IN THE NEUTRAL EXPERT PROCEEDINGS
UNDER THE INDUS WATERS TREATY 1960
IN RESPECT OF THE RATLE AND KISHENGANGA HYDROELECTRIC PLANTS
(PCA CASE NO. 2023-14)

-between-

THE REPUBLIC OF INDIA

-and-

THE ISLAMIC REPUBLIC OF PAKISTAN

TERMS OF REFERENCE FOR MODELLING SPECIALISTS

Neutral Expert
Mr. Michel Lino

Technical Assistant to the Neutral Expert
Mr. Luc Deroo

Registry
Permanent Court of Arbitration

25 May 2026

1. BACKGROUND

1.1. On 19 September 1960, the Governments of the Republic of India and the Islamic Republic of Pakistan (collectively, the "**Parties**"), together with the International Bank for Reconstruction and Development (the "**World Bank**"), concluded the Indus Waters Treaty 1960 (the "**Treaty**").

1.2. On 4 October 2016, India requested that the World Bank appoint a neutral expert under Paragraphs 4(b)(ii) and 5(c) of Annexure F to the Treaty, in respect of differences between the Parties concerning India's Kishenganga and Ratle Hydroelectric Plants (the "**KHEP**" and the "**RHEP**"), and notified the World Bank of its Statement of "Points of Difference".

1.3. On 13 October 2022, following a "pause" imposed by the World Bank and after consultation with each of the Parties, the World Bank appointed Mr. Michel Lino as the neutral expert in these proceedings (the "**Neutral Expert**") pursuant to Article IX and Annexure F to the Treaty.

1.4. Pursuant to Paragraph 4 of Annexure F to the Treaty, the Terms of Retainer of the Neutral Expert were fixed on 2 May 2023 upon the signature thereof by the Neutral Expert on that date after their signature by the representatives of each Party (the "**Terms of Retainer**").

1.5. Through the Terms of Retainer, the Neutral Expert appointed as his Technical Assistant Mr. Luc Deroo (the "**Technical Assistant**"), who was then CEO and is currently Chief Technical Officer of ISL Ingénierie, a French design and engineering company in the fields of dams, hydraulic and maritime infrastructure, energy, and floods and drought management ("**ISL**"). As Technical Assistant in these proceedings, Mr. Deroo acts in his personal capacity.

1.6. By letter dated 5 June 2023, the Neutral Expert appointed the Permanent Court of Arbitration (the "**PCA**") as Registry and Secretariat of these proceedings. The proceedings are administered by the Vienna Office of the PCA, in cooperation with the PCA's Mauritius office; Ms. Evgeniya Goriatcheva, PCA Senior Legal Counsel, acts as Registrar.

1.7. On 10 February 2023, in advance of a first meeting with the Parties on 27 and 28 February 2023 (the "**First Meeting**"), the Neutral Expert circulated draft supplemental rules of procedure for the Parties' consideration, *inter alia* proposing provisions for the appointment of independent experts to report on specific issues determined by the Neutral Expert. Pakistan commented on this proposal in writing on 17 February 2023, noting that the appointment of such experts would raise certain issues and that, while it did "not preclude the possibility that such experts could serve a useful purpose, it consider[ed] that such issues should be deferred for consideration in due course in the event that the Neutral Expert considers, by reference to some explicitly identified issue, that he would benefit from the appointment of an additional expert adviser."

1.8. At the First Meeting, the Neutral Expert and the Parties further discussed the possibility that, in the course of the proceedings, the Neutral Expert might wish to use or develop physical or numerical models for tests or simulations, including in the preparation of his Synthesis Memorandum. The Neutral Expert indicated that, through the Technical Assistant, Mr. Deroo, he could potentially access ISL's engineering resources, including its expertise in numerical modelling.[1] The Neutral Expert also noted that, in due course, a need might arise to engage an external expert to advise him on some specific matter and that it would therefore be desirable to provide for such possibility in the supplemental rules of procedure. India commented that there was no need to discuss such matters in detail at that stage, but that it was the "prerogative" of the Neutral Expert and that "he may decide on his own" and "at the appropriate time" whether "certain

[1] First Meeting Tr., 28 February 2023 (Day 2), 112:23-114:5.

studies or physical models" are required.[2] Pakistan accepted the possibility that the Neutral Expert might require external assistance, but suggested that the appointment of any external expert be considered if and when needed, on the basis of a concrete proposal.[3]

1.9. On 1 June 2023, having consulted the Parties on a further draft, the Neutral Expert issued the Supplemental Rules of Procedure (the "**Supplemental Rules**"). Paragraph 12 of the Supplemental Rules provides for the appointment of independent experts:

> 12.1 […] The Neutral Expert may, after ascertaining the views of the Parties, also appoint a legal assistant, as well as one or more independent experts to report to him on specific issues to be determined by the Neutral Expert.
>
> 12.2 Before appointing a legal assistant or independent expert, the Neutral Expert shall consult the Parties regarding the identity, qualifications, and impartiality and independence of any candidate.
>
> 12.3 The Neutral Expert shall not delegate his decision-making function to any assistant or expert.

1.10. During the fourth meeting held from 17 to 21 November 2025 (the "**Fourth Meeting**"), the Neutral Expert informed the Parties that he was considering the desirability of appointing "one or several independent experts under section 12 of the [Supplemental Rules], in order to assist with respect to certain circumscribed aspects of the differences that are before [him]."[4] *Inter alia*, the Neutral Expert indicated that, in the light of the applicable timelines, the Neutral Expert and the Technical Assistant might require additional engineering capacity to run simulations.[5]

1.11. By letter dated 10 February 2026, the Neutral Expert informed the Parties that upon reflection, he had determined that it would assist him in the discharge of his functions at this stage of the proceedings to procure additional capacity to carry out numerical modelling in connection with certain of the differences placed before him. The Neutral Expert thus proposed to appoint Mr. David Collomb, Mr. Olivier Barbet and Mr. Salah Shaiek of ISL as modelling specialists, each in charge of a particular modelling software (SRH-1D, Telemac and Ansys CFX, respectively), and circulated their draft terms of reference, proposed scope of work and *curricula vitae* to the Parties for their comments.

1.12. By letters dated 18 February and 2 March 2026, Pakistan provided its comments on the proposed modelling exercise. Pakistan indicated that it accepted the independence and impartiality of the proposed modelling specialists and acknowledged their expertise (with the caveat that they do not have Himalayan Run-of-River HEP design experience). Pakistan also addressed a number of queries to the Neutral Expert, and proposed that the modelling exercise proceed on the basis of a three-stage process.

