

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

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

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COURT OF ARBITRATION:

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

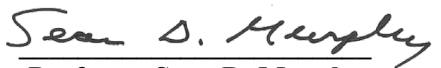
SECRETARIAT:

The Permanent Court of Arbitration

ON BEHALF OF THE COURT OF  
ARBITRATION:

CERTIFIED PURSUANT  
TO  
PARAGRAPH 19 OF ANNEXURE G

11 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 4

Thursday, 11 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

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BETWEEN:

THE ISLAMIC REPUBLIC OF PAKISTAN  
-and-  
THE REPUBLIC OF INDIA

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Transcript produced by Trevor McGowan  
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<p>1 Thursday, 11 July 2024</p> <p>2 (9.30 am)</p> <p>3 THE CHAIRMAN: Good morning, everyone. This is the fourth</p> <p>4 day of our hearing, and I see that Sir Daniel is at the</p> <p>5 podium. So I will give the floor over to him to get us</p> <p>6 started.</p> <p>7 SIR DANIEL: Thank you very much, Mr Chairman, members of</p> <p>8 the Court. Good morning. I hear rumours that there was</p> <p>9 a football match yesterday, but some of us didn't have</p> <p>10 an opportunity to glance at it. There we are.</p> <p>11 (9.31 am)</p> <p>12 Submissions on Construing the Design Criteria</p> <p>13 of Paragraph 8 of the Treaty</p> <p>14 SIR DANIEL: Against the background of our building-block</p> <p>15 submissions over the past days, we are turning today,</p> <p>16 Mr Chairman, members of the Court, to address Pakistan's</p> <p>17 detailed case on the interpretation of the paragraph 8</p> <p>18 design criteria.</p> <p>19 As you know from our scheme of submissions, we will</p> <p>20 do this through a number of submissions, starting with</p> <p>21 Dr Morris, followed by a cascade of submissions by</p> <p>22 Professor Webb and Dr Miles, who, until this point, has</p> <p>23 had to sit quietly and patiently waiting for his moment</p> <p>24 to come. But it will come: he will be on his feet three</p> <p>25 times over the course of the next two days.</p> <p style="text-align: center;">Page 1</p>	<p>09:33 1 Integral to this is the issue that the constraints</p> <p>2 in question are design constraints that must be written</p> <p>3 into the HEP before it is constructed. This is the only</p> <p>4 way to safeguard Pakistan's right of unrestricted use of</p> <p>5 the waters of the Western Rivers, as the Treaty does not</p> <p>6 contain an effective mechanism for the operational</p> <p>7 oversight of a HEP once it is constructed.</p> <p>8 So if a permissive approach is adopted to the design</p> <p>9 of a plant, for purposes of allowing for operational</p> <p>10 flexibility in due course on the basis of India's</p> <p>11 unilateral appreciation, Pakistan would have little real</p> <p>12 remedy or recourse. Even if the Treaty does contain</p> <p>13 important operational limitations -- for example, in</p> <p>14 paragraph 15 of Annexure D -- it has no effective</p> <p>15 real-time compliance and enforcement mechanisms that</p> <p>16 apply to India's operation of its Western River HEPs.</p> <p>17 Critically, therefore, Pakistan's Treaty rights can only</p> <p>18 be meaningfully safeguarded at the design stage, before</p> <p>19 the HEP is built.</p> <p>20 And the Treaty recognises this, as it is at the</p> <p>21 design stage that the constraints on India's conduct</p> <p>22 fall to be imposed. So the chapeau of paragraph 8,</p> <p>23 which I took you to the other day and with which you'll</p> <p>24 be very familiar, is cast in terms of mandatory design</p> <p>25 criteria:</p> <p style="text-align: center;">Page 3</p>
<p>09:31 1 I will start us off this morning with something</p> <p>2 a little bit more substantive than my MC role over the</p> <p>3 past two days, addressing the topic of construing the</p> <p>4 design criteria of paragraph 8 of the Treaty. My</p> <p>5 purpose is to draw together some of the points that</p> <p>6 we've addressed over the past three days that will be</p> <p>7 relevant to the analysis to come.</p> <p>8 I expect that I'll be on my feet for about</p> <p>9 30 minutes or so. And depending on the timing of the</p> <p>10 rest of the day, I expect to be back at the end of the</p> <p>11 day to make some brief submissions about the calculation</p> <p>12 of pondage, which are intended to be a bridge to</p> <p>13 Dr Miles's submissions tomorrow, who will do the heavy</p> <p>14 lifting on the topic.</p> <p>15 So I start with three broad points, to frame the</p> <p>16 issues.</p> <p>17 First, the dispute of which you are seised is</p> <p>18 a dispute about two issues: the sediment management of</p> <p>19 and the storage of water by Indian run-of-river HEPs on</p> <p>20 the Western Rivers. The question in respect of both is:</p> <p>21 what is the scope and the content of the constraints</p> <p>22 imposed by paragraph 8 of the Treaty on India's</p> <p>23 latitude, first of all, to manage the accumulation of</p> <p>24 sediment in its Western Rivers; and second, to store</p> <p>25 water?</p> <p style="text-align: center;">Page 2</p>	<p>09:34 1 "... the design of any new Run-of-River Plant ...</p> <p>2 shall conform to the following criteria: ..."</p> <p>3 That's the chapeau of paragraph 8.</p> <p>4 Mr Chairman, members of the Court, this appreciation</p> <p>5 is important, and it will be important to the Court's</p> <p>6 task, as it means that if they are to be useful, the</p> <p>7 interpretations that the Court will reach on the various</p> <p>8 subparagraphs of paragraph 8 will need to be precise and</p> <p>9 certain; insofar, of course, that you will conclude that</p> <p>10 you can be precise and certain. Interpretations that</p> <p>11 say, for example, "it depends", are likely to be less</p> <p>12 than helpful, as there are unlikely to be effective</p> <p>13 avenues to resolve the disputes that will almost</p> <p>14 certainly follow from anything that is less than precise</p> <p>15 and certain. It is essential that the interpretations</p> <p>16 arrived at by the Court provide workable and effective</p> <p>17 clarity for the parties on the meaning of these</p> <p>18 contested terms.</p> <p>19 My second framing point is that, within margins,</p> <p>20 largely to cater for the site of its proposed HEPs,</p> <p>21 India, for the past 32 years, has been presenting</p> <p>22 Pakistan with one largely standard design for its HEPs.</p> <p>23 Since Baglihar in 1992, the parties have thus been stuck</p> <p>24 in a loop of proposal and objection, followed by</p> <p>25 standoff.</p> <p style="text-align: center;">Page 4</p>

<p>09:36 1 Amongst many others, there are two important reasons                  2 for this impasse. The first is that India is designing                  3 for its 5,000-plus large dams countrywide, not for its                  4 201 Western Rivers HEPs. The second is that, seemingly                  5 with a view to frustrating meaningful engagement on its                  6 designs, India has been and is being less than                  7 forthcoming in its compliance with the exchange of                  8 information obligations under the Treaty, whether this                  9 is under paragraph 9 of Annexure D or under Article VII,                  10 paragraph (2) of the Treaty.                  11 As you will recall, the language used by Pakistan's                  12 Commissioner in his testimony to you on Monday was that                  13 Pakistan is being presented successively with fait                  14 accompli. And as you heard from Dr Morris, India                  15 appears not to be designing its plants with a view to                  16 taking into account downstream effects. This is                  17 a significant problem and one that, once again, calls                  18 for a precise and clear articulation of the meaning of                  19 the mandatory design criteria in paragraph 8.                  20 Mr Chairman, members of the Court, with an eye to                  21 the principle of effectiveness of treaties, you may                  22 indeed consider that you can also say something in due                  23 course about the cooperation and information-sharing                  24 obligations under the Treaty, insofar as they are linked                  25 to the effectiveness of the paragraph 8 criteria.</p> <p style="text-align: center;">Page 5</p>	<p>09:40 1 So these provisions intrude into the decision-making                  2 space of each state.                  3 Within this framework, India's choice of site for                  4 its HEPs will, or at the very least may, be highly                  5 material to its ability to comply with its obligations                  6 under the Treaty.                  7 If, for example, India chooses to design a high dam                  8 in a wide gorge with significant dead storage, all for                  9 purposes of raising the operating pool to an elevation                  10 that will generate sizeable head, there is every chance                  11 that the size of the reservoir will give rise to issues                  12 of Treaty compliance with regard both to pondage and to                  13 sediment management. As Dr Morris explained yesterday,                  14 in such a case, every metre in height of the dam wall                  15 will impound an enormous volume of water in the                  16 reservoir. It is the inch-thick, mile-wide calculation.                  17 In contrast, India could choose to locate the dam of                  18 a HEP upstream, on the basis that the head otherwise                  19 planned to be achieved by constructing a large dam would                  20 be achieved through a longer headrace tunnel, with the                  21 result that there would be no need to raise the height                  22 of the operating pool. This may comply more readily                  23 with the Treaty's requirements for pondage, as well as                  24 other design elements, and would be more conducive to                  25 the sound management of sediment.</p> <p style="text-align: center;">Page 7</p>
<p>09:38 1 My third framing observation comes to a point made                  2 repeatedly by Dr Morris, and one to which I will also                  3 return more than once, and I suspect he will return to                  4 again once I've concluded, and it is that India has                  5 a choice of sites, a choice of where to locate its HEPs.                  6 And as Dr Morris put it, design engineers are not                  7 presented with a river: they are presented with a site.                  8 India evidently considers that it is free to choose                  9 where it wishes to locate its HEPs. Viewed with a long                  10 lens, this is certainly true. It is not for Pakistan to                  11 tell India where it can or should build its HEPs. But                  12 what you see through a telescope you see rather                  13 differently through a microscope, and close review                  14 paints a more complex picture.                  15 The Treaty, a cornerstone legal instrument governing                  16 relations between the parties, imposes obligations on                  17 both parties which intrude into their decision-making                  18 space. Pakistan cannot dam up the waters of the Eastern                  19 Rivers, or otherwise interfere with the flow of the                  20 waters of the Eastern Rivers, before they finally cross                  21 into Pakistan. Similarly, India is under an obligation                  22 to let flow the waters of the Western Rivers, and to                  23 exercise the exceptions that avail it in respect of the                  24 non-consumptive use of those waters, in a manner that                  25 will not impede Pakistan's right of unrestricted use.</p> <p style="text-align: center;">Page 6</p>	<p>09:41 1 I will come in a moment, when I pick up some of the                  2 threads from Dr Morris's presentation, to give you                  3 a reference to the Kishenganga partial award where the                  4 Court, in those proceedings, in fact recognised                  5 precisely this issue.                  6 India has a choice of where to locate its HEPs.                  7 When doing so, however, it must have regard to its                  8 international obligations to Pakistan under the Treaty.                  9 Its choice of site will facilitate or it will hinder or                  10 it will frustrate India's ability to comply with its                  11 Treaty obligations. This may also give rise to higher                  12 or lower costs of compliance with the requirements of                  13 the Treaty. India's choice of site and costs of                  14 compliance to its mandatory Treaty obligations must,                  15 however, hew to the Treaty, not the other way round.                  16 As you again heard from Dr Morris yesterday, at                  17 a reasonable site, there will always be effective                  18 Treaty-compliant means of sediment management. India's                  19 choice of site will be critical to the design choices                  20 that it will be required to make, if it is to meet its                  21 Treaty obligations. It cannot treat the choices of site                  22 as falling outside the framework of the Treaty. The                  23 interpretation and application of the mandatory design                  24 criteria of paragraph 8 must take account of this, and                  25 cannot proceed on the basis that the paragraph 8</p> <p style="text-align: center;">Page 8</p>

1 criteria only become engaged once India has chosen its  
 2 preferred site.  
 3 Mr Chairman, members of the Court, I turn from these  
 4 framing points to recap a number of points about the  
 5 scheme of Article III and of Annexure D, and paragraph 8  
 6 thereof, that will be relevant to your interpretative  
 7 task. And we've addressed these already, so I'm just  
 8 pulling out a number of summary points.  
 9 First, to the point of the rule and its exceptions,  
 10 whatever may be the doctrinal debate between  
 11 Humphrey Waldock and Gerald Fitzmaurice, as two of the  
 12 International Law Commission special rapporteurs, the  
 13 controlling consideration is the structure of  
 14 Article III, and the way that the rule and the exception  
 15 is expressed. And we say that in our case this leaves  
 16 no room for debate at all. The Waldock/Fitzmaurice  
 17 debate is a doctrinal debate that is taking place  
 18 somewhere at the far corner of the garden; it's not in  
 19 this room.  
 20 The provisions on which we are focused are not  
 21 structured as two detached clauses that might be  
 22 interpreted in isolation from or independent of each  
 23 other. The rule is stated: Pakistan shall receive the  
 24 unrestricted use of the waters, and India is under  
 25 an obligation to let flow. The rule is then elaborated

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09:46 1 by way of a principal and superior clause, Pakistan's  
 2 right to unrestricted use, and, by way of a subordinate  
 3 clause, India's entitlement, by way of exception, to  
 4 generate hydroelectric power.  
 5 In our submission, it follows that on the basis of  
 6 settled canons of treaty interpretation, which you heard  
 7 about from Professor Webb, the exception falls to be  
 8 construed narrowly. In other words, it falls to be  
 9 construed in a manner that does not diminish the primary  
 10 rights of Pakistan, unnecessarily so; or it falls to be  
 11 construed in a manner that is as least intrusive as  
 12 possible into Pakistan's right.  
 13 Turning to the scheme of Annexure D. I took you  
 14 through its structure on Monday. Let me recap briefly  
 15 some of those elements in headline terms.  
 16 Firstly, we have the definitions in paragraph 2, key  
 17 elements of which were given special meanings. And let  
 18 me just pause for a moment to emphasise this point about  
 19 special meanings.  
 20 You heard Professor Webb on the issue of special  
 21 meanings under the general rule of treaty interpretation  
 22 in Article 31, paragraph 4. If a special meaning is  
 23 intended, that special meaning must be accorded when it  
 24 comes to the interpretation of the Treaty.  
 25 And as Professor Webb has addressed, as I addressed,

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09:44 1 upon: India shall not interfere with the waters and  
 2 shall not store any waters. And then the hydropower  
 3 exception is enumerated: except for the generation of  
 4 hydroelectric power and associated storage, as provided  
 5 for in Annexure D for these purposes.  
 6 These three elements -- the statement of the rule,  
 7 the elaboration of the rule and the statement of the  
 8 exception -- are all addressed in a single article, in  
 9 Article III. And the structure of the article leaves no  
 10 doubt whatsoever about the superior and subordinate  
 11 relationship of these provisions.  
 12 It is also material that the hydropower exception,  
 13 while expressed in Article III, is only elaborated in  
 14 Annexure D. Annexure D, however, is not a self-standing  
 15 provision, as its subheading and paragraph 1 make  
 16 abundantly clear: it is subordinate to Article III.  
 17 Annexure D cannot, therefore, be construed without  
 18 reference or regard to Article III. The language of  
 19 Article III(2) and III(4) also are expressly drafted in  
 20 terms of a principal, affirmative statement of  
 21 Pakistan's right or entitlement, followed by a carve-out  
 22 for the exception for India's hydropower generation.  
 23 Mr Chairman, members of the Court, the structure and  
 24 the terms of Article III and Annexure D do not, we say,  
 25 do not admit of any other reading than that they state,

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09:48 1 and as both Professor Webb and Dr Miles will come on to  
 2 address in due course -- I should say, as also Mr Rae  
 3 has addressed -- there are a number of critical  
 4 provisions in the Treaty in Annexure D which are  
 5 accorded special meanings, meanings that are different  
 6 from the meaning that is attributed to them in normal  
 7 engineering parlance. "Pondage" is one, "Firm Power" is  
 8 another, and there are others as well.  
 9 So we've got paragraph 2, which provides a number of  
 10 definitions, and accords special meaning to a number of  
 11 key provisions. Paragraph 8 then sets out the mandatory  
 12 design criteria. We then have in paragraphs 9 to 11 the  
 13 information-sharing, objection and dispute settlement  
 14 provisions; and then finally, the provisions addressing  
 15 the operation of the plant set out in paragraph 15.  
 16 We will come to all of those in these submissions  
 17 over the course of the next two days. There are, of  
 18 course, other relevant provisions, which we will cite as  
 19 appropriate, but these are the key ones for present  
 20 purposes.  
 21 Leaving aside subparagraph (g) of paragraph 8, which  
 22 is not present for present purposes, each of the other  
 23 subparagraphs essentially address two issues: first,  
 24 constraints on the storage of water; second, constraints  
 25 on the design of the plant for purposes of sediment

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<p>09:49 1 management.                  2 Subparagraphs (a), (b) and (c) address design                  3 criteria relevant to the storage of water: (a) the dam                  4 shall not be capable of artificially raising the level                  5 of the water; (b) the importance of taking into account                  6 the requirements of surcharge storage and secondary                  7 power; and (c) the calculation of maximum allowable                  8 pondage.                  9 Subparagraphs (d), (e) and (f) then set out design                  10 criteria that essentially impose design constraints that                  11 address the management of sediment. They are, of                  12 course, not expressly cast in these terms or exclusively                  13 focused on sediment management, but it is evident that                  14 this is their primary purpose. And this much is clear                  15 from the terms of subparagraph (d), which, as                  16 Professor Webb will shortly address, is the controlling                  17 provision in this cascade of provisions.                  18 Addressing outlets -- all outlets --                  19 subparagraph (d) says that:                  20 "There shall be no outlets below ... Dead Storage                  21 Level, unless necessary for sediment control or any                  22 other technical purpose ..."                  23 As well as the express reference here to "sediment                  24 control", the absence of any reference to what is meant                  25 by "other technical purpose" is a strong indicator that</p> <p style="text-align: center;">Page 13</p>	<p>09:52 1 threads together which are relevant to the task of                  2 construing paragraph 8. And I will just pick up                  3 a number of headline points from one or two of the                  4 submissions. By this I don't mean to undermine the                  5 richness of the submissions elsewhere. The submissions                  6 that you've heard up until now, setting the very broad                  7 base of the pyramid, will be a rich vein to be mined for                  8 interpretative purposes. But I just want to shine                  9 a light on a number of them.                  10 I start with two from Ms Rees-Evans's review of the                  11 circumstances of conclusion of the Treaty and its                  12 travaux préparatoires.                  13 The first is that since 1948, Pakistan has lived in                  14 the shadow of water weaponisation: that India, its                  15 powerful upper riparian neighbour, has the ability to                  16 cut off or manipulate its supply of water at will. It                  17 was Pakistan's appreciation of the risk of weaponisation                  18 that drove its negotiating position on the Treaty in                  19 favour of water independence; in other words, Pakistan's                  20 right of unrestricted use. This was a constant theme in                  21 the negotiations, which ultimately found expression in                  22 India's let-flow, non-interference and no-storage                  23 obligation in the final text of the Treaty.                  24 And then second, while India attempted to cut back                  25 Pakistan's position, and was indeed able to secure</p> <p style="text-align: center;">Page 15</p>
<p>09:51 1 the principal focus of this provision is sediment                  2 management. And as I've just said, and as Professor                  3 Webb will elaborate upon, paragraph (d) is the gateway                  4 through which you then get to paragraphs (e) and (f) as                  5 well.                  6 As will become clear from the submissions by                  7 Professor Webb and Dr Miles, each of these provisions of                  8 paragraph 8 are designed to work together. They each                  9 address a different aspect of the design of                  10 a run-of-river HEP. They are not independent provisions                  11 that operate in isolation of one another. Taken                  12 together, as must be done, they disclose an unambiguous                  13 intent on the part of the drafters of the Treaty, agreed                  14 to by the parties, to impose tight constraints on                  15 India's design latitude in respect of new run-of-river                  16 plants.                  17 These constraints need to be construed to achieve                  18 the effect for which they were intended, both                  19 individually and collectively: namely, to confine, by                  20 design, India's ability to store water and to manipulate                  21 the use of that stored water in a manner that would or                  22 could undermine Pakistan's right of unrestricted use of                  23 the waters of the Western Rivers.                  24 So let me then come to some takeaway points of legal                  25 interpretation from the last few days, to draw some</p> <p style="text-align: center;">Page 14</p>	<p>09:54 1 various exceptions to Pakistan's right of unrestricted                  2 use, notably for the generation of hydroelectric power,                  3 this exception was tightly constrained.                  4 I follow these points from Ms Rees-Evans's                  5 submissions with three principles or propositions drawn                  6 from Professor Webb's submissions that can be very                  7 briefly stated. I anticipate you have these well                  8 already.                  9 First, paragraph 8 must be construed in the wider                  10 context of the three bargains at the heart of the                  11 Treaty: the peace bargain, the Treaty bargain and the                  12 hydro bargain.                  13 Second, being an exception to the primary rule,                  14 paragraph 8 must be read subject to the primary rule of                  15 unrestricted use, let flow, non-interference and no                  16 storage in Article III(1), III(2) and III(4), and must                  17 be construed narrowly.                  18 Third, the Treaty not only does not exclude best                  19 engineering practices, but it positively requires that                  20 India adopt such practices in the service of the Treaty.                  21 Mr Chairman, members of the Court, there are other                  22 principles and propositions to be drawn from our legal                  23 submissions these past days that will be relevant to                  24 your task of construing paragraph 8, but these are the                  25 ones that are key that I shine a light on just for the</p> <p style="text-align: center;">Page 16</p>

09:55 1 moment.  
 2 I turn then -- and I will conclude with this -- but  
 3 I turn then to a number of takeaway engineering points  
 4 from the submissions by Dr Morris and Mr Rae.  
 5 Starting with Dr Morris, I note six headline points  
 6 under which will be captured a wider array of salient  
 7 engineering insights that will inform your  
 8 interpretative task.  
 9 First, the issue writ large arising from the  
 10 interpretation and application of paragraph 8 is one of  
 11 risk and damage to Pakistan that would flow from  
 12 a permissive interpretation of the paragraph 8  
 13 provisions. For India, there will always be  
 14 a workaround. This is not the case for Pakistan.  
 15 Second from Dr Morris, sediment is the primary issue  
 16 of challenge and concern for run-of-river HEPs in the  
 17 Himalaya. Sediment will be the primary factor that will  
 18 control design.  
 19 Third, where to locate a HEP is a discretionary  
 20 choice for India. Where India chooses to site its HEPs  
 21 will be a critical factor in its ease of compliance with  
 22 the paragraph 8 design criteria.  
 23 Fourth -- and this is perhaps the biggest, as it  
 24 were, in volume terms, takeaway from Dr Morris's  
 25 submissions -- fourth, there are a wide range of

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09:59 1 drawdown, or empty, flushing, not least of all  
 2 environmentally. It is not unusual to have restrictions  
 3 or even prohibitions on flushing; in contrast to  
 4 sluicing, which, as Dr Morris explained, tries to "mimic  
 5 the natural pattern" of the river (Day 3, page 44,  
 6 line 21). And one example that he gave of the  
 7 contrasting regulatory approaches to flushing and  
 8 sluicing is found in the 2005 US Army Corps of Engineers  
 9 regulatory guidance letter, which is at Exhibit P-612.  
 10 Now Dr Morris was on his feet for about two and  
 11 a half hours. I think that there is a richness in his  
 12 submissions -- and he will pick up on some of these  
 13 themes shortly -- a richness in his submissions for  
 14 purposes of the interpretation of paragraph 8 from  
 15 an engineering perspective. Of course, the controlling  
 16 text is a legal text, which is why we are presenting it  
 17 in this form. But I would very much invite the members  
 18 of the Court to go back over Dr Morris's submissions,  
 19 both the ones given and no doubt the ones to come as  
 20 well.  
 21 From these takeaways from Dr Morris, I would add  
 22 three from Mr Rae's submissions.  
 23 First of all, run-of-river HEPs operate on the basis  
 24 of storage on a day-to-day basis: they are intended as  
 25 daily peaking plants.

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1 effective sediment management techniques that would be  
 2 available to India to address issues of sediment  
 3 management. Apart from drawdown or empty flushing,  
 4 these include: sluicing, the use of desanders, dredging,  
 5 resort to sediment-guided operations, turbine coating  
 6 and the use of off-site reservoirs. Sediment management  
 7 should be treated as an issue of operational cost when  
 8 it comes to run-of-river HEPs, for example, with respect  
 9 to the coating of turbines.  
 10 Fifth from Dr Morris, if the choice of site is  
 11 reasonable, there will always be effective workarounds  
 12 to address sediment management and workable alternatives  
 13 to flushing. There is nothing inherently overwhelming  
 14 about the design constraints of the Treaty. There is  
 15 not a one-size-fits-all approach.  
 16 And in this regard, also drawing the link to my  
 17 submissions a moment ago, I draw attention to the  
 18 analysis and conclusions of the Kishenganga Court at  
 19 paragraph 521 of its partial award, which expressly  
 20 considered and addressed the issue of the size and  
 21 location of a HEP when it came to the issue of dam  
 22 design for purposes of effective sediment management.  
 23 That's paragraph 521.  
 24 And then finally from Dr Morris, there are very  
 25 significant downstream problems associated with

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10:00 1 Second, there is a good deal of uncertainty and  
 2 variability in load curves. These change over time with  
 3 changing demand, with changes in a country's level of  
 4 development and other factors. And these are  
 5 observations that Mr Rae made in response, Mr Minear,  
 6 to questions that you posed.  
 7 And third from Mr Rae, and this is a point that  
 8 I will come back to later this afternoon: the Treaty  
 9 adopts bespoke definitions, special meanings, for -- in  
 10 particular for these purposes -- "Pondage" and  
 11 "Firm Power".  
 12 The definition of "Firm Power" in the Treaty is, in  
 13 Mr Rae's words (Day 3, page 75, lines 2-8):  
 14 "... a ... formula that simplifies [the] computation  
 15 of ... firm power by establishing the flow rate that  
 16 will be used to calculate firm power. And this  
 17 simplification allows for the definition of firm power  
 18 without resorting to ... assumptions."  
 19 Mr Chairman, members of the Court, I am at the end  
 20 of my submissions. Both Dr Morris and Mr Rae's  
 21 submissions provide, again, rich veins of expert  
 22 engineering insight, from which a range of other  
 23 principles and propositions may be drawn to inform your  
 24 interpretative exercise. The points that I have just  
 25 now drawn out will inform the submissions that you will

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1 hear shortly from Professor Webb and from Dr Miles:  
 2 Professor Webb addressing outlets, spillways and power  
 3 intakes; that is, the interpretation of subparagraphs  
 4 (d), (e) and (f) of paragraph 8. Dr Miles will follow  
 5 Professor Webb this afternoon, addressing the issue of  
 6 freeboard; that is, the interpretation of  
 7 subparagraph (a) of paragraph 8. And Dr Miles will  
 8 return tomorrow for a lengthy period to address pondage  
 9 and the interpretation of subparagraph (c) of  
 10 paragraph 8. But before any of that, we have the  
 11 benefit once again of Dr Morris's further submissions on  
 12 the subject of approaching paragraph 8 from the  
 13 perspective of an engineer.  
 14 Without more ado, Mr Chairman, unless there is  
 15 anything with which I can help you or other members of  
 16 the Court, may I ask you to invite Dr Morris to take the  
 17 podium.  
 18 THE CHAIRMAN: Thank you, Sir Daniel. I don't have any  
 19 questions relating to what you just said. But I've been  
 20 reflecting a little bit on the presentations from  
 21 yesterday, so I thought I would offer up just a few  
 22 comments/questions that you don't need to take on right  
 23 now, but it may help you with respect to presentations  
 24 to come, and possibly second round as well.  
 25 (10.03 am)

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10:05 1 award. There may be some utility in breaking them out,  
 2 if having an award related just to paragraph 35(a) on  
 3 a sooner-rather-than-later timeframe was helpful to the  
 4 parties for whatever reason.  
 5 So I just wanted you to think about that. I know  
 6 tomorrow you'll be talking to us a bit about what the  
 7 dispositif might look like, what the reparation you seek  
 8 looks like, and perhaps in that context you'd want to  
 9 provide us any reflections on that.  
 10 Completely separate from that, I think it was during  
 11 Professor Webb's presentation, we had some interest in  
 12 the relationship of Annexure D to Annexure E. And  
 13 I realise that Annexure E is not before the Court in  
 14 this particular proceeding.  
 15 Having said that, it does seem that to the extent  
 16 that Pakistan believes that a let-flow,  
 17 non-interference, no-storage principle should help guide  
 18 us and inform us in our interpretation of Annexure D,  
 19 then perhaps we should have some eye on Annexure E,  
 20 which seems to allow for a fair amount of storage of  
 21 water, and therefore arguably works a little bit against  
 22 the idea of "let flow", or at least we don't quite  
 23 understand how it relates to that Annexure E.  
 24 I suppose I'm also curious about: the volume of  
 25 storage that Pakistan is worried about in the context of

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10:03 1 Questions from THE COURT  
 2 THE CHAIRMAN: The first is that Mr Fietta yesterday  
 3 presented to us on the issues concerning precedential  
 4 effects of Court of Arbitration decisions and Neutral  
 5 Expert determinations. Those issues, as we know, fall  
 6 under paragraph 35(a) of Procedural Order No. 6, and  
 7 they seem to be questions that are somewhat different in  
 8 nature from the other questions that we are also looking  
 9 at from the remainder of paragraph 35.  
 10 As one ponders ultimately deciding on these  
 11 questions, one possibility is to decide them all  
 12 together, in a single award. The other possibility  
 13 would be to take those particular questions and separate  
 14 them out for a separate award.  
 15 I raise this in part because one might imagine that  
 16 that separate award on paragraph 35(a) might be capable  
 17 of being issued on a sooner rather than later timeframe,  
 18 whereas the other questions before us have a certain  
 19 depth and complexity to them that perhaps will take  
 20 a bit longer.  
 21 In either instance, I will emphasise, the Court is  
 22 going to taking the time it needs to do its work in  
 23 properly assessing and deciding the questions. But  
 24 there may be advantages in keeping these all together,  
 25 in a single, relatively comprehensive systemic questions

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10:07 1 Annexure D, how does that relate to the volume of  
 2 storage that is allowed under Annexure E? To the extent  
 3 that it's a small percentage in Annexure D of  
 4 Annexure E, then one wonders why there would be a lot of  
 5 emphasis on Annexure D as opposed to Annexure E.  
 6 Perhaps they're the same amount of volume. We just  
 7 don't know, because you haven't really spoken to us on  
 8 that issue.  
 9 The use of the storage in Annexure E also isn't  
 10 entirely clear to us. How readily India can release  
 11 from the storage units and then fill them back up seems  
 12 as though it may be relevant to this issue of the "let  
 13 flow" and the concern that Pakistan has.  
 14 One way of approaching talking about that could be:  
 15 what were the problems with KHEP, in the context of  
 16 being a storage facility as opposed to a hydroelectric  
 17 plant? We don't know, I don't know if that provides any  
 18 insights.  
 19 But again, I don't expect you to answer this; it's  
 20 not actually the subject we're talking about today. But  
 21 because it came up yesterday and because it's on my  
 22 mind, I thought I would at least offer it up to you as  
 23 things to be thinking about in the days to come.  
 24 SIR DANIEL: Thank you very much, Mr Chairman. Let me just  
 25 make a brief response on the second of your points, and

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10:09 1 perhaps a slightly fuller but still brief response on  
 2 the first of your points.  
 3 Certainly we will come back on the question of  
 4 Annexure E, and the relationship between Annexure D and  
 5 Annexure E. I think that we will do so in the second  
 6 round next week, because I think that some of the issues  
 7 that you've put on our plate are quite big issues that  
 8 we'll want to try and unpack, rather than trying to feed  
 9 them into the submissions that we're making at the  
 10 moment.  
 11 As you say, there's going to be a little bit of  
 12 history here which we can try and unpack, in particular  
 13 with regard to Kishenganga, going back to 1988 and its  
 14 evolution from the proposal that was originally in  
 15 Annexure E, storage plants, to which we objected, and  
 16 then it metamorphosed into an Annexure D plant. So we  
 17 will have a look at that.  
 18 There are, in fact, some very real and pressing  
 19 issues which are not now before you, but we'll have to  
 20 give careful thought just to how they may play into  
 21 this. For example, on the Chenab -- as Dr Morris was  
 22 talking about -- in fact, upstream of a number of the  
 23 run-of-rivers -- of Baglihar, Ratle, Dul Hasti -- you've  
 24 got the construction of a very, very large storage dam,  
 25 Pakal Dul, and there are questions associated with that

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10:12 1 of your Court as it's to come, particularly because this  
 2 is likely to have helpful implications for unpacking  
 3 a little bit your duty of comity that you've set out in  
 4 paragraph 6. So that is immediately attractive at one  
 5 level.  
 6 There is, though, a question that comes to our  
 7 minds, which we will think further on, but I'm not sure  
 8 ultimately that this is something that will be in our  
 9 control to calibrate, but it most certainly would be  
 10 within your control to calibrate. And that is that if  
 11 you give a partial or preliminary award on the  
 12 interpretation of paragraph 35(a) issues, and those open  
 13 up issues of substance which need to be revisited with  
 14 regard to the 35(b) through to (g) issues, there may  
 15 very well be a question as to whether you want then to  
 16 have further submissions from us as to how the partial  
 17 or preliminary award that you render on -- if I can, by  
 18 shorthand, use it -- "the res judicata point", whether  
 19 that has any implications for the arguments that we've  
 20 been making on the other issues.  
 21 So you will be able to calibrate that as you go  
 22 along, because if you come to a conclusion on  
 23 paragraph 35(a), you will have, I imagine, a pretty good  
 24 sense of whether this will have knock-on implications or  
 25 not.

