



Registrar

National Electric Power Regulatory Authority

Islamic Republic of Pakistan

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No. NEPRA/TRF-351/PPIB-2016/11318-11321

August 18, 2016

Subject: Determination of the Authority in the matter of Tariff Petition filed by Private Power and Infrastructure Board (PPIB) for \pm 660 KV, 4000 MW HVDC Transmission Line Project [Case # NEPRA/TRF-351/PPIB-2016]


Dear Sir,

Please find enclosed herewith the subject Determination of the Authority along with Annex-I and Annex-II (78 pages) in Case No. NEPRA/TRF-351/PPIB-2016.

2. The Determination is being intimated to the Federal Government for the purpose of notification in the official gazette pursuant to Section 31(4) of the Regulation of Generation, Transmission and Distribution of Electric Power Act (XL of 1997).

3. Order of the Authority along with Reference Tariff Table (Annex-I) and Debt Servicing Schedule (Annex-II) of the Determination needs to be notified in the official Gazette.

Enclosure: As above



18.08.16

(Syed Safeer Hussain)

Secretary
Ministry of Water & Power
'A' Block, Pak Secretariat
Islamabad

CC:

1. Secretary, Cabinet Division, Cabinet Secretariat, Islamabad.
2. Secretary, Ministry of Finance, 'Q' Block, Pak Secretariat, Islamabad.

**National Electric Power Regulatory Authority
(NEPRA)**

No. NEPRA/TRF-351/PPIB-2016

**DETERMINATION
OF
TARIFF PETITION FOR \pm 660 kV 4000 MW
MATIARI TO LAHORE HVDC TRANSMISSION LINE**

Date: August 18, 2016

Filed by

PRIVATE POWER INFRASTRUCTURE BOARD (PPIB)

NATIONAL ELECTRIC POWER REGULATORY AUTHORITY (NEPRA)

Case No. NEPRA/TRF-351/PPIB-2016

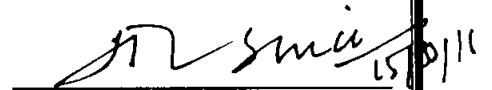
August 18th, 2016

Petitioner

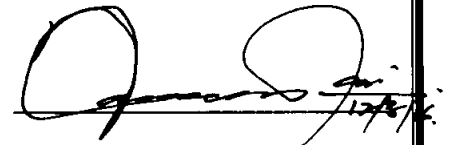
Private Power and Infrastructure Board (PPIB)

Authority

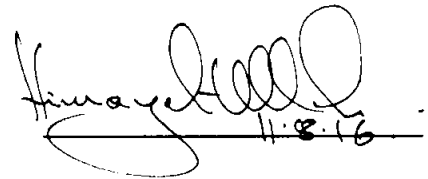
Maj (R) Haroon Rashid
Member

 15/8/16

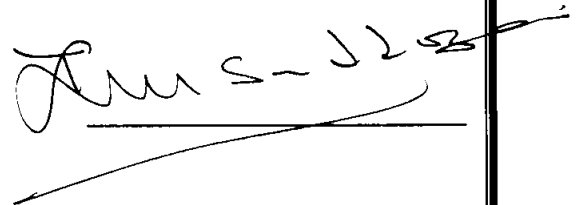
Syed Masood-ul-Hassan
Member

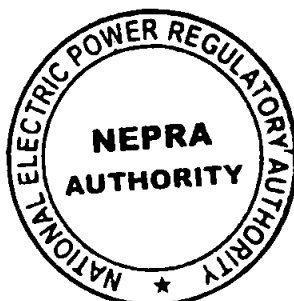
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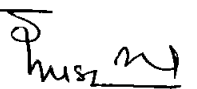
Himayat Ullah Khan
Member/Vice Chairman

 11.8.16

Brig (R) Tariq Saddozai
Chairman





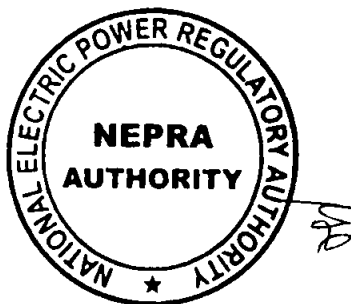

18-08-16

**DETERMINATION OF THE AUTHORITY IN THE MATTER OF TARIFF PETITION FILED BY PPIB
FOR $\pm 660\text{KV}$, 4000MW HVDC TRANSMISSION LINE PROJECT**

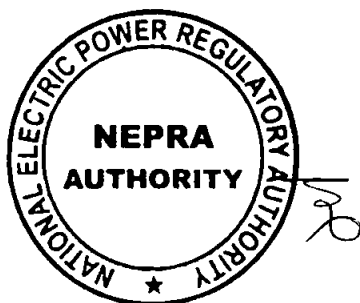
1. PPIB hereinafter referred as "Petitioner" filed a tariff petition vide its letter No. 6 (618)PPIB/UT/TLP/FIN/0-45933 dated February 08, 2016 under Rule 3 of NEPRA Tariff (Standards & Procedure) Rules, 1998 (hereinafter referred to as "Rules"), for approval/ determination of Tariff for $\pm 660\text{ KV}$ HVDC Matiari-Lahore Transmission Line Project..

Back ground of the Case:

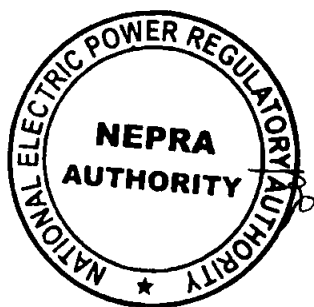
2. Earlier NTDCL vide its letter No MD/HVDC/5246-28 dated November 24, 2015 submitted application for an award of upfront tariff for the same Matiari Lahore Transmission Line project under Policy Framework for Private Sector Transmission Line, 2015, as referred to be duly approved by ECC.
3. NTDCL in its Petition submitted that NTDCL has arranged feasibility studies including system studies and cost studies through SNC lavalain (Canada) in 2013 which evaluated options of 500kV AC expansion 765kV AC and $\pm 600\text{ kV}$ DC and recommended the HVDC option as most viable technically and economically in the long term. Accordingly NTDCL has opted for high voltage DC transmission line for transmitting huge capacity of power from south to mid Country and is planning to construct HVDC transmission line from Matiari to Lahore. NTDCL also submitted that it has conducted a system stability study with assistance of CET and as confirmed the $\pm 660\text{kV}$ HVDC transmission line is the most viable option for the evacuation of power. NTDCL further expressed its inability to arrange financing investment for construction of this HVDC project.
4. In the petition it was also referred that NTDCL has planned to execute this project through private sector on BOOT basis. Accordingly, NTDCL and State Grid Cooperation of China (SGCC) have signed a cooperation agreement on April 20, 2015 for development of this Project. This Project is included in the priority Projects under China Pakistan Economic Corridor (CPEC). Under the said Cooperation Agreement, both parties agreed that nominated subsidiary of SGCC i.e. China Electric Power Equipment and Technical Company Limited hereinafter referred as "CET" will develop the facility on BOOT basis and will also be the EPC contractor for two transmission projects prioritized under CPEC (including this Project).
5. Under the referred cooperation agreement NTDCL has following responsibilities for this Project:
 - a. Determine route for the project,
 - b. Carry out interconnection studies,
 - c. Acquire land and ROW,



- d. Provide data to CET for further studies,
 - e. Pay the transmission service charge on monthly basis in a timely manner.
 - f. Open a revolving account following the occurrence of commercial operations date (COD) for making payments.
6. Under the referred Cooperation Agreement SGCC/CET is required to design, construct, and complete this project, collect all necessary information and to execute Transmission Service Agreement and Implementation Agreement.
7. As per the referred Cooperation Agreement, Government of Pakistan has provided following guarantees;
 - a. Guarantee for securing the payments obligations of NTDCL under IA
 - b. Protection against default of NTDCL under TSA
 - c. Provide compensation in case NTDCL defaults in its obligations towards CET
 - d. Protection against changes in certain laws/taxes/duties
 - e. Protection against force majeure risk
8. In the petition, NTDCL also submitted that there are certain economic benefits for the government and the consumers because of this transmission line. NTDCL submitted that HVDC technology provides the economical solution for large distance bulk power transfer with low losses and enhanced system reliability. NTDCL also expressed the indirect and secondary benefits of this Project including employment generation and improved standard of living.
9. The Authority vide its letter No NEPRA/SAT-I/LAT-100/18198 dated December 23, 2015 informed NTDCL that the tariff petition submitted is not within the ambit and scope of NEPRA (Upfront Tariff Approval and Procedure Regulations, 2011) and is thus not maintainable. NTDCL was also informed that upfront tariff cannot be determined for a single project moreover various technical and financial parameters are project specific for HVDC transmission lines. The Authority also directed that the deficiencies indicated by Teshmont Consultants in their report should be addressed before referring to Authority for a tariff determination.
10. NTDCL vide their letter No: MD(NTDCL)/GSC/5460-63 dated January 02, 2016 again requested for upfront tariff and stated that NEPRA has the competency to amend Regulations to accommodate this upfront tariff under "Upfront Tariff (Approval and Procedure) Regulations, 2011"
11. NTDCL in the mentioned letter advocated the establishment of this HVDC Transmission Line based on the feasibility study it had carried out through the international consultants, SNC Lavalin (Canada).

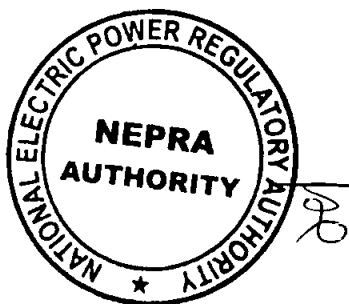


- NTDCL also referred studies carried out have been submitted to the Authority and some studies are being carried out in parallel by NTDCL and China Electric Power Equipment & Technologies Company Limited (hereinafter referred as "CET"). NTDCL also proposed that this Project to be taken as first initiative in power transmission sector, therefore may be considered for allowing the upfront tariff based on specific bands of length of transmission line.
12. NTDCL while reiterating its stance to consider the application for determination of upfront tariff also referred that it is NEPRA's purview to ascertain the legitimacy and correctness of cost estimates compared with other international practices and prices. NTDCL also referred that it had submitted the estimated cost comparison prepared by it as per SNC Lavalin, Teshmont and CIGRE. NTDCL therefore requested again for early public hearing for award of an upfront tariff.
13. The Authority vide its letter No NEPRA/SAT-I/LAT-100/299-302 dated Jan 08, 2016 informed NTDCL that its request for carving or altering NEPRA's Regulation to accommodate a single project is against the principle of transparency and also being ultra vires to existing law, cannot be acceded to. The Authority again emphasized the need for due diligence by NTDCL on the technical and financial aspects of this Project, as the information submitted by NTDCL have not been duly supported with credible evidences for a tariff consideration.
14. The Authority also observed that the Cooperation Agreement between NTDCL and State Grid Cooperation of China "SGCC" was signed on April 20, 2015 with no subsequent steps in this regards. NTDCL was also directed that without indulging in needless correspondence, the applicant Company should file a petition under NEPRA tariff (Standard and Procedures) Rules, 1998 justifying the tariff based on cost to be incurred along with application for grant of Special Purpose Transmission License. The other mode referred by Authority in the correspondence was that the relevant agency to conduct international competitive bidding in the manner as prescribed in NEPRA Competitive Bidding Tariff (Approval Procedures) Regulations, 2014.
15. Subsequently, PPIB filed this tariff petition based on the same information forwarded by NTDCL, vide its letter No. 6 (618)PPIB/UT/TLP/FIN/0-45933 dated February 08, 2016 referring to Rule 3 of NEPRA Tariff (Standards & Procedure) Rules, 1998 (hereinafter referred to as "Rules"), for approval/determination of Tariff for $\pm 660\text{ KV}$ HVDC Matiari-Lahore Transmission Line Project.
16. The Petitioner referred that submission of this tariff petition for the project has been duly approved by Secretary Water and Power and Chairman PPIB Board / Minister for Water & Power. Subsequently, it also referred that PPIB Board ratified the filing of this tariff petition before NEPRA by PPIB for ± 660



HVDC Matiari-Lahore Transmission Project and to perform all actions deemed appropriate and necessary or incidental in relation thereto.

