PCA Case No. 2023-01

IN THE MATTER OF AN ARBITRATION

-before-

THE COURT OF ARBITRATION CONSTITUTED IN ACCORDANCE WITH THE INDUS WATERS TREATY 1960

-between-

THE ISLAMIC REPUBLIC OF PAKISTAN

-and-

THE REPUBLIC OF INDIA

CERTIFIED TRANSCRIPT
(HEARING FOR THE FIRST PHASE ON THE MERITS)

COURT OF ARBITRATION:

Professor Sean D. Murphy (Chairman)
Professor Wouter Buytaert
Mr. Jeffrey P. Minear
Judge Awn Shawkat Al-Khasawneh
Dr. Donald Blackmore

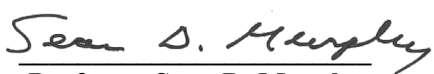
SECRETARIAT:

The Permanent Court of Arbitration

ON BEHALF OF THE COURT OF ARBITRATION:

CERTIFIED PURSUANT TO PARAGRAPH 19 OF ANNEXURE G

10 July 2024



Professor Sean D. Murphy
Chairman

In the matter of an arbitration
pursuant to Article IX and Annexure G
of the Indus Waters Treaty 1960
PCA Case No. 2023-01

Permanent Court of Arbitration
Peace Palace
The Hague
The Netherlands

Day 3 Wednesday, 10 July 2024

Hearing of the First Phase on the Merits

Before:
PROFESSOR SEAN D MURPHY
HE JUDGE AWN AL-KHASAWNEH
DR DON BLACKMORE
MR JEFFREY P MINEAR
PROFESSOR WOUTER BUYTAERT

BETWEEN:

THE ISLAMIC REPUBLIC OF PAKISTAN

-and-

THE REPUBLIC OF INDIA

Transcript produced by Trevor McGowan
Georgina Vaughn and Lisa Gulland

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THE REPUBLIC OF INDIA WAS NOT REPRESENTED

FOR THE PERMANENT COURT OF ARBITRATION

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09:10 Wednesday, 10 July 2024
(9.33 am)
THE CHAIRMAN: Good morning, everyone. Good to see you again.
I see that Sir Daniel is at the podium, perhaps to tell us how things will unfold over the course of the day. So, Sir Daniel, you have the floor.
SIR DANIEL: Thank you very much, Mr Chairman. I hope that you managed to survive the deluge last night. It's only when we saw the orange rain warning that we appreciated the 5.30 stop yesterday evening!
(9.34 am)
Day 3 Overview
SIR DANIEL: Mr Chairman, members of the Court, before Dr Morris stands up to continue his submissions of yesterday, let me just give you the very briefest of roadmaps of what you'll be hearing from us today. It will be building the next layer of the pyramid, getting narrower in focus, and preparing the foundation -- can you hear with the ...?
THE CHAIRMAN: I think we will need to close the windows, at least temporarily, until we have less noise coming in from the outside. So if you'll just bear with us for a moment, Sir Daniel, we'll do that. (Pause)
Okay, I think we are ready to proceed.

09:35 SIR DANIEL: It is uplifting for the spirits to think that there is someone who is cutting the lawn outside while we are working in here.
As I was saying, just before Dr Morris stands up to continue his submissions of yesterday, I'd like to give you just a brief roadmap of what you'll be hearing from us today. It will be building on the next layer of the pyramid, getting ever narrower in focus, and preparing the foundation a little bit more for the detailed submissions that you will hear from us tomorrow about the interpretation of the paragraph 8 design criteria.
Following Dr Morris, you will have three submissions today. Dr Morris will be followed by Mr Rae, who will be addressing you on incorporating run-of-river HEPs into an integrated power system.
After Mr Rae, we will return to the legal issues, with Mr Fietta then addressing you on Baglihar and Kishenganga systemic interpretation issues. And Mr Fietta will also be responding to the Court's question 35(a) on the effect of past decisions of Courts of Arbitration and Neutral Experts on future Article IX settlement processes.
Mr Fietta will be followed by Professor Webb, who will address you on the Western Rivers run-of-river hydro bargain and the controlling effect of Article III.

09:36 And she will also address the Court's question 35(b) on the extent to which non-Treaty-based best practices can be or must be incorporated into the Treaty. A number of these issues have already been addressed, but these will take them to another level of detail.
Mr Chairman, members of the Court, each of the submissions that you are hearing and have heard and will hear from us has the purpose of putting an additional layer of bricks into our interpretative structure, and to ensure that particular evidential underpinnings are properly cemented into that structure. It may not always be apparent with all of the presentations exactly what those bricks are, but we will attempt to draw all of the threads together; that's certainly one of the things that I'll attempt to do tomorrow morning.
The purpose of Dr Morris's presentation, and which he is in the midst of, is both to provide you with an opportunity to revisit some of the design and operation issues that you heard about during the Neelum-Jhelum site visit and to make a number of points about the constraints that apply to the design and operation of all run-of-river HEPs in the Himalaya. Dr Morris will continue with this shortly.
I know, for reasons of time constraint, there was perhaps a self-denying ordinance on your part not to ask

09:38 him questions -- perhaps there were no questions -- but please do feel free to put questions to him. One of the reasons why we have presented him here in an open-ended format, rather than through a witness statement or anything like that, was precisely to allow you to engage with him, including on the Neelum-Jhelum issues.
I should note that Dr Morris's presentations of yesterday afternoon and today are also intended to provide the jumping-off platform for his second presentation tomorrow, which will be on approaching the paragraph 8 design criteria from the perspective of an engineer. So this is the foundation; tomorrow he will actually be looking at the texts.
And as I say, we will be endeavouring to pull the threads together of these presentations during the course of tomorrow.
Following Dr Morris, Mr Rae will be coming to the podium. And as I've already said, Mr Rae brings a rather unique experience and insight to the table. Unusually, as I understand -- our engineering colleagues will know more -- but unusually, as I understand, Mr Rae has an experience that goes from the design of HEPs through to their operation, rather than simply focusing on particular aspects of HEPs. And he is also a veteran of the Baglihar proceedings.

09:39 His presentation on incorporating run-of-river HEPs into an integrated power system was in fact suggested to us internally, as we were reflecting on this hearing, by a number of the exchanges that you, the members of the Court, had with the site experts at the Neelum-Jhelum plant on how run-of-river hydropower plants would or might fit into an integrated power grid that was also fed by solar, by wind, by nuclear. But I think the focus of your questions, as I recall them from the site visit, was in particular with regard to renewable energy resources and environmental and climate change considerations. So the session, again, is intended to provide you with an opportunity to address these issues further with an expert engineer who is working in the field.

Following Mr Rae, we will return to the legal issues with Mr Fietta. And Mr Fietta's submissions on the weight that should be accorded to the conclusions of the Kishenganga Court and the weight or otherwise -- we say "or otherwise" -- that should not be given to the Neutral Expert's determination in the Baglihar proceedings are, of course, central to Pakistan's case and we appreciate that they will be central to your deliberations. Because one of the issues that we have put before you is: what weight is to be given to

09:41 Raymond Lafitte's determination in 2007 in Baglihar? We say the methodology was completely flawed and the conclusions were inconsistent with the Treaty. So these issues are central to our case, and they will be central to your deliberations.

The Kishenganga Court, we say, laid down some dispositive findings of systemic interpretation, notably with regard to -- but not confined to -- the prohibition on drawdown flushing or empty flushing, under the Treaty, which the Kishenganga Court actually dealt with as a systemic question, not simply as a question that was confined to the KHEP. And in so doing, the Kishenganga Court expressly rejected the Neutral Expert's analysis in Baglihar and the systemic application of his determination beyond the Baglihar HEP.

Mr Fietta will address these issues in the round. But in so doing, he will also respond to your question 35(a), which asked directly about the weight and effect of previous decisions of Courts of Arbitration and Neutral Experts.

Mr Fietta's submissions will, of course, also necessarily address the weight and effect that will in due course attach to your award in this first phase of the merits. And indeed, the reason why we are here

09:42 precisely is because in the period leading up to February 2016 -- you will recall that's when the letter was sent by the Pakistan Commissioner for Indus Waters to his Indian counterpart saying, "We're moving beyond all of the discussion about the Neutral Expert; we believe that this has to be taken to a Court of Arbitration, because we believe these questions need to be settled with systemic effect" -- and the reason why we are here is precisely because of the concerns about Baglihar; that these issues could not be addressed on a plant-by-plant basis for evermore; and that if the Indus Waters Treaty was to return to functionality, that it would be necessary to secure a binding interpretation of systemic effect on the meaning of the design criteria in paragraph 8 of Annexure D.

Mr Chairman, members of the Court, perhaps I might pause there to step away from my scripted remarks to make an observation, because it's one that has of course been weighing upon us; and we expect, in particular from some of the questions that you've been posing over the course of the last couple of days, that it is quite properly weighing heavily on your shoulders as well.

What this first phase of the merits is addressing are systemic issues. And what is going to be called upon from you is a systemic interpretation that is going

09:43 to address all of these issues, for evermore, for all of these treaties.

We very much appreciate that this will weigh heavily upon you. And one of the reasons why we're going into such small and sometimes, it may appear, such tedious detail is that we would like you to have the evidential underpinnings for every single issue that you feel you need to join up in order to reach your systemic interpretation. But I'll come back to that perhaps in my closing on Friday.

Following Mr Fietta, Professor Webb will return to the interpretative issues. And she will focus on peeling back the skin in greater detail on what we say is the Western Rivers run-of-river hydro bargain; that is the third of the bargains embodied in the Treaty. You will recall that the hydro bargain is the bargain that is constructed, as we have characterised it -- we believe correctly -- around the rule and the exception for hydroelectric power in Article III and Annexure D.

Mr Chairman, I come on to make an observation which I think goes to your exchange with Professor Webb around the Waldock drafts. She will come back to those in due course, but let me just make the observation in advance of her.

The rule of unrestricted use, as you know, is that

09:45 of Pakistan's right to unrestricted use of the waters of the Western Rivers, and India's corresponding obligations of let flow, non-interference and no storage, subject to certain tightly constrained exceptions. So I think that's the way that we are characterising it; Professor Webb will deal with it more fully.

When one has a look at the language of Article III, paragraph 1 and Article III, paragraph 2, the rule is unrestricted use. That's our right, Pakistan's right. The corresponding obligation on the part of India is let flow, no storage, non-interference, and then subject to the exceptions, in particular for hydroelectric power here.

Just going back to the exchanges yesterday, in particular with Ms Rees-Evans around the travaux préparatoires, let me just underscore, in case the point has not come across clearly enough or in case it's been caught in the mangle of the move from the travaux to the Treaty, it has never been Pakistan's case that it has an unfettered right to use the waters of the Western Rivers. That's not what the Treaty says. Pakistan's case is that it has a right to the unrestricted use of those waters, and that India is subject to imposing obligations in respect of that right. But Pakistan

09:47 acknowledges that the right is subject to exceptions.

But we also go on to say that the exceptions are tightly constrained and must be construed for what they are: exceptions to a right, not as a self-standing provision of entitlement that avails India without regard to Pakistan's right. And perhaps this comes to the Fitzmaurice/Waldock debate, if I can put it in those terms.

The exception for hydroelectric power is a carve-out from Pakistan's right of unrestricted use, in which the attribution of the right also expresses the exception, with a renvoi to Annexure D. You find the headline right in the same provision you find the exception, and then you have articulation of the detail of the exception in Annexure D. It's not that you have a right and somewhere else in the Treaty, semi-detached, you have an exception. Perhaps, Professor Murphy, this goes to your question yesterday. But as I say, Professor Webb will come back and unpack that all.

Then finally, Mr Chairman, members of the court, starting tomorrow, we will endeavour to draw the threads together of all of these various presentations and apply them to the interpretative task of construing the paragraph 8 design criteria. And I do emphasise and again have in mind that our approach to all of this has

09:48 been very much like a pyramid, starting with the broadest of brushes and building up, and from tomorrow you'll begin to have sight of the summit. The summit is where the air is thin, where the temperatures are cold, where the winds blow, but also where the end is in sight.

So thank you very much. With that, I'd invite you to ask Dr Morris back to the stand.

THE CHAIRMAN: Very good. Thank you, Sir Daniel, for those very helpful introductory comments. We appreciate as well your revisiting some of the points that were raised in prior questions to give us a little bit more insight into Pakistan's position, and appreciate that it will be followed up as well in due course by others in their presentations.

So at this point I do invite Dr Morris to return to the podium for the completion of his presentation from yesterday.

SIR DANIEL: Mr Chairman, perhaps while Dr Morris is just setting up all of his electronics, I might just add -- you may be aware of this because this is a discussion that we've had with the Secretariat and with the technicians -- Dr Morris does not only have his presentation on his laptop but he is also iPad-enabled and has the facility to speak through drawings, not only

09:50 words.

The reason why I mention this is because we have had discussion with the Secretariat and with the technicians just to make sure that the drawings are also properly captured in the record, so that they are not sort of somehow lost. The drawings will be the engineer speaking through his drawings, rather than through his words.

THE CHAIRMAN: Very good. Thank you very much. Dr Morris.

(9.50 am)

Himalayan Run-of-River Design and Operation: An Engineering Perspective (continued)

DR MORRIS: (Slide 30) Good morning. (Pause) Today in the morning I'll start talking about management options to preserve reservoir capacity. (Pause)

(Slide 31) This diagram outlines four basic ways to manage sediment. And sediment management is something that historically, in storage reservoirs, you would design a reservoir to have 50 to 100 years of sediment storage. That was the way to manage it, and in the future then someone else will deal with the problem.

But run-of-river plants are very interesting because they have historically not had large storage capacities. So the sediment problem that many storage reservoirs are

09:51 facing today were addressed early on -- and I mean early on in the prior century -- and addressed successfully by the run-of-river plants. So a lot of the techniques that are being applied to storage plants today actually originated with the run-of-river plants.

So it's kind of interesting to see that the run-of-river plants were actually the precursors of successfully implementing sediment management strategies which are now being moved into the realm of storage plants. I just want to make that clear. And I learned quite a bit about sediment management that would be viable in a storage plant based on lessons learnt from run-of-river plants.

Now, basically, this is a diagram that I worked up some years ago, but it shows four basic strategies: you can reduce sediment yield, you can route sediments, you can remove deposited sediment or you can adapt to sediment. In other words, the adaptive strategies are things that you do when you're not touching the sediment, but you're, like, for instance, putting coatings on a turbine or something like that.

(Slide 32) Basically, reducing sediment yield: erosion control. Routing sediments is passing the sediments through or around your storage. Removal: flushing and dredging. And your adaptations: turbine

09:53 coatings, et cetera.

(Slide 33) Watershed management in the High Himalaya is quite limited, the potential is quite limited, because successful watershed management focuses on the restoration of vegetation. We see that when you have excessive grazing, poor agricultural practices, that you destroy the soil cover, you destroy the vegetative cover, and this greatly accelerates the erosion rates, by a factor of, say, 100. It's not unusual to see a hundredfold increase in erosion rates on properties or pieces of land that have been degraded.

So watershed management, where you have enough water and the climate is amenable to vegetation, you can achieve very considerable improvements in reducing the sediment load. And we have in the United States a number of areas of the country where we see quite a dramatic decrease because of all the conservation programmes that have been worked on in farms.

Pakistan, in the Mangla Reservoir watershed, has also been successful in reducing sediment loads by watershed works. But High Himalaya, it's not going to work up there. So it can work in the proper environment -- but the potential for this to work in the Himalaya is limited because you have landslides, which of course are accelerated by things such as road

09:54 construction -- but it's not a cure-all, by any means.

Let me make one more comment. As a dam owner, if you want to change your watershed, you have to deal with thousands of people and thousands of property owners. So when I deal with dams, I say: yes, you can look at watershed, you should deal with it; but really you need to focus on how you're going to operate what you can control.

So we have two -- yes.

THE CHAIRMAN: Dr Morris, if you don't mind, Dr Blackmore has a question for you.

DR BLACKMORE: I liked the introduction and the contrast. I was just interested though on the Himalayas. Because we're going to move on to reservoirs now, but before we do that, more generally I'd like you to give me your understanding of sediment generation through seismic activity in the Himalayas, because we know we can't manage that, but whether that's a significant issue, from your perspective.

DR MORRIS: It's a significant issue because it helps to generate landslides.

There was one of the reservoirs, Kulekhani, in Nepal, there was an earthquake and there was also a large monsoon which tended to coincide in time, and dramatic loss in sediment. The place where I've seen

09:56 this the most severe is in Taiwan, which is where I was able to really visualise it.

Earthquakes produce landslides, and they produce scars on the landscape, and that is where you are generating your sediment. A landscape scar can produce easily 100 times more sediment per square metre of land surface compared to vegetative land which is next door.

So seismic activity is important, but it's just part of the picture. But it's definitely an important part.

DR BLACKMORE: So the Indus Valley was created by erosion.

DR MORRIS: Mm.

DR BLACKMORE: And we've now effectively cut off -- we've got sediment traps --

DR MORRIS: Yes.

DR BLACKMORE: -- called dams that have cut off the vast majority of sediment and silt getting to those landscapes. So I just want to understand, from your perspective, the bigger picture, before we go back to dealing with the small.

So we now have three major dams, and a whole lot of smaller dams around, that have effectively cut off the flow of sediment, changed the morphology of the river. And I'm just wondering, given that you have given this a great deal of thought, what do you see as the future of the area downstream of these dams, and what happens

09:58 if you reintroduce sediment?
DR MORRIS: That is a wonderful question, and that is the next challenge.
When you talk about geology, you talk about long-term periods. When you talk about dams, you're talking about a blip in geology. This is one of the things that I have been working with Pakistan to have them understand, as well as other countries. But particularly Pakistan, because I think Pakistan has probably the most severe water resource problem of any country in the word, in terms of the challenge that it faces. And one of the challenges -- the big challenge -- is exactly what you put your finger on: the sediment.
For instance, along the Indus, we have Tarbela, which has now lost over 40% of its capacity; we have Dasu, which is being built upstream; and we also have Diamer-Bhasha upstream. But even if you let Diamer-Bhasha and Dasu fill to their design level, you only buy 40 years of storage at Tarbela.
You cannot stop erosion in the Himalaya: it's going to go downstream, and it's going to go downstream either over the dam or through the dam or around the dam. It's going to get downstream.
And one of the issues at Tarbela is that you do not

09:59 have the option of walking away from it. Tarbela has got about 150 million tonnes of sediment. Of that, about 70 is sand. Sand going over the flip bucket will reach a velocity of about -- there's two spillways, and the velocity will be in the range of 40 metres a second. And you put 40 metres a second, 70 million tonnes of sand against a flip bucket, and your spillway is gone in one monsoon. You lose your spillway, the dam can fail: catastrophic downstream consequences. You cannot run away from it, you have to deal with it.
So the whole objective that we're focusing on, after getting through this hearing, is working on the Indus to try and create a system where we can run sediment from the upstream, through the two reservoirs, through Tarbela and into the downstream.
What are we going to do with the sediment? That's the big question everybody wants to know. And it's really interesting because, in very round numbers, we have about 200 million tonnes of sediment a year. We have 100,000 square kilometres of irrigated area. That is equivalent -- when we correct for bulk density et cetera, it's about 1.5 millimetres of deposition on the floodplain -- on the irrigated floodplain -- in a year.
The other option, of course, is to run it downstream

10:01 and into the ocean, which is ideal. But in my visits and discussions with the operators at Kotri Barrage -- which is the most downstream barrage on the Indus, just before it goes into the Arabian Sea -- they have assured me that the recent -- not "recent", but this is just pre-Covid recent -- that their modifications and rehabilitation allows them to divert all the remaining water to irrigation.
So we have a river with a large sediment load, very little water going to the sea, and we have to deal with what we're going to do. We do not yet have the answer, but we will find the answer. And if we don't find the answer, it's going to happen anyway.
The dams are only temporary. They can only store a very small amount of sediment compared to what geology is giving us.
DR BLACKMORE: I'm only following this line of enquiry because when you've got a hydraulic civilisation like Pakistan, or in Egypt on the Nile, with Aswan, and many others we could spend hours talking about, you've bought a period of time when you've got stability; and then you've got a period of time when you have instability, because you'll change the morphology of the river, depending on how you elect to transport.
How long -- you said "finite", so I wondered whether

10:02 you had a number for how long before remedial action, of the nature of passing sediment in a controlled way, or managed way, or whichever word we want to use -- how long before we reach that for something like Tarbela, in your view?
DR MORRIS: Ideally, it would have been already working. Realistically, it will take at least ten years to get something put together and operating.
But there's not a lot of time available. Like I said, Tarbela has lost about -- Tarbela started impounding in 1975. Here we are in 2024 and it's already lost a little more than 40% of its capacity. So it's -- and the two upstream reservoirs, if you're going to use them for power, you have to manage them appropriately.
DR BLACKMORE: So we've now accumulated all this sediment, and it's got a slope to it from the delta through to the outlet works. And I understand the outlet works have been expanded so that we're excluding sediment going through the turbines for a period of time.
DR MORRIS: They're being lifted, yes.
DR BLACKMORE: So I'm interested in what happens if we have a seismic event now, given that we've got -- I first took evidence on this in 1998, in Sri Lanka. And I'm just interested in the evolution of time: where it was

10:04 known as a problem, there was no solution at the time. And I'm just wondering whether there's still the possibility of a catastrophic event, caused by an earthquake blocking the sediment over the outlet. So I'm wondering what thinking has been going on in that space.

DR MORRIS: Yes. That has been a real concern at Tarbela. And there was an extensive study done in 2013 -- which is, what, 12 years ago, 11 or 12 years ago -- and they reanalysed that issue. Their conclusion was that the slope on the delta is about 2%.

And the delta actually has two slopes: you have the face of the delta, and it flattens out; and then in front of the intakes, you have a scour cone that goes down to the intakes, where the slope in some areas is as high as 3%.

But the conclusion was that for slopes less than 2%, the earthquake shaking would not generate a slide which would be self-propagating. I should say: an underwater landslide. That it would move a little bit, but it wouldn't destabilise the entire delta. You wouldn't have this massive blocking. With the raising of the intakes, that problem, that danger, is essentially eliminated for the time being. And so that's why it's important now to stabilise this and work in that

10:06 direction.

Just let me make one more point here. I'm going to talk about dredging in a minute, but since we're on this.

In the Indus cascade, the three reservoirs, you have the Diamer-Bhasha, you have Dasu, Tarbela and Ghazi-Barotha, which is another 1,400 MW plant that is basically connected -- it takes the water that comes out of the turbines in Tarbela and passes them another 50 kilometres downstream. That's about 14,000 MW of capacity. You can't turn 14,000 MW off. I mean, the country won't have power.

So what we're looking at is a way where we operate the top reservoirs to pass sediment down to Tarbela, and at Tarbela we use dredging. And dredging sounds like a crazy idea, and when I started studying Tarbela I said: dredging is a crazy idea, because it's too expensive.

But Tarbela produces power at less than 1 cent per kilowatt hour, US. Why? It's paid for. It's paid-for infrastructure. All you're doing is operating it. And the operational cost of hydropower is the cheapest thing there is: it's cheaper than solar. Like I mentioned yesterday, the plant that I was at in Peru, it's running on 100-year-old equipment and it's producing power and

10:07 generating money.

So when we worked out the numbers on dredging, you can dredge Tarbela and pay for it by doubling the cost of power. Your power from Tarbela will go from 1 cent to 2 cents, which would still make it the cheapest source of power that there is.

The other interesting thing is that they did look at flushing at Tarbela. And what happens is that if you flush Tarbela, you have to turn the turbines off for a minimum of 30 days, maybe closer to 45. 30 days, power off at Tarbela. Buying replacement power from a fossil fuel plant will cost you about $500 million for one month. And for $500 million, we can do a lot of dredging. So ...

THE CHAIRMAN: Thank you, Dr Morris. It's been a very interesting discussion, but I have to confess -- and this may be the lawyer in me -- I'm not entirely sure I understand the relevance of Pakistan's management of sediment downstream for the purposes of this case.

It strikes me that there's value in understanding how one can control sediment in upstream dams other than using, say, drawdown flushing. That seems of relevance. But another possible relevance is, to the extent that Pakistan wishes to avoid sediment flows, there might be some value in having a lot of upstream dams that are

10:09 taking sediment out of the river.

So I'd be interested in your reflections on just the relevance of what it is you're talking about for purposes of the case.

DR MORRIS: Yes, okay.

What I'm trying to do in this presentation is to give you an idea of the variety of options that we have in sediment management. And the Tarbela example is, I think, a good example because it shows that they looked at flushing here as the logical first thing you think about, and it turns out that it's not feasible because of the amount of power that you have to forgo. And this is a problem when you do flushing at any plant. Any plant.

So in that respect, I know that India is very focused on doing flushing. But at the same time, we are not clear that they have really put into the equation two things: (1) the cost of turning those plants off, the implications of turning the plants off for flushing; and (2) the downstream implications of releasing sediment downstream. Because when you flush, you basically are taking one year's worth of sediment and releasing it in a slug. If you're going to flush once a year, you're going to release all that sediment in, what, a week?

10:10 So these are the types of problems that are inherent in flushing as a strategy, and we'll go into that in a couple of minutes. So like I said, I think it's relevant what happens in lots of different reservoirs because it shows that there's a lot of different strategies available.

(Slide 34) Let me continue with this and just say that the sediment routing techniques, we have off-stream storage, we have on-stream storage, we have bypass tunnel or we can do a compartmented reservoir. Compartmented doesn't really apply here because it's more for flat land with round reservoirs. And we can pass through, where we have turbidity currents or drawdown sluicing.

(Slide 35) Off-channel storage is basically where you use an intake to divert water into an off-stream storage reservoir. This is in Colombia, it's in a mountainous area of Colombia, and they have two reservoirs in series. I worked with this project and I just thought it was an interesting example.

(Slide 36) This photograph is from the Tinguiririca project in Chile, where you have -- it's probably 4,000 metres elevation. I'm converting to -- it's around 3,500 metres elevation. And they had the unique situation in their topography where they could use

10:12 an off-stream storage.

The dam is actually right here: you can see the dam (indicating). It was affected by a debris flow event: the dam was completely filled with sediment, boulders. But the off-stream reservoir retained its capacity, and the operators insisted that they had had no problem and they had not had appreciable sedimentation.