1.13. By letter dated 13 March 2026, noting that India had not provided any comments on the proposed modelling exercise, the Neutral Expert replied to Pakistan's queries and comments and circulated a further draft of the proposed scope of work, *inter alia* making the following comments:

[2] First Meeting Tr., 28 February 2023 (Day 2), 114:6-24 (Mr. Kushvinder Vohra).
[3] First Meeting Tr., 28 February 2023 (Day 2), 116:6-20 (Sir Daniel Bethlehem KC).
[4] Fourth Meeting Tr., 21 November 2025 (Day 4), 185:12-17.
[5] Fourth Meeting Tr., 21 November 2025 (Day 4), 188:3-12.

1. The Neutral Expert is generally content to proceed on the basis of a three-stage process, as proposed by Pakistan.

2. The Neutral Expert accepts Pakistan's offer to "elaborate a more complete proposed Treaty-compliant alternative design for the RHEP, including relevant design data, that would be amenable to 3D modelling" as a preliminary step to the independent modelling exercise (the "Design Elaboration Stage") (Pakistan's letter dated 2 March 2026, para. 14). The Neutral Expert expects this preliminary step to be very useful, while acknowledging Pakistan's submission that it did not, to date, "advance a complete and holistic design alternative for the RHEP on the basis that the exercise in which the Neutral Expert is engaged should not involve a binary choice between two competing design models, one advanced by India and an alternative advanced by Pakistan" (Pakistan's letter dated 2 March 2026, para. 10).

3. In respect of the second stage of the process—the "Independent Modelling Stage", the Neutral Expert wishes to clarify that the intention is for the Modelling Specialists to leverage their considerable proficiency in the use of the relevant software to implement specific instructions provided by the Neutral Expert and/or the Technical Assistant. The involvement of the Modelling Specialists will accordingly enable the Neutral Expert to carry out modelling that he considers essential for the fulfilment of his mandate under the Treaty, with greater efficiency and at a lower cost than if that modelling were undertaken by the Neutral Expert and the Technical Assistant alone. This may be done in an iterative manner where modelling results may spur the Neutral Expert and/or the Technical Assistant to provide additional instructions to the Modelling Specialists. However, the Neutral Expert does not propose that the Modelling Specialists engage in an evaluation or assessment of any design options for the RHEP and the KHEP, be it from a technical or legal standpoint, or in the aiding of design development. The evaluation or assessment of design options and of the modelling results and their relevance, weight and meaning in connection with the differences at issue in these proceedings is a matter for the Neutral Expert.

4. The Neutral Expert agrees with Pakistan that it would be appropriate and useful to provide the Parties with "the full details of the iterative and developing instructions" given to the Modelling Specialists (Pakistan's letter dated 18 February 2026, para. 8). As set out in the enclosed draft Scope of Work, it is proposed that such instructions be prepared by the Neutral Expert and/or the Technical Assistant in the form of "Assumption Notes", which will be provided to the Modelling Specialists, as well as the Parties.

5. As follows from item 3 above, the Neutral Expert considers that the third stage in the process should not consist of an "Engaged Evaluation Stage", but of a "Results Presentation and Discussion Stage", where the Parties will be given an opportunity to comment on the results of the modelling exercise and to put questions to the Modelling Specialists. The Neutral Expert would envisage, for instance, the following process: (i) the Technical Assistant and the Modelling Specialists would submit a detailed report to the Parties in respect of each calculation, including, as requested by Pakistan, "the model itself, and any iterations thereof, together with all underlying data and directions" (Pakistan's letter dated 2 March 2026, para. 18); (ii) the Parties would comment on the reports in writing; (iii) the Parties would be given an opportunity to put questions to the Modelling Specialists at an on-the-record Neutral Expert Meeting with the Parties; and (iv) the Parties would be given an opportunity to discuss the modelling exercise with the Neutral Expert and the Technical Assistant at that same Meeting. In respect of (iii), the Neutral Expert notes that, while all three Modelling Specialists are proficient in written English, two of the Modelling Experts would answer any questions put by the Parties through interpretation.

6. As also follows from item 3 above, the Neutral Expert does not consider it necessary to instruct the Modelling Specialists on the compliance of any design elements with the Treaty or any other matter regarding the Treaty.

> 7. The Neutral Expert does not foresee a need to go beyond evidence that is, or will be introduced, on the record by the Parties (apart from the Google Earth images of the Baglihar reservoir delta referred to at paragraph 18 of the enclosed draft Scope of Work). Should such need arise, the Neutral Expert will so inform the Parties and seek their views.
>
> 8. The Neutral Expert draws the attention of the Parties to Calculation C, which has been added in the enclosed draft Scope of Work.

1.14. In his letter of 13 March 2026, the Neutral Expert invited the Parties to submit further comments on the modelling exercise by 23 March 2026. This deadline was subsequently extended to 31 March 2026 at Pakistan's request.

1.15. On 31 March 2026, Pakistan submitted further comments on the proposed modelling exercise.

1.16. By letter dated 17 April 2026, noting that India had still not provided any comments on the proposed modelling exercise, the Neutral Expert circulated a further revised version of the modelling specialists' terms of reference and scope of work, as well as the *curriculum vitae* of Mr. Marc Desné of ISL, proposing that he carry out the additional Calculation C (as defined in Section 4.2 below). The Neutral Expert noted that he considered the revised versions of the terms of reference and scope of work to be final or near-final, and invited the Parties to propose specific and realistic deadlines for the steps of the modelling exercise foreseen in those documents.

1.17. By letters dated 30 April and 7 May 2026, Pakistan indicated that it (i) had no further comments on the revised terms of reference and scope of work; (ii) agreed that Mr. Marc Desné of ISL carry our Calculation C; and (iii) provided its comments regarding the scheduling of the modelling exercise. India did not provide any comments on these matters.

2. THE MODELLING SPECIALISTS

2.1. Having regard to the above, Mr. David Collomb, Mr. Olivier Barbet, Mr. Salah Shaiek and Mr. Marc Desné of ISL shall assist the Neutral Expert and the Technical Assistant as modelling specialists in accordance with these Terms of Reference (the "**Modelling Specialists**").

2.2. The Modelling Specialists' contact details are as follows:

2.3. The Modelling Specialists' *curricula vitae* are enclosed as **Annex A** (Mr. Collomb), **Annex B** (Mr. Barbet), **Annex C** (Mr. Shaiek) and **Annex D** (Mr. Desné) to these Terms of Reference.

3. THE MODELLING SPECIALISTS' UNDERTAKINGS

3.1. The Modelling Specialists hereby declare that they will perform their duties honourably and faithfully, impartially and conscientiously, as directed by the Neutral Expert and in accordance with international standards.

