



**एनएचपीसी लिमिटेड**  
(भारत सरकार का एक नवरेत्न उद्यम)  
**NHPC Limited**  
(A Government of India Navratna Enterprise)  
CIN: L40101HR1975GOI032564



**सुबनसिरी अपर जल विद्युत परियोजना**  
**Subansiri Upper HE Project**  
Village Sippi, PO&PS – Daporijo,  
Dist. Upper Subansiri,  
Arunachal Pradesh – 791122  
Email: subansiriupper@nhpc.nic.in

NH/SUP/WO/2024-25/23

Date: 26.03.2025

Work Order

To,  
The Director,  
Indian Institute of Technology,  
Department of Civil Engineering  
Hauz Khas, New Delhi-110016

Kind attention: Dr. Deepanshu Shirole, Assistant Professor  
Email: [dshirole@civil.iitd.ac.in](mailto:dshirole@civil.iitd.ac.in)

Sub: Letter of Award for "Linear and Nonlinear dynamic analysis of the maximum overflow and non-overflow section by FEM method of Subansiri Upper Hydroelectric Project, NHPC Ltd."

Ref:

- 1) NHPC Email dated: 06.01.2025.
- 2) IIT Delhi proposal dated 11.03.2025, vide email dated 11.03.2025.

Sir,

In response to above-referred offer and subsequent correspondences on the subject matter, We are pleased to place the work order for **Conducting Linear and Nonlinear dynamic analysis of the maximum overflow and non-overflow section by FEM method of Subansiri Upper Hydroelectric Project, NHPC Ltd.** with the following terms & conditions:

**1) Scope of Work:**

The scope of the proposed work by IIT, Delhi includes the following:

1. Two-dimensional (2D) finite element analysis (FEA) of the maximum height of overflow and non over flow sections of the dam.
2. The 2D FEA will include the following:
  - (i). Static analyses,
  - (ii). Pseudo-static analyses,
  - (iii). Modal Analyses,
  - (iv). Response Spectrum Analyses,
  - (v). Linear dynamic analyses in time-domain,
  - (vi). Non-linear dynamic analyses in time-domain
3. Load Combinations: All load combinations shall be followed as per codal provisions and NCSDP guidelines. Uplift forces shall also be modelled suitably.
4. Hydrodynamic Analyses: Hydrodynamic analyses shall be carried out using both Westergaard method as well as Euler-Lagrange method.
5. Constitutive Models to be used for non-linear analyses: Concrete Damage Plasticity (CDP) will be adopted for concrete. Dam foundation will be modelled by Mohr-Coulomb model or any other suitable model considering an equivalent continuum.



6. Accelerogram: Site-specific rock outcrop accelerogram shall be provided by M/s NHPC Ltd. IIT Delhi shall perform deconvolution analyses and obtain deconvoluted accelerogram at the base of the model. The deconvoluted accelerogram shall be applied at the base and the dam response will be then obtained corresponding to site-specific accelerogram at the rock outcrop.
7. Mass of Dam and foundation: The analyses shall be carried out:
  - (i) considering mass of dam but neglecting mass of the foundation; and
  - (ii) considering mass of both foundation and dam.
8. Dam-Foundation Interface: Dam-foundation interface will be modelled with contact elements.
9. Software Platform to be used: Abaqus.
10. Expected Outcomes:
  - (i) Pseudo-static Analyses: Displacements, stresses and factor of safety
  - (ii) Modal Analyses: Mode shape, natural frequency
  - (iii) Response Spectrum Analyses: Displacement, maximum stress, stress contours.
  - (iv) Non-linear dynamic analyses in time-domain: Displacements and stresses at the crest, heel, toe, upstream slope change in the Dam profile; Values of minimum factor of safety against sliding and overturning; and Indicators of cracking in form of damage output results obtained from Abaqus.
  - (v) Linear elastic dynamic analyses in time-domain: All responses given in 10(iv) except the last one related to indicators of cracking.

**2) Cost:**

The total charges for the studies shall be ₹ 60,00,000.00 + GST @ 18% = ₹ 70,80,000.00 (Rupees Seventy Lakh Eighty Thousand only) ( ₹ 60,00,000/- + 10,80,000/-GST @ 18%) . No increase in the cost during the studies shall be entertained.

**3) Time schedule:**

The study shall be completed within 6 months reckoned from date of Award of Work, deposit of Advance amount and providing of requisite data by NHPC.

**4) Support and Facilities to be Provided by the NHPC Ltd.:**

The proposal does not envisage any site visit. However, if any site visit is requested by M/s NHPC or needed by IIT Delhi, the cost of such visit shall be borne by IIT Delhi. M/s NHPC Ltd. will provide necessary permissions and facilitate such visits.

**5) Payment Terms:**

- i. 100% of the total cost of ₹ 70,80,000.00 (Rupees Seventy Lakh Eighty Thousand only) ( ₹ 60,00,000.00 + ₹10,80,000.00 (GST@18%)) the project shall be made in advance for the proposed study.





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Email: subansiriupper@nhpc.nic.in

- ii. Payment shall be made by crossed demand draft, drawn in favor of the IRD ACCOUNT IITD payable at State Bank of India, Indian Institute of Technology, Huaz Khas, New Delhi-110016,  
Or

By electronic transfer in favor of IRD ACCOUNT IITD payable at State Bank of India.  
Account No. : 10773572600  
Branch name: Indian Institute of Technology, Hauz Khas, New Delhi-110016  
IFSC Code: SBIN0001077

**6) Goods & Service Tax:**

Goods & Service Tax@ 18% has been included in the total cost of the studies.

**7) Submission of technical report:**

Two reports will be submitted to M/s NHPC Ltd. during the duration of this work:

- First report at the end of three months: This will include information on the model parameters and geometry, and results pertaining to pseudo-static analyses, modal analyses and response spectrum analyses.
- Final report at the end of the project: This will include information on the investigation results pertaining to linear and non-linear time history dynamic analyses.

IIT, Delhi shall provide three sets of hard copies of the report and software input data along with soft copy of the analysis.

**8) Engineer-In-Charge:**

Group General Manager (Civil)-HOP, Subansiri Upper HE Project, Upper Subansiri, Arunachal Pradesh.

**9) Paying Authority:**

Project finance representative/ Senior Manager (Finance), RO Itanagar, Arunachal Pradesh.

**10. Visit of Design team:**

NHPC Ltd. Design team shall visit the IIT, Delhi during the studies, as & when required.

This letter of award is issued to you in duplicate. The duplicate copy duly signed and stamped on each page will be returned to this office as token of acknowledgment and acceptance of the same.

Yours sincerely,

(Deepak Rattan Sagar)

**Group General Manager (Civil)-HOP**  
**Subansiri Upper Hydro Electric project**

Copy to:

- Executive Director (D&E), Corporate Office, Faridabad
- Project finance representative.