So it's a strategy which is not a general strategy, but there are places where it will work.

(Slide 37) The bypass tunnel, we have discussed that a little bit. But the objective of the bypass tunnel is to pass your sediment-laden flows around the zone that you're preserving for pondage uses. In my own work in the Himalaya, I've found that this tends to be a good strategy for smaller reservoirs. It doesn't really pan out for larger reservoirs, where we have longer tunnels, et cetera. And you can design these tunnels so they can pass bed load, or they can pass suspended load only.

(Slide 38) This is an example from Japan. This is actually for a pumped storage project. This is the lower dam which is on the river, and then they have a higher reservoir which has only a very small watershed. But this is at the upstream end of the reservoir. And the cofferdam, when they draw it down, the cofferdam diverts bed material. You see the gravel

10:13 on the bottom. It diverts it into the tunnel and releases it about 3.5 kilometres downstream. I think it's about a 3-kilometre tunnel, if I remember correctly.

So bypass tunnels can be designed for bed material, can be designed for suspended material. What I have done in the projects we've worked with is design them for suspended load rather than bed load, because the bed load tends to degrade the invert of the tunnel.

We do have an example in Pakistan, the Patrind project, which is not too far away from Neelum-Jhelum: it's about 100 kilometres, I think. It does incorporate a bypass tunnel. So it is something which now has been used in the Himalaya.

(Slide 39) Drawdown sluicing is a strategy by which you open the gates of the reservoir during a flood event. Most of your sediment -- not most, but a large portion of your sediment, is delivered during flood events. It depends on your hydrology. But, for instance, in the Caribbean, some areas of South America, Taiwan, where you get typhoons and cyclones, you can get half your annual sediment load in one or two days a year. In the Himalaya it's more spread out over time, but you still have these very large events that produce a lot of sediment.

10:15 And the objective in drawdown sluicing -- as seen in part (B) of this slide, down at the bottom -- is to open the gates when the flood is not yet arrived at the dam, so if the dam is drawn down, and the flood can pass through it.

Now, in the Himalaya, with a prolonged wet season, the strategy which is typically employed is to keep the gates open, keep the water level at the minimum operating level -- which in the Treaty is called the "Dead Storage Level" -- and keep it at that level during the entire wet season, because that changes your reservoir, your pondage pool, into a river.

And instead of holding the water level at the top of the pondage pool, you drop it to the bottom of the pondage pool. So the pondage pool is not accumulating sediment because it's empty. It will accumulate some sediment upstream in the delta, but the pondage is empty and therefore it's not going to accumulate sediment.

And the area from the bottom of the pondage pool to the bottom of the reservoir is flowing as a river, particularly during the large events, so that you can pass a 10- or 20-year flood at a high velocity, and that's what maintains that profile.

Basically, the difference between sediment flushing and sediment routing is that this top one is the

10:17 sediment sluicing. You see here? I'll get the cursor. During the dry season, the pondage pool gets filled, and the levels fluctuate up and down on a daily basis. And during the wet season, you drop the water level, and maintain the water level at your minimum operating level, which allows you to operate your turbines throughout the year, you don't have to have the shutdown. And then at the end of your wet season, you refill and operate the pondage again.

In contrast, flushing. You have these flushing events: maybe one, maybe two, maybe -- in extreme cases -- three per year. And you may operate the plant at the maximum level, or you could also operate it at a sluicing level. But the difference is that the flushing requires these deep drawdowns. And that is where the issue with the Treaty comes in. So the top one, because you're not drawing down below the dead storage level, is compliant, and the bottom one is not compliant.

(Slide 40) The advantages of preserving capacity by sluicing is that the power plant can remain in operation, subject to sediment-guided operation. Remember we mentioned yesterday that some of these days have very high sediment loads, so there are going to be a couple of days a year where you will probably want to

10:18 either turn the plant off or run at, say, half power.

Really important is the second item here: the sediment that's released downstream is released over the period of the wet season or by floods. That large volume of water dilutes the sediment, so your concentrations remain within a more or less natural range, and it gives you the hydraulic capacity you need to move it downstream. When you flush on an annual basis, let's say, you get this big slug of sediment, and you can't just close the gates when the reservoir gets empty.

In other words, imagine you draw the reservoir down, open the gates, empty it, it flushes out. Okay, I've released the sediment that I want to release from my reservoir, now I'm going to close the gate. But what happens when you close the gate: all that sediment you released downstream just settles into the river, and it settles into your irrigation canals or wherever.

And what we have seen in, for instance, Sanmenxia in China, on the Yellow River: they have had to release a significant amount of clear water after the flushing event so that this stuff moves downstream.

When we did the flushing experiments at Warsak Reservoir in Pakistan two years ago, we did a rapid drawdown, we released a lot of sediment, and the sand

10:20 collected in the riverbed and it came up 3 or 4 metres. And we had to then have a secondary release of clear water to help move this material downstream.

So flushing is not just "Let me get the sediment out of the reservoir"; it's "I've got to do something downstream too".

The high flows during sluicing maximises the width of the channel. Now, if you have a river, rivers have a certain dimension, and those dimensions are created by nature. And you have a low flow, and you have a little river; and you have higher flows, you have a bigger river. And the size of this river channel is, geomorphically speaking, equivalent more or less to about a two-year discharge. Then it starts to overflow into floodplains, et cetera.

When you have a reservoir that you're going to maintain by flushing or sluicing, you have to put as much water as possible through it to make that wide enough. Because if you start flushing with a small flow, you have essentially converted the river into a small river instead of a big river. Because, remember, the river is determined by your large flows: that gives you the dimension of the channel. And if you flush with small flows, the channel dimension in your reservoir is going to be smaller. So sluicing allows

10:21 you to pass the large floods through the reservoir and gives you the maximum width.

Go ahead.

THE CHAIRMAN: Dr Morris, are there circumstances in the Himalayas where, to deal with sediment at a particular site, you do find it necessary to use something like flushing, either as the exclusive means of addressing the sediment issue or as at least a partial means, in conjunction with other possibilities?

DR MORRIS: That is a very interesting question, and I need to answer it in the following manner.

You have flushing here on the left and sluicing here on the right, but there is this big area in between, and there is no fixed line that says, "This is flushing and this is sluicing". Because I can put my gates -- my sluicing gates or my flushing gates, whatever name we want to apply -- I can put them at an elevation of 100 metres or 99 metres or 98 metres or 97 or 96 or 95: I can move the gates down 1 metre at a time. And when we do the simulations, that's basically what we do: we look at all the different levels, the types of control we get. So it's not really a black and white demarcation: is this flushing or is this sluicing?

The overall objective in sluicing is to maintain flow downstream during flood events; you want to

10:23 minimise deposition. Flushing, on the other hand, is focusing on scouring previously deposited sediments and then releasing that downstream. When you do sluicing, you will get scour of previously deposited sediments. When you do flushing, you will get some sediment pass-through with whatever your flushing flow is. So it's really something of a misnomer to say that this is exactly sluicing or flushing.

But what happens in the case of the Treaty is you have a line which just says that: if you draw down below this level -- which is dead storage -- then we could consider it to be flushing; whereas if you can keep it to that level, we can consider it to be sluicing. But some projects, there's very clear flushing; some projects, very clear sluicing. And some projects are: well, maybe, either way; you could describe it either way.

THE CHAIRMAN: I guess another way of putting my question is: assuming we do have the Treaty constraints in place, and assuming that they prohibit a particular type of deep orifice that would normally perhaps be used for flushing, are there circumstances where you, in complying with that requirement, would not be able to build a dam at a particular site; or will there always be, in your view, alternative means of sediment control

10:25 that could be employed?

DR MORRIS: Within the constraints of the Treaty, you cannot do anything you want at a site. And we'll get into this more on Thursday.

But just imagine that if we have a small dam that we can sluice sediment, we can put the powerhouse downstream at the end of a tunnel, and that will give us 200 metres of head, let's say. But I can also make a very tall dam at the site of the powerhouse with a very short tunnel, and what I've done is I have converted my small and narrow reservoir into a very wide reservoir.

Because remember, what we saw yesterday is, as you go deeper and deeper and deeper, you go up in elevation, the reservoir gets wider. So as it gets wider, this flushing channel, which is only going to be a certain width because you only have a certain discharge, the flushing channel now is a small portion of the entire width of your reservoir at the higher elevation, whereas initially it was occupying the full width of the reservoir.

So whereas on a given river, at one location for a power plant, I can put a small dam upstream and control sedimentation; but if I move the dam downstream and make it a very tall dam, now I am forced to go to

10:26 flushing, just because of where I've decided to locate the dam.

So there's two ways of approaching the design problem. And for conceptual means, we'll just say we pick the powerhouse site, and we can put the dam upstream or we can put it downstream. But the consequences for sediment management are completely different.

And I'll have a diagram of that on Thursday that will explain that maybe a little bit more clearly.

THE CHAIRMAN: That's very helpful, thank you. Please proceed.

DR MORRIS: Now, I did mention that you will get delta deposition when you do sluicing. But what we've seen in the Himalaya, in the projects I've worked with throughout the Himalaya, the bed material, the bed-load transport, is very low compared to suspended load. So the delta deposition has not been a major issue for the big material. The sand we can move. But the delta, with moving big cobbles and gravels, has not been a significant problem.

Disadvantages of sluicing: you have to have a desander; and you're probably going to face increased turbine repair cost.

(Slide 42) One other thing that I think is important

10:28 to understand is, if you're going to have a -- let's call it a "sluicing level" at this level (indicating), that water level at the dam will define the water surface profile going upstream and the equilibrium profile for the sediment. You, for instance, run a hydraulic model or a sediment transport model, and what you define to run the model is that water level at the dam.

So if I establish the water level at the dam, I can achieve that by, in this example, a crest-gated spillway or a deep orifice spillway. In both cases, the water level at the dam is the same, so my sediment profile will be the same, except that at the orifice spillway we'll have a steep scour cone, which is typically rather steep. In Tarbela, it's not so steep because it's a fine sediment. But if it's sand, it will be close to the angle of repose, the submerged angle of repose.

So it's just important to understand that if you do have a defined profile and a defined water level, that you don't get anything extra by putting the outlet deeper.

(Slide 43) Now, let's use just a quick example of a sluicing project. This is Kali Gandaki: it's a small -- I'll put in parentheses "small" -- 144 MW project in Nepal. But this is not a small river. When

we want to look at this and compare it to, say, the rivers in the Treaty area, the sediment load here -- we'll go to the next slide (44). Look at this number: 43 million tonnes a year. By comparison, the sediment load of the Chenab at Baglihar is half of that. Chenab, 20 million; Kali Gandaki, in the order of 40 million.

So this little project is managing twice the load that Baglihar gets. It's got a surface intake. It's got a desander. They've had abrasion problems, which is one of the reasons why I was involved in this project for several years, and different types of studies.

And this is a project that is located about 200 kilometres to the west of Kathmandu: it supplies the Pokhara area. And there was no good grid connection at the time. So the plant had to run 24/7 regardless, because it was the major plant supporting the grid for that area of the country.

They did not have a good operator training programme. They were taking data; they weren't looking at the data. They did not have coated turbines. They did not perform sediment-guided operation.

You can't see the intake here because it's buried under -- I mean, this is the winter and it's high level. But the intake had a kink in it. It was not in the design; the contractor just built it that way, no one

could figure out why. But that, of course, impaired intake efficiency in excluding sand. Of the total load coming into the turbines here, 43% was sand, which should never happen.

And the desanders also had a hydraulic roller that was vertical. The water would come in, go to the bottom and then come back up again, which we again discussed yesterday.

So the objective of this project, which was World Bank-financed, was to modify and correct a number of deficiencies so that this project would operate better. But here's a project on a river twice the sediment load of the Chenab, surface intake, sluicing, and it works.

And the operating rule is like this: the sediment concentration goes up as soon as you drop the level down, because it now starts to flow as a river. During the wet season, the desanders are operating to take out sediment. During the dry season, you don't even have to use them because there's basically no sediment in the river. If you've seen Himalayan rivers in the winter, they're beautiful: they're just crystal-clear, beautiful. So in the load on this project, the sediment load would fill the reservoir with sand within a couple of months in the monsoon. So it handles a large load.

(Slide 45) Now, another example, to move to the other end of the scale, is Three Gorges in China, 22,500 MW, the largest hydropower plant in the world. And they have a sediment load of 400 million tonnes. The reservoir is about 660 kilometres long.

And they have an operating rule again based on a sluicing process, whereby it's a multipurpose reservoir, but basically during the flood season, which is in the summer in China, you have the water level at a low level for two purposes: (1) to sluice sediment, to establish an equilibrium profile. The original studies indicated that this profile would be established after and be fully stabilised within 100 years. They have been revising the rule and optimising the project operation. But they operate this year-round.

So, smaller project, larger project, you can do this.

(Slide 46) Now let's take a comparative look at flushing. What you do when you flush -- in the drawing here you can see: this is your minimum operating level, the dotted line -- you stop the turbines and then you draw the reservoir down.

And your rate of drawdown depends on two things: the dam. If it's an earthen dam, your drawdown rate will be low, because it will create instability within

the dam if you draw it down quickly. It also depends on the stability of the banks. Because when the reservoir is up high, of course, all the rock and soil surrounding the reservoir is full of water, and if you drop that rapidly, this water, as it drains out, so to speak, the pressure will cause, or can cause, collapsing of the sides of the reservoir.

So you have a drawdown rate.

Then you get the reservoir empty and you have a period of flushing. And as the sediments remove, the water level can gradually go down, and then you have to refill the reservoir and then you can restart the turbines. But of course at the end of this flushing event, you will also have to be releasing some water downstream. You're not going to empty the river: you're not going to turn the gates off and the fish will be out there flopping on the ground.

So this whole process takes time, and it's time that the turbines will not be operating. As I mentioned, in the case of Tarbela, it was a minimum of 30 days.

The flushing events, because they do release a lot of sediment in a short period of time, you will typically have to deploy -- under the procedures, you will have to deploy a mitigation and monitoring team. Depending on your regulatory environment, you may have

10:36 a rather large team: you may have 50 people in the field. And you may have follow-up activities, et cetera.

(Slide 47) So the procedure is schematically illustrated here, where the river enters the reservoir, picks up sediment and delivers the sediment downstream, and this concentration of the sediment in the water is typically in excess of 100,000 milligrams per litre. When we did Warsak, which is an Indus distributary that comes out of Afghanistan instead of coming out of Kashmir, we hit concentrations of 130,000 milligrams per litre. So the second flushing we did, we lowered the rate of decline so we could control the maximum concentrations, which of course elongates your flushing period.

So you're going to be limited in your drawdown rate not only by the reservoir and by the dam conditions, but also by the sediment concentration that you can release downstream.

100,000 milligrams per litre will kill most things in the river, if it's sustained. And if you have a downstream filter plant, it's not going to be operable. If you have downstream irrigation canals, they will fill with the sediment, the canals will fill with sediment. So there's a lot of things to consider

10:38 here. It's not just: we'll open the gates and the problem is solved.

(Slide 48) When we talk about capacity preservation by flushing, when you flush through a cascade -- when you have a cascade, you need to flush through the cascade. It doesn't really help you a lot if you're going to flush out of one reservoir and then just deposit it in the next one downstream. You need to take advantage of the operation. So you're going to probably be having all of these reservoirs out of service at the same time. Which, as I mentioned, was why we looked at dredging at Tarbela, because if we were to release sediment from the upstream reservoirs, taking the plants out of service, Tarbela can remain in operation.

Also if you have an upstream dam, you can control releases, and therefore create artificial flushing flows for the downstream dam. For instance, along the Chenab, India has proposed the Pakal Dul storage dam upstream. And that can be used for two things: it can be used to generate the flows that will pass through all the downstream run-of-river plants, basically using the storage plant as a big pondage pool; and also you can generate flows for sediment management downstream.

So being able to control the downstream hydrology is, of course, an advantage of a cascade. So the

10:39 cascade has certain advantages and certain disadvantages.

The thing I had mentioned previously on the bottom right-hand, here on slide 48, is: the flushing channel, the width will be limited. And in the bottom left-hand corner of that graphic, you can see the -- it's a regime-type equation that was basically worked out for reservoirs in primarily silty sediments; it's from China.

There's an article by Kantoush in Japan looking at Japanese reservoirs which have more gravel: the channel will be about half this width.

But the end message here is that channel width is limited. So if you have a tall reservoir, very wide, your flushing channel is going to be limited.

And finally, because we have the problem of having the sediment load concentrated in time, it can produce a lot of downstream consequences. And one of the reasons that flushing in many jurisdictions is basically infeasible is because of downstream impacts.

(Slide 49) Here, just giving an example, the regulatory guidance letter from the US Corps of Engineers (P-612), which I think has been introduced into the record. It basically makes a differentiation between sluicing and flushing.

10:41 Now, in the United States, if you have to get an Army Corps of Engineers permit, that is like the worst thing that can happen. Basically, it's a permit that involves all your federal agencies and typically goes through all of your state agencies also. So all the agencies have to get on board and agree with what you're going to do, including National Marine Fisheries, Fish and Wildlife Service, Environmental Protection Agency, plus all of your local agencies. And there's also a public review process. So you have a lot of fingers in the pie, and it's a difficult, time-consuming and costly process.

Sluicing is exempted. It's exempted because -- look at the bottom. I think it got cut off when they reformatted this, but it says "sluicing structures that mimic the natural increase ... of sediment in a stream", where the sediment that's discharged through the structure basically follows the natural pattern, is exempted from having to get the permit. Because this is basically a dredging permit. Flushing is considered to be dredging; sluicing is not, because your sluicing is trying to mimic the natural pattern.

So to have a prohibition against flushing is actually not unusual.

(Slide 50) Now, let's talk about dredging real

10:43 quick.

This is the Bajo Anchicayá project in Colombia, and I worked on this project about ten years ago. It's a small 74 MW project. It's on the Pacific drainage of Colombia. And they had a flushing event, and it created a lot of downstream problems in terms of social issues. There are some very special social issues in this area: there are indigenous tribes which have a lot of protection in Colombian law, et cetera. So they were faced with regulatory actions, lawsuits, and this is still ongoing after decades.

But they started dredging here in 1962. This is, as far as I have seen anywhere in the world, the longest continuous dredging project in any reservoir. They've been continuously dredging since 1962. And the interesting thing is that if you compare the amount dredged here per year -- and they use two dredges.

You can see this is a suction cutter-head dredge that discharges into a tunnel right about here (indicating), just upstream of the dam, which discharges just below the dam. And not visible in the photograph, but upstream, is what they call a Sauerman dredge, which is like a dragline. But it's not a dragline that's on a tracked vehicle: it's a permanently installed dragline that goes out, collects sediment, and dumps it also into

10:44 the same tunnel. So the dragline picks up the larger material -- gravels and cobbles -- and the cutter-head dredge picks up gravels and sand.

The dredging quantity of 528,000 cubic metres a year, divided by your 74 MW, gives you something like 7,000 metres per MW, or some number like that. If you apply that to the 900 MW Baglihar plant, this converts into something on the order of about 9 million cubic metres a year of dredging. And if you look at the overall sediment load from Baglihar, you're talking about being able to -- this is equivalent to having a dredge in Baglihar which would dredge something like 40% of the total inflowing load. And of course, part of your load is going to go through your turbines anyway, and part of the load is going to go over the dam when you have the big flood.

So everybody says dredging is not feasible, but here's an example where it is feasible. And I explained: even on very large scale, it is an option, and even in the Himalaya.

(Slide 51) So to close this part of the discussion, dredging, sluicing, flushing: a lot goes into taking into account the production cost and the cost of forgone production of power and the downstream impacts. If you have dispatch availability and problems with your PPA,

10:46 your power purchase agreement -- it's a contract for the sale of power, and that will typically have obligations to deliver; and if you don't deliver, you may have additional cost that you have to pay. And these other factors, plus all the downstream costs, all factor into the decision of whether or not to flush, how to do it, and how to draw the reservoir down and how to move the sediment downstream.

Dredging does not require interruption of power production. Sluicing minimises the interruption of power production. Flushing does require emptying: a rather prolonged shutdown of the power plant. And you also have the problem of the downstream sediment release.

(Slide 52) So your selection of a sediment management strategy depends on your site hydrology; your physical features: site, sediment load; your drawdown rate; the plant head; the type of turbine that you're going to be using; how quickly you can repair it. And it also depends on your socioeconomic environment: your legal, your regulatory environment, which is especially relevant to flushing; the sensitivity of the downstream environment; the slope of the river; can the sediment be transported; ecological richness.

Spawning beds: you release sediment into spawning

10:48 beds, the sediment will accumulate in the spawning gravels, and that blocks the flow of oxygenated water where the fish lay their eggs. For instance, a salmon lays eggs in gravel; the gravel gets coated with sediment; the eggs will die because there's no oxygen.

Social sensitivity to sediment downstream. And downstream infrastructure: canals, intakes, et cetera.

(Slide 53) Now, I would just like to close this section with making a couple of comments on climate change. I know that that's of interest here. And I would just like to point out that when you design in this environment, you're thinking about climate change. And in the projects that I've worked with in the Himalaya, and especially bank-financed projects, climate change is always a big deal. But there's a couple of things here.

When you look at design, you have years of high sediment load and low sediment load, and you design for the high loads. So if your climate is going to change your sediment load, you're already designing for high load. You don't design a project saying, "Well, the sediment load is always going to be average", because it's not.

The Treaty doesn't allocate water: the Treaty allocates watersheds. So we had discussions of: how

could we change the Treaty to make it more "climate-sensitive", let's say. And what you really see when you look at that is: the Treaty apportions watersheds, and India gets certain watersheds and Pakistan gets certain watersheds. So within that context, it's not obvious how you could do anything to -- quote-unquote -- "modify", "alter", "reinterpret" the Treaty to manage climate change in a different way, especially since both of the parties will probably have very similar climate impacts.

As was described yesterday, we're not clear exactly what those impacts are going to be across their full spectrum, but we do know that it will increase -- and is increasing -- the demand for irrigation. More heat, more evapotranspiration from the plants, more irrigation demand. So that part is pretty certain. The part that's uncertain is the precipitation patterns in the mountains, which is unfortunately an area which has rather a paucity of historical data.

So basically that's, in a nutshell, what I would like to say at this point about climate change. Like I said, I've given it a lot of thought. And it seems that the Treaty, the way it's set up, apportioning watersheds, basically is -- how would you say? -- it's equitable, in a way, even when climate change comes down

and affects this, because both parties are going to have similar types of problems to deal with.

It does make it clear though that the Treaty is focused on sustaining the hydrology coming into Pakistan. And if there is a change in that hydrology, it doesn't change, let's say, the obligation or the need for Pakistan to receive the waters as it naturally comes down.

(Slide 54) So just to conclude. I hope I have been able to have you understand that there's a lot of ways of focusing and solving sediment issues. In English, we'd say there's -- I mean, American; I don't know if it's an expression over here -- but there's many ways to skin a cat. There are many ways to approach a problem. And sluicing and flushing are both viable methods, no doubt about it. And they can both work in the Himalaya, and I have worked on projects on both ends of the spectrum.

I should mention that I showed you that table at the beginning with all the different methods: in my professional career, I have worked with all of them at different projects in different locations. So I'm not here to say, "This is the way to do it", or, "This other way is the way to do it". There's a lot of things that can be done, there's a lot of options.

About half of my work is remedial work with plants that have problems, and what we see repeatedly is that people just weren't thinking, they weren't cognisant. It's something that they aren't really accustomed to working with, because you go to school and you learn about steel and concrete and hydraulics, but sediment isn't in the regular curriculum. So it's something that, when you put your mind to it, you can solve it. Where there's a will, there's a way.

Both methods, sluicing and flushing, have advantages and disadvantages. And I would also like to say that a lot of progress has been made in the recent decades in the areas of coatings and better understanding how to management sediment. From when I started working in this field to today, huge advances have been made.

So I would just like to close by saying that a lot of options are available, and we are not locked into "This is the way to do it".

So with that I will close, and maybe there's more questions.

THE CHAIRMAN: Professor Buytaert.

(10.54 am)

Questions from THE COURT

PROFESSOR BUYTAERT: Thank you very much, Dr Morris. Again, a very clear presentation. I've got a few questions.

My first one relates to this concept of weaponisation of infrastructure: essentially, call it the on-purpose management of infrastructure to create downstream harm, which is a concern in this context. It has been brought up mostly in the context of India switching off the water towards Pakistan.

But from a sediment perspective, can you think of any scenarios where sediment is managed in such a way that it might create substantial downstream harm?

DR MORRIS: Water and sediment travel at different velocities down a river. And when we've looked at this, the principal problem for Pakistan will -- we expect it to be the interruption of supply.

There's a second problem: that because the dams have -- for instance, Baglihar has very large gates, you can pass large, large floods, and you can open those gates and create flood conditions downstream. But when we've looked at the flood-control capacity of the downstream barrages in Pakistan, it looks like we have the capacity to manage the flood.

So the flood is an issue which is not as worrying as the interruption of supply. Because if you can imagine running an irrigation system where you have three or four weeks of no water, and then all of a sudden it all comes in a spike, and then you have another two or

10:56 three weeks with no water, you're not going to be successful in your irrigation scheme.

The third that you mentioned here is sediment. Now, the sediment, when it's released, it will flow downstream. But in the case, for instance, of the Chenab, the sediment will go through the Salal project in India first. So the Salal project in India would be the very first to be impacted and would receive the biggest impacts of any downstream infrastructure.

So it seems that, yes, the sediment -- well, let me go back a little bit.

As the sediment is released, it tends to deposit on the riverbed. And what we've seen in the experiments at Warsak, we monitored bridges at different distances from the dam, up to, I think it was, about 35 kilometres downstream, and the sediment concentrations decreased going downstream. Because sediments are being deposited, basically, on the riverbed; some of it goes into your irrigation canals.

So the sediment arriving in Pakistan will probably be the number three problem, rather than the number one problem. The number one problem is the interruption of the water supply; number two is the flood. And of course the interruption means you'll have, like, zero flow or a greatly reduced flow and then a peak, and

10:57 then -- you know, there is the potential to do that. So it's interruption of supply; number two would be flooding; and number three would be the sediment release. And particularly because, on the Chenab in particular, India would be more affected: they would be basically inundating their own plant with sediment.

PROFESSOR BUYTAERT: Thank you very much.