17. The Petitioner also referred that due to constraints of public sector resources and borrowing capacity of NTDCL, Government of Pakistan has developed a policy framework to invite private sector for construction of transmission network in addition to power generation. The induction of private sector in transmission line will not only enhance the estimated network capacity but will also bring stability, reliability and sustainability in the system.
18. As per the documents submitted the background of the Project was explained that NTDCL earlier hired NESPAK for the feasibility study of transmission line from Karachi to mid Country load centers. However, NESPAK due to its limited capacity engaged SNC-Lavalin International for the referred study. The initial scope of work was the feasibility study of 1300 km transmission line for the dispersal of 2500-3000MW power from the imported coal based project. The scope was divided into two phases; Phase-1 (conceptual design study) was concerned with the system studies, selection of technology and voltage for the transmission line, and initial environmental and social assessment, Phase-2 was concerned with the detailed system studies for the selected transmission option, GIS mapping and satellite imaging, field surveys and routing of the transmission line, engineering design of the transmission line and substation functional specification, project costing, economic analysis and environmental and resettlement/ social assessment.
19. At a later stage after the completion of phase-1, NTDCL decided that in view of the uncertainty associated with the development of the generation capacity in area considered, it would be premature to undertake the detailed study and physical survey of the transmission line route from Karachi to upcountry. Instead taking into consideration the strong possibility of generation capacity development in the Thar region due to availability of huge indigenous coal reserves, it was decided that the detailed studies and the physical surveys should be carried out for the following two transmission lines originating from Thar;
 1. 500kV HVAC line from Thar to Matiari (235 km approximately)
 2. $\pm 600\text{kV}$ HVDC line from Thar to Lahore (960 km approximately)
20. The Petitioner submitted that the main objective was to evacuate power from Thar coal power plants through an HVDC line. The feasibility study had earlier proposed transmission line from Thar to Lahore, though later Matiari site was selected as sending-end Converter Station because the upcoming southern power plants were at three different sites, i.e. Port Qasim, Hubco (in coastal area) and at Thar. Moreover, the plant capacities at any one site were not enough to plan HVDC line directly from



these individual sites to the load Centre. Therefore, on the basis of capacities, locations and timelines of Port Qasim and HUBCO Coal Plants, it was considered an optimal solution to connect them to Matiari with 500 kV HVAC lines for further transfer to Lahore through an HVDC line.

21. Certain information including the EPC cost proposal and the review report by Teshmont Consultants hereinafter referred as "Teshmont" were also submitted. The referred review report by Teshmont expressed, pointed out and highlighted comments on various technical and financial aspects for this first HVDC project of the Country.
22. Teshmont submitted that they have reviewed the claimed EPC cost in context of:
- Recently awarded HVDC project
 - Teshmont internal cost , estimates ,database
 - Cost provided in SNC lavalin feasibility study, and
 - Recent price information for steel and cable

Teshmont also reviewed the cost subcomponents of converter stations and transmission line and compared it with CIGRE technical data also. They analyzed and expressed that the claimed EPC cost is evaluated as high.

Admission and Proceedings under the Tariff Regulatory Framework:

23. The Authority admitted the referred tariff petition under Rule 4 of NEPRA Tariff (Standards and Procedures) Rules, 1998. Advertisement for public hearing along with salient features of the tariff petition was published on Feb 27, 2016 in widely circulated dailies inviting the intervention or comments from the interested stakeholder. Moreover separate notices were also issued to relevant stakeholders for hearing.

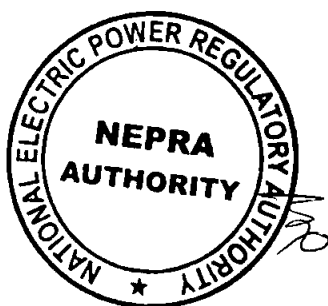
Salient feature of the Tariff Petition:

24. The salient feature of the subject tariff petition are;

a. **Technical and Financial Parameters:**

- i. Following are technical parameters of the project:

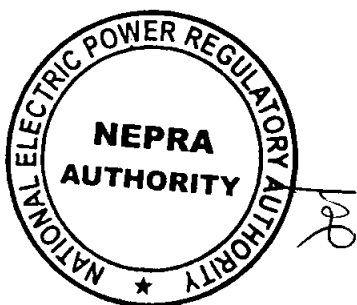
Design Transmission Capability	4000MW
Design transmission capability (converted into kWh)	35,040,000000kWh
Length of the Transmission line (Matiari to Lahore)	878 km
Voltage Level	$\pm 660\text{ kV}$ HVDC



Conductor	4*1250 mm ²
Allowed Loss Ratio	4.3% per annum for Bi-pole operations

ii. SGCC/CET Cost basis and Estimates for +660 kV HVDC Transmission Project:

S.No	Project Cost Heads	Basis for cost claim	Project cost US \$ million
i.	EPC Cost	As per the details provided by SGCC/CET to NTDCL	1,757.20
ii.	Non EPC Costs/Development Cost	Assumption	32.921
iii.	Financial Charges @ 3.5% of Debt	Assumed as 3.5% of total debt	58.81
iv.	NTDCL Development Cost	Assumed cost of site survey, load flow studies, environmental studies, land lease costs, crop compensation, ROW which will be incurred by NTDCL later these costs will be reimbursed by SGCC to NTDCL	15.21
v.	*Insurance during construction	As claimed by CET, along with report of insurance broker's (Marsh and McLennan) (submitted later)	19.3
vi.	Sinosure fee/premium	Upfront fee @ 7% of total debt servicing/annual premium @ 0.63% commitment fee @ 0.095 %	21.26
vii.	Taxes	Custom duty @ 5% Sindh infrastructure Cess 1.05%	106.31
	Project cost excluding IDC		2,011.01
viii.	Interest During Construction	For 27 months period; as per the debt drawdown scheme i.e. 65% for	108.67



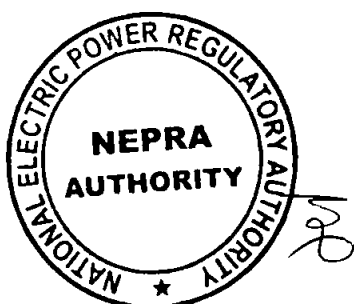
	Year 1, 35% for year 2 and 5 % for year 3 (Foreign loan has been assumed)	
	Total Project Cost Including IDC	2,119.68

iii. The EPC cost consisted of following major components:

Sr	Description	Basis for cost claim	Amount (US \$ million)
1	2 convertor stations (including AC yard, DC yard, electrode ground and other auxiliary system)	As per the details provided by SGCC/CET to NTDCL	1,260.14
2	Approx. 878 km transmission line (1250 mm ²) and three repeater stations	As per the details provided by SGCC/CET to NTDCL	497.06
		Total	1,757.20

iv. Other operational costs basis and estimates:

Sr	Description	Basis for cost claim	Cost US \$ million
1	Fixed O & M Cost-Foreign	Cost includes pay and allowances, tools, spare parts, social security, administration, imported spare parts and for both converter stations	37.62
2	Fixed O & M Costs-ITC Local	Includes local cost associated to the converter stations, partial overhaul/ replacement costs, partial spare parts cost and company partial spare parts cost and operational cost, local spare parts, tools and services for transmission lines and repeater stations,	19.95
3	Fixed O & M Costs - NTDCL Local	NTDCL cost for routine maintenance and patrolling	16.78
4	Land Lease Costs	Annual land lease cost- NTDCL will acquire land and ROW and will lease it to ITC.	2.46
5	Insurance during operations	As per the report of their insurance broker's (Marsh and McLennan) (submitted later).	21.09



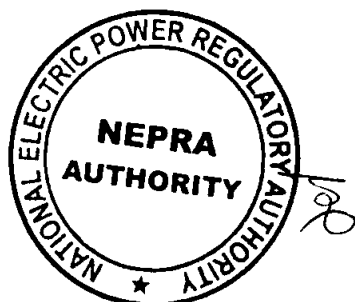
6	Sinosure Fee	annual premium @ 0.63% Calculated as per the following formula; [(Current outstanding debt principle at start of the year + Proposed debt drawdown during the year+ Expected IDC accumulated up till the end of current year)*annual premium @ 0.63%]	-
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v. Proposed Tariff by the Petitioner:

Tariff Break Up (levelized tariff)	PKR/kWh
Fixed O & M- Foreign	0.111
Fixed O & M- ITC Local	0.059
Fixed O & M- NTDCL O& M Local	0.050
Land Lease	0.007
Insurance Cost	0.0693
Sinosure Fee	0.015
Debt Service	0.435
Return On Equity (ROE)	0.218
Return On Equity including ROEDC	0.051
Levellized Tariff (Year 1-25)	1.0153

vi. Financial parameters/assumptions provided by the Petitioner for the calculation of levelized tariff:

Debt :Equity	80:20	
Interest Rate	Foreign Financing =0.45% (Six Month LIBOR) + 4.75% Local Financing = 8.5% (6 month KIBOR)+ 3%	
Debt Payment Schedule	Semi-annual Payment inclusive of principal and interest	
Loan tenure	Loan tenure 10 years repayment period plus 27 months grace period	
Construction period	27 months	
Debt drawdown / Equity Drawdowns	Year 1- 65% Year 2- 30% Year 3- 05%	Year 0-12% Year 1-53% Year 2-30% Year 3-05%
Reference Exchange Rate	1 UD Dollar= Rs 103.5	
NPV Discount	10%	
Terms of the project (BOOT)	25 years from COD	
Return on Equity (ROE) IRR based	17%	
Return on equity during construction	17%	



Withholding Tax on dividends	Nil-Pass through as per actual
Corporate income tax	Pass through up to first ten (10) years from COD

vii. The Petitioner along with its tariff petition earlier submitted following list of coal based power plants for transmission of power from south to north (which was revised subsequently);

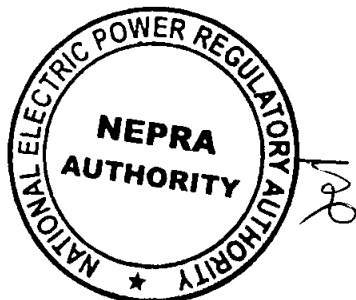
Sr.No	Project Name	Location	Gross Capacity (MW)
1.	Engro Thar Coal Company Ltd. (Phase-I)	Thar, Sindh	330
2.	Engro Thar Coal Company Ltd. (Phase-II)	Thar, Sindh	330
3.	SSRL Thar Coal	Thar, Sindh	1,320
4.	Port Qasim Project	Port Qasim	1,320
5.	The Hub Power Company Ltd. (Phase-I)	Hub Baluchistan	660
6.	The Hub Power Company Ltd. (Phase-II)	Hub Baluchistan	660
7.	Siddique Sons Energy	Port Qasim	330
Total			4,950

Intervention Requests:

25. In response to the public advertisement for hearing to be held on March 24, 2016 two intervention requests i.e. from Anwar Kamal Law Associates (AKLA) and Lucky Power Electric Company Limited were received on March 08, 2016 and March 15, 2016 respectively.

a) **Anwar Kamal Law Associates (AKLA)** submitted following comments/observations;

- Project is being processed in haste without proper technical, financial and legal scrutiny of the issues involved in the matter.
- AKLA appreciated the question framed by NEPRA. However they referred that these questions should be sent to the Petitioner and after reply from the Petitioner, uploaded on NEPRA's website for soliciting comments from all stakeholders for meaningful participations of all the stakeholders.



- Tariff Petition has been filed by the Private Power Infrastructure Board (PPIB). NEPRA needs to answer under which capacity PPIB submitted this Tariff Petition and why is NEPRA entertaining it?
- The name and address of the Petitioner is mentioned as Mohammad Arshad Managing Director of the National Transmission and Dispatch Company Limited. Why then has NTDCL not submitted this Tariff Petition? Moreover, the Petition has been submitted without the signatures of the Petitioner.
- Has NEPRA ensured that the NTDCL Board has accorded permission to file this Tariff Petition? If so, NEPRA is requested to share this information with AKLA

The comments were forwarded to the Petitioner for response. The observations/objections raised by the commentator as well as Intervener have been discussed under relevant heads.

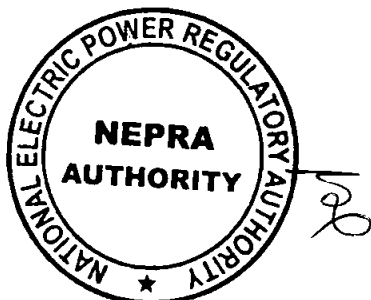
- b) Lucky Power Electric Company Limited submitted that given list of Power Projects in Petition excludes Lucky Electric Coal Fired Power Plant (660 MW), which is likely to achieve COD in 2019 and sought the relief that the petitioner may be directed to amend and resubmit the tariff petition after inclusion of Lucky Electric Coal Power Project to be set up in the southern region.

