session, the format will be different from other sessions. Instead of proceeding in a question and answer format, those undertaking the estimation work have in advance been requested by the Commission to describe the purpose of the work, the nature of the inputs, the estimation model being used and the types of outputs that will be produced. These will be presented to the Commission this morning. The results of the estimation work will be disclosed by the Commission in February 2016 when it releases its tentative findings.

Finally, it should not be assumed that because the Commission has requested an estimation as to the potential viability of various activities that it may recommend in due course that those activities ought to be undertaken. As the Commission has explained, there is much more to consider. Potential impacts on the community and the environment must also be considered and weighed as part of the consideration as to the overall feasibility and desirability of any of these activities. However, the Commission must, under its terms of reference, consider potential commercial viability and that is the purpose of commissioning this specialist estimation work. Mr Jacobi.

MR JACOBI: Today's first session is quantitative analyses and business case for uranium conversion, enrichment and fuel fabrication facilities in South Australia. Quantitative analyses will be undertaken to determine engineering, procurement, construction and life cycle operating and maintenance costs associated with the possible development of facilities in South Australia for the processing of uranium oxide into fuel for use in nuclear reactors. The case studies to be considered are the establishment of conversion, enrichment and fuel fabrication processes for a light-water reactor and conversion and fuel fabrication processes for a pressurised heavy-water reactor. To that end the presentation and evidence will be given by Mr Brian Gihm of Hatch Pty Ltd.

COMMISSIONER: Brian, would you please proceed. Brian, I think you're muted.

MR GIHM: Yes, sorry about that. Good morning, everyone. My name is Brian Gihm. I am the product manager at Hatch undertaking the study of fuel processing facilities for South Australia. I'm going to start with the presentation overview. I will be discussing the study objectives, have a brief discussion about nuclear fuel cycle, what are the base-case scenarios, process overview and base-case scenarios, finally some modelling and we'll be discussing inputs to finance our models, including high-level assumptions, facility sizes (indistinct) and product cost calculations, also infrastructure assumptions, contingency assessment and high-level assumptions and exclusions in this study.

Next slide. The study objective is to investigate the potential business case for establishing uranium conversion, enrichment and fuel fabrication facilities in South Australia. In order to achieve this we will estimate the direct and indirect capital cost and fixed and variable operational costs for uranium processing facilities. We will estimate life cycle project cost of the facilities, including engineering, construction, procurement, commissioning, operation and decommissioning activities. We will also investigate the investment justification based on possible service revenues.

Next slide. If I present a simplified study overview, currently the fabricated light-water reactor fuel cost is between $US1500 to $US2000 per kilogram. In 2014 the yellow cake export price from Australia was $92.80 per kilogram. The (indistinct) that this yellow cake is enriched to 4 per cent and used as light-water reactor fuel we will be requiring 8.7 kilograms of yellow cake. So now the question is, in that present value what is the life cycle processing cost of uranium, and if we subtract yellow cake cost and life cycle processing cost from fuel sales cost, what will that be? So in this study I will estimate the levelised cost for yellow cake processing to be nuclear fuel such that we can see what is this residual cost after we subtract all the facility costs and yellow cake cost from fuel price.

MR JACOBI: Mr Gihm, can I just ask you a question back then?

MR GIHM: Yes, sir.

MR JACOBI: You referred to a price for uranium oxide. Was that a price in Australian dollars or US dollars. The price for fuel was in US but the price for yellow cake, was that in Australian dollars or US dollars?

MR GIHM: The price for yellow cake was in Australian dollars. This is the overview of the nuclear fuel cycle. In this study we will be focusing on the front end cycle facilities but not including uranium mining. So we will be discussing conversion facilities, enrichment facilities and fuel fabrication facilities. Next slide. There are three basic case scenarios that you can consider. First case is having conversion facility only, second case is conversion and enrichment facilities and third case is having conversion, enrichment and fuel fabrication, all three facilities. For fuel conversion facilities we are examining two types of facilities. The first one is conversion. The second one is dry conversion. We will be examining three different configurations. We will be examining configurations such that they can produce either 100 per cent LWR applicable fuel or both LWR and pressurised heavy-water reactor fuel in 90 per cent and 10 per cent split.