Another question relates to the last point you mentioned on climate change. I believe you mentioned yesterday GLOFs and LLOFs, which do occur in mountainous environments, including the Himalayas, and are likely to increase in intensity and frequency under conditions of climate change.

So far, how big has the impact of GLOFs and LLOFs been in managing dams and reservoirs in this region? And what is your view on the potential increase in risk as a result of climate change and changing environmental conditions more generally?

DR MORRIS: If you read some of the information that comes out in the media, you will know that some of the Indian projects -- some large Indian projects, in fact -- have been impacted.

There was a project on the Teesta River which was impacted by -- I can't remember if it was a GLOF or a landslide lake flood. But a 1,200 MW project. The

10:59 dam was completely destroyed. Completely destroyed: it's gone. And people died downstream. And it was not the only event; there was another event, I think, in 2013 that affected another area of the Himalaya.

And we have problems of that type in Nepal, for instance. I don't have it in this presentation, but I've got a picture of one of the landslide lakes in Nepal that severely damaged and completely inundated a couple of small run-of-river plants.

So, yes, it's a problem. But you also have to understand that a lot of the problems have occurred because people have not paid attention to it. You need to do a proper mapping of what's upstream, and you may find that there are certain areas that just basically aren't good areas to do hydro projects because of that specific danger.

If you do a concrete dam, it can get overtopped, then you can maybe work your way out of it, but it's costly. If you're a government, maybe you can afford it, maybe you can find the money to do it. If you're a private entity, maybe it will be more difficult.

But it's a problem that can be addressed through proper design. And part of the design question is: do I really want to put a plant in the area where I have such a large risk?

11:00 Again, one of the slides that's not in the presentation here is the Jagran plant in Kashmir, in Pakistan, 30 MW, which was affected by a debris flow. You had boulders coming over the dam. But in this case it was designed for this type of event. You have a low dam, an ungated crest spillway. And then, looking downstream, on the left-hand side you have a couple of sluice gates in front of the intake. Just pure run-of-river; they don't have pondage at this plant. And the event came through; the sediment, including the boulders, went over the spillway. They came back with a bulldozer, cleared out the area in front of the intake, and the plants are ready to go to work again.

Unfortunately, their switchyard was placed too close to the river and the switchyard got wiped out, along with a mosque that had been there for 120 years. So it was an extraordinary event. But the dam was not materially damaged; and of course the powerhouse, which was an underground powerhouse, was completely intact.

So you can design for this.

PROFESSOR BUYTAERT: Thank you, I think that's a very helpful example. More generally, would you design a dam very differently if you knew that GLOFs and LLOFs were a substantial risk?

DR MORRIS: Yes, you have to understand what your risks are

and you have to plan for them and you have to design for them.

Like I had said at the beginning, engineering is a very fascinating profession. Every project is its own little problem, or big problem: your physical factors, your problems with regulatory limitations; there's all types of things. But you put your mind to it and the solutions will come up. But there are sites that you shouldn't build on.

PROFESSOR BUYTAERT: Thank you.

My last question is a bit more conceptual in nature. If you have a valley with hydropower potential and you're looking for installing a certain capacity, and you have the option between fewer large plants or more smaller plants -- and obviously there are many considerations that would influence that decision -- but from a sediment perspective, would you be able to say: well, we'd rather go for fewer large plants or more smaller plants? Is there a general trend towards which of those is easier to manage from a sediment perspective?

DR MORRIS: That's a question that doesn't have really a good answer. You can, of course, management sediment appropriately in either case.

In general, the larger plants tend to be less costly

on a per-megawatt basis. Maybe even, if you compare a 1,000 MW versus a 20 MW, you're maybe looking at half the cost per megawatt. But your 1,000 MW plant, you're looking at $1.5 billion: that's a big nut to crack. And if you have a problem -- for instance, the one I mentioned in the Teesta River, where they have a 1,200 MW plant, the dam is gone -- you have a lot of investment in one project.

So I don't think that there is what you could call a good answer to that. My preference, if I was going to work on it, if I was given a pristine river, I would select plants which are probably moderate in size. I would not try to do a 3,000 MW plant to do the whole river, and I wouldn't certainly do 30/20 MW plants. Either extreme is probably too extreme. But I know it's not a really good answer.

But the other thing is that as an engineer, you're never given a river: you're typically given a segment of a river or a site. And the planning stage in many of these rivers was done many years ago, like 60 years ago. And maybe the question is: should we replan this, based on, for instance, high dam/short tunnel, versus low dam and longer tunnel? Those types of questions, which are more overall questions.

But by the time your design engineer comes, it's

typically at the point of, "This is where you want to build it"; maybe not at this exact spot, but move it up and down a kilometre, or something like that. You've got a general idea of where you want to put it.

PROFESSOR BUYTAERT: Thank you very much. I certainly did not expect a straightforward answer. But your views are very, very helpful nevertheless. Thank you.

THE CHAIRMAN: Mr Minear.

MR MINEAR: Dr Morris, thank you for your presentation. I have a question related to Dr Buytaert's first question about sediment management.

As I recall, Neelum-Jhelum is downstream from Kishenganga. Would sediment management at Kishenganga affect the operation of Neelum-Jhelum?

DR MORRIS: Yes, because Kishenganga is currently accumulating sediment. In our office, we simulated Kishenganga, what, 15 years ago, as part of the first case, and at that time we were anticipating that it would come into sediment balance after more or less 40-50 years, something in that range; I don't remember the exact number.

But Kishenganga is quite a distance upstream of Neelum-Jhelum. So with respect to the bed load, bed material, you will not see it at Neelum-Jhelum, you will not be able to measure it. With respect to suspended

load, you may see something, but it is only a portion of the entire watershed. And so the sediment management at Kishenganga will probably not have an appreciable or significant impact.

It may have a measurable impact, if we had good measurements. But in this part of the world, we don't have, like, United States Geological Survey quality stations that have been running data for 30 years. We don't have that. So it would be difficult, within all the variability that we see, to pick out, "Well, this is what the condition was before Kishenganga, and this is the condition after". So it's probably not something that they would be able to even measure at this point.

So, yes, from the standpoint of sediment -- water is completely different. But from the standpoint of sediment, probably not much impact. And if there is, it would be a reduction in sediment for the next several decades.

MR MINEAR: Thank you.

THE CHAIRMAN: Dr Morris, you mentioned the possibility of cascades of dams in the context of sediment management. And I was wondering if you could step back from the sediment control context and just say something about whether there are inherent limits on the building of a cascade of dams in the Himalayas.

11:08 And by that I mean: are there reasons why at a certain point you can't continue to do a cascade, for reasons of sediment but also just hydrology? Or is it the case that you can design these dams in a way that you can have almost an unlimited number on the same river system?

DR MORRIS: You can design them as a stair step, where the tailwater of one falls at the powerhouse of the next upstream dam. There's no physical limitation to doing that.

Of course, you have limitations in terms of where you're going to place dams because you have existing communities. So you have to work around -- you don't want to flood communities. And if you have a cascade of dams, you're going to have flooding everywhere along the river. So that's our number one constraint. And it's not just the communities on the main stem: you have tributaries. So it's the main stem plus whatever tributary communities you have.

The second limitation is going upstream. You get to a point higher in the watershed where you have less water, you have more risk of GLOF events, landslides, all types of risks. And this is just characteristic of working in mountains: you get to a certain elevation, and it becomes so difficult that it doesn't make any

11:10 sense. You have access problems, et cetera.

So basically, your limitations are riverside communities in the downstream section; and you reach an area upstream where you just have too much risk, too much cost, too many geologic problems, et cetera.

THE CHAIRMAN: Very good. Thank you very much.

I don't think we have any further questions, so let me just thank you very much for your presentation. It was very helpful.

I think we are now at a time where we might take our coffee break. So why don't we return at 11.40. And at that point we will resume, I take it, with Mr Rae.

SIR DANIEL: That's correct. Thank you, Mr Chairman.

THE CHAIRMAN: Thank you very much.

(11.11 am)

(A short break)

(11.41 am)

THE CHAIRMAN: Okay, I think we are reassembled. So, Mr Rae, whenever you're ready, please proceed.

Incorporating a Run-of-River HEP in an Integrated Power System

MR RAE: Mr Chairman, members of the Court, I'm pleased to be able to speak to you today about this topic. I'm going to present the Court with some background on the operation of run-of-river hydropower projects in

11:41 an integrated power system.

(Slide 2) The objective today is to explain power systems in general, and how a run-of-river hydropower project is used in that power system. I will also comment on the evolution of power systems and power generation, especially the recent trend to solar and wind resources and the associated role and operation of hydropower with the integration of those resources. My purpose here is to provide a general grounding in hydropower operation, which will become more relevant to you as we proceed through the week. (Pause)

In slide 3, I'm going to discuss four main topics.

Firstly, an overview of the characteristics of an integrated power system in general, looking at global growth in electricity generation, and then the specifics of the system in India.

I'll then discuss some of the general aspects of generation expansion planning for a power system, and this is to determine how we get to select the plants that we actually design for a system.

The use of run-of-river hydroelectric power will be illustrated with respect to the services they provide for the power system and some of the limitations they have in those systems.

Then my final section concerns the ongoing evolution

11:43 of power systems to integrate the other renewable energy sources. These energy sources are very important and they require significant system supports to enable effective dispatch.

(Slide 4) So firstly now, we'll go on to the power system in general.

In slide 5, just as a bit of a background for interest's sake, I illustrate the growth in primary energy in demand in the world from 1800 to the present. What you see here is primary energy demand, which is the total energy used before transformation, whether for electricity or waterpower or mills or whatever. This is the total energy consumed.

The energy demand globally shows the transition through a series of industrial revolutions, which started in the middle of the 18th century and has continued to the present. The most rapid growth in energy demand starts from the beginning of the 20th century and accelerates significantly from the 1950s.

So going on, looking at electricity demand. It's a similar pattern shown in slide 6. And it also shows the main sources of energy, which you see on the right side of the slide there.

Electrical energy itself is a relatively recent

development in the arc of human history. The first real commercial developments of any scale date to the late 19th and beginning of the 20th century.

I'd like to appreciate this by considering that my own grandparents were born within a couple of years on either side of the turn of the 20th century, so that the lifetime of global electricity use that we look at now is within the span of three generations. Hopefully I will continue for a while longer!

But electrical energy demand has grown in parallel with the global energy demand shown in the previous slide. There have been significant advances in the technology for electric power generation in this period, with associated improvements in efficiency and cost-effectiveness. And similarly, the end uses for electric power generation have changed dramatically, both in the range of uses but also in the pervasiveness of electricity in our lives.

Note that global hydropower production has grown slowly relative to the growth in other sources, and this is evident in this slide that's in front of you. The usage of some of the thermal fuels has recently started to drop off: it's not growing as rapidly. And recently there has been a dramatic and significant growth in other renewable energy sources, which you see as the

orange colour at the top of the slide.

But that said, the core product of the power system has not changed from its earliest development under the direction of innovators such as Edison, Westinghouse or Tesla. Power systems still operate to provide electricity at a fixed voltage and frequency. So the energy production itself has evolved, but the underlying physics of electricity is fundamentally the same.

And you'll note here, I've highlighted on the slide the date of the Indus Waters Treaty, which is early in the development of hydropower, but that doesn't change how the energy envisaged in that Treaty was involved.

(Slide 7) So from that general background, we can then look at: well, what's the situation in India?

Well, India has also seen a rapid growth in energy generation, which is the orange line to the bottom of the figure, which shows a rapid growth from the mid-1940s to where we are today. And this is associated both with an increasing population but also the increasing consumption of energy per capita, which is what you would expect from an industrialising or developing nation. So you have an energy growth on both counts.

Then the next slide, slide 8, shows how we get the historical energy generation in India for the same

period. This is pointing out that the total generation of course has grown very rapidly; but the majority of the growth historically has been in thermal fuels. This has been coal, largely, in India, but to some degree other fuels as well.

An important thing to see in the slides is the recent growth of renewable energies that have grown dramatically within the last decade, and the more gradual growth of hydro over the period of time illustrated here. The other renewables, shown as the green line in the figure, are now increasing in the range of 10-15% per year. Again, there is the Indus Waters Treaty early in that process.

Going on to slide 9, I wanted to illustrate the difference between the installed capacity and the energy generation by source in India as of 2023. It's important to recall here that there's a very important difference between installed capacity, or what we refer to as "power", and the energy produced using that capacity. They are two entirely different things.

Capacity in the system is shown in the figure on the left, and energy is in the figure on the right. So looking at the capacity first of all, I know the figures below are not all that clear. (Pause)

The thermal fuels is typically in black on the

figure, and they account to about 57% of the capacity of the system. Of the thermal fuels, there is largely coal and you have some gas, you have some oil and you have some diesel use. They're about 57% of that figure on the left.

When you come to the energy produced in the system, which is the figure on the right, the thermal fuels then make up almost 75% of the energy generated in India.

The light blue colour, which is on the lower-right side of the left figure, is the amount of generation from solar. And the capacity of solar in India now is about 30% of the total capacity of the system, which now makes up about 12% of the total energy being produced.

The hydro is the darker blue colour, and it comprises about 11% of both the capacity and the energy.

It's important to understand what's in the system so we have a better appreciation for how these plants will be operating in that overall system.

One of the difficulties with the solar and wind sources is their intermittent nature and the need to provide dedicated energy storage to allow the available energy to be dispatched during the evening hours. Again, although the renewables capacity may be 30%; the energy is that smaller component. Then issue then is: how do we get that energy dispatched in the system?

So along with the solar capacity, there is dedicated energy storage required in these systems: you have to have some way of storing the solar that's generated. And that has led to a growth globally in the use of batteries. Around the world, the largest amount of energy storage for solar is with batteries at this moment.

India also has plans to implement a large programme of pump storage development that will provide energy for solar implementation. CEA lists 57 GW of pump storage projects, several of which are now in final planning or construction.

So overall, the Indian system is the third largest in the world, and is large relative to the power stations that we're discussing on the Indus Waters. For example, the Baglihar Hydropower Project, with a capacity of 900 MW, is only 0.2% of the installed capacity in India.

So a word about system interconnection. And this is shown in slide 10, where we show the regional power grids in India. There's five interconnected regional power grids: the northern, northeastern, eastern, southern and western. The figure there shows the general geographic area of those power grids. The interconnected system allows the power stations to work

in a complementary manner to supply the overall demand.

But historically, if we go back into the early part of the 20th century, electricity development had many isolated grid systems where a plant would serve a single industrial user or a small utility grid. These isolated grid systems have largely been replaced around the world as power systems and have become more integrated and extended their capability through transmission.

So the northern grid region here includes the Indus River basins, the tributaries in Jammu and Kashmir, as well as other basins not covered by the Treaty. This region is fully interconnected with the other regional power grids in India.

And as I point out in the pie chart here, the northern region has an installed capacity of about 100,000 MW. So it's not a small system; it's quite large. In proportion to the total -- each of the grids are a similar size, but you see an idea of how large they are here.

Interconnection is important in that it provides system diversity that reinforces the capabilities of the renewable energies and supports the provision of power system ancillary benefits. And I'll come to those in a few moments. The interconnections also affect how hydropower and other energy resources are utilised in

meeting system demands.

It's also interesting to observe that making a transition from isolated to integrated grids has made some projects possible where previously there would not have been sufficient demand. An example would be a remote watershed where there might have been a project available, but there was no demand locally for it, and that would have constrained the ability to develop that project. We are now in a world where we have integrated these to such a degree that we're able to develop remote watersheds. And the Indus Basin comes into consideration in this respect as well.

Each of the grids that we see regionally here is managed by a system operator, and they determine the daily dispatch of generating plants to meet the demands. So they work day by day to determine who's on and who's off.

(Slide 11) So with that general overview, I'd now like to give some comments or a very brief introduction to how power stations are actually planned.

In slide 12, I give a diagram here which gives a very simplistic description of what goes into a generation expansion planning exercise.

The purpose of the planning is to determine the optimal mix of new power stations that will satisfy

technical and financial constraints. The process includes identification of a power and energy demand forecast, what is it we're trying to achieve, and this is generally tied to an economic growth forecast of its own.

It's then followed by an assessment of the available resources: what can be produced in terms of fuels, hydropower, solar or whatever. They all go into a basket to be identified.

We then go through a process of selecting the technologies, and balancing the supply and demand so that we add enough power stations to meet the demand that's arriving from the forecast.

This then goes to the next step of, with the available projects, analysing the production costs of actually producing the power and energy from that system, which ultimately leads to an appreciation of what would be the tariff for end-users: what you or I would pay for on our monthly utility bills.

The procedures involved in this are typically extremely complex, and they seek to represent the capabilities of the system while considering the probabilistic availability of each power station and its associated capacity and yield.

To grossly simplify the process -- it's what

I've put on the right-hand side of the side -- we define options, we estimate the demand, we develop a plan for new plants and we estimate what is the cost of energy from that plan. And then we go through an economic evaluation process to make sure that we have an optimum plan that is affordable within the tariff expectations.

The key step for my purposes today is that step on the selection of the generation expansion; that is, what is the least cost combination of plants with firm power and firm energy capacity to just meet the demand forecast. Stated another way, what is the capital investment plan for the power stations that will meet our demand forecast?

Open power markets in many countries have changed some aspects of how planning is done, with a transition from direct utility investment in favour of market structuring and policy to encourage independent power producers. But the underlying requirement to have sufficient demand to meet forecast still exists. So all markets, public or private, must provide firm power and firm energy to supply the peak demands in the power system.

The planning process I have just summarised is performed very early in the development process for power stations. It is generally when the underlying

studies are at a pre-feasibility or feasibility level, so they are identified and there's a preliminary layout and a preliminary costing available for them. The process then proceeds after the generation plan is confirmed and additional studies are performed to define the project in preparation for its design. This can be a period of many years between when it might be identified in the planning to when it ultimately becomes available for design.

So turning to slide 13. I've been referring to the terms "firm power" and "firm energy", and it's very important to recognise the differentiation between the two. But they're key inputs to the generation expansion planning process. In essence, they determine how much of the demand forecast can be reliably provided by any given power station, which then establishes when plants must be added to meet those demands. So the firm power and firm energy is the input to the generation expansion plan, or when we're going to add plants into the system.

The firm power and firm energy define the capabilities of the individual power stations as it's added to the power system. So at each step, the firm power is the firm power of the total system, and the firm energy is the firm energy of the total system with that plant added.

It's important to note here that the terms I use reflect a normal power planning application. Critically, the Indus Waters Treaty adopts a specific formula that simplifies this computation of the firm power by establishing the flow rate that will be used to calculate the firm power. This simplification allows for the definition of firm power without resorting to a generation planning analysis or any other assumptions. So effectively it has removed this process from being under the remit of the Treaty.

So Dr Miles will address you on the meaning and application of the terms "Firm Power" and the associated term for "Pondage" as they are used in the Treaty, and you'll be able to follow up with him, I believe, tomorrow.

The energy though is the accumulated amount of power over a time period. It's the same as what appears in your household utility bills as the monthly consumption in kilowatt hours. Hydropower energy is computed at the power system level as the outcome of what can be produced with the available hydrology and the power capability of the power stations.

Firm energy is that amount that will have an assured availability from the power station for delivery to the customers. And typically, firm energy is found as the

combination to the overall power system when a power station is added. It is computed for a critical low-flow period in the case of hydropower. It's not an average, it's actually a low-flow condition, so it has assured reliability in all cases. To be considered firm, it must be available for the planning period with the selected reliability.

Firm power also must be assured available, but it's the capacity of the individual power stations and it's merely the rate at which energy is produced. It does not show the total amount of energy; it's only the rate of production of energy.

People dealing with power planning and hydropower, we're quite protective of the terms "power" and "energy" as different items, in much the same way that there's a difference between cement and concrete. I would recall that in my first year of engineering, I took a course on concrete methods, and was told: if you refer to it as "cement", you fail. And the same thing comes with power and energy: they are different things and we deal with them differently.

The firm power that can be produced by a hydropower station can be larger than the power generated with the flow rate available on a given day, and that's because pondage can be available so that the plant can be

scheduled for less than 24 hours in a day. We take the volume of water, which is analogous to the volume of energy, and we can then reschedule that into a shorter period of time so we can use a greater degree of power.

The daily peaks for that peaking operation can be a few hours during an evening period, but can be quite short. But generally in the order of four to eight hours in a typical day.

It's important that if you're doing a peaking operation like this, there is a period of the day when the plant does not operate. And during that period of the day you'll accumulate the water in the pondage so that you can release it at the higher rate at a later time of day.

So firm power is the amount available in megawatts that's available for dispatch by the power station at any time, and the amount of energy to be generated with that firm power determines the number of hours that the plant can operate. A traditional method of planning uses load duration analyses to show how firm power and energy from plants can be combined to stack in the overall load, and I'll show you an illustration of that in a moment.

So an important thing, going forward, that is: in addition to power and energy production, power

systems as a whole must have characteristics such as what are listed in slide 14 here, which ensure the quality of supply. And this slide is reproduced from a report by the Pennsylvania-New Jersey-Maryland grid system in the United States (P-603), and I find it's a useful diagram to illustrate typical power services common to all power systems.

The columns in the chart -- and they're a bit hard to read here, but in a sense it's not essential we get every minor detail. The columns in the chart shows various services often referred to as "ancillary" or "secondary" benefits. These services include factors such as the ability to regulate voltage and the ability to regulate frequency; the ability to follow a varying load in the power system; and what is called "spinning reserve", which is the reserve available in the power system able to react quickly to changes in the load; and standby reserves, which is the ability of the plant to start up and deal with a load over a period of anywhere from minutes to hours.

Other columns in the diagram are: how quickly a plant can start up; whether it has storage available for its fuel; and its ability to enable the power system to start from a black start situation: for example, after a power outage, can you bring it up and get it

going again?

So the rows going down the left-hand side show the contribution from the different available generation resources, and the one at the top is hydropower. You can see, going across the diagram, it has blue dots for almost everything, which means it is a very valuable producer of ancillary services.

The ones closer to the bottom are solar, wind and battery storage. Solar and wind particularly, being the bottom two, have very few of the blue dots. So they don't have such great contributions to the ancillary services.

The other ones in the middle, the thermal plants, whether oil or natural gas or steam or nuclear, all have some contribution to ancillary services.

At one time, most generating facilities could contribute to these ancillary services. But as we add more solar and wind resources, utility planners must now make dedicated provisions for the ancillary services, which are defined either as direct investments or by incentivising investment by private investors through policy.

The hydropower is a valuable source of the ancillary services, as indicated in the slide, but its value does depend on whether the hydro is run-of-river or storage,

or even pumped storage.

(Slide 15) Let's look at some of the details of how hydropower itself is operating.

(Slide 16) Electricity is created by the conversion of the potential energy of water to mechanical energy at the turbine, I think as was described to you earlier. The electrical energy at the generator is provided for transmission to the power grid for distribution to the customers.

Potential energy of the water is simply the difference in head between the reservoir upstream and the tailwater downstream and the density of water, and gravity. That's the potential energy. The electrical energy is a function of the efficiencies of the turbine, generator, transformer and other electrical systems. And that electrical energy comes about as we convert the potential energy of the water through the turbine to kinetic energy, and then to electrical energy in the generator.

The generator itself must spin at a constant speed to create a constant electrical frequency. The frequency is determined from the rotational speed of the generator and the design of the rotor and the stator, which are the spinning and stationary part of the generator itself. And the turbine is directly coupled

12:09 to the generator so it also spins at a constant speed, even with changes in flow rate.

The output from the hydropower plant is the power, which varies with the flow rate and the generating head. And it's simply, again, the rate at which the energy can be delivered for a given flow rate, and it's independent of the hydrology.

The other primary output is the energy, which is, again, different from power. The energy is a function of the flow rate available in the river and the power capacity of the plant. The energy is computed by aggregating the power produced in each second of the day for the whole period of time that the plant operates. As such, it's simply a sum of power over time. Energy then will be expressed in kilowatt hours or gigawatt hours, whichever; whereas power is expressed in kilowatts, megawatts or gigawatts.

A very, very simplistic view here, which is important for how the plant operates -- this is in slide 17 -- that all power stations are controlled by a governor, whether hydropower or thermal power, even. The governor functions to maintain a constant frequency in the power system or to control key requirements such as flow rate and water level. The governor has different operating modes, depending on the plant

12:10 characteristics and the power system.

This is one of the large sets of equipment that you will have seen on the turbine floor level during the Neelum-Jhelum visit. It will have been large tanks of oil and other gear that were pretty hard to understand what they were. But this is part of the governor system.

In very simplified terms, there's a sensor which continuously monitors the rotating speed of the turbine and the position of its wicket gates. If the speed falls below a set point, then the governor injects oil in the system, which causes the wicket gates to open and the speed of the turbine to increase to match the set point. And similarly, it goes the other direction and reduces the flow if it's going down.

But the governor also has set points available to be able to control water level, flow rate or even power output. The governor systems available today then monitor the speed, and react to the power system to adjust the power plant to maintain the set point positions.

So during our visit to the Neelum-Jhelum control room, if you recall, the operator said that the generator was operating for frequency control on that day. What he means by that is that turbine generator

12:12 units were operating at part-load, and were available to the power system to have the load adjust up or down, as needed to contribute to correction of the frequency of the power system. So they were working for ancillary benefits generation during that period of time.

So we sometimes think that hydropower plants only provide a block-loading of power and energy for peaking. That's part of the role; and it's important, of course, but the availability of the ancillary services is actually also an important function of hydroelectric plants. The provision of some ancillary services will generally require that a hydropower plant is operated at a partial load, subject to governor control.

What I've shown on slide 18, on the right-hand side, is a typical efficiency diagram for a Francis turbine. On the bottom is the flow rate; and the other side, the vertical axis, is efficiency. And typically, we want the plant to operate between about 60% and 100% of the rated flow. Ideally, it would operate around 80%, where it's close to the peak efficiency.

So if the plant is available for ancillary services function, it's able to operate at the peak of the efficiency curve, and allow the governor to operate to vary the load a little bit up or down from that, as it's needed to provide whatever services, whether frequency

12:14 control or spinning reserve, or to follow the load changes in the power system.

But the contribution of run-of-river hydropower will vary seasonally. And a plant on full load during the wet season produces more energy, but it contributes less to what I call the ancillary services.