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10:10 1 for the downstream. Pakal Dul, for example, is likely  
 2 to act as a sediment trap for some of the smaller  
 3 downstream plants.  
 4 But let us give some thought to the interaction  
 5 between E and D, and we'll come back to that.  
 6 You've enumerated -- I've made a note here --  
 7 I think three elements in relation to Annexure E that  
 8 you have in mind from our submissions to this point.  
 9 But if there are any particular points that you would  
 10 like to draw to our attention, including in the  
 11 questions that you will put to us on Saturday, that  
 12 would certainly help to focus our minds on addressing  
 13 your concerns.  
 14 On the question of whether there may be advantage to  
 15 a single award which encapsulates all of the  
 16 paragraph 35 questions, or some advantage in having  
 17 a partial award much more quickly, focused on 35(a), and  
 18 then coming back to the other issues later, I am going  
 19 to address you a little bit on this tomorrow, and we  
 20 will come back to this, obviously, in our closing  
 21 submissions in the light of the exchanges tomorrow.  
 22 There would certainly, instinctively, be some  
 23 advantage in clearing away, to useful effect, the, if  
 24 you like, precedential weight of decisions of the  
 25 Kishenganga Court, the Baglihar Neutral Expert, indeed

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10:13 1 I imagine, though, that it will be very helpful,  
 2 certainly for us, maybe also to clear away some of the  
 3 underbrush in your thinking; and undoubtedly, I expect,  
 4 for the Neutral Expert to have some guidance on this.  
 5 Because he is quite clear, on the public record of his  
 6 proceedings which are before you, that he is not  
 7 a lawyer and he's not going to be turning to questions  
 8 of legal interpretation. And it is quite clear from  
 9 paragraph 1 of Annexure F that his remit is limited, as  
 10 an engineer, to those technical engineering points. So  
 11 there would be, possibly, some very useful effect of  
 12 that.  
 13 Just one last observation, and this is  
 14 an observation that I was going to make in any event  
 15 tomorrow. You said quite clearly and quite forcefully,  
 16 laying down a marker for us, that you are going to be  
 17 taking the time that you need to get this right. In  
 18 fact, I was going to stand up here tomorrow and say that  
 19 we very much appreciated the expedition with which you  
 20 rendered your Competence Award last year, but we very  
 21 much appreciate that these are very complex issues on  
 22 the basis of very detailed submissions, and your award  
 23 is going to be an award for all time.  
 24 So we do not want to rush you on this. You are not  
 25 going to be coming under pressure from us for you to

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10:15 1 render an award in whatever time. We want you to take  
 2 the time that you feel that you need to render an award  
 3 which properly covers the ground and allows you a proper  
 4 opportunity to deliberate and to draft.  
 5 So that's also part of the wider context of the  
 6 35(a) separate issue, which we will think about and  
 7 I'll return on.  
 8 THE CHAIRMAN: Two other elements to factor into that last  
 9 point. One is that under our Supplemental Rules of  
 10 Procedure, it does say that "The Court shall endeavor to  
 11 [issue an] Award within 6 months" after a hearing. Of  
 12 course, the word "endeavor" means it may or may not  
 13 happen on that timeframe.  
 14 But the second element worth recalling is that we  
 15 have called upon Pakistan to produce certain documents.  
 16 Those documents are due no later than September 30.  
 17 This means there will be some post-hearing events  
 18 happening. In all likelihood, those documents are  
 19 pertinent to questions other than 35(a), and therefore  
 20 wouldn't necessarily affect the decision that could be  
 21 reached regarding 35(a) issues.  
 22 But given that there will be at least those  
 23 post-hearing developments, it may well be that the  
 24 typical six months is not just six months from the  
 25 hearing, but from perhaps our ability to have a complete

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10:18 1 that Dr Morris would be up at the podium for about  
 2 an hour and a half, which will mean that he will  
 3 straddle the coffee break. But although we are a little  
 4 bit more stressed for time than we have been over the  
 5 course of the early part of the week, I think that we  
 6 still do have a little bit of wriggle room. So, again,  
 7 these are very important submissions, and we would  
 8 invite the Court to raise the questions that you feel  
 9 you need to raise.  
 10 THE CHAIRMAN: Very good. Thank you, Sir Daniel.  
 11 Bearing that in mind, as we approach the normal time  
 12 for a coffee break at 11.00, perhaps I will see if  
 13 Dr Morris is thinking that there's a good place for  
 14 a break. But we can discuss that when we get to that  
 15 point.  
 16 So, Dr Morris, please proceed whenever you are  
 17 ready. (Pause)  
 18 (10.19 am)  
 19 Approaching Paragraph 8 from the Perspective of an Engineer  
 20 DR MORRIS: Good morning, gentlemen. It's a pleasure to  
 21 address the Court one more time.  
 22 (Slide 2) Today I would like to talk about  
 23 paragraph 8 in Annexure D, which covers the run-of-river  
 24 hydro. We will be covering it from the standpoint not  
 25 of a lawyer, but the standpoint of an engineer who would

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10:16 1 record in front of us.  
 2 SIR DANIEL: Once again, Mr Chairman, we will obviously wish  
 3 and want and hope to receive your award as soon as you  
 4 can render it, but you are not going to come under  
 5 pressure from us. And the "[will] endeavor" I think is  
 6 an appropriately phrased but sufficiently flexible  
 7 standard.  
 8 I note that from the date of your Competence Award,  
 9 or the date of your directions, if I recall, in PO7, it  
 10 took us, I think, eight months to produce our Memorial,  
 11 and we've been thinking about these issues for some  
 12 time. I don't think that we are going to want to hold  
 13 you to a standard which we felt we were unable to meet.  
 14 We would like you to get it right, because this is  
 15 going to be the roots of the next 64 years of the  
 16 Treaty. So we don't want something that you are not  
 17 going to be content with because you don't have  
 18 sufficient time.  
 19 THE CHAIRMAN: Very good, thank you.  
 20 In that case, I think we are ready to move on. And  
 21 if I understand correctly, it's Dr Morris who will be  
 22 coming to the podium.  
 23 SIR DANIEL: It is indeed. (Pause)  
 24 Perhaps while Dr Morris is just gathering his  
 25 things, I'll say that we've been planning on the basis

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1 have to deal with these types of restrictions in the  
 2 design of a plant, design and operation.  
 3 So basically there are seven design parameters. And  
 4 when looking at a plant, we look at physical factors,  
 5 social factors, financial factors. But they need to be,  
 6 for a Treaty-compliant plant, developed within the  
 7 context of what the Treaty says.  
 8 (Slide 3) The first thing the Treaty says is that  
 9 works "shall not be capable of raising artificially the  
 10 water level": not to raise it above the full pondage  
 11 level that's specified in the design.  
 12 Now, you can structurally modify dams to increase  
 13 the water level. Typically, it's not done very  
 14 frequently because it's costly, you increase upstream  
 15 flooding. But it can be done. And some dams in fact  
 16 are designed to eventually have higher gates, et cetera.  
 17 But the key concept here is that the operator should  
 18 "not be capable". In other words, I understand the  
 19 capability here is that you can't easily do this, short  
 20 of structural modification.  
 21 This is one reason why it's also important to limit  
 22 the freeboard, because the more freeboard, the more  
 23 potential space you have to increase the water level.  
 24 And it's quite important because -- we looked  
 25 yesterday at the elevation capacity curve, and we saw

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10:22 1 that on this curve we can see the area of the red dotted  
 2 line on slide 4. And if you raise above the full  
 3 pondage level, every increment, every metre of increased  
 4 elevation, gives you a lot more storage capacity. So  
 5 it's very important to limit the ability to  
 6 conditionally raise the level.  
 7 (Slide 5) And you will remember from the prior  
 8 discussion that if you have a crest spillway, the  
 9 ability to raise the level is limited by overflow over  
 10 the spillway crest. But if you have an orifice  
 11 spillway, and you do not have a crest associated with  
 12 it, then the operator can simply operate the gates to  
 13 raise the water level.  
 14 So the conclusion as a designer from this particular  
 15 parameter is: if I am going to provide an orifice  
 16 spillway, I also have to have a surface spillway.  
 17 I have to have both. I can't just do an orifice  
 18 spillway, because that would allow the operator to  
 19 simply utilise the freeboard as additional storage.  
 20 That's pretty straightforward.  
 21 (Slide 6) 8(b), surcharge and secondary power:  
 22 "The design of the works shall take due account of  
 23 the requirements of Surcharge Storage and ... Secondary  
 24 Power."  
 25 Now, the Treaty defines, in paragraph 2(e), the

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10:25 1 put as much generating capacity as they want on the  
 2 plant, because the generating capacity is not related to  
 3 the storage volume, and it's also not related to --  
 4 remember, you have a certain amount of water you can  
 5 release downstream on a daily rate: you have a maximum  
 6 and a minimum. So within those parameters, they can put  
 7 whatever generating capacity they want.  
 8 (Slide 7) Pondage. This is where it starts to get  
 9 interesting.  
 10 "The maximum Pondage in the Operating Pool shall not  
 11 exceed twice the Pondage required for Firm Power."  
 12 And "Pondage" is defined elsewhere, and someone else  
 13 will talk about -- I think Dr Miles will talk about  
 14 pondage a lot.  
 15 But the Treaty defines the allowable pondage based  
 16 on firm power, which in turn is directly related to the  
 17 hydrology of the site. It's not the design capacity of  
 18 the turbine. In normal operation, you'd say: I have  
 19 this much plant capacity, I want to be able to operate  
 20 it, let's say, four or six hours a day, so given my  
 21 plant capacity, given my operational hours for peaking,  
 22 this gives me the pondage.  
 23 It doesn't work that way here. The pondage comes  
 24 from the hydrology. And this is entirely appropriate  
 25 because the Treaty is set up to protect Pakistan's

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10:23 1 "Surcharge Storage" as being the "uncontrollable storage  
 2 ... space above the Full Pondage Level"; in other words,  
 3 uncontrollable, like we saw on the prior slide, because  
 4 it would overtop the gates if you were to use the  
 5 storage volume. Of course, during a flood, the gates  
 6 would be open and this area fills with floodwaters; and  
 7 as the flood recedes, the level goes down. So it's not  
 8 controllable storage.  
 9 And again, I see this as pretty straightforward. It  
 10 just says that you are allowed to use flood surcharge  
 11 storage, which is absolutely perfectly normal. Some of  
 12 the plants that India has done do not include surcharge  
 13 storage; others do. There's nothing unusual about that  
 14 at all.  
 15 And it also says that they will take in the  
 16 requirements of secondary power. And the way I read  
 17 that is basically to ensure that India can in fact build  
 18 the capacity of a plant as they want. It doesn't mean  
 19 the capacity of pondage, but the generating capacity.  
 20 So the Treaty goes into the definition of "Firm Power".  
 21 And the language here, the way I read it, is to ensure  
 22 that the Treaty is not misread to say that India's  
 23 installed power is limited to the "Firm Power" that's  
 24 defined in the Treaty.  
 25 So it's basically a protection of India's ability to

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10:27 1 hydrology. So therefore, if you're going to protect the  
 2 hydrology, the pondage is defined in terms of hydrology.  
 3 It's also interesting because you're going to design  
 4 a dam, or look at a river system and put dams on it.  
 5 Dams control water. And your starting point, the very  
 6 first thing you have to have, information on that site,  
 7 is the flow. If you do not know the flow rate in the  
 8 river, you cannot do anything with respect to design of  
 9 dams; nothing.  
 10 So your starting point for design process is flow.  
 11 And from the flow, you get pondage. So basically, under  
 12 a Treaty-compliant reservoir, the first parameter, the  
 13 first design parameter that is defined is pondage. And  
 14 that's a little bit different from most design  
 15 processes. But because the objective of the Treaty is  
 16 to protect hydrology, it completely makes sense.  
 17 (Slide 8) Now, the Treaty also limits drawdown to  
 18 the bottom of the pondage pool. In other words, you  
 19 have the operating pool, pondage: that has a full  
 20 pondage level and it has a dead storage level. So that  
 21 operating pool is the region within which you can  
 22 operate the plant for power production and also operate  
 23 the plant for sediment management.  
 24 Now, in the Himalaya we have a pretty high sediment  
 25 load. So you're thinking about: I need to have some

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10:29 1 variation in my water level for sediment management,  
 2 in addition to pondage. And we've done a couple of  
 3 diagrams on that in the last couple of days.  
 4 Flushing also requires drawdown, but it requires  
 5 emptying below the dead storage level so it's not  
 6 Treaty-compliant. So I will not discuss flushing here,  
 7 within the context of this particular item.  
 8 So assuming that you have a Treaty-compliant design,  
 9 your drawdown for sediment management is limited to the  
 10 depth of your operating pool.  
 11 (Slide 9) Now, remember the graph we showed a couple  
 12 of slides ago of the elevation capacity curve. This is  
 13 the curve for Baglihar. This is taken from data that  
 14 India provided under the Baglihar proceeding.  
 15 And as shown in the generic graph, you see that as  
 16 you go to larger volumes of storage here -- at the  
 17 bottom you see 400 million cubic metres, which is the  
 18 total volume of storage of the reservoir. And if I'm at  
 19 the top of the reservoir -- this is 127 metres deep;  
 20 this is 127 metres deep from the original riverbed to  
 21 the top of the full reservoir level: it's the water  
 22 depth. And if I'm using 32.5 million cubic metres of  
 23 pondage, which was defined by Professor Lafitte, I can  
 24 accommodate 32.5 million cubic metres in the top  
 25 4 metres of that reservoir. I can only draw down my

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10:32 1 a design configuration which makes it difficult to use  
 2 Treaty-compliant methods instead of non-compliant  
 3 methods.  
 4 (Slide 10) Now, here are the same two sites: here on  
 5 the left is the Neelum-Jhelum height of dam, here on the  
 6 right is the Baglihar height of dam, and they're  
 7 represented here true to vertical scale. And what's the  
 8 difference? I can do either one of these on the river.  
 9 But I'm going to trade off a tall dam and a short tunnel  
 10 versus a short dam and a longer tunnel. Okay?  
 11 (Slide 11) Here it is represented in a different  
 12 way. Same two projects, configurations on the same  
 13 river. Here we have the turbine powerhouse at the same  
 14 level in both cases. These are again true to scale  
 15 vertically. Here you have the tall dam, short tunnel;  
 16 and here you have the shorter dam, long tunnel.  
 17 Why should we worry about long tunnels? I don't  
 18 know. Dul Hasti has a 9.5-kilometre tunnel. Pakal Dul,  
 19 which is under construction now, has also  
 20 a 9.5-kilometre tunnel. Kishenganga,  
 21 a 22-kilometre-long tunnel. So building long tunnels is  
 22 not something that India does not know how to do.  
 23 Now, let me just address one other issue here. If  
 24 you have this tall dam, now you're going to start  
 25 talking about, "We need to flush". And we talked

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10:30 1 reservoir by 4 metres.  
 2 If that dam is a smaller dam -- and let's put the  
 3 dam at 47 metres instead of 127 metres. 47 metres is  
 4 the same height as Neelum-Jhelum, which you saw on the  
 5 field trip. It is still not a small dam. But at  
 6 47 metres at this site, my operating pool depth for the  
 7 same volume is now 24 metres. I've gone from a 4-metre  
 8 operating pool to a 24-metre operating pool by changing  
 9 the height of the dam.  
 10 To put this into perspective, remember yesterday  
 11 I talked about Kali Gandaki, that plant in Nepal, that  
 12 has 40 million tonnes of sediment a year, which is  
 13 double the sediment load at Baglihar: that plant is  
 14 operated and manages sediment with 6 metres' operational  
 15 range. 6 metres.  
 16 And India, by selecting the height of the dam, is  
 17 basically selecting the allowable operating range under  
 18 the Treaty. So if you select a very tall dam --  
 19 remember to think of it as a triangle: the dam gets  
 20 deeper, gets taller, gets wider, it gets longer; you  
 21 know, mile-wide and inch-deep -- so what happens is that  
 22 you end up with a tall dam with a very restricted  
 23 operating pool. And what you've done is: by your design  
 24 choice, you have created a complicated sediment  
 25 management problem. In other words, you've selected

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10:34 1 a little bit about flushing yesterday, and how you have  
 2 the cost of forgone power, et cetera, but I didn't give  
 3 you any numbers. So let's think about the specific case  
 4 of Baglihar.  
 5 Based on the level of the outlets at Baglihar, from  
 6 the outlet level up to the full pool, we have  
 7 208 million cubic metres. So let's take 200 million  
 8 cubic metres. We're going to empty this to do  
 9 a flushing event. We're not going to empty it all at  
 10 once, because that requires a downstream discharge of  
 11 more than 2,000 metres a second. So you're going to  
 12 flush during the monsoon season, when you have good  
 13 flows, because remember you want good flows to  
 14 efficiently remove sediment and have as wide a flushing  
 15 channel as possible.  
 16 So we're in the monsoon, we've got this flow, and  
 17 we're going to release water downstream, not all on the  
 18 same day. And just for round numbers, let's say we're  
 19 going to release an additional 700 metres a second above  
 20 the inflow rate, which seems kind of reasonable. So  
 21 it's going to take me three days to lower this  
 22 reservoir, and I'm not producing power for three days,  
 23 900 MW. Okay?  
 24 Now, once I've gone down to my low level, I'm really  
 25 starting to release a lot of sediment. And you can't

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10:36 1 release 20 million tonnes of sediment in one day.  
 2 It just will not happen. Physically, the river will not  
 3 move that much sediment, and to put 20 million tonnes in  
 4 one day downstream is disastrous. So we'll just use,  
 5 for this discussion, five days of flushing. We're going  
 6 to remove 4 million tonnes of sediment per day and push  
 7 it downstream.  
 8 So we've got three days of drawdown, we've got  
 9 five days of flushing, and now we have to refill it.  
 10 But we're not going to close the gate and turn the river  
 11 off downstream, to leave the fish flopping on the  
 12 riverbed; we're going to continue to release flows  
 13 downstream. So let's say that the refill period, let's  
 14 take another couple of days. So we've got basically  
 15 three plus five plus two: that's ten days to do this  
 16 flushing event.  
 17 And let's assume that the electrical power costs  
 18 5 cents a kilowatt hour, which is \$50 a megawatt.  
 19 I don't know what India's rates are, but this is  
 20 a fairly typical rate for new power plants, new hydro  
 21 plants. If you get a PPA, you're looking at -- it  
 22 depends on the country, of course. But \$50 a megawatt  
 23 is a very reasonable number: it's neither high nor low.  
 24 Although as Peter showed the other day, the cost of new  
 25 hydro production facilities is increasing over time.

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10:37 1 But at \$50, we're talking about on the order of  
 2 \$13 million to do that flushing. First of all, you  
 3 released 200 million cubic metres through the gates:  
 4 it didn't go through the turbines. There's \$3 million  
 5 of power lost right there. And then all the flushing  
 6 period, all the inflow that you're not passing through  
 7 the turbines. So you've got \$13 million worth of cost  
 8 to do this flushing event. And for \$13 million a year,  
 9 you could buy new runners.  
 10 But that's not all, because you have someone else  
 11 downstream: it's called Salal, another 690 MW. And when  
 12 you're flushing and releasing 4 million tonnes a day at  
 13 Baglihar, you're not going to run that through the  
 14 turbines at Salal.  
 15 So you've got at least a minimum five days that  
 16 Salal is not going to operate. And because you have  
 17 deposited all the sediment in the river all at once,  
 18 your non-operation period at Salal will probably be  
 19 closer to -- you know, it may be ten or fifteen days,  
 20 because you don't want all that sediment coming through  
 21 the turbines. But we'll just use five days. And the  
 22 last day of our drawdown plus our five days of flushing  
 23 makes six days at Salal where you're not going to be  
 24 producing power: another \$5 million.  
 25 So now \$13 million plus \$5 million: now you're at

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10:39 1 \$18 million for one flushing event.  
 2 So yesterday I mentioned that flushing is not cheap.  
 3 And this is just the cost of forgone power. If you have  
 4 anything else you have to do -- any type of mitigation  
 5 work, any type of compensation work, anything --  
 6 it's going to be more than this \$18 million.  
 7 Yes.  
 8 THE CHAIRMAN: Dr Morris, that point is clear.  
 9 I'm interested in your thoughts on: when this  
 10 flushing occurs, does the dam operator successfully  
 11 remove the entire bed load of the sediment, or is it  
 12 typically just a partial removal? And whatever the  
 13 amount is, how often would you need to repeat the  
 14 flushing in order to achieve what you're trying to  
 15 achieve?  
 16 DR MORRIS: Okay. At Baglihar, what you will have is mostly  
 17 sand and silt. The bed load will be quite limited, for  
 18 a couple of reasons. Remember on the first day I showed  
 19 you photographs of bed material in some Himalayan  
 20 rivers, big material, and that doesn't move very  
 21 rapidly. So you're going to have a limited movement to  
 22 begin with.  
 23 And upstream of Baglihar, we have Dul Hasti, which  
 24 acts as a gravel trap for the large sediment, and  
 25 they're also making Pakal Dul. So the upper part of the

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10:41 1 watersheds will be cut off in terms of supply of large  
 2 material: gravels, cobbles, et cetera.  
 3 So you're basically dealing with sand and silt. And  
 4 what you want to do in flushing is you want to have your  
 5 annual flow of sediment come in, and you want to balance  
 6 that with an annual discharge.  
 7 So I mentioned 20 million tonnes a year; this is  
 8 from India's rating curve and the daily data. And what  
 9 we get, of course, is: some years have more, some years  
 10 have less. So this is the long-term average. So the  
 11 operator will pass -- on a timeframe of, let's say,  
 12 five years -- 100% of that downstream. If some years he  
 13 sees that he's passing not enough, then the next year he  
 14 may flush for five, six, seven or eight days; whereas  
 15 another year he might flush for only two or three days.  
 16 The problem though is: if you do this flushing on  
 17 an annual basis, you can move it downstream more or less  
 18 regularly; but if you start saying, "I'm going to flush  
 19 every other year", then what happens is that instead of  
 20 having 20 million tonnes to deal with, now you've got  
 21 40, and you've got to pass 40 down in a flushing event,  
 22 or two flushing events. And then you say, "Well, am  
 23 I going to do two flushing events in a monsoon?"  
 24 And of course, every flushing event here, the dollar  
 25 cost is not related to the sediment release: it's the

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10:43 1 dollar cost of the water that doesn't go through the  
 2 turbines. So if I flush twice a year, the dollar cost  
 3 basically doubles.  
 4 Now, if I did have a significant bed load -- and we  
 5 saw this at Kali Gandaki, there's nothing upstream  
 6 preventing it: we were seeing gravels being flushed  
 7 through the reservoir. Not very much gravel was coming  
 8 down the system, there wasn't very much, but it was  
 9 passing through the reservoir and moving downstream.  
 10 So it will pass much of your bed material; not the  
 11 boulders. But that is also why you need to do this with  
 12 high discharges, because high discharges move that  
 13 material. And of course, targeting periods of high  
 14 discharge means that your rate of drawdown is limited  
 15 because you already have flood conditions and you can't  
 16 suddenly release 200 million cubic metres downstream to  
 17 create a monster flood.  
 18 So hopefully that has answered the question.  
 19 THE CHAIRMAN: Yes, I think so.  
 20 Would it be correct to say that the typical approach  
 21 to doing a flushing would be on an annual or a biannual  
 22 basis, not: we wait five years, we wait ten years and  
 23 then we do it?  
 24 And then the second proposition would be that the  
 25 objective is not necessarily to clear out all the

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10:46 1 So ...  
 2 THE CHAIRMAN: And if you were trying to gauge the amount of  
 3 water within a reservoir that was available for  
 4 potentially flooding downstream, you would need to take  
 5 account that there's going to be some percentage of the  
 6 reservoir that's been filled up with sediment, and  
 7 therefore leaving a pool of water, if you will, above  
 8 that bed load, that that's what's available for the  
 9 flooding event?  
 10 DR MORRIS: Yes. And that's why I put these numbers based  
 11 on 200 million cubic metres, not 400, because the bottom  
 12 200 million cubic metres is going to be full of  
 13 sediment. So these numbers are based only on the volume  
 14 from the outlet on up.  
 15 DR BLACKMORE: For Baglihar, for example, how long does it  
 16 take it to fill up to the sill level of the low-level  
 17 outlet of sediment?  
 18 DR MORRIS: From the information that we had originally from  
 19 the Baglihar case, we're probably looking at something  
 20 in terms of -- round numbers -- 30 years. Because if  
 21 you've got 20 million tonnes a year, you're going to  
 22 have a bulk density of about 1.4 tonnes per cubic metre,  
 23 so you will fill up your bottom 200 million cubic metres  
 24 in a little less than 30 years. Well, about 30 years.  
 25 DR BLACKMORE: So while that's filling in, presumably it's

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10:44 1 sediment from the reservoir, but to maintain a stable  
 2 amount within the reservoir?  
 3 DR MORRIS: Correct.  
 4 (Slide 11) Answering the second one first, what you  
 5 will have -- follow the red dot, go about halfway up the  
 6 dam, and you would have a profile that goes from halfway  
 7 up the dam up until the upstream part of the reservoir.  
 8 So what you're doing is you're basically raising up the  
 9 riverbed up to the level of the low-level outlets. And  
 10 then that becomes a new profile through the reservoir  
 11 which you maintain by these flushing events.  
 12 Baglihar is big: flush it once a year. Small  
 13 reservoirs, like one of the ones I showed you  
 14 schematically yesterday that we worked with in Nepal,  
 15 we're looking at two, three, even four flushing events  
 16 a year, because the reservoir is very small and there's  
 17 very little capacity to store sediment.  
 18 And of course at Kali Gandaki, which is a sluicing  
 19 operation, you are essentially flushing continuously,  
 20 and the profile of the bed hits the top of the spillway  
 21 crest, and your operating pool is defined from the  
 22 spillway crest up, and that's 6 metres of operating  
 23 level. Your gates of course are higher, because your  
 24 operating level is within the range that you can operate  
 25 your intake.

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10:47 1 taking a proportion of the sediment coming in, it's  
 2 falling into that space. So do we know how much of the  
 3 sediment load coming in -- some going into storage, and  
 4 the rest being viable to be passed down -- do we know  
 5 what percentage that is?  
 6 DR MORRIS: We do not know. We do not know. That  
 7 information is not available to us. But let me just  
 8 give you some insight from long-term simulations that  
 9 I've done on some of the Nepali reservoirs, which are  
 10 storage reservoirs, not small ones like the  
 11 Kali Gandaki, which is a run-of-river.  
 12 But what we see is that you initially have a delta  
 13 that advances into the reservoir, because the Himalayan  
 14 sediments tend to settle pretty quickly. And you can  
 15 wait until the delta reaches the dam, but that's not  
 16 a good strategy. Because what happens is: when you draw  
 17 down, then you're going to start cutting into that delta  
 18 material, and your initial years of flushing will have  
 19 huge loads going downstream.  
 20 So the recommended procedure would be to start doing  
 21 drawdowns maybe five or ten years into the operation, so  
 22 that you start moving this profile towards the outlets  
 23 gradually. You do not want to all of a sudden, "Well,  
 24 it's reached the dam, now I have this big pile of  
 25 sediment, my outlet is down here, I have to flush", and

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10:49 1 now you're going to cut through this, and that's where  
 2 you're going to get concentrations of a couple of  
 3 hundred thousand milligrams per litre. Your riverbed  
 4 downstream is going to go up, people's houses are going  
 5 to get flooded; it's not good.  
 6 DR BLACKMORE: So does a dam like Baglihar have the  
 7 potential to have a delta?  
 8 DR MORRIS: It will have a delta, for sure.  
 9 DR BLACKMORE: How far into the dam is it likely to go?  
 10 DR MORRIS: It would go all the way to the dam. It depends  
 11 on the way they operate it.  
 12 Just like Tarbela: it's the same type of sediment,  
 13 basically. It's the same hydrology, basically: it's  
 14 Indus River hydrology monsoon, and you will get this  
 15 delta.  
 16 And the top of the delta will be defined by the  
 17 operating level. If they maintain it at a high  
 18 operating level -- and at this site, they only have  
 19 a 4-metre-tall pool. So if they maintain it within that  
 20 level, that delta is going to fill up the reservoir  
 21 almost a flat line to the dam. And that's what we see  
 22 at Tarbela.  
 23 DR BLACKMORE: So this dam has been around for a while now.  
 24 So do we have data on what that looks like right now?  
 25 Baglihar, I'm speaking about.

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10:52 1 The design necessity is frequently found in  
 2 engineering of dams. There are dam safety requirements  
 3 that establish a variety of necessities. One, for  
 4 instance: we have what we call the n-1 criteria for gate  
 5 design. You have multiple gates on your reservoir, and  
 6 at any point in time, one of the gates may fail; it may  
 7 be out of service for maintenance. So you design your  
 8 dam to discharge your design flood with one gate out of  
 9 service. That's your n-1, the total number minus 1.  
 10 That adds cost, but it's a necessity.  
 11 The power intakes is an outlet that has to be below  
 12 the dead storage level. Because if you're not below  
 13 dead storage, you can't, of course, divert water into  
 14 the intake.  
 15 The spillway crest must also be below the dead  
 16 storage level for sediment sluicing. If it's higher  
 17 than the intake level, you're not going to be able to  
 18 control the sediment in front of the intake.  
 19 But as we showed in the previous slides, if you  
 20 select a tall dam with a very limited operating pool,  
 21 your design strategy -- the designer will artificially  
 22 create the appearance of the necessity of having  
 23 excessive drawdown, when in fact that drawdown is simply  
 24 a consequence of a design decision.  
 25 And once you have created the artificial need for

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10:50 1 DR MORRIS: We don't have data on what's happening in that  
 2 reservoir. What's happening in the reservoir is  
 3 happening underwater. I can look at Google; I can't  
 4 see it.  
 5 DR BLACKMORE: Yes, okay.  
 6 THE CHAIRMAN: Very good. So please proceed. I do note  
 7 that we're about ten minutes from the normal coffee  
 8 break, so I leave it to you, perhaps, Dr Morris, to let  
 9 us know when there might be a good break.  
 10 DR MORRIS: Okay. Let's try one more topic here: outlets  
 11 below dead storage.  
 12 (Slide 12) "There shall be no outlets below Dead  
 13 Storage Level, unless necessary for sediment control or  
 14 any other technical purposes; [and] any such outlet  
 15 shall be of the minimum size, and located at the highest  
 16 level, consistent with sound and economical design and  
 17 with satisfactory operation ..."  
 18 The key concept here is the concept of necessity.  
 19 It's considered a necessity if a practical way of  
 20 achieving this or practical alternatives exist,  
 21 independent of whether it is the least-cost solution.  
 22 Because least-cost solutions are not necessarily the  
 23 best solution in any environment. When you go buy  
 24 a car, you don't buy the cheapest car: you buy the car  
 25 that's most suited to your purpose.

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10:54 1 a necessity to draw down, then this leads to design and  
 2 operational procedures to correct the problem that was  
 3 created from the onset by the design that you selected.  
 4 And this produces absurd results which violate the very  
 5 heart of the Treaty's intent, which is to limit the  
 6 controllable storage in Indian dams.  
 7 (Slide 13) Now, remember the concept of controllable  
 8 storage. We have pondage, which is at the top of the  
 9 reservoir, but the gates really define what you can  
 10 control. And when you have large low-level gates, sized  
 11 to pass the design flood, then everything above that  
 12 gate becomes controllable storage.  
 13 Now, you look at the pondage volume at Baglihar and  
 14 the controllable storage at Baglihar: pondage is  
 15 32.5 million cubic metres, controllable storage is 209.  
 16 Controllable storage is six times larger than pondage.  
 17 So controllable storage has a much greater potential to  
 18 impact downstream hydrology than pondage.  
 19 Let's look at this realistically now. These are the  
 20 dams --  
 21 THE CHAIRMAN: Excuse me, Dr Morris. Sorry.  
 22 DR MORRIS: Yes, Dr Blackmore.  
 23 DR BLACKMORE: Can we go back to the last slide for  
 24 a second?  
 25 DR MORRIS: Sure.

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10:55 1 DR BLACKMORE: I'm a bit slower than the other people here,  
 2 so it takes me a little while to get into gear.  
 3 (Slide 13) So I'm looking at this, and nothing  
 4 you've said I've got an argument with.  
 5 DR MORRIS: Okay.  
 6 DR BLACKMORE: But I'm just trying to understand. So  
 7 a minute ago we talked about -- we're talking about  
 8 Baglihar now.  
 9 DR MORRIS: Mm-hm.  
 10 DR BLACKMORE: We're talking -- at Baglihar, let's assume  
 11 that we've got this particular facility here, so we've  
 12 got a delta profile going up. So we have immediately  
 13 reduced some of the storage capacity, somehow.  
 14 DR MORRIS: Mm-hm.  
 15 DR BLACKMORE: So the controllable storage is 209 minus the  
 16 amount occupied by sediment.  
 17 DR MORRIS: Okay. We have 400 at Baglihar.  
 18 DR BLACKMORE: Yes, in total.  
 19 DR MORRIS: Okay. So the bottom 200 --  
 20 DR BLACKMORE: Yes, yes.  
 21 DR MORRIS: So this is a level pool, controllable storage.  
 22 DR BLACKMORE: Yes.  
 23 DR MORRIS: And if they flush it effectively, the river  
 24 is -- it's a fairly narrow valley: you will have  
 25 a fairly deep flushing channel. Your side slopes, from

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10:58 1 pondage, if you like, to -- listening to you, to be  
 2 a nuisance, that can be used in a way that would be  
 3 difficult for other participants.  
 4 And then you went on to say -- so just take it for  
 5 this, I just want to understand. So this is in  
 6 a sequence of dams. There's one downstream that has got  
 7 sediment issues as well.  
 8 DR MORRIS: Yes.  
 9 DR BLACKMORE: So when you look at them as a tandem set of  
 10 facilities, and there will soon be other ones,  
 11 presumably -- I didn't quite close the loop. You've  
 12 just moved the sediment from this dam to the next dam  
 13 down.  
 14 DR MORRIS: Okay.  
 15 DR BLACKMORE: So what's the combined controllable storage?  
 16 How does that then, between the two dams -- which is  
 17 what you would be worried about in terms of potential  
 18 threat, weaponisation, or however you want to describe  
 19 it. So I'm just interested to know.  
 20 DR MORRIS: Two quick answers.  
 21 First of all, Salal downstream is completely  
 22 sedimented, so we don't have storage there.  
 23 And your second answer is on the next slide (14).  
 24 What do they say: great minds think alike!  
 25 Okay. On the left-hand side -- did you want to

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10:57 1 what we have seen at other -- for instance, in the  
 2 Warsak flushing, we expected the side slopes will slough  
 3 off, and that they will be able to control --  
 4 permanently maintain open for storage -- a very  
 5 significant part of that 209 million cubic metres.  
 6 I have not done simulations of Baglihar, so I do not  
 7 have a profile of that equilibrium profile. But your  
 8 controllable storage initially will be 209. Within  
 9 50 years, with flushing being conducted, it would be  
 10 something like -- just to use a number, let's say 150.  
 11 If they never draw down below dead storage, then  
 12 your controllable storage will become in the range of  
 13 maybe 50. But then they have the problem of: how are  
 14 they going to manage the plant?  
 15 DR BLACKMORE: So they've got a trade-off.  
 16 DR MORRIS: Yes.  
 17 DR BLACKMORE: So they're running an active trade-off on the  
 18 economic performance of the hydroelectric facility,  
 19 keeping active storage. So there's plenty of moving  
 20 parts.  
 21 DR MORRIS: Yes.  
 22 DR BLACKMORE: And it's a matter of choice and management  
 23 choices.  
 24 The point I'm trying to get to for myself is to see  
 25 what active steps they have to take to keep the maximum

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11:00 1 break for coffee at this point?  
 2 THE CHAIRMAN: If now is a convenient time, then yes,  
 3 I think we should take a break, and we'll come back and  
 4 start off with this slide. Thank you.  
 5 (11.00 am)  
 6 (A short break)  
 7 (11.28 am)  
 8 THE CHAIRMAN: Okay, I think we are reassembled. So,  
 9 Dr Morris, whenever you're ready, please proceed.  
 10 DR MORRIS: Yes. Following up on some of the questions that  
 11 were just being made, I prepared a small sketch on the  
 12 iPad, and maybe if we'd like to put it on the  
 13 click-share, you can see it, and we can just really  
 14 briefly discuss a couple of concepts.  
 15 The concept that I was talking about with respect to  
 16 the ... Okay. Here is the dam, and here is your  
 17 low-level outlet: you see it part way up the dam, right  
 18 here. It's shown with a red arrow. This is the outlet.  
 19 So we can bring water out of the outlet.  
 20 And upstream we have the delta, which is  
 21 a characteristic formation that we see in Himalayan  
 22 reservoirs, reservoirs that have a lot of sand and  
 23 coarse silt. We see this pattern in Tarbela very  
 24 distinctly. And over time, if you maintain the  
 25 operating level very high -- and let's put this dotted

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11:29 1 line to show the minimum operating level -- you can  
 2 expect this delta to advance basically in this pattern,  
 3 just advance forward. And again, this is what we've  
 4 seen at Tarbela, developing over decades.  
 5 Now, what you want to do is you want to develop  
 6 a profile through your reservoir, which I'm drawing here  
 7 as a red line, it will look something like this. This  
 8 is your equilibrium profile. And everything under here  
 9 will be permanent sediment deposits.  
 10 So when you operate, you would normally want to draw  
 11 your reservoir down so these deposits which I'm showing  
 12 here, circled in red, don't become really huge. Because  
 13 when they reach the area of the dam, then you have this  
 14 type of situation. And if you draw down to do any  
 15 flushing, for instance, then you have the need to  
 16 evacuate this material. That's why, if you do flushing,  
 17 you would do it every year. Of course, if you have  
 18 a smaller dam and you have very limited deposits,  
 19 you essentially avoid that problem.  
 20 So I hope this clarifies the placement of the outlet  
 21 on the dam. And some of the sediment will be permanent  
 22 deposit, and everything above that permanent deposit  
 23 line can be removed if you operate for flushing, which  
 24 of course is not Treaty-compliant. And that's why, when  
 25 you have an operating pool of only 4 metres, it puts you

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11:33 1 I suspect were designed in the 1950s or 1960s in  
 2 concept, but we've seen this emerging technology with  
 3 tunnels in the last 20 years, pretty much, from my  
 4 perspective. But I'm interested in your perspective in  
 5 the region.  
 6 So when people got confident, we got to see dams  
 7 with these large tunnels: Neelum-Jhelum and so on. When  
 8 has there been a high level of confidence in tunnelling  
 9 in the Himalayas? How long ago would you say that  
 10 technology became a force?  
 11 DR MORRIS: Tunnelling in the Himalaya of course is more  
 12 difficult than many other areas. But the development of  
 13 TBMs, tunnel boring machines, has developed remarkably  
 14 over the last, let's say, 30 years. Tunnelling geology  
 15 has remarkably improved.  
 16 So I would say that more or less we're looking at,  
 17 in general, a timeframe of 30 years. But of course, if  
 18 you look at technology starting in the year 1900, you've  
 19 got 120 years, and every decade there's significant  
 20 improvement. So there's not really a critical point.  
 21 But certainly the development of effective TBM machines  
 22 is relatively recent decades.  
 23 DR BLACKMORE: If I follow that line of thought, we've got  
 24 a legacy of what you'd call "historically designed" dams  
 25 that come out of the technologies of the 1950s and 1960s

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11:32 1 into a rather uncomfortable situation. You know, you've  
 2 just made the problem worse for yourself through your  
 3 design decisions.  
 4 So I think that's -- I will provide a PDF of this to  
 5 go on the record. But we can go back over to the  
 6 presentation now.  
 7 THE CHAIRMAN: Dr Blackmore.  
 8 DR BLACKMORE: Thank you.  
 9 I just want to ask a question that goes before that  
 10 one, and it came from your presentation before the  
 11 break, where we had the small dam with the tunnel and  
 12 the larger dam. I'd just like to get your view. I take  
 13 it you've been in this industry for more than  
 14 five years: like me, you've been around for a day or  
 15 two.  
 16 DR MORRIS: Or three!  
 17 DR BLACKMORE: So what I'm looking at, I'm looking at these  
 18 very large dams, and the alternative, you've got small  
 19 dam and tunnel. I am going back to World Commission on  
 20 Dams days when we took evidence in the region about dams  
 21 and development effectiveness -- nothing to do with the  
 22 Treaty -- but we started to see an emergence of new  
 23 technologies related to tunnels, boring machines and  
 24 the like.  
 25 I'm just interested in -- many of these dams