3.2. The Modelling Specialists further declare that they are, and shall remain, impartial and independent with respect to each of the Republic of India and the Islamic Republic of Pakistan and that to the best of their knowledge there are no facts or circumstances, past or present, likely to give rise to justifiable doubts with respect to their impartiality or independence.

3.3. The Modelling Specialists affirm that they shall refrain from involvement in any other proceeding or project involving either of the Parties or relating to the subject matter of the present proceedings for the duration of this reference. The Modelling Specialists further affirm that they shall, in perpetuity following this reference, refrain from involvement in any other proceeding or project relating to the KHEP and the RHEP.

4. SCOPE OF WORK

4.1. The purpose of engaging the Modelling Specialists is to augment the capacity of the Neutral Expert and the Technical Assistant to carry out numerical modelling in accordance with the Scope of Work set forth in **Annex E**.

4.2. Specifically, the Modelling Specialists shall assist the Neutral Expert and the Technical Assistant in relation to (i) the modelling of sediment transport in the Chenab River and sediment transport conditions in the future Ratle reservoir ("**Calculation A**" as set out in Annex E), (ii) the modelling of flow patterns occurring in the immediate vicinity of the Ratle dam intake and spillway area ("**Calculation B**" as set out in Annex E), and (iii) the calculation of the sediment volumes deposited in the KHEP reservoir between 2019 and 2021, and between 2021 and 2023 ("**Calculation C**" as set out in Annex E).

4.3. All work shall be carried out by the Modelling Specialists upon specific instructions and under the direct supervision of the Neutral Expert and/or the Technical Assistant. No decision-making function shall be delegated to the Modelling Specialists.

4.4. In accordance with Annex E, the Technical Assistant and the Modelling Specialists will prepare and provide to the Parties a detailed report in respect of each of Calculations A, B and C, including the model used, all underlying data and any directions by the Neutral Expert (the "**Written Reports**").

4.5. The Modelling Specialists may be requested, and shall make themselves available, to review data and materials from the record.

4.6. The Modelling Specialists may be requested, and shall make themselves available, to attend meetings with the Neutral Expert and/or the Technical Assistant, as well as meetings between the Neutral Expert and the Parties.

4.7. The Modelling Specialists confirm their availability to provide the required assistance during the following period: 15 May 2026 – 31 March 2027.

4.8. In addition, the Modelling Specialists confirm that they will attend meetings between the Neutral Expert and the Parties if so requested by the Neutral Expert, including the Fifth Meeting from 8 to 10 June 2026, and any other meeting that the Neutral Expert considers necessary after

ascertaining the views of the Parties and upon consulting the Modelling Specialists regarding its scheduling

4.9. The Neutral Expert reserves the right to modify, supplement, or expand the Modelling Specialists' scope of work in consultation with the Parties as he determines necessary.

5. ESTIMATED COSTS

5.1. The estimated costs for the scope of work as set forth in Annex E (the "**Estimated Costs**"), excluding the attendance of any meetings with the Parties and VAT (if applicable), are as follows:

[redacted]

5.2. The Estimated Costs do not include potential time overruns for model construction and calculation convergence, or any additional simulations beyond those described in Annex E.

5.3. It is understood that the Estimated Costs are provided for information and planning purposes and may be revised or adjusted as a function of time actually spent on the assignment.

6. FEES AND EXPENSES

[redacted]

7. CONFIDENTIALITY

7.1. The Modelling Specialists hereby declare that they will refrain from divulging or using, outside the context of the tasks to be performed by them in these proceedings, any documents, files and information which may come to their knowledge in the course of the performance of their task.

7.2. The Modelling Specialists further declare that they will refrain from making any public comment on the subject matter of the proceedings; the conduct of any aspect of the proceedings; the positions or arguments of the Parties; or the outcome and/or reasoning of any finding or recommendation by the Neutral Expert.

7.3. The Modelling Specialists' duty of confidentiality in accordance with these Terms of Reference shall extend both throughout the conduct of these proceedings and in perpetuity thereafter. The Modelling Specialists' duty of confidentiality shall continue irrespective of any termination of this agreement.

8. TERMINATION OF TERMS OF REFERENCE

8.1. The Modelling Specialists, either together or individually, or the Neutral Expert, either in relation to one or more of the Modelling Specialists, may terminate this agreement at any time by providing written notice of intent to terminate one month before the termination should become effective. Termination of the agreement with respect to any one Modelling Specialist shall apply only to that Modelling Specialist, in which case this agreement shall remain in full force and effect with respect to the other Modelling Specialists. The agreement may be terminated by the Neutral expert with immediate effect in case of a breach of the Modelling Specialists' obligations under Sections 3.1, 3.2 and 7 of these Terms of Reference.

9. SIGNATURE OF TERMS OF REFERENCE

9.1. These Terms of Reference may be signed in counterparts, collectively forming one composite signed document.

[*signature page follows*]

Dated: 25 May 2026

Mr. David Collomb
Modelling Specialist

Mr. Olivier Barbet
Modelling Specialist

Mr. Salah Shaiek
Modelling Specialist

Mr. Marc Desné
Modelling Specialist

Michel Lino
Neutral Expert

Evgeniya Goriatcheva
Registrar
Permanent Court of Arbitration

ANNEXES A, B, C AND D ARE REDACTED

ANNEX E

SCOPE OF WORK

I. CONTEXT

1. These Neutral Expert Proceedings were set into motion by India when, on 4 October 2016, it requested that the World Bank appoint a neutral expert under Paragraphs 4(b)(ii) and 5(c) of Annexure F to the Treaty, in respect of differences between the Parties concerning India's Kishenganga and Ratle Hydroelectric Plants (the "**KHEP**" and the "**RHEP**"), and notified its Statement of "**Points of Difference**".[1]

2. The Neutral Expert's mission is defined by the Treaty and the Points of Difference, in which India set forth its "considered view" that (specific elements of) its design of the KHEP and the RHEP are in accordance with the provisions of the Treaty.[2]

3. In its Memorial dated 31 August 2023 (the "**Memorial**"), India made submissions in support of its position as stated in the Points of Difference and requested, *inter alia*, that the Neutral Expert make a determination that the design of the KHEP and the RHEP is in accordance with the provisions of the Treaty.[3] The Memorial was accompanied by expert and other evidence.

4. Pakistan replied to India's submissions in its Counter-Memorial dated 7 August 2025 (the "**Counter-Memorial**"), which was also accompanied by expert and other evidence.

5. Under the initially-established Work Programme for these proceedings, the Memorial and Counter-Memorial were to be followed by India's Reply and Pakistan's Rejoinder, as well as one or more meetings of the Neutral Expert with the Parties for the presentation of the memorials and the testing of the expert evidence.[4] In the event, however, in mid-2025 India withdrew from the Neutral Expert Proceedings. Accordingly, it did not attend the Fourth Meeting at which the Memorial and Counter-Memorial were to be presented, and there is no indication at present that it will make any further submissions in these proceedings. In these circumstances, the Neutral Expert has not had and does not expect to receive the benefit of India's views regarding Pakistan's Counter-Memorial.