At part-load, the plant has some spinning reserve. And spinning reserve again is: every time you go in a room and you flip on a light switch, you increase the power demand in the power system, and some power station somewhere in the system must react in order to pick up all those thousands of people flipping on light switches. And that's what spinning reserve does: it allows the plant to operate automatically to make that adjustment.

The governor will vary the turbine flow to follow the frequency, to control water levels or to control the flow rate, whatever is set as the requirement. The operating turbine can ramp the load up or down rapidly, if it's already operating. This is frequently required for systems that include solar generation. I'll demonstrate to you in a moment here how variable solar can be, and why it's important to have systems like hydro that can provide some of this contribution.

So why do I say all this? Well, pondage is

12:15 necessary in hydropower projects to provide the energy storage needed to allow for these variations in the turbine discharge when it does not match precisely with the inflow. So you may have all of these things happening in the power system, and that creates minor change or small changes in the power plant, and we then need the pondage to buffer those. It provides a volume available for surplus or deficit storage within the system.

So in this sense, the pondage is reacting to the loads of the system by adjusting the loads of the plant. I differentiate loads of the system from loads of the plant: they're again different, because any one plant doesn't deal with the entire system; they're no longer isolated, they're all integrated. So pondage is our buffer to provide that ability to deliver these ancillary services to a power system. Pondage is also used for the daily peaking if the plant is scheduled for only certain hours in the day.

So if we come down to the level of the power system, what I've put on the slide here in slide 19 is a typical daily load curve for the "all India" case in India. These are produced by an agency in India which makes some information available. But it shows, minute by minute, the power that must be delivered into the

12:17 system. And if you take the area under the curve, that would be the energy; whereas the left axis is the power; and of course the bottom is the time. So if you take the area, you're taking the power in megawatts times the time, giving you megawatt hours, which is the area under the curve or the energy.

And note also that this is only the upper part of the curve. The left axis would actually show that about 100 GW below the bottom of this curve is baseload: it's there all the time. And it's only the variability on the top, which is about from 80% to 120% of the average.

So in practice, the system operator, or the dispatch operator, has to select a pattern of power stations to enter the system on a daily basis to respond to this sort of load variation. The operator must always schedule plants that are going to deliver whatever required ancillary benefits. Whether the spinning reserve or standby reserve or frequency control or whatnot, they also have to be scheduled. So they actually have a big job, if we're looking at a system of about 100 GW and we're scheduling plants of 100 MW, those plants start to look pretty small. So you have to imagine the operator, doing this every day, has to have some shortcuts.

(Slide 20) But before we get there, this comes to

12:19 an illustration of the effect of the curves day by day or season by season. And what we see here is that there is not a single load curve that is characteristic for the power system, where each day is reproduced identically. They are different: every day, every month, and from year to year. This is four that were presented for 2014 and 2015 in the available reference.

It shows again that there's a very significant baseload, but it also shows some significant difference between years, which I don't fully understand, to be honest, but this is what was provided in the reference document. The difference is very significant between the seasons, and this is four typical seasons of the year.

So all plants in the power system will operate to some degree to supply this hourly demand variation, and this is especially true of storage hydropower projects that have flexibility to schedule the timing of their generation. Gas turbine and diesel plants adjust load very quickly and they will tend to fill the upper part of the peaks in these diagrams. And even coal-fired plants will fill part of it, and that would be typically from the nighttime through part of the daytime.

Run-of-river hydropower projects can vary their load subject to the pondage available and the flow available

12:20 in the river. Peaking using pondage, though, is only available during the part of the year when the flow rate is less than required to generate at the installed capacity.

If you are into the wet season of the year and these plants are full-loaded, they are supplying the load at the bottom of these diagrams, where it's continuous through the day. In the dry season, there is some variation through the day, and it's a matter of making that continuous enough to fill those long periods of the higher loads, which are typically in the order of six to eight hours.

But it's important to recognise that pondage is not the only factor that determines the peak-period energy provided from a run-of-river plant. The energy available is ultimately limited by the stream flow on any day.

(Slide 21) So what we do with these is actually, from a generation planning perspective, we want to simplify this, because those are very difficult to deal with if you're doing generation planning analysis. So we've simplified them here by reorganising them into load duration curves. And all this is showing is a percentage of time on one axis and power on the other axis. And again, if you were to integrate the area

underneath these curves, you would come up with energy. So again, the two remain different.

All our generation planning process does is try to determine how we could what we call "stack" the projects in there, so that each one has a slice horizontally where the area of the slice is equal to the energy available and the depth of the slice is equal to the power available. So if we have a firm power available for a plant, we then take the amount of energy we have, and we find a place in that diagram where the two fit and match it optimally.

When we actually do it for generation planning, it gets a whole lot more complicated, but I don't think we need to get into the details for that.

(Slide 22) So that brings me to operation with other renewable sources.

What is often referred to as "other renewables" is now the fastest growing source of power generation in almost every part of the world. "Other renewable energy" generally refers to solar and wind as the main contributors, but the classification can also include biomass, geothermal, ocean energy and a host of other systems that are available. The largest, though, of these is solar and wind. The addition of the other renewable energy to an integrated system affects how the

other generation works, especially hydropower.

So when we look at the area here, as illustrated in slide 23, India, and even more so Pakistan, is well situated for solar generation. I am speaking predominantly about solar in the coming remarks, although it's to some degree also related to wind. Both countries are well situated for generation of solar, which can be obtained from utility-scale plants, plants in the order of hundreds of megawatts, as well as from farm- or household-scale plants.

Solar and wind energy can be expected to exceed hydropower generation in coming years, as new solar and wind generation will outpace the possible additions to the hydropower sector. As an example, there's recent press reports in India of a solar park to produce 30 GW of power that's planned for the state of Gujarat. That's 30,000 MW in one solar park.

An important advantage of these resources is that solar especially can be located closer to the demand, allowing for some reduction in transmission losses. However, the other renewable resources do require improvements in the transmission grid generally, but the connectivity, at the same time, improves the reliability and consistency of solar and wind.

Both projects have characteristics that require

complementary facilities in the power system, both from various electrical devices at the distribution level but also at the generation level. A key issue is the variability of the generation and the need for energy storage, which must be provided after the transformation to electricity.

With our traditional generation resources, energy storage was easily available. It was done before we generated electricity: we had heaps of coal at power stations, or we had liquid fuels, or we had nuclear fuel bundles, or we had natural gas reserves. All of these were energy stored before transformation.

Hydropower plants -- storage hydropower, reservoirs -- can provide seasonal energy storage, but run-of-river doesn't offer much in the way of energy storage because the energy is available on a day-by-day basis. It has some very short-term storage that we can talk about.

Pumped storage -- and I've referred to this a little bit today -- or batteries can be used to provide dedicated energy storage not limited by hydrology, and can be configured to maximise financial returns available from the marketing of energy.

(Slide 24) So just to give a bit of a background on these sources. What I show in this diagram -- and this

is taken from the organisation IRENA, which shows the evolution in costs for renewable energy sources. I don't know if it's very clear, but in each column, or in each section, you have bioenergy, geothermal, hydropower, solar photovoltaic, which is most of what we get from solar, onshore and offshore wind, and what's called concentrating solar power.

It's interesting to look at each of these. I'll focus mainly on the solar and wind. It shows levelised cost of energy, which is a way of computing a value of energy which determines its capacity cost and all lifecycle costs involved in the generation of energy from that source, and it allows us to compare projects on a common basis.

The values here are world weighted averages. So there can be locally different conditions, but the trends over the time periods are clear.

We can see in the yellow in the middle of the figure -- I hope it's coming through as yellow for you -- that the cost of solar has declined dramatically over the ten-year period that was given here, and now we're producing solar at about 4.9 cents per kilowatt hour. One over, at the onshore wind, it's producing energy at a cost of about 3.3 cents per kilowatt hour.

Hydropower is the other key source in there. It has

12:28 a typical value of around 6, or just over 6 cents per kilowatt hour. But note that the cost of the solar and wind especially are declining with time, whereas hydropower continues to increase, because it's more affected by the general economic development, and it's a mature technology, so it doesn't have technological improvements that would tend to bring down costs.

The hydropower costs will vary depending on whether the plant is configured with a storage reservoir or as run-of-river. But generally, a storage reservoir hydropower would allow for much greater capture of the available energy, while increasing the benefits to the power system for firm energy and firm power. So we might see a greater value in one of those projects.

(Slide 25) For comparison -- if you just remember those numbers: 3.3, 4.9 and 6 -- if we look at thermal power plants, which is from the same reference and is showing the cost of thermal power plants from combined-cycle gas turbines, which is actually the most common thermal plant in the United States right now, coal, which is the steam plant using coal as a fuel, which is declining in many areas but still prevalent here, open-cycle gas turbine and oil-fired plant. The best cost of these is about 5.8 cents.

The big uprise to the right of these diagrams just

12:30 shows the sensitivity to the price of fuels. We've had, of course, some important upheavals in the latter years, because of Covid and geopolitical interruptions around the world.

But the floor value for the LCOE for thermal plants is about 5.8 cents, based on this information. Note these are just the costs for the supply of energy. The end-user cost is higher, once the additional system costs for transmission, distribution, energy storage and, importantly, ancillary services are included in the analysis.

So, having said now that we can produce solar at a lower cost than thermal, or likely even lower than hydro, why isn't it the only new generation being provided? Slide 26 illustrates part of the problem.

On a good day, on the left-hand side, the generation tracks the solar radiation through the daylight hours, even though there are still some minor fluctuations. However, on a poor day, the solar production varies significantly, with frequent large swings in output. This is the bits jumping up and down very rapidly. These figures come from a small solar installation on the roof of my house in southern Canada, so I can pick any day you'd like and I can come up with similar diagrams.

12:31 But a key thing is the variability within the day for solar, and the biggest limitation is that it doesn't have anything, of course, in the nighttime hours. So we need other generation sources to complement the solar, and a key requirement is fast-reacting power.

But one of the limitations we have is that even with those spikes up and down that you see on that figure, they're faster than what a typical hydro turbine can react to. The hydro turbine will have a certain amount of inertia, but its ability to change its load to follow these spikes, that ability is not there. It can change in minutes, not seconds. So there is a need for short-term storage using batteries to buffer some of this.

So to the extent that there is extended periods during the day when the power shuts off, that's when the spinning reserve and the hydropower can react and fill in those periods. But the nighttime storage is needed for the transfer of surplus from the daytime to the nighttime.

When it comes to run-of-river hydropower, it's important to realise that run-of-river hydro does not actually store energy. What we're able to do in a run-of-river is only defer the energy available in one part of the day to the latter part of the day, or

12:33 into the peaking period or nighttime period. It's an energy deferral, it's not an energy storage. For me, an energy storage is if I take part of that surplus available in the daytime and I can store it and draw from it later. Run-of-river doesn't do that.

The energy storage available or the energy deferral available for run-of-river can be unreliable because it depends on the watershed hydrology, so what is the flow rate of that day. And that tells me how much energy I can actually get in the peak period, if I'm able to do some moderate peaking.

So the system still requires something to do that. And that's where we come into the development of storage hydropower, which is specifically developed to provide dedicated storage for these systems; or the use of battery storage, which both deals with the short-term buffering of the very abrupt changes, but also for utility-scale uses for the daily energy storage.

(Slide 27) If I go off my rooftop, this is what you get in the state of California. I picked a typical day: this is June 5, 2024, just for information's sake. It shows how the other renewable energy sources are integrated in a large power system.

The gold colour is solar. That's what's produced on a typical day in California where we are today. And the

problem for the system operator is: how do I react to that? How do I fit that in and fill the evening?

Another thing to notice in here is the hydro line, which is the pale blue near the bottom. That draws from a whole series of hydropower energy resources within the state of California, but it has a very moderate peak between the day and the evening. This is largely due to a variety of hydrological, technical or environmental constraints that constrain how these projects can be used abruptly.

Most of the contribution to the evening peak, over there, is provided by the fact that on this particular day, it wasn't very windy during the day, but then the wind picked up in the evening, so there was some generation from there.

But the largest part, a discretionary availability to the power utility, is natural gas sources, which is the darker blue across the bottom, and the use of batteries, which is in the pale green colour.

California is a state that has recently developed over 10,000 MW of battery capacity dealing with this evening storage problem. Note that -- it's hard to see in the figure, but the battery actually gets used almost through the entire day, because it's also dealing with that short-term variability of the solar as it comes on

and off: clouds pass by and whatnot.

A similar picture to this occurs in any area of the world with large solar power inputs to the system. The system must have energy storage available to shift some of that daytime surplus into evening hours and it must also be able to contend with, in the case of run-of-river, the available hydrology.

So one of the keys for system planning is to increase the connectivity within the grid system. That filters some of the local variability with the solar and wind. But it's also improving regional interconnection so that the energy can be shared in a larger pool and we see that in this diagram as the imports, which are regional power exchanges between the power pools in the United States. In the case of India, they have regional exchanges between their power pools.

In the industry, there's a lot of talk about solar-hydro hybridisation. On slide 28, I put some items around this.

In particular, given that solar can produce energy at a very good price, what can we do with a hydropower system so we can turn that variable solar energy into a dispatchable energy that's well suited for the power system? That's what we mean by hydro-solar hybridisation.

So the hydropower in that case provides the ancillary benefits to support the solar, especially with respect to the inertia, the spinning reserve and the load following. The inertia has to do with making sure that you don't have very abrupt changes in the system. You want enough of what's called "inertia" so that small interruptions don't create a large disruption at the customer level.

However, these sorts of benefits -- spinning reserve, load falling, inertia -- they're only available if the hydropower station is actually running during the period when solar energy is being produced. The energy transfer for peaking is also possible, but the run-of-river hydropower is of course limited in this because of the amount of energy available for deferral.

Another difficulty is that the ability of run-of-river hydro to transfer energy during the wet season is effectively zero. So it doesn't have solar energy storage in wet season because the water is available to run as baseload. What that means is that the poor utility planner has to provide enough capability in the system so that they can provide that energy storage and energy transfer during the whole year.

If you've provided it for the wet season, because

your poor run-of-river hydropower project cannot provide it then, so you've provided it anyways. To the extent that you get some capability in the dry season, well, I've already got that capability in these other facilities, so I can't count that as a benefit of that run-of-river hydro: it's just an energy producer.

So solar generation is important, but it doesn't really fundamentally change how we're going to use our run-of-river hydro plants. They will be used in the power system because of their ability to generate baseload energy. They have some capability for peaking in the dry season, at least to some degree, with the energy available. But they don't completely replace other dedicated energy storages that are going to be needed for the other renewable energies.

The ancillary services that are provided with the energy peaking are limited to that available from the hydrology. So in some ways, the more important operation of a hydro coming even in the dry season may be to be available for provision of the ancillary services, more so than the peaking, because we've provided dedicated energy storage for the solar and the wind somewhere else. So the best thing you maybe get from this is the amount of the ancillary services, which comes down to frequency, inertia, spinning reserve and

the like and that's a very valuable resource within the system, and it doesn't diminish the value of the project; it just changes how it's considered in the system.

(Slide 29) So a very brief word, because how the plant is used in the system depends on its pondage. When I talk about, "Perhaps, with more solar, we're going to have a greater use of ancillary services for the plants", well, that comes into the need to have some pondage available. Because you need that pondage to be able to have minor fluctuations from the power system, which affects the plant, which then doesn't necessarily match directly with the flow available, so we get the pondage as the buffer.

So when we compute pondage, typically we're simply taking the energy available on the day, we're seeing if we can shift it to part of the day, and we can then calculate the volume. It's a fairly straightforward computation: it just determines the number of hours of dispatch and the volume we store.

When we deal with pondage for hydropower energy transfer with the solar, we can calculate it the same way, but then we would recall that we're not necessarily going to use it the same way. So we look for this ongoing transition. It's my own opinion, to be honest,

but I expect these run-of-river hydro plants to be used much more for the ancillary services role, or the buffering role, than they will be for the energy transfer role, which we're going to get from other services.

So whether it's used seasonally -- provision of some daily energy or storage, for some energy storage for peaking, or for the ancillary benefits -- the run-of-river hydros still have a benefit and they still have a value in the system; it's just that the value or the usage may change somewhat.

Now, the Indus Waters Treaty has special definitions for "Pondage", and I don't want to go further into the calculation of it here; this will be discussed by Dr Miles in the coming days.

But the role of the hydropower projects with wind and solar is going to be similar to what it's doing now: it's going to provide limited daily peaking seasonally, some ancillary services benefits, and the baseload operation in the wet season. Clearly it does not replace the need for dedicated energy storage for the other renewables.

(Slide 30) So I've covered a lot of different aspects and, to be honest, very superficially but I would like to summarise with a few observations and

then leave it to your own discretion if you want to know more. These are mainly observations, as opposed to conclusions.

(Slide 31) But I would say that recent cost trends show that there will be increasing development of variable renewable energy sources in the coming years. This is something that we can anticipate everywhere around the world.

We can also anticipate that hydropower will be developed selectively to capture the ancillary services benefits, and plants with limited flexibility will find it more difficult to compete with lower cost energy producers. And by "limited flexibility", I mean if you're heavily constrained by environmental constraints or physical constraints, it may affect how they work when they're compared against alternatives.

I would also anticipate that fewer thermal power producers will be available in most power systems as we go forward. You see this in North America, certainly; the province of Alberta just this week announced that they've finally shut their last coal-fired plant. So years ago I worked on design of coal-fired plants in Alberta, and now they're all gone. And they've replaced with a system of solar, wind and natural gas.

Wind and solar in particular require dedicated

energy storage, and to date this has involved large battery installations in many utilities and they're important because they're available year-round. So they don't have the seasonal differentiation that we get with some hydro.

Pumped storage is available or is planned in many countries, India included. They have a very ambitious programme of pumped storage here. It provides a useful combination of dedicated storage, the ability to consume surpluses, and the provision of ancillary services. And with pumped storage, you can provide ancillary services both on the pumping and the generation phase, so you get it on both parts, depending on the equipment you put in.

I've illustrated that power system load curves are variable and there is no single characteristic daily pattern of loading. As such, these curves are not used for the design of any individual power station, but they're rather used for the overall power system. You only deal with the curves as you add plants in combination with other plants to fulfil the whole load duration curve.

Pondage: you'll be hearing a lot more about pondage coming up, but it's a function of the energy available from the hydrology and the firm power available for the site and the three -- power, pondage and energy -- are

12:47 related, as will be discussed in more detail coming up. It is an important factor in the optimal use of a run-of-river hydropower project, but it doesn't replace other dedicated energy storages required in the power system.

That would conclude my prepared remarks.

THE CHAIRMAN: Thank you, Mr Rae, very much.

Let me just check with my colleagues and see if we have any questions.

Professor Buytaert.

(12.47 pm)

Questions from THE COURT

PROFESSOR BUYTAERT: Thank you very much, Mr Rae. This is a question that doesn't directly relate to what you presented here. But as you know, we've had the honour of visiting the Neelum-Jhelum plant, where we got a lot of details about its design and its operation.

But do you have any insights on how, for that particular plant, the pondage calculations were done, what factors were included to get to the number that was eventually built?

MR RAE: I don't have any insight on that myself. I wasn't directly involved with that plant, or involved at all with the plant. So I would have to defer that question to our colleagues in Pakistan.

12:48 I thought that question was asked during the visit, was it not?

SIR DANIEL: And I think it was one of the written questions, which we'll come back to.

PROFESSOR BUYTAERT: Okay, thank you.

MR RAE: Sorry.

PROFESSOR BUYTAERT: That's fine.

And then a second, broader question. So you very clearly sketched the evolution towards more renewables. How would the design of a plant and pondage in particular -- or how does that inform the calculation of pondage? Is there any established methodology to deal with the inevitable uncertainty of future changes in demand and variability?

MR RAE: I would say this is an area which is changing extremely rapidly within the industry, and there is a lot -- so I can't say that there's any one accepted methodology yet. I would say that it's changing so dynamically that almost month by month, people are coming up with different ideas of how to do this.

I'm involved with another project in Liberia, on a panel where we're trying to integrate the hydro and the solar in a hybrid way, where we mix in a mix of batteries along with the plants in order to work in an isolated way from any other thermal power resources.

12:50 I can say it's a difficult problem to do, because you're dealing with parameters or data which changes very quickly, and at the same time you're trying to match variable power with variable production, and the limitations of the hydro equipment. For example, a hydro turbine governor, we talk about them being able to react, but they can't react in milliseconds, which is what we're getting on the solar. So we have the other buffers involved.

Pondage does come out of that calculation. In that case it's further complicated because we're trying to match pondage with an eco-flow study, so that the outcomes of the eco-flow are matched into the optimisation of the hydro.

So it's a long way of saying I don't have an answer. I can say that it's evolving very quickly. But at the initial point, people have just been making what looks like reasonable provision for pondage and then seeing how it works if they start modelling the systems in more detail.

PROFESSOR BUYTAERT: Thank you.

THE CHAIRMAN: Mr Minear.

MR MINEAR: Thank you, Mr Rae. It was very helpful.

I have two questions. One just goes to my understanding of your presentation and talking about

12:51 turbine governors.

You said that the object here was to maintain constant speed despite variation in the flow rate. Does that mean you're effectively moderating the water pressure in the turbine?

MR RAE: What it does is: when the governor operates, if it senses a change in speed, it injects hydraulic oil into the system, which then gets amplified through pumps and the like, and it moves the wicket gates. So if there's a change in speed, it actually turns the wicket gates, which affects the amount of flow going through the turbine.

So anything to do with frequency or any other change occurring at the generator level produces an adjustment in the flow rate through the unit; and by changing the flow rate, you're adjusting to correct the speed.

MR MINEAR: I see. Thank you.

My other question goes to load curves, and the variability of load curves. You mentioned that there's seasonal variability; I imagine there's also variability depending on the developed character of a nation. For instance, I would think that the load curve for a developed country would be quite different from a developing country. Am I right in that?

MR RAE: You are correct in that. And at one time we used

12:52 to use these things for generation planning and these load-stacking arrangements, and what you find is that the slope of the curve, as you increase your level of development, this slope becomes flatter.

If you have a very -- one of the problems with the smaller, isolated grid systems is the curves are always very steep, because you were dealing with a small group. The plant shut down that night, so the load went to zero and the load disappeared.

So, yes, the shape depends on the level of development in the grid.

MR MINEAR: Just to explain why I'm asking these questions, I expect we'll talk about load curves with regard to India's approach to pondage, and I just want to make sure I have a good understanding of some of the variabilities in load curves.

My other question with regard to load curves: is there a change over time with regard to changes in the supply and demand of energy? For instance, in the United States we're using more electrical cars now, and so they are charged at night. I assume that would change the load curve; is that right?

MR RAE: Yes, electric cars are a very interesting thing, because the other thing that's happening and starting to emerge in the US is demand management. And demand

12:54 management allows you to take advantage of all those electric cars as one of your ways of doing energy storage. And if you can incentivise people to make their batteries available at a certain time of day for either storage or support, then you can start to mitigate the amount of other storage you need in the system.

So there's a whole part of power utility development which is around the demand management part of it which goes in there.

But with respect to the load curve, you're also correct, in that the time-of-use structure affects these curves. In most utilities, whether in Europe or North America, we have pricing structures which tend to favour certain times of day. The whole idea is to bring down the peak and bring up the base so that you get a more uniform load through the day. We do that through policy and through pricing. Ultimately it's going to be through more demand management, and active management.

The problem with demand management is: many people in the United States don't want to give up the freedom to say, "I can operate any way I like".

But in the ultimate demand management, the utility is able to control when you turn your hot-water heater on or off, and that sort of thing. Part of what we do

12:55 in trying to minimise the use of energy in peaks is to do exactly that sort of thing.

I do it at home. My hot-water heater doesn't come on at certain hours of the day because it costs me more money. But I use it in the morning, and by the time I come back to it the next morning, it's hot.

There's storage of energy in your hot-water heater in the form of heat. If we get more people's behaviour to change, that we're storing at different times, then we adjust the shape of the load curves with time.

MR MINEAR: One last question, again going to what I anticipate will be some questions for Dr Miles.

Is the shelf life of demand curves shortening over time? I assume that these load curves are often based on a 15- or 20- or 30-year time horizon.

MR RAE: (Slide 21) Well, you see on this figure they're done annually. But you can see on the figure there's a kind of an evolution from 2008 to 2015, or 2015/16. And unfortunately the curves go the opposite to what I said a minute ago. They should be becoming flatter; they're actually becoming steeper in this case. But that, I think, has got to do with how the system is evolving and the particular details here.

But we do them every year. And when you go into a generation planning process, you tend to pick a load

12:57 duration curve like this and use that as a basis. Because there's so many other imprecisions in the analysis that somehow the finer details don't really have that much effect.

MR MINEAR: Thank you, Mr Rae.

THE CHAIRMAN: Mr Rae, when Sir Daniel was introducing the speakers today, he noted that you were involved in the Baglihar proceeding. And in your presentation today, you talked a bit about: pondage needs to be computed to address the fluctuations in the water to deliver energy into the system.

I think I noted on Monday that Pakistan's method for calculating maximum pondage, as was argued in the Baglihar proceeding, seems to be different from the method that is being advocated for in this proceeding. Specifically, when I looked at Exhibit 9 to Pakistan's Memorial in the Baglihar proceeding, it seemed to see relevance in a seven-day mean minimum discharge, and in developing pondage based on lower inflows than the mean over the course of a week.

So my basic question is: why did Pakistan change its mind about how pondage should be calculated?

MR RAE: I think some of those details will be dealt with by Dr Miles. But I would reflect that some of what you see in those documents was driven a bit by what the Neutral

Expert was asking us for, so that in some sense we were trying to respond in some cases to questions; in other cases it appeared in the memorial or rejoinder.

But I would like to defer that question so that I can look more closely at what we said in Baglihar on this particular issue, and also to Dr Miles's presentation. I think he is planning to go through the history of these.

THE CHAIRMAN: Well, I welcome your reflecting on it, and I certainly welcome Dr Miles's presentation on Friday. I do hope that Dr Miles doesn't tell us that he wasn't involved in the Baglihar proceeding and therefore can't answer the question, because obviously we are interested in the answer.

MR RAE: If it's unclear, I am certainly happy to come back and help at some point, when I've reviewed the file on the particular issue.

THE CHAIRMAN: That's fine. Thank you very much.