We will be also examining one enrichment facility which is gas centrifuge technology. There will be two fuel fabrication facility configurations. Again, this will be configured to produce 100% LWR fuel and the other configuration to produce 90% LWR and 10% HWR fuel. For the business case, there are (indistinct) possible scenarios when you combine both configurations, including brown-filled and green-filled (indistinct) there will be 16 best case scenarios.

It will be modelled at all facilities located at single location, but within their separate (indistinct) the process overview in a little more detail - on the far left side, there are three boxes which form the conversion facilities. Left bottom is the (indistinct) facility (indistinct) process the two Uranium Hexafluride and it is fed into gas centrifuge for (indistinct) in fuel fabrication, it is essentially a two stage process. The first is Uranium Hexafluride to Uranium Dioxide conversion. Second portion is the actual fuel fabrication. Next slide.

So these are eight possible scenarios that we will be examining and the final product, LEU, means low emission uranium, which is used for light water reactor fuel. NU is the natural uranium which is used for PHWR fuel. Next slide. So what we are essentially trying to do is create a financial model which is based on (indistinct) capital product analysis approach of using discrete cash flows, discrete time period and accounting of cost to evaluate the product's net present value and internal rate of return. We will be performing statistic analysis and to evaluate the impact of CAPEX and (indistinct) variations at present value and the internal rate of return. Next slide.

In order to provide inputs to this financial model we will be estimating the following inputs that are fuel service revenue, production rate, initial capital cost for both direct and indirect cost, and operating cost which really includes variable and fixed cost, plus sustaining capital cost, and facility closure cost. Next slide. This is one of high level assumptions in our study. Uranium production and (indistinct) is entirely dependent on nuclear fuel generating capacity changes only. So these fuel facilities will not impact the demand or supply of uranium. Uranium market is a restricted market. There are insignificant quantities of these services being traded on exchanges and majority of fuel sales are on the long term contract.

So what will be impacted if these hypothetical possibilities are introduced, it will impact conversion (indistinct) and fuel fabrication (indistinct) services. Next slide. This is a revenue assumption. We will be using poor service model for the best case scenarios and the financial modelling. In (indistinct) services, the facility is contractually obligated to process customer owned uranium. These facilities provide services, conversion enrichment and fuel fabrication services only. They do not actually (indistinct) any of uranium. These services are not exposed to locate (indistinct) directly.

The service contracts are typically charged as a fixed price per kilogram of uranium or per separative work unit, which I will be using (indistinct) and they are generally adjusted for inflation. Contrary, most nuclear fuel service companies operate their facilities under (indistinct) service model, which includes chemical, general electric (indistinct) and capital electric nuclear fuel in Korea. Next slide. When you look at the poor services for conversion we have found very strong correlation between the global Uranium Hexafluride price and the (indistinct) price (indistinct) therefore the long term conversion service price is expected to be predictable.

For (indistinct) we will be using service award market long term (indistinct) price forecast, which is US Dollars 67 per pound, however it is not a factor impacting on this case in poor service model. Next slide. For (indistinct) services we also found that there is a positive correlation between the spot SW price and yellow cake price. Therefore (indistinct) revenue can be reasonably obtained, however there are many uncertainties, including secondary market supply and social political factors that will be impacting SW price.

The licence fuel fabrication price - we were not able to find there was any direct correlation between yellow cake price and fuel fabrication price. The reason is that fuel fabrication services are traded in the long term private contracts and incident quantities are traded (indistinct) most fuel facilities are strategically located in the country which is country utilising nuclear power. Next slide.

The following are our assumptions in sizing these facilities for modelling. We sized the conversion (indistinct) and fuel fabrication facilities based on 10,000 tonnes of uranium processing per year. These are based on two assumptions. The first is that the international energy agency products that global nuclear power generation capacity will grow by 37% from 2014 to 2030. Today's generating capacity is 376 gigawatt and in 2030 international energy agencies expecting the generating capacity to be 518.6 gigawatt. The second assumption is that Australia will maintain the current uranium market share. In past 10 years Australia has produced and exported about 7,400 tonnes of uranium per year and by increasing this amount by 37% we are expecting that roughly 10,000 tonnes of uranium will be produced and exported. Next slide.

