Corrigendum IX

Responses to Bidder queries on Technical Matters

With reference to **NIB No. NEEPCO/PEN/IND/001**, below please find the responses to the bidders-queries received in responses to corrigendum no. VII.

Sl. No.	Bidder's Query	Response
	Section 2.9.2	
1.	If the minimum gap between the pipes is 3 mm, what is the maximum gap (this may control) ?	Analysis is to be done with a gap of 3mm between the metallic pipes for the required design pressure. Adequacy of composite shall be ascertained for the assumed gap of 3mm.
2	It appears that the intent is to consider a composite design with ¼ of the steel thickness welded. Is ¼ of the welded thickness on the outside of the steel plate thickness? If there are leaks, this implies there are areas with no weld. How should this be considered?	This is a design assumption for FEA modelling. The wielded thickness is 1/4 th of steel pipe thickness on the outside only. Notwithstanding physical joint condition gap of 3mm should be considered in the analysis.
3.	In the documents 2000 microstrains is allowable strain in CFRP, which is also the strain at yield of mild steel. We need to understand the yield strain of high strength steels used in the penstock – please provide the mill certs and stress-strain data for the steels used.	The Yield Stress of the steel used in the Penstock works correspond to 2000 micro strain only.
4.	Since partial weld (1/4 thickness) is a crack like configuration, is there a concern that the weld may crack prior to reaching 2000 microstrains instead of yielding.	It is a design assumption where 1/4th of the shell plate is considered to be continued and the remaining 3/4th is to be considered discontinuous with a gap of 3mm to idealise the defects in weldment.
5.	What are the "load conditions"? Does this include hydraulic thrust for the circumferential joints, or just temperature and Poisson's effects of pressure?	

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	We consider the following loads – please confirm: a) Sustained pressure and design pressure as per the table below. Please clarify which pressure should be considered as the long term pressure for which the CFRP repair should be designed. Our understanding of the pressures is that the "Sustained Pressure" should be considered as working pressure occurring in a flowing penstock over years of service, and "Design Pressure" is a short term pressure occurring when the valve at the lower end of the penstock is closed a few times per day during load commissioning (design pressure, i.e., closed valve and full penstock condition is not expected to last more than a day). b) Transient pressure – please provide pressure that occurs over short time (fraction of a second) as a result of closing of the valves, or opening of the valves, if there is any such pressure. c) There is no negative pressure. d) Soil load is taken by the steel pipe. CFRP need not be designed to take the soil load. e) Ground water is up to ground level. Ground water may be applied on an empty penstock and should be considered as an external pressure on CFRP f) Temperature change is specified as 25C. g) Thrust is specified to be 1850 MT in the lowermost region (zone 12) due to MIV. Hydraulic thrust at all other elbows is resisted by the thrust blocks on the above ground portion, and by the concrete/rock on the below grade	a) The understanding is found to be correct. b) The design pressure is inclusive of Transient Pressure. c) Agreed d) Agreed. e) Agreed f) Agreed g) Except in the Lowermost region within Zone -12, the CFRP lining is not required to take Hydraulic Thrust h) Agreed i) Zone 12 is also included in the repair

Sl. No.	Bidder's Query	Response
	portion of the penstock, and CFRP does not need to be designed for hydraulic thrust in these areas. h) There is no live load (truck or other) over the penstock. i) Please clarify the limits of repair, and if the CFRP repair includes Zone 12 or not.	
	Section 2.9.3	
6.	Same questions as 2.9.2, only related to longitudinal joints.	Reply same as furnished above for section 2.9.2
	Section 2.9.4	
7.	Please clarify "preferably 3σ should be considered". We typically use characteristic values of strength based on ASTM D3039 tests, which is a 5 percentile value with 80% confidence as specified in AWWA C305. Should we use these values or some other?	Characteristic strength shall be as per ACI Characterization Method (ACI 440-2R-08).
	Section 2.9.5	
8.	Max allowed strain is 0.002. Should we use 0.002 or characteristic value of short term strain divided by 5? Factor of safety on CFRP in the end use condition after consideration of creep and exposure is less than 5.	Please note that short term value should not be less than 10000 micro strain. Design value shall be smaller of 2000 macrostrain and one fifth of short term strain.
	Section 2.9.6	
9.	Please note the appropriate design for this repair, meeting industry standards, will include different layups (thickness) of CFRP as the pressure in different zones vary.	Noted
	Section 2.9.7	
10.	If concrete does not provide restraint to radial expansion (reasonable since it does not have much tensile capacity), please confirm if concrete provides bearing and frictional resistance at elbows? How is hydraulic thrust resisted if not by concrete and surrounding soil?	Internal Pressure is resisted by the liner and the thrust at bend is resisted by concrete and surrounding rocks. Moreover, necessary bearing at bottom is provided by backfill concrete/rock.