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11:35 1 and the like, and we're still seeing the legacy of  
 2 those.  
 3 Do you see, in the current forward-looking  
 4 projections, a move towards the sorts of  
 5 configurations -- not only in the Himalayas but other  
 6 areas -- small dam, long tunnel?  
 7 DR MORRIS: I would not characterise it that way.  
 8 Most of the construction in the Himalayas is  
 9 relatively recent. You have to put it, first of all, in  
 10 that context. And so we're not looking at long-term  
 11 trends over the last 50, 60, 70 years. The Himalayan  
 12 developments, particularly the ones that are in  
 13 challenging areas, are quite recent: 20-30 years.  
 14 What we do have is studies that were done, let's  
 15 say, in the 1950s and 1960s which identified -- you took  
 16 the river system; there was no project. You send your  
 17 geologists out, you do some flow measurements. And in  
 18 the 1950s and 1960s, you'd lay out your system: here's  
 19 a good dam site, here's a good dam site, here's a good  
 20 dam site.  
 21 And you develop this based on 1950s technology.  
 22 Because if you're developing this in the 1950s, so that  
 23 you have a plan by the year 1960, you know, 1960s is  
 24 using 1950s technology. So you develop this and you  
 25 don't have the benefit of today's understanding and

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11:37 1 today's technological capabilities, particularly, as you  
 2 mentioned, with respect to tunnelling; and also, of  
 3 course, with respect to the design of dams.  
 4 You saw that the Neelum-Jhelum, that dam is built on  
 5 a fault. At one time, people would have said, "We can't  
 6 do it". But as you develop technology, you're able to  
 7 do development on sites which are increasingly  
 8 challenging.  
 9 So what happens, as an unfortunate consequence, is  
 10 that you end up with a "system of dams", or a layout of  
 11 your system, which is based on technology from  
 12 50-60 years ago, which might not be the best way to do  
 13 it today. But nevertheless, by 1960 they knew about the  
 14 restrictions of the Treaty and they also had the  
 15 potential to modify any pre-existing designs to be  
 16 compatible.  
 17 So that's about all I can say about it.  
 18 DR BLACKMORE: So if I was in the region and I had the  
 19 Tarbela experience, where the bypass tunnels collapsed  
 20 and created havoc until they were repaired, and I live  
 21 in this region and I'm at the end of the Himalayas, how  
 22 would I deal with that in terms of my design decisions  
 23 for other large facilities?  
 24 I'm just asking the question rhetorically, more or  
 25 less, to say that there have been issues around tunnel

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11:40 1 plants, that have this very strict storage limitation,  
 2 closely defined pondage volume; and then you have the  
 3 storage plants under Annexure E.  
 4 Now, on the Chenab, we have one Annexure E plant,  
 5 and that's Pakal Dul. It's been designed for  
 6 108 million cubic metres of live capacity. And you see  
 7 that in the right-hand diagram circled in red. But when  
 8 you look at the controllable storage, which we define  
 9 based on the low-level outlet location, Baglihar --  
 10 which is a hydropower dam under Annexure D which should  
 11 not have much storage -- actually has twice the  
 12 controllable volume of the storage project.  
 13 So how can a storage project have 108 million  
 14 cubic metres of storage, whereas Baglihar, which is  
 15 a run-of-river plant, has double that controllable  
 16 storage, as controlled by your low-level outlets? That  
 17 can't be right. I mean, this is absurd, that the Treaty  
 18 would allow an Annexure D plant to have more storage  
 19 than an Annexure E plant.  
 20 So how does this happen? And here we come to the  
 21 location of intakes and the relocation of your low-level  
 22 outlets. You can develop an intake -- we will call it  
 23 a surface intake, a high-level intake -- which is  
 24 designed to withdraw water from the highest level  
 25 possible. We can separate the intake, which is the

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11:38 1 construction in the region that have highlighted the  
 2 level of difficulty. So I'm just trying to get  
 3 an understanding of where you see the development of  
 4 them for these long-planned large interventions.  
 5 DR MORRIS: Yes, and Tarbela does have notoriously difficult  
 6 geology.  
 7 Okay, let's move to the next slide (14). And here  
 8 we're going to talk about controllable storage.  
 9 Now, there is Annexure D, which talks about the  
 10 run-of-river projects, and these projects are supposed  
 11 to have a very limited storage capacity. And I was  
 12 struck the first time I read the Treaty, many years ago,  
 13 that when they talked about interference with flow,  
 14 et cetera, they even made an exception for bridge piers.  
 15 The pier of the bridge is going into a river, and that,  
 16 of course, will give you some obstruction to flow. They  
 17 said: no, bridge piers don't count. I have never seen  
 18 that type of language anywhere.  
 19 And if you are thinking that a bridge pier needs to  
 20 be cited as an exception, this indicates that there is  
 21 a real desire, in the formulation of the Treaty, to very  
 22 strictly control the ability of India, in its  
 23 run-of-river plants, to manipulate flow and retard flow  
 24 and otherwise change the hydrology coming into Pakistan.  
 25 So you have the Annexure D plants, the run-of-river

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11:42 1 point at which the water departs from the reservoir, and  
 2 we separate the intake from the entrance to the headrace  
 3 tunnel.  
 4 (Slide 15) Now, what India does of course is they do  
 5 not use any type of barrier in front of the headrace  
 6 tunnel. They said the headrace tunnel entrance is the  
 7 intake, and therefore we have to have a certain level of  
 8 submergence below the dead storage level for the concept  
 9 of anti-vortexing. And the result is that instead of  
 10 having an overspill-type intake like this one -- which  
 11 is actually the type of intake which was used at the  
 12 Kali Gandaki project in Nepal that I showed the pictures  
 13 of yesterday -- you end up with a pretty deep intake.  
 14 And this intake has to be protected against sediment.  
 15 And because it has to be protected against sediment,  
 16 then you have to put your outlet below the intake.  
 17 Now, here comes the second part of the problem.  
 18 Your outlets -- it's a spillway, it's an orifice  
 19 spillway. And so you know that you have to have  
 20 a spillway capacity equal to design flood.  
 21 (Slide 16) Now, here is the design flood for  
 22 Baglihar: it's about 17,000-and-something metres  
 23 per second. And you have to design for that. And if  
 24 I put that gate size at an elevation lower than my  
 25 intakes, now I have a deep intake and a much deeper

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11:44 1 spillway. So by selecting my type of intake, I push it  
 2 down; and in selecting my spillway, I go down even  
 3 lower; and by making the spillway capable of passing the  
 4 design flood, it becomes a very big and very deep  
 5 spillway. Yet I don't need all of that capacity for  
 6 passing sediment.  
 7 Why? Your design flood is more or less  
 8 a 10,000-year event. How many 10,000-year events are  
 9 we going to experience in Baglihar in the next  
 10 100 years? Not terribly likely. But we will be passing  
 11 sediment, once the system is stabilised, every year. So  
 12 you're designing in the long term for passing sediment  
 13 every year.  
 14 So the flows that you will be using for sediment  
 15 management are not even the flows that are shown on the  
 16 bottom part of this graph, which is the maximum day of  
 17 each year, because you don't know in advance what that  
 18 maximum day is going to be. So ideally, if you were  
 19 able to prognosticate this, you could say, "Well, I know  
 20 that next week we're going to have the flood of the  
 21 year, so I'm going to set up the flush". You don't know  
 22 that: you never know that. So you flush during a period  
 23 or you do your sluicing during a period when you have  
 24 the anticipation that you'll have good flows.  
 25 So you're not managing sediment and either sluicing

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11:48 1 reservoir with the gates open.  
 2 So what you do is by limiting the gate capacity  
 3 below DSL to only that flow needed for sediment  
 4 management, you have made the gates to the minimum size  
 5 necessary. Because you can put -- and this is very  
 6 typical in dams: you have a spillway at the top, and the  
 7 flood goes over the top of the dam, it doesn't go out of  
 8 the bottom; obviously there are dams with different  
 9 spillway configurations. But the concept here is that  
 10 the only thing that's necessary below DSL is the  
 11 capacity to pass sediment, your smaller events. Your  
 12 monster event, you're going to pass that with a gate  
 13 that's at a higher level.  
 14 So paragraph 8(d) is a design constraint that can be  
 15 accommodated by providing spillway capacity necessary  
 16 for sediment management below sediment level, below dead  
 17 storage level, while the balance of the capacity used to  
 18 manage the design flood is placed above dead storage  
 19 level.  
 20 And of course, as we discussed previously, this  
 21 depth between the dead storage level and the full  
 22 pondage level, the depth of your operating pool, is  
 23 defined by the selection of the height of your dam.  
 24 It's a design which is basically where you're going to  
 25 place the dam on the river, your tunnel length, where

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11:46 1 or flushing based on your 10,000-year flood, based on  
 2 your 100-year flood; you're not even managing it based  
 3 on your 25-year flood. You are managing it primarily  
 4 based on floods that occur every year, and that may  
 5 occur with some limited frequency: maybe a 5- or 10-year  
 6 flood, let's say. And that's the capacity you need for  
 7 your outlets. And you design that capacity through  
 8 simulation modelling.  
 9 So what happens, going on to slide 17, is that -- on  
 10 the right-hand-side graphic I have a gate configuration  
 11 which is not Treaty-compliant, because I have put the  
 12 gates having the entire capacity of sediment management  
 13 plus flood control below DSL. But the Treaty restricts  
 14 the capacity below DSL, and the only necessary part that  
 15 occurs below DSL is what you need for sediment  
 16 management.  
 17 So let's move to the left-hand side, and you can see  
 18 what I've done is I've, for graphic purposes, shown this  
 19 as a single crest gate. This lower part of the gate is  
 20 the capacity that I need to pass my five- or ten-year  
 21 flood at DSL. That's what I need for sediment  
 22 management every year. Every year.  
 23 This higher part, that's where the reservoir is  
 24 going to fill during my design flood, and it's going to  
 25 fill up to the limit of the maximum flood level in the

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11:49 1 your power plant is going to be. It's the very first  
 2 conceptual thing that you address.  
 3 (Slide 18) To do this analysis for a gated spillway,  
 4 you provide your gate configuration, you develop your  
 5 discharge relationships for the gates and you run  
 6 sediment transport modelling. And you look at different  
 7 gate levels, different gate capacities, and find the  
 8 gate capacity that (1) will pass sediment, and (2) then  
 9 you use the remaining capacity above DSL to give you the  
 10 capacity to release your design flood.  
 11 And you go through multiple iterations of gate  
 12 configurations, different operating rules, and you  
 13 select the configuration that provides the highest level  
 14 crest and the minimum size below DSL. And in that way,  
 15 this is the iterative procedure by which you are able to  
 16 comply with the Treaty requirements.  
 17 And this is a very standard procedure for sizing  
 18 gates and dams. You don't set out and say, "This is  
 19 where my gates are, and that's the final solution". The  
 20 design will typically progress through a series of  
 21 different configurations, and fine-tuning of those  
 22 configurations, until you find the correct or the  
 23 optimal solution.  
 24 (Slide 19) Intake placement:  
 25 "The intakes for the turbines shall be located at

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11:51 1 the highest level consistent with satisfactory and  
 2 economical construction and operation of the Plant as  
 3 a Run-of-River Plant and with customary and accepted  
 4 practice of design for the designated range of the  
 5 Plant's operation."  
 6 And of course this means the customary practice for  
 7 a run-of-river plant, not for a storage plant. Storage  
 8 plants typically have a deep intake; run-of-river plants  
 9 will typically have a high intake.  
 10 Due to the settling velocity of coarse sediment, as  
 11 we discussed, your concentration of sediment at the top  
 12 of the water column is less than at the bottom. So  
 13 therefore, where you have a run-of-river plant and you  
 14 want to exclude sediment from the turbines -- the coarse  
 15 sediment in particular, because it's much more abrasive  
 16 than the fine sediment -- the accepted practice is to  
 17 put your intake at the highest level possible to  
 18 minimise the entrainment of sediment.  
 19 So in this respect, the Treaty requirement that the  
 20 intake be at the highest level possible presents nothing  
 21 out of the ordinary with respect to design of  
 22 run-of-river intakes; in fact, it's accepted and  
 23 recommended practice. And this, of course, is in  
 24 contrast to the intakes at storage reservoirs, which are  
 25 typically placed quite deep, because you typically have

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11:53 1 a very considerable many metres, or tens of metres, of  
 2 variation in water level.  
 3 And if you do install a deep intake configuration on  
 4 a run-of-river reservoir, then that brings to you the  
 5 necessity of maintaining deep water in front of that  
 6 intake, through your design decision. If you have  
 7 a skimming wall in front of your intake on  
 8 a run-of-river plant, you're taking water off the top of  
 9 the water column. But a deep intake, you're taking much  
 10 deeper water, and then you have to have a deeper clear  
 11 space with no sediment below that to minimise your  
 12 entrainment of sediment. And that's what drives your  
 13 intake level down and then your outlet level down even  
 14 further, and this is what makes it not Treaty-compliant.  
 15 (Slide 20) So this little graphic here I think was  
 16 presented previously, but it basically shows you the  
 17 difference between a deep intake, on the left-hand side,  
 18 and a surface intake, on the right-hand side.  
 19 The difference is, of course, that on the surface  
 20 intake, the intake is where you take the water from the  
 21 reservoir; it's not necessarily the entrance to the  
 22 tunnel. And in fact, in a run-of-river, it typically  
 23 isn't, because between the intake and the tunnel  
 24 you will have a desander, just like you saw at  
 25 Neelum-Jhelum. You had the intake, the desanders, and

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11:54 1 from the three desanders they went into a collector  
 2 canal, and from that canal, the water flowed toward the  
 3 left, into the tunnel.  
 4 So basically, you are able to provide a high-level  
 5 intake by separating the intake from the tunnel, and  
 6 there's nothing unusual in this configuration. You  
 7 would, of course, provide barriers to prevent floating  
 8 debris from entry, trash screens, and all those normal  
 9 things. But conceptually, there is no problem with this  
 10 part of the requirements in the Treaty.  
 11 (Slide 21) Regulating basin. This is not an issue  
 12 that is of concern between the parties.  
 13 But basically, what a regulating basin does is: when  
 14 you have peaking plant, you turn the power on and off  
 15 and on and off, so your river flows go up and down and  
 16 up and down, and the up-and-down water levels cause bank  
 17 collapse and erosion and caving in. It's not good for  
 18 your ecology. If you have irrigation intakes, it will  
 19 be extremely difficult to effectively divert water for  
 20 an irrigation intake if the flow is going up and down  
 21 every day.  
 22 So what a regulating basin actually does, it just  
 23 takes this irregular flow, stores it, and has an outlet  
 24 that converts it into, basically, constant flow.  
 25 So it's in the Treaty, it's a requirement under

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11:56 1 item 8; it's not an issue between the parties.  
 2 (Slide 22) And now we come to weaponisation.  
 3 Pakistan is particularly concerned about the ability  
 4 of India to manipulate water. Pakistan did have a bad  
 5 experience early on when the water supply was  
 6 interrupted. I'm not here to say who or why or  
 7 whatever, but the fact is that it happened. And I've  
 8 been working in Pakistan quite a number of years and  
 9 I'm always reminded of this. So it's very clear in the  
 10 minds of the people in Pakistan that: yes, this is  
 11 a real issue.  
 12 And when we look at the world in general, it's not  
 13 a trivial or abstract or academic concept. June of last  
 14 year in Ukraine, the Kakhovka Dam on the Dnieper River  
 15 was blown up to create a flood, apparently for military  
 16 purposes. So the idea of weaponising dams is not  
 17 an abstract concept.  
 18 And another interesting thing is that you have  
 19 Pakistan and India: they both have conventional weapons,  
 20 they both have nuclear weapons, but India is the only  
 21 one that can control the water. There is no tit-for-tat  
 22 here. India has the ability to control the water;  
 23 Pakistan does not have an equivalent rejoinder, we might  
 24 say.  
 25 So Pakistan is particularly sensitive to this issue.

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11:58 1 And as I explained yesterday, the primary concern here  
 2 is the interruption of water supply for irrigation.  
 3 Flooding, being able to open the gates and create  
 4 downstream flooding, is a secondary issue; and the  
 5 sediment is a third-level issue. Primarily, supply of  
 6 irrigation water.  
 7 Now, what I did to look at this -- because how  
 8 serious is this, what's the potential? -- I created  
 9 basically a hydrologic model. And what I did is I took  
 10 the inflow time series we have in the vicinity of  
 11 Baglihar and I put in 400 million cubic metres of  
 12 storage. So the model takes the inflow, accumulates the  
 13 water in the dam, and when the dam fills up, then it  
 14 opens the gates.  
 15 Now, of course the whole 400 million cubic metres is  
 16 not at Baglihar: we have multiple dams upstream. So you  
 17 would operate the dams upstream to continue feeding  
 18 water into Baglihar so that the whole system becomes  
 19 emptied, and then the whole system closes gates and  
 20 refills.  
 21 I didn't go to the detail of trying to model all the  
 22 hydraulics. But the travel time between these dams is  
 23 quite short, they're pretty close together: we're  
 24 talking about opening the gate at one dam and having it  
 25 arrive downstream in a couple of hours. So the routing

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12:01 1 middle of December, release for a couple of days; middle  
 2 of January, release for a couple of days; beginning of  
 3 February, another release for two/three days; March,  
 4 another release for a couple of days, et cetera. Of  
 5 course, in the monsoon period, it will fill much more  
 6 quickly, so you'll have a very punctuated pattern.  
 7 I'm not saying that this is the way it would be  
 8 operated, but it gives you an idea of the potential.  
 9 And this is what, of course, worries everyone  
 10 downstream.  
 11 (Slide 24) I also looked at a different scenario  
 12 which is a little bit more, let's say, nuanced. And  
 13 again, here you can see the red is the natural flow.  
 14 And here, instead of cutting off the water 100%, I cut  
 15 it off 50%, so that the downstream user is getting  
 16 something. And if this was to happen, it might be more  
 17 in this direction rather than the on/off. Because if  
 18 you're getting some water downstream, it's a little bit  
 19 easier to, let's say, hide what's going on upstream.  
 20 But here, look at what happens: you have periods of  
 21 a month and a half between large releases, and you've  
 22 cut the downstream flows by 50%. You have created --  
 23 from a natural year, from an average year, you've  
 24 created an extreme drought.  
 25 So this is just a conceptualisation of the potential

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12:00 1 of the flows, it's not like you're trying to route  
 2 something from one day to the next.  
 3 So the first thing I looked at was an extreme case:  
 4 let's say that we open the gates, empty Baglihar, and  
 5 all the upstream dams open their gates and all the water  
 6 goes out, then we close all the dates and we accumulate  
 7 water. Gates closed, no water leaving. What would be  
 8 the pattern, the timing of flows below Baglihar?  
 9 And this is what it looks like. This is starting in  
 10 the middle of the monsoon. In the middle of the  
 11 graph -- and this is slide 23 -- in the middle of the  
 12 graph you have the winter, and here around April and May  
 13 you have the planting for the Kharif crop, the early  
 14 crop.  
 15 And what it does is it shows that for this year,  
 16 which is 1986, which is selected as the mean, the year  
 17 having mean annual flow -- in other words, half the  
 18 years in the time series are higher flows on an annual  
 19 basis, half are lower flows, and 1986 also doesn't have  
 20 any strange huge floods or anything. So this we can  
 21 consider to be an average year.  
 22 And during the winter, I can store about a month's  
 23 worth of water for several months running. I can store  
 24 water for the month of November, release it at the end  
 25 of November for a couple of days, start refilling;

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12:03 1 magnitude, and the purpose here is just to put the whole  
 2 weaponisation thing into some sort of a context on how  
 3 consequential it could be.  
 4 Now, this is not to say that the existing Government  
 5 of India is going to do this. But these dams are going  
 6 to be here for a long time: hundreds of years. So there  
 7 very well could be a point in time when the situations  
 8 deteriorate to the point that this does happen.  
 9 Remember, in Ukraine it was only a military exercise by  
 10 Russia until they entered the border.  
 11 THE CHAIRMAN: Dr Morris, I think we have some questions for  
 12 you.  
 13 Dr Blackmore.  
 14 DR BLACKMORE: Thank you.  
 15 I'm just interested in two aspects of this. One was  
 16 the overall volume of water that eventually reaches  
 17 Pakistan.  
 18 DR MORRIS: We have not looked at the volume that reaches  
 19 Pakistan but the -- so I don't have this on the border.  
 20 But because there is no diversion of water, this would  
 21 be the same volume that would reach Pakistan. What  
 22 would happen is that of course the flood flows would be  
 23 spread out a little bit more in time.  
 24 DR BLACKMORE: Okay. So we've got the same volume. And so  
 25 the issue then is there's obviously people who are along

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12:05 1 these rivers directly that may be impacted. But the  
 2 main irrigation development is downstream of the  
 3 re-regulating facilities in Pakistan.  
 4 So I'm just wondering what the percentage of one of  
 5 these periods, say in February to March, where you've  
 6 held water for 30 days, what percentage of the overall  
 7 water use by Pakistan, so downstream of Tarbela, would  
 8 this represent?  
 9 DR MORRIS: Okay. The irrigation in Pakistan, most of it  
 10 occurs in the summer. But Pakistan has two cropping  
 11 seasons, and the critical part of the cropping season is  
 12 the beginning of the Kharif irrigation in the spring.  
 13 And that is the part that is most sensitive, because if  
 14 the Kharif crop gets delayed, then the subsequent crop  
 15 can itself be delayed, and that affects the productivity  
 16 of both crops.  
 17 So that is why the Kharif irrigation season,  
 18 April-May, is the most critical one. This shows the  
 19 potential, assuming this happens repeatedly, repeatedly,  
 20 repeatedly. But again, this is not a probable scenario:  
 21 it just gives you an idea, if you chose to do this at  
 22 this time of year, what would be its impact versus  
 23 a different time of the year.  
 24 DR BLACKMORE: Yes, I understand fully. I'm just trying to  
 25 get a scale on: if this is 0.02% of the flow that's

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12:08 1 through the power station, there's a sequence of days  
 2 where they've had no power.  
 3 DR MORRIS: Yes.  
 4 DR BLACKMORE: And then, as I read this, there's far too  
 5 much water to just go down through a power station, so  
 6 some has to be released through a spillway facility.  
 7 So there is an economic cost to India. And I don't  
 8 know what it is, but it's likely to be immense. So I'm  
 9 just interested if you could conceptualise what it might  
 10 be, and say, "Well, we're talking about a \$100 million  
 11 or a \$500 million penalty". To weaponise it like the  
 12 way you've described it, is it a \$5,000 problem or  
 13 a \$500 million problem to India? That's what I want to  
 14 know. Thanks.  
 15 DR MORRIS: You're totally correct about the turbines:  
 16 it would not be passed through the turbines, they don't  
 17 have the capacity. And of course, if you're passing  
 18 through the turbines, then you're -- under the scenario  
 19 where you're passing 50% of the flow, maybe you could  
 20 run that through your turbines. But with the increase  
 21 in the range of water levels, we would assume that most  
 22 of it would not be generating power.  
 23 If India were to release large floods, it would, of  
 24 course, be very damaging to India's infrastructure as  
 25 well. The Salal plant which we mentioned is downstream

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12:07 1 needed to support the Kharif, because you've got lots of  
 2 other water coming in that is not controlled this way,  
 3 I'm trying to get an understanding of that.  
 4 DR MORRIS: We can find numbers like that.  
 5 DR BLACKMORE: Yes.  
 6 DR MORRIS: But of course, because of the ways the canals  
 7 were set up, the rivers are connected to specific  
 8 canals. So when you have a shortage in one river that's  
 9 at a certain part of this system, it's fed by gravity,  
 10 that then will not have the water.  
 11 DR BLACKMORE: But the vast majority of the irrigation area  
 12 is downstream, and re-regulating storage is under the  
 13 control of Pakistan.  
 14 DR MORRIS: Yes, and most of it also comes out of either  
 15 Tarbela or Mangla.  
 16 DR BLACKMORE: Absolutely correct. Alright.  
 17 So I'm just interested in the scale: I want to get  
 18 an idea of what the magnitude is, in terms of ...  
 19 DR MORRIS: We can work up numbers on that.  
 20 DR BLACKMORE: So the second question then is that this  
 21 comes at a cost to India, because they've elected to  
 22 forgo generation -- or making the most of their  
 23 generation, because I haven't really sorted out these  
 24 numbers. But I presume they can't release this through  
 25 the power station. And even if they could release it

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12:09 1 here. There's a number of communities that are  
 2 downstream that would be impacted. And there of course  
 3 is the cost of forgone power. It would be a very  
 4 significant decision on the part of India to do this,  
 5 not because of impacts to Pakistan but because of  
 6 impacts to India.  
 7 So I totally agree with your line of thought, and  
 8 I have thought about that quite a bit. And for that  
 9 reason, I think that the probability of using this type  
 10 of an operation is not high, because of the impacts to  
 11 India. But at the same time, we see sometimes that  
 12 things happen that we don't think make any sense.  
 13 DR BLACKMORE: I'm not trying to get to the bottom of the  
 14 sociopolitical decision that would cause to go; I'm just  
 15 trying to get a scale around the numbers so I get  
 16 a sense of it.  
 17 I've worked in plenty of places where dams are  
 18 designed particularly for weaponisation, and to wash  
 19 tanks off causeways, all sorts of interesting outcomes.  
 20 But this is not that. This is a way you can maximise  
 21 the nuisance value of this reservoir to a neighbour, but  
 22 it comes at a cost. So let's just find out what that  
 23 is --  
 24 DR MORRIS: Yes.  
 25 DR BLACKMORE: -- so that that gives us a frame of

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12:11 1 reference.  
 2 DR MORRIS: Final thoughts --  
 3 THE CHAIRMAN: Before you continue, Dr Morris, I have  
 4 a couple of questions.  
 5 DR MORRIS: Okay.  
 6 THE CHAIRMAN: I'm just looking to see if others have any as  
 7 well.  
 8 So the scenarios are very interesting. I'd be  
 9 interested in whether the scenarios are driven mostly by  
 10 a Baglihar low-level orifice versus a Baglihar pondage  
 11 level that's higher than what Pakistan had hoped would  
 12 be decided by the Neutral Expert.  
 13 DR MORRIS: This is driven by the low-level orifices and the  
 14 volume of storage which is above that. And the volume  
 15 of storage of 400 million metres which I use combines  
 16 all that controllable storage across all of the dams.  
 17 THE CHAIRMAN: So if you were to eliminate the low-level  
 18 orifice at Baglihar, but retain the Neutral Expert's  
 19 pondage level, does that radically alter the scenarios  
 20 that you indicate?  
 21 DR MORRIS: Yes, it does. If you considered that plus Ratle  
 22 together, they constitute a large part of this.  
 23 And if we can go back a few slides. I recall  
 24 slide 14, and it shows a controllable storage between  
 25 Baglihar and Ratle: we've got 260 million cubic metres,

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12:12 1 more or less. Pakal Dul is a storage plant. Salal has  
 2 basically zero storage. And the other three --  
 3 Dul Hasti, Kwar and Kiru -- their storage is quite small  
 4 and would not lend itself to this type of operation very  
 5 well.  
 6 THE CHAIRMAN: I suppose what I'm getting at is: I can see  
 7 the so-called "weaponisation" point as it relates to the  
 8 low-level orifices. It's a little less obvious to me  
 9 whether it speaks to the setting of the maximum pondage  
 10 level at either a Baglihar Neutral Expert level or at  
 11 Pakistan's preferred level, either in that proceeding or  
 12 in this one.  
 13 DR MORRIS: And you are correct: the pondage volumes here  
 14 are really insufficient to have a huge impact in terms  
 15 of weaponisation.  
 16 Basically it's a problem of the placement and the  
 17 capacity of these large orifice spillways. Because to  
 18 release the water very quickly, to allow it to empty and  
 19 then refill, that again comes from not only the  
 20 location, the height of the orifices, but their  
 21 capacity.  
 22 THE CHAIRMAN: So let's assume that the dams at issue,  
 23 including Baglihar, do not have the low-level orifice.  
 24 But let's further assume that there are storage  
 25 facilities, storage plants of a magnitude permitted

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12:14 1 under Annexure E.  
 2 Does the same weaponisation issue arise? Can you  
 3 manipulate the storage facilities to bring about the  
 4 scenarios you're referring to?  
 5 DR MORRIS: Yes. It doesn't matter whether it's labelled  
 6 "storage", or what label you put on to it. The whole  
 7 key to being able to control the large flow rates that  
 8 are simulated here is the placement and the size of  
 9 low-level outlets.  
 10 If you have a storage project that has a discharge  
 11 at a low level which is limited, and then you have crest  
 12 gates for handling the flood, that's completely  
 13 different than if you eliminate most of your crest gate  
 14 capacity, you only keep a small gate to discharge  
 15 floating debris, and put most of your gate capacity near  
 16 the bottom of the dam. That's the difference.  
 17 THE CHAIRMAN: Well, this may be a function of my not fully  
 18 understanding the storage plants. But assuming that  
 19 there are no low-level orifices in the Annexure D  
 20 plants, is it the case that you could use the storage  
 21 plants to bring about the same weaponisation that you're  
 22 talking about in these scenarios?  
 23 DR MORRIS: The storage plants under the Treaty have  
 24 a stated schedule for filling and releasing, and that's  
 25 outlined in Annexure E. So that, for instance, during

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12:16 1 the springtime, they have to deliver water volume which  
 2 is equal to or greater than the natural inflow rate.  
 3 So --  
 4 THE CHAIRMAN: Right. But in your scenarios you're assuming  
 5 non-compliance with the Treaty, I think.  
 6 DR MORRIS: Yes.  
 7 THE CHAIRMAN: So my question is: assuming you're  
 8 non-compliant with the Treaty, could you use the storage  
 9 plants in Annexure E to bring about the weaponisation  
 10 you're talking about?  
 11 DR MORRIS: Correct. You could use a storage plant to  
 12 release less than, or significantly less than, what was  
 13 required by the Treaty.  
 14 THE CHAIRMAN: And bring about the same type of scenarios  
 15 you're referring to?  
 16 DR MORRIS: The same type of scenario, correct.  
 17 THE CHAIRMAN: So --  
 18 DR MORRIS: But -- yes.  
 19 THE CHAIRMAN: So just to drive that home, even if there's  
 20 no low-level orifices in the Annexure D plants, and even  
 21 if the pondage is at a level that Pakistan is urging in  
 22 this proceeding, there is already a potential for  
 23 so-called "weaponisation" from the plants that are  
 24 regulated under Annexure E?  
 25 DR MORRIS: Yes. The difference being that the volume of

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12:17 1 the storage plant is significantly less than the volume  
 2 of all the plants combined. So this limits your  
 3 capacity. And remember, the storage plant is not on the  
 4 main stem of the Chenab: it's on a tributary. It's  
 5 a major tributary, but it's not on the main stem.  
 6 THE CHAIRMAN: Well, again, it may be interesting for us to  
 7 learn a bit more about Annexure E, and to learn how you  
 8 would relate that maximum amount of storage that is  
 9 permitted in Annexure E to the existing active storage  
 10 of Annexure D plants. You're making it sound as though  
 11 it's much less in Annexure E.  
 12 DR MORRIS: It is.  
 13 (Slide 14) If you look at the left-hand side,  
 14 controllable, Pakal Dul, the controllable storage is  
 15 147, and this is to the bottom of the low-level outlet.  
 16 The combined is 453. So Pakal Dul is, what, one third.  
 17 That's the storage plant.  
 18 THE CHAIRMAN: Right. But Pakal Dul could be higher than  
 19 that as a storage plant, could it not, and still be  
 20 compliant with Annexure E?  
 21 DR MORRIS: It could be larger?  
 22 THE CHAIRMAN: Sure.  
 23 DR MORRIS: I can't answer that right now. I mean, there's  
 24 not enough in my mind as to what the limitations on  
 25 storage are.

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12:20 1 a single unit for this purpose. So if you have a single  
 2 dam, for instance Pakal Dul, it has a much smaller  
 3 watershed and it has one third of the capacity, so the  
 4 simulation would look quite different: much less impact.  
 5 THE CHAIRMAN: Dr Buytaert.  
 6 PROFESSOR BUYTAERT: Thank you, Mr Chairman.  
 7 Thank you, Dr Morris. A follow-up question on the  
 8 relevance of the deep-level orifices in Baglihar, and  
 9 potentially other plants.  
 10 I think in your answer to the question of  
 11 Mr Chairman, you mentioned that it has a big impact.  
 12 Which I can see in terms of the volume stored, because  
 13 obviously it very clearly makes a difference in the  
 14 amount of volume stored in Baglihar. But am I correct  
 15 in assuming that it would not have much of an impact on  
 16 the maximum floods you can create?  
 17 If you perhaps go to the next slide (23). So you  
 18 have there a maximum peak volume, but you ... (Pause)  
 19 So you have here a maximum volume, or a maximum  
 20 discharge, of around 9,500. Am I right that that's  
 21 determined by the capacity of Baglihar, and potentially  
 22 Salal, of the amount of water that the dam can release,  
 23 which is directly related to the design of the  
 24 10,000-year return period design flood?  
 25 DR MORRIS: Correct. The gate capacity is actually a little

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12:18 1 THE CHAIRMAN: That's fine. I suppose what I'm driving at  
 2 is: there's an aggregate amount of storage that is  
 3 permitted under Annexure E that's not driven by what's  
 4 actually at Pakal Dul.  
 5 DR MORRIS: Yes.  
 6 THE CHAIRMAN: And whatever that amount is, if India were to  
 7 exploit it to its maximum, I think what I'm hearing you  
 8 say is it leads to a similar weaponisation scenario.  
 9 DR MORRIS: Yes, any storage could be used in an adverse  
 10 manner. The point I'm trying to make here is that the  
 11 way that the Treaty has been interpreted to date, you  
 12 end up with actually more storage in your run-of-river  
 13 plants than you have in your storage plant. And that's  
 14 the point on which, as I see it, there is a real problem  
 15 with the way that these things have been interpreted and  
 16 resultant design.  
 17 THE CHAIRMAN: Judge Al-Khasawneh.  
 18 JUDGE AL-KHASAWNEH: Thank you, Dr Morris.  
 19 My question is with respect to the potential  
 20 scenario of weaponisation. What effect would cascading  
 21 have on this scenario which would take place? Would it  
 22 augment the effect of weaponisation?  
 23 DR MORRIS: Okay, thank you.  
 24 The simulation that I showed here incorporates the  
 25 assumption that the entire cascade will be operated as

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12:21 1 bit larger than this; this is actually an n-1 scenario.  
 2 So basically, the amount of water that can be  
 3 released in a flood is dependent entirely on the gate  
 4 location and the capacity. Of course, as the water  
 5 level drops, the flow through the gate will decline over  
 6 time.  
 7 But the capacity of a gate to release a very large  
 8 flood, but with a limited volume of water -- for  
 9 instance, let's look at Pakal Dul: it has a much more  
 10 limited volume. And let's assume it has very big gates:  
 11 I can release this instantaneous flood. But by the time  
 12 it passes through Ratle, passes through Baglihar, passes  
 13 over Salal and goes down to Pakistan, that flood will  
 14 be -- there's no volume there, there's very little  
 15 volume. It's not like I have rain occurring plus  
 16 snowmelt, or rain on snow across the entire watershed.  
 17 So because the volume is limited, by the time it  
 18 hits Pakistan, it will probably not be an issue from the  
 19 standpoint of flooding.  
 20 PROFESSOR BUYTAERT: Thank you.  
 21 THE CHAIRMAN: Okay, Dr Morris, I think we're now ready for  
 22 your final concluding thoughts.  
 23 DR MORRIS: Okay, yes. Real simple.  
 24 (Slide 25) The Treaty's limitations are clearly  
 25 designed to protect Pakistan's hydrology. They are not

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12:23 1 designed to satisfy India's desire to build high dams  
 2 and maximise storage. India does have Treaty-compliant  
 3 design options, but has simply ignored them.  
 4 So I think that concludes the key points that  
 5 I wanted to make here. If there are any other  
 6 questions, I would be happy to answer.  
 7 THE CHAIRMAN: Thank you, Dr Morris.  
 8 Professor Buytaert.  
 9 (12.23 pm)  
 10 Questions from THE COURT  
 11 PROFESSOR BUYTAERT: Yes. I would like to go back quickly  
 12 to what you presented before the coffee break on the  
 13 options of a large dam with a shorter tunnel and a small  
 14 dam with a longer tunnel. You presented that as  
 15 a design option where the engineer can choose which of  
 16 the two, and I wondered how frequent or how regular it  
 17 is that a certain site presents or allows for both  
 18 options.  
 19 Particularly, for example, in Baglihar, from your  
 20 understanding of Baglihar, would, in this particular  
 21 case, the design of a small dam with a long tunnel have  
 22 been a feasible option for that particular site?  
 23 DR MORRIS: I would anticipate the answer is: yes. Because  
 24 if you look along the river, you will find places which  
 25 are appropriate for dam construction and other areas

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12:26 1 was conceived back in the 1950s or 1960s.  
 2 DR MORRIS: I'm sure that the Pakistan representatives will  
 3 know that.  
 4 DR BLACKMORE: Okay, thank you.  
 5 SIR DANIEL: If it would be useful -- this, I think,  
 6 Dr Blackmore, is not perhaps precisely your question,  
 7 but you will recall that Pakistan first put in  
 8 an objection in 1992, but of course it would have been  
 9 conceived much before that.  
 10 We can come back. We will provide you with that  
 11 detail.  
 12 THE CHAIRMAN: Dr Morris, let me build on a question that  
 13 Professor Buytaert just asked you.  
 14 To the extent that there are multiple possible  
 15 locations for the site of a dam, is it true that there  
 16 would always be a possibility of pursuing  
 17 a hydroelectric plant that does not involve a high dam?  
 18 In other words, if we're trying to understand the idea  
 19 in 8(d) of situations where it's necessary, for sediment  
 20 control, to have an outlet below dead storage level, are  
 21 you saying that there will always be a possibility of  
 22 picking a site where there would not be a necessity for  
 23 such an outlet?  
 24 DR MORRIS: I would tend to say: yes. And I will explain  
 25 that in a couple of ways.