We are using two different facility configurations. The first configuration is that the (indistinct) from these facilities will (indistinct) in 90% and 10% split for light water reactors and (indistinct) fuel, and the second case is that only 100% of light water reactor fuel fabrication will be considered. These configurations are based on the current installed capacity of light water reactors and pressurised heavy water reactor plants in the work. Their proportions are approximately 93% and 7% respectively. The annual natural uranium consumption by these two types of reactors - light oil reactors and HWR proportional to the installed capacity, and these numbers are 94% and 6% respectively. Next slide.

So our model facilities are roughly 10% of the global capacity in 2013. For conversion facility, it will represent roughly 10 to 13% of the global capacity. The (indistinct) facility will represent 8 to 10% of the global capacity and the fuel fabrication facility will add 8 to 9% of light water reactor fuel capacity and 23% of HWR fuel capacity. Next slide. Now I will discuss how we are calculating the capital cost. It is expected that the (indistinct) of capital cost will incur during procurement and construction stages. Our estimates will be based on the existing commercial facilities for conversion enrichment and fuel fabrication, and assembly facilities.

We will identify the most capital and operating costs intensive mechanical (indistinct) and their cost, and installation (indistinct) and all these costs, and labour hours will be individually estimated. For small (indistinct) such as pumps and valves, they will be added as percentage values of the major (indistinct) cost. The capital cost for electrical (indistinct) and civil structural components are estimated as percentage values of building and site direct costs. Next slide.

For operating experience calculation, major cost model and energy costs are individually calculated, or some are scaled from similar facilities. Major costs, including general maintenance and security, are scaled from similar facilities. It is expected that the majority of labour cost will incur during procurement, construction, commissioning and operation phases.

Next slide. Project costs such as build of, materials and labour for engineering, construction, commissioning are estimated from Hatch's past EPCM experiences in similar chemical, mechanical and high-tech chemical plant projects. Nuclear costs and productivity factors are applied whenever required and regulatory and licensing costs are (indistinct) that these requirements will be similar to the Canadian requirement. That is because we reason that South Australia and Saskatchewan in Canada share many similarities such as having large uranium reserves, having many active uranium mines, mining industry, but not any of the fuel processing facilities.

MR JACOBI: Mr Gihm, can I just interrupt you there. You referred to there being a project cost based on Hatch's experiences with projects in Canada. I'm just interested whether there's any cost uplift for the Australian context.

MR GIHM: Yes, I will actually get to that point in the next few slides. The last one is the decommissioning cost. This will be based on projected decommissioning costs of similar facilities. So, as you just asked, the reference plant cost will be initially estimated in the currency of the country they are presently located in but these costs will be adjusted for South Australian local conditions by applying recent specific material and labour cost and productivity factors. (indistinct) and power-(indistinct) ratios will be applied whenever this direct South Australian cost cannot be obtained for certain plant components and labour. You should know that the cost estimates are order of (indistinct) of completions at this stage and they are based on several assumptions made in this study.

So for reference point we are examining several reference plants listed in this presentation but they also include other facilities to increase our estimate increases. So for conversion facilities we are looking at wet and dry conversion facilities. For wet conversion facility we are using Cameco's Blind River refinery and Cameco's Port Hope conversion facility as the reference plants. For dry conversion facility we are using the Honeywell Metropolis facility in the United States as the reference plant. Conversion facilities are essentially chemical plants.

Next slide. For enrichment facility we will be examining the second generation technology which is gas centrifuge. A gas centrifuge plant is essentially a mechanical plant. We will be using the Urenco USA facility as the reference plant and we will be using Urenco TC21 centrifuge as the cost modelling basis. Next, please. For fuel fabrication we will be looking at conversion, plant production and assembly. So for conversion it will be conversion of uranium hexafluoride to uranium dioxide through integrated dry route process.