So I think we have no further questions. But I do want to thank you very much, Mr Rae, for your presentation. It was very helpful to us. You have taken us exactly to the lunch hour, so well done in that regard as well.

Sir Daniel, I note that we are a little bit behind where we thought, but we also had a fair amount of time

built in as a contingency this afternoon, so it seems that we're not under any particular time pressure. And I'm wondering in that regard if we might reconvene at 2.15 rather than 2.00, to give us a little bit more time for a lunch break, unless you think that poses any difficulties.

SIR DANIEL: No, Mr Chairman, I think that would be fine from our perspective.

Just to give you a sense of how we were hoping to plan the rest of the day, immediately after the lunch break, Stephen Fietta will be coming on. And we expect that his submissions, barring too many questions, would take us up to the coffee break. And then Professor Webb just after the coffee break. And once again, her submissions, including some questions -- not a huge volume of questions -- should take us through to the end of day.

I wonder whether we might have a little bit of a latitude of 10-15 minutes at the end of the day to complete Professor Webb's submissions, so that we've got then a clear run on some of the paragraph 8 stuff tomorrow, or whether you want to have your 5.30 as a sharp guillotine for the end of the day.

THE CHAIRMAN: I think we want to keep 5.30 relatively sharp. So in light of what you've just said, I think we

come back at our normal time of 2 o'clock.

SIR DANIEL: An alternative may be just to have a sort of slightly shortened coffee break if we feel we need it. It may be that Stephen Fietta and Philippa Webb go rather shorter than our one-and-a-half-hour planning.

THE CHAIRMAN: Alright. Well, let's come back at 2.15 and see where we are as we move along in the afternoon, and we may have a shorter coffee break then.

SIR DANIEL: Thank you very much.

THE CHAIRMAN: Very good. See you at 2.15.

(1.02 pm)

(Adjourned until 2.15 pm)

(2.21 pm)

THE CHAIRMAN: Okay. With apologies for a few minutes of delay in reassembling, it's good to see everyone again.

I believe it's Mr Fietta who is up next in the order. So, Mr Fietta, whenever you're ready, please proceed.

MR FIETTA: Thank you, Mr Chairman, members of the Court. I hope you had a good lunch and we're now, I think, ready to go with the next presentation.

Could we load it up? Thank you.

Submissions on Baglihar and Kishenganga Systemic Interpretation Issues and Response to Question (a)

MR FIETTA: (Slide 1) So, Mr President, members of the

Court, my task today is to address you on the systemic interpretation issues under the Treaty and respond to your question (a) in Procedural Order No. 6, dated 6 July 2023.

You should have your latest party pack from me in your folders: I think it should be at tabs 7 and 8. You won't need to go to it for now, until I prompt you. I will take you to tab 8 when we get there, where we have another A3 presentation, but that will be some time into my address.

(Slide 2) Before I elaborate on Pakistan's substantive responses to question (a), I would like to make a number of high-level remarks by way of introduction and context to the Court's question. First, a recap, briefly, of the origins and context of question (a) in Procedural Order No. 6.

PO No. 6 was, of course, issued simultaneously with the Court's Award on Competence of the same date, and against the backdrop of Pakistan's previous submission of a statement on "Coordination between the Court of Arbitration and the Neutral Expert". In that statement, Pakistan had proposed a sequential exercise of functions between this Court and the parallel Neutral Expert proceeding as a means of effectively settling the parties' various differences and disputes with respect

to the Treaty, while at the same time ensuring coordination between the two fora and avoiding the risk of inconsistent decisions with respect to the same or related matters.

As the Court noted at the beginning of its analysis at paragraph 23 of PO No. 6:

"... the dispute presently before the Court arises in circumstances that have seen both the constitution of a Court of Arbitration and the appointment of a Neutral Expert."

The Court continued at paragraph 24, indicating that:

"It is ... apparent that the dispute placed before this Court and the matters referred to the Neutral Expert involve a significant degree of overlap ..."

Namely in respect of what the Court described in shorthand as "the KHEP/RHEP Design and Operation Issues"; in other words, issues concerning the application of the Treaty to the design of India's Kishenganga and Ratle HEPs.

"At the same time", the Court observed:

"... it is also apparent that the dispute placed before this Court includes the determination of certain general questions concerning the interpretation or application of the Treaty that are not before the

Neutral Expert."

This distinction drawn by the Court, between the general issues of interpretation and application of the Treaty that are only before this Court and the specific issues of application of the Treaty that are also before the Neutral Expert, was emphasised again by the Court at paragraph 32 of its order.

At paragraph 34 of its order, the Court therefore decided to organise the proceedings "in phases", starting with "a series of issues relating to the interpretation or application of the Treaty that are not part of the difference before the Neutral Expert".

So that's my first orientation of this question, which will be familiar, of course.

There is a second point, though, of context to your question (a): namely, of course, the dispute before you arises in circumstances where a previous Court of Arbitration, in the Kishenganga case, and a previous Neutral Expert, in the Baglihar case, have rendered decisions which are, in significant parts, mutually incompatible, and which potentially overlap with parts of the dispute presently before you.

Indeed, as we will see, those two mutually incompatible decisions have been cited by the parties' Indus Waters Commissioners during their discussions

since 2013 with respect to pondage and related issues now before you. Pakistan and its Commissioner have repeatedly cited the rulings of the Court in the 2013 Kishenganga awards, while India and its Commissioner have repeatedly cited the earlier 2007 determination of the Neutral Expert in the Baglihar case.

It's against this backdrop of, first, ongoing parallel proceedings before a Court and Neutral Expert and, second, inconsistent previous decisions of a Court and Neutral Expert that this Court has raised its question (a). That question essentially concerns the legal effect of the past decisions of dispute resolution bodies established pursuant to Article IX of the Treaty, both upon the parties to the Treaty and upon subsequent dispute resolution bodies.

(Slide 3) So at this point I can take you to my first slide, which is Procedural Order No. 6 and the terms of the question, which merit review before I continue. But I'm sure they are sufficiently familiar to the Court for me not to need to read them again into the record.

Those who are well versed in the Treaty and its jurisprudence may ask why this question is necessary. After all, as the Court itself noted in PO No. 6, and as I will explain, the Treaty provides answers to many

aspects of this question, and the jurisprudence, in the form of the Kishenganga decision, fills in the gaps.

But this question remains of critical importance, notwithstanding the text of the Treaty and notwithstanding the clear holdings of the Kishenganga Court. And it remains of critical importance today for three reasons.

First India continues to adopt positions which manifestly contradict the Treaty and its Article IX jurisprudence, including by refuting the binding and precedential nature of the awards in the Kishenganga case, and by asserting a quasi-precedential role for the earlier Baglihar expert determination, even in respect of Indian HEPs yet to be designed or constructed on the Western Rivers. And I will explain my "quasi" reference shortly, in connection with the quasi-precedential role given by India to Baglihar.

Second, India continues to rely on Baglihar while pursuing a parallel proceeding before another Neutral Expert, which, as PO6 observes, concerns certain design and operation questions that are essentially identical to some of the questions before this Court.

And third, this question is critical because, accordingly, it is inevitable that questions will arise in both proceedings concerning not only the legal status

14:29 of previous decisions of the Baglihar Expert and Kishenganga Court, but questions will also arise concerning the legal status of previous decisions of this Court.

Pakistan therefore welcomes the opportunity in this phase to lay to rest the important systemic issues of treaty interpretation and application raised by the Court's question (a).

This Court's decision on question (a) will confirm, once and for all, the extent to which the previous decisions of the Baglihar Neutral Expert and the Kishenganga Court of Arbitration are final and binding, both for the parties, for the Court of Arbitration and for the Neutral Expert. The Court's decision on question (a) will also confirm the binding nature of the decisions of this Court already made, and that it is yet to make, in this proceeding.

Already in its Award on Competence, this Court has made decisions falling within each of the four categories numbered (i) to (iv) in the Court's question (a): competence, matters of fact, interpretation of the Treaty and application of the Treaty in particular circumstances. The latter two categories of the Court's question are addressed in the dispositif of your Competence Award. Elsewhere in your

14:31 Competence Award, you addressed issue of fact critical to your competence; and you addressed issues of competence, of course.

So on my next slide (4), I show the dispositif. I apologise for the size of the text on this slide, but I think we don't need to go through the words as such.

It shows the Award on Competence dispositif with colouring, red and blue, and that's to help orientate how that decision fits in with the categories of decision that you identify in question (a). And in particular, in blue, your decision on competence, those two paragraphs, B and G, address issues of interpretation of the Treaty. And in red, there are a number of decisions on application of the Treaty in the particular factual circumstances of this case.

So this issue is already live as regards the consequences of your own decisions so far in this proceeding.

(Slide 5) I'd like to address for a few minutes the parties' ongoing differences with regard to the legal status and relevance of Baglihar and Kishenganga.

The parties' ongoing differences with regard to that issue are manifest. As subsections 2F.1 and 2F.2 of Pakistan's Memorial recount, the discussions between the PCIW, the Pakistani Commissioner, and the ICIW, the

14:32 Indian Commissioner, particularly with respect to India's designs of the KHEP and RHEP, provide a fulsome record of the ongoing disagreement between Pakistan and India about the legal relevance and precedential value of the Baglihar and Kishenganga decisions.

In short, first, Pakistan has consistently maintained that the partial and final awards in Kishenganga have binding and precedential effect under the Treaty, both as regards the KHEP and as regards all other Indian HEPs on the Western Rivers. This flows from the Court's exclusive role in deciding disputed questions related to systemic application or interpretation -- in this case it's systemic interpretation, of course -- of the Treaty.

The only exception to the precedential effect of the Kishenganga awards, which was noted by the Court itself in Kishenganga, is those Indian HEPs that were already in operation or already under construction, with no objection by Pakistan, as at 18 February 2013; in other words, those Indian HEPs that were already in operation or construction on the Western Rivers, without protest by Pakistan, as at the date of the Kishenganga partial award.

So that's Pakistan's approach to Kishenganga.

As regards Baglihar, Pakistan has consistently

14:34 maintained that the Baglihar determination of Maître Lafitte has no precedential status or value beyond the specific issues addressed in that determination as regards the Baglihar HEP. In other words, the Baglihar determination has no precedential status or value at all for other HEPs on the Western Rivers.

This is because, under the Treaty, Neutral Experts are not competent to decide disputed questions related to systemic interpretation or application. They're only competent to resolve a finite list of technical issues or disputes identified in the Treaty, and only in respect of the individual plant or plants at which such specific disputes have arisen that have been referred to the relevant Neutral Expert.

So the Neutral Expert in Baglihar was competent, under Annexure F of the Treaty, to resolve only the technical disputes between the parties about compliance of the Baglihar plant with Annex D, paragraphs 8(a) related to freeboard, 8(c) related to pondage, 8(e) related to gated spillways and 8(f) related to turbine intakes; nothing else.

In taking these positions with respect to Baglihar and Kishenganga, Pakistan has relied both on the applicable wording of the Treaty and the Court's clear,

14:35 binding and definitive holdings in Kishenganga about the contrasting legal status and scope of Court of Arbitration and Neutral Expert decisions under the Treaty. So when I address you on the detail of Pakistan's submission on question (a), I will spend some time on, first of all, the text of the Treaty, of course; and second, the relevant paragraphs in the Kishenganga awards, of which there are a number.

I've looked at Pakistan's consistent positions vis-à-vis Kishenganga and Baglihar. Turning to India, by contrast, India consistently dismisses the precedential value of the Kishenganga awards, including in connection with its designs for KHEP and RHEP. India also dismisses those passages in the Kishenganga partial award that are clear, definitive and binding as regards the legal status and scope of Court and Neutral Expert decisions. Instead, India continues to rely on the previous Baglihar Neutral Expert determination when attempting to justify its other HEP designs under the Treaty.

But one very important point to note -- and I will be taking you to the detail of this in connection with India's position -- is that India has never gone so far as asserting that the Baglihar determination is legally binding beyond the Baglihar plant, whether on a Court of

14:37 Arbitration or on the parties with respect to plants other than Baglihar. Instead, it asserts only that the determination is a "guideline" for other Indian HEPs on the Western Rivers, or "authoritative", but not -- explicitly not -- "binding". And we'll see that when I take you to the record.

This was what I meant earlier when I said that India's position asserts really that Baglihar only has quasi-precedential value.

This is telling for the purposes of your question (a), of course, because, first, even India has never gone so far as to say that Baglihar has general binding effect as a matter of law; and second, it appears that in India's view, especially following the unfavourable Kishenganga awards, in its view, there is no dispute resolution body with competence under the Treaty to render general and binding interpretative decisions.

This must be wrong. It's nonsensical for the effective resolution of disputes or the efficient, even, resolution of disputes even under the Treaty; and, as I will explain, it is also inimical to doctrines of res judicata and legal certainty and predictability. And that latter principle has been recognised both by the Baglihar Expert and by the Kishenganga Court as

14:39 essential to the dispute resolution process under the Treaty.

It's instructive to pause then here to recall in more precise terms the record of the Indus Waters Commission meetings between 2013 and 2015 -- so this is the meetings held after the Kishenganga awards -- and the associated correspondence between the parties shortly before they each commenced the dispute resolution procedures under Article IX that are ongoing today. That record demonstrates both the consistency of Pakistan's positions on issues raised by question (a) and the limits of India's own position, which was notably cautious with respect to the legal status of the Baglihar decision.

So I'm going to take you through four slides which summarise the positions of each party taken in the Indus Waters Commission meetings following the Kishenganga case.

(Slide 6) So first of all, we have the record of the 108th meeting of the Commission in March 2013, dated 24 September; that's P-70.

Here we have consistent statements by the Pakistan Commissioner as to the "conclusive" nature of the Kishenganga decision on the question of drawdown flushing; importantly here, both in respect of plant

14:40 specific disputes and "in general for all the future run-of-river HEPs on the Western Rivers".

And again, in relation to Baglihar, the Pakistani Commissioner stated that:

"Pakistan did not consider the interpretation provided by the [Neutral Expert] in Baglihar ... as a valid interpretation of the Treaty."

Here we see the Indian Commissioner taking a slightly more cautious position in respect of the decision on which India relies, namely Baglihar. He said that:

"... irrespective of the views held by the Pakistan Commissioner on the [Expert]'s interpretations in Baglihar ... Pondage is governed by the provisions of the Treaty."

So at that point there was no explicit reliance on Baglihar itself for the purposes of the other HEPs under discussion.

At the next meeting, on the next slide (7) -- or next but one, the 110th meeting (P-24) -- in 2014, the Pakistan Commissioner again adopted a consistent approach. He highlighted the binding quality of the Kishenganga Court decision, both in respect of plant-specific disputes and more generally on the Western Rivers. And he indicated that that extended to

14:41 the:
"... settled matter that India cannot drawdown the reservoir below [dead storage level] except in an unforeseen emergency -- not only [at] Kishenganga ... but in general for all the future run-of-river HEPs on the Western Rivers."
He dismissed the reasoning of the Neutral Expert on the substance in Baglihar and rejected its purported erga omnes effect by reference to the finding of the Kishenganga Court on that issue. And he stated that while the Baglihar Neutral Expert's decision was "final and binding in respect of the particular matter on which the decision [was] made", the Neutral Expert's interpretation on maximum pondage "could not be accepted as a guideline". And we'll see he picked up that term from India.
So in the next slide (8), you will see at the same meeting, the 110th meeting, the Indian Commissioner put forward as "guideline" the methodology proposed by the Baglihar Expert for calculating maximum pondage. He stated that:
"... an unambiguous neutral view is available in the Baglihar determination which can always serve as [a] guideline ... [in relation to] all run of the river [HEPs] on [the] Western Rivers ..."

14:43 And he noted that:
"Though the determination of pondage by the Neutral Expert was for Baglihar ..."
So he conceded that point:
"... the same can be considered as [again] a guideline for other projects of India on the Western Rivers."
Then at the next meeting, in February 2015, the PCIW again rejected any broader effect for the Baglihar decision. And we go to the next slide (9). And these positions were taken up in correspondence in 2015 and 2016. Here we have the PCIW's letters at P-26 and P-23, the first one in January 2015, reiterating that Baglihar:
"... had no general precedential value ... was only binding in the specific case before him but not in respect of [other] plants, while the decision of the Court of Arbitration, by contrast, would be binding generally for all such plants."
And addressing India's position in his following letter in February 2016, he said:
"India's reliance upon the Neutral Expert's decision on pondage with respect to ... Baglihar ... was 'invalid' because [following] Kishenganga ... '(t)he effect of a neutral expert's determination is restricted

14:44 to the elements of the design and operation of the specific ... plant considered by that Expert.'"
So the parties' position are clear, and the limits of the Indian position on this issue are clear, particularly in relation to Baglihar.
But despite the clarity of both the Treaty and the Kishenganga awards on these issues raised in question (a), a further final and definitive ruling is warranted so as to settle this ongoing dispute in relation to the legal and precedential status of the Baglihar and Kishenganga determinations.
Otherwise, as the Pakistani Commissioner indicated in his letter on 25 February 2016 -- I'll just finish the quote -- he said:
"[India's] positions on these and related issues, which Pakistan rejects, present legal questions of Treaty interpretation which will inevitably recur as India proceeds with other HEP projects on the Western Rivers."
That's Exhibit P-23.
Thank you for bearing with me, Mr Chairman.
THE CHAIRMAN: No, of course. Thank you, Mr Fietta.
So it may be you are going to get to this in due course, but while it's clear from the quotes and extracts you provided the parties' respective positions

14:45 on Baglihar, it's a little bit less clear to me what respective positions are on Kishenganga.
Earlier in your presentation, you said that India "dismisses" the Kishenganga Court's decision. And I'm wondering: by that, do you mean it basically doesn't talk about it, or do you mean that they've affirmatively said it does not have a binding quality with respect to decisions that are to be taken thereafter with respect to plants?
MR FIETTA: Thank you for the question.
We will see India's position in a little more detail as we go to the record in the Kishenganga proceeding, which of course looked at this issue, and even on the request for interpretation of that decision, of the partial award.
India's position certainly is that -- it does not repeatedly and expressly dismiss the precedential value of the Kishenganga award. One would assume that that may be because it is aware of the weakness of its legal position. It's clear though that its position on the Baglihar determination completely disregards any precedential value for the Kishenganga award. Because if the Kishenganga award had general precedential value and was dispositive, for example, on the question of drawdown flushing, then India would not be able to adopt

14:47 the position it does, in reliance still on Baglihar, in connection with that issue.

We will see though the precise wording, as far as India is willing to go in connection with that issue, when we look at the record from the Kishenganga case.

THE CHAIRMAN: Well, I'm interested in what's happening post-Kishenganga. Whatever they might have said before the Kishenganga Court isn't directly speaking to the issue of India's posture after the Court of Arbitration issues its decision.

From what you've said so far, it sounds as though they have never, in your reading of the record, expressly said that the Kishenganga Court's determination/judgment/award does not have precedential effect; it's more in the nature of simply not giving it much attention in the course of the interactions between the parties. Is that a correct understanding?

MR FIETTA: Well, it is clearly -- I think Pakistan's position has been very clear as regards the precedential effect of Kishenganga. And in those meetings, India has certainly never agreed in any way with that position.

I will check one last time for you before next week. My understanding of the record is though -- because I don't want to make a definitive statement -- but my clear understanding of the record on that point is that

14:49 India has never made a legal statement in those terms denying the precedential effect of the Kishenganga determinations under the Treaty. But I will check, as a matter of fact, on that point.

I think -- and this is the tenor of my submission -- that India's position is much more nuanced and carefully framed so as to avoid expressly making out that position. But I will confirm it, if needed, next week.

One final point before I get to the detail of question (a). Pakistan's consistent position, which aligns with the position of the Court in Kishenganga about the respective legal and precedential value of Court of Arbitration and Neutral Expert decisions, Pakistan's position makes eminent sense: from a skill-set, from a competence and from a policy perspective.

Courts of Arbitration, as we know, are by definition multidisciplinary and comprised of at least five -- otherwise seven, as in Kishenganga -- individuals, with a mix of international law and engineering expertise. They are inherently qualified to resolve questions of Treaty interpretation and application on both a plant-specific and systemic, generic basis.

By contrast, any Neutral Expert is a single individual who must be a highly qualified engineer. But

14:50 he or she need not be -- and invariably will not be -- a lawyer, at least not a lawyer skilled in the interpretation and application of treaties.

As such, while a Neutral Expert may have to engage in some Treaty interpretation in order to resolve a technical dispute with relation to a specific HEP under Annexure F, he or she cannot do so on a systemic basis, or in any way that is generally binding on the parties and other dispute resolution bodies under the Treaty. The decision only goes so far as the particular HEP concerned.

Unfortunately, the Neutral Expert in the Baglihar case, Maître Lafitte, did take it upon himself to engage in a lengthy and in some ways questionable Treaty interpretation exercise. He extended that analysis of international law under the Vienna Convention, et cetera, far beyond the technical paragraphs at issue under Annexure D, into putative interpretations of the Treaty's preamble, its object and purpose, of Article III, of Article XI, of Article XII. And he included in his determination, as you will know, a seven-page section, section 5.1, specifically on the topic of Treaty interpretation; not in relation to Annexure D at all, and the specific technical issues that he was concerned with, but much more broadly in

14:52 connection with the issues that I described.

The seven-member Court of Arbitration in Kishenganga unanimously confirmed later that his approach was "misplaced" and wrong in law. Among other errors, he strayed into purporting to interpret the Treaty provisions that were plainly not within his competence. He took a superficial view of the Treaty's object and purpose and the circumstances of its conclusion. And in passages that were explicitly rejected by the Court of Arbitration, he determined that any interpretation of Annexure D must take into account the state-of-the-art design and the best and latest practices in the field of construction and operation of hydroelectric plants.

As we've seen, India has repeatedly cited that determination as a "guideline", including in connection with India's KHEP and RHEP, notwithstanding the fact that it was unanimously rejected by the Kishenganga Court as being both inconsistent with a proper interpretation of the Treaty and of no precedential value beyond the Baglihar plant. As we'll explain, the Kishenganga Court's holdings in that regard, unlike those of the Baglihar Neutral Expert, are of general binding and otherwise controlling effect.

So the distinction between the competencies of Courts of Arbitration and Neutral Experts also serves to

avoid inconsistent decisions being made with respect to the generic matters of Treaty interpretation or application.

This isn't to say that some specific matters, such as those of a technical nature related to the design of a particular HEP, it's not to say that those issues cannot be before both a Court and a Neutral Expert at the same time, where the necessary mutual consent of the parties exists. This much is acknowledged in your own Procedural Order No. 6. But as the Court continued in its PO6 after paragraph 28, you said:

"In such circumstances, there is a general duty ... to exercise ... competence in such a manner as to facilitate the actual resolution of the Parties' dispute and to avoid the risks of duplicative proceedings or conflicting decisions."

And you then said that a general duty of "mutual respect and comity" applies.

And as the Baglihar determination and Kishenganga awards show, the fact that a Neutral Expert has reached one conclusion on interpretation of the Treaty with respect to a specific plant does not prevent a Court of Arbitration from later reaching a different conclusion with respect to the general interpretation or application of the Treaty. In such a situation, it is

the interpretation of the Court, not the earlier interpretation of the Neutral Expert, which is binding for all future Indian plants on the Western Rivers.

So I now turn to the detail of Pakistan's response to question (a).

The question, as we will see, is on the screen again. We are on slide 10. It requires consideration of the binding or other controlling effects of four types of Court of Arbitration decision, numbered (i) to (iv) there; and four types of Neutral Expert decision too, the same categories. And it requires analysis of those four types of decision across the two different fora from four perspectives, and that's the perspectives (a) to (d): the parties, the present proceedings, the present proceedings before the Neutral Expert and future proceedings.

So there's quite a few -- if you unpackage it -- quite a few questions there. And I'm not going to spend lots of time addressing all of them, because there is some overlap, but I am going to answer all of them.

But for your benefit -- and it's something that you don't need to read in detail now, but I have prepared for you a matrix at the back of your handout; I think it's tab 8. There's two matrices summarising Pakistan's answers on each of the 16 questions, effectively, that

you have posed in relation to, first of all, Courts of Arbitration, the binding effect of Court of Arbitration decisions; and secondly, the binding effect, or not, of Neutral Expert decisions.

I'm going to take you through the reasoning set out in each of those matrices and I'll take you through each of the Treaty provisions and each of the decisions in paragraphs that we cite to there. And there's a simple colour code, just for your ease of reference later, where the green indicates binding decisions, the blue indicates binding decisions with respect to matters within the competence of a Neutral Expert and the red indicates non-binding decisions.

I'm going to take you through our reasoning as reflected and summarised in those matrices. But I just wanted to make sure we answered every one of the 32 questions implied in question (a).

So the remainder of my presentation will address question (a) with respect to, first, the decisions of a Court of Arbitration, and that's matrix 1; and second, decisions of a Neutral Expert, that's matrix 2. By the conclusion of my presentation, I will have led you through all of the salient elements of each of those matrices and I'll make some concluding remarks.

(Slide 11) So first of all, I'm going to address the

"binding or otherwise controlling effect" of decisions of a Court of Arbitration.

Examining first then these Court of Arbitration decisions. As explained in our Memorial at paragraphs 8.62 to 8.69, the binding character on the parties of the decisions of a Court of Arbitration is explicitly confirmed by the relevant paragraphs of Annexure G. And that is my next slide (12), paragraphs 16 and 23.

Paragraph 23 makes clear that any award rendered by a Court of Arbitration in accordance with the provisions of Annexure G in regard to a dispute is "final and binding on the Parties with respect to that dispute".

Now, what is a "dispute"? Under Article IX of the Treaty, a "dispute" can arise out of:

"Any question ... concerning the interpretation or application of this Treaty or the existence of any fact which, if established, might constitute a breach of this Treaty ..."

So on the face of Article IX, differences of questions of fact, questions of interpretation, application of the Treaty and of course competence are all capable of forming "disputes" for the purposes of paragraph 23. Decisions of a Court of Arbitration on all of those matters are therefore final and binding on

15:00 the parties.

As for decisions relating to competence, paragraph 16 of Annexure G there provides that:

"Subject to the provisions of this Treaty and except as the parties may otherwise agree, the Court shall decide all questions relating to its competence ..."

Such decisions are made in the form of awards, like this Court's Award on Competence dated 23 July last year, and are thus equally binding on the parties by virtue of paragraph 23.