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12:24 1 which are much less appropriate. And the dams along  
 2 this river are not the only locations where you can  
 3 construct dams. They were selected to not interfere  
 4 with the communities: you don't want to flood towns and  
 5 things like that.  
 6 So there are multiple dam sites along rivers. And  
 7 when we have done -- like, we did an island-wide study  
 8 in Puerto Rico, you know, it's a little, small area, and  
 9 we came up with 200 dam sites pretty easily. There are  
 10 lots of potential dam sites.  
 11 So it's not like this is the only place you could  
 12 put a dam. And that means that they did have that  
 13 option, I have to presume that they did have that  
 14 option, and they selected this particular configuration  
 15 for reasons unknown.  
 16 PROFESSOR BUYTAERT: Thank you.  
 17 THE CHAIRMAN: Dr Blackmore?  
 18 DR BLACKMORE: I'm just interested in getting the timeframe  
 19 around Baglihar. I can probably go back and read the  
 20 documents. But do you know when Baglihar was first  
 21 conceived as a -- you know, in what ...  
 22 DR MORRIS: I do not know. Peter Rae may know: he was  
 23 involved with that litigation. I was not involved with  
 24 that at that time.  
 25 DR BLACKMORE: I'm just wondering whether it was a dam that

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12:27 1 First of all, if you're going to do  
 2 100-150-metre-tall dam, your site options for that size  
 3 of a structure are more limited than the options for  
 4 doing a 40- or 50-metre-tall dam. So right off, if I'm  
 5 going to do a small dam with a tunnel, I will probably  
 6 have more dam sites available. For one thing, I won't  
 7 have as much of an area that I'm going to flood. So  
 8 socially I can place it closer to communities, for  
 9 instance. It eliminates several types of problems.  
 10 The remaining problem is the tunnelling. And  
 11 tunnelling conditions vary considerably. But when we  
 12 are in the Himalaya, we have a lot of rock that's  
 13 available. You want to tunnel typically in, of course,  
 14 as strong a rock as possible. And you want to tunnel  
 15 relatively deep, because shallow tunnels tend to be more  
 16 problematic than deeper ones, because you have less  
 17 overburden and it's a problem.  
 18 So from the point of dam construction, I think  
 19 there's always going to be other sites. The tunnelling,  
 20 you may have differences in tunnelling difficulty; but  
 21 again, probably not insurmountable.  
 22 And you had the question yesterday about one big dam  
 23 versus multiple dams. The other thing to remember is  
 24 that you can't really do one big dam, because then your  
 25 watershed is limited to the big dam; whereas multiple

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12:29 1 dams along the river, you're picking up more water from  
 2 the tributaries. So it's typically broken up anyway.  
 3 And this is the way Chenab was developed. Remember,  
 4 you have Dul Hasti that has a relatively small dam and  
 5 a tunnel; and then immediately downstream, you have  
 6 Ratle, which is the opposite: it's a tall dam with  
 7 a short tunnel.  
 8 THE CHAIRMAN: I suppose what I'm trying to understand is:  
 9 if it is the case that there are always options for  
 10 smaller dams, then why wouldn't we have seen 8(d)  
 11 written in a simpler way: "No dam shall be above  
 12 [X] metres"?  
 13 DR MORRIS: I read the travaux some years ago, and there was  
 14 a lot of back-and-forth in that. For instance, we have  
 15 had difficulty with the pondage issue, and that's one of  
 16 the things that I said: why did they not define this  
 17 better?  
 18 And one of the ideas that really came out to me is  
 19 that you had two parties who were very opposed, and they  
 20 had a deadline, and there were certain items they simply  
 21 could not come to agreement on. I think that's  
 22 basically what it comes down to. And that's where  
 23 a number of items in the Treaty that you may say today,  
 24 "Why did they do or not do this?", I think it comes down  
 25 to that, because there was, let's say, a lot of bad

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12:32 1 I appreciate your candour, Dr Morris.  
 2 We have another question from Dr Blackmore.  
 3 DR BLACKMORE: I'll stick to the technical.  
 4 I'm just interested in your take on seismic. We're  
 5 in an area with very high seismic activity and, well,  
 6 high risk. And looking at the way knowledge is evolving  
 7 quickly around all of this, I'm just interested in your  
 8 take on tunnelling technology in the seismic environment  
 9 vis-à-vis high and low dams, where you see the balance  
 10 or risks in that area.  
 11 DR MORRIS: I can't really go into tunnelling more than what  
 12 I've already mentioned, in terms of we have seen a lot  
 13 of advancements, because tunnelling is not my area. So  
 14 I would have to defer that question.  
 15 THE CHAIRMAN: Mr Minear?  
 16 MR MINEAR: Mr Morris, this might be my last chance to ask  
 17 an engineer this question. But we spoke the other day  
 18 about the travaux, and how at one point Pakistan's  
 19 negotiators had specified a minimum load factor as a way  
 20 to regulate pondage, but they later, without  
 21 explanation, switched to a bespoke definition of  
 22 "Firm Power".  
 23 As an engineer, do you have any insights of why they  
 24 would have gone from the minimum load factor as the  
 25 criterion to the "Firm Power" definition?

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12:31 1 blood in those days.  
 2 THE CHAIRMAN: So you think there wasn't a meeting of the  
 3 minds as to what was actually meant by something like  
 4 paragraph 8(d)?  
 5 DR MORRIS: The Treaty was basically imposed upon the two  
 6 parties. In other words, they had to come to agreement  
 7 to get financing from the World Bank. And they were  
 8 stuck that they can't finance the development that they  
 9 need to do without having a treaty.  
 10 So the Treaty is developed, the parties are in  
 11 opposing viewpoints. And there were certain things that  
 12 they were able to agree on; and there were certain  
 13 things that they couldn't really agree on the details,  
 14 so they didn't.  
 15 That is my personal reading of it, and the team may  
 16 have a little bit different way to express that. But  
 17 that is my personal opinion, from what I saw from all of  
 18 my interaction over the years, reading the travaux and  
 19 watching the dynamic as it has evolved within the realm  
 20 of my own experience.  
 21 SIR DANIEL: Professor Murphy, just to say, to save  
 22 Dr Morris, we may be taking him into the territory of  
 23 a lawyer. So if there are issues, then we'd be happy to  
 24 come back to those.  
 25 THE CHAIRMAN: Yes, that's fine.

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12:34 1 DR MORRIS: I can't answer that, because it's been a few  
 2 years since I've looked at the travaux. So I apologise  
 3 that I can't answer it in detail.  
 4 MR MINEAR: Thank you.  
 5 THE CHAIRMAN: Okay, I think we are done questioning you,  
 6 Dr Morris. But thank you very much for your  
 7 presentation. It was extremely helpful and we're very  
 8 grateful.  
 9 DR MORRIS: It's been a pleasure. And I will give the PDF  
 10 of the sketch I made to the gentleman at the ...  
 11 THE CHAIRMAN: Very good. Thank you.  
 12 So I think that we are now moving on to  
 13 a presentation by Professor Webb: "Outlets, spillways  
 14 and power intakes". Perhaps it could be subtitled "from  
 15 the perspective of a lawyer"!  
 16 So we welcome you, Professor Webb, to the podium.  
 17 (Pause)  
 18 While you're getting yourself sorted out there,  
 19 I suppose I'll note: we have a little less than  
 20 a half-hour before the lunch break, but I understand  
 21 that Professor Webb's presentation will extend well  
 22 beyond that. So if the top of the hour is a convenient  
 23 time to make the break, Professor Webb, please feel free  
 24 to let us know.  
 25 SIR DANIEL: Mr Chairman, just on that point, I anticipate

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12:36 1 that probably we will get through Professor Webb and  
 2 Dr Miles on freeboard this afternoon, and I might start  
 3 off the day on the brief submissions on pondage tomorrow  
 4 morning, so that we can not stress the timing on these  
 5 too much.  
 6 THE CHAIRMAN: That's fine.  
 7 Professor Webb.  
 8 PROFESSOR WEBB: Thank you, Mr Chairman, members of  
 9 the Court.  
 10 (12.36 pm)  
 11 Submissions on Outlets, Spillways and Power Intakes  
 12 PROFESSOR WEBB: (Slide 1) The Court has just heard from  
 13 Dr Morris on these features, outlets, spillways and  
 14 power intakes, and how they play a crucial role in  
 15 controlling the water contained in the reservoir and  
 16 managing sediment. The Court also heard from site  
 17 experts during the Neelum-Jhelum site visit on how these  
 18 are designed and operated in a generic hydropower plant.  
 19 And you had a firsthand view of these features during  
 20 that site visit.  
 21 I'm going to be placing these features in their  
 22 Treaty context. Because we're no longer dealing with  
 23 a generic plant, we're not dealing with Neelum-Jhelum;  
 24 we're in the realm of the hydro bargain that I spoke to  
 25 you about yesterday.

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12:38 1 (Slide 2) This is demonstrated by this table, which  
 2 is drawing on data on the record. So you see, for  
 3 example, projects Baglihar, Kishenganga and Ratle, the  
 4 pondage amount, but then the different number for the  
 5 total controllable volume, which reflects that volume  
 6 above the invert of the lowest outlet.  
 7 So we see Baglihar has a pondage of 32.56, but it  
 8 has a controllable volume of 209 million cubic metres;  
 9 Kishenganga, 7.55 of pondage, but a controllable storage  
 10 of 17.94; and Ratle, as it's designed, 23.86 of pondage  
 11 and 59.91 of the controllable volume.  
 12 So this exactly illustrates the point that you were  
 13 discussing on the difference between pondage and  
 14 controllable storage in terms of weaponisation and other  
 15 uses.  
 16 I just want to pick up on your question about  
 17 Annexure E plants and their potential role, given that  
 18 they have different conditions under Annexure E. And  
 19 we will be coming back to this, I'm sure, in the second  
 20 round. But I just wanted to point you to paragraph 11  
 21 of Annexure E, paragraphs (e), (f) and (g).  
 22 So paragraph (e) provides, in relevant part, that  
 23 the outlets:  
 24 "... shall be located at the highest level  
 25 consistent with sound and economical design and the

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12:37 1 So outlets, spillways and intakes reflect the means  
 2 by which an operator may control the water contained in  
 3 the reservoir by opening and closing the means of  
 4 discharge. And the extent to which the operator  
 5 possesses such control, as you've heard, will depend on  
 6 the position of each component within the reservoir: the  
 7 deeper the component, the greater the control.  
 8 And consistent with the object and purpose of the  
 9 Treaty, the paragraph 8 criteria can only be interpreted  
 10 as a deliberate effort by the drafters to materially  
 11 limit India's ability to store water on the Western  
 12 Rivers and to control the use of that water that is  
 13 stored. And that is the point of each criterion in  
 14 paragraph 8. The deeper that India wants to place  
 15 an outlet, a spillway or an intake in the reservoir, the  
 16 more factors it has to demonstrate before the Treaty  
 17 will permit that placement.  
 18 The water volume controllable by India includes not  
 19 only the pondage, but also the additional volume below  
 20 dead storage level but above the invert of the lowest  
 21 outlet. And depending on the placement of the outlets,  
 22 this controllable volume can be quite large. And this  
 23 goes directly to the exchange that the Chairman and  
 24 Dr Morris just had about the difference between pondage  
 25 and controllable storage.

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12:40 1 satisfactory operation of the ... Work."  
 2 (f) provides:  
 3 "Any outlets below the Dead Storage Level necessary  
 4 for sediment control or any other technical purpose  
 5 shall be of the minimum size, and located at the highest  
 6 level, consistent with sound and economical design and  
 7 with satisfactory operation of the Storage Work."  
 8 And (g):  
 9 "If a power plant is incorporated in the Storage  
 10 Work, then the intakes for the turbines shall be located  
 11 at the highest level consistent with satisfactory and  
 12 economical construction and operation of the plant and  
 13 with customary and accepted practice of design for the  
 14 designated range of the plant's operation."  
 15 So we see the hydro bargain, in a sense, being  
 16 transposed to Annexure E in these provisions, because  
 17 there are very similar -- if not identical in some  
 18 respects -- limits on outlets, spillways and intakes.  
 19 So outlet placement is crucial.  
 20 Now, for each of these features, I'm going to  
 21 briefly recall its function in a hydroelectric power  
 22 plant, although we are now all very familiar with that,  
 23 and then apply the Treaty interpretation. And I will,  
 24 along the way, be referring to the analysis that was  
 25 given by the Kishenganga Court and the Baglihar

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<p>12:41 1 Neutral Expert. 2 I will also be answering the Court's question 2(a) 3 received on 20 June, which is that: 4 "The Court invites Pakistan to ... explain in as 5 much detail as possible Pakistan's understanding of 6 India's current interpretation." 7 Along the way, I will also recall questions posed 8 and answers provided during the Neelum-Jhelum site visit 9 and in Procedural Order No. 6. So I hope this will give 10 a full picture of the legal analysis of these 11 provisions. 12 (Slide 3) So I will first briefly set out the 13 relationship between paragraphs 8(d), (e) and (f), 14 before moving to interpret each of them individually: 15 outlets, spillways and then intakes. 16 So the term "outlet" is a generic one in 17 paragraph 8(d). Spillways and intakes are special types 18 of outlets. And this is worth emphasising because, as 19 Sir Daniel flagged this morning, 8(d) is the gateway to 20 all kinds of outlets that appear in a hydropower plant. 21 (Slide 4) So in a generic hydroelectric plant, 22 spillways are large-capacity outlets designed to 23 discharge flood flows into the river below the dam. And 24 as we've heard, they are usually used on a seasonal 25 basis.</p> <p style="text-align: center;">Page 101</p>	<p>12:45 1 I'll be coming back to these in more detail and applying 2 the principles of treaty interpretation. But just to 3 highlight them now at the beginning. 4 (Slide 5) So in paragraph 8(d) -- which, as we said, 5 is the kind of "gateway" provision dealing with any 6 outlet that is below dead storage level -- this is 7 governed by "sound and economical design and ... 8 satisfactory operation of the works". 9 Paragraph 8(e), on spillways, refers again to "sound 10 and economical design", and "satisfactory construction 11 and operation of the works". It adds in construction. 12 And in paragraph 8(f), on intakes for the turbines, 13 we have "satisfactory and economical construction and 14 operation of the Plant as a Run-of-River Plant". And we 15 have the addition of a phrase that has come up a few 16 times this week, "customary and accepted practice of 17 design for the designated range of the Plant's 18 operation". 19 These differences in language are deliberate. 20 (Slide 6) Paragraphs 2(a) and (b) of Annexure D are 21 relevant here as well, again coming to special meanings 22 intended by the parties to be used in the implementation 23 of this Treaty. 24 So "Dead Storage" is the "portion of ... storage ... 25 not used for operational purposes", and that defines the</p> <p style="text-align: center;">Page 103</p>
<p>12:43 1 Intakes, in a generic plant, act as an outlet from 2 the reservoir, as well as an intake for delivering water 3 for beneficial uses. So in a generic plant, they 4 deliver water for irrigation, municipal supply, 5 industrial use and environmental flows to the river 6 below the dam. We are going to be concerned with power 7 intakes that divert water from the reservoir into the 8 conveyance system supplying the power station. 9 Outlets may serve multiple functions in 10 a hydroelectric power plant. A crest-gated spillway may 11 play a role in sediment management but also enable the 12 plant to safely discharge floods. 13 And Pakistan has no objection to such 14 a dual-function spillway. This has arisen in the 15 Commission. This is actually one of the features that 16 India described as so-called "state-of-the-art". And 17 there was no objection to India including dual-function 18 spillways for that purpose in their designs, but always 19 provided that the requirements of paragraph 8 are 20 complied with. 21 Outlets, spillways and intakes may have common 22 features, in that they pass water over and through and 23 around the dam. But despite these features in common, 24 we do see specifically different language in the three 25 paragraphs that we're focusing on in paragraph 8. And</p> <p style="text-align: center;">Page 102</p>	<p>12:46 1 "Dead Storage Level". And "Live Storage" is "all 2 storage above" that. 3 As the Kishenganga Court said, "Dead Storage" under 4 the Treaty is "truly 'dead' -- an area to be filled 5 once, and not thereafter subject to manipulation" 6 (PLA-3, paragraph 505). This reflects the hydro 7 bargain, which places on India an obligation to "let 8 flow", as we know, and imposes limitations on 9 interference and storage of those waters. 10 So this means that the only water in an Annexure D.3 11 HEP that can be used for operational purposes is live 12 storage, which is stored above the dead storage level. 13 So with this understanding, paragraph 8(d), on 14 outlets in general, places a strict prohibition, subject 15 to very limited exceptions, on any outlets below the 16 dead storage level. It also has no reference to 17 construction, unlike the other two provisions. And this 18 implies that the size and placement of outlets cannot be 19 justified by reference to the cost or the difficulty of 20 actually building them. 21 And this limitation is critical because whereas 22 pondage is specifically limited within the Treaty, there 23 is no limitation on the volume of water that can be 24 impounded by way of dead storage. So this makes it 25 critical that the depth of outlets below dead storage</p> <p style="text-align: center;">Page 104</p>

12:48 1 level are strictly limited for purposes of constraining  
 2 that controllable volume of water.  
 3 By contrast, spillways and power intakes under 8(e)  
 4 and (f) tend not to be placed entirely below dead  
 5 storage level. Where the intake is below dead storage  
 6 level, then it becomes a low-level orifice that has to  
 7 be justified by reference to the requirements in 8(d).  
 8 You are not only in the realm of 8(f) if your intake is  
 9 below dead storage level.  
 10 Paragraph 8(e), on spillways, provides that a gated  
 11 spillway is not the default choice: it has to be  
 12 justified as necessary by the conditions of the site  
 13 that is being chosen. But even when you meet that  
 14 condition of a gated spillway being necessary due to  
 15 site conditions, there are additional requirements in  
 16 8(e): that the bottom level of the gates is located at  
 17 the highest level consistent with various conditions.  
 18 And as I said, the use of "construction" appearing  
 19 in 8(e) indicates that you may consider difficulties in  
 20 actually building the spillway -- for example, due to  
 21 geological or technical challenges -- you may take that  
 22 into account in justifying the level of the bottom of  
 23 the gate within the reservoir. However, if that  
 24 structure is below dead storage level, you enter 8(d).  
 25 8(f), on power intakes and turbines, adds the

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12:51 1 "First, to release flow with the water level at the  
 2 minimum operating level requires the crest of the outlet  
 3 to be set below the minimum operating level.  
 4 Second, sediment management to maintain reservoir  
 5 storage capacity requires establishing a new riverbed  
 6 profile [as you see on the slide] through the  
 7 reservoir ... The new profile will be defined by the  
 8 water level at the dam during flood flows responsible  
 9 for most sediment scour and transport.  
 10 However ... once the outlet has been set at the  
 11 location needed to produce the target water level,  
 12 further lowering of the outlet will produce no  
 13 beneficial change in the profile other than to create  
 14 a highly localised cone ... of scour at the upstream  
 15 face of the outlet."  
 16 So as already explained by Dr Morris, sediment  
 17 management has two aspects: first, it is to prevent  
 18 sediment accumulation that's going to reduce your live  
 19 storage; and second, it is to prevent or reduce turbine  
 20 abrasion. And effective sediment management involves  
 21 multiple techniques, and some of these would call for  
 22 low-level outlets and some do not require low-level  
 23 outlets. The key point is that there is a variety of  
 24 techniques available. And I'll just recall those;  
 25 I know you're becoming very familiar with them.

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12:50 1 requirement of being specific to the construction and  
 2 operation of a run-of-river plant. And when I come to  
 3 8(f), I will deal with that in more detail.  
 4 (Slide 7) You've seen this slide a few times before,  
 5 and it's just to make the point that an "outlet", in dam  
 6 engineering, is any opening that will allow water to be  
 7 discharged through or around the dam. And in a generic  
 8 plant, it may be located at any depth. That is not the  
 9 situation in a Treaty dam, which expressly restricts  
 10 where India is permitted to locate outlets below dead  
 11 storage level.  
 12 We've just heard from Dr Morris that the central  
 13 function of an outlet is sediment management. And  
 14 I recall the Court's question 2 asked during the site  
 15 visit (Site Visit Day 4, page 92, lines 6-11), which  
 16 was:  
 17 "What are the range of circumstances where an outlet  
 18 below dead storage level might be either beneficial or  
 19 required for a run-of-river hydroelectric project on the  
 20 Western Rivers of the Indus Basin, in particular for the  
 21 purpose of sediment control?"  
 22 And I recall the answer provided by the site expert.  
 23 This is the site visit transcript, Day 4, pages 97 to  
 24 98. And he mentioned "two main circumstances", of  
 25 course referring to a generic hydropower plant:

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12:53 1 (Slide 8) Pressure flushing for managing sediment  
 2 requires a low-level outlet: it creates a scour cone.  
 3 It will not address sediment accumulation along the  
 4 length of the reservoir. This is really only  
 5 a technique that can be used to remove sediment from the  
 6 immediate area of the intakes.  
 7 (Slide 9) Another strategy also you're very familiar  
 8 with now is empty flushing. You've seen this slide  
 9 during the site visit, and you're familiar with the  
 10 technique.  
 11 You've also been told, by both the site expert  
 12 during the visit and by Dr Morris during these  
 13 proceedings, the challenges of empty flushing, quite  
 14 apart from its prohibition under the Treaty, in terms of  
 15 its negative downstream impacts and its requirement to  
 16 stop production.  
 17 So those are the low-level outlet techniques.  
 18 (Slide 10) But then we come to techniques that do  
 19 not require a low-level outlet. And you've heard from  
 20 Dr Morris about sluicing. And I recall this slide both  
 21 from his presentation and the site visit.  
 22 Sluicing mimics the natural pattern of the river.  
 23 And spillways located at or just below the minimum  
 24 operating level are fully opened during the flood  
 25 conditions to pass the floods through the reservoir at

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12:54 1 the highest possible velocity, essentially transforming  
 2 the reservoir into a fast-flowing river. And Dr Morris  
 3 took you through the seasonal drawdown, and how that  
 4 operates during the time of year when pondage is not  
 5 needed for power peaking.  
 6 The appropriate sedimentation management strategy  
 7 will depend on a range of factors, whether you're in  
 8 a generic plant or an Annexure D.3 plant. You're going  
 9 to be looking at hydrology, at the sediment load, at the  
 10 variation over time, at the river, at the reservoir  
 11 geometry. You will also be looking at regulatory  
 12 factors that are domestic, regional, international. For  
 13 an Annexure D plant, you're looking as well at the  
 14 Treaty.  
 15 (Slide 11) And with that, I turn to paragraph 8(d),  
 16 which is the controlling provision on all outlets below  
 17 dead storage level.  
 18 (Slide 12) And we can distil the requirements of  
 19 that paragraph into a sequence of questions and steps to  
 20 be followed.  
 21 First, India must show that the low-level outlet is  
 22 necessary for sediment management or some other  
 23 technical purpose.  
 24 Second, if it does show that it is necessary, then  
 25 it must identify appropriate options with respect to

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12:56 1 that outlet that comply with sound and economical  
 2 design. That can include innovations, that can include  
 3 best practices, that can include advances in design that  
 4 have occurred since 1960. But it's informing  
 5 a paragraph 8(d) analysis.  
 6 The third step is that once those options are  
 7 identified, India must pick the design option that  
 8 complies with the hydro bargain and with the  
 9 requirements of paragraph 8(d), so the smallest and  
 10 highest low-level outlet. Even a marginal decrease in  
 11 the size and depth of that outlet will be enough for one  
 12 design to be preferred over the other.  
 13 And finally, there has to be satisfactory operation  
 14 of the works: performing its designed function in  
 15 an acceptable manner. Construction, as I said, does not  
 16 come into the paragraph 8(d) analysis.  
 17 (Slide 13) So I now turn to our application of  
 18 Treaty principles to the various phrases of  
 19 paragraph 8(d). So the first is the starting point, the  
 20 default position:  
 21 "There shall be no outlets below ... Dead Storage  
 22 Level ..."  
 23 As the Kishenganga Court observed, these opening  
 24 words reflect the expectation of the drafters that India  
 25 would have no capacity to control dead storage in its

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12:57 1 reservoirs via the use of low-level outlets. As they  
 2 said, it is "an area to be filled once, and not  
 3 thereafter subject to manipulation" (PLA-3,  
 4 paragraph 505).  
 5 (Slide 14) If the default position doesn't apply, if  
 6 India has discharged the burden of showing that  
 7 an outlet is necessary for sediment control or any  
 8 technical purpose, we move to the second step.  
 9 So in terms of ordinary meaning of these terms,  
 10 "sediment control" means sediment management to preserve  
 11 live storage and to minimise the entry of sediment into  
 12 the turbines.  
 13 "Technical purpose" means "having [a] special and  
 14 usually practical knowledge especially of a mechanical  
 15 or scientific subject" (P-526). Read in the context of  
 16 this provision, it refers to the operation of the plant  
 17 and its associated features.  
 18 So the outlet must be required for the operation of  
 19 the plant as such, not connected with some other  
 20 purpose. An example would be irrigation or water for  
 21 domestic use. So we can say that a technical purpose  
 22 that could fall within paragraph 8(d) would be the  
 23 passing of the design flood.  
 24 (Slide 15) Then we move to the meaning of  
 25 "necessary". And this was addressed by the Kishenganga

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12:59 1 Court in the context of paragraph 15(iii) of Annexure D.  
 2 But applying our treaty principles of reading terms in  
 3 context where they are intended to have the same  
 4 meaning, it would be the same meaning here. And  
 5 I'm just going to read the emphasised points (PLA-3,  
 6 paragraph 397):  
 7 "The Court sees no reason, for [the] purposes of the  
 8 Treaty, to ascribe to it any special meaning beyond the  
 9 normal use of the term to describe [an] action that is  
 10 'required, needed or essential for a particular  
 11 purpose' ..."  
 12 And they emphasise (paragraph 398):  
 13 "This interpretation does not, however, reduce  
 14 necessity to a mere test of what is desirable, nor does  
 15 it become a self-judging matter for India alone to  
 16 evaluate."  
 17 I see we have come to the top of the hour,  
 18 Mr Chairman. I am very happy to stop here and continue  
 19 after the lunch break.  
 20 THE CHAIRMAN: Very good.  
 21 I think we have a couple of questions for you, which  
 22 you can either answer now or hold them over the lunch  
 23 break and come back to us on.  
 24 Mr Minear.  
 25 MR MINEAR: Professor Webb, I noted that you have implicitly

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13:00 1 put the burden on India with regard to making each of  
 2 these showings.  
 3 PROFESSOR WEBB: Yes.  
 4 MR MINEAR: Did the Kishenganga Court place the burden on  
 5 India?  
 6 PROFESSOR WEBB: I believe they did. But let me check that  
 7 and come back to you after the lunch break.  
 8 MR MINEAR: Thank you.  
 9 THE CHAIRMAN: A question from me is: I'm having a little  
 10 bit of trouble reconciling what I heard Sir Daniel say  
 11 this morning about needing to take into account the  
 12 location of the site of the dam when we're thinking  
 13 through, I think, the paragraph 8 requirements.  
 14 You are approaching this issue of outlets on  
 15 an assumption, I think, that the site has already been  
 16 selected and we're now trying to figure out: for  
 17 sediment control, do you really need an outlet below  
 18 dead storage level? And that I can understand, and  
 19 I think the Memorial was largely oriented towards that.  
 20 What's less clear to me is how this features in a point  
 21 in time before that, where you're looking at the  
 22 location of the site.  
 23 And I suppose I'll connect this back to a question  
 24 I had for Dr Morris. If it's the case that there would  
 25 always be a site where you would not need to have

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13:03 1 a low-level orifice?  
 2 PROFESSOR WEBB: Yes. So there are sites where you can have  
 3 sluicing and other techniques for sediment management  
 4 where you may still need a low-level orifice, so you may  
 5 still enter the paragraph 8(d) analysis, and that may be  
 6 because of the topography of the site, the geology, the  
 7 seismicity. So there are other factors that may come  
 8 in. And as Dr Morris flagged, and as I'll come in to  
 9 show as well, there are scenarios where you may have  
 10 a low-level orifice, it's not completely excluded by the  
 11 Treaty, but it has to be as small as possible, it has to  
 12 be as high as possible in relation to the dead storage  
 13 level.  
 14 So there's scenarios beyond just the drawdown  
 15 flushing where you may need some kind of low-level  
 16 outlet.  
 17 THE CHAIRMAN: Yes, I think you understand what I'm driving  
 18 at, and it's really trying to understand where we're  
 19 drawing the line. I think what I'm hearing you saying  
 20 is: it may well be the case that there are sites where  
 21 a low-level orifice is going to be needed. And I'm  
 22 trying to figure out: well, why isn't it at an earlier  
 23 point in time that one would say, "Well, don't put it  
 24 there; put it somewhere elsewhere you don't need that  
 25 low-level orifice"?

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13:02 1 an outlet below dead storage level, then how should we  
 2 be thinking about -- do we even get to the point, once  
 3 we're at the site, of having to go through the analysis  
 4 that you're talking about?  
 5 PROFESSOR WEBB: Let me give an initial response on that,  
 6 which is: as the Kishenganga Court confirmed, the Treaty  
 7 prohibits drawing down below dead storage level. And  
 8 that feeds into the choice of site, because if you  
 9 choose a site and choose a design where empty flushing  
 10 is your so-called "only option" for maintaining live  
 11 storage and protecting turbines from abrasion, then you  
 12 have already put yourself in a position where you're  
 13 going to have these low-level outlets below dead storage  
 14 level, where you're going to have extremely large  
 15 orifice spillways, and all the other design features we  
 16 see in the typical Indian design that I'll be coming  
 17 later in the presentation.  
 18 So I think the choice of site comes initially into  
 19 that aspect of the Treaty's requirements.  
 20 THE CHAIRMAN: Right. But again, the point would just be  
 21 that if it's always the case that there will be another  
 22 site, where you don't even get then to the issue of  
 23 needing that low-level orifice, then does it always  
 24 drive you to a site where you don't actually have to  
 25 then think, as you're constructing this dam: do I need

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13:05 1 PROFESSOR WEBB: Yes.  
 2 THE CHAIRMAN: So maybe you could think about that a little  
 3 bit and let us know your thoughts in due course.  
 4 PROFESSOR WEBB: Yes, thank you.  
 5 THE CHAIRMAN: Okay, I think we are at the lunch break. Why  
 6 don't we stop here and come back at 2 o'clock.  
 7 Thank you very much, Professor Webb.  
 8 PROFESSOR WEBB: Thank you.  
 9 (1.05 pm)  
 10 (Adjourned until 2.00 pm)  
 11 (2.02 pm)  
 12 THE CHAIRMAN: Good afternoon, everyone.  
 13 Professor Webb, we're back in your hands.  
 14 PROFESSOR WEBB: Thank you, Mr Chairman.  
 15 Just returning to the questions asked just before --  
 16 Mr Minear, on your question about what the Kishenganga  
 17 Court said about the burden being on India to show that  
 18 something is necessary, I have now clarified this.  
 19 The Kishenganga Court did not actually have to  
 20 decide on burden, or chose not to decide on the question  
 21 of burden, because it found that there was a prohibition  
 22 on drawdown flushing. So it wasn't a question of rule  
 23 and exception, and showing one falls within it, but they  
 24 found a prohibition.  
 25 Now, of course there is a very, very narrow

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14:03 1 exception to drawdown flushing, which is the unforeseen  
 2 emergency. But India did not try to bring itself within  
 3 that exception in the Kishenganga case. Actually the  
 4 parties both agreed that sediment accumulation was not  
 5 an unforeseen emergency. So the question of burden  
 6 didn't arise.  
 7 However, I can cite an ICJ case that makes clear  
 8 that when you have a treaty that talks about necessity,  
 9 the burden is on the party seeking to show that  
 10 a certain act or technique is necessary. And that's the  
 11 Certain Iranian Assets case, which is at our  
 12 Exhibit PLA-0041, and the relevant point is at  
 13 paragraph 108.  
 14 MR MINEAR: I thank you.  
 15 PROFESSOR WEBB: Mr Chairman, on your question about the  
 16 role of site choice, and where it comes at the different  
 17 phases of a development and also within the Treaty,  
 18 I would just cite to you -- as I think was cited  
 19 earlier -- the Kishenganga decision on clarification or  
 20 interpretation, PLA-0021, paragraph 33, which makes this  
 21 point about "whether a ... site will be available as  
 22 a practical matter to India for hydro-electric  
 23 development" in the context of drawdown flushing.  
 24 And just building on that, I want to share a few  
 25 observations on site selection.

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14:06 1 two potential locations along a river for a plant, and  
 2 one would permit the use of desanders because of the  
 3 space available to build the desanders, and the other  
 4 site along the same river would not permit the use of  
 5 desanders and therefore require India to drawdown flush,  
 6 then India is required to choose the first site under  
 7 the Treaty.  
 8 But once a site is chosen, there is still the  
 9 continuing relevance of the criteria that I am taking  
 10 you through in paragraph 8. And as I mentioned before  
 11 the break, paragraph 8(d) still envisages that India may  
 12 include a low-level outlet below dead storage level for  
 13 sediment control and/or other technical purpose. And  
 14 those examples could include contributing to passing the  
 15 design flood, for example, in conjunction with a number  
 16 of other spillways. And I'll have a diagram later that  
 17 shows that scenario.  
 18 THE CHAIRMAN: That's very helpful. Just to pursue it  
 19 a little bit, am I hearing you to say that in the course  
 20 of site selection, a party should not choose a site that  
 21 artificially requires a low-level outlet?  
 22 PROFESSOR WEBB: Yes.  
 23 THE CHAIRMAN: But that standard is not the same as what we  
 24 then will find in paragraph 8(d) and so on. That's  
 25 a different kind of standard one is applying. That's

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14:04 1 The first is that a site for a hydroelectric power  
 2 plant is not preordained: it's always going to be in  
 3 comparison with a number of other sites. And given the  
 4 huge investment and the time and energy that these  
 5 projects involve, the party will be screening for  
 6 a number of parameters in any scenario.  
 7 In the Treaty, India should be screening -- and is  
 8 required to screen -- for compliance with the Treaty  
 9 framework. And in particular, as I said before the  
 10 break, that will be not choosing a site where it is  
 11 forced into a drawdown flushing scenario.  
 12 Now, that will only exclude a very small number of  
 13 sites as possibilities. It may be a site that's  
 14 extremely narrow, that cannot be widened because of weak  
 15 geology along the dam axis: that is one that would call  
 16 for drawdown flushing, and that is a site that should  
 17 not be chosen.  
 18 But whatever site is chosen is not going to be  
 19 ideal: there will be different challenges facing the  
 20 engineers and the operators. And it may take greater  
 21 expense or greater time or greater complexity of design  
 22 for India to make that site, and the way it's designed  
 23 and operated to be treaty-compliant. But that is  
 24 something that the Treaty envisages as well.  
 25 Just to give you a concrete example, if there were

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14:08 1 not quite the same thing as the "necessary for sediment  
 2 control or any other technical purpose"; is that  
 3 correct?  
 4 PROFESSOR WEBB: Well, it is different, but it is also  
 5 related because, as Dr Morris said, India, by choosing  
 6 particular sites and designing plants in a particular  
 7 way, creates an artificial necessity for drawdown  
 8 flushing, because it has built these dams in these  
 9 particular areas and with these particular types of  
 10 outlets.  
 11 So it creates a necessity, but it's not the  
 12 "necessity" that we talk about under the Treaty, because  
 13 there was a choice earlier, at the time of site  
 14 selection -- a choice recognised by the Kishenganga  
 15 Court -- that means that at that point in time, India  
 16 had to choose a different site.  
 17 THE CHAIRMAN: Right. I think we're seeing this in  
 18 a similar way. I'm just trying to be sure.  
 19 When you were talking about paragraph 8(d), you were  
 20 making it very clear that in Pakistan's view, there is  
 21 no reference here to construction, and therefore there  
 22 should be no weight put on cost difficulty, things of  
 23 that sort.  
 24 But in the context of a site selection process,  
 25 where we're just trying to think through, "Are we

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14:09 1 picking the site artificially to develop a low-level  
 2 outlet?", it seems as though maybe in that context you  
 3 would be thinking about cost issues, difficulty of  
 4 construction and so on. Is that correct?  
 5 PROFESSOR WEBB: I think you're thinking more broadly at  
 6 that stage. That would come into it, but you'd be  
 7 thinking more broadly about: how are we going to manage  
 8 sediment in this area? And how are we also going to  
 9 deal with potential flood risk, seismic risk, geological  
 10 issues? There's a lot of things that come in.  
 11 But when you're thinking about the sediment  
 12 management issues -- which, as we've heard, is the  
 13 crucial issue in the Himalayas -- what the Treaty  
 14 requires, both in its specific prohibition on drawdown  
 15 flushing but also in its overall object and purpose, is  
 16 that India does not choose a site where it has created  
 17 this necessity for low-level outlets.  
 18 THE CHAIRMAN: Very good. Thank you.  
 19 PROFESSOR WEBB: Thanks.  
 20 THE CHAIRMAN: Mr Minear.  
 21 MR MINEAR: Professor, can I just ask you: when does  
 22 Pakistan have an opportunity to weigh in on India's site  
 23 selection?  
 24 PROFESSOR WEBB: Can I come back to you on that?  
 25 MR MINEAR: Sure.