6. It is in this context that the Neutral Expert considers that the modelling exercise contemplated in this Scope of Work will assist in the discharge of his functions. The framing of the modelling exercise does not reflect a judgment as to which Party bears the burden under the Treaty of proposing

[1] Decision on Certain Issues Pertaining to the Competence of the Neutral Expert, 7 January 2025, para. 14.

[2] Decision on Certain Issues Pertaining to the Competence of the Neutral Expert, 7 January 2025, para. 4.

[3] India's Memorial, Volume 1, para. 542.

[4] *See* Work Programmes of 21 August 2023, 11 October 2023, 4 November 2023, 29 May 2024, 4 June 2024, 11 March 2025.

a Treaty-compliant design or on any aspect of burden of proof in these proceedings more generally.

7. As noted in the Neutral Expert's letter dated 13 March 2026, the Neutral Expert acknowledges that "Pakistan has not to date advanced a complete and holistic design alternative for the RHEP on the basis that the exercise in which the Neutral Expert is engaged should not involve a binary choice between two competing design models, one advanced by India and an alternative advanced by Pakistan."[5] The Neutral Expert further notes Pakistan's observations in its letter dated 18 February 2026: "Pakistan, in its written and oral submissions to the Neutral Expert, has been utterly clear that it has not and does not propose a specific design approach for the RHEP. Having regard to the mandatory design criteria of Paragraph 8 of Annexure D of the Treaty, as well as other controlling interpretations of law, Pakistan addresses, *inter alia*, the RHEP's Treaty-design-compliance. Insofar as Pakistan proposes alternative design possibilities, it does so only for purposes of illustrating that there are a range of Treaty-compliant design possibilities that exist that would be available to India."[6]

8. Pakistan argues in its Counter-Memorial that sediment management in the RHEP reservoir using the sluicing method can achieve a stable long-term equilibrium compatible with the operation of the hydroelectric plant.[7]

9. Pakistan's Counter-Memorial proposes a range of design concepts that, in its view, are available to India for the RHEP and would be Treaty-compliant. While Pakistan provided design parameters considered to be Treaty-compliant, it did not provide information on any specific geometric configuration or design details.

10. In this context, it would assist the Neutral Expert to test the contention that alternative design arrangements are available for the RHEP that would comply with the Treaty while remaining compatible with hydroelectric operation.

11. Pakistan argues that the spillway and intake arrangements proposed by India are not compliant with the Treaty. It has prepared technical analysis to illustrate that the statements made by India to justify its proposed design are unfounded. Pakistan's contentions include the following:

- India's intake design is conceptually flawed with respect to Treaty provisions because it incorporates a deeply submerged intake when a higher-level surface intake may be used instead.

[5] Letter from the Neutral Expert to the Parties, 13 March 2026, p. 2, item 2, *referring to* Pakistan's letter to the Neutral Expert, 2 March 2026, para. 10.

[6] Letter from Pakistan to the Neutral Expert, 18 February 2026, para. 27.

[7] Fourth Meeting Tr., 21 November 2025 (Day 4), 127:13-21; *see also* Pakistan's Final Submission, 21 November 2025, p. 6: "sediment sluicing is a technically and economically viable sediment management technique at the RHEP".

- Pakistan-modelled sediment transport in the Chenab River, as well as sediment transport and deposition conditions in the future RHEP reservoir using SRH-1D software, indicate that a higher-elevation crest spillway may be used to control sediment accumulation and sustain Pondage by sluicing at Dead Storage Level ("**DSL**"), instead of India's proposed deep spillways.[8]

- The specific configuration of the RHEP—located in a pronounced bend of the Chenab River, with intakes positioned on the outer bank—reduces the potential for sediment deposition in front of the intake when combined with pressure flushing during high flow periods, and the intake location at this point will maximise the withdrawal of water near the reservoir surface where sediment concentrations may be expected to be lower than the cross-section average.

- Pakistan's reservoir sediment transport and sedimentation modelling is based on calibration of the model for the conditions reported in the Baglihar reservoir. Model calibration incorporates sensitivity to the hydrology, sediment characteristics, operating rule selected, as well as the transport equation which can—together with other factors—duplicate the known conditions reported in field data.

12. Pakistan's Counter-Memorial concludes that a substantially different design from that presented in India's Memorial can be contemplated that would be compliant with the Treaty. Pakistan suggests the following potential adaptations, among others:

- An inlet sill at the intake location, with a level determined from the DSL.[9]

- A crest-gated spillway with six gates that are 13.85 m wide and 16.62 m high, with a sill level at 1012.38 masl, and no drawdown below the DSL.[10]

- Or, in the alternative, "any other modifications considered appropriate by the Neutral Expert."[11]

13. According to Pakistan, these parameters show the direction in which the HEP design could be taken if Treaty compliance were the designer's intent. Pakistan has not, however, proposed a specific design configuration that would allow for quantitative assessment.[12]

[8] Pakistan's Counter-Memorial, 7 August 2025, para. 7.177 *et seq*.

[9] Pakistan's Final Submission, 21 November 2025, p. 5 *et seq*.

[10] Pakistan's Final Submission, 21 November 2025, p. 6.

[11] Pakistan's Final Submission, 21 November 2025, p. 7.

[12] *See* Fourth Meeting Tr., 21 November 2025 (Day 4), 129:24-130:23.

14. Under the sluicing option proposed by Pakistan, the equilibrium riverbed level in the reservoir will be high in relation to the intake weir. Furthermore, since the RHEP is being constructed without a desander, during the sluicing period, water with undesirably high sediment concentrations may be delivered to the turbines. Pakistan's approach is that the design concept for hydropower operations will have to combine the intake geometry with additional complementary sediment management measures needed to manage high sediment concentration. According to Pakistan, such complementary measures may include pressure flushing, turbine coatings, sediment-guided operating rules, sediment under-sluices, dredging, and possibly other measures.

15. The rendering of Pakistan's design guidelines into a design compatible with hydropower operation would fully depend on the design's geometry together with possible complementary management measures. As such, the Neutral Expert's design determinations would themselves be dependent on such design. Given this dependency on design development, Pakistan has accepted that it would assist the Neutral Expert's appreciation of the issues, in the present circumstances of the proceedings, for it to develop the elements of its design conception into a more elaborated design of sufficient dimensional detail to allow it to be rendered into a 3D modelling environment, together with development of the complementary sediment measures needed to adequately manage high sediment concentration ("**Pakistan's Elaborated Design**").