As paragraph 23 makes clear, the formal requirements of any "award" are simple: it must be in writing; it must be accompanied by a statement of reasons; signed by four or more members of the Court; and delivered by the Court to each party in signed form.

So these paragraphs are determinative as regards those parts of question (a) concerning the parties in relation to Courts of Arbitration. And this plainly applies to any form of award, including an award on competence, a partial award, a final award, like those in Kishenganga, or any other award "on the issues in dispute". And in fact, at paragraphs 123 and 189 of last year's Competence Award, you explicitly confirmed the binding nature of the Kishenganga awards on India and Pakistan as parties.

15:01 The binding quality of the Court's decisions more generally, including on subsequent Courts of Arbitration or Neutral Expert proceedings under the Treaty, follows from a combination of the Court's broad competence to resolve disputes under Article IX and paragraph 23 of Annexure G and the res judicata effect of its decisions as a matter of basic international law. As I'll explain shortly, this was explicitly confirmed by the Court -- and tacitly acknowledged even by India -- in the Kishenganga case.

So this was again a tacit reference -- to go to your question -- by India as regards the role of res judicata. But again, it was a tacit position; it wasn't explicit, as we will see.

As a matter of plain meaning and object and purpose, an award that's "final and binding" on the parties, and which thus finally "resolves" a dispute under the Treaty, must also be binding on other dispute resolution mechanisms which may be seised of disputes or other differences under the same Treaty, whether in parallel or in future. Otherwise, the final and binding nature of a Court's award, and the ability of a Court to resolve the dispute, would be critically undermined, because the parties could circumvent an award simply by engaging in fresh dispute resolution procedures under

15:03 Article IX.

This is the crux of res judicata. That doctrine, as Pakistan says in its Memorial at paragraph 8.70, "precludes re-litigation of the same subject matter between the same parties in later proceedings".

Res judicata is a general principle of law -- and this is my next slide (13) -- a general principle of law applicable throughout international judicial proceedings.

THE CHAIRMAN: Mr Fietta, before you move on, if you could go back to the prior slide (12). And if you plan to address this later on, that's fine. But I'm wondering if you could say a few words about what constitutes the award.

The award could be the entire decision that's been rendered, from paragraph 1 through to the dispositif; it could be just the dispositif. And this language at paragraph 23 that says, "The Award shall be accompanied by a statement of reasons" might be read to mean that the award is something like the dispositif, but not the reasons. And this seems relevant when we're then thinking about the res judicata effect of the award.

So if you have thoughts in that regard, I'd welcome them.

MR FIETTA: Yes.

15:04 So the award as a whole, is the easy part, I guess, so long as it's rendered in accordance with the provisions of the annexure, "shall be final and binding". It's final and binding "with respect to [the] dispute". And the dispute can extend to disputes related to issues of fact, law, application of law and the Treaty to specific plants.

So to the extent that the provisions in the award resolve the dispute, we say they are final and binding on the parties. That will extend beyond the dispositif of the award, into other relevant holdings of the Court that underpin the dispositif in the award and that resolve the dispute, all of the disputed issues between the parties, whether they be issues of fact, law or application.

I am coming on to this also in connection with the principle of res judicata, because there is a debate within international law as to the extent of res judicata: does it extend beyond the pure wording of the dispositif of a decision? And I will be taking you to some jurisprudence which indicates that does.

But our starting point is the wording of the Treaty, and that the "final and binding" nature of an award covers all of the issues in dispute.

The point on res judicata is more explicit in saying

15:06 that to the extent necessary to understand the reasoning behind the decision in the dispositif, then other parts of an award can be treated as res judicata, and I'll be taking you to the recent Colombia v Nicaragua decision in relation to that issue.

THE CHAIRMAN: So you don't see any significance in the wording here in paragraph 23 that, "The Award shall be accompanied by a statement of reasons", rather than saying, "The Award shall include a statement of reasons"?

MR FIETTA: No. I think it would be overly artificial to indicate or to expect that an award under paragraph 23, that the award proper would be limited to the two paragraphs that might appear in the dispositif, and that the rest is simply a statement of reasons which has no legal impact and no binding effect between the parties. And I think that certainly would be inconsistent with the jurisprudence on res judicata, which does indicate that the underlying reasons themselves can form part of the res judicata. Because otherwise, the final and binding effect of the decision itself will be put in jeopardy.

So, for example, in your Award on Competence you reached a number of findings on fact in your underlying analysis: as regards the constitution of the Court, for

15:07 example. Your dispositif said that was in accordance with the Treaty. But the factual findings as to the way in which the Court had been constituted were also final and binding: they could not be challenged or reopened by another attempt to refer the dispute to a third party under Article IX. If a party could have reopened those findings of fact in the main body of your Award on Competence, then the res judicata of your decision on competence would be fatally undermined, potentially.

THE CHAIRMAN: Thank you. And again, you may be getting to this in due course. But I take it what you're saying is: it's not just the dispositif; it does include aspects of the reasoning underlying what is determined in the dispositif. There may be other aspects of the award that are not directly germane to the outcome that might not have res judicata effect. Is that the way you're seeing it?

MR FIETTA: That's correct. Yes, that is correct.

(Slide 13) So res judicata is a general principle of law, as I was saying, applicable throughout international judicial proceedings; confirmed by Bin Cheng, of course, in his seminal work (PLA-95), which will be familiar to some members of the Court, which appears on my slide. And he cites the no less seminal Trail Smelter award as one of many which confirm

15:09 the nature of the principle of res judicata.

The award, back in 1941, indicated:

"'That the sanction of res judicata attaches to a final decision of an international tribunal is an essential and settled rule of international law.

'If it is true that international relations based on law and justice require arbitral or judicial adjudication of international disputes, it is equally true that such adjudication must, in principle, remain unchallenged if it is to be effective to that end.'"

And even before Trail Smelter, of course, there were many other decisions that Trail Smelter cited, from previous jurisprudence from the Permanent Court of International Justice and otherwise.

So status of the principle in law is unshakable and essentially unchallenged.

(Slide 14) As to the meaning of the doctrine of res judicata, Bin Cheng cites back to the Société commercial de Belgique case back in 1939:

"'... [it] means nothing else than recognition of the fact that the terms of that award are definitive and obligatory.'"

And in its pure sense, to go to your question, res judicata in its purest sense applies to the operative clause. But it certainly does not end at the

15:10 operative clause, as I was saying, or the dispositif.

(Slide 15) And the ICJ looked at this point quite recently in the Delimitation of the Continental Shelf beyond 200 miles -- that's PLA-108, and the relevant paragraphs are on your slide -- and it did so in order to ascertain the meaning and scope of res judicata in the dispositif. It said (paragraph 59) that:

"... it is also necessary to ascertain the content of the decision, the finality of which is to be guaranteed."

And the court continued by observing, in the highlighted text (paragraph 61):

"... in order to ascertain what is covered by res judicata, it may be necessary to determine the meaning of the operative clause by reference to the reasoning set out in the judgment in question."

And of course, in that case the court was faced with such a situation, because Nicaragua and Colombia disagreed fundamentally on the operative clause of the earlier decision in the case between them in 2012. And therefore the court analysed the underlying rationale of that decision in the main body of the 2012 judgment in order to assess whether or not the question before them in the new case was res judicata or not. And it decided, having looked at the underlying rationale of

15:12 the decision in 2012, that the new case was not res judicata.

(Slide 16) The ICJ has also explained the basic rationale for res judicata. In the Bosnian Genocide case, for example, PLA-109 (paragraph 116), the court said:

"The Court's function, according to Article 38 of its Statute, is to 'decide', that is, to bring to an end, 'such disputes as are submitted to it' ... Depriving a litigant of the benefit of a judgment it has already obtained must in general be seen as a breach of the principles governing the legal settlement of disputes."

The key word with reference to the statute there was "decide". For your purpose, the key word is "resolve", under the Indus Waters Treaty. And we say that the task of resolving a dispute is directly analogous -- it's the same -- as the task of deciding a dispute at the ICJ under its statute.

Notably for purposes of question (a), in the following paragraph, paragraph 117, the ICJ confirmed that the res judicata doctrine applied to questions of competence or jurisdiction, just as it applied to questions of merit. (Pause)

THE CHAIRMAN: Mr Fietta, since you've paused, I'll jump in.

15:13 And this question may be one that's better addressed by Professor Tanzi on Friday when he takes to the podium.

But I'm curious if there are examples where the text of a judgment or an award are cross-referenced in a dispositif in a way that that to some extent addresses this issue that we've been talking about, where it's quite clear from the dispositif itself that there's particular reasoning that is pertinent to that conclusion in the dispositif. If there are such examples, I'd welcome Pakistan informing the Court about them.

MR FIETTA: Yes, indeed. Professor Tanzi will be addressing you on the narrative dispositif, and that would very much encapsulate such a technique, potentially, in the drafting of a dispositif. So I'm sure we will come back to that later in the week.

THE CHAIRMAN: Thank you.

MR FIETTA: In short, the recognition of judgments or awards of competent international courts and tribunals as being "definitive and obligatory", in the words of the PCIJ, and thus res judicata, is essential for the effectiveness of adjudication and consequently for the stability of international legal relations. It is no less essential to the system of adjudication under the Indus Waters Treaty.

15:15 As the Kishenganga Court acknowledged in its partial award, "stability and predictability ... are vitally important for the effective utilization of rights accorded to each Party by the Treaty". And that's PLA-3, paragraph 457.

Related doctrines of good faith are also relevant. It's difficult to see how a Court of Arbitration or a Neutral Expert could in good faith disregard the final and binding decisions contained in the award of a previous Court of Arbitration.

Pakistan's submission on the binding quality of the Court's decisions, both in respect of plant-specific disputes and more generally with respect to Indian HEPs on the Western Rivers, is confirmed by a close examination of the Kishenganga case. So we'll turn to that now.

In that case, the Court addressed two threshold questions: namely, the legality under the Treaty of a proposed diversion of the Kishenganga; and secondly, the permissibility under the Treaty of drawdown flushing at the Indian HEPs on the Western Rivers.

On my next slide, slide 17, in its partial award and final award in relation to that first question, diversion, the Court rejected the plant-specific declaration requested by Pakistan and proceeded to make

15:16 a series of decisions relating to the application of the Treaty to the specific circumstances of the KHEP. And they are summarised on the slide here at paragraph A of the dispositif.

In relation to the second question -- that is, drawdown flushing -- the Court rendered a general interpretative declaration, and it's clearly on its face a general declaration.

We can go to the next slide (18). That general declaration indicated that "the Treaty does not permit reduction below Dead Storage Level of the water level in the reservoirs", except in cases of unforeseen emergency, of course. And the Court proceeded to hold that "the accumulation of sediment in the reservoir of a run-of-river plant on the Western Rivers" did not constitute such an emergency.

So that's dispositifs B(1) and (2). And the Court then proceeded at dispositif B(3) to issue a plant-specific instruction to India on the back of those generic holdings, namely not to employ drawdown flushing at the reservoir of the KHEP to an extent that would entail depletion of the reservoir below dead storage level.

(Slide 19) The Court emphasised earlier in the partial award that the scope of the second question

about drawdown flushing was general in nature, and that its rulings would apply to future HEPs on the Western Rivers. And you can see that in this quotation from paragraph 466, for example, where the Court said that:

"The question facing the Court is therefore whether the Treaty prohibits drawdown flushing by India at the KHEP and at other, future Run-of-River Plants on the Western Rivers."

The generic nature of the Court's decision on the legality of drawdown flushing was emphasised repeatedly in the Court's subsequent decision on the request for clarification or interpretation; that's PLA-21. Notably, this request was brought by India in the Kishenganga case.

(Slide 21) Paragraph 25 of the decision on the request indicated that:

"With respect to the scope of the question submitted and discussed by the Parties, this Court considers it to be beyond doubt that the permissibility of drawdown flushing was put before the Court as a general issue."

In other words, it had been part of the dispute, and the parties had made submissions in relation to that general dispute.

And at paragraph 27, the next slide (22):

"Faced in the Second Dispute with a question of

interpretation centred on the general meaning and application of a particular provision ... and its relationship with the Treaty as a whole, the Court's answer to it was general as well and not limited to the KHEP ... The inclusion of such an express limitation ..."

Well, I'll come to that point actually, the express limitation point, in a second.

India itself acknowledged the generic nature of the Court's decision in Kishenganga as regards the legality of drawdown flushing. As we can see on my next slide (23), in its request for clarification or interpretation of the partial award on 18 May 2013 (P-548), India explained that its application was motivated by the fact that the partial award had set out a general prohibition against the use of "drawdown flushing for sediment control in all future Run-of-River plants". This is from India's own application.

India thus requested clarification or interpretation in an attempt to preserve an ability to reduce water levels below dead storage during drawdown flushing at other Western Rivers sites in the future. That's clear from paragraph 3 of the Indian application. And that's perhaps, on the record that we have, the clearest indication that at least before the decision on the

request for clarification/interpretation, India did acknowledge the generic binding effect of the Court's findings. It's only after it lost on this application that it adopted a different position and stepped away from that acknowledgement of the binding effect of the Kishenganga award beyond the KHEP.

(Slide 24) As we have seen, the Court was unmoved by India's request for interpretation and clarification. At paragraph 34 of its decision on India's request, the Court emphasised again, as it had in its underlying partial award, the generic nature of its prohibition against drawdown flushing at Indian HEPs on the Western Rivers. It held that the prohibition constituted a "regulatory consideration" which formed "part of the Treaty's essential bargain", and which would bind India when assessing sites for all future HEPs.

So this is a point to which Sir Daniel took you, I think, yesterday: the fact that this "essential bargain" is one of the regulatory constraints on the construction of HEPs and design of HEPs under the Treaty, and it may be that it does preclude India from building HEPs at certain locations, and instead having to choose others where drawdown flushing is not required. But the prohibition under the Treaty is clear, and the generic effect of the Kishenganga's

award's decision on that prohibition was emphasised again in this decision on clarification/interpretation.

It's notable that these passages refer throughout to the binding nature of the Court's decision across plants as a whole. In effect, therefore, the Court's decision was to be binding both as regards the parties and as regards future Neutral Expert or Court proceedings. Otherwise, the Court's operative decision with respect to the prohibition against drawdown flushing under the Treaty would have been deprived of any res judicata effect.

Turning back to the partial award dispositif, I'm going to take you to a question of exception and limitation, which is a separate part of your question (a): to what extent are there exceptions or limitations to the final and binding effect of decisions of a Court of Arbitration? And the Kishenganga partial award is illustrative on this point.

(Slide 25) It concerns the fourth paragraph of the dispositif in the Court's award (PLA-3), highlighted here. And it's an exception to the general binding effect of the Kishenganga Court's rulings with respect to the issues before them, namely that those rulings would not apply to Indian HEPs on the Western Rivers that were "in operation at date of issuance of this

15:24 Partial Award". So the prohibition on drawdown flushing would not apply to Indian HEPs on the Western Rivers that were in operation already on the date of issuance of this partial award, or that were already under construction as at that date, "the design of which, having been duly communicated by India ... had not been objected to by Pakistan" under Annexure D.

This was the first of two limitations or exceptions to the res judicata nature of the Court's awards in Kishenganga. And this important proviso to the systemic interpretation on drawdown flushing was sound from a legal perspective, not least in recognising the res judicata effect of the earlier Baglihar decision for the Baglihar HEP. It was also essential from a practical perspective, because any retrospective application of the decision would have had enormous adverse consequences for India, of course, with respect to other HEPs already in operation by the time of the Kishenganga award.

So this proviso at paragraph B(4) goes directly to your question about exceptions and limitations. That is, Courts of Arbitration, in rendering systemic interpretations, should be mindful of the res judicata effect of previous final and binding decisions, including of Neutral Experts, with respect to specific

15:26 HEPs, and they should avoid casting doubt retrospectively on those Indian run-of-river plants that are already in operation on the Western Rivers.

THE CHAIRMAN: It may be a fine point Mr Fietta, but is this really an exception to res judicata effect, as opposed to the Court reaching a judgment that excluded certain matters, and the res judicata then is that it reaches some matters and not others?

MR FIETTA: Yes, I think there is a discussion to be had around that issue. As regards the generic interpretation and the final and binding effect of the drawdown flushing holding, it was an exception; but it was an explicit exception or limitation to that generic holding, which itself formed part of the dispositif, and therefore is res judicata. So, yes, I take the point.

Of course, paragraph B(4) was only required because the Court's interpretative holdings under B(1) and B(2) that we saw earlier were otherwise of general application. And the Court recognised this in its subsequent decision on clarification or interpretation in the passage that we saw a moment ago. (Pause)

(Slide 26) Yes, and then there's reference to B(4) that we just looked at. This was in the subsequent decision on interpretation (PLA-21):

"The inclusion of such an express limitation makes

15:28 clear that -- except where so limited -- the Court's Decision applies to Run-of-River Plants generally."

There's some more context about that aspect of the decision at paragraph 523 (PLA-3), on my next slide (27):

"It would not be in accordance with the governing principles enunciated in this Partial Award for the interpretation of the Treaty, and its application, to cast doubt retrospectively on ... Plants already in operation ..."

So you can see the rationale for that limitation there.

I've spent some time addressing the question of permissibility of drawdown flushing at Indian HEPs because it's the most notable exercise, perhaps, by the Kishenganga Court of a generic interpretative exercise and the exercise of that competence under the Treaty. Moreover, that general interpretative competence was exercised against the backdrop of a contrary decision of the Neutral Expert, of course, and in a context where India itself acknowledged the general interpretative competence of a Court of Arbitration in the context of its request for interpretation, as compared with the plant-specific competence of a Neutral Expert on the same question.

15:29 So as such, the history related to the question of drawdown flushing is of great assistance, we say, to the Court's question (a), both as regards the general interpretative competence exercised by the Court under the Treaty in that case and as regards the more limited interpretative competence of Neutral Experts, to which I will return shortly.

Now, aside from the issue of drawdown flushing, the Kishenganga Court made a series of other important and binding interpretative decisions.

(Slide 28) These included, first of all, with respect to the duty of Courts of Arbitration to interpret and apply the Treaty in light of rules and principles of international law; a duty which would be, of course, both unrealistic and inappropriate for a Neutral Expert engineer when deciding a plant-specific issue. That's at paragraph 452. And therefore the Court said it was incumbent on it to interpret and apply the Treaty in light of those customary international law principles.

This is obviously with reference also to paragraph 29 of Annexure G, of which there is no equivalent, of course, in Annexure F, relating to Neutral Experts.

(Slide 29) The Court also made definitive findings

15:31 in relation to the let-flow obligation and the division of the six main watercourses under the Treaty as a "defining characteristic of the Treaty", and in that context that:

"... Pakistan is given priority in the use of the waters of the Western Rivers, just as India has priority in the use of ... the Eastern Rivers."

(Slide 30) And importantly, given the Court's question (a), it made an interpretative holding that only awards of a Court of Arbitration have general binding effect under the Treaty, in contrast with the technical plant-specific determinations of a Neutral Expert. That's paragraph 470. And I think this is a good example of where the rationale underpinning the Court's generic holding on drawdown flushing and its explicit overruling, effectively, moving forward, of the Baglihar decision is explained through the reasoning of the award and forms a part, we would say, of the res judicata of the award.

(Slide 31) The Kishenganga final award also reiterated the pertinence of the principle of res judicata. You'll recall the Court was devoted largely to setting minimum flows in its final award at the Kishenganga/Neelum River, to be released during the operation of the KHEP.

15:32 Between paragraphs 117 and 119 of the final award, the Court noted the importance of res judicata under the Treaty in ensuring "stability and predictability". However, the Court went on to say that future flows upstream may come to differ significantly from the historic record as a result of factors beyond the control of either party. The Court therefore proactively put in place a mechanism for future reconsideration of its decision on the minimum flow in the event that, as the Court put it, "its reasoning no longer accords with reality along the Kishenganga/Neelum".

This was perhaps a second limitation or exception identified by the Court to the otherwise res judicata effect of its awards. The first limitation or exception, as we saw before, prevented retroactive application, whether it's formally an exception to res judicata or actually part of the res judicata and a limitation on the general binding effect. That was the first exception or limitation: it would not be retroactive. And secondly, here, this is a more forward-looking limitation or exception, designed to allow for an amended application of the Treaty in the event of uncontrollable but significant changes in circumstances.

15:34 Now, unsurprisingly, given the overriding importance of stability and predictability under the Treaty, and the otherwise binding nature of Court of Arbitration decisions, the Court set a high threshold for any such reconsideration in the future: "reasoning [that] no longer accords with reality". So the reasoning of the decision must no longer really make sense in the new circumstances.

Although it's difficult to anticipate exactly when such a threshold might be met, one can imagine that climate change might present a situation in which an interpretation or application of the Treaty could be superseded by subsequent events, as indicated explicitly by paragraphs 117 and 118 of the final award in Kishenganga.

So that takes me to the end of my submissions on the Court. I'm then going to move on to the Neutral Expert, on which I will be briefer because a number of the points I made will apply equally to the Neutral Expert.

THE CHAIRMAN: Thank you, Mr Fietta.

I do have a question for you on the slide that was just up on the screen (31). And my question is whether this concept of the res judicata effect not extending beyond the life of the award in certain circumstances is a broader potential exception than what is indicated

15:35 here.

In other words, certainly in this particular context, the Court said, "We think that there may be reasons why our award may need to be changed, and we're going to put a time limit on that". But is it also possible that there's a recognition here that res judicata should not apply in other circumstances, where the reasoning of the award does not accord with reality over time, including with respect possibly to climate change or other factors? Because if that's the case, it seems like a rather important exception that you're identifying with respect to res judicata.

MR FIETTA: Yes. Well, I think my answer for now would be really to focus on what the Court says in this passage, which does go, to an extent, to the broader issues that you've raised pertinently in your question. And it's a point to which we can return, of course.

But the Court, in that passage where it said that it "considers it important not to permit the doctrine of res judicata to extend ... [where] reasoning no longer accords with reality", that high threshold, it was explicitly against the context in the previous paragraph of such a change in circumstances whereby the reasoning no longer accords with reality "as a result of factors beyond the control of either Party, including climate

15:37 change", which was certainly in the minds of the Court there, and had been mentioned in the context of minimum flow; not in the context, of course, of drawdown flushing and the other part of the decision.

This was limited to the minimum flow, the 9 cusecs part of the decision, where the Court believed that that may need to be reviewed in future as a result of any dramatic changes in circumstances specific to that plant and that river. I don't think you can read this decision more broadly in connection with climate change being a potential basis to reopen res judicata generally. I think it was very specific to a specific situation addressed around this minimum flow issue, and for now I certainly would not read more into it.

THE CHAIRMAN: I mean, it's certainly an interesting approach, in that one could imagine writing paragraphs 117 to 119 simply to say that, "For the next seven years, in the event that there are changes of some kind that relate to this issue, either party may return to the Court to revisit/reconsider this particular judgment", as opposed to saying, as it does here, that, "The doctrine of res judicata is somehow affected when there is a change in circumstances".

I understand what you're saying, that you see it as limited in this particular context. But it arguably

15:39 opens the door to a broader potential effect on res judicata.

MR FIETTA: Well, I think our position is certainly that it would not open the door to a broader relevance or exception to res judicata based on climate change more broadly. I think this was designed to protect Pakistan, primarily, in the event that, as a result of a fundamental change on that specific river and the flow on the river, an ability to reconsider the decision on the minimum flow if these factors outside the control of either party should necessitate such a reconsideration.

Of course, that has not happened. There has been no such dramatic change in circumstances beyond the control of either party.

I certainly don't think -- and the Court was not here intending to say -- that climate change more broadly could be a basis to reopen hard and fast rules set under the Treaty, including as regards the design and operation of HEPs on the Western Rivers. And we saw elsewhere in the award, in connection with the concept of environmental flow, that the Court was very careful to indicate the limits of that principle in similar terms.

MR MINEAR: In common law jurisdictions, it's commonplace, when an equitable decree is entered, to provide that the

15:40 parties can reopen the decree in light of changed circumstances. Is there a similar principle in international law that would apply?

MR FIETTA: No, I don't think there's a direct equivalent to that, and there's no equivalent tool or procedure provided for under the Treaty here. And that's, I think, partly why the Court felt it needed to make explicit provision along those lines in its final award.

MR MINEAR: The language here is strikingly similar to equitable decrees that are entered in inter-state disputes in the United States, and that's why I asked the question. Thank you.

MR FIETTA: It may be that Judge Schwebel, who was president of that Court, had those US rules in mind when writing this part of the award. But certainly that's not a canon of international law.

MR MINEAR: Thank you.

THE CHAIRMAN: Two smaller questions relating to Courts of Arbitration, before you move on to the Neutral Expert, if that's okay.

One is: in Annexure G, paragraph 29, we've got the applicable law provision. It does refer to the possibility, when necessary, of applying treaties and applying customary international law. It does not then go on to refer to, for example, judicial decisions, as

15:42 one might have expected, given Article 38 of the ICJ Statute. I'm wondering if we should draw any significance from that for the purposes that you were discussing.

One thought, just while you're gathering your thoughts, is that the Treaty elsewhere, as you've already walked us through, addresses the final and binding nature of Court of Arbitration awards and Neutral Expert determinations. So perhaps that's where it's picked up. But I'm wondering whether you think its absence here, in paragraph 29, is of any significance.

MR FIETTA: Well, I think, as you say, the final and binding nature of Court of Arbitration awards under the Treaty is dealt with elsewhere, and the limited final and binding nature of Neutral Expert decisions within their competence is dealt with elsewhere, so that issue did not need to be addressed here.

As regards broader jurisprudence in international law, if you like, I think two points.

I think it makes sense, given the specific nature of this Treaty -- almost a lex specialis around governing the Indus Waters -- that it should not explicitly indicate a role in the interpretation or application of this Treaty to broader international jurisprudence, as such, directly. But of course those decisions do come

15:44 in in any event through the fact that customary international law itself is part of the applicable law here in certain situations, and of course customary international law itself will provide a gateway to the citation of international jurisprudence.

Clearly paragraph 29 is very carefully drafted so as to limit aspects of the applicable law, and to focus on primarily the primary importance of the wording of the Treaty.

THE CHAIRMAN: I had one other relatively small question. And I do think maybe we are close to the point of a coffee break, and if you want to look at this during the break, feel free to do so.