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14:12 1 In justifying a low-level outlet under  
 2 paragraph 8(d), India of course cannot breach other  
 3 provisions of the Treaty, in particular the prohibition  
 4 on drawdown flushing except for an unforeseen emergency.  
 5 (Slide 16) This brings me to, actually, the point  
 6 about site selection in the decision on interpretation  
 7 or clarification (PLA-21, paragraph 33), where the Court  
 8 explains that the Court recognises:  
 9 "... the actual impact of sediment at any particular  
 10 site can only be evaluated in the context of that site."  
 11 But:  
 12 "Rather than limiting the application of the  
 13 Treaty's prohibition on drawdown flushing ..."  
 14 As India urged:  
 15 "... this fact goes to the question of whether  
 16 a particular site will be available as a practical  
 17 matter to India for hydro-electric development."  
 18 (Slide 17) Coming to the next phrase in  
 19 paragraph 8(d). If an outlet is proven to be necessary  
 20 below dead storage level and it is for sediment control  
 21 or any other technical purpose, then there are other  
 22 conditions that are triggered, which are it has to be:  
 23 "... of the minimum size, and located at the highest  
 24 level consistent with sound and economical design ..."  
 25 And I'll come to "satisfactory operation".

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14:10 1 PROFESSOR WEBB: Because that's a good point, and it will be  
 2 in the cooperation and reporting requirements, which are  
 3 very detailed. But, yes.  
 4 MR MINEAR: Great. I didn't mean to interrupt your flow.  
 5 PROFESSOR WEBB: No, no, that's a good point that we'll come  
 6 back to. Thank you.  
 7 (Slide 15) I'm now taking us back to the  
 8 interpretation of necessity in paragraph 8(d). And  
 9 there are four points to make about this interpretation  
 10 following the Kishenganga partial award, of "required,  
 11 needed or essential for a particular purpose".  
 12 As we've been discussing in the context of  
 13 questions, it is not sufficient for India to  
 14 demonstrate, by reference to a cost-benefit analysis,  
 15 that a low-level outlet would be preferable: it has to  
 16 be "required, needed ... essential for a particular  
 17 purpose".  
 18 As we've seen, paragraph 8(d) creates a presumption  
 19 against the use of low-level outlets. And as the  
 20 Kishenganga Court has stated, that test of necessity is  
 21 not self-judging. It is not up to India -- and this  
 22 goes to the false necessity creation point -- to say  
 23 that such a low-level outlet is necessary. It must  
 24 consult with Pakistan and it must also be objectively  
 25 necessary.

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14:13 1 This is again consistent with the hydro bargain. By  
 2 limiting the size of the outlet, this minimises the  
 3 amount of water that India can discharge on  
 4 a second-by-second basis. And by limiting the depth of  
 5 the outlet, making it as high as possible, the Treaty  
 6 removes India's ability to control the additional water  
 7 volume between the dead storage level and the outlet  
 8 level.  
 9 The word "design" means the rendering of  
 10 a particular feature on paper and in practice. It is  
 11 a word used throughout paragraph 8, not only in the  
 12 subparagraphs we're looking at but also in the chapeau,  
 13 that talks about "the design of any new run-of-river  
 14 plant ... [that] shall conform to the following  
 15 criteria". It goes beyond a mere plan or scheme.  
 16 "Design" is also active, in that it includes the "art of  
 17 planning and creating in accordance with an appropriate  
 18 function[]" (P-527).  
 19 "Sound and economical", also in terms of its  
 20 ordinary meaning: "sound" refers to "free from any decay  
 21 or defect; undamaged, unbroken; in good condition"  
 22 (P-418). We can apply it to this context by saying: fit  
 23 for the purpose for which it is designed. It also  
 24 brings in dam safety elements, when we talk about  
 25 something being "safe and sound".

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14:15 1 "Economical" means "Characterized by or tending to  
2 economy, careful [utilization] of resources; not  
3 wasteful" (P-527); and applying to this, not  
4 disproportionately expensive given the purpose for which  
5 it has been designed.  
6 So as a result, India can design the size and height  
7 of a low-level outlet by reference to what works in the  
8 circumstances and what is affordable in that context.  
9 It is not able to claim that so-called "best practices"  
10 entitle it to a design and placement that would maximise  
11 its utility for India, in disregard of potential  
12 damaging downstream consequences for Pakistan. And if  
13 I could recall the first step set out by the Chairman  
14 yesterday afternoon, which is exactly what we apply  
15 here: that we do not use best practices that negate  
16 a specific Treaty requirement.  
17 So as I explained on Tuesday, India is not precluded  
18 from taking advantage of advances in technology and  
19 engineering practice. We say actually paragraph 8(d)  
20 requires India to improve its design, as long as it  
21 remains within the bounds of the Treaty.  
22 To just draw on an example that you were discussing  
23 with Dr Morris earlier, and in the exchange with  
24 Dr Blackmore, tunnel boring machines are an example of  
25 such technology, where really since the 1980s we've seen

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14:16 1 rapid improvements in the size, cost and speed of these  
2 machines that allow long tunnels to be bored through the  
3 mountains.  
4 (Slide 18) So finally, 8(d) requires "satisfactory  
5 operation of the works". "Operation", the ordinary  
6 meaning is "The condition of functioning or being  
7 active" (P-418). Applied to this context, it is the way  
8 in which the HEP functions once construction has been  
9 concluded and it has come online. And "satisfactory"  
10 means "sufficient" or "adequate" (P-418); not optimal,  
11 necessarily.  
12 Paragraph 8(d) applies the same standards to the  
13 operation of a low-level outlet as to its design. So  
14 India is entitled to a low-level outlet that performs  
15 its designed function in an acceptable manner.  
16 As I've already shown in the introduction, unlike  
17 paragraphs (e) and (f), paragraph 8(d) does not allow  
18 a low-level outlet to be justified by reference to  
19 construction, and we say that India cannot rely on  
20 construction considerations to justify a lower or larger  
21 outlet. So outlets below dead storage level, whether  
22 they are intakes or spillways or another type of outlet,  
23 are much harder to justify than outlets above dead  
24 storage level.  
25 So that brings me -- after your question!

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14:18 1 THE CHAIRMAN: Thank you, Professor Webb. Just because you  
2 may be moving on from 8(d).  
3 PROFESSOR WEBB: I'm not, but ...  
4 THE CHAIRMAN: Okay. Well, the question may still be  
5 timely.  
6 PROFESSOR WEBB: Yes.  
7 THE CHAIRMAN: I'm wondering: how this does relate to  
8 something like an intake? As I understand it, an intake  
9 typically needs to be located, at least partially, if  
10 not fully, below dead storage level.  
11 So one possibility is that you view that as  
12 necessary for a technical purpose, and therefore it's  
13 outside the scope of this provision. Another  
14 possibility is that outlets that are only partially  
15 below dead storage level aren't actually covered here by  
16 8(d).  
17 So I was wondering if you could just clarify that  
18 for me.  
19 PROFESSOR WEBB: Yes. Yes. Let me just come to the  
20 wording.  
21 So you're right -- and I will come to this more when  
22 I turn to intakes -- that in most scenarios, they should  
23 be at least partially below the dead storage level. And  
24 as Dr Morris explained, there's this sort of delicate  
25 balance to be struck between being deep enough to avoid

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14:19 1 vortexing, but also high enough to help with sediment  
2 control and not to be subject to too much sediment  
3 accumulation, although there are other techniques for  
4 dealing with that.  
5 So they will be within 8(f), obviously; and if they  
6 are fully submerged, they will be within 8(d) as well.  
7 THE CHAIRMAN: So a partially submerged outlet is not in  
8 8(d); is that what you're saying?  
9 PROFESSOR WEBB: I think that is what I am saying, yes.  
10 I may clarify that when I come to deal with 8(f). Thank  
11 you.  
12 THE CHAIRMAN: Thank you.  
13 PROFESSOR WEBB: So the reason we're still on 8(d) is that  
14 I now turn to the Court's question of 20 June, which is  
15 to set out as precisely as possible India's approach to  
16 the interpretation of this provision.  
17 A constant theme in India's approach has already  
18 been referred to by Sir Daniel and Mr Fietta, and this  
19 actually applies across these provisions, which is that  
20 the terms of "sound and economical design",  
21 "satisfactory operation", the "customary and accepted  
22 practice", according to India, are a gateway for  
23 incorporating so-called "best practices" and  
24 "state-of-the-art".  
25 Now, Pakistan doesn't believe that these are always

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14:21 1 actually best practices or state of the art. As we  
 2 said, we welcome such innovations as long as they're  
 3 compatible with the Treaty. But this language is used  
 4 by India to look to practices and sources external to  
 5 the Treaty.  
 6 So as a result, India's designs tend to include  
 7 fully submerged orifice spillways entirely below the  
 8 dead storage level, and India claims that these are  
 9 necessary for sediment management and flood control, and  
 10 are to be sized for the flood control function. So this  
 11 implicates both 8(d) that we are talking about now, but  
 12 also 8(e), when we come specifically to spillways.  
 13 (Slide 19) This is a picture of the typical Indian  
 14 design. This is from our Memorial, figure 10.11. It is  
 15 the proposed spillway design for the Baglihar HEP,  
 16 which, as we've set out, has been replicated in multiple  
 17 designs across the Western Rivers.  
 18 Now, as Dr Morris explained, the use of an orifice  
 19 spillway for flood control and sediment management can  
 20 comply with the Treaty, but only if India proves that it  
 21 meets the requirements of both 8(d) and 8(e). And one  
 22 sort of bright line, or red line, is that India must not  
 23 use the multi-use orifice spillway to empty the  
 24 reservoir below the dead storage level. So it could use  
 25 a multi-use orifice spillway to undertake sluicing at

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14:25 1 exchanges, we get an even greater insight into what  
 2 India's case is here.  
 3 (Slide 20) Pakistan's Commissioner raised this issue  
 4 of how the low-level outlets were being designed in the  
 5 111th meeting of the Commission. And I'll just read out  
 6 the first paragraph (P-25, paragraph 29):  
 7 "PCIW said that despite the fact that clear  
 8 guidelines are provided regarding sediment management in  
 9 Baglihar and Kishenganga cases yet India keeps on  
 10 proposing deep orifice spillways in its designs. The  
 11 [Kishenganga Court] has imposed a restriction upon India  
 12 that it will not draw the water level down below [Dead  
 13 Storage Level] for flushing and India has given  
 14 assurance to abide by the Award of the Court. PCIW  
 15 further stated that Pakistan does not have any  
 16 objections to sluicing but is of the view that once  
 17 drawdown flushing is ruled out, crest-gated spillways  
 18 can effectively pass the sediments through the  
 19 reservoir."  
 20 Those spillways being above the dead storage level.  
 21 (Slide 21) India responded in the same meeting  
 22 (P-25, paragraph 33):  
 23 "Neither the Treaty nor the Court has imposed any  
 24 restriction on placement of orifice[s]. There has not  
 25 been any literature which substantiates Pakistan

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14:23 1 the dead storage level, but not as a form of sediment  
 2 management that depletes the water below the dead  
 3 storage level.  
 4 I really can't say it better than as Dr Morris  
 5 explained it this morning in relation to his slide 17,  
 6 which is: when you look at a spillway, the gate capacity  
 7 below the dead storage level is the flow that you need  
 8 for sediment management. And as he explained, that's  
 9 a 5-10-year flood. Whereas the gate capacity above the  
 10 dead storage level is to pass the design flood. And  
 11 that's how those gates should be designed to fulfil the  
 12 criteria of minimum size and highest level.  
 13 And actually the ICOLD guidelines -- and I'll cite  
 14 Bulletin 115, Exhibit P-0530, at pages 79 and 81 --  
 15 indicate that flushing for outlet capacity should be  
 16 capable of passing a 5-year flood, not the 10,000-year  
 17 event. And this has very significant implications for  
 18 design.  
 19 So if we take the Baglihar HEP, a 5-year flood at  
 20 Baglihar is estimated to be 4,250 cumecs. The PMF,  
 21 which is defined as the 10,000-year flood at Baglihar,  
 22 is 16,500 cumecs, and that's what they have designed  
 23 for.  
 24 So Pakistan and India have exchanged on this  
 25 specific issue within the Commission. So through these

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14:26 1 side[']s view that orifice spillway can only be provided  
 2 for drawdown flushing and not for sluicing. The  
 3 restriction imposed by [the Kishenganga Court] is  
 4 operational and India has given unequivocal assurance to  
 5 abide by the same. India has right to manage the  
 6 sediments within the means available and there is no  
 7 provision in the Treaty which states orifice spillway  
 8 cannot be provided by India. [The Kishenganga Court]  
 9 has duly considered the orifice spillway configuration  
 10 provided by India and has not objected to the same.  
 11 India has adopted techno-economically sound design as  
 12 per Treaty provisions duly considering all technical  
 13 requirements including sluicing."  
 14 Now I'll explain why India's position as expressed  
 15 here, and which we believe remains their consistent  
 16 position, is wrong.  
 17 Pakistan's position is not based on what India calls  
 18 "engineering literature" showing that an orifice  
 19 spillway cannot be used for sluicing. It is based on  
 20 the terms of paragraph 8(d), which precludes the use of  
 21 low-level outlets for sediment management "unless  
 22 necessary". Where sluicing is sufficient for sediment  
 23 management, and can be accomplished by a crest-gated  
 24 spillway above dead storage level, a deep orifice  
 25 spillway, unless otherwise required to pass the design

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<p>14:27 1 flood, is not necessary, and its inclusion in 2 an Annexure D.3 plant will breach paragraph 8(d). 3 The second problem with this statement is that the 4 Kishenganga Court did not directly consider compliance 5 of the deep orifice spillway design at Kishenganga with 6 paragraph 8(d) because the question wasn't before it. 7 But under the second dispute before that Court, it 8 considered whether drawdown flushing was prohibited 9 under the Treaty, and concluded, as a systemic 10 interpretation, that it was prohibited. And as you 11 heard from Dr Morris, the Court would have felt 12 comfortable with that outcome, since there are always 13 options alternative to drawdown flushing if you haven't 14 chosen a site that completely precludes other options. 15 While the restriction on drawdown flushing 16 identified by the Kishenganga Court is operational in 17 character, that doesn't prevent it from limiting India's 18 design options. Here you see India arguing that this is 19 purely an operational point. The Kishenganga Court 20 clearly drew the connection between design and operation 21 when it said -- and this is at paragraph 506 of the 22 partial award (PLA-3) -- that: 23 "... in many instances the Treaty does not simply 24 restrict the Parties from taking certain actions ..." 25 Operational:</p> <p style="text-align: center;">Page 133</p>	<p>14:30 1 Expert's reasoning in Baglihar led him to approving the 2 design of an orifice spillway in which the bottom level 3 of the gates in Baglihar is located 27 metres below the 4 dead storage level. 5 (Slide 23) So I conclude this part on 8(d) by 6 returning to your question in Procedural Order No. 6 at 7 paragraph 35(e), where the Court asked: 8 "... what is to be taken into account for the 9 purposes of designing low-level sediment outlets for 10 a plant and what is to be excluded?" 11 (Slide 24) And let me emphasise that what we see 12 here is not a tick-box exercise because, as we've 13 already discussed, there's levels of decision-making and 14 compliance with the Treaty that start even at the choice 15 of the site. But this is, in response to the Court's 16 questions, some factors that will be relevant -- not 17 necessarily an exhaustive list -- and factors that will 18 be irrelevant. 19 So looking at whether a low-level outlet is 20 required, and then is designed in the proper way, it is 21 relevant to look at the necessity for sediment control; 22 the necessity for another technical purpose, which would 23 be, we say, the design flood; the need for that sediment 24 control to be within the Treaty limits; and then from 25 more of a design perspective, it is relevant to look at</p> <p style="text-align: center;">Page 135</p>
<p>14:29 1 "... but also constrains their entitlement to 2 construct works that would enable such actions to be 3 taken." 4 Which is the design aspect. 5 (Slide 22) So the Kishenganga partial award stated 6 (paragraph 522) that: 7 "In the case of [Kishenganga], the Court is 8 cognizant that changes to the design of the project may 9 be required to optimize the management of sediment in 10 light of this partial award." 11 In light of the prohibition on drawdown flushing. 12 And that was the expectation that just because it's 13 difficult or costly or time-consuming doesn't mean that 14 it is taken outside of the Treaty requirements. 15 I'm going to address the approach of the Neutral 16 Expert in Baglihar in more detail in the context of 17 paragraph 8(e) on spillways, but for the moment I note 18 that the Neutral Expert stated that paragraph 8(d) was 19 the controlling provision for determining whether India 20 was allowed to site its orifice spillway below the dead 21 storage level. But his analysis was flawed by his 22 finding that depletion below dead storage level was 23 permissible under the Treaty for sediment management, 24 a position that the Kishenganga Court later, and 25 rightly, rejected. And this flaw in the Neutral</p> <p style="text-align: center;">Page 134</p>	<p>14:32 1 the position of that outlet relative to other structures 2 and other requirements for structural and 3 hydromechanical design. 4 It is irrelevant for India to look to an ancillary 5 non-technical benefit that might be social, economic, 6 environmental: irrigation, for example. It's irrelevant 7 to look at objectives separate to sediment management or 8 the design flood. And it is irrelevant, under 8(d), to 9 look to construction. It doesn't matter if it's easier 10 or cheaper for India to build a low-level outlet rather 11 than a higher one in the reservoir. 12 (Slide 25) So now turning to paragraph 8(e) and 13 spillways. 14 As you know, a spillway is a large outlet 15 principally designed to pass floodwater downstream and 16 prevent unsafe overtopping of the dam. You saw this 17 image during the site visit: this is the crest-gated 18 spillway at Tarbela Dam. 19 Now, the site expert on the visit explained that 20 although the principal function of a spillway is to 21 manage flood conditions, the additional control granted 22 to the operator by a controlled spillway means that it 23 can also be used for other purposes, such as water level 24 control, and that could be important for things like 25 sluicing.</p> <p style="text-align: center;">Page 136</p>

14:34 1 Dr Morris explained that a spillway's capacity will  
 2 usually depend on the design flood. The design may  
 3 allow for some damage during extreme floods, but it is  
 4 expected to be able to discharge smaller floods without  
 5 any damage.  
 6 (Slide 26) Another slide that you've seen during the  
 7 site visit and during these proceedings, and I'm sure  
 8 you will see again during the freeboard presentation.  
 9 The Court asked during the site visit:  
 10 "What are the range of circumstances where a gated  
 11 spillway might be beneficial or required for  
 12 a run-of-river HEP on the Western Rivers ...?"  
 13 (Slide 27) And this was answered during the site  
 14 visit, during presentation 6, and this is the slide that  
 15 was shown in response to your question and the different  
 16 spillway configurations. And just to recap them for the  
 17 context of paragraph 8(e).  
 18 So the left image is the most basic spillway design:  
 19 a surface or ungated spillway. It is recommended by  
 20 default by many engineering standards, due to its  
 21 simplicity. The discharge rate from such spillways is  
 22 the function of the height of the reservoir level over  
 23 the spillway crest, and flood discharge requires that  
 24 the reservoir level and the storage experience  
 25 a surcharge above the full pondage level.

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14:35 1 Now, the middle and the right-hand images are both  
 2 of gated spillways, the middle one being a crest-gated  
 3 spillway, like you saw at Tarbela, and the one on the  
 4 right being an orifice spillway. These use large  
 5 mechanical gates to control the discharge of water, and  
 6 they may be located at any level within the reservoir.  
 7 Crest-gated spillways tend to be at the top of the dam  
 8 wall or an adjacent abutment. Orifice spillways are  
 9 located within the dam and are fully submerged. Because  
 10 the gates are mechanical, they may remain stuck in  
 11 a closed position during a flood, due to mechanical  
 12 failure, operator error or debris blockage.  
 13 (Slide 28) So we can look at these spillways from  
 14 another angle, and this is another slide you saw during  
 15 the site visit.  
 16 So this time looking at the ungated surface spillway  
 17 on the left, we can see that the discharge capacity is  
 18 fixed by the length of the spillway, and the maximum  
 19 width is going to be a function of the width of the  
 20 valley, which comes back to the topographical and  
 21 geological constraints that any hydropower plant will  
 22 face.  
 23 In the middle, we have the gated surface spillway  
 24 that allows water to be stored and controlled in a zone  
 25 otherwise than for flood surcharge.

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14:36 1 If the valley is not wide enough for a crest-gated  
 2 spillway to pass the design flood, then the dam designer  
 3 may provide for orifice spillways, as illustrated in the  
 4 right image.  
 5 Now, the deep outlet operates under higher water  
 6 pressure, enabling the discharge capacity of a crest  
 7 spillway to be obtained with a smaller orifice. And you  
 8 can see in the cross-section that the orifice spillway  
 9 has a fixed size, it doesn't have any space above it,  
 10 obviously being in the dam wall, and its capacity to  
 11 increase the flow rate under a flood surcharge condition  
 12 is therefore also limited.  
 13 By contrast, when you look at the surface spillway,  
 14 you can see that the area of flow will increase as the  
 15 flow depth increases over the spillway crest. So the  
 16 increasing area of water flow will provide much more  
 17 excess capacity in an ungated spillway as compared to  
 18 an orifice discharge. So the crest-gated spillway in  
 19 the middle will be more capable of passing larger than  
 20 design floods.  
 21 But as I said in response to your question earlier,  
 22 and as Dr Morris has also explained, an orifice spillway  
 23 may still, depending on the plant and the conditions,  
 24 serve a purpose when you have an area where it limits  
 25 the width of the spillway that you can use. And

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14:38 1 situating the orifice spillway in the middle, rather  
 2 than at the crest, can also potentially reduce  
 3 construction costs; which are, of course, not relevant  
 4 to 8(d).  
 5 Having said that, orifice spillways in and of  
 6 themselves are not without their drawbacks. The  
 7 increased velocity and density of the water jet that  
 8 exits the spillway can erode the riverbed at the foot of  
 9 the dam more than the other spillway designs; and it  
 10 also, from a construction point of view, has to deal  
 11 with that greater water pressure.  
 12 During the site visit, the site expert who showed  
 13 you these slides explained that a plant would not  
 14 typically have just an orifice spillway, what we see on  
 15 the right-hand side; it would usually be combined with  
 16 other designs.  
 17 (Slide 29) And you saw this image as well, which is  
 18 Karun-3 Dam in Iran, where it's an example of the  
 19 inclusion of multiple spillways. So, for instance, the  
 20 risk of gate failure that you could get with the  
 21 crest-gated spillway or the orifice spillway is  
 22 mitigated by including an ungated spillway for which  
 23 gate failure would not be an issue.  
 24 At Neelum-Jhelum, you also saw the use of multiple  
 25 spillways at different elevations performing different

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14:40 1 functions. That project, not being a Treaty project,  
 2 incorporates orifice and surface gated spillways,  
 3 together with undersluices that are in the intake  
 4 structure for sediment management.  
 5 So in a non-Treaty plant like Neelum-Jhelum, the  
 6 design will take into account the flood conditions, the  
 7 topographical conditions, geological conditions and the  
 8 dam site layout. Once we come within the Treaty, there  
 9 will be additional constraints.  
 10 That takes me -- oh, that's a surface gated spillway  
 11 you saw there as well (slide 31).  
 12 (Slide 32) That takes me to the provision that  
 13 specifically focuses on spillways in the Treaty, 8(e).  
 14 According to this paragraph, we also have a default  
 15 condition. So the default condition in 8(d) is no  
 16 low-level outlet; the default condition in 8(e) is to  
 17 use an ungated spillway. But if the conditions at the  
 18 site make it necessary, then a gated spillway is  
 19 permitted, but this then, of course, has to comply with  
 20 other conditions: being "at the highest level",  
 21 compliant with "sound and economical design", and this  
 22 time "satisfactory construction and operation of the  
 23 works".  
 24 (Slide 33) So we can see here the equivalent  
 25 flowchart for the decision-making process under

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14:41 1 paragraph 8(e).  
 2 The default position is an ungated spillway.  
 3 If it is shown that a gated spillway is necessary,  
 4 then it will come into the second phase of looking at  
 5 the various options compliant with sound and economical  
 6 design.  
 7 In selecting among those various options, we once  
 8 again come to the object and purpose of the Treaty, to  
 9 the hydro bargain and protecting the hydrology of  
 10 Pakistan on the Western Rivers. So if it is possible  
 11 that there can be even a marginally higher spillway,  
 12 then that design is to be preferred over another one.  
 13 And then finally we come to "satisfactory  
 14 construction and operation of the works": once again,  
 15 "satisfactory" meaning "acceptable", "suitable", but not  
 16 more than that.  
 17 So if you have a spillway that is entirely below  
 18 dead storage level -- and actually I return to the  
 19 question of Mr Chairman, and this applies equally to  
 20 intakes: it is if it is entirely below that it would  
 21 require reference to 8(d).  
 22 (SLIDE 34) But imagining that we are not entirely  
 23 below the dead storage level, then the analysis would  
 24 follow through paragraph 8(e). And the first condition  
 25 is that:

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14:43 1 "... the conditions at the site of a Plant make  
 2 a gated spillway necessary ..."  
 3 "Necessary" of course here, applying treaty  
 4 interpretation principles, has the same meaning as it  
 5 does in 8(d): essential for the purpose required and  
 6 needed. It is to be determined objectively, it's not  
 7 self-judging, and the burden is on India to discharge  
 8 that.  
 9 Now, necessity here is clarified as being  
 10 a reference to "conditions at the site". And a relevant  
 11 site condition is one that is related to the acceptable  
 12 purposes of a spillway and relevant factors of the  
 13 design. And I'll highlight three relevant conditions at  
 14 the site.  
 15 (Slide 35) So the first is flood control, especially  
 16 control of the design flood as a relevant condition at  
 17 the site. And we can turn here to ICOLD Bulletin 178  
 18 (P-529), which emphasises that:  
 19 "Simplicity of design and construction is conducive  
 20 to simpler [operation], and simple rules which can be  
 21 implemented quickly are ... obviously a determining  
 22 factor [for] safety. This means that an ungated  
 23 free-overflow spillway is the ideal solution which all  
 24 dam operators would prefer."  
 25 So in paragraph 8(e), by having the default position

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14:44 1 being an ungated surface free-overflow spillway, that's  
 2 actually where the Treaty is aligned with best practice.  
 3 Now, the type of dam is also relevant to flood  
 4 control. An ungated spillway is the preferred design  
 5 for an erodible rock-filled or embankment dam because  
 6 they are at a higher risk of failure if they are  
 7 overtopped, and it would be the safest option to avoid  
 8 potential mechanical or operator problems with the  
 9 gates.  
 10 (Slide 36) Just to illustrate that point, last year,  
 11 in October, the 16-metre-high concrete-faced rockfill  
 12 dam of the 1,200 MW Teesta Stage III HEP in India was  
 13 breached by floodwaters. The dam was overtopped and  
 14 failed catastrophically. This was attributed by the  
 15 Indian experts to the spillway not being designed to  
 16 accommodate a high flow due to a GLOF. And there was  
 17 also no functional early warning system.  
 18 The powerhouse was submerged; the bridge connecting  
 19 the powerhouse was washed away; roads, bridges and towns  
 20 were flooded; and more than 100 people died.  
 21 That gated spillway was designed to handle a maximum  
 22 flood of 7,000 cusecs, which is now found not to be  
 23 sufficient. And the spillway gates were not opened due  
 24 to the inability of the operators to reach the controls  
 25 due to the overtopping.

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14:46 1 (Slide 37) So the second factor for conditions at  
 2 the site is geology and topology. And it could be that  
 3 India departs from the default ungated spillway position  
 4 if the site of the plant is not suitable for  
 5 an uncontrolled spillway. And this is a photo of  
 6 a typically narrow-valley dam, which is the Aldeadávila  
 7 Dam in Spain. You've got eight gates channelling water  
 8 into four spillways.  
 9 Now, if the valley is not sufficiently wide to  
 10 accommodate an uncontrolled spillway capable of passing  
 11 the design flood without overtopping, then that's  
 12 an example of it being necessary to have a gated  
 13 spillway. Another scenario is where the geology of the  
 14 valley means it can't be widened to accommodate  
 15 an uncontrolled spillway capable of passing the design  
 16 flow.  
 17 (Slide 38) A third site condition is sedimentation,  
 18 of course. If the sedimentation analysis at a site  
 19 reveals that sluicing is necessary to maintain live  
 20 storage or prevent sediment from entering the turbines,  
 21 then a gated spillway may be necessary to enable  
 22 sluicing to occur. And according to ICOLD Bulletin 115,  
 23 once the design discharge and stage at the dam is known,  
 24 it is possible to design controlled outlets with  
 25 sufficient discharge capacity for sluicing.

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14:50 1 for purpose, not unfeasibly expensive. It does not  
 2 entitle India to claim its design reflects the best  
 3 practices of the day in a manner detached from the  
 4 Treaty requirements.  
 5 But there are best practices that are compatible  
 6 with the Treaty requirements. One example is to use  
 7 a plant surcharge storage, which of course it has to  
 8 design for under 8(b), to situate an ungated auxiliary  
 9 spillway for extreme flood conditions, therefore  
 10 enabling the main spillway gates to be smaller and  
 11 higher. So that's an example of an engineering  
 12 innovation that we can apply that actually helps to  
 13 fulfil the conditions in paragraph 8(e).  
 14 "Satisfactory construction and operation of the  
 15 works". As I said earlier, "satisfactory" means  
 16 sufficient or adequate. Construction considerations are  
 17 relevant to the extent of being adequate and sufficient.  
 18 Where this threshold is met by a crest-gated spillway,  
 19 India is not entitled to situate its spillway deeper in  
 20 the reservoir because of any perceived operational  
 21 advantage derived from an orifice spillway.  
 22 So in reality, this means that circumstances in  
 23 which an orifice spillway will be justifiable will be  
 24 pretty rare; not completely excluded, but unusual. In  
 25 nearly all cases, a crest-gated spillway will do the job

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14:48 1 Of course, where other sediment management  
 2 techniques are sufficient to achieve sediment control,  
 3 this option of sluicing using a gated spillway would not  
 4 be necessary.  
 5 (Slide 39) Finally, the phrase "conditions at the  
 6 site" in 8(e) cannot encompass cost. Cost may be  
 7 a consequence of the site conditions, but it is not  
 8 a site condition in and of itself.  
 9 As Dr Morris has pointed out, dam engineering  
 10 doesn't happen in a void: it's always within a set of  
 11 constraints. In this case, the constraints include the  
 12 Treaty provisions.  
 13 (Slide 40) If a gated spillway has been justified as  
 14 necessary, it has to still comply with design  
 15 requirements of paragraph 8(e), and this may lead to  
 16 variations in the type of gate that is chosen.  
 17 So paragraph 8(e) favours a wide crest-gated  
 18 spillway with comparatively shallow gates over a narrow  
 19 crest-gated spillway with comparatively deep gates,  
 20 because the first type is going to be higher. And India  
 21 would have to provide further justification for a fully  
 22 submerged orifice spillway.  
 23 (Slide 41) We come back to the phrase "sound and  
 24 economical design", and it should be read identically as  
 25 it appears in 8(d). It refers to a design that's fit

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14:51 1 of an orifice spillway just as well, or only marginally  
 2 less well, from a purely hydraulic or construction cost  
 3 standpoint.  
 4 The crest-gated spillway also has the advantage of  
 5 offering a greater increase in discharge capacity beyond  
 6 the design value, as water level surcharges above the  
 7 design level, as compared to the orifice spillway, which  
 8 is limited by its fixed cross-sectional area.  
 9 It may also be considered that a crest-gated  
 10 spillway is more effective in preventing India from  
 11 utilising freeboard for water storage.  
 12 So the selection of a crest-gated spillway is  
 13 a potentially viable option under 8(e), if it is shown  
 14 that an ungated spillway is not possible.  
 15 So I now turn to how India has approached this  
 16 paragraph. Pakistan's understanding of India's current  
 17 interpretation is informed by the pleadings of India in  
 18 the Baglihar and Kishenganga proceedings, and also the  
 19 exchanges in the Commission, as I showed for 8(d).  
 20 (Slide 42) Now, I've shown you this typical design  
 21 before. Now we're looking at the orifice spillways, so  
 22 they are submerged entirely below the dead storage  
 23 level, and India claims that they are necessary for  
 24 sediment management and flood control.  
 25 In the 103rd meeting of the Commission (P-66),

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14:53 1 India's Commissioner stated that an orifice spillway was  
 2 "consistent with the state-of-the-art practices", and  
 3 referred to it as:  
 4 "... a trend that has been growing ... of setting  
 5 the top of the gate well below [the dead storage level]  
 6 & surmounting it by a massive reinforced concrete water  
 7 retaining wall ..."  
 8 (Slide 43) In the 111th meeting (P-25), India  
 9 attempted to justify its use of orifice spillways in the  
 10 Commission. I previously showed this to you in the  
 11 context of 8(d), because they had to be read together,  
 12 given that this was entirely below the dead storage  
 13 level. And I explained to you how this statement was  
 14 wrong with respect to the interpretation of 8(d). I now  
 15 will explain how it is inconsistent with the correct  
 16 interpretation of paragraph 8(e).  
 17 India must justify any departure from the default  
 18 position of paragraph 8(e) that it is entitled to  
 19 an ungated spillway. While sediment management and the  
 20 role of the gated spillway in sluicing may factor into  
 21 determining whether a departure from that default  
 22 position is required, the Treaty poses a clear  
 23 restriction on the use of a gated spillway by reference  
 24 to the conditions at the site.  
 25 Pakistan's position, despite what the Indian

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14:56 1 a single ungated spillway.  
 2 (Slide 45) Now, the Neutral Expert first analysed  
 3 whether a gated spillway was "necessary" within the  
 4 meaning of 8(e). And in this respect only, he correctly  
 5 commenced the analysis with an examination of the  
 6 conditions at the Baglihar site. So he said the  
 7 following (PLA-2, paragraph 5.2.4), that:  
 8 "The determination of the possible arrangement of  
 9 spillways must be driven by the general conditions of  
 10 the site, which can be classified into ...  
 11 four categories:  
 12 - hydrology and sediment yield,  
 13 - topography,  
 14 - geology, and  
 15 - seismicity."  
 16 So Pakistan, to that extent, would agree that these  
 17 are the correct identification of site conditions. Not  
 18 an exhaustive list, but these are actually site  
 19 conditions.  
 20 In the case of the Baglihar plant, it is built in  
 21 a narrow valley, 70 metres at the river elevation,  
 22 300 metres at the dam crest elevation, and it has a high  
 23 flood discharge, high seismic activity and poor geology,  
 24 and with that reducing the ability to do anything to  
 25 widen the valley.