16. On the basis of Pakistan's Elaborated Design, including the data underpinning such Design, the Neutral Expert proposes to conduct numerical modelling to review Pakistan's calculations and fundamental design characteristics. The Neutral Expert's intent, however, is not to enter into full design details and optimisation of the design and operational elements.

II. PROCEDURE AND SCOPE OF WORK

17. On the basis of the preceding, the following steps will be undertaken:

- **Pre-Design Elaboration Stage Meeting**—An initial meeting will take place between the Neutral Expert, the Technical Assistant and the Parties prior to the Design Elaboration Stage (see bullet point immediately below) with the object of ensuring that there is agreement on such matters as datasets, output file format compatibility, etc. The Neutral Expert, in his discretion, may invite the Modelling Specialists to participate in the pre-Design Elaboration Stage meeting, if necessary. The meeting will take place by videoconference. Each Party will submit a proposed list of issues for discussion two weeks in advance of the meeting.

- **Design Elaboration Stage**—Pakistan will develop a geometric design as well as a design memo (the "**Design Memo**") specifying the basis of the design configuration together with the complementary measures needed for the RHEP to be rendered compatible with hydroelectric operation (the "**Design Elaboration Stage**").

  As part of this Design Elaboration Stage, Pakistan will perform the modelling exercises it understands to be necessary to develop and test the design. Pakistan's Elaborated Design

should demonstrate the long-term preservation of Pondage, suitable hydraulic conditions in the area of the intake and spillway, and the ability to sustain plant operation under the anticipated sediment loads and concentrations.

- **Independent Modelling Stage**—The models used by Pakistan to develop and confirm Pakistan's Elaborated Design, together with the resulting design geometry and Design Memo, will be provided to the Neutral Expert for the use of the Modelling Specialists for purposes of their modelling work, under the direction and control of the Neutral Expert and/or his Technical Assistant (the "**Independent Modelling Stage**"). The Neutral Expert and/or the Technical Assistant may direct the Modelling Specialists to replicate the geometry developed by Pakistan for testing in their software of choice or to modify the geometry if deemed necessary.

  As an essential part of this stage of work, the Neutral Expert will provide clear, explicit and detailed directions to his Modelling Specialists (the "**Assumption Notes**"). The Assumptions Notes will include: the proposed design (Pakistan's Elaborated Design), an update of the Scope of Work regarding the description of the assumptions for Calculations A, B and C, and the details of the Calculations A and B process required to provide a complete description of the intended modelling. The Assumptions Notes will be provided, transparently and in full, to the Parties for their review and comment at the start of the Independent Modelling Stage.

  During the Independent Modelling Stage, the Neutral Expert may, at his discretion, schedule meetings between the Neutral Expert, the Technical Assistant, the Modelling Specialists and the Parties in the event of any uncertainties arising in the course of the Independent Modelling Stage that would benefit such engagement (the "**Intra-Independent Modelling Stage Meetings**"). Any Intra-Independent Modelling Stage Meetings will be held by videoconference.

- **Presentation of the Results and Discussion Stage**—The Parties will have the opportunity to review and comment on the modelling performed by the Neutral Expert's Modelling Specialists (the "**Presentation of the Results and Discussion Stage**").

  The written and oral process of the Presentation of the Results and Discussion Stage will be as follows:

  a) a meeting will be held by videoconference between the Neutral Expert, the Technical Assistant, the Modelling Specialists and the Parties at which (i) the Technical Assistant, assisted by the Modelling Specialists as needed, will give an overview PowerPoint presentation of the Independent Modelling Stage; and (ii) the Parties will be given an opportunity to comment or raise questions in order to minimise any ambiguities before the finalization of the written report(s) referred to at item b) below (the "**Oral Report Meeting**") .

b) the Technical Assistant and the Modelling Specialists will prepare and provide to the Parties a detailed report in respect of each of Calculations A, B and C, including the model itself, and any iterations thereof, together with all underlying data and directions (the "**Written Report**");

c) the Parties will be given an opportunity to comment on the Written Report in writing; and

d) a meeting will be held between the Parties and the Neutral Expert, in person or by videoconference, at which the Parties will be given an opportunity to: (i) put questions to the Modelling Specialists; and (ii) discuss the modelling exercise with the Neutral Expert and the Technical Assistant (the "**Final Modelling Meeting**").

18. Pakistan's Elaborated Design and accompanying Design Memo, plus the results of the Independent Modelling Stage and Results' Presentation Stage will assist the Neutral Expert, when preparing his Decision, to form a view about whether the alternative design, or elements thereof, are both Treaty-compliant design and compatible with long-term hydroelectric operation.

19. It is not intended that the Elaborated Design and accompanying Design Memo and the Independent Modelling Stage provide a complete design for the RHEP. Ultimately, the (Treaty-compliant) design of the RHEP is the responsibility of India.

III. INDEPENDENT MODELLING STAGE – PLANNED CALCULATIONS

20. Based on Pakistan's Elaborated Design and accompanying Design Memo, the Neutral Expert's Modelling Specialists will undertake the following modelling work.

A. CALCULATION A — SEDIMENT TRANSIT IN THE CHENAB RIVER AND FUTURE RHEP RESERVOIR

i. Objective

(a) General Objective

21. The objectives of the analysis include:

- To verify Pakistan's computation of the long-term sediment equilibrium profile in the RHEP reservoir by performing sensitivity testing of the SRH-1D model calibrated by Pakistan.
- To identify and analyse the discrepancies between the sediment equilibrium profile derived by India (IN EX 13) and by Pakistan in its Counter Memorial.
- To verify that sediment sluicing will be effective to sustain Pondage capacity with the proposed spillway arrangement.

(b) Summary of Method

22. The method is as follows:

- The modelling calculations will be performed using the SRH-1D software.
- The model should be based on a model calibrated for the conditions recorded in the Baglihar HEP reservoir.
- The model will be used to verify Pakistan's assumptions and results, performing a sensitivity analysis on the main assumptions.

ii. Details

23. Subject to adjustments during the modelling, Calculation A will be carried out based on the SRH-1D model provided by Pakistan.

24. Two models will be developed:

- A model integrating a section of the Chenab River and the Baglihar HEP reservoir that will be used to confirm calibration parameters related to the sediment characteristics and sediment transport computation methodology.

- A model integrating a section of the Chenab River and the future RHEP reservoir to analyse the sedimentation of the reservoir and equilibrium profile based on the calibration parameters developed from the Baglihar simulation, and incorporating available hydrological record, spillway/outlet design characteristics, reservoir operating policies.

- Any other assumptions deemed useful by the Neutral Expert may be tested, provided that the Parties are duly informed.