But it's at your Memorial, paragraph 8.73, which is on page 239. I found that paragraph a little bit confusing. So if you could explain what is meant in due course, that would be helpful.

It refers to the possibility of relitigating before a Neutral Expert a matter of Treaty interpretation that was made by a prior Court of Arbitration, and it seems to allow this when the matter before the Neutral Expert falls outside the dispute before the prior Court of Arbitration. But I don't see how that's relitigating a matter. That's where my confusion comes from. So perhaps you could look at that and let us know.

15:46 In any event, I think we're close to a point where we should take a break. Sir Daniel?

SIR DANIEL: Thank you, Mr Chairman.

I had just a practical question. I notice -- and we'll have an opportunity to discuss this with Mr Fietta -- but he's got a fair way still to go, and from a position where we were feeling comfortable with time, I think we're now feeling a bit stressed with time. So I just have a question as to whether you would be content to shrink the coffee break just a little bit, as we were discussing just before lunch, and I will discuss with Mr Fietta whether he might be a little accelerated in respect of what he still has to cover.

In saying this, I would like, though, to emphasise that we absolutely do not want to cut off any questions from the Court, because the compendium of questions that we are compiling will in fact inform our second-round submissions. But it may be that we will have a bit of a self-denying ordinance in actually giving answers, or answers of any length.

I do want to make sure that Professor Webb has at least 75 minutes to cover the ground before 5.30.

THE CHAIRMAN: Well, that's fine. Why don't we take just a 15-minute coffee break, come back roughly at the top of the hour, maybe two minutes afterwards, and then

15:47 we'll resume and hopefully we'll make up time.

SIR DANIEL: Thank you very much.

(3.47 pm)

(A short break)

(4.02 pm)

THE CHAIRMAN: Okay, I think we are reassembled. So, Mr Fietta, whenever you're ready, please proceed.

MR FIETTA: Thank you, Mr Chairman, members of the Court.

Just two quick points before I proceed, just cleaning up on issues arising before the break.

Your question related to the separate reasoning wording in paragraph 23, alongside the reference to an award. Just for now, a reference, which will be picked up by my colleague Professor Tanzi later in the week. It's addressed at Memorial paragraph 13.14, which addresses that issue. We'll elaborate on that submission subsequently to pick up your question.

And then your question just before the break in relation to: paragraph 8.73 of the Memorial perhaps could have been drafted a little more clearly. Just to be 100% clear on the intention of that paragraph.

It wasn't intended to raise the possibility of relitigation of the same dispute. It is intended to cover the situation where a new difference arises between the parties that, as the paragraph later says,

16:04 "falls strictly outside 'the dispute' addressed in [the] earlier Court of Arbitration [decision]". And therefore we would say that in that situation the concept of res judicata would not apply because it is a different dispute.

(Slide 32) Turning then to Neutral Expert decisions. I can be much briefer, because we've addressed many of the principles and paragraphs of the Kishenganga award relevant to this issue.

Decisions of Neutral Experts appointed under the Treaty are final and binding on the parties, on Courts of Arbitration and on other Neutral Experts, but only on matters falling within their more limited competence under the Treaty. And this is made clear by the Treaty itself at paragraphs 7 and 11 of Annexure F.

(Slide 33) Paragraph 11 makes clear that:

"[A] decision of a Neutral Expert on all matters within his competence shall be final and binding, in respect of the particular matter [concerned] ..."

And specifically addressing all of the constituencies in your question, effectively, including a future Court of Arbitration.

To the extent that the decision of the Neutral Expert therefore falls within his or her competence, it is res judicata in connection with the specific

16:05 issues concerned at the specific plant concerned, and my previous submissions on res judicata would apply in that strict context.

(Slide 34) Crucially, however, pursuant to Article IX of the Treaty, the competence of a Neutral Expert is limited to a closed list of differences of a technical or engineering nature falling within the list at subparagraphs 1 to 23 of paragraph 1 of Part 1 of Annexure F. And this is commensurate with the fact, of course, that the Neutral Expert must be a "highly qualified engineer"; competent, therefore, to address only, but importantly, those technical issues that may arise under the 23 paragraphs at Annexure F.

So unlike a Court of Arbitration, a Neutral Expert has no general interpretative competence under the Treaty and it's confined to these technical matters. A Neutral Expert cannot make general interpretative findings or systemic findings on the wording of the Treaty.

(Slide 35) Paragraph 7 of Annexure F is also important because it confirms that the competence of a Neutral Expert extends to resolving disputes between the Commissioners as to whether any particular difference falls within Part 1 of Annexure F. So a Neutral Expert can render a binding decision with

16:07 respect to his competence which has res judicata effect, save insofar -- another important proviso -- as that decision on competence itself takes him or her outside his or her competence and into the territory of paragraph 13 of Annexure F.

A Neutral Expert does not, therefore, have compétence de la compétence in the same way as does a Court of Arbitration. It arises from the fact that questions of whether or not such decisions themselves fall within the competence of a Neutral Expert, or are otherwise ultra vires under the Treaty, are subject to the overriding jurisdiction of a Court of Arbitration.

Consistent with Pakistan's position, at paragraph 316 of its Competence Award, this Court recognised that decisions of a Neutral Expert that are within his competence are final and binding with respect to the matter on which the decision was made.

The only dispute to have been resolved under the Treaty to date by a Neutral Expert was the Baglihar decision, of course. As is well known, Pakistan profoundly disagreed with that determination.

(Slide 36) The Kishenganga partial award subsequently agreed with Pakistan, and thus squarely rejected the Baglihar Neutral Expert's approach, in adopting its systemic interpretation of the Treaty as

16:08 regards this issue of drawdown flushing in particular. The Court observed (PLA-3, paragraph 522):

"It is not for the Court to apply 'best practices' in resolving this dispute ... any exercise of design involves consideration of a variety of factors -- not all of them technical."

Then the Court goes on, in a passage we've read previously, to talk about, among other things, the regulatory constraints set by the Treaty for the design of Indian plants. And the Court concluded by saying that:

"... the optimal design and operation of a [HEP] is that which can practically be achieved within constraints imposed by the Treaty."

But, importantly, the interpretation adopted in the partial award did not apply to the Baglihar HEP, as we've seen. It was not retrospective, and Pakistan had never requested otherwise.

(Slide 37) Paragraph 469 of the Kishenganga award is relevant in this context. The Court explained why its decision would have no effect to the Baglihar HEP. As the Court put it, Maître Lafitte's determination had "quite literally been realized in concrete at Baglihar".

(Slide 38) But as the Kishenganga Court continued at paragraph 470:

16:10 "The effect of a neutral expert's determination is restricted to ... elements of the design and operation of the specific [HEP] considered by that Expert."

And again contrasting with the Baglihar decision, the Court said:

"... the present decision, by contrast, is binding in respect of the general question presented in these proceedings."

Paragraph 470 has summarised, in terms which are crystal-clear, the decisive and clear difference under the Treaty's dispute resolution architecture between the pervasive binding or otherwise controlling effect of Court of Arbitration decisions on systemic issues, at least, and the more limited binding effect of Neutral Expert decisions.

Notably, in Kishenganga, even India stopped short of arguing that the Baglihar determination had any binding effect on the Court of Arbitration, just as it has stopped short of arguing that the decision has binding effect in negotiations, as we saw earlier.

(Slide 39) In its rejoinder to the Court, India explicitly stated that it did not rely on Baglihar as constituting a binding precedent. We can see that in the first part of the highlighted passage here (P-227, paragraph 4.44). Rather, India's position was more

nuanced, talking about Baglihar being authoritative, but not binding:

"Such reliance is not sought as a binding precedent ..."

So I think it is quite clear that India appreciates the limited effect -- res judicata effect, certainly -- of Neutral Expert decisions.

(Slide 40) And similarly, at 4.110 of its rejoinder in Kishenganga, India did not go further than saying that:

"The decision of the Neutral Expert in the Baglihar case holding [drawdown flushing] a maintenance measure permitted by the Treaty, while not binding on this Court, is a sound precedent ..."

So they were following the rationale, but they did not argue that it was binding in any sense on the Court.

And in the Kishenganga hearing, India again referred to Baglihar not as binding but as a precedent, shying away from any legal submission that went beyond that.

(Slide 41) As we've seen, the Court roundly rejected India's position at paragraph 470 of its award, saying that Baglihar did not have any general precedential value.

So the sum effect of Kishenganga was then that the Court rejected the Baglihar Neutral Expert's conclusion

that India was entitled under the Treaty to build a HEP on the Western Rivers with a deep orifice spillway for the purposes of drawdown flushing. The Court concluded that drawdown flushing was prohibited at Indian HEPs on the Western Rivers by paragraph 14 of Annexure D and paragraph 19 of Annexure E of the Treaty.

This conclusion did not displace the Neutral Expert's determination of seven years earlier with respect to the Baglihar HEP, but it did apply both to the KHEP and to all future Indian HEPs on the Western Rivers.

So at this point I can conclude my submission just by taking you back to the matrices which I gave you earlier. I won't spend any time on the substance of them. But the net effect, as you will have heard, of my submission, and of the colour-coding in the matrix to simplify things, is that Court of Arbitration decisions or awards within the scope of the disputes referred to them, which can be of many different types, are binding on all the constituent parties there: the parties, future courts, Neutral Experts and future Neutral Experts; whereas the position is much more restricted on the second matrix, in connection with the decisions of a Neutral Expert, which are binding only in respect of matters within their competence, binding only on the

parties with respect to those issues, or with respect to the Court and present proceedings before the Neutral Expert, and otherwise in connection with their competence.

Unless there are any further questions, that will conclude my submission. Thank you.

(4.15 pm)

Questions from THE COURT

THE CHAIRMAN: Just one question from me, Mr Fietta. I have not yet fully studied your matrix too; I look forward to doing so.

But I'm wondering about the circumstance where a Neutral Expert decides that a certain matter is within his competence -- that is, falling within Annexure F, Part 1 -- and that decision is not challenged, and therefore doesn't go on to a Court of Arbitration. Is that decision on competence of the Neutral Expert thereafter binding on a Court of Arbitration?

So let's say at some later point in time, one party or the other decides to say, "The Neutral Expert wasn't allowed to decide that matter". Is it open to a later Court of Arbitration to decide that it's not final and binding?

MR FIETTA: Well, in that situation -- and that's reflected in the matrix in connection with decisions on competence

of a previous Neutral Expert in the present or future Courts of Arbitration -- the decision about competence under paragraph 7 would be binding, because it's within his competence, save in respect of a situation where there has been a challenge. But if there is no challenge and no contrary decision of the Courts of Arbitration, then there is no dilution of the res judicata effect.

And of course this touches on the paragraph of Annexure F. It's paragraph ... I think I mentioned it.

THE CHAIRMAN: Paragraph 13 is where it could be challenged as outside competence.

MR FIETTA: Yes, thank you:

"... if any [decision] (including a claim ...) which is not within the competence of a Neutral Expert should arise out of his decision, that question shall, if it cannot be resolved by agreement, be settled in accordance with the provisions ..."

So it would need to be raised. There would be a dispute or a difference that would be raised about whether or not the decision was within the competence of the Neutral Expert. That would need to go through the procedures at Article IX that ultimately end up with the Court of Arbitration.

THE CHAIRMAN: Right. And the question is --

16:18 MR FIETTA: There is no limitation period to that.
THE CHAIRMAN: And the question is: if it doesn't do that, and at some later point in time, before some other Court of Arbitration, there's a challenge made that that was outside the competence of the Neutral Expert, is that to be regarded as final and binding because it wasn't challenged at the time, or not?
MR FIETTA: Yes.
THE CHAIRMAN: So if that's true, then to the extent that Pakistan regards anything the Neutral Expert did in Baglihar as being outside the scope of his competence, given that that was not challenged at the time, why is that not regarded as final and binding by a subsequent Court of Arbitration such as this one?
MR FIETTA: You may need to repeat the question. Pakistan does not, just to be clear, challenge the final and binding effect of the Baglihar determination in connection with the Baglihar plant relating to the specific issues raised in Baglihar. But did your question ...
THE CHAIRMAN: Well, I thought I heard you say earlier in your presentation that the Neutral Expert did things outside the scope of his competence.
MR FIETTA: Yes.
THE CHAIRMAN: And to the extent that that's Pakistan's

16:19 position, is it not for this Court to look at that, because it wasn't challenged at the time?
MR FIETTA: Well, he did that, but only in connection with his decision concerning the Baglihar plant. So those broader statements of Treaty interpretation, object and purpose, they are certainly not of any legal consequence in this proceeding because they were context to his specific decision in relation to the technical issues that he decided at the Baglihar plant.
Pakistan is on record as having disagreed with those aspects, alongside a number of others, of his decision. But there is no need to re-examine them here because those paragraphs have no legal significance to this proceeding.
THE CHAIRMAN: Okay. Thank you very much, Mr Fietta. So we appreciate your presentation, and I think we now have Professor Webb to take up the task of further educating the Court about the matters at hand. (Pause)
Professor, please proceed.
(4.22 pm)
Submissions on the Western Rivers Run-of-River Hydro Bargain
PROFESSOR WEBB: (Slide 1) Thank you, Mr Chairman, members of the Court. I'll be addressing you on the Western Rivers run-of-river hydro bargain which underpins the Treaty.

16:22 This bargain consists, on the one hand, that Pakistan "shall receive for unrestricted use all those waters" on the Western Rivers, as a result of which India must "let flow" those waters and "shall not permit any interference with [those] waters". That's on the one hand.
The other side of the bargain is the tightly constrained exceptions, including the exception that the waters of the Western Rivers can be used for the generation of hydroelectric power in accordance with Annexure D.
(Slide 2) I will be proceeding in four parts. First, looking at Article III and the rule there. Second, at the relationship between Article III and other provisions, going through hydroelectric power, other uses, and briefly on storage. Third, I'll look at the cooperation and reporting requirements that reflect and underpin this bargain, and there is a handout for you in that regard that I will refer to at that stage. And then finally, I will address question (b) from paragraph 35 of Procedural Order No. 6.
(Slide 3) So I start with Article III of the Treaty, which guarantees Pakistan's exclusive use of the waters of the Western Rivers, subject to strict exceptions. I'm not going to read it out; I'm just going to

16:24 highlight the terms that underpin this bargain.
So in the first paragraph, the "unrestricted use" accorded to Pakistan, and the matching obligation of India to "let flow".
In the second paragraph, again the obligation to "let flow", and the more precise obligation not to "permit ... interference" with those waters. And I'll come to the definition of that.
In paragraph (3), again the reference to "unrestricted use" of the waters.
And in paragraph (4), "Except as provided for in Annexures D and E", the prohibition on storage by India of any water on those Western Rivers.
Mr Minear pointed out yesterday that "let flow" is an unusual form of words in treaty practice. And Pakistan, insofar as it's been able to determine looking at a database of 600 international water conventions, has found that there is no direct comparator to the Indus Waters "unrestricted use"/"let flow"/"non-interference" obligation; again reinforcing the very bespoke nature of this Treaty.
The concept of "flow" itself is included in a handful of agreements, but with a very different emphasis and scope. And just to give you one example, the 1961 US-Canada Treaty relating to Cooperative

16:25 Development of the Water Resources of the Columbia River Basin (PLA-100, Article II(1)) refers to Canada providing certain storage "usable for improving the flow of the Columbia River". So a very different use of "flow" there.

(Slide 4) So four points are worth noting about the wording of paragraph (1) of Article III.

The first is that "let flow" is the corollary obligation of Pakistan's right of "unrestricted use": they go together.

"Let flow" is not framed in terms of an obligation of non-appropriation. So India can use the waters of the Western Rivers, so long as they are replaced in an equivalent amount.

"Let flow" is a positive obligation: that means it is a starting point for analysing compliance, not an afterthought.

And "let flow" is not limited in terms of the volume: it applies to all the relevant waters. So it wouldn't be permissible, for example, for India to argue that it only partially impeded the flow of the Western Rivers. "Let flow" is associated with "all the waters". And of course this is relevant to the Treaty bargain that we've set out, where India was allocated the waters of the Eastern Rivers for its use under the Treaty.

16:27 Article III(2) introduces the principle of non-interference with the waters of the Western Rivers, except for tight restrictions. And the parties understood at the time that this meant that India should not alter the flow, in quantity or timeliness, of the Western Rivers as they pass into Pakistan.

Ms Rees-Evans has already taken you through the travaux; I am not going to go through them in detail. But I just want to highlight a handful of documents that really express the hydro bargain as it developed through the negotiations.

(Slide 5) So the first is a letter from Pakistan's Minister of Industries of 10 September 1957 (P-420). So this is quite early in the process of negotiations and expresses Pakistan's position very clearly. And it says:

"Being the lower riparian, Pakistan alone is vulnerable to interference by India. By introducing for the first time at this stage new uses on [the] Western Rivers ... [such as the] unrestricted right to develop hydro-electric power from those rivers, India has, while trying effectively to secure to herself the exclusive use and development of the Eastern Rivers, sought to deny the reciprocal independence to Pakistan which the Bank Proposal and the Aide Memoire promised to afford to

16:28 each country."

And the appendix to that letter noted that interference by hydroelectric work "is repugnant to the provisions of the Adjusted Bank Proposal and Pakistan cannot agree to any such works in areas under the control of India".

So that was the position on 10 September 1957.

As we heard from Ms Rees-Evans, Pakistan came under pressure from the World Bank and eventually made a concession. It accepted a narrow exception to its right of unrestricted use during August and September 1959.

(Slide 6) So a provision for a carve-out for India's generation of hydroelectric power then appeared in the heads of agreement from 1959 (P-136), and the language was one of entitlement. You see that on the left-hand side of the slide. At that time India was being "entitled to generate hydro-electric power". But with the first drafts of the Treaty itself, it changed into an exception from an entitlement, and you see that in the document on the right (P-139).

This shift from entitlement on the part of India to an exception that India has to come within is significant, because it makes "unrestricted use" and "let flow" the rule, and the generation of hydroelectric

16:30 power under certain conditions the exception.

So I spoke yesterday about context in the role of treaty interpretation, and that involves looking at other provisions of the Treaty. And I turn, with that, to Article I(15) and the travaux behind that provision, which defines the obligation of non-interference.

(Slide 7) So in the draft of December 1959 (P-139), it was quite a brief statement that:

"The term 'interference with the waters' [is] any act of withdrawal ... or any man-made obstruction ... that causes a change in volume of the daily flow ..."

In the final version of the Treaty, we have the emphasised language that makes very clear how strict this prohibition on interference is. It reads:

"Provided, however, that an obstruction which involves only an insignificant and incidental change in the volume of the daily flow, for example, fluctuations due to an afflux caused by bridge piers or a temporary by-pass, etc., shall not be deemed to be an interference with the waters."

So this language was inserted in response to discussions about: what did it mean to have a change in the volume of the daily flow? And the final version of the Treaty, in this subparagraph, gives a very clear answer: any practically measurable change in the flow

16:31 caused by India that exceeds something "insignificant or incidental" is not permitted. And the examples given, such as water flowing around a bridge pier, show just how strict this definition is. This affirms the importance of the rule in Article III of the Treaty.

(Slide 8) Coming now to the third paragraph of Article III, which provides that "Pakistan shall have the unrestricted use of all waters" and "India shall not make use of these waters". So this is again showing the underpinning of the hydro bargain, which is infused throughout this provision.

Pakistan has a right to unrestricted use of all the waters, other than the Eastern Rivers; and on the other hand, India is prohibited from making use of these waters. And the same provision -- so it's not put separately; it's in the same provision, so it's very much tied to this balance -- says that there will be "discharge observation stations", emphasising that constant monitoring and cooperation is envisaged to make this balance stick.

(Slide 9) Article III(4) deals with the principle of no storage by India, and that is subject to the provisions of Annexures D and E.

As the Kishenganga Court held, this again reflects the bargain and it reflects the object and purpose of

16:33 the Treaty. It stated (PLA-3, paragraph 504) that:

"... one of the primary objectives of the Treaty is to limit the storage of water by India on the Western Rivers."

The travaux préparatoires confirm the importance of the no-storage principle. I'm not going to go through them in detail; Ms Rees-Evans has done that. But just to highlight how this was very much in the minds of the drafters and how it was addressed.

(Slide 10) So in August 1959 -- this is the document on the left-hand side of the screen (P-468) -- both parties' draft heads of agreement envisaged that India's hydroelectric use of the Western Rivers would be a type of "non-consumptive use", but India's draft also proposed that it be given a limited storage capacity for hydroelectric power plants. The President of Pakistan wrote on 21 August 1959 emphasising Pakistan's consistent position that it must be guaranteed the "total flow of the Western Rivers, excepting for insignificant uses in Jammu and Kashmir only".

A new request by India was then made of "no limit to uses from Indus, Jhelum above lake, and Chenab RL 2000 covering Jammu and Kashmir". This was in direct response to the strong position that Pakistan had put forward.

16:34 The parties then engaged in intense negotiation through spring of 1960. This actually held up progress on the drafting of the annexures of the Treaty while they tried to resolve this issue. And again, under pressure from the World Bank, Pakistan made a concession to include the reference to Annexure D in the draft of June 1960, so allowing the production of hydroelectric power, but only with those criteria in Annexure D constraining that production.

Yes, Mr Chairman.

THE CHAIRMAN: This may fall outside the remit of your presentation. But because you mentioned the issue of storage as it might relate to Annexure E, are you able to say a few words about the relationship between the two annexures? In Annexure E, there are some specified limitations on storage. And it wasn't entirely clear to me to what extent that speaks as well to potential storage at hydroelectric plants that are governed by Annexure D.

PROFESSOR WEBB: Right, right.

THE CHAIRMAN: And if you're able to address that now, or someone in the course of the next day or two, that would be useful.

PROFESSOR WEBB: Yes, I will be coming to it briefly. But just to give a direct answer now, this is part of the

16:36 context of interpretation: that the unrestricted use, let flow, non-interference and no storage all come together in the hydro bargain.

But having said that, Annexure E has different criteria to Annexure D. Unless there's an express cross-reference, you can't transpose them. And those specifications on storage in Annexure E would not be applicable to a run-of-river plant, as opposed to a storage work that is governed by Annexure E. What is important from this is how strict those conditions are even for a storage work, reflecting again how strict Annexure D criteria are as well.

But we can certainly come back to that more specifically.

THE CHAIRMAN: That's very helpful. Just if I understand it, the storage works regulated by Annexure E may well be associated with a hydroelectric plant governed by Annexure D.

PROFESSOR WEBB: Yes, that's true.

THE CHAIRMAN: But these are different storage requirements that we're talking about, in terms of what E addresses, and then what pondage and freeboard and whatnot relates to in Annexure D.

PROFESSOR WEBB: Exactly. And Mr Minear pointed out, I think yesterday, the cross-reference in Annexure E to

16:37 "Pondage", capital P, in Annexure D. So where that is expressly cross-referenced, then you would read them together. But otherwise, these are dealing with separate works; and where they do coincide, that's specifically dealt with in the Treaty.

(Slide 11) So that brings me to the relationship between Article III and the provisions of the Treaty in other sections. And this brings me to the relationship between the rule and the exception. And you could combine these in one diagram. But just because we're not dealing with Annexure E as such in this dispute, you can see the difference there.

So we have the unrestricted use, let flow, non-interference and no storage as the rule; and the exceptions set out in Article III and the paragraphs of Annexure D; the no storage rule which is subject to Annexures D and E.

I want to come back here to the Treaty point and Sir Humphrey Waldock, which Sir Daniel flagged this morning.

Mr Chairman, yesterday you observed that the restrictive interpretation canon had been considered by the ILC and not expressly included in Articles 31 and 32 of the Vienna Convention. And you suggested that India may prefer a competing canon of interpretation, also not

16:39 expressly in Articles 31 or 32, that would interpret the exception in of itself, without regard to some idea that it needs to be narrowly construed. And I just want to set out Pakistan's position on that.

First of all, there is evidence in the travaux of the Vienna Convention, and certainly in the jurisprudence of international courts since then, that there is a customary principle that exceptions to a rule are to be interpreted restrictively.

But quite apart from that, and in any event, we do not need to rely on a canon of restrictive interpretation because, as Sir Daniel said this morning, in application of the general rule, Article 31, we reach a narrow interpretation of Annexure D. It is compelled by the object and purpose of the Treaty, by the context, by the obligation of good faith, by the ordinary meaning of the words and by the effet utile, which is linked to the object and purpose.

And India's potential argument on interpretation, looking at the exception in and of itself, doesn't work, because the exception is written into the rule. It is not just in Annexure D: it is in Article III itself. So we cannot construe Article III without construing the exception, and we cannot construe Annexure D without construing the rule. It's not a self-standing

16:40 provision.

I now turn to five factors that reinforce this rule-exception relationship.

(Slide 12) The first is just the text: the way that the exception is expressly addressed on the face of Article III.

The second is that the exceptions are not only exceptions to India's let-flow obligation, but also to Pakistan's right of unrestricted use, and the injunction that India shall not permit any interference with the waters of the Western Rivers. "Interference with the waters of the Western Rivers" is a term of art. I've just shown you how strict it is: it basically just excludes water going around a bridge pier or a temporary bypass. So the "let-flow" obligation is broad. The non-interference obligation is clear and precise.

The third point is that the hydroelectric power generation exception in Article III(2)(d) is expressly contingent on compliance with Annexure D. It doesn't say simply that India can use the waters of the Western Rivers for hydroelectric power generation; it says it can use the waters "as set out in Annexure D".

So Annexure D is an inextricable part of hydroelectric power generation. And if India does not bring itself within the terms and conditions of

16:42 Annexure D, then it cannot bring itself within the hydroelectric power exception in Article III. And this would be compatible with Sir Humphrey Waldock's preference, which is that the basic rule of treaty interpretation is the primacy of the text (from his Third Report).

The fourth factor is that the terms of Article III(4) are an injunction that is not located in paragraph (2) of Article III. It is instead set out in a self-standing clause that is subject to its own exception which I have already taken you to, "Except as provided in Annexures D and E". So these two rules and these two exceptions together complete the circle by conditioning any use and storage of water by India on the Western Rivers with complying with strict criteria set out in the Treaty.

And fifth, as we will explain in the coming days, the terms of Annexure D itself heavily constrain India's right to the use of the waters for hydroelectric power generation. Paragraph 2(g) of Annexure D provides that a run-of-river plant is one "that develops power without Live Storage ... except for Pondage". And the criteria in paragraph 8 of Annexure D are those to which the design of any new run-of-river plant "shall conform"; mandatory language. So the effect is again to reinforce

this rule-exception relationship.