The Petitioner in the subsequent correspondence ref No. 6(618) PPIB/TLP/FIN dated July 29, 2016 has submitted following Projects to be connected with Matiari switching stations for power transmission through this HVDC transmission line;

Sr.	Project Name	Capacity(MW)	Expected COD
1	Engro Thar Unit I & II	660 MW	June, 2019
2	Thar Coal Block-1(Shangai)	1320MW	Aug, 2020
3	Port Qasim	1320MW	June ,2018
4	Hub Power Port Qasim	1320MW	March 2020
	Total	4,020	

The Authority believes that the revised list of power plants provided by Petitioner for power transmission through this HVDC transmission line does not include certain power generation Projects but NTDCL having integrated system is responsible (under PPAs signed) for evacuation of power. Therefore, intervener's concern is already covered under relevant legal covenants.



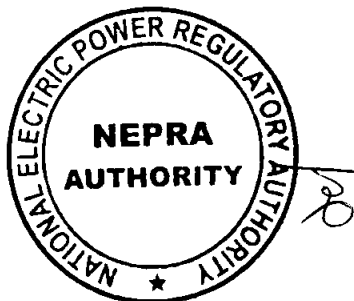


Framing of issues:

26. Considering that this is the first HVDC project and will be of great importance in future in the national transmission arrangement, various questions were identified to be addressed. Following are the issues and questions that were framed, as approved by the Authority;

I. Overall Aspect of petition:

- (1) Is the tariff petition submitted by PPIB duly approved by its Board?
- (2) The Tariff Petition has been filed by PPIB under Rule 3 of NEPRA's Tariff Standards & Procedures Rules, 1998 while the contents of the Petition indicates that the Petitioner is NTDCL which intends to seek a Tariff from NEPRA pursuant to the "Policy Framework for Private Sector Transmission Line Projects, 2015"? Can the Petitioner clarify this anomaly?
- (3) Has PPIB given consideration to technical and financial aspects in its due diligence before forwarding the tariff petition? Has it evaluated reasonableness for capital costs and operational costs claimed?
- (4) Has the NTDCL looked into the option of construction of the Transmission Line through its own resources or through other funding resources including supplier credit etc.?
- (5) Have the issues highlighted by Teshmont Consultants addressed? If yes, what changes have been proposed in the Project design and cost?
- (6) Is the EPC and O&M cost claimed rationale in view of SGCC built Ningdong-Shandong HVDC Transmission line (also $\pm 660\text{ kV}$ 4000 MW)? If not, what is the justification for difference in EPC cost etc?
- (7) Whether the option of HVDC instead of HVAC is justifiable? What is the outcome of any economic and financial evaluation carried out?
- (8) What is the rationale and criteria for the selection of $\pm 660\text{ KV}$ HVDC? Considering the cost differential between $\pm 660\text{ KV}$ & $\pm 500\text{ KV}$ what is the outcome of any technical and financial evaluation carried out? What is the estimated resultant impact on consumer end tariff?
- (9) What will be the technical and financial impact of lowering the requirement of power transfer from 4000 MW to 3000 MW. Has any scenario analysis carried out if voltage level is lowered or both power transfer and voltage level are lowered?
- (10) What is the status of the Transmission Service Agreement (TSA) and Implementation Agreement?
- (11) What is the status of CET application for a special purpose transmission license (SPTL) for the proposed project?
- (12) What is the status of compliance with the section 19 of the NEPRA Act under which a Licensee for SPTL is required to provide transmission and interconnection services /facilities to the National Grid Company (NGC) for making available its transmission facility to NGC?



II. EPC Costs:

Whether the Proposed/Claimed EPC Cost is justifiable?

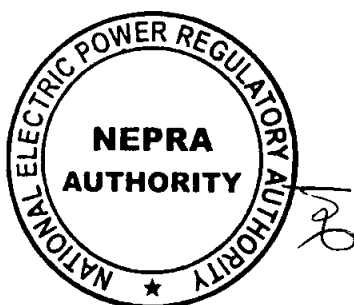
- (13) What process has been followed by the Petitioner to ensure EPC cost submitted for this HVDC Transmission Line is competitive and comparative internationally?
- (14) Are cost components claimed for each convertor station rationale and justified? This in particular include the costs claimed for sub-components of:
 - Civil & Installation Works (US\$ 251.8 million)
 - Equipment and Material (US\$ 817.46 million)
 - Basic Engineering & Detailed Engineering (US\$ 303.5 million)
 - Station Commissioning & System Commissioning Cost (US\$ 10.83 million)
 - Transportation Cost (US\$ 48.48 million)
- (15) What are the major cost components of each Electrode/Grounding Stations?
- (16) What are the major cost components of each Repeater stations?
- (17) What is the basis of selection of Tower design? Is the design and cost of Towers and Cable rationale and justified?
- (18) Has the tower designed optimized to minimize the land acquisition and ROW costs?
- (19) As CET will be the only EPC contractor, are there any overlaps of substantial Project Management costs being claimed under sub-components of EPC?

S.No	Description	Purpose	Amount US\$ million
1	Project Management	Convertor Station	11.44
2	Project Management	Transmission Line	5.57
3	Security Cost (responsibility of GOP)	Convertor station	2.34
4	CET Security Coverage Cost (responsibility of GOP)	Transmission Line	9.89
5	Supervision for construction & Installation	Convertor station	14.68
6	Supervision for construction & installation	Transmission Line	5.38

III. Non-EPC Cost:

Whether the Non-EPC cost is Justifiable?

- (20) What are the cost components and estimation basis of the claimed 'NTDCL Development Costs' of US\$ 15.21 million?