25. The Modelling Specialists' model will be based on Pakistan's Elaborated Design but with modified input parameters to develop scenarios that assess the validity of the Elaborated Design. Parameters considered in sensitivity tests will first be tested against the Baglihar HEP calibration data on the record of the Neutral Expert Proceedings to determine parameter compatibility to the field data. These sensitivity parameters will then be applied to the RHEP model.

26. Test parameters may comprise:

- Varying the sediment transport model equation(s);
- Varying the gravel fraction transported and the grain size distribution;
- RHEP design and operational parameters, to be determined, that could impact the long-term equilibrium profile.

27. The Baglihar HEP model will be calibrated using known data from that reservoir for comparison with the calibrated model provided by Pakistan:

- The specific hydrological years of Baglihar's reservoir operation for which data have been provided by India (among them: data at Premnagar gauging station, items 1a) and 1b) of India's letter dated 31 July 2024 and BHEP logbook, item 7 of India's letter dated 21 January 2025);
- Baglihar's reservoir delta evolution through the years appreciated using the complete set of Google Earth images available online;
- Baglihar's 2015 bathymetry data (Annexure 6 of India's letter dated 30 November 2023);
- Bed samples in Baglihar's reservoir (presented in DHI's 2023 report, Exhibit IN EX 13 of India's Memorial, Fig. 2.15 and Appendix E).

28. Calibration will be assessed by comparison of the computed sedimentation profiles with the available data.

29. The Baglihar HEP model's calibration parameters will then be applied to the RHEP to simulate long-term stable equilibrium configurations in the reservoir, subject to site-specific geometry, geometry of spillway and intake, sluicing durations and other relevant operational parameters, but without drawdown below DSL.

30. Profile calculations will be performed with two pondage depth hypotheses: a DSL level at 1015.86 masl, taken from India's Memorial, and a DSL level at 1024.2 masl, proposed by Pakistan. If considered necessary, the Neutral Expert may also undertake simulation of an intermediate level.

B. CALCULATION B — HYDRAULIC MODELLING NEAR THE DAM AND INTAKES

i. Objective

(a) General Objective

31. The objectives of the analysis include:

- Develop model mesh required for CFD modelling using the three-dimensional geometric design as provided by Pakistan.
- Model flow conditions in the reservoir, including the effects of long-term sediment deposition and the curving reservoir geometry, to determine near field velocity, streamlines, secondary current patterns associated to assumed sediment bed levels in the vicinity of the power intake and spillways.

- Assess potential sediment deposition and erosion dynamics across the face of the intake. This assessment may be based on a review of Pakistan's methodology and may also involve a review of the computed pattern of tractive forces for sediments near the intake and spillway.
- Model hydraulic conditions through the intake with the skimming wall (and weir flow over the skimming wall).

32. The Calculation B model does not include bottom outlets. However, the general design of the Calculation B Ansys CFX model will allow for future integration of one or several bottom outlets, so that additional simulations with bottom outlets can be performed if the Neutral Expert considers they are necessary. These additional simulations are not included in the present SOW.

33. The analysis does not seek to determine the long-term sediment bed levels in the vicinity of the power intake, but seeks to evaluate a credible upper bound for these long-term sediment bed levels.

(b) Summary of Method

34. The method is as follows:

- To facilitate the work of the Neutral Expert's Modelling Specialists, for purposes of its Elaborated Design, Pakistan will use conventional 3D project design software to produce details sufficient for the CFD modelling of the intake and spillway. As part of this design, Pakistan will prepare the 1D and multi-dimensional models needed to develop and confirm its design.

- To analyse reservoir flow conditions, the Neutral Expert's Modelling Specialists may utilise Pakistan's model or may calculate reservoir flow conditions using the Telemac model to provide a pseudo-3D simulation. The reservoir model will extend from the dam face upstream for a distance of at least 500 m. This extent is to reduce the impact of boundary conditions assumptions on the flow conditions approaching the intake. Test simulations will be carried out to confirm the extent of the model and ensure that the boundary conditions assumptions do not influence flow conditions at the intake.

- The reservoir simulations will be used to incorporate and confirm 3D velocity fields at the intake and spillway under a range of operating scenarios.

- A CFD model incorporating the intake and the spillway will be used to simulate in greater detail the near-field flow conditions along and over the skimming wall and through the intake structure to the headrace tunnel. Flow conditions at the upstream boundary will be extracted from the Telemac model. The CFD model will show streamlines and velocities in a domain encompassing: the spillway, the skimming wall and the intake.

35. Numerical Models — Hydraulic modelling by the Neutral Expert's Modelling Specialists will be conducted using Telemac 3D (pseudo-3D) and verified with Ansys-CFX (full 3D), with the option

to adapt the modelling tools used by Pakistan, if different.[13] Both software packages can model sediment transport, but for this exercise modelling will be limited to hydraulics only.

ii. Model Set Up

36. Model 1: Telemac approach flow condition — The Telemac model will be used to simulate flow patterns and velocity approaching the power intake and spillways. The model will include:

- The skimming wall, the spillway gates, and the dam.
- The reservoir upstream of the intake and spillway area to model the bend effect.

37. The upstream limit of the model shall be located such that boundary conditions do not affect flow patterns in the vicinity of the intake structure and spillway. A model limit of approximately 500 m can be considered as a minimum, as illustrated below. A longer model would be desirable.