I now turn to the relationship between Article III and the provisions on hydroelectric power.

(Slide 12) Under the hydro bargain, India is entitled to generate hydroelectric power insofar as it does so within the constraints set out. So I'm not going to read this out, but you see that provision expressly there in (2)(d).

Now, the chapeau of Article III(2) expressly restricts the use of waters, save for an exception for irrigation in Annexure C, to "the drainage basin" of the Western Rivers.

Annexure D is divided into five parts. Two of them are relevant for our purposes, the present purposes: Part 1, defining key terms; and Part 3, on how new run-of-river plants are to be designed and operated.

(Slide 13) So paragraph 1 of Annexure D again has this constraining language: it says that it is "subject to the provisions of [the] Annexure", the generation of the power, and "Provided that" certain criteria are met.

So that wording of "Provided that" ensures that new hydroelectric plants that incorporate storage works are to be addressed under Annexure E, so that means that new run-of-river plants cannot be plants that incorporate storage works. And while run-of-river plants are

permitted to store a limited volume of water as pondage, there's a restricted volume of live storage.

(Slide 14) Paragraph 2(g) defines a run-of-river plant as one that:

"... develops power without Live Storage as an integral part of the plant, except for Pondage and Surcharge Storage."

And Annexure D then goes on to describe in detail those design requirements, and we will be going through them in detail over the next couple of days. I just want to, in advance of that, highlight a few concepts that we will be addressing in greater detail, and some of which reflect the special meaning that I mentioned yesterday that departs from the ordinary meaning in either dictionaries or engineering parlance.

(Slide 15) So "Dead Storage" is defined in paragraph 2(a) of Annexure D as the water stored in the reservoir for non-operational purposes; and, as we've heard already, pursuant to paragraph 19 of Annexure E, and extended to Annexure D by paragraph 14, cannot be discharged for anything other than an unforeseen emergency.

The "Dead Storage Level" sits below the operating pool and accounts for all the remaining water in the reservoir. This is a term with a special meaning, and

different to how it would be used in ordinary engineering usage. It's been tailored to the Treaty.

"Live Storage", pursuant to paragraph 2(b) of Annexure D, is the water in the reservoir above the dead storage level, used operationally.

And "Pondage" we'll be spending a lot of time on on Friday. [It] is defined with a special meaning of:

"... Live Storage of only sufficient magnitude to meet fluctuations in the discharge of the turbines arising from variations in the daily and ... weekly loads of the plant."

And this in turn leads to the "Full Pondage Level", being the normal upper level of the reservoir corresponding to maximum pondage that has complied with paragraph 8(c).

And above the operating pool we have "Surcharge Storage", which is "uncontrollable storage occupying space above the Full Pondage Level", usually from emergency flood conditions.

(Slide 16) So when dealing with a new run-of-river plant, India is required to comply with the design criteria of paragraph 8, understanding these concepts and designing for these concepts as they are defined in the Treaty. And these are mandatory design criteria. I'm not going to go through them; we will be hearing

a lot about them over the next two days.

(Slide 17) But I would observe, from the hydro bargain point of view and from the point of view of the object and purpose of the Treaty, that these criteria are not value-neutral. They reflect the object and purpose of the Treaty. And Mr Fietta just showed you this paragraph in the previous presentation from the partial award (PLA-3, paragraph 522), where the Court made very clear that "the optimal design and operation of a hydro-electric plant" is defined as one that "can practically be achieved within the constraints imposed by the Treaty".

(Slide 18) So coming back to these criteria and how they reflect the hydro bargain. Except for paragraph 8(g) at the end, on regulating basins, the point of each of these criteria is to limit India's control of water and storage of water on the Western Rivers; once again, being consistent with the object and purpose of the Treaty.

(Slide 19) And the impact of these design criteria can be illustrated by the change in the Kishenganga plant and how, whether you're designing under Annexure D or E, different issues arise.

So the Kishenganga plant was first conceived as a storage work under Annexure E in 1971. In the

16:50 original design, it was to store water during the high-flow season in a 220-million-cubic-metre reservoir behind a 77-metre-high dam wall. And it was to be used for enhanced power generation during the winter using stored water, not running water.

Following Pakistan's objections in the Commission, India redesigned the Kishenganga plant in 2006 with a 35.48-metre-high dam wall and reservoir of 18.35 million cubic metres. But in India's own words, "the revised Run-of-River design is largely the same as the earlier design". That was noted in the partial award of the Kishenganga Court (PLA-3) at paragraph 236. Now, the numbers were much smaller. But as the Court explained, "the axis of the dam, the location and [the] layout of the project, [and] its installed capacity [and] diversion works" had not changed.

And to be clear, Pakistan considers the design and operation of Kishenganga to be inconsistent with the Treaty, even moving it from a storage work to a run-of-river plant, and would say it's actually better characterised as a storage work. And as we well know, it has disputes with India as regards to pondage intakes, outlets and spillways of the Kishenganga plant.

(Slide 20) So moving from paragraph 8 to paragraph 15, we come to operational restrictions. And

16:51 paragraph 15 sets out the general rule for hydroelectric plant operation that is intended to maintain the consistency of the downstream flow.

I won't read it out but just to point out that paragraphs (i) to (iii) of paragraph 15 provide a series of river-specific limitations, in addition to the chapeau condition about maintaining consistency of flow. So we have specific conditions for Chenab Main, different locations, and then on the Jhelum and the tributaries.

Paragraph 15 also imposes additional storage limitations on India. India cannot, for example, use a hydroelectric plant reservoir to store 100% of the waters for a fortnight and then release it down in a flood, creating downstream hazards for Pakistan. So once again, these conditions, this consistency of flow and this absence of interruption, reinforce the rule underlying the hydro bargain.

(Slide 21) And once again, from the perspective of the context of the Treaty, and looking at how the other provisions cast light on paragraph 8, we see that the other exceptions in Article III also reflect this rule and exception, and this control over what India is able to do.

So Article III(2)(a) permits "Domestic Use", which

16:53 you see defined in Article I(10) at the bottom of the screen. Now, the first two domestic uses are relatively non-invasive: drinking, washing, sanitation, and household and municipal purposes. The third so-called domestic use, of "industrial purposes", could be more significant, because it could require significant offtake in some industries such as mining and smelting.

(Slide 22) But that offtake is limited by Article IV(12), which provides limits on "The use of water for industrial purposes". So we have the narrowing down, through each provision, of what India is able to do with these waters.

And this is interesting from the perspective of changing times, because this provision protects Pakistan from increasing industrial demands by India in the years following the Treaty's conclusion. The permitted consumption of water for an industrial process is limited to the quantum of use in 1960, ensuring that India cannot take advantage of developments that require more water, although it could take advantage of technology or new knowledge that require less water.

In the case of an unforeseen but later developed industrial process, India can only use it to extract water from the Western Rivers to the extent that such a process does not have a substantially adverse effect

16:55 on Pakistan. And under the second clause of subparagraph 13, India is entitled to extract water from the Western Rivers for use in an industrial process, but it is obliged to use "best endeavours", as you see there, "to return to the same river ... all water withdrawn therefrom".

(Slide 23) Article III(2)(b) permits "Non-Consumptive Use", and that is defined in Article I(11). India can only rely on this exception to the extent that the use in question is for a relevant purpose, which are listed there. And it has to ensure that any water removed from the watercourse, beyond a de minimis amount, is returned to it; again, consistent with the let-flow obligation.

You will note in Article I(11), and relevant discussions that we've been having over the last couple of days, that one "Non-Consumptive Use" by India is for the purpose of "flood protection or flood control"; it's in the second line of that provision.

But again, that is limited under the Treaty, because in Article IV(2) it provides that:

"In executing any scheme of flood protection or flood control each Party will avoid, as far as practicable, any material damage to the other Party, and any such scheme carried out by India on the Western

16:56 Rivers shall not involve any use of water or any storage in addition to that provided [by] Article III."

So that reference to "flood protection or flood control" in Article I(11) is not a licence for a so-called emergency use of water.

(Slide 24) Finally, Article III(2)(c) and Article I(9) deal with agricultural use. There are ten paragraphs in Annexure C setting strict limits on India's irrigation from the Western Rivers in terms of the amount of water and the land area that can be irrigated.

(Slide 25) So I now turn to storage, and Annexure E, again for context. This is not part of the current dispute, but it informs the hydro bargain.

So as you see in Article III(4), "India shall not store any water ... or construct ... storage works", "Except as provided in Annexures D and E". The exception is built into the primary provision. We can't separate them and read them in a different way.

(Slide 26) Under the Treaty, the capacity of India to construct any storage work is severely limited by Annexure E, and that starts with the definition of a "Storage Work":

"... a work constructed for the purpose of impounding the waters of a stream ..."

16:58 (Slide 27) And I don't know if this is what you were referring to earlier, Mr Chairman. Paragraph 7 of Annexure E sets out the "aggregate storage capacity" of reservoirs constructed by India, and these are very small amounts.

MR MINEAR: Professor Webb?

PROFESSOR WEBB: Yes, Mr Minear.

MR MINEAR: Excuse me, Professor Webb. Earlier, on slide 19, you indicated that Kishenganga was initially planned as a storage work.

PROFESSOR WEBB: Yes.

MR MINEAR: And it is on the Jhelum River; is that right?

PROFESSOR WEBB: Yes.

MR MINEAR: What confuses me is on the paragraph 7(c) --

PROFESSOR WEBB: Apologies, it's on the Neelum.

MR MINEAR: Oh, it's on the Neelum.

PROFESSOR WEBB: Before it joins the Jhelum.

MR MINEAR: The Neelum, yes.

Well, is it subject to the power storage capacity limitation set forth in paragraph 7? If it's on the Jhelum, it says "Nil", "Power Storage Capacity". I don't understand how the power storage capacity limitations would allow that at Kishenganga.

PROFESSOR WEBB: Yes. I will have to come back to you. But since the Neelum isn't mentioned there expressly, we may

16:59 not be in this table. But can I come back to you on that?

MR MINEAR: Sure, that would be fine. Thank you.

PROFESSOR WEBB: And I should emphasise that whether it was a storage work or a run-of-river plant, Pakistan's position is it did not comply with the Treaty.

MR MINEAR: Thank you.

PROFESSOR WEBB: (Slide 28) So paragraph 11 has the detailed design criteria for storage works, not run-of-river works. And I'm not going to go through them, but what I will refer to is what the Kishenganga Court said.

(Slide 29) And this runs through the theme of both what the Kishenganga Court said (paragraph 506) and what the Treaty requires, which is that:

"... the Treaty doesn't [just] restrict the Parties from taking certain actions ..."

It doesn't just prohibit the use of storage on certain rivers:

"... but [it] constrains their entitlement to construct works that would enable such action to be taken."

So it's not that the act has yet taken place; it's that even the means to undertake that act are constrained, and sometimes prohibited.

(Slide 30) So the hydro bargain also relies not just

17:00 on this rule-exception relationship, but on cooperation and reporting requirements. And this takes us back to the preamble of the Treaty that refers to the "cooperative spirit" that is expected of the parties.

Now, you have already heard on Monday about how these very detailed cooperation, consultation and information-sharing requirements operate -- or perhaps do not operate -- in practice from Pakistan's Commissioner for Indus Waters. And I have provided a handout -- it's more for your reference; I won't be going through it -- that provides an overview of each party's rights and obligations under the Treaty. We have Pakistan's rights; Pakistan is also subject to obligations. We have India's rights, and India is also subject to obligations.

You will notice the difference in the detail and length of each of those categories. But what is important is: there is no blank column there. The parties are inextricably linked in how they are meant to be cooperating and sharing information throughout the design and operation and construction process.

So Article VI(2) provides that either party may request the supply of data relating to the hydrology of the rivers. Article VII, on "Future co-operation", imposes that they have to cooperate by mutual agreement.

(Slide 31) And VII(2), on the screen, provides that if either party planned to construct any engineering work that would "cause interference with the waters of the Rivers", that would affect the other party "materially", it is obliged to notify the other party of its plans. And the party planning the work shall, if requested, supply data if the work would cause interference with the waters, even if it did not consider that the other party will be materially affected.

So this provision reflects the importance of the obligation of non-interference. Even if a party does not think there will be a material effect on the other, there is still an obligation to notify and to start engaging in that process of consultation.

(Slide 32) Now, as we know, the most important site for cooperation under the Treaty is the Permanent Indus Commission. This is provided in Article VIII. And it is expressed there in paragraph (4) that the purpose and functions of the Commission are to maintain and establish these "co-operative arrangements" and "promote co-operation" on an ongoing basis.

(Slide 33) And under paragraph 9 of Annexure D, which was also a provision that Pakistan's Commissioner took you to, India shall communicate in writing, at

least six months in advance of the beginning of the construction, very defined information.

So as part of the hydro bargain -- stepping back from the detail of these cooperation and reporting requirements -- India's design, construction and operation are subject to constant monitoring for compliance with the Treaty.

It has to measure a variety of inputs daily and provide the data to Pakistan monthly, or daily if requested. It must inform Pakistan of any planned works likely to affect Pakistan's rights and interests, and provide it with information on them. It has a positive obligation to cooperate with Pakistan on river development and to promote such cooperation through the Commission. And India must also give Pakistan's Commissioner timely access to any facility it builds on the Western Rivers on demand, so that compliance can be assessed.

(Slide 34) The implications of gathering all of this data and information are set out in paragraphs 10, 11 and 12 of Annexure D, which address the action to be taken if a question arises as to whether a design is compliant, and which confirm the ongoing nature of the obligation of cooperation.

So for the provisions of Annexure D to work as

intended, cooperation between the parties on information-sharing is required from the outset and at each stage of design, construction and operation. And if these work as they were intended to work -- and as we heard from Pakistan's Commissioner, that is not the case -- it is supposed to permit the Commissioner to supervise Indian hydroelectric power plant construction and operation so that any issues can be identified early and resolved in accordance with Article IX.

The Kishenganga Court took note of this (PLA-3, paragraphs 443 to 444), saying that:

"... the Treaty prescribes a formal procedure designed to bring a measure of order and certainty in the resolution of competing claims, and to questions of propriety of Plant design, before construction commences."

India's compliance with the unrestricted use, let flow, non-interference and no-storage obligation is not presumed by the Treaty. It is a system of "trust, but verify".

(Slide 35) I now come to the question of the Court in paragraph 35(b) of Procedural Order No. 6, which is:

"To what extent can non-Treaty-based design and operational practices be taken into account for purposes of interpreting the technical requirements set out in

Annexure D, paragraph 8?"

Pakistan's position is that non-Treaty-based design and operational practices can only be taken into account to the extent that such practices are consistent with the framework and the object and purpose of the Treaty.

This gives India a degree of flexibility. The Treaty does not prescribe the materials with which the spillway gates or the turbines or other components must be constructed. The Treaty does not require that a hydroelectric plant use a desander, or prohibit the use of a desander. The Treaty does not fix the minimum size of outlets by reference to the technological capability of 1960, and it doesn't define what is necessary with respect to sediment control or conditions at site by reference to technology at the time the Treaty was concluded.

Non-Treaty-based design and operational practices can be taken into account, including through -- as we will show in the coming days -- the language of paragraphs 8(d), (e) and (f) of Annexure D. But India cannot appeal to extraneous sources, or to so-called "best practice", without bringing it within those constraints.

I want to recall pertinent points made by Dr Morris this morning to link the engineering insights with the

17:08 legal framework here.

As Dr Morris said, climate change can be taken into account. He explained that engineers design for high, not average, sediment loads. So if climate change will affect the amount of sediment, then you're already designing for that high load.

He also said there's always innovations in hydropower engineering, including sediment management, such as turbine coatings. Such innovations are entirely compatible with the Treaty framework, and indeed they maybe be required by the Treaty framework, through the reference, for example, to "sound and economical design".

He also observed that every project has its own little problem, or big problem: physical factors, geological factors, seismic factors and regulatory limitations, quite apart from the Treaty. But as he said, engineers can put their minds to it and the solutions will come up, whether it's a technology, a technique, a change of design or a change of site.

As we stated in the Memorial, the correct approach to technological advancements or so-called "best practices" can be seen in the assessment of two issues by the Kishenganga Court. And I just want to go through them briefly to show how that Court took into account

17:10 developments and changing conditions, but without defaulting to a so-called "best practice" outside of the Treaty.

(Slide 36) So the first was the role and scope of environmental impact assessments that India had to conduct to evaluate downstream effects from Kishenganga.

Now, Pakistan's argument was that India's EIA was inadequate because the most important area -- that was "the area below the dam site" -- was not part of the EIA. So that was the scope.

India countered that argument by invoking best practices, saying best practices only required that the EIA "be in writing", that it "be conducted sufficiently early on to be taken into account in decision-making", that it "include an opportunity for public comment", and that it "be comprehensive". And it tried to use this invocation of best practices to avoid defining the scope of its EIA.

The Court, faced with these competing arguments, concluded that the evidence did "not provide an adequate basis" for the determination of the "maintenance of minimum flow downstream of the KHEP". It requested India to provide "further data concerning the impacts of a range of minimum flows to be discharged" at Kishenganga, including "environmental concerns from the

17:11 dam site at Gurez to the Line of Control" and to "incorporate a sufficient range of minimum flows so as to give the Court a full picture of the sensitivity of the river system".

So underlying the Court's approach was its appreciation that the Treaty required India to operate Kishenganga to preserve the downstream flows. And that was informed by the requirement that states "take environmental protection into consideration when planning and developing projects that may cause injury to a bordering State".

The Kishenganga Court wasn't stuck in 1960. It drew upon the International Court of Justice's analysis in the 2010 Pulp Mills judgment, and it emphasised (PLA-3, paragraph 450) that an EIA has to be undertaken:

"... where there is a risk that the proposed industrial activity may have a significant adverse impact in a transboundary context, in particular, on shared resources."

It also referred to the 2007 Iron Rhine arbitration, and spoke about the duty to mitigate significant environmental harm "when pursuing large-scale construction activities".

So it didn't refer to best practices as such, and certainly not in the way that Indian invoked them. But

17:13 it did rely on current and promising practices and decisions regarding EIAs that informed what the parties were required to do under the Treaty.

The second issue in which this argument about best practices came up was drawdown flushing.

India contended that drawdown flushing was one of the most effective techniques for maintaining the sustainability of reservoirs, and it cited practices in India, Switzerland, Austria, China, New Zealand and Venezuela. Pakistan responded that sediment sluicing offered a "feasible alternative" that respected the Treaty's framework.

And as we know, the Court accepted Pakistan's argument, noting that "it is not for the Court to apply 'best practices'" -- and I note that the Court put "best practices" in quotation marks; it was not resistant to a real best practice -- and that "the Treaty restraints on the construction and operation by India of reservoirs" are "a regulatory factor" in plant design, such that the Treaty prohibited drawdown flushing (PLA-3, paragraph 522).

So the Court again did not accept the mere invocation of best practice to circumvent the Treaty requirements. But it was still very much open to engineering practices and innovations that are within

17:14 the Treaty framework.
In its approach to the interpretation of the Treaty, and the hydro bargain in particular, India tends to turn Article III on its head. It tends to take a narrow approach to the rule in Article III and an expansive approach to the exceptions also within Article III and as set out in Annexure D.
India is motivated by its plan to "harness[] the significant hydro-electric potential available on the Western Rivers", as it has stated. I'm citing its Rejoinder in the Kishenganga arbitration, which is our Exhibit P-0227, at paragraph 4.97.
And to this end, motivated by desire, India tries to characterise the object and purpose of the Treaty as the utilisation of waters, as I showed you yesterday. It only reads the first part of the preamble, and it overlooks the second part of the preamble, speaking of the:
"... fixing and delimiting, in a spirit of goodwill and friendship, the rights and obligations of each in relation to the other concerning the use of these waters."
In Ms Rees-Evans's exchange with Mr Minear yesterday, she confirmed that the Treaty does not limit the number of plants or the amount of power that India

17:16 can generate on the Western Rivers. But a limit is there because it comes in through the criteria in paragraph 8 of Annexure D.
India has interpreted each requirement in Annexure D so as to maximise its ability to control and manipulate the waters through the design and operation of hydroelectric plants. And as we've heard already, the Kishenganga plant and the Ratle plant are just examples of the standard Indian HEP design with common features that is being replicated in dozens of plants.
India purports to adopt a "state-of-the-art" approach in order to circumvent the design and operational restrictions in Annexure D. But in reality, its designs are not state of the art, including their sole focus on empty flushing, as Dr Morris has explained, while also being in violation of the Treaty.
(Slide 37) So I come back to the rule and the exception. The correct interpretative approach is to treat Article III as the rule, and to restrictively interpret, according to the ordinary meaning and the object and purpose, the exceptions in Article III(2) and Annexure D.
This reflects the bargain at the heart of the Treaty. This approach requires that any best practices are adopted within the framework of the Treaty, and in

17:17 a manner consistent with its object and purpose. As Dr Morris said, the Treaty is focused on sustaining the hydrology coming in to Pakistan. That is its object.
The peace treaty and hydro bargains that were struck after years of negotiation, and with the assistance of the World Bank, was not an agreement for a fixed period. It wasn't an agreement that allowed for unilateral revision, or for reassessment through a continuously available process. It was meant to be stable and secure, and underpinned by cooperation and goodwill.
That concludes my submissions. I'm very happy to take any questions, or we might have an early night.
THE CHAIRMAN: Mr Minear?
(5.18 pm)
Questions from THE COURT
MR MINEAR: Thank you, Professor Webb.
I want to return to my question earlier about Annexure E, paragraph 7, and whether Kishenganga would comply with that. I think I've answered that question to my own satisfaction myself. I briefly said: the Neelum is a tributary of the Jhelum, and so therefore it would fall within 7(b). If I'm mistaken about that, please inform me later.
PROFESSOR WEBB: I will.
MR MINEAR: But I'd like to relieve you of the work of

17:18 trying to correct --
PROFESSOR WEBB: Thank you for the steer.
THE CHAIRMAN: Professor Buytaert?
PROFESSOR BUYTAERT: Thank you.
I'm afraid I will bring you back to the table that you showed on your slide 27 about Annexure E. I know you've answered a previous question to the Chairman about this, but it wasn't entirely clear to me.
In the second column here, so the "power storage capacity", I think you mentioned that Annexure E would not be applicable to run-of-river hydroelectric plants. So I wonder then: what kind of power production does the second column here refer to?
PROFESSOR WEBB: I think that is power production from a storage work. But can I come back to you to clarify that?
PROFESSOR BUYTAERT: Yes, I think if that's your answer, my follow-up question would be: what kind of power storage work is permitted under the Treaty?
PROFESSOR WEBB: I will come back to you on that as well. Thank you.
PROFESSOR BUYTAERT: Thank you.
THE CHAIRMAN: So I just have one question, and then we'll let you and everyone go.
I was particularly interested in the last part of

17:20 your presentation, where you were answering that question that we had in paragraph 35(b). One could focus in on that particular question, which is about practices. But I'm wondering if one can look at this a little bit more holistically, as to where in the overall scheme of sources of law, or practices, one might see a progression of reasoning that should take place in any given instance.

So let me read out to you what I discerned from your Memorial. And I don't expect you to answer this now, but it may be something worth pondering overnight and in the days to come. It seems to me that maybe Pakistan is advancing the following five steps as the sequence for applying sources of law or practices.

First, the Treaty's specific requirements in all instances must be observed.

PROFESSOR WEBB: Yes.

THE CHAIRMAN: So, for example, don't use best practices to negate a specific Treaty requirement, such as perhaps on drawdown flushing.

Second, those Treaty requirements sometimes allow for construction of a hydroelectric plant on the Western Rivers by India with reference to design or customary or accepted practices; and I know we'll be talking about that tomorrow. But this will often depend on

17:22 a plant-by-plant analysis, such as the materials you would use to construct a spillway gate, or something like that.

Third, it's possible for Treaty rights and obligations to be informed by, but not negated by, customary international law. So an example of that would be the Kishenganga use of international environmental law, as you just discussed to us.

Fourth, on an issue not regulated by the Treaty, the parties are still bound by other treaties to which they are a party and customary international law. I think that probably then falls to a large extent outside the scope of the Treaty.

And then fifth, on issues not regulated by any treaty or customary international law, the parties have discretion in the design and operation of the hydroelectric plants.

This is my attempt to pull together into one place the propositions that were advanced in the Memorial. I may have got them right, I may have got them wrong. But I'd be interested in hearing from Pakistan at some point a gathering-together of these various sources in a way that might allow for a progression of analytical reasoning.

PROFESSOR WEBB: Yes, thank you. That's very helpful, and

17:23 we will study the transcript closely. I just give two reactions now.

On your third point, that Treaty rights and obligations are informed by customary international law but not negated by it, I would add in there the necessity criterion from paragraph 29, Annexure G. So it's not just a test of: this doesn't negate what the Treaty says. To enter that gateway of customary international law or other conventional law, it has to be necessary.

And on your fifth point, that there's discretion in design and operation if it's not issues falling within treaty or customary international law, I would add: the spirit of the Treaty, and also the role of the Commission, even in that instance, that there be data-sharing, consultation, visits and so on.

THE CHAIRMAN: Very good. In that case, there are perhaps ways you'd want to massage the scheme I presented to you, and that's precisely why I put it to you not as an immediate response but a response in due course.

PROFESSOR WEBB: Yes, and we will reflect on that, thank you.

THE CHAIRMAN: I think we don't have any further questions for you. But thank you, Professor Webb. Your presentation was very helpful.

17:25 I'll turn to Sir Daniel. I think we are probably done for the day, and relatively caught up. So unless there's other business, we will end the day and resume tomorrow morning.

SIR DANIEL: Thank you, Mr Chairman. I think that's absolutely right, and I'm grateful for your indulgence over the coffee break. I hope that there was no self-denying ordinance on the part of the members of the Court in terms of asking questions, but no doubt otherwise we will get them in a flood on Saturday. And we are caught up in terms of timing, so we will start again tomorrow, and we are almost within sight of the pinnacle.

THE CHAIRMAN: Excellent. We'll see you at 9.30 then.

SIR DANIEL: Thank you.

(5.26 pm)

(The hearing adjourned until 9.30 am the following day)