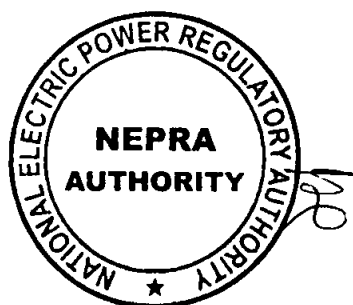
- (21) What is the scope, duration and deliverables of the 'Advisors and Consultants' to be engaged against the amount of US \$ 7.89 million claimed?
- (22) Has the entire amount paid or accrued for US \$ 5.4 million claimed on account of feasibility Study? What was the selection process adopted for the purpose?
- (23) Have all the issues proposed in Feasibility study addressed? Relevant source documents of the study and payments may please also be provided?
- (24) What is the summary of HR cost of US\$ 8.79 million claimed?
- (25) What is the basis of additional cost being claimed on account of Security when GoP has to make necessary arrangements for this?
- (26) What is the summary of the assets and vehicles claimed for US \$ 2.88 million? Particularly the same has already been claimed as part of O&M cost as well?
- (27) What is the summary of the Project Administrative cost claimed for US \$ 2.78 million?

IV. Operation & Maintenance:

- (28) Is it financially and technically optimal to segregate the O & M responsibilities among different organization?
- (29) What will be the difference of scope and responsibilities between foreign & local O&M Contractors to be engaged with costs of US\$ 37.6 million and US \$ 19.95 million respectively?
- (30) Have the Foreign O&M Sub-Contractor been identified for the US\$ 37.6 million cost claimed?
- (31) What is basis of segregation under same head between Foreign O&M Cost and Local O&M Cost for convertor station?

S.No	Description	Foreign O&M US \$ million	Local O&M US \$ million	Total US \$ million
1	Administrative cost	4.56	8.16	12.72
2	Pay & Allowances	5.88	1.52	7.4
3	Spares & Tools	2.06	1.24	3.3
4	Spare Parts	Transmission Line	2.659	

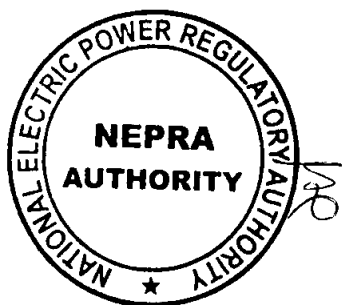
- (32) Is the high percentage 'Administration' cost justified representing 64% of local O&M total cost for Convertor Stations?
- (33) Does NTDCL have required capacity to carry out O&M operations and render quality service for the HVDC Transmission Line?



A

V. Technical issues

- (34) What are the major differences in design from the earlier parameters proposed by SNC-LAVALIN in their feasibility study?
- (35) As referred in Cooperation agreement, has NTDCL carried out interconnection studies, including load flows, short-circuit and transient stability studies for the Project.
- (36) Is the Petitioner and NTDCL are satisfied with load flow studies carried out by SGCC/CET for this project in view of future generation and load centers?
- (37) Has the Petitioner taken into account the proposed RLNG based and Coal based Generation plants near load centre in north before finalizing the design of line?
- (38) What is the rationale for the proposed losses and non-penalized 1.5% non-availability period in view of international practices for an HVDC line?
- (39) Has there been any assessment of impacts including estimated losses variations if the power generation for referred coal projects varies from anticipated production determined for transmission?
- (40) What is the rationale for heavy towers instead of guyed towers?
- (41) Has the reliability of Transmission networks in line with the requirements of NEPRA Performance Standards (Transmission) Rules-2005 been evaluated and confirmed?
- (42) What International Standards will be complied for type/make/model number of equipment/materials & how their compliance will be monitored and ensured?
- (43) What is the status of system studies that were required to be conducted by NTDCL which include following;
- Insulation coordination;
 - AC and DC filter design, rating and performance ;
 - Reactive power studies , switching arrangement and logic;
 - Temporary overvoltage;
 - Transient over voltage, surge arrester stress;
 - Sub-synchronous resonance (SSR) studies
 - AC equivalent study;
 - Load flow, stability, modulation and frequency controller design study;
 - Dynamic overvoltage study
 - Reliability and availability study
- (44) Whether critical path analysis carried out for the project including readiness of the HVAC system?
- (45) Whether N-1 contingency has been made available for this transmission line?
- (46) How will integration with the HVAC be ensured and whether NPCC would be ready for the new scenario? Are training of NPCC and other professionals' part of the project?
- (47) Whether need for additional reactive support is foreseen and whether it is included in scope of work and cost?



VI. Financial Parameters:

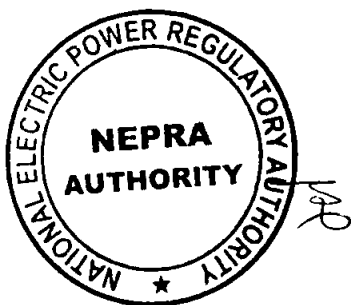
- (48) Whether the proposed/claimed Capital Structure for the project is justified?
- (49) Whether the minimum IRR of 17% guaranteed under Cooperation agreement is justified for a transmission Project, particularly with GOP providing guarantee for securing payment obligation also?
- (50) Whether the construction period of 27 month is reasonable? Does the proposed timeline of the subject project match with the revised timelines of the power generation projects expected to be installed in the Southern part of the Country?
- (51) Whether the proposed spread of 4.75% justified with GOP providing guarantee for securing payment obligation?
- (52) Whether the proposed spread of 4.75% over Six Months' LIBOR be justified in the presence of sinosure fee and GOP guarantees?
- (53) Is the assumption that Withholding Tax on dividends shall be considered as a pass-through item justified?
- (54) Do the NTDCL have the required financial health & working capital to meet payments monthly /annually obligations?
- (55) What will be allied cost of A.C lines? What additional cost will be borne for system stability with proposed induction of HVDC?

VII. Right Of Way (ROW) & Environmental Issues

- (56) What is the estimated timeline for ROW acquisition by NTDCL?
- (57) Whether the route finalized and necessary approval taken for ROW from concerned Provincial and related Authorities?
- (58) What is the segment wise ROW cost worked out? Will ROW be acquired at official rates?
- (59) Is the population along the path of this HVDC electrified justifying the HVDC technology?
- (60) Have all the requirements of Pakistan Environmental Protection Agency (PEPA) Act 1997 complied? Have necessary approvals taken in this regards?
- (61) Has the EIA and IPSA report prepared for this transmission line as specified in Cooperation agreement?
- (62) Whether corrosion level in different zones along the corridor has been evaluated?