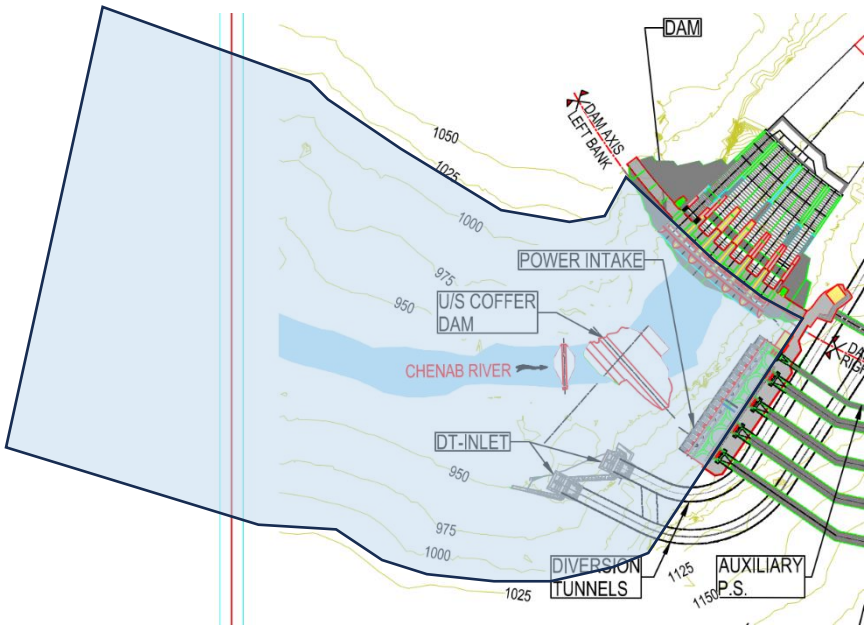


Figure 1 – Telemac 3D Reservoir Model Domain – Typical sketch

38. Given the size of the 3D domain, the geometry of the dam, structures and the topography will be simplified.

[13] Telemac is regularly used for large 3D hydraulic calculations, since the pseudo-3D (each layer is treated as a 2D model, with vertical exchanges between the layers) allows for reasonable computation times for large domains. Examples of 3D models with Telemac-3D show its capability of capturing 3D effects. For additional information see: http://wiki.opentelemac.org/doku.php?id=user_manual_telemac-3d Ansys-CFX is often used for 3D hydraulic simulations at hydraulic structures such as intakes or spillways. For additional information see: https://ansyshelp.ansys.com/public/Views/Secured/corp/v251/en/pdf/Ansys_CFX-Solver_Modelling_Guide.pdf

39. Spillways will be represented as partially open gates arranged on the crest of the dam and will be arranged and operated in accordance with Pakistan's Elaborated Design. The intake will be represented by flow over the inlet sill to the wet well intake. Details of the wet well and intake bell-mouth sections will not be simulated in the Telemac model.

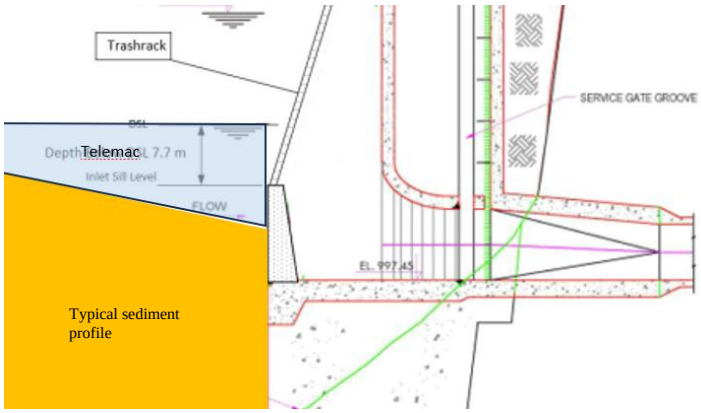


Figure 2 – Telemac 3D Reservoir Model - Domain boundary at the intake

40. The Telemac model will be used to derive the velocity and flow distribution in the near field zone of the intake and spillways. A series of 3 to 4 models will be used to assess the impact of spillway operating priority on sediment dynamics in the vicinity of the intake and in the vicinity of the spillway. The Assumption Note will indicate the spillway operation models to be tested. One of these models will correspond to the spillway operating preferences indicated by Pakistan's Elaborated Design and Design Memo.

41. The Telemac model will be used to derive a credible upper bound for the long-term sediment profile along the skimming wall. This typical upper bound is derived through an iterative procedure. A provisional definition of this procedure (which the Neutral Expert and/or the Technical Assistant will adapt during the process) is as follows:

a. The model is a fixed-bed model with sediment elevations at each location in the reservoir interpolated from the sediment elevations at locations A to J (see Figure 3 below).
b. Sediment elevations at locations D, G, H, I and J are fixed and determined from the SRH_1D model.
c. Sediment elevations at locations A, B, C, E and F are determined by the Telemac3D modelling by an iterative procedure:
    i. An initial elevation is assumed, according to Table 1 below.
    ii. At each of these locations, if the iteration indicates a strong tendency to erosion, the sediment assumed elevation is reduced by a standard step; if the iteration indicates a tendency to accretion, the sediment assumed elevation is increased by a standard step; the standard step is defined by Table 1.
    iii. A strong tendency to erosion is a bed velocity (or a tractive force) at least twice the erosion threshold; a tendency to accretion is a bed velocity (or a tractive force) under the deposition threshold. Both erosion and deposition

threshold will be defined in the General Assumption Note.

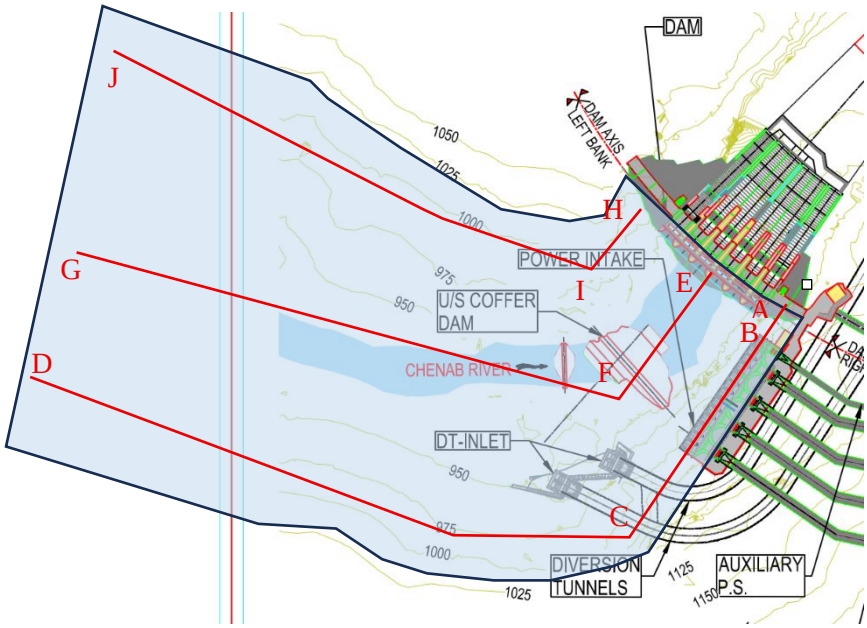


Figure 3 – Telemac 3D Reservoir Model – Reference locations for bed reservoir sediment elevations