For production and fuel assembly we will be looking at the assembly and production cost for light-water reactor fuels and HWR fuels. For LWR fuel we will be looking at AP1000 fuel, EPR fuel and G (indistinct) reactor assemblies. For HWR we will be using CANDU 37-element bundle as the reference bundle. We'll be using Cameco plant in Canada and Westinghouse plant in USA and KEPCO nuclear fuel plant in Korea as the reference plants for this analysis.

Next, please. For site infrastructures we are looking at transportation and road requirements which can transport about 40 tonnes of materials per day. We do not expect that we will be requiring any rail access. For power requirement we are looking at a total of 80 megawatt. Of this 10 megawatt will be used for conversion, 50 megawatts will be used for enrichment and 20 megawatts will be used for fuel fabrication. In terms of labour requirement we are looking at approximately 2000 people working at the site during the operation. This includes 500 for conversion plant, 250 people for enrichment plant and 1200 people for fuel fabrication plant. For water requirement we are looking at approximately 1.5 million cubic metres per year and most of this water will be consumed by the wet conversion facility and for fabrication facility.

For site we will be looking at brownfield and greenfield locations and some of the considerations are access to 275-kilovolt transmission line and access to nearby port facility. Some of the possibility are co-locating the fuel facilities with other nuclear facilities that are being studied, (indistinct) power plant and waste repository. The last possibility is the site could be near existing uranium production facilities.

MR JACOBI: Mr Gihm, can I just interrupt you there. You've identified certain labour figure assumptions. I'm just interested in the basis for those labour figures that you've identified.

MR GIHM: Sorry, I couldn’t hear you clearly. Could you repeat the question?

MR JACOBI: You've identified certain labour figure assumptions for the plants. I'm just interested to understand the basis for those assumptions.

MR GIHM: These are based on the existing facilities. For wet conversion facilities the numbers vary between 300 and 800. For enrichment facilities of 7 million SWU size the number seems to be consistently 250. Fuel fabrication facility numbers vary a little bit but 1200 people is based on Westinghouse fuel manufacturing facility in the United States which, coincidentally, produces 1200 metric tonnes of fuel per year. Did I answer your question?

MR JACOBI: Thank you.

COMMISSIONER: Proceed.

MR GIHM: Next slide, please. For project risk and contingency assessment we will be utilising the following method to identify the project contingency factors in our study. The identification of project risk affecting (indistinct) and facility schedules will be done first. We will be creating risk identification tables and qualitatively determine what are the potential impacts. Some of the risk items include construction, licensing and regulatory availability of skilled labour, infrastructure, technology strategy and contracting strategies such as EPC versus EPCM. Cost impact will be quantitatively assessed. Impact will be ranged to evaluate the most likely optimistic and pessimistic scenarios and we will be conducting multicoloured statistical analysis to determine contingency levels for project risks. Schedule contingency will be qualitatively assessed at this point.

MR JACOBI: Mr Gihm, you just used two acronyms, EPC and EPCM. Can you explain what they are?

MR GIHM: EPC is basically a turn-key project. It's engineering, procurement and construction. EPCM is engineering, procurement and construction management. So with EPC model the vendors generally assume the whole risk of completing the project under fixed price and the vendor will charge a certain percentage of the capital cost of project as the risk premium. Under EPCM the vendor will be only managing the project for the owner. Therefore, the vendor does not assume the risk for delivering the project with fixed price. Therefore, the risk basically falls on the owner and there is no risk premium associated with EPCM.

MR JACOBI: Thank you.

MR GIHM: So the last slide is the exclusions. This study excludes the following considerations: cost for regulatory and legal framework set-up, sociopolitical factors, secondary supply of enriched uranium, inter-government (indistinct) which is expected to be necessary for the enrichment facilities, cost for marketing and customer relations and all cost factors that will be incurred outside of the facility boundaries and any other classified information that's associated with costing. Thank you.

COMMISSIONER: Any questions? Brian, thank you very much for your evidence. That concludes the first session. For those who are following us on the stream, the copies of the slides will be available on our website later today. I now adjourn until 9.45.

ADJOURNED **[9.30 am]**