Sl. No.	Bidder's Query	Response
	Section 2.10.1	
11.	In Fig. 1 showing the test apparatus, there is a circumferential joint and CFRP is applied over it. It is not clear what longitudinal force is applied over the joint and resisted by CFRP. It is not clear from the drawing how is the axial force in the test apparatus resisted. Since the pressure is applied between inner and outer shells, the full-scale test model of the circumferential joint does not apply the full bulkhead thrust (axial force, thrust, is much smaller because pressure is applied over an annular area and does not represent the bulkhead condition).	The main intention of the test is to check the performance of the CFRP against Hoop Stress and the associated secondary stresses. Performance of the CFRP against applied Axial force/ Thrust is not intended in the test.
12.	There is apparently also a similar test setup with a longitudinal joint (or is it one test with both longitudinal and circumferential joints?). Are joints without continuity, or do they have ¼ thickness weld?	Only one test with both Longitudinal and circumferential Joints shall be done. Joint shall be simulated with 1/4th Weld.
13.	Please provide details of the test setup, loading, test procedure and instrumentation.	Shall be provided to the successful bidder.
14.	Please provide a drawing of the test specimen, including detailing of the end caps and manner in which pressure will be applied.	Shall be provided to the successful bidder.
15.	Please provide a detailed testing procedure, as this could significantly impact project schedule. At a minimum, provide following: a) How many fatigue cycles will be performed and at what pressure? b) How long will the "long term static internal pressure" be applied and at what pressure? c) What are the dimensions for the full scale model?	Cyclic loading of 20 times pressurisation as well as total depressurisation shall be done. The initial pressure shall be considered as operating pressure of penstock. In each cycle, there would be 20 sub-cycles of pressure variation between sustained pressure and design pressure.
16.	How many tests will be conducted?	One Cyclic Load Test followed by Hydrostatic Test.
17.	Please clarify that the CFRP for the test shall be provided and installed by the successful bidder, and that this cost should be	Noted

Sl. No.	Bidder's Query	Response
	factored into the proposed price. It is essential that the CFRP be installed properly into the test specimen.	
	Section 2.10.5	
18.	Please clarify if the inspection referenced is to take place on all layers of FRP as they are installed?	The inspection will take after every 3 layers of CFRP.
	Section 2.10.6	
19.	Please provide testing procedure for the ultrasonic test to be performed on the FRP materials. This is not a standard test performed on FRP for civil infrastructure (such as pipelines) and there is concern regarding using a technique not typical for defect identification.	Ultrasonic test shall be performed by NEEPCO through Third Party Agency as per industry practice.
	Section 2.10.7	
20.	Please clarify the type of testing listed in this section and who the QA Agency is?	Testing shall be done to find out the hardness and volume fraction of composite. QA agency for these two test shall be engaged by NEEPCO.
21.	Additional clarification needed: Per our email submitted on April 9th, we request the following to be provided as part of the design criteria: Please mark up the attached drawing to display the following: a. Exact location of repair areas b. Length of repair areas (lineal meters/feet) c. Design criteria associated with each repair area (if there are differences)	These issues are already addressed in the original Bid Documents and subsequent corrigendum issued.

Rehabilitation of Penstock in Kameng HEP using combination of CFRP and GFRP		Corrigendum IX NIB No. NEEPCO/PEN/IND/001 Date: 02/05/2019

Sl. No.	Bidder's Query	Response
1.	Addendum 7 states the design safety factor should be 5 with a maximum strain of 0.2% (2,000 microstrains). Do the strain limits apply to both the FRP and steel host pipe? I have never seen a SF of 5.0 in the construction industry or strain limit set so low for FRP or steel. These would result in unnecessarily high costs.	Bid condition (Addendum 7) shall prevail.
2.	Addendum 7 also reads the cracks will be treated as ¼ bonded (welded) and 3/4th separated across the pipe thickness? Can you confirm this? This will help the design greatly, but there must not be any cracks that are completely separated; that is, an opening all the way through the host pipe.	Reply at Sl. No. 2 above may be seen.
3.	For the ¼ th welded pipe wall, should we assume that the remaining 3/4th is offset both at longitudinal and circumferential cracks?	The design assumption shall be 1/4th thickness of Pipe Wall is welded and remaining 3/4th thickness with a gap of 3mm for all longitudinal and circumferential joint..
4	What is the basis for cyclic load test? It does not seem as surge is an issue or there will be frequent fluctuations in pressure… Do they realize any full-scale tests will add several months to the project?	Reply at Sl. No. 15 above may be seen.
5	Is there a reason to require 8 MPa (1,160 MPa) bond strength? This is remarkably high, and may be difficult to achieve.	Bid condition (Addendum 7) shall prevail.

Bidders are requested to note the points and prepare & submit their proposal accordingly.

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