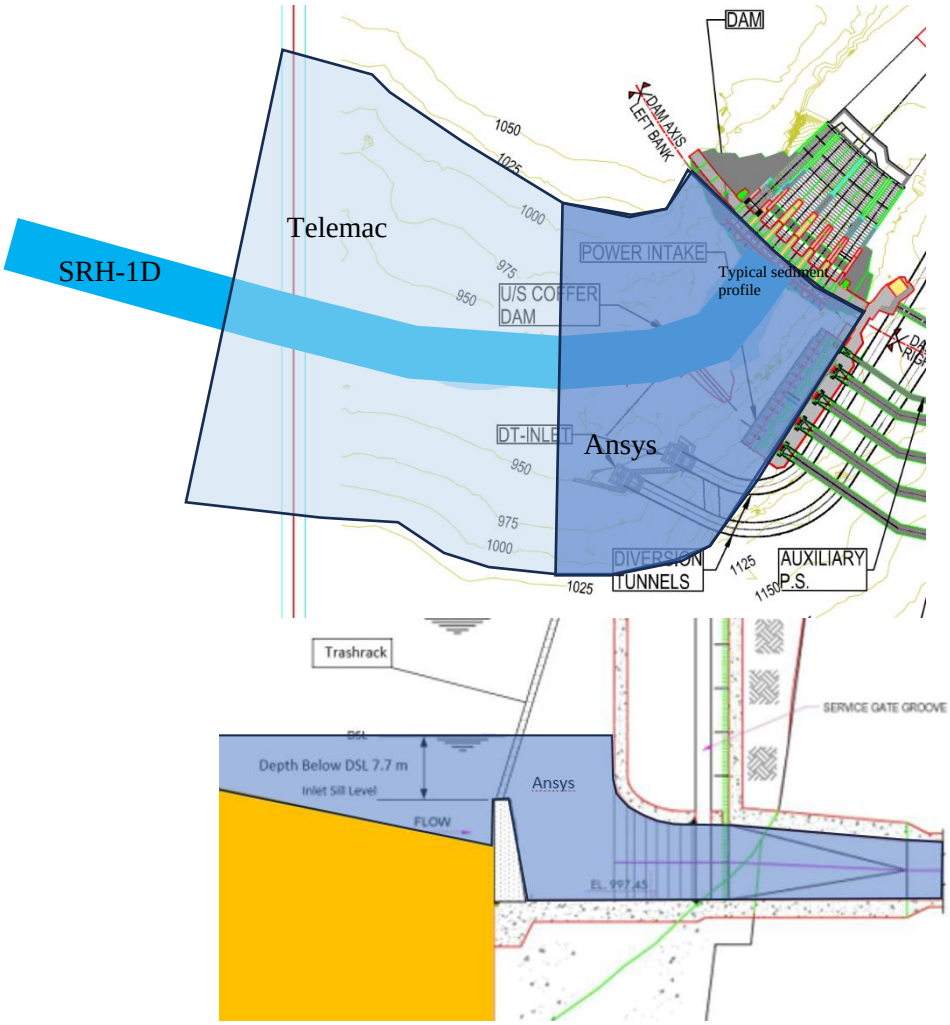
Table 1: Telemac3D - Reservoir bed sediment elevation for locations A to J

Reservoir bed sediment elevation	**Approximative Location**	**Type of condition**	**Initial elevation**	**Sediment elevation: step between two iterations**
z_A	At the dam, right bank	To be determined	Spillway sill level	± 3 m
z_B	At the intake, right bank	To be determined	Skimming wall – 5m	± 3 m
z_C	Upstream end of the bend, right bank	To be determined	Skimming wall – 5m	± 3 m
z_D, z_G, z_J	Upstream boundary condition	Fixed	Taken from SRH_1D simulation	
z_E	At the dam, along the reservoir centreline	To be determined	Spillway sill level	± 3 m
z_F	Upstream end of the bend, right bank, reservoir centreline	To be determined	Taken from SRH_1D simulation	± 3 m
z_H, z_I	At the dam, left bank and Upstream end of	Fixed	Taken from SRH_1D	

	the bend, left bank		simulation	

42. Model 2: ANSYS CFX — The CFX model will be used to simulate flow patterns and velocity near the intake and through the power intake structure. The model will include:

a. the intake, extending from upstream of the skimming wall, through the wet well, and into the bell-mouth headrace tunnel entrance;
b. the partially-open spillway gates;
c. a fixed-bed reservoir elevation resulting from the Telemac model.



43. The limit of the model shall extend sufficiently upstream so that boundary conditions do not significantly affect the flow patterns. The boundary condition will be defined by water level and velocity distributions as determined from the Telemac model or as determined by Pakistan's modelling, to be determined by the Neutral Expert's Modelling Specialists.

44. The model is a fixed-bed model. The reservoir bed sediment elevations are taken from the Telemac3D simulations. The purpose is to examine whether the bed sediment elevations derived from the Telemac3D simulations also appear as an upper bound for the more precise Ansys CFX simulation.

iii. Design

45. All structural design features used in the modelling will be rendered into the model mesh using the 3D geometry provided by Pakistan. These structural features will be determined based on a DSL proposed by Pakistan and possibly for Pakistan's Elaborated Design adjusted and tested in accordance with a second DSL that the Neutral Expert may select for testing.

46. Given the size of the 3D domain, the geometry of the dam, structures and the topography will be simplified: the details of the topography will be smoothened, the geometry of the civil structures will be simplified, the trash rack will not be included in the models.

iv. Simulation Scenarios

47. Simulation scenarios for the design geometry and DSL under investigation will include, as a minimum, the following flow rates and operating conditions:

- $Q_{min,monsoon}$ = 928 m³/s (all spillway gates closed; entire discharge through turbines).
- $Q_{avg,monsoon}$ = 2,000 m³/s.
- $Q_{max,monsoon}$ = 3,000 m³/s (typically exceeded a few days per year).

The anticipated flow conditions for the Calculation B simulations are as follows:

- For both Qmin,monsoon and Qavg,monsoon, the intakes are assumed to operate at full capacity.
- For Qmax,monsoon, two scenarios will be simulated: intakes open at full capacity and intakes closed.

48. Calculations will be steady state. For each calculation, a reference geometry of the sedimentation level will be used. Expected results include velocity fields:

- Bed velocities in the reservoir, upstream of the bend and within the bend, to assess erosion/sedimentation dynamics and compare tractive forces to erosion thresholds.
- Velocities throughout the water column in the intake area, to evaluate intake supply conditions and the "sediment-excluding" nature of the intake with the skimming wall.

C. CALCULATION C — SEDIMENTATION VOLUME AT KHEP

i. Objective

49. According to India, the average annual sediment load at the Kishenganga dam site is 0.73 MCM/year.[14] No source or justification for this statement is given. However, three bathymetric surveys of the KHEP reservoir are available (2019, 2021, 2023). They have not been exploited by the Parties. Calculation C is a calculation of the sediment volumes deposited in the reservoir between 2019 and 2021, and between 2021 and 2023.

ii. Method

50. The location of the survey cross sections is given by three AutoCAD files (DWG). The elevation of the reservoir bed at the survey point are given in three Excel files (Data as requested by the NE on 11 October 2023 – Annexe 2 -Bathymetric data KHEP). Three Digital Terrain Model (DTM) will be generated and the sediments volumes will be derived.

[14] India's Memorial, 31 August 2023, para. 411.