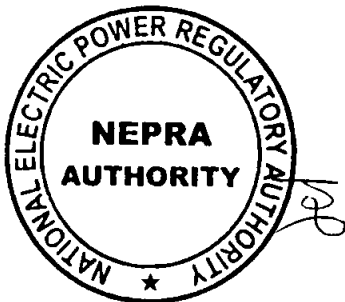
VIII. Others:

- (63) Whether the matters highlighted in NEPRA's letter No NEPRA/SAT-I/LAT-100/2570 dated February 24, 2016 have been duly addressed?



Hearing:

27. During the hearing held on March 24, 2016, there was wide participation from various stakeholders including academia, legal, technical and financial expert. Various questions were raised during the hearing, which were also referred to the Petitioner for response.
28. The petitioner informed that the hearing is being attended along with the Managing Director NTDCL and his team along with representatives of CET, which are three key stakeholders for execution of this Project. The petitioner expressed that this petition is in context of the umbrella framework agreed between the two Governments.
29. During the hearing NTDCL representatives informed about the Transmission flow that will be parallel to this HVDC Transmission Line. On query by Authority, NTDCL expressed that they can only do the basic level studies as NTDCL does not have capability to carryout advanced level study with HVDC modeling and will provide all relevant data to CET for the purpose. However, they expressed that there will be no big change on the project cost and related aspects in view of ongoing studies.
30. On request of petitioner, the EPC contractor (CET) also explained the salient aspects of the Project and profile of SGCC. They also expressed the responsibilities with regards to the operation and maintenance of the Transmission Line. They also assured the local capacity development on HVDC technology. Authority directed them to provide a comparison with their international Projects.
31. During the hearing it was informed that PPIB has negotiated an implementation agreement and NTDCL has negotiated Transmission Service Agreement for this transmission line, which will be finalized after the award of tariff. On the query from the Authority, the petitioner responded that there are certain Projects in South and irrespective of the merit order aspect; the power from those power plants will have to be evacuated as in case of non-evacuation there are financial implications associated, therefore the transmission lines are required.
32. The Petitioner during the hearing failed to comprehensively respond to the certain issues framed. The Authority expressed that besides NTDCL, it is Petitioner's responsibility to provide all relevant information and directed to submit comprehensive responses latest by April 15, 2016. However, the Petitioner did not respond against the given timeline. The Petitioner was directed vide various correspondence for earliest submission of revised responses. Eventually the responses were received from the Petitioner on June 30, 2016. For certain matters, that were not comprehensively addressed, had to be again referred back to the Petitioner for responses.



33. **Whether the Proposed/Claimed EPC Project Cost is justifiable?**

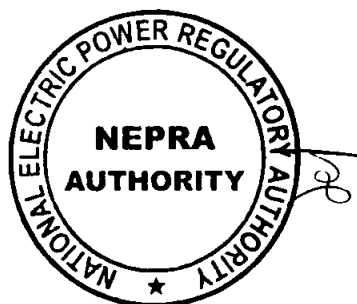
33.1 Having examined the petition it was noted that EPC is the major component of the claimed project cost representing approximately 84% as per the tariff petition. The total claimed EPC cost of USD 1,757.20 million has USD 1,260.14 million (72%) for two (2) converter stations (including AC yard, DC yard, ground electrode etc.) while the balance USD 497.06 million (28%) is for the 878 km HVDC transmission line.

33.2 Below is the summary of EPC cost claimed for the converter stations and transmission lines;

Detail of Converter Station Cost		
Items	Description	USD
A	Construction and Installation of Converter Station	276,287,364
B	Construction and Installation of Electrodes	14,068,628
C	Supply of Materials, Equipment and Systems (including Spare Parts for warranty period)	817,443,997
D	Engineering (Basic engineering and Detail engineering)	42,446,596
E	Commissioning	10,830,054
F	Project Management	31,418,619
G	Transportation Costs and Custom clearance	48,478,638
H	Security Control System (Installed in the NTDCL Gird System)	8,169,934
I	Foundation Treatment at Converter Station	8,651,302
J	CET Security Coverage Cost (The cost for security company. This does not include any cost and charges of the Government of Pakistan (GOP) security service)	2,343,898
	Total	1,260,139,030

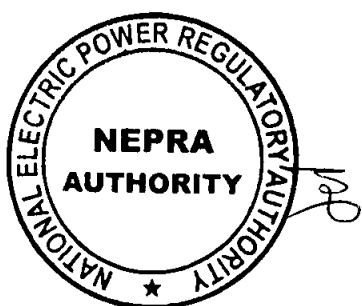
33.3 The table below summarizes the transmission line claimed cost:

Detail of Transmission Line Cost		
Items	Description	Claimed US \$
A	Plant and Equipment Including Spare Parts	220,769,906
B	Design Services (Basic and detailed Engineering)	11,395,464
C	Installation & other services	221,834,843
D	local Transportation, Insurance and Other Incidental Services	18,239,586



E	CET Security Coverage Cost (The cost for security company. This does not Include any cost and charges of GOP security service	9,895,358
F	Project. Management	10,956,826
G	Relay Station	3,663,217
H	OPGW connection	301,471
	TOTAL	497,056,671

- 33.4 The claimed EPC cost for converter stations (i.e. 1,260.139 million) for 4000 MWs capacity turns out to be USD 315,034 per MW and claimed cost for transmission line (i.e. 497.056 million) turns out USD 566,123 per km against the length of 878 km.
- 33.5 As part of the questions framed, Petitioner was directed to support the claimed cost in view of due diligence carried out by it. The Petitioner was also directed to provide the comparison of the claimed cost with international projects including those constructed by SGCC itself in Brazil and China. In earlier response, the Petitioner submitted that all the Brazilian projects cost information is confidential and cannot be provided. However, later Petitioner submitted a comparison (i.e. converter station cost and transmission line cost) of Ningdong Shandong HVDC project and two Brazilian HVDC projects carried out by SGCC. The Petitioner did not index the comparative cost with change of various cost from 2009 to 2016 for a meaningful comparison. The Petitioner referred that being first HVDC project in Pakistan, the Authority may obtain information/data for such projects from other sources, as it deems appropriate for its due diligence.
- 33.6 Being first of this kind of project in Pakistan and in view of the limited information provided by the Petitioner, information from various sources had to be sought including related details of larger international HVDC Projects, Regional HVDC Projects, manufacturers etc. Moreover, considering that the EPC price claimed is not substantiated on a competitive or substantial comparative basis therefore Authority had to closely consider the comments of Teshmont as well an international HVDC expert to arrive at a fair assessment in the instant case.
- 33.7 Below is the comparison of claimed EPC costs for converter stations and transmission line with the international HVDC projects obtained from different sources:



33.7.1 Comparison of EPC cost of Matiari Lahore Transmission line Project with cost data of Brazilian HVDC Projects:

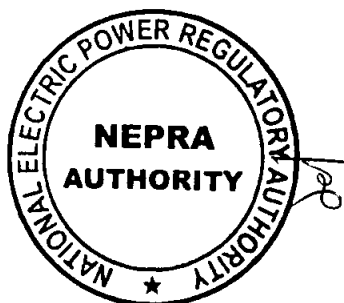
33.7.1.1 Brazil is one of the leading Country that opened up its transmission projects for the private sector participation. Over the past 15 years it has carried out bidding for over 60 transmission lines with a cumulative length of over 21000 km.

33.7.1.2 The table below reflects a comparison of the EPC cost claimed in the tariff petition with EPC cost for large Brazilian HVDC Projects;

Description	Matiari Lahore Bipole $\pm 660\text{kV}$ 4000MW 878km Claimed Cost US \$	Comparison with Brazilian HVDC Projects			
		Maderia Project Bipole 1 $\pm 600\text{kV}$ 3150MW 2375km 2009 US \$	Maderia Project Bipole 2 $\pm 600\text{kV}$ 3150MW 2375km 2009 US \$	Belo Monte Bipole 1 $\pm 800\text{kV}$ 4000MW 2192 2014 US \$	Belo Monte Bipole 2 $\pm 800\text{kV}$ 4000MW 2518 2015 US \$
Cost of Converter Station/MW (Indexed upto 2016 and adjusted for kV and MWs)	315,034	248,425	203,298	178,279	229,381
Cost of Transmission Line /km (Indexed upto 2016)	566,123	291,476	280,711	358,421	287,948

33.7.1.3 The aforementioned Brazilian projects were awarded under a competitive process wherein the organizations inviting bids, made its own assessment of the investments required for each of the project auctioned. The assessment was used as benchmark for evaluation of bids received on the basis of least revenue requirement. Later, the successful bidder submits to the regulator its breakdown of regulatory budget and its revenues. Actual costs are adjusted at the project completion.

33.7.1.4 The Authority noted that cost comparison of Matiari-Lahore Transmission Line Project with Brazilian HVDC projects reflect that for both converter stations and transmission line, the cost claimed by Petitioner is substantially high even giving due consideration to various distinct aspects specific to Matiari-Lahore Project including the voltage, capacity, availability etc.



33.7.1.5 The Authority also observed that indexed cost range emerged for the converter station as per Brazilian actual cost data is US \$ 178,279/MW-US \$ 248,425/MW and for the transmission line is US \$ 280,711/km-US \$ 358,421/km. For a prudent analysis with Matiari Lahore Project due consideration was also given to all related factors including type of conductors, insulators, tower design, number and type of towers, allowed losses, terrain of the above referred lines. Likewise the Transmission Line availability factor and related aspect of indexations and forex risk being claimed for Matiari Lahore Project were also considered.

33.7.1.6 Authority also considered that SGCC was the part of two out of four aforementioned projects namely Belo Monte Bipole 1 and Belo Monte Bipole 2. These Projects were awarded under a competitive process.

33.7.2 Comparison of EPC cost of Matiari-Lahore Transmission line with cost data of Indian HVDC Projects:

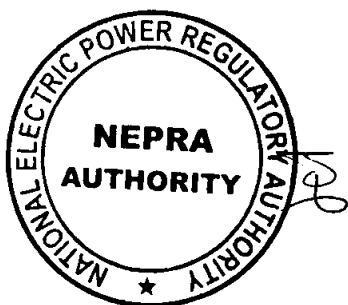
33.7.2.1 The Authority also considered regional HVDC Project cost, data with respect to two HVDC transmission lines installed in India in 2013 and 2014. It was noted that the two projects (Champa Kurakshetra I & II) of 800 kV transmitting 3000 MW got same bids for the converter stations, i.e. USD 540 million. In terms of MWs, this cost works out to be USD 180,000/MW which is even more competitive and lesser than Brazilian projects referred above.

33.7.2.2 In order to make a meaningful comparison project specific costs were adjusted including relevant indices at the prevailing price level of 2016. Due consideration was also given to the adjustment of voltage level and MW; on the basis thereon converter station cost for the Matiari Lahore Project works out to be approximately 200,000/MW, which is still substantially less than the claimed cost for Matiari-Lahore Project converter station cost (US \$ 315,034/MW).

33.7.2.3 The Authority also noted that in the referred projects, both in Brazil and India, the transmission projects were awarded under a competitive process. Consequently, relevant organizations particularly Power Grid Corporation of India Limited (PGCIL) has been extremely successful to get competitive price as referred above.

33.7.3 Comparison of EPC cost of Matiari-Lahore Transmission line with cost data of Chinese HVDC Projects built by CSG:

33.7.3.1 Petitioner in its revised replies submitted since China is the lead market on HVDC; therefore the cost estimates submitted by CET are justified. The Authority considers that being in the lead market does not form a justified basis to accept the cost claimed in the petition. In order to be consider as prudent cost it needs to be justified and supported by reliable evidences. Information was therefore also sought



from Chinese HVDC Projects built by China Southern Power Grid Company Limited (CSG) which constructs and operates power grids in Guangdong, Guangxi, Yunnan, Guizhou, and Hainan provinces in China. CSG has established 16 transmission lines with a total transmission capacity of approximately 35 GW. CSG has been involved in various generation Projects.

33.7.3.2 The table below reflects the project costs of transmission line built by CSG along with related features of those transmission lines.

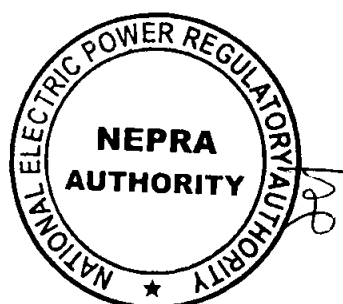
Project Title	