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14:55 1 Commissioner speculated, was not based on engineering  
 2 literature: it was based on the limitations of  
 3 paragraph 8(e), including that crest-gated spillways are  
 4 designed for very large discharges, with the capacity  
 5 determined by the height and width of the gate.  
 6 Precedents for orifice and crest-gated spillway-gated  
 7 spillways can be referenced to determine limits, but the  
 8 majority of dam sites can be configured with crest-gated  
 9 spillways.  
 10 The Kishenganga Court did not directly assess  
 11 compliance with the deep orifice spillway design of the  
 12 KHEP because, as I said before, the question wasn't  
 13 before it. But the restrictions that are identified, in  
 14 particular on drawdown flushing, obviously influence the  
 15 design choices, including for the use of a fully  
 16 submerged orifice spillway.  
 17 (Slide 44) I want to now turn to what the Neutral  
 18 Expert said in Baglihar. These were the competing  
 19 designs that the Neutral Expert was facing. The one on  
 20 the left I've already shown you: this is the Indian  
 21 design. The one on the right was Pakistan's design.  
 22 So we see in the Indian design that we have three  
 23 separate spillways: a submerged orifice spillway with  
 24 five gates; a crest-gated spillway with three gates; and  
 25 a single auxiliary spillway. Pakistan's design has

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14:58 1 The valley has an insufficient width for an ungated  
 2 spillway to handle the design flood; and it cannot, as  
 3 I said, be safely widened, due to the weakness of its  
 4 geology. But even with the possibility of human and  
 5 mechanical error involved in having a gated spillway, it  
 6 may still have been necessary in that case: it might  
 7 have passed the "necessary" test.  
 8 But for the avoidance of doubt, Pakistan does not  
 9 concede that a gated spillway was necessary for the  
 10 Baglihar plant, but notes that this element of the  
 11 Neutral Expert's analysis, at least in this respect, was  
 12 defensible under 8(e). He was looking at the right  
 13 conditions to determine necessity driven by site  
 14 conditions.  
 15 (Slide 46) But from that point onwards, the Neutral  
 16 Expert took a wrong turn in Baglihar. He took into  
 17 account the costs of a gated versus ungated spillway,  
 18 which are not conditions at the site and therefore  
 19 irrelevant for determining necessity. He said (PLA-2,  
 20 paragraph 5.2.4):  
 21 "... for a given level of safety and taking into  
 22 account site conditions, the economics of the project  
 23 lead to the selection of the optimum arrangement of ...  
 24 spillway devices."  
 25 He discussed the maximisation of production, so

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14:59 1 that's using the maximum available head, and he talked  
 2 about the minimisation of construction costs. When you  
 3 build an ungated spillway, it usually means the dam  
 4 height has to be higher, so there's the additional cost  
 5 of concrete and the construction.  
 6 He also reviewed projects in Uganda, The Gambia,  
 7 Sudan and Portugal where they had used large orifice  
 8 spillways.  
 9 He concluded (PLA-2, paragraph 5.28) that:  
 10 "... it has been demonstrated that the provision of  
 11 gates on large spillways is a frequent practice ..."  
 12 And:  
 13 "... the sole use of an ungated free-overflow  
 14 spillway is marginal when the required capacity for  
 15 flood releases is higher than 15,000 [cumecs]."  
 16 But this approach is not the approach that the  
 17 Treaty requires.  
 18 The comparison with dams in Uganda, Sudan, Gambia  
 19 and Portugal does not demonstrate that the use of  
 20 a gated spillway in a run-of-river HEP under the Treaty  
 21 is "necessary". It simply shows that such spillways are  
 22 preferred by designers when they are given a free hand  
 23 and when they're dealing with completely different site  
 24 conditions.  
 25 And second, all of the relevant plants in Uganda and

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15:02 1 comes to reaching a satisfactory standard, that's when  
 2 you can look at the economics of it.  
 3 What is not relevant are: factors that are not at  
 4 the site, they are not going to be site conditions;  
 5 economic and cost considerations for the test of  
 6 necessity; and a wider situation away from the HEP site,  
 7 whether that's upstream or downstream.  
 8 So the application of paragraphs 8(e) and (d) to the  
 9 different designs can be illustrated by the following  
 10 slide (49). This reflects a scenario where a gated  
 11 spillway is necessary due to conditions at the site.  
 12 Starting from the left, you have a crest-gated  
 13 spillway sized for the probable maximum flood. And this  
 14 would comply with the Treaty because the bottom level of  
 15 the gates in the normal closed position are located at  
 16 the highest level consistent with sound and economical  
 17 design, and satisfactory construction and operation of  
 18 the works. They are designed to provide the required  
 19 discharge capacity. And the sill level of the gates  
 20 would allow for sediment sluicing, as well as being  
 21 located below the possible level of the power intake.  
 22 So that, despite being a gated spillway, would, once  
 23 the necessity is shown, comply with 8(e).  
 24 The second design combines different spillway  
 25 designs. It has gated spillways at the highest possible

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15:01 1 so on would have been constructed with the economic  
 2 considerations in mind that are irrelevant to the test  
 3 of necessity under paragraph (e).  
 4 So paragraph 8, as we've said, does not preclude  
 5 evidence of hydroengineering practice being used to  
 6 inform the application of provisions. If India was to  
 7 present evidence of a Nepalese run-of-river HEP in  
 8 similar conditions to the Baglihar HEP that suffered  
 9 catastrophic damage due to the lack of a gated spillway,  
 10 that would be highly relevant to determining whether  
 11 a gated spillway was "necessary" under paragraph 8(e).  
 12 But all of this has to be brought in as relevant and  
 13 assessed carefully under the Treaty.  
 14 (Slide 47) Now I come to Procedural Order No. 6 and  
 15 your question on:  
 16 "... what is to be taken into account for the  
 17 purposes of designing gated spillways for flood control  
 18 for a plant and what is to be excluded?"  
 19 (Slide 48) And once again, this is a non-exhaustive  
 20 list. But what will be relevant are the conditions at  
 21 the immediate site of the plant: the valley width, the  
 22 geology, seismicity, hydrography, of course  
 23 sedimentation. Whether a gated spillway, given these  
 24 conditions is necessary; not cheaper, not more  
 25 convenient, not preferable, but necessary. And when it

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15:04 1 level above dead storage level, and two smaller orifice  
 2 spillways that are below dead storage level, of the  
 3 minimum size and the highest level, and that's why they  
 4 are relatively small compared to what we saw with the  
 5 crest-gated spillway.  
 6 But the third image, just the large orifice  
 7 spillway, would not comply with 8(e). They are not at  
 8 the highest level and they are not of the minimum size  
 9 required for sediment management or another technical  
 10 purpose, and there are alternatives available that could  
 11 be located at a higher level.  
 12 Depending on the site, this is possibly the range of  
 13 options that India would have for designing its  
 14 spillways. And the preferable -- indeed, required --  
 15 design would be the crest-gated spillway on the left or  
 16 the combination of the crest and orifice spillways, if  
 17 those orifice spillways complied with 8(d).  
 18 I'm now, unless there are questions on spillways,  
 19 going to move to intakes. Okay.  
 20 So a power intake is a structure through which the  
 21 water is abstracted from the reservoir to the turbines  
 22 via a pipe, tunnel or canal. It, as I said at the  
 23 beginning, has a dual function, in that it's an intake  
 24 for the turbines but it's an outlet for the reservoir.  
 25 (Slide 50) Now, during the site visit you saw this

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15:06 1 slide, which is a cross-section of the intake at  
 2 Neelum-Jhelum going into the desander. There are six  
 3 intake gates and three undersluice gates, and the  
 4 intakes are used to divert water for power production.  
 5 Now -- and this was a point flagged by Mr Chairman  
 6 earlier -- intakes have to be situated to take advantage  
 7 of the full range of the live storage at the plant in  
 8 the operating pool. So the bottom level of the intake  
 9 must be placed below the minimum operating level and  
 10 below the dead storage level in an Annexure D.3 HEP to  
 11 enable the design flow rate to enter the intake when the  
 12 reservoir's water level is at its minimum operating  
 13 level; that is, DSL. This will convert all water above  
 14 the invert of the intake into controllable storage, just  
 15 as with the case of the height of the crest elevation of  
 16 the outlet.  
 17 But that still leaves a range of design options as  
 18 to how that intake is placed, and what other features  
 19 may be placed around it to enhance its functioning and  
 20 enable its highest position.  
 21 (Slide 51) So this shows two potential power intake  
 22 configurations in a run-of-river HEP.  
 23 On the right, we have a surface-level intake in  
 24 which the water is flowing from the reservoir into the  
 25 intake. It's continuously open to the atmosphere; it's

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15:09 1 construction, operation of the plant and ... customary  
 2 and accepted practice ..."  
 3 So it's the same wording as we're seeing in 8(f).  
 4 Now, there may be different considerations  
 5 influencing what is "sound and economical" and what is  
 6 "satisfactory" in a storage work as compared to  
 7 a run-of-river plant. But there's still the reflection  
 8 of the hydro bargain in trying to minimise the  
 9 controllable storage, even in a storage plant.  
 10 THE CHAIRMAN: I was just wondering -- we really haven't  
 11 talked about Annexure E that much. But is it the case  
 12 that a typical operation would allow for you to draw  
 13 down the storage perhaps quite far in order to do things  
 14 with it, not just for hydro purposes?  
 15 PROFESSOR WEBB: Irrigation and so on?  
 16 THE CHAIRMAN: Yes.  
 17 PROFESSOR WEBB: I will have to consult with my engineering  
 18 experts to firmly answer that for you.  
 19 THE CHAIRMAN: That's fine.  
 20 PROFESSOR WEBB: But certainly there are other  
 21 considerations at stake. But even with that, we are  
 22 seeing a preference for the highest type of intake, even  
 23 in a storage work.  
 24 (Slide 52) Now, we also saw this slide during the  
 25 site, which just shows how the water is abstracted from

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15:07 1 not submerged. And it may include a structure which  
 2 limits withdrawals to the highest extent to minimise the  
 3 entry of sediment. And that then flows into the tunnel.  
 4 So you see -- and this is similar to a slide that  
 5 Dr Morris showed you -- you see how it goes from  
 6 a higher level at the surface intake and then into the  
 7 tunnel, with an anti-vortex water seal depth taken into  
 8 account.  
 9 On the left, we see a submerged or a deep intake,  
 10 and this is what India's plant designs include. This  
 11 results in all the water above the intake's invert being  
 12 converted into controllable storage. So the tunnel  
 13 leading to the turbines terminates directly in the  
 14 reservoir, without any structure excluding sediment.  
 15 And this configuration, as Dr Morris also said, you  
 16 would usually see in a storage work, but we are seeing  
 17 it in India's replicated run-of-river HEP designs.  
 18 Since it's below dead storage level, this kind of  
 19 deep intake is also subject to regulation under 8(d).  
 20 The one on the right would not be.  
 21 THE CHAIRMAN: Does Annexure E allow that type of intake for  
 22 the storage works?  
 23 PROFESSOR WEBB: According to paragraph 11(g) of Annexure E:  
 24 "... the intakes ... shall be located at the highest  
 25 level consistent with satisfactory and economical

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15:11 1 the reservoir via the headrace, which we know is  
 2 pressurised.  
 3 The fact that an intake is a surface intake does not  
 4 prevent the incorporation of a pressurised headrace  
 5 complete with a water seal. So the design at the  
 6 surface can absolutely and does work, as we saw, through  
 7 this type of conveyance mechanisms.  
 8 There are three important considerations during the  
 9 plant planning process to consider with intake design.  
 10 The first is the minimum operating level of the  
 11 reservoir: that sets the benchmark for the placement of  
 12 the intakes. The second is the need to minimise  
 13 sediment entering the intakes, because of course we know  
 14 that's going to go directly into the turbine and abrade  
 15 it. And there's also the need to prevent or minimise  
 16 air entering the intakes through vortexing, which will  
 17 result in the loss of power.  
 18 (Slide 53) Now, during the site visit we showed you  
 19 this slide, which is an example of poor intake design.  
 20 This is Pakistan's Warsak Dam. And as the site expert  
 21 explained to you, this dam was built in 1960 with  
 22 14-metre-deep intakes and no effective way to manage  
 23 sediment, and it's now submerged deep beneath the sand.  
 24 (Slide 54) As the site expert explained using this  
 25 cross-section, the intake has been buried up to the

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15:12 1 spillway crest. So what you see there that's not even  
 2 visible, the 14-metre-deep intake, on this cross-section  
 3 is at the spillway crest level, between 1,200 and  
 4 1,250 feet.  
 5 It has been possible to maintain power production by  
 6 passing more water through the turbines. But this is  
 7 obviously an example of poor design.  
 8 I come back to the Court's question 3 during the  
 9 site visit.  
 10 "What are the range of circumstances where it might  
 11 be either beneficial or required to locate, at  
 12 a relatively low level, the power intake for the  
 13 turbines of a run-of-river HEP on the Western  
 14 Rivers ...?"  
 15 The response that I recall being given to you was  
 16 listing the circumstances for a generic plant, where  
 17 a lower-level intake may be beneficial or not  
 18 beneficial. So these obviously have to then be overlaid  
 19 by the Treaty's regulatory requirements.  
 20 The site expert explained that a deeper intake --  
 21 oh, and let me give you the references: transcript  
 22 Day 4, page 111 -- a deeper intake is beneficial for  
 23 minimising the entry of floating debris. This benefit  
 24 is actually marginal because much of the debris in the  
 25 rivers in this area floats below the water surface; it's

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15:16 1 literature, and this is from Gordon at Exhibit P-0312:  
 2 "For a conventional hydroelectric intake, with  
 3 a deck slab ... above water level, the cost of the  
 4 intake structure increases with increasing depth of gate  
 5 sill below water level. For maximum economy the gate  
 6 sill should be set as high as possible."  
 7 And the depth needed to prevent vortices forming can  
 8 be reduced by hydraulic design of the intake  
 9 arrangement. So you could have a broad and shallow  
 10 inlet to the tunnel: that will require less submergence  
 11 than a narrow and deep inlet. So these are all creative  
 12 and very available engineering techniques that can allow  
 13 the raising of the intake to manage that vortex  
 14 formation.  
 15 A deeper intake is also harder to clean and  
 16 maintain, and it has to operate at higher pressure and  
 17 have more robust gates.  
 18 So in the run-of-river HEPs that you see in the  
 19 Himalayas, you actually see intakes -- not in the Indian  
 20 plants, but in the other plants -- situated as high as  
 21 possible in the reservoir, while still allowing for the  
 22 live storage to be used in its entirety.  
 23 (Slide 55) Let's now overlay this with the Treaty  
 24 requirements, and this is paragraph 8(f). By requiring  
 25 that the power intakes are placed as high as possible

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15:14 1 not actually on the surface, such as the plastic trash  
 2 that we saw during the site visit. So that's a benefit  
 3 of a deeper intake: it will minimise the entry of that  
 4 floating debris, or neutrally buoyant debris.  
 5 On the other hand, a deeper intake will bring in  
 6 more sediment. Sediment concentration tends to increase  
 7 with depth; this is shown in a sediment concentration  
 8 gradient. The sands, which are the ones that are most  
 9 dangerous for turbine abrasion, tend to be concentrated  
 10 near the bottom of the water column, rather than the  
 11 top. So this means a sample collected at the water  
 12 surface will not be representative of a cross-section.  
 13 But it also means that, in the Himalayas, sediment  
 14 control for turbine protection is better achieved by  
 15 putting intakes higher, where there is less  
 16 concentration of sand.  
 17 A higher level intake has the risks of vortices  
 18 forming, which may bring in air and reduce turbine  
 19 efficiency. But as I said, it's a delicate balance: you  
 20 want to avoid the sediment entry and you want to avoid  
 21 the vortices forming, and that pushes you in two  
 22 different directions. But once you reach the minimum  
 23 depth to control vortex formation, going any lower is  
 24 not going to be of any benefit in terms of vortexing.  
 25 This is confirmed by the hydroengineering

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15:17 1 within the reservoir, it limits the extent to which they  
 2 can be used to manipulate controllable storage; once  
 3 again, consistent that we see with the other provisions,  
 4 and with the object and purpose of the Treaty.  
 5 But even outside of a Treaty context, higher intakes  
 6 are the preferred design choice for run-of-river plants.  
 7 (Slide 56) This time we have a three-step instead of  
 8 a four-step process for applying paragraph 8(f), because  
 9 we don't start with a default option. So we don't have  
 10 the default of no low-level outlets and we don't have  
 11 the default of a surface spillway. Instead, we start by  
 12 identifying the options for that intake design. And  
 13 you're guided there by the requirements of it being  
 14 satisfactory and economical.  
 15 Once those options are identified, India is obliged  
 16 to choose the design that best protects Pakistan's  
 17 hydrology, Pakistan's interests on the Western Rivers,  
 18 meaning the highest level intake possible in the  
 19 reservoir. If there's a choice in design, and one is  
 20 higher, then the higher one has to be chosen, even if  
 21 it is more expensive.  
 22 And the third step is that the intake design shall  
 23 be consistent with customary and accepted practice of  
 24 design for the designated range of a HEP's operation;  
 25 that means the range between the full pondage level and

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15:19 1 the dead storage level.  
 2 (Slide 57) Now, taking these in turn, these opening  
 3 words are very clear, that it has to be:  
 4 "... at the highest level consistent with  
 5 satisfactory and economical construction and  
 6 operation ..."  
 7 But as we've already accepted, owing to the need for  
 8 power intakes to use the full range of the operating  
 9 pool, there will be a part that is below dead storage  
 10 level.  
 11 (Slide 58) They have to be "satisfactory and  
 12 economical"; and importantly, in the context of the  
 13 operation of the plant as a run-of-river plant. And  
 14 this specification is deliberate because of the specific  
 15 issues that run-of-river plants face, as opposed to  
 16 other types.  
 17 (Slide 59) I actually do have the matching wording  
 18 in Annexure E here, 11(g) that I read out earlier, which  
 19 also talks about being:  
 20 "... located at the highest level, consistent with  
 21 satisfactory and economical construction and  
 22 operation ..."  
 23 Given that the principal difficulty for run-of-river  
 24 HEPs is sediment control, this can be managed by various  
 25 techniques, as we've heard. And a well-designed

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15:22 1 this is a potentially evolving provision, in the sense  
 2 that, within the constraints of the Treaty, what is  
 3 customary and accepted practice does change.  
 4 This also relates to Mr Chairman's second step of  
 5 treaty interpretation from yesterday, where he noted  
 6 that treaty requirements sometimes allow for  
 7 construction by reference to customary or accepted  
 8 practices, and this will often depend on  
 9 a plant-by-plant analysis. And we fully agree with that  
 10 characterisation.  
 11 Now, when it comes to applying customary and  
 12 accepted practice to intakes, there has of course been  
 13 a development since 1960. They've been more in the  
 14 nature of fine-tuning rather than dramatic differences.  
 15 So the functions, and what you need for an effective  
 16 intake, or a satisfactory intake, have remained stable;  
 17 but how you achieve that obviously has changed over  
 18 time.  
 19 So you want to have an intake that minimises the  
 20 entrainment of sediment, that's capable of excluding  
 21 floating debris, that can be cleaned of floating debris,  
 22 that minimises vortexing and that is easy to maintain.  
 23 That's the same as in 1960. But the way that we do that  
 24 has changed.  
 25 Just to give you some examples, the practice is to

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15:20 1 surface-level intake can be one of those techniques,  
 2 complemented by a desander, as we saw at Neelum-Jhelum,  
 3 and enhanced by a skimming wall, for example.  
 4 (Slide 60) Now we come to language that only appears  
 5 in 8(f), compared to (d) and (e), which is the:  
 6 "... customary and accepted practice of design for  
 7 the designated range of the Plant's operation."  
 8 Let me start with "designated range of the Plant's  
 9 operation". Applied to the context of this paragraph,  
 10 that is the varying levels of water in the reservoir, so  
 11 between the full pondage level and the dead storage  
 12 level.  
 13 (Slide 61) Then we come to "customary and accepted  
 14 practice of design". And this recalls, I think, some  
 15 comments made this week by Mr Minear and by the Chairman  
 16 pointing out this language.  
 17 Going back to Mr Minear's point -- I think that was  
 18 made on Tuesday -- he rightly pointed out that this  
 19 language appears in Article IV(12)(a) of the Treaty,  
 20 which refers to the use of water for industrial  
 21 purposes, and it talks about customary and accepted  
 22 practice as of the "Effective Date", which was  
 23 1 April 1960.  
 24 That is not an evolving provision. We don't have  
 25 the "Effective Date" constraint in this paragraph. So

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15:24 1 have now more automated machines for the cleaning of the  
 2 intakes. We saw an example of that at Neelum-Jhelum  
 3 with the crane.  
 4 There's technological developments now leading to  
 5 even more sophisticated machines, such as autonomous  
 6 underwater robots. That wouldn't have been envisaged in  
 7 1960 but it certainly can be used as a practice.  
 8 Also the way that trash racks are designed in  
 9 intakes, they are now designed frequently to handle the  
 10 maximum head loss across the rack, which wouldn't have  
 11 been done necessarily in 1960.  
 12 And as I mentioned, we have improved hydraulic  
 13 design and understanding of how to make these intakes  
 14 most effective, including the way that the inlet leads  
 15 up to them.  
 16 So we see that there is a role for customary and  
 17 accepted practice, and that this has been included here  
 18 in 8(f). And just to give the ordinary meaning,  
 19 "customary", we would say, is: in accordance with  
 20 established customs of a particular community. Here  
 21 that would be hydropower engineering. And "accepted"  
 22 means: generally recognised as correct and valid.  
 23 Now I'm turning to India's approach to the  
 24 interpretation of 8(f).  
 25 (Slide 62) This is India's preferred power intake

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15:25 1 design. It is fully submerged, entirely below the dead  
 2 storage level. And this is the design for the Baglihar  
 3 HEP and it's from figure 10.12 of the Memorial.  
 4 (Slide 63) This design is also seen in the  
 5 publicly available Bureau of Indian Standards for  
 6 hydraulics intakes, which were reaffirmed in 2000. And  
 7 you see how, as compared to the example I showed earlier  
 8 of a surface intake that then descends into the tunnel,  
 9 you just have a straight intake here, straight from the  
 10 reservoir into the tunnel.  
 11 Now, this type of design is a completely submerged  
 12 design. And it means that sediment management must be  
 13 undertaken, because this design, without the skimming  
 14 wall and with its deep placement, will quickly face  
 15 sedimentation problems. This creates a false necessity  
 16 for, in India's view, reservoir flushing.  
 17 India's approach to its intake design is linked to  
 18 its position on pondage, as calculated under  
 19 paragraph 8(c), because the pondage determines the size  
 20 of a particular plant's operating pool and, by  
 21 extension, the location of its dead storage level. And  
 22 this aspect will shortly be addressed by Dr Miles.  
 23 (Slide 64) This again has been the subject of  
 24 discussion in the Commission. Pakistan's Commissioner,  
 25 in the 108th meeting (P-70) observed that

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15:29 1 (Slide 66) In the discussion specifically on the  
 2 Ratle plant, Pakistan's Commissioner noted that reduced  
 3 pondage would reduce the operational pool depth and  
 4 make it:  
 5 "... possible to provide a surface intake which can  
 6 subsequently be converted to [a] pressure conduit  
 7 a short distance downstream of the intake face."  
 8 India replied to that suggestion by saying:  
 9 "... satisfactory operation as well as  
 10 techno-economics requires a deep seated intake as  
 11 proposed by India ... at this project site the river  
 12 carries significant suspended fines and hence a surface  
 13 intake is not justifiable on that account."  
 14 And the same concerns were aired in later meetings.  
 15 I think, Mr Chairman, that brings us to the time for  
 16 the coffee break. I estimate I have maybe 10 to  
 17 15 minutes more after that point.  
 18 THE CHAIRMAN: Very good. Why don't we take the break,  
 19 we'll come back and have you finish your presentation,  
 20 and then we will be moving on, I think, to Dr Miles. So  
 21 let's do that, and we will resume at 4.00 pm.  
 22 PROFESSOR WEBB: Thank you.  
 23 THE CHAIRMAN: Thanks.  
 24 (3.30 pm)  
 25 (A short break)

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15:27 1 a surface-level intake is recommended for run-of-river  
 2 HEPs:  
 3 "He elaborated that [the] higher Pondage created the  
 4 requirement [for a] submerged intake for which the water  
 5 seal was required for protecting it from entry of air  
 6 and formation of vortex at the mouth of the tunnel ...  
 7 pushing the intake further down. This ... causes the  
 8 intake to draw coarser sediment particles which are  
 9 harmful for the turbines and exposes it to the risk of  
 10 overwhelming by the deposited sediments. Pakistan[s]  
 11 Commissioner suggested that instead of providing this  
 12 arrangement the designers should go for surface intake  
 13 and obviate the possibility of its overwhelming by  
 14 deposited sediments."  
 15 (Slide 65) But India rejected this suggestion in the  
 16 same meeting, with their Commissioner saying:  
 17 "... Pondage does not dictate the type and location  
 18 of the power intake. Hydraulics, topography, geology,  
 19 techno-economics and many other factors play a role in  
 20 the decision-making ... more often than not, site  
 21 conditions do not allow surface intake as  
 22 a techno-economically feasible option. Keeping in view  
 23 that Pondage is needed to meet load fluctuations,  
 24 intakes accordingly provided with requisite water seal."  
 25 Meaning submerged in all cases.

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16:01 1 (4.01 pm)  
 2 THE CHAIRMAN: Okay, I think we are back in session.  
 3 Professor Webb, over to you.  
 4 PROFESSOR WEBB: Thank you. If my slide could be displayed,  
 5 please. (Pause)  
 6 THE CHAIRMAN: This is once again Murphy's law coming into  
 7 play, I think!  
 8 PROFESSOR WEBB: (Slide 66) Just before the break, I was  
 9 showing you the exchange between the Pakistani  
 10 Commissioner and the Indian Commissioner on this issue  
 11 of the placement of intakes (P-83). And the Indian  
 12 Commissioner had made the point that:  
 13 "... satisfactory operation as well as  
 14 techno-economics requires a deep seated intake as  
 15 proposed by India ..."  
 16 (Slide 67) However, a submerged intake of the type  
 17 that India prefers is difficult to justify in  
 18 circumstances where, as you can see in this drawing, the  
 19 design of an intake can allow for a surface-level intake  
 20 which meets Pakistan's concerns, while maintaining  
 21 a water seal for vortex control above the headrace  
 22 tunnel that would meet India's concerns. So India's  
 23 deep intake could easily be modified by incorporating  
 24 a skimming wall to raise the minimum invert level of the  
 25 intake, which is the outlet used to divert water to the

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16:03 1 plant.  
 2 (Slide 68) And this is shown in this comparison of  
 3 intake designs. So you see, on the left, India's  
 4 design: a straight intake as deep as possible. However,  
 5 in a modified Treaty-compliant design, you can  
 6 incorporate a skimming wall that would raise the  
 7 effective invert elevation of the intake. It not only  
 8 renders the design Treaty-compliant but, by withdrawing  
 9 the water near the surface, it will deliver water  
 10 containing a lower sediment content, in particular of  
 11 sands, into the turbines.  
 12 So sediment management generally compels the  
 13 adoption of a surface-level intake with minimal  
 14 intrusion below the dead storage level. And the  
 15 selection of India's design, on the left, a deep intake,  
 16 knowing that this is operating in a region with a high  
 17 sediment load, is not a sound practice. And it leads  
 18 into this sort of perpetuation of a cycle, where you  
 19 have the intake that's deep, that's therefore very  
 20 susceptible to problems of sediment. We then have  
 21 designs from India that insert an orifice spillway below  
 22 the intake because they need to, in their view, engage  
 23 in drawdown flushing to create a buffer between the  
 24 intake seal and the sediment level; all of which is in  
 25 violation of the Treaty.

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16:07 1 "... recourse to anti-vortex devices at the design  
 2 stage is not common practice, and should be limited to  
 3 particular cases where other measures cannot be  
 4 undertaken to provide protection against the development  
 5 of vortices."  
 6 But paragraph 8(f) actually compels that such  
 7 options be assessed with its reference to "satisfactory  
 8 and economical construction and operation of the Plant  
 9 as a Run-of-River Plant".  
 10 (Slide 70) The Court has asked, in Procedural  
 11 Order No. 6:  
 12 "... what is to be taken into account for the  
 13 purposes of designing submerged power intakes for  
 14 a plant and what is to be excluded?"  
 15 (Slide 71) So we say the relevant factors include  
 16 that the intakes are built and operated satisfactorily  
 17 and economically in the light of the challenges that  
 18 a run-of-river plant in the Himalayas faces. That means  
 19 sediment ingress into turbines, vortexing and other  
 20 operational questions.  
 21 The other relevant factor is the need to place the  
 22 intake's invert at a level to allow pondage to be drawn  
 23 upon, which will be below dead storage level but not  
 24 completely submerged.  
 25 We say irrelevant factors are: factors that are

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16:05 1 So I now turn to how the Neutral Expert addressed  
 2 this issue of intakes in the Baglihar proceedings. He  
 3 considered two competing designs for the intakes that  
 4 I showed you on the previous slide: the deep intake of  
 5 India sitting near the bottom, and Pakistan's  
 6 alternative selective withdrawal intake situated  
 7 partially above the dead storage level.  
 8 (Slide 69) Unfortunately, in his analysis of these  
 9 intake designs, he committed some very serious errors.  
 10 First of all, he only assessed India's design by  
 11 reference to paragraph 8(f), though as a fully submerged  
 12 intake below the dead storage level, he should have also  
 13 applied the even more stringent conditions under 8(d).  
 14 He also gave undue weight to the need to prevent  
 15 vortexing, and didn't take sufficient account of the  
 16 even more serious problem of sediment ingress. So he  
 17 erred in prioritising technical reasons for lowering the  
 18 intakes -- vortexing -- while ignoring the technical  
 19 reasons for raising them, which was to minimise sediment  
 20 entrainment.  
 21 He also said that an assessment of intake height  
 22 could take place without considering whether anti-vortex  
 23 devices could effectively be introduced into the design.  
 24 He said (PLA-2, paragraph 5.10.7) -- and the quote is on  
 25 the slide:

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16:08 1 related to non-run-of-river plants, they have very  
 2 distinctive needs when it comes to intakes; factors that  
 3 are not directly related to the HEP's operation, that's  
 4 clearly in the large of 8(f); and factors unrelated to  
 5 the designated range of the plant's operation.  
 6 (Slide 72) So I come now to the key takeaways from  
 7 this analysis of paragraphs 8(d), (e) and (f).  
 8 As we've been discussing, the choice of site is  
 9 crucial. Not every potential site may be viable for  
 10 development based on geology, seismic activity,  
 11 topography, hydrology, social and environmental impacts  
 12 and economics, but also because of the constraints of  
 13 the Treaty. It may be that a site is not suitable for  
 14 an Annexure D.3 HEP. And the solution is for  
 15 a different site to be chosen, not to build and operate  
 16 a non-compliant HEP.  
 17 There's always going to be more than one option for  
 18 a site, and there is no such thing as the perfect site.  
 19 There will be a range of factors to take into account,  
 20 of which the Treaty is a requirement for India on the  
 21 Western Rivers.  
 22 The design and operation of a hydroelectric power  
 23 plant never takes place in a vacuum: it always operates  
 24 within a set of constraints. And the Treaty, with its  
 25 peace, treaty and hydro bargains, is a set of

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16:10 1 constraints that apply to India's plants on the Western  
 2 Rivers. And as with all engineering challenges, it's  
 3 necessary to find a solution within the overall context  
 4 of prevailing constraints.  
 5 On low-level outlets, the default is not to have  
 6 a low-level outlet in an Annexure D.3 HEP. India must  
 7 establish its burden that there is a necessity for  
 8 a low-level outlet. If it does manage to establish  
 9 that, then they need to be as small as possible, as high  
 10 as possible in the reservoir. The strategy of using  
 11 low-level outlets to pass the design flood has resulted,  
 12 in breach of the Treaty, in the maximum size of the  
 13 low-level outlet, not the minimum size.  
 14 For spillways, the default position is to have  
 15 a surface ungated spillway. India may show -- and it  
 16 may discharge the burden -- that a gated spillway is  
 17 necessary due to conditions at site of the plant. If it  
 18 manages to do that, then the bottom level of the gates  
 19 has to be located as high as possible, the design must  
 20 be sound and economical, and that will usually mean  
 21 a crest-gated spillway rather than a fully submerged  
 22 orifice spillway.  
 23 For power intakes, the most effective as well as the  
 24 Treaty-compliant design will be a surface intake that  
 25 sits largely above the dead storage level and is

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16:15 1 (Slide 3) Now, as we're all aware, the Court has  
 2 asked a question on freeboard in its Procedural Order  
 3 No. 6, and we've got that now on the slide for you:  
 4 "With respect to Annexure D, paragraph 8(a), what is  
 5 to be taken into account for the purposes of designing  
 6 a freeboard for a plant and what is to be excluded?"  
 7 (Slide 4) So now we have on the slide paragraph 8(a)  
 8 itself. First, of course, we have the common  
 9 paragraph 8 chapeau:  
 10 "Except as provided in paragraph 18, the design of  
 11 any new Run-of-River Plant ... shall conform to the  
 12 following criteria: ..."  
 13 And then we have the text of paragraph 8(a) itself:  
 14 "The works themselves shall not be capable of  
 15 raising artificially the water level in the Operating  
 16 Pool above the Full Pondage Level specified in the  
 17 design."  
 18 Now, on the slide as well we have a further  
 19 provision which, in Pakistan's submission, provides  
 20 essential context for paragraph 8(a). And that is, of  
 21 course, paragraph 8(b), which states that:  
 22 "The design of the works shall take due account of  
 23 the requirements of Surcharge Storage and of Secondary  
 24 Power."  
 25 So between these two provisions, paragraph 8 defines

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16:12 1 designed to minimise the entrainment of coarse sediment.  
 2 Mr Chairman, that concludes my submissions.  
 3 I'm happy to answer any questions.  
 4 THE CHAIRMAN: Thank you, Professor Webb. (Pause)  
 5 I don't think we have any questions for you. Thank  
 6 you so much for your presentation.  
 7 PROFESSOR WEBB: Thank you. And I ask that you now call  
 8 Dr Miles to address you on freeboard. Thank you very  
 9 much.  
 10 THE CHAIRMAN: Very good. It is indeed Dr Miles's time,  
 11 after sitting patiently, as Sir Daniel said.  
 12 So, Dr Miles, you are welcome to come to the podium.  
 13 DR MILES: Thank you. If you will just give me a few  
 14 moments to set myself up. (Pause)  
 15 Ready when you are, Mr Chairman.  
 16 THE CHAIRMAN: Please proceed.  
 17 DR MILES: Thank you.  
 18 (4.15 pm)  
 19 Submissions on Freeboard  
 20 DR MILES: (Slide 1) Mr Chairman, members of the Court,  
 21 it is a pleasure to be before you again, this time in  
 22 an environment in which more than cordial greetings are  
 23 possible. Today I will be addressing you on the  
 24 question of the HEP's freeboard, which is regulated by  
 25 paragraph 8(a) of Annexure D of the Treaty.

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16:16 1 the permissible height of a HEP freeboard.  
 2 Now, in this presentation we will explore how these  
 3 provisions are to be unpacked, so that the Court's  
 4 question on freeboard may be answered.  
 5 (Slide 5) To that end, I propose to proceed as  
 6 follows. First, I will revisit the concept of HEP  
 7 freeboard, picking up on some of the concepts that  
 8 Dr Morris has mentioned. Second, I will turn to  
 9 paragraph 8(a) and explain how it is to be interpreted  
 10 by reference to the relevant definitions in paragraph 2  
 11 of Annexure D. Third, I will address India's case on  
 12 freeboard and explain why it is incorrect. And fourth,  
 13 I will return to the Court's question and proffer  
 14 Pakistan's suggestion on how it might be answered.  
 15 (Slide 6) So let's start with the engineering  
 16 concept of the freeboard. Dr Morris has already kindly  
 17 discussed this, and so I can hopefully be brief.  
 18 (Slide 7) On the slide you will see our old friend  
 19 the Neelum-Jhelum hydroelectric plant, and we've got the  
 20 freeboard and the full pondage level marked in yellow.  
 21 So as you can see from the diagram, the freeboard is  
 22 that part of the dam wall between the normal top of the  
 23 reservoir, so the full pondage level, which for the  
 24 NJHEP is 1,015 metres above sea level, and the lowest  
 25 portion of the dam wall that is not designed for

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16:18 1 overflow.  
 2 So why does a dam need this? Safety. Freeboard  
 3 provides an additional margin between the reservoir and  
 4 the top of the dam. This prevents the reservoir from  
 5 overflowing in the face of sudden and unexpected events,  
 6 such as: waves caused by wind; waves caused by  
 7 earthquakes or landslides; sudden floods depositing  
 8 large amounts of water into the reservoir; or the  
 9 failure of a gated spillway, either because of human or  
 10 mechanical error.  
 11 Such overflow is referred to as dam "overtopping".  
 12 And depending on the type of dam used, the consequences  
 13 can be catastrophic. For an embankment dam, overtopping  
 14 will lead to the erosion of the dam, and the result of  
 15 that is dam collapse. Teesta III, the Indian HEP to  
 16 which Dr Morris and Professor Webb drew your attention,  
 17 was one such example of an embankment dam, a rock-filled  
 18 concrete-faced dam.  
 19 But when dealing with a pure concrete dam, however,  
 20 the consequences of overtopping are usually less severe,  
 21 due to the resistance of concrete to rapid erosion.  
 22 Indeed, some concretes dams may be designed to be  
 23 overtopped for short periods of time.  
 24 Now, the result of all this, of course, is that you  
 25 will normally need a higher freeboard with an embankment

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16:19 1 dam than you will with a concrete dam.  
 2 (Slide 8) Now, what I've just said about the sort of  
 3 general purpose of freeboard and the way in which it is  
 4 incorporated into a HEP is on the slide. That's from  
 5 the US Bureau of Reclamation's Criteria and Guidelines  
 6 for Computing Freeboard Allowances (P-535). There's no  
 7 need for me to read it out. I've just got it flagged  
 8 there so that you can examine it for yourselves in  
 9 slower time.  
 10 Now, another issue at play when determining  
 11 freeboard is spillway design, with which you are now all  
 12 extremely familiar. This may result in the introduction  
 13 of yet another concept into freeboard design, which is  
 14 that of surcharge storage.  
 15 Surcharge storage, also known as flood surcharge, is  
 16 a portion of additional storage above the normal full  
 17 pondage level. It's empty space, intended only to be  
 18 filled in the event of a flood.  
 19 (Slide 9) Now, of course this prompts the question:  
 20 Dr Miles, if you have a spillway, why do you need flood  
 21 surcharge? And of course the image on the slide  
 22 provides the answer. Simply put, the need for this  
 23 additional space is driven by spillway design.  
 24 An ungated spillway, on the left, has a fixed and  
 25 uncontrolled discharge capacity. To put it in blunt

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16:20 1 terms, it can't get any deeper than it already is. It  
 2 may not, therefore, be able to discharge the entire  
 3 design flood of the HEP immediately. Surcharge storage  
 4 above the spillway allows the discharge to increase as  
 5 the water level rises.  
 6 Now, a gated spillway -- and that's examples (b) and  
 7 (c) on the slide -- whether surface or orifice, may have  
 8 its gates sized such that the HEP's design flood may be  
 9 discharged without the need for surcharge storage.  
 10 Smaller gates may, however, require the inclusion of  
 11 a small amount of surcharge storage for much the same  
 12 reason as an ungated spillway: the higher water level  
 13 with surcharge increases the spillway capacity without  
 14 risk of overtopping.  
 15 (Slide 10) Now, where surcharge storage is included  
 16 in HEP design, we end up with two types of freeboard,  
 17 which you can see on the slide. So first of all we have  
 18 the normal freeboard, which is from the full pondage  
 19 level to the top of the dam; and then we have the  
 20 minimum freeboard, which sits within the normal  
 21 freeboard. And that designates the margin between the  
 22 high flood level, at the top of surcharge storage, and  
 23 the top of the dam.  
 24 So when we pull all this together, we can see that  
 25 we've got a number of factors that are going to start

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16:22 1 influencing our freeboard height. I'll address these  
 2 all later by reference to the relevant international  
 3 standards. But for present purposes, we can split these  
 4 into two categories: the first concerning HEP design,  
 5 and the second, site conditions.  
 6 (Slide 11) So far as HEP design is concerned, we  
 7 have -- and you can see here on the left of the slide  
 8 we've got design factors and site conditions -- we've  
 9 got the type of dam used. As I've already said,  
 10 an embankment dam is going to need more freeboard than  
 11 a concrete dam.  
 12 And then we also have spillway design. As we've  
 13 noted already, an ungated spillway will need more  
 14 freeboard than a gated spillway, due to the need to  
 15 incorporate surcharge storage.  
 16 So far as site conditions are concerned, we have  
 17 meteorological conditions, particularly with respect to  
 18 wind at the HEP site. And it's this wind that leads to  
 19 waves, which can overtop the dam, creating a possible  
 20 collapse risk for an embankment dam.  
 21 Then we've got the bathymetric conditions, which  
 22 refer to the depth and length of the reservoir, both of  
 23 which can affect the formation and movement of these  
 24 waves within the reservoir.  
 25 And then finally, we have a variety of geological

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16:23 1 conditions which may cause movement of the dam or  
 2 displacement of water in the reservoir, including dam  
 3 and foundation consolidation, site seismicity, and risk  
 4 of landslide.  
 5 So if we can put this in roundabout general terms,  
 6 an embankment dam with an ungated spillway in a windy  
 7 and earthquake-prone zone will need a higher freeboard  
 8 than a concrete dam with a large gated spillway in  
 9 a sheltered region with stable geology.  
 10 But this is all, of course, a question of  
 11 engineering. What is required in terms of freeboard  
 12 will vary from site to site and from dam to dam. As  
 13 always in these things, there's no one-size-fits-all  
 14 approach.  
 15 (Slide 13) Now that we know what freeboard is, we  
 16 can see how it's regulated by paragraph 8(a). And  
 17 that's now back for you on the slide.  
 18 So, first observation -- hands up -- freeboard is  
 19 not mentioned in there at all. But it is subsumed in  
 20 the fact that paragraph 8(a) refers generally to "the  
 21 works", a term that, within the Treaty, includes the  
 22 entirety of the HEP structure, including the freeboard.  
 23 So what this means is that freeboard regulation  
 24 under paragraph 8(a) forms part of the wider examination  
 25 of the way in which the HEP is designed. And it's this

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16:25 1 "Dead Storage Level", which is located at  
 2 paragraph 2(a). This means "the level [of the  
 3 reservoir] corresponding to Dead Storage", which is,  
 4 of course, the portion of the storage not used for  
 5 operational purposes. As the Kishenganga Court said  
 6 (PLA-3, paragraph 505):  
 7 "... Dead Storage is ... truly 'dead' ... to be  
 8 filled once, and not thereafter subject to  
 9 manipulation."  
 10 As for the "Full Pondage Level", paragraph 2(d)  
 11 provides that this means "the level [of the reservoir]  
 12 corresponding to the maximum Pondage provided in the  
 13 design in accordance with Paragraph 8(c)".  
 14 I will be leaving paragraph 8(c) right where it is  
 15 for the moment; we will be talking about it in detail  
 16 tomorrow. But suffice to say for present purposes,  
 17 pondage is a form of live storage that can be used for  
 18 operational purposes; and to that extent, it is the  
 19 contents of the operating pool that defines the volume  
 20 of the operating pool.  
 21 Then finally, we might look at "Surcharge Storage",  
 22 as defined in paragraph 2(e). This is the  
 23 "uncontrollable" -- underline "uncontrollable" --  
 24 "[live] storage occupying space above the Full Pondage  
 25 Level". And we've addressed this briefly already when

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1 wider interaction of freeboard with the works as a whole  
 2 that will determine whether a HEP is  
 3 paragraph 8(a)-compliant.  
 4 What is paragraph 8(a) intended to prevent? Well,  
 5 we know this from the words that follow:  
 6 "The works ... shall not be capable of raising  
 7 artificially the water level in the Operating Pool above  
 8 the Full Pondage Level specified in the design."  
 9 (Slide 14) Now, unpacking this statement is going to  
 10 require a brief detour into the definitions section of  
 11 Annexure D, which is of course paragraph 2, now on the  
 12 slide. We'll be returning to deal with these in more  
 13 detail tomorrow, when I will be dealing with the much  
 14 anticipated question of pondage. But for now, the  
 15 critical points are as follows.  
 16 The first is another general observation: the  
 17 definitions that are here relevant are those dealing  
 18 with the composition of a HEP's reservoir. By this,  
 19 I mean that they define the water levels within the  
 20 reservoir.  
 21 So if we can start at "Operating Pool" down at the  
 22 bottom, paragraph 2(f) provides that this means "the  
 23 storage capacity between the Dead Storage Level and the  
 24 Full Pondage Level".  
 25 This leads us, in turn, to the definition of the

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16:27 1 dealing with paragraph 8(b) and the concept of flood  
 2 surcharge.  
 3 (Slide 15) So if we pull all this together, we get  
 4 the longitudinal profile of the HEP's reservoir that  
 5 we have on the slide. Each long-suffering spouse or  
 6 partner of a member of Pakistan's counsel team has had  
 7 this drawn for them on a cocktail napkin at some point  
 8 over the past two years, but you remember it possibly as  
 9 figure 12.2 from Pakistan's Memorial.  
 10 Just in terms of principal features from the bottom  
 11 of the reservoir up, at the bottom we see our dead  
 12 storage, terminating at the dead storage level. Then we  
 13 have the operating pool, filled with pondage,  
 14 terminating at the full pondage level. Above the full  
 15 pondage level, we have our uncontrollable surcharge  
 16 storage.  
 17 That terminates in what we have termed the  
 18 "surcharge storage level" on this diagram. That's  
 19 obviously not mentioned in the Treaty, but it is known  
 20 in almost every run-of-the-river HEP, including the  
 21 NJHEP, as the "high flood level".  
 22 And we've indicated that both pondage and surcharge  
 23 storage constitute live storage for the purposes of  
 24 a HEP governed by Annexure D.  
 25 Then at the far left of the profile, we have the

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16:28 1 freeboard, which is the normal freeboard, encompassing  
 2 the space between the full pondage level and the top of  
 3 the dam wall, and the minimum freeboard, encompassing  
 4 the space between the high flood or surcharge storage  
 5 level and the top of the dam wall.  
 6 When we pull all of this together, we can see what  
 7 paragraph 8(a) is really driving at: India is prohibited  
 8 from building a HEP that can be artificially filled  
 9 beyond the full pondage level. Put another way, India  
 10 cannot build a HEP in which the operator is able to  
 11 simply shut the outlets and allow the water in the  
 12 operating pool to rise until the usual limits of the  
 13 operating pool are exceeded, allowing India more live  
 14 storage than it is entitled to.  
 15 More to the point, while the additional vertical  
 16 space that this additional live storage could occupy is  
 17 relatively limited, once it is multiplied out across the  
 18 entire surface of the reservoir -- and indeed, in this  
 19 case, above the normal surface of the reservoir -- it  
 20 becomes very large indeed.  
 21 (Slide 16) You will recall the elevation capacity  
 22 curve introduced by Dr Morris in this respect, which is  
 23 now back on the slide. And the point is a simple one:  
 24 to coin a phrase, even an inch of additional depth will  
 25 result in considerable additional storage when it's

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16:29 1 a mile wide. So several metres of additional freeboard  
 2 height at this elevation will lead to considerable  
 3 additional live storage.  
 4 THE CHAIRMAN: Dr Miles, if you don't mind going back to the  
 5 prior slide, 15.  
 6 DR MILES: Yes.  
 7 THE CHAIRMAN: I'd still like to hear you say a little bit  
 8 more about how we should be interpreting paragraph 8(a).  
 9 As you, I think, previously noted, it says:  
 10 "The works ... shall not be capable of raising  
 11 artificially the water level ... above the Full Pondage  
 12 Level ..."  
 13 Then we have in (b): well, we can "take due account"  
 14 of surcharge storage. That seems, by its text, to say  
 15 it's fine to go up to the green line, but you can't go  
 16 above that.  
 17 DR MILES: I'm coming on to exactly that point.  
 18 THE CHAIRMAN: Alright.  
 19 DR MILES: So if you bear with me, I'll be right with you.  
 20 If I have not answered the question after that, you have  
 21 licence to pull me up and I'll do my very best.  
 22 (Slide 17) Now, as to why the Treaty is hostile to  
 23 this idea of overfilling that we've been discussing,  
 24 we need only consult the critical rule from which  
 25 Annexure D departs, which is Article III.

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16:31 1 Article III has already been covered in some detail  
 2 by Professor Webb, and I will be returning to it  
 3 tomorrow. But for present purposes, the language of  
 4 Article III(4) is key:  
 5 "Except as provided for in Annexures D and E, India  
 6 shall not store any water of, or construct storage works  
 7 on, the Western Rivers."  
 8 As Professor Webb has explained, the Treaty is  
 9 presumptively suspicious of any attempt by India to  
 10 store the waters of the Western Rivers. Once we  
 11 understand this, we can see why paragraph 8(a) of  
 12 Annexure D is framed as it is. Between Article III(4)  
 13 and Annexures D and E, the Treaty tightly controls  
 14 India's right to store the waters of the Western Rivers.  
 15 And now I hope I'm coming on to what the Chairman's  
 16 point in his question was.  
 17 (Slide 18) This hostility is reflected in the first  
 18 three subparagraphs of paragraph 8. Looking at these on  
 19 the slide from the bottom up.  
 20 Paragraph 8(c) gives India a fixed amount of  
 21 pondage, being the principal form of live storage under  
 22 the Treaty.  
 23 Paragraph 8(b) requires India to incorporate such  
 24 surcharge storage as may be necessary into its design,  
 25 and that storage is by definition uncontrollable; and

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16:32 1 "uncontrollable" is the answer to the Chairman's  
 2 question.  
 3 And paragraph 8(a), with which we are presently  
 4 concerned, is inserted to guarantee that India cannot  
 5 obtain more pondage than it is entitled to by the simple  
 6 expedient of ensuring that the operating pool of  
 7 an Annexure D.3 HEP cannot be deliberately overfilled.  
 8 Now, another point that might be noted is that these  
 9 three paragraphs together constitute what might be  
 10 called the "storage criteria" of paragraph 8 of  
 11 Annexure D. And these tell India the limits within  
 12 which its reservoir is to be designed.  
 13 The other provisions of paragraph 8 --  
 14 paragraphs 8(d), (e) and (f) which Professor Webb dealt  
 15 with compendiously just before me -- deal with those HEP  
 16 features that allow India to manipulate the content of  
 17 the reservoir, so outlets, spillways and intakes. And  
 18 we can refer to these as the "control criteria" of  
 19 paragraph 8.  
 20 There is a critical difference between the storage  
 21 and control criteria. Whereas the control criteria give  
 22 a margin of objective appreciation, with references to  
 23 "sound and economical design" and so forth, the storage  
 24 criteria posit strict and absolute limits: maximum  
 25 pondage "shall not exceed" twice the pondage required

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16:33 1 for firm power; the design of the works "shall take due  
2 account" of the need for, or indeed the lack of need  
3 for, surcharge storage; and the works "shall not" be  
4 capable of artificially increasing the level of the  
5 operating pool above the full pondage level.  
6 So how is India to ensure that the reservoirs of  
7 its HEPs cannot be filled above the full pondage level?  
8 There are two answers to this.  
9 The first -- which is the answer to the Chairman's  
10 question -- concerns whether water within the surcharge  
11 storage can drain away freely at the full pondage level  
12 following a flood. This engages, in turn, questions of  
13 spillway design and surcharge storage.  
14 The second answer concerns freeboard configuration,  
15 which can only be properly understood in light of the  
16 first answer.  
17 So I will address each now in turn, starting with  
18 the full pondage level.  
19 (Slide 19) On the slide we've got a photo of  
20 an ungated surface spillway -- I think this one's from  
21 Queensland -- combined with its diagram of its freeboard  
22 arrangements.  
23 If we assume that the crest of the spillway is at  
24 the full pondage level, is this design compliant with  
25 paragraph 8(a)? Answer: plainly, yes. If an attempt

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16:35 1 were made by the HEP operator to fill above the full  
2 pondage level, the ungated spillway would prevent  
3 additional water from being stored. The reservoir would  
4 simply overflow the crest and discharge into the river  
5 below the dam.  
6 A further important point is that this arrangement  
7 is not offended by surcharge storage, which occupies the  
8 space above the full pondage level. As to why this is  
9 the case, paragraph 8(a) prohibits only the  
10 artificial -- that is, controlled -- filling of the  
11 operating pool above the full pondage level. The HEP  
12 operator cannot be permitted to simply shut all the  
13 outlets and watch the reservoir fill. And second,  
14 paragraph 8(b) qualifies paragraph 8(a) by requiring  
15 surcharge storage to be taken into account, but  
16 paragraph 2(e) confirms that surcharge storage is  
17 uncontrollable in character.  
18 So to sort of put a finger on the Chairman's  
19 question: yes, you are allowed to fill your HEP to the  
20 high flood level, provided the space between the full  
21 pondage level and the high flood level is filled only by  
22 uncontrollable surcharge storage.  
23 Now, when a HEP includes an ungated surface  
24 spillway, both of the criteria that I just mentioned are  
25 met. The ungated character of the spillway prevents the

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16:36 1 HEP's reservoir from being filled above the full pondage  
2 level, for the reasons that I've already explained. And  
3 at the same time, that same spillway also guarantees  
4 that our surcharge storage remains uncontrolled. While  
5 it may be filled in the case of a flood, the HEP  
6 operator cannot manipulate the surcharge deliberately,  
7 as the floodwater will drain away immediately over the  
8 ungated spillway. And the result of this is a HEP  
9 that's paragraph 8(a)-compliant.  
10 So that's the position with respect to an ungated  
11 surface spillway; what about a gated surface spillway?  
12 (Slide 20) Assuming the top of the gates for our  
13 ungated surface spillway are set at the full pondage  
14 level, which is the normal practice, this design would  
15 also be paragraph 8(a)-compliant. Because, as we can  
16 see from the photograph -- which again you'll recognise  
17 from Neelum-Jhelum -- gated surface spillways usually  
18 include a gap between the top of the gate and the dam  
19 wall through which uncontrolled flow can occur.  
20 This design feature allows for free overflow of the  
21 reservoir in flood conditions, allowing for safe  
22 spill-over in the event of gate malfunction or delay.  
23 For the purposes of paragraph 8(a), that gap performs  
24 much the same function as an ungated surface spillway --  
25 admittedly with a far smaller discharge capacity --

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16:38 1 preventing artificial filling of the operating pool  
2 above the full pondage level.  
3 This also means that any surcharge storage, to the  
4 extent it's even required in such a design under  
5 paragraph 8(b), remains uncontrolled. Again, if the  
6 surcharge storage were filled and the gates closed,  
7 floodwater would still escape the reservoir through this  
8 free overflow feature.  
9 But where problems really start to emerge -- as  
10 Dr Morris said earlier -- under paragraph 8(a) is with  
11 respect to India's preferred design: the orifice  
12 spillway.  
13 (Slide 21) Why this is the case is immediately  
14 apparent from the slide. An orifice spillway -- and  
15 you'll recognise the gates once more from  
16 Neelum-Jhelum -- is designed to be wholly submerged. As  
17 such, its gates do not have a free overflow feature,  
18 like a gated or an ungated surface spillway, but form  
19 a watertight seal with the dam wall.  
20 This means that there will ordinarily be no outlet  
21 between the top of the orifice spillway gates and the  
22 top of the dam, allowing the reservoir to be filled  
23 artificially above the full pondage level, contrary to  
24 paragraph 8(a). And it will also mean that any  
25 surcharge storage in the design will be controllable,

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16:39 1 contrary to paragraph 8(b).  
 2 The upshot of this is that paragraphs 8(a) and 8(b)  
 3 impose a constructive ban on a HEP design that includes  
 4 only an orifice spillway.  
 5 Now, this does not necessarily create a problem for  
 6 India. As Professor Webb explained, paragraph 8(e)  
 7 does, in certain circumstances, allow India to include  
 8 an orifice spillway in its design, if required by the  
 9 conditions at the site together with considerations of  
 10 sound and economical design and so forth.  
 11 But what it does not allow is for India to include  
 12 only an orifice spillway in its designs. It must also  
 13 include in the design another type of free overflow  
 14 feature, preferably an ungated surface spillway, that  
 15 renders uncontrollable both the surcharge storage and  
 16 the freeboard.  
 17 (Slide 22) We showed why this is the case in figure  
 18 12.3 of the Memorial, which is on the slide.  
 19 On the right, we see a paragraph 8(a) non-compliant  
 20 HEP design. As you can see, this has an orifice  
 21 spillway only, and can easily be filled by India above  
 22 the full pondage level simply by closing the spillway  
 23 gates and allowing the water level to rise.  
 24 These problems are not, however, present for the  
 25 design on the left of the image. Here, an ungated

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16:40 1 surface spillway is included in the design at the full  
 2 pondage level. If India were to fill past that level,  
 3 the excess water would be discharged through this free  
 4 overflow feature, and what was, in the design on the  
 5 right, controllable surcharge storage becomes, in the  
 6 design on the left, uncontrollable surcharge storage.  
 7 (Slide 23) Now, as I think Professor Webb mentioned,  
 8 combination spillways of this kind are by no means  
 9 unheard of. You'll recall similar points being made by  
 10 Dr Abbas on the site visit by reference to the spillway  
 11 at the Karun-III HEP in Iran, designed by our very own  
 12 Peter Rae, and that's currently on the slide.  
 13 Karun-III includes three different spillways:  
 14 an orifice spillway, a surface gated spillway and  
 15 an ungated surface spillway. Provided that at least one  
 16 of the surface spillways is at the full pondage level,  
 17 this design would be paragraph 8(a)-compliant, at least  
 18 insofar as our overfilling is concerned.  
 19 And that's also a feature of the NJHEP on the right;  
 20 we saw that on the site visit. As you will recall, the  
 21 NJHEP includes an orifice spillway, but also includes  
 22 a surface gated spillway as an auxiliary structure to  
 23 assist in passage of the design flood and allow for the  
 24 passage of floating debris. Provided the gap at the top  
 25 of the auxiliary spillways gates is at the full pondage

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16:42 1 level, this design would also be  
 2 paragraph 8(a)-compliant; again, at least so far as the  
 3 possibility of overfilling is concerned.  
 4 So those are the points that I wish to make on the  
 5 way that paragraph 8(a) regulates what happens at the  
 6 full pondage level. So that's our first part of the  
 7 analysis.  
 8 (Slide 24) On to the second, freeboard; or more  
 9 particularly, the height of the freeboard.  
 10 As I mentioned previously, although freeboard is not  
 11 mentioned expressly in paragraph 8(a), it is  
 12 nevertheless part of the works, and nevertheless falls  
 13 to be regulated by paragraph 8(a). And the reason why  
 14 is on the slide.  
 15 Now, you may recognise these from the NJHEP: we  
 16 walked past them a couple of times. They're stoplogs,  
 17 which are watertight barriers used to seal off spillway  
 18 gates so that they may be de-watered for maintenance  
 19 purposes.  
 20 The import of these with respect to our surface  
 21 gated spillway, our free overflow feature, is obvious.  
 22 Ordinarily, the gap at the top of the gates will serve  
 23 as a free overflow structure that will prevent the  
 24 reservoir from exceeding the full pondage level. But  
 25 with stoplogs in place, that gap will be blocked, or at

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16:43 1 the very least diminished in size, allowing the  
 2 operating pool to be overfilled.  
 3 The same can be said, by the way, for ungated  
 4 surface spillways. Although these are not usually  
 5 constructed with stoplogs in mind -- which is  
 6 unsurprising, because they don't have moving parts, and  
 7 therefore don't require maintenance in the usual course  
 8 of events -- the crest elevation can still be raised --  
 9 that is to say, the spillway can be blocked -- using  
 10 structural elements such as fusegates or flashboards,  
 11 which are designed to break away during large floods,  
 12 but can still be used to overfill the operating pool.  
 13 It's for this reason that paragraph 8(a) limits the  
 14 height of a HEP's freeboard to that of the minimum  
 15 required for safety in the circumstances.  
 16 (Slide 25) This is confirmed by the argument before  
 17 the Neutral Expert in the Baglihar case. We've got his  
 18 summary on the slide for you (PLA-2, paragraph 5.8.1).  
 19 And at the top we see:  
 20 "For a surface gated spillway, the artificial  
 21 raising of the level is possible by increasing the  
 22 height of the gates; however, this is not technically  
 23 easy unless measures for this purpose were allowed for  
 24 in the initial design."  
 25 Pausing there, stoplogs may plainly be allowed for

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16:44 1 in the initial design: the NJHEP is proof of that.  
 2 Professor Lafitte also, in that paragraph, mentions  
 3 another method by which artificial raising of the  
 4 operating pool can be accomplished, which is that you  
 5 simply install bigger gates after the fact.  
 6 He then continues:  
 7 "In the case of ungated surface spillways, the  
 8 artificial raising of the full pondage level is easier.  
 9 It is a generally accepted way of improving the  
 10 performance of an existing dam. This is achieved by  
 11 placing gates on the crest (possibly fusegates) so as  
 12 not to affect the spilling capacity of the spillway."  
 13 So far, this is entirely consistent with what  
 14 I've set out.  
 15 Then finally, the final paragraph:  
 16 "A way to limit the technical possibility of raising  
 17 the Full Pondage Level is to limit the freeboard to the  
 18 minimum required."  
 19 (Slide 26) This consideration is then carried  
 20 through to his intermediate conclusion which we have for  
 21 you on this slide. And he says there (PLA-2,  
 22 paragraph 5.8.9):  
 23 "The possibility of [raising further] the Full  
 24 Pondage Level and the extent of ... possible raising is  
 25 directly related to the height of the ... freeboard."

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16:45 1 (Slide 27) And then on to his final analysis  
 2 (paragraph 6.4.2):  
 3 "... the dam crest elevation should be set at the  
 4 lowest elevation compatible with a sound and safe design  
 5 based on the state of the art."  
 6 Now, on this issue, Professor Lafitte got it right,  
 7 although the reason for this outcome was that the issue  
 8 of the freeboard is not one that was caught in what  
 9 we say was the mangle of the Neutral Expert's  
 10 methodological errors on the interpretation of the  
 11 Treaty. Paragraph 8(a) of Annexure D regulates the  
 12 height of a HEP's freeboard to limit further the  
 13 artificial raising of the operating pool above the full  
 14 pondage level.  
 15 Now, this is not to say that India does not get  
 16 a freeboard for its Annexure D.3 HEPs. To the contrary,  
 17 given the role that the freeboard plays in dam safety,  
 18 these HEPs must have a freeboard for the safety of India  
 19 and Pakistan both. But -- and herein lies the rub --  
 20 that freeboard must be no higher than safety requires.  
 21 Now, I should add: this is a position that's  
 22 consistent with reality. HEPs are, as we know,  
 23 expensive to construct. Every additional metre of  
 24 height to a HEP's dam may add millions of dollars in  
 25 cost; a cost that will not necessarily benefit the HEP

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16:46 1 operator, as a higher freeboard does not translate to  
 2 a higher generating head that could be used for  
 3 increased power production. As such, paragraph 8(a),  
 4 insofar as its regulation of freeboard is concerned,  
 5 merely confirms what is already implicit in the  
 6 economics of HEP construction.  
 7 Now, this all, of course, prompts the question of  
 8 what freeboard safety requires. In Pakistan's  
 9 submission, this is an engineering question to be  
 10 governed by the relevant international standards.  
 11 (Slide 28) On the slide we have a summary from the  
 12 US Bureau of Reclamations 1982 technical memorandum on  
 13 Freeboard Criteria and Guidelines for Computing  
 14 Freeboard Allowances (P-535), to which I referred  
 15 earlier. This is the most complete standard that  
 16 Pakistan has been able to locate. Of course, there may  
 17 be others; but to my understanding, everything is kind  
 18 of broadly similar. Several of them are on the record,  
 19 and we're happy to provide references if you think it  
 20 convenient.  
 21 For present purposes, I could perhaps point you to  
 22 two: ICOLD's Bulletin No. 82 on Selection of Design  
 23 Flood, that's P-0536, and in particular, section 4.6  
 24 thereof is most illuminating; and the US Federal Energy  
 25 Regulatory Commission's guidelines concerning Selecting

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16:48 1 and Accommodating Inflow Design Floods for Dams, P-0532,  
 2 and in particular, section 2-4.3.  
 3 Despite its age, the Bureau's memorandum, which we  
 4 have again on the slide, has been referred to regularly  
 5 with approval, and it's still referred to regularly with  
 6 approval, including in the Federal Energy Regulatory  
 7 Commission guidelines I just mentioned, which are from  
 8 slightly more recently: 2015.  
 9 Returning to the slide, we can see the Bureau's  
 10 presumed or default position -- and it is only  
 11 a presumption, it's only a default position -- on  
 12 concrete dams, which is that:  
 13 "A standard 3.5-foot (1.1-m) high parapet wall  
 14 provides all of the freeboard that is required for  
 15 concrete dams. This wall is intended to keep waves from  
 16 washing over [dams] during high reservoir levels."  
 17 THE CHAIRMAN: Just a moment Dr Miles.  
 18 DR MILES: Yes.  
 19 THE CHAIRMAN: Dr Buytaert.  
 20 PROFESSOR BUYTAERT: Sorry to interrupt you. But in the  
 21 previous slide, would you be able to clarify whether the  
 22 freeboard that's referred to here would be the minimum  
 23 freeboard, or freeboard including surcharge?  
 24 DR MILES: This, I believe, is the minimum freeboard. If  
 25 you need surcharge, that's obviously going to be

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16:49 1 dependent on the size of your spillway gates or your  
 2 spillway. So I believe this would probably be minimum  
 3 freeboard.  
 4 I will of course check that with my engineering  
 5 colleagues and if I've got that wrong, I'll get right  
 6 back to you.  
 7 PROFESSOR BUYTAERT: Please do. Thank you very much.  
 8 DR MILES: Now, in terms of factors of freeboard height,  
 9 including this conclusion, the Bureau requires  
 10 consideration of the following.  
 11 Floods, meaning the design flood and the probable  
 12 maximum flood.  
 13 Wind setup and wave run-up. These are the  
 14 predominant factors in the determination of the  
 15 freeboard and consider the circumstances in which large  
 16 waves could develop at the HEP site. These include:  
 17 wind velocity, duration and orientation with respect to  
 18 the reservoir, as well as the "fetch", being the length  
 19 of the open-water approach across which the wind can  
 20 cause waves to develop; and of course we also include  
 21 there the height and steepness of any waves and the  
 22 slope of the dam face.  
 23 Next, we also have reservoir operations. This  
 24 refers to how the HEP operator plans to operate the  
 25 reservoir at different times of the year. For example,

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16:51 1 formation of waves. In the case of the latter,  
 2 consideration may also be given to the question of  
 3 whether landslide-prone areas around the reservoir can  
 4 be removed as part of the process of HEP construction.  
 5 We've got, of course, the dam type at the top,  
 6 meaning the use of a concrete or embankment dam; and  
 7 including the risk, in the latter case, of whether the  
 8 foundations of the embankment are likely to settle  
 9 during an earthquake.  
 10 Then we've got various additional factors, including  
 11 climate change, downstream conditions and damage  
 12 potential, remoteness of the dam site and so forth.  
 13 (Slide 30) Now, these track, more or less, the  
 14 factors that Professor Lafitte relied on in Baglihar,  
 15 although in that case he was confined to considering  
 16 a concrete dam and was not in a position to opine on the  
 17 proper approach to be taken to an embankment dam.  
 18 In calculating the freeboard at the Baglihar HEP,  
 19 Professor Lafitte considered a variety of site-specific  
 20 scenarios, which is the usual in this situation. The  
 21 principle in play here is that the combination of  
 22 various factors should have a similar probability of  
 23 occurrence for any scenario considered.  
 24 So normal freeboard is determined for a flood with  
 25 a high probability of occurrence in the life of a dam

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16:50 1 if the HEP operator wants to keep the operating pool  
 2 empty during the monsoon season for sediment management  
 3 purposes -- and as Dr Morris has indicated, that is in  
 4 fact best practice -- the threat of overtopping the dam  
 5 during a flood will be much reduced because you've got  
 6 your whole operating pool which effectively becomes, in  
 7 that circumstance, a form of surcharge storage.  
 8 We then have the possibility of gate failure. The  
 9 greater the possibility of gate failure, the higher the  
 10 freeboard required, and this is going to depend on the  
 11 type of spillway used. So for an ungated surface  
 12 spillway, there's obviously no threat of gate failure as  
 13 there are no gates, but there remains the possibility  
 14 that the spillway could be blocked by debris during  
 15 a flood. So that's really going to depend on how big  
 16 your spillway outlet is.  
 17 For a gated spillway, the possibility of gate  
 18 failure can be exacerbated by site-specific conditions,  
 19 such as: the reliability of gate operations from actual  
 20 experience; the identity and experience of the dam  
 21 tender; the size and complexity of gate structure, and  
 22 so forth.  
 23 We then have the seismicity of the site. That  
 24 refers to the possibility of earthquakes or landslides  
 25 around the reservoir, both of which may cause the

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16:53 1 combined with a high wave condition. Extreme freeboard  
 2 conditions would be evaluated by developing several  
 3 scenarios with different combinations of flood, wind,  
 4 gate reliability, each with a similar combined  
 5 probability. And it would be unusual to combine the  
 6 most extreme flood with extreme wave conditions and  
 7 extreme malfunction conditions. I mean, that's just not  
 8 the sort of thing that you would expect to happen in the  
 9 lifetime of the dam, at least in a probabilistic  
 10 scenario.  
 11 So to that end, Professor Lafitte considered the  
 12 four scenarios that we have on the slide.  
 13 First, he considered what would occur during the  
 14 statistical 1-in-10000-year design flood, assuming the  
 15 initial level of reservoir was at the full pondage level  
 16 and all spillway gates were operating, taking account of  
 17 wind setup and wave run-up.  
 18 He then considered what would occur during the  
 19 probabilistic PMF, again assuming that the reservoir was  
 20 at the full pondage level and the spillway gates were  
 21 all fully operational, taking account again of wind  
 22 setup and wave run-up.  
 23 He considered what would occur in the so-called  
 24 "n-1" scenario in which one of the spillway gates  
 25 malfunctions during a flood event.

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16:54 1 And then finally, he considered what would occur in  
 2 extreme wind conditions, noting that this scenario would  
 3 not be associated with any low-frequency flood event.  
 4 And applying these scenarios and their likely  
 5 consequences to the Baglihar HEP, he saw fit to reduce  
 6 its freeboard from 4.5 metres above the full pondage  
 7 level to 3 metres above the full pondage level.  
 8 Now, what this consideration demonstrates is that,  
 9 as with many things in this field, a variety of things  
 10 need to be taken into account when we're considering  
 11 freeboard height. These are broadly agreed as between  
 12 the international standards, although some standards  
 13 provide for detail than others.  
 14 (Slide 31) Now, it's for this Court, expert lawyers  
 15 and expert engineers, to determine which criteria suit  
 16 it best. But the following broad categories may serve  
 17 as a useful starting point.  
 18 So first we have our type of dam. Do we have  
 19 a concrete dam? Do we have an embankment dam? What's  
 20 the risk of erosion if it's overtopped?  
 21 Then we have our flood conditions. What's the  
 22 design flood? What's the PMF? What's the capacity of  
 23 the reservoir to absorb the flood, if it arrives?  
 24 We have wind and wave conditions. Do we have severe  
 25 winds at the site? What's the reservoir orientation?

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16:55 1 What's the wave run-up?  
 2 Then we have our type of spillway. Are we dealing  
 3 with a gated or an ungated spillway? Are we dealing  
 4 with the risk of gate failure? What are the  
 5 consequences of gate failure? Do we need flood  
 6 surcharge?  
 7 Then we have seismicity and geology. What's our  
 8 earthquake risks? What's the consequences of  
 9 an earthquake? Ditto for landslides. And is removal of  
 10 landslide-prone areas a possibility during the process  
 11 of HEP construction?  
 12 Finally, we've got our reservoir operations. How is  
 13 the reservoir going to be operated in flood conditions?  
 14 And more particularly, is the operating pool going to be  
 15 empty in the monsoon?  
 16 (Slide 32) This ends, for now, my submissions on  
 17 Pakistan's position on the proper interpretation of  
 18 paragraph 8(a) of Annexure D, and I will return to that  
 19 in closing. Before I do, however, it's necessary to  
 20 address India's case on this question, and I hope to do  
 21 so relatively quickly.  
 22 Detailed statements of India's case were made by its  
 23 Commissioner during the 109th and 110th PIC meetings in  
 24 September 2013 and August 2014 with respect to the RHEP;  
 25 that's the Ratle plant.

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16:56 1 Now, pausing there, I emphasise that Pakistan is  
 2 not, in this phase of the proceedings, asking you to  
 3 reach a conclusion on the proper freeboard for the RHEP.  
 4 I mention it here merely as an illustration of what  
 5 India's position on freeboard is as a general matter.  
 6 (Slide 33) So on the slide we have India's position  
 7 at the 109th meeting (P-83), and it starts with the  
 8 Indian Commissioner declaring the difference between the  
 9 parties:  
 10 "The calculated value of Free Board by Pakistan is  
 11 1.1m ..."  
 12 Guess where that number came from:  
 13 "... as against that of India's value of 2.07m."  
 14 Pausing again. Although that difference may appear  
 15 minor, it should be borne in mind, as I said earlier,  
 16 that the contested metre will be located at the very top  
 17 of -- and indeed above the surface of -- the reservoir,  
 18 taking in the largest possible surface area. You'll  
 19 recall once more Dr Morris's elevation curve. If India  
 20 is able to fill that space, it will obtain  
 21 a considerable volume of additional storage in a manner  
 22 not permitted by the Treaty.  
 23 THE CHAIRMAN: Dr Miles, a question from Mr Minear.  
 24 DR MILES: Yes.  
 25 MR MINEAR: Dr Miles, I understand where you got 1.1 metres

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16:58 1 of freeboard. Where did India come up with 2.07 metres?  
 2 DR MILES: Well, as you can see here, the difference in  
 3 values of the freeboard computed by India and Pakistan  
 4 seems to arise mainly because Pakistan presumed wind  
 5 speed of 140 kilometres an hour. But the important  
 6 part -- and I'm glad you've raised this -- is Indian  
 7 Code of Practice, and I'll come back to that in  
 8 a second. It's a very important point.  
 9 MR MINEAR: Thank you.  
 10 DR MILES: India's Commissioner then goes on to state --  
 11 Mr Minear preempting me -- what he considers to be the  
 12 principal difference between the parties, and we've just  
 13 gone over that.  
 14 And so, put another way, India is relying on wind  
 15 setup and wave run-up as a basis for larger freeboard.  
 16 For the avoidance of doubt, Pakistan of course agrees  
 17 that is a valid concern. But the use of Indian  
 18 standards on this point, the formulation of which is in  
 19 India's sole control, could perhaps raise eyebrows.  
 20 "Indian side also cited ... the provisions of the  
 21 ACER manual which requires that in case of deep water  
 22 wave length, freeboard has to be computed as per  
 23 provisions of Para 2(f) of the manual, applicable to  
 24 relatively deep reservoirs. In the instant case, depth  
 25 of water is deeper than one half of the wave length."

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16:59 1 The ACER manual was actually the Bureau of  
 2 Reclamation memorandum that we looked at earlier. And  
 3 Pakistan obviously has no objection to that,  
 4 particularly its statement that concrete dams like the  
 5 RHEP require no more than a 1.1-metre parapet wall by  
 6 way of freeboard in the default position.  
 7 But the Indian Commissioner then continues:  
 8 "In the instant case, [Full Pondage Level] and  
 9 MWL ..."  
 10 That's "maximum water level", or high flood level:  
 11 "... are identical."  
 12 So no surcharge storage.  
 13 This actually perhaps answers Professor Buytaert's  
 14 question. 1.1 metres does not include surcharge  
 15 storage, otherwise Pakistan wouldn't be advocating for  
 16 1.1 metres in circumstances where there is no surcharge  
 17 storage. If there was surcharge storage planned for the  
 18 design, there would be more that was perhaps required.  
 19 The Indian Commissioner then continues:  
 20 "As such, when the gates are in position at [the  
 21 Full Pondage Level] the spillway bridge beams have to be  
 22 adequately clear of the wave splashes generated due to  
 23 wind. As such, from a practical consideration, the  
 24 provided freeboard of 2.0 m is bare minimum."  
 25 So here the Indian Commissioner is stating that the

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17:01 1 freeboard is not subject to further regulation. That's  
 2 rather odd, in our submission, when Professor Lafitte  
 3 reached the opposite conclusion, and India has been  
 4 happy to follow Professor Lafitte on pretty much  
 5 everything else.  
 6 But then we've got a further statement:  
 7 "Further, Indian side mentioned that keeping the  
 8 bearings of the bridge below the [Full Pondage Level] is  
 9 neither advisable nor an adopted practice throughout the  
 10 world. There is no scope for reduction of depth of  
 11 girder either which has been kept as bare minimum from  
 12 structural point of view to keep the deflections within  
 13 permissible limit. The freeboard provided by India is  
 14 bare minimum from practical point of view as the girder  
 15 depth under spillway-bridge ... cannot be reduced below  
 16 1.70 m from structural considerations."  
 17 And then we've got two further statements:  
 18 "There cannot be any credible argument for keeping  
 19 the bearings submerged in water by keeping them below  
 20 [Full Pondage Level]. It is a worldwide practice to  
 21 provide freeboard of about 2 m wherever crest gated  
 22 spillways are provided."  
 23 I'll come on to the first statement in a moment, but  
 24 the second is very curious in its own right. No  
 25 evidence for it is provided, and it takes no account of

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17:00 1 full pondage level and the maximum water level are the  
 2 same, so there's no surcharge storage in the design.  
 3 Pakistan agrees, however, that the need for surcharge  
 4 storage is a relevant consideration when calculating  
 5 freeboard height.  
 6 The Indian Commissioner then mentions a further  
 7 consideration, which is that the spillway bridge  
 8 beams -- so the supports for the bridge that crosses the  
 9 spillway at the top of the dam -- need to be insulated  
 10 from splashes, and that this justifies adding a further  
 11 metre to the top of the dam.  
 12 (Slide 34) Let's turn now to the 110th meeting  
 13 (P-24), which sees a slight evolution in India's  
 14 position. Again, this is on the slide:  
 15 "Regarding freeboard provision, ICIW mentioned that  
 16 with crest gate top at Full Pond Level ... there is no  
 17 possibility to raise [the] water level artificially."  
 18 This is a reflection of the fact that the RHEP  
 19 design includes multiple spillways: a main orifice  
 20 spillway with five bays, and an auxiliary crest-gated  
 21 spillway with a single bay and a gap at the top of the  
 22 gate at the full pondage level.  
 23 So because of that gap, the Indian Commissioner  
 24 seems to be saying, the RHEP design is ex facie  
 25 paragraph 8(a)-compliant, and the height of the RHEP

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17:02 1 what we already know to be the standard recommendation  
 2 for a concrete dam by the Bureau of Reclamation, which  
 3 is that such a dam requires a 1.1-metre parapet wall and  
 4 nothing else.  
 5 And then a final statement:  
 6 "PCIW requested ICIW ... details/drawings of the  
 7 girder for examination. Indian side mentioned that  
 8 details have already been explained to Pakistan side."  
 9 So Pakistan's Commissioner asks for some drawings of  
 10 the bridge so he can better appreciate India's position,  
 11 and the Indian Commissioner says that all Pakistan's  
 12 Commissioner is getting is a verbal explanation.  
 13 (Slide 35) So if we can boil down India's case on  
 14 freeboard to three core propositions, based on these  
 15 meeting minutes.  
 16 The first proposition is that paragraph 8(a) does  
 17 not regulate freeboard, and the design of  
 18 an Annexure D.3 HEP will be paragraph 8(a)-compliant  
 19 merely if it includes a free overflow feature at the  
 20 full pondage level.  
 21 Second, if paragraph 8(a) does regulate freeboard,  
 22 then wind setup and wave run-up are material concerns,  
 23 and Indian standards may be taken into account for the  
 24 purposes of determining permissible height.  
 25 Third, if paragraph 8(a) does regulate freeboard,

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17:04 1 then the presence of structures at the top of the dam,  
 2 such as spillway bridges, but presumably other  
 3 facilities as well, and the need to protect them from  
 4 wave splash, justifies the further raising of the  
 5 freeboard.  
 6 Now, Pakistan considers each of these propositions  
 7 to be wrong to a greater or lesser extent.  
 8 So on India's logically antecedent position that  
 9 paragraph 8(a) does not regulate freeboard, that's  
 10 plainly wrong, for the reasons given by Professor  
 11 Lafitte in Baglihar. If India were to insert stoplogs  
 12 into the RHEP's gated spillway or add additional height  
 13 to the spillway gates, the gap that that spillway relies  
 14 on to render it paragraph 8(a)-compliant would be  
 15 diminished or eliminated, and its operator could easily  
 16 fill the operating pool above the full pondage level,  
 17 breaching paragraph 8(a). Freeboard regulation  
 18 minimises the potential for such abuse, and is therefore  
 19 a logical and necessary element of paragraph 8(a).  
 20 On India's second position, that wind setup and wave  
 21 run-up are material concerns when setting freeboard  
 22 height, Pakistan agrees with the basic proposition. And  
 23 I would add to that such other concerns as I mentioned,  
 24 concerning type of dam, flood conditions, surcharge  
 25 storage, reservoir operations, and so on and so forth.

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17:06 1 bridges eroding? Build them out of concrete like the  
 2 rest of the dam. Still worried about the few remaining  
 3 metal components? Provide proper coatings and undertake  
 4 proper maintenance and repair. Still -- for reasons  
 5 that pass understanding -- concerned about the longevity  
 6 of the bridge? Move the beams out of the way so that  
 7 they are no longer submerged.  
 8 Put simply, India's design convenience does not  
 9 allow it to increase the height of its Western Rivers  
 10 HEPs' freeboard.  
 11 Paragraph 8(a), as I have demonstrated, is intended  
 12 to place firm limits on India's capacity to store the  
 13 waters of the Western Rivers. This is consistent with  
 14 the controlling injunction of Article III generally, and  
 15 the deep suspicion of storage reflected in  
 16 Article III(4).  
 17 India's choice of bridge design at the RHEP, or any  
 18 other site for that matter, does not trump Pakistan's  
 19 rights under Article III, which rights form the  
 20 essential gravamen of the Treaty so far as the Western  
 21 Rivers are concerned, as Professor Webb has shown. And  
 22 the fact that India is driven to argue in multiple  
 23 meetings of the Commission that its design convenience  
 24 does trump Article III shows, with respect, the poverty  
 25 of its position.

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17:05 1 But where Pakistan parts ways with India -- alluding  
 2 to Mr Minear's point -- is with India's reliance on  
 3 standards that it sets itself. These are within the  
 4 unilateral control of India and cannot be the sole basis  
 5 of its position.  
 6 Now, Pakistan isn't necessarily hostile to Indian  
 7 standards, but it would hope and expect that the Indian  
 8 standard would be corroborated by an accepted  
 9 international benchmark -- be it ICOLD, US Army Corps of  
 10 Engineers, US Bureau of Reclamation -- before that  
 11 standard, the Indian standard, could constitute  
 12 an objective metric by which freeboard could be  
 13 assessed.  
 14 Then on India's third position, that structures on  
 15 top of the dam may justify an increase in freeboard  
 16 height, Pakistan disagrees with this position. In no  
 17 international standard of which Pakistan is aware are  
 18 such concerns considered material. The reason for this  
 19 is that freeboard is intended to guarantee the safety of  
 20 the dam as a whole. It is not intended to improve the  
 21 longevity of additional structures such as bridges by  
 22 preventing them from getting wet.  
 23 This is, a fortiori, moreover, in circumstances  
 24 where multiple Treaty-compliant workarounds are  
 25 available to India. You're concerned about the spillway

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17:08 1 (Slide 36) I think I can leave India's position  
 2 there and turn now to the final part of Pakistan's  
 3 position on freeboard: providing an answer to the  
 4 Court's question.  
 5 (Slide 37) We've come full circle. It's now back on  
 6 the slide for you:  
 7 "With respect to Annexure D, paragraph 8(a), what is  
 8 to be taken into account for the purposes of designing  
 9 the freeboard of a plant and what is to be excluded?"  
 10 (Slide 38) You'll recognise this diagram, or at  
 11 least the format.  
 12 The first part: what is to be taken into account?  
 13 I've already answered this. It is the safety factors  
 14 I have mentioned earlier, as defined by reference to the  
 15 applicable international standards. And these reflect  
 16 the serious and material safety concerns that freeboard  
 17 is intended to address; concerns that, if not  
 18 appropriately weighed, can endanger the dam itself, and  
 19 everything and everyone downstream.  
 20 So just to remind you of what they are -- you've got  
 21 them on the slide -- type of dam, type of spillway, need  
 22 for flood surcharge, flood conditions, wind and wave  
 23 conditions, seismicity, geological conditions, reservoir  
 24 operations. And all of this is under the umbrella of  
 25 the first item, which is the need to minimise freeboard

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17:09 1 within safe limits.  
 2 Now, despite their seriousness, when dealing with  
 3 a concrete dam, this will usually result in a fairly  
 4 limited freeboard. Again, I recall in this respect the  
 5 Bureau of Reclamation's guidance that a concrete dam  
 6 will, as a default, require only a 1.1-metre parapet  
 7 wall by way of freeboard.  
 8 But turning now to the second part of the Court's  
 9 question: what is to be excluded? The obvious answer  
 10 is: anything that is not expressly included or required  
 11 by necessary implication. But a more specific answer  
 12 could be: any factor not intended to guarantee the  
 13 safety of the dam as a whole; and in particular,  
 14 considerations arising from structures that India wishes  
 15 to situate atop the dam. If India does want to build  
 16 such structures, it can select designs approaches that  
 17 are Treaty-compliant. Paragraph 8(a) does not exist to  
 18 service India's design convenience.  
 19 Members of the Court, thank you for bearing with me.  
 20 This concludes Pakistan's submissions on paragraph 8(a)  
 21 of Annexure D and the question of freeboard. Unless you  
 22 have any further questions for me or I can assist you  
 23 further, those are my submissions.  
 24 Professor Buytaert.  
 25 THE CHAIRMAN: Professor Buytaert.

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17:11 1 I heard you earlier say perhaps you would hold off till  
 2 tomorrow. So what's your preference?  
 3 SIR DANIEL: Mr Chairman, if we can get it done today,  
 4 I think it would be useful to do so. My submissions  
 5 I think are around 20 minutes, maximum 25 minutes.  
 6 We've got time to do it tomorrow. So it really depends  
 7 on whether there is a guillotine at 5.30 precisely or  
 8 whether you will allow me a couple of minutes if I go  
 9 over.  
 10 THE CHAIRMAN: I don't think it's a problem to go a couple  
 11 of minutes over, so I would say let's go ahead and  
 12 proceed.  
 13 SIR DANIEL: Thank you.  
 14 (5.12 pm)  
 15 Submissions on Situating the Calculation of Pondage  
 16 within the Scheme of the Treaty  
 17 SIR DANIEL: Thank you very much, Mr Chairman, members of  
 18 the Court.  
 19 Before we end the day, I would like just to make  
 20 some brief remarks on the subject of pondage, really to  
 21 build a bridge to the submissions that we will hear from  
 22 Dr Miles tomorrow on the subject. And you will have him  
 23 on his feet for two and a half-plus hours in the morning  
 24 and then he'll be back just after lunch to address you  
 25 on your written questions relating to the redesign of

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17:10 1 (5.10 pm)  
 2 Questions from THE COURT  
 3 PROFESSOR BUYTAERT: Thank you, Dr Miles. If you could  
 4 perhaps go back to your previous slide (38); I think  
 5 that's the best one to illustrate.  
 6 My question is: if India were to argue that climate  
 7 change affects a lot of these factors and introduces  
 8 an additional factor of uncertainty that requires, for  
 9 example, a larger freeboard, would that be a relevant  
 10 factor for Pakistan; and if so, where in this graphic or  
 11 in this schema would that come in?  
 12 DR MILES: Speaking, as always, under the control of my  
 13 engineering colleagues, I believe that would probably  
 14 come into flood conditions, which are already included  
 15 there. You may see a situation in which you see  
 16 slightly larger floods in climate change times, and that  
 17 would need to be included. So I think it's already  
 18 included in the matrix here.  
 19 PROFESSOR BUYTAERT: Thank you.  
 20 THE CHAIRMAN: Okay, I think we don't have any further  
 21 questions. Thank you, Dr Miles, very much for your  
 22 presentation.  
 23 DR MILES: Thank you, sir.  
 24 THE CHAIRMAN: So, Sir Daniel, we originally had you on for  
 25 saying something at the end of the day, but I thought

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17:13 1 the Neelum-Jhelum plant and the Baglihar plant. So this  
 2 is really a bridge to his day tomorrow.  
 3 I note also that unless, Mr Chairman, you signal  
 4 that you are entirely satisfied with what you hear both  
 5 from me now and from Dr Miles tomorrow on the subject of  
 6 Pakistan's case on pondage in the Baglihar proceedings,  
 7 we will come back to this in closer detail next week, as  
 8 it has certainly been evident from your questions over  
 9 the course of the last few days that the Court has some  
 10 interest in the change, the modification in Pakistan's  
 11 approach to the methodology of the calculation of  
 12 maximum allowable pondage that Pakistan has advanced in  
 13 these proceedings and the approach that it advanced in  
 14 the Baglihar case.  
 15 So if you wish to give us a steer after Dr Miles  
 16 tomorrow as to whether we've satisfied your curiosity or  
 17 you'd like us to come back with greater detail, that  
 18 would be very helpful.  
 19 Now, I'll come back to this modification in  
 20 methodology in just a moment. But I'd like to begin,  
 21 though, with Professor Buytaert's concluding question to  
 22 Mr Rae yesterday, which provides a useful way into the  
 23 subject of pondage.  
 24 Professor Buytaert, you put the following question  
 25 to Mr Rae yesterday, and I'm quoting from the

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17:14 1 transcript, Day 3, page 106, lines 8 to 14. You said:  
 2 "So you very clearly sketched the evolution towards  
 3 more renewables. How would the design of a plant and  
 4 pondage in particular -- or how does that inform the  
 5 calculation of pondage? Is there any established  
 6 methodology to deal with the inevitable uncertainty of  
 7 future changes in demand and variability?"  
 8 That was your question. Mr Rae responded as  
 9 follows:  
 10 "I would say this is an area which is changing  
 11 extremely rapidly within the industry, and there is  
 12 a lot -- so I can't say that there's any one accepted  
 13 methodology yet. I would say that it's changing so  
 14 dynamically that almost month by month, people are  
 15 coming up with different ideas of how to do this."  
 16 And that's transcript Day 3, page 106, lines 15  
 17 to 20.  
 18 Mr Rae then went on to give a fuller explanation of  
 19 the issues associated with undertaking a pondage  
 20 calculation in which, as he put it, you are "trying to  
 21 match variable power with variable production" in  
 22 circumstances in which one is trying to "match pondage  
 23 with an eco-flow study". And this is at transcript  
 24 Day 3, page 107, lines 1 to 14.  
 25 Now, this question and answer at the end of Mr Rae's

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17:17 1 will come back to this in a great deal of detail.  
 2 For reasons of time, I won't ask you to turn these  
 3 up again now; and you will, in any event, already be  
 4 familiar with them. But you may nonetheless, in advance  
 5 of Dr Miles's submissions tomorrow morning on pondage,  
 6 like to refresh your memory of the definition of the  
 7 term "Firm Power", which is given in paragraph 2(i) of  
 8 Annexure D, and the meaning given to "Pondage" in  
 9 paragraph 2(c). There's also the meaning given to "Dead  
 10 Storage" and "Dead Storage Level" at paragraph 2(a), and  
 11 the formulation of the design criterion in respect of  
 12 the maximum allowable pondage in paragraph 8(c). There  
 13 are other pertinent provisions that will be important,  
 14 but these are the key ones.  
 15 So going back to Mr Rae's submissions of yesterday,  
 16 which I've just read out to you, he said -- and I read  
 17 his statement again -- he said:  
 18 "... critically, the Indus Waters Treaty adopts  
 19 a formula that simplifies this computation of the firm  
 20 power ..."  
 21 That's the computation for firm power in  
 22 paragraph 2(i) of the Treaty:  
 23 "... by establishing the flow rate that will be used  
 24 to calculate the firm power. And this simplification  
 25 allows for the definition of firm power without

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17:16 1 submissions followed earlier submissions by Mr Rae in  
 2 which he was careful to explain that, in contrast to the  
 3 normal use of the terms "Pondage" and "Firm Power", as  
 4 he was discussing them:  
 5 "... critically, the Indus Waters Treaty adopts  
 6 a specific formula that simplifies this computation of  
 7 the firm power by establishing the flow rate that will  
 8 be used to calculate the firm power. And this  
 9 simplification allows for the definition of firm power  
 10 without resorting to a generation planning analysis or  
 11 any other assumptions. So effectively it has removed  
 12 this process from being under the remit of the Treaty."  
 13 That's transcript Day 3, page 75, lines 3 to 10.  
 14 Mr Chairman, members of the Court, this provides  
 15 a useful platform for me to make some initial framing  
 16 observations for the submissions to come from Dr Miles  
 17 on pondage.  
 18 The key terms in the Treaty addressing pondage and  
 19 the calculation of maximum allowable pondage are given  
 20 a special meaning in the Treaty, being used in  
 21 a Treaty-specific way that is entirely different from  
 22 the way in which these terms are used in normal  
 23 engineering practice. And I think you've heard this  
 24 from me in overview previously, I think it's also  
 25 a topic that Professor Webb has addressed, and Dr Miles

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17:19 1 resorting to a generation planning analysis or any other  
 2 assumptions. So effectively it has removed the process  
 3 from being under the remit of the Treaty."  
 4 Now, Mr Rae put his finger on a number of important  
 5 points in this exchange and brief statement. First, the  
 6 key terms of the Treaty, in particular with regard to  
 7 pondage and the calculation of the maximum allowable  
 8 pondage, are given special meanings. Second, the  
 9 purpose of these special meanings is to address the  
 10 possibility of uncertainty arising in respect of the  
 11 meanings given to these terms that might otherwise  
 12 result from normal engineering usage. And third,  
 13 flowing from this, the purpose of the special meanings  
 14 is to reduce complexity and to simplify the definition  
 15 for computational purposes. And this is also going to  
 16 be relevant when I come to explain the very slight  
 17 modification in Pakistan's position.  
 18 As Mr Rae said, with respect to the definition of  
 19 firm power, which is at the very heart of the  
 20 calculation of pondage -- the calculation of pondage in  
 21 8(c) refers back to firm power, as you'll recall -- firm  
 22 power under the Treaty is tied to the flow rate of the  
 23 river. This makes the calculation that is required for  
 24 the calculation of firm power much more straightforward  
 25 than it might otherwise have been.

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17:20 1 Now, I'm not going to invite you to cross-examine me  
 2 on these issues now, because Dr Miles will unpack this  
 3 further in his submissions tomorrow. The points with  
 4 which I'd like to leave you from this excursus into the  
 5 exchange with Mr Rae are three.  
 6 First, his observation on the rapidly changing  
 7 dynamic with regard to the calculation on pondage in the  
 8 case of non-Treaty issues does not apply to the approach  
 9 of the Treaty to the calculation of pondage. That  
 10 dynamic change that he was referring to does not apply  
 11 in the case of the Treaty. Second, as Mr Rae  
 12 emphasised, the Treaty accords special meaning to the  
 13 key terms with which we are concerned. And third, the  
 14 special meanings are intended to and have the effect of  
 15 simplifying the calculation that was required.  
 16 Mr Chairman, members of the Court, I'd like to move  
 17 on to make some brief observations on the issue of the  
 18 dispute with respect to pondage and the change in  
 19 Pakistan's method of calculation from its Baglihar  
 20 submissions to the method of calculation that we have  
 21 put forward in the Memorial in these proceedings.  
 22 Mr Chairman, as I go through this list, if there are  
 23 issues that we have misperceived, or there are other  
 24 issues in your minds on this point, please do identify  
 25 them for us. But as we apprehend it, there are four

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17:23 1 Pakistan's Baglihar submissions. If you would like us  
 2 to go into these issues, we will happily do so next  
 3 week.  
 4 Then I pause here just to say that although I and  
 5 we anticipate that this is not what is driving your  
 6 enquiry, if you consider that, for competence reasons,  
 7 you should be seized of the technical detail of  
 8 Pakistan's methodology that was used at the point at  
 9 which Pakistan filed its Request for Arbitration on  
 10 19 August 2016, we can include our contemporaneous  
 11 computational methodology as part of our final  
 12 submissions and address them to you in detail next week,  
 13 just to shine a light a little bit more brightly on  
 14 that.  
 15 We are not entirely sure whether your questions  
 16 about Baglihar methodology are being driven by  
 17 an interest relating to competence, or whether it's  
 18 a question that is being driven by an interest in  
 19 knowing what our methodology was and why it changed, so  
 20 that you can better inform yourself when you come to  
 21 undertake that computation.  
 22 THE CHAIRMAN: Perhaps I'll just note that I believe our  
 23 interest was the latter and not the former. I don't  
 24 know whether perhaps Pakistan connected the questions  
 25 relating to competence to this issue, but that wasn't,

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17:22 1 issues that arise with respect to the Baglihar enquiry  
 2 that you have articulated so far.  
 3 They are, first of all: is the dispute of which you  
 4 are seized the same dispute expressed in Pakistan's  
 5 Request -- now its Amended Request -- for Arbitration?  
 6 We're not quite sure whether that is one of the issues  
 7 in your mind or whether we are misperceiving it on our  
 8 side of the podium.  
 9 Second, what is the reason that pushed Pakistan to  
 10 modify the methodology of its calculation from that  
 11 advanced in the Baglihar proceedings?  
 12 Third, what implications does this modification of  
 13 methodology have for Pakistan's case in these  
 14 proceedings?  
 15 Then fourth, what are the technical details of the  
 16 pondage calculation that Pakistan advanced in the  
 17 Baglihar proceedings as a learning exercise, if I can  
 18 put it in those terms?  
 19 That's the universe of points of enquiry that we've  
 20 taken from your questioning of us over the course of the  
 21 last few days.  
 22 I will begin a discussion on these issues, but I'm  
 23 only going to respond, certainly at the moment, on the  
 24 first three questions. I will not step into the  
 25 technical issues of the calculation at the heart of

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17:25 1 I think, our intention.  
 2 Our intention, in terms of competence, was simply to  
 3 try to understand: when Pakistan believes that a prior  
 4 decision of the Neutral Expert is or is not binding, we  
 5 were attempting to understand whether it mattered  
 6 whether it had been appealed or not appealed. And we  
 7 were not, in that context, thinking back to the Baglihar  
 8 Neutral Expert determination with respect to our own  
 9 competence.  
 10 SIR DANIEL: Thank you very much, Mr Chairman. I think that  
 11 that's very helpful, and it may make some of what I'm  
 12 about to say a little bit beside the point. I'll make  
 13 them in any event, just for completeness. I think we  
 14 had understood it the way that you have just explained  
 15 it, but we wanted to make sure that we were not  
 16 misunderstanding.  
 17 What may, though, be interesting and useful and  
 18 illuminating to you, before I come to address the slight  
 19 modification in methodology, is to compare the various  
 20 pondage values in respect of the Baglihar plant that  
 21 were advanced in and subsequent to those proceedings, to  
 22 actually get a sense of what the changing computational  
 23 methodology actually led to or would achieve.  
 24 So first of all, going into the Baglihar  
 25 proceedings, India's calculation advanced as part of its

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17:26 1 case in Baglihar was for a maximum pondage of  
 2 37.722 million cubic metres. Pakistan's calculation,  
 3 going into the Baglihar proceedings, advanced a case for  
 4 a maximum of 6.22 million cubic metres. That was the  
 5 big divide between India and Pakistan at the same time.  
 6 The Neutral Expert's determination in the Baglihar  
 7 case settled on a maximum allowable pondage of  
 8 32.56 million cubic metres, so slightly less than that  
 9 advanced by India. India was 37.722; the Neutral Expert  
 10 settled on 32.56. So slightly less than India's, but  
 11 not by much, but still significantly at odds with that  
 12 advanced by Pakistan.  
 13 As Dr Miles will address, the Neutral Expert in  
 14 Baglihar varied India's calculation methodology  
 15 marginally. And following the Baglihar determination,  
 16 India has adopted the Neutral Expert's approach, which  
 17 it maintains today.  
 18 On the basis of Pakistan's simplified calculation of  
 19 maximum allowable pondage that we have put before you in  
 20 these proceedings, advanced in the Memorial, the  
 21 Baglihar maximum pondage would have been 5.43 million  
 22 cubic metres, and that's a contrast to 6.22 as we  
 23 advanced it in our Baglihar submissions. In other  
 24 words, it was a little bit less: broadly the same,  
 25 a little bit less, but not by much. But it was

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17:30 1 2(c) and paragraph 15 into the calculation of maximum  
 2 allowable pondage, while using the installed capacity of  
 3 the plant.  
 4 Pakistan, on the other hand, considers that the  
 5 paragraph 8(c) criterion is the critical provision, and  
 6 that incorporates the definition of "Firm Power" in  
 7 paragraph 2(i); and that the operational constraints of  
 8 paragraph 15 must be referred to only for the purpose of  
 9 assessing whether the HEP will be capable of working  
 10 within the prescribed design criteria.  
 11 The constant element in Pakistan's position has been  
 12 that the pondage is to allow the plant to operate at  
 13 firm power. So there is a very clear divide in the  
 14 methodology that Pakistan and India have been deploying  
 15 or resorting to over the years.  
 16 The parties are also in dispute about the relevance  
 17 of load to the calculation of pondage. India says that  
 18 it is entitled to a level of pondage that will enable  
 19 them to meet the demand requirements of the Indian  
 20 electricity grid, and that portion of the load that they  
 21 wish to place on the particular HEP in question; one of  
 22 the reasons why we've been so interested in the  
 23 questions from the Court on load.  
 24 Pakistan contests this approach. As both Dr Morris  
 25 and Mr Rae explained, the bespoke definition of "Firm

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17:28 1 significantly at odds both with India's initial  
 2 calculation and with the Neutral Expert's determination,  
 3 which India has now adopted.  
 4 So this then brings me to the first of my issues: is  
 5 the dispute of which you are seised the same dispute  
 6 expressed in Pakistan's Request for Arbitration? And  
 7 the answer is unequivocally yes. And I expect that you  
 8 will have this very much in mind, because when you  
 9 addressed in your Competence Award the evolution of the  
 10 dispute, you addressed many of these exchanges.  
 11 As I mentioned yesterday, this was addressed  
 12 expressly in paragraphs 11.1 to 11.4 of Pakistan's  
 13 Memorial. In the interests of time, I don't propose to  
 14 read these into the record, but you will find the issue  
 15 addressed succinctly at that point.  
 16 The key takeaway is that the contours of the  
 17 parties' respective positions on the calculation of  
 18 pondage, and what is relevant for purposes of that  
 19 calculation and what is excluded, are essentially  
 20 unchanged over the years. India does not conceive of  
 21 its right to generate hydroelectrical power as  
 22 an exception to Pakistan's right of unrestricted use.  
 23 India also draws on the definition of "Pondage" in  
 24 paragraph 2(c) for purposes of its calculation, and on  
 25 the operational provisions in paragraph 15. It draws

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17:31 1 Power" ties the calculation of pondage to the hydrology  
 2 of the river, not to the demands of India's electricity  
 3 grid.  
 4 So once again, we have a very stark divide between  
 5 the parties.  
 6 And indeed, if it was tied to the demands and the  
 7 variability of demand of India's electricity grid and  
 8 the HEP's place within it, our concern is that India  
 9 would be able to manipulate the pondage calculation as  
 10 it saw fit.  
 11 In addition, as Ms Rees-Evans explained at the end  
 12 of her presentation on Tuesday, the evolution of the  
 13 Treaty drafts on this point supports a clear move away  
 14 from the relevance of load as part of the pondage design  
 15 criterion. And I think that was some of the exchanges  
 16 between Ms Rees-Evans and Mr Minear.  
 17 That the dispute that is addressed in Pakistan's  
 18 Memorial is the dispute of which you are seised by  
 19 Pakistan's Request for Arbitration is also demonstrable  
 20 by reference to the formulation of Pakistan's objection  
 21 to India's approach to pondage from its very inception,  
 22 in 1992, in the context of the then proposed Baglihar  
 23 plant, all the way through to its statement of objection  
 24 in the Request for Arbitration, to the way in which it  
 25 is addressed in Pakistan's Memorial.

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17:33 1 I won't take you to any of the documents, but I drew  
 2 your attention yesterday, if I recall correctly -- time  
 3 has gone in a little bit of a blur -- but I drew your  
 4 attention to Pakistan's objection to India's Baglihar  
 5 proposal on 12 August 1992. That was an exchange of  
 6 correspondence from the PCIW to the ICIW. This is  
 7 Exhibit P-0586. And this was the point at which  
 8 Pakistan first set out its objection to India's  
 9 methodology for the calculation of pondage.  
 10 As I say, I won't take you to that, in the interests  
 11 of time, but I do refer you to paragraph 5 of that  
 12 letter, the 1992 letter. And as you will see when you  
 13 turn it up, that letter puts forward Pakistan's  
 14 objection to India's approach to pondage in terms that  
 15 could simply have been cut-and-pasted into Pakistan's  
 16 Memorial in these proceedings. So from that point, in  
 17 August 1992, until today, 32 years later, there has been  
 18 a consistency in Pakistan's view, and indeed  
 19 a consistent opposition of the parties on the question  
 20 of methodology.  
 21 So what this shows is that the dispute between  
 22 Pakistan and India on this point is not a dispute over  
 23 the fine detail of the calculation but a far more  
 24 fundamental dispute concerning the actual premise of the  
 25 calculation itself. In other words, the dispute is

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17:34 1 whether the basis of the pondage calculation is "Firm  
 2 Power" within the meaning of paragraph 8(c) and  
 3 paragraph 2(i) of Annexure D, as Pakistan contends, or  
 4 whether the calculation must take into account the need  
 5 to meet a fluctuating load on the plant, rooted in  
 6 paragraph 2(c) and paragraph 15 of Annexure D, as India  
 7 contends.  
 8 This dispute persisted through the Baglihar Neutral  
 9 Expert determination process and in exchanges between  
 10 the Commissioners in the PIC subsequently. It is also  
 11 expressed in Pakistan's Request -- now its Amended  
 12 Request -- for Arbitration, in particular at  
 13 paragraphs 47 to 56, and paragraphs 63 to 64. So once  
 14 again, you can see a golden thread running from 1992 in  
 15 the exchanges between the parties on this question of  
 16 the calculation methodology.  
 17 This brings me to my second issue, which is: what is  
 18 the reason that pushed Pakistan to modify the  
 19 methodology of its pondage calculation from that which  
 20 it advanced in the Baglihar proceedings? And I note,  
 21 first of all, that there is only a relatively small  
 22 modification in Pakistan's methodology of calculation in  
 23 respect of the operating presumption in respect of which  
 24 firm power should be presumed for purposes of the  
 25 calculation.

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17:36 1 In the Baglihar case -- and I appreciate that the  
 2 Court already has this, because it's evident from the  
 3 questions that you put to us -- but in the Baglihar  
 4 case, Pakistan premised its operationalisation of  
 5 paragraph 8(c) on the idea that it required pondage  
 6 sufficient to allow for constant firm power; in other  
 7 words, firm power for 24 hours a day, 7 days a week.  
 8 That was the basis of the calculation that Pakistan  
 9 advanced at that stage: 24 hours, 7 days a week,  
 10 constant firm power.  
 11 After Baglihar, as one would expect, Pakistan went  
 12 back to the drawing board; and more particularly, in the  
 13 context of the preparation for these proceedings, which  
 14 had been paused for all of those years, and Pakistan  
 15 concluded that there was too much complexity in the  
 16 calculation that it had advanced previously, and too  
 17 much variability in the outcome of the calculation, to  
 18 make it a sensible approach to the calculation of  
 19 maximum allowable pondage under the Treaty. And given  
 20 this appreciation, Pakistan modified the methodology of  
 21 calculation, informing its revised approach both by  
 22 a legal interpretation of the construction of the Treaty  
 23 as well as an engineering appreciation.  
 24 Just to illuminate this a little further, I note  
 25 that one of the challenges with the position that

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17:38 1 Pakistan advanced in the Baglihar proceedings was that  
 2 it did not produce a fixed and unique pondage figure for  
 3 each HEP. Rather, it produced a range of possible  
 4 numbers from which a correct figure then had to be  
 5 selected.  
 6 As you will have seen from our Memorial, and as  
 7 Dr Miles will address with you in some very precise  
 8 detail, one of the driving considerations that we have  
 9 concluded needs to be at the heart of the calculation of  
 10 pondage is that it needs to come up with a number  
 11 certain for each HEP. Otherwise it just introduces  
 12 complexity, uncertainty and dispute.  
 13 There are other reasons for preferring our modified  
 14 approach to the calculation, which I need not go into  
 15 now, but we'd be happy to do so. It may be that  
 16 Dr Miles will touch upon them in the course of his  
 17 submissions tomorrow; otherwise we would be happy to do  
 18 so and come back to them in detail next week.  
 19 So this brings me -- and I'm about to conclude --  
 20 but it brings me to my third issue, namely: what  
 21 implications, if any, does this modification in  
 22 Pakistan's approach have for the calculation of maximum  
 23 allowable pondage in these proceedings?  
 24 The short answer, Mr Chairman, members of the Court,  
 25 is that it has no implications, as you have before you,

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17:39 1 in Pakistan's Memorial, Pakistan's best and most  
 2 carefully considered statement of what it submits is the  
 3 correct approach to the calculation of maximum allowable  
 4 pondage under paragraph 8(c).  
 5 I add that in reaching this view, Pakistan, together  
 6 with its internal and external engineering teams and its  
 7 internal and external legal teams, looked again at every  
 8 possible approach that we could possibly conceive of,  
 9 including that advanced by India and that adopted by the  
 10 Baglihar Neutral Expert, for purposes of coming up with  
 11 what Pakistan would consider to be the most compelling  
 12 approach to the interpretation of paragraph 8(c). We've  
 13 been very conscious that what we were addressing you on  
 14 in writing in the Memorial and what we are addressing  
 15 you on now orally and what we are asking of you is  
 16 a systemic interpretation of 8(c). And particularly  
 17 with the absence of the Respondent, we took it as  
 18 a guiding principle that we needed to be as rigorous and  
 19 as transparent as possible in coming up with our  
 20 calculations.  
 21 Now I come back to, as it were, the offer that  
 22 I made at the beginning, and with this I will close.  
 23 If, Mr Chairman, members of the Court, you would like us  
 24 to address the technical detail of the Baglihar  
 25 calculation in the second round, we would be happy to do

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17:42 1 generally speaking, it just would be interesting to hear  
 2 perhaps a little bit more about that.  
 3 But I'll let you think about that and look forward  
 4 to the presentations tomorrow.  
 5 SIR DANIEL: I'm sure Dr Miles will be able to address that.  
 6 And to the extent that there are any dangling elements  
 7 to that, we can come back to that next week.  
 8 THE CHAIRMAN: Very good. In which case I think we are done  
 9 for the day and we will see you again tomorrow morning  
 10 at 9.30.  
 11 SIR DANIEL: Thank you very much.  
 12 THE CHAIRMAN: Thank you.  
 13 (5.43 pm)  
 14 (The hearing adjourned until 9.30 am the following day)  
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17:40 1 so. We would have to work it up, but we have the means  
 2 to do so, and I anticipate that we would have the time  
 3 to do so. So if you would find it illuminating or  
 4 informative for purposes of the calculation that you  
 5 have to undertake, we'd be very happy to do that next  
 6 week.  
 7 That brings an end to my submissions, and thank you  
 8 for allowing them to go on at this point, because  
 9 I think it's a useful bridge to Dr Miles tomorrow.  
 10 THE CHAIRMAN: That's fine, Sir Daniel. Let me just check  
 11 to see if I have any questions from -- no questions.  
 12 I will say I think that it was a very helpful  
 13 explanation you gave. And certainly for my part, I take  
 14 the point that the general approach of Pakistan to  
 15 calculation of pondage has been consistent, and that  
 16 it's more perhaps the fine detail that has changed over  
 17 time.  
 18 I'll be interested in hearing the presentations  
 19 tomorrow. To the extent that you're able to at least  
 20 say a little bit about how, if you were to take your  
 21 current approach for calculation of pondage and modify  
 22 the fine detail to a seven-day approach, whether that  
 23 changes it in any significant way. It sounds like, from  
 24 what you said, it wouldn't: that for Baglihar, it  
 25 wouldn't make much of a difference. And if that's true

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ARBITRATION PURSUANT TO ARTICLE IX AND ANNEXURE G OF THE INDUS WATERS TREATY 1960

Day 4 -- Hearing on the Merits, First Phase

Thursday, 11 July 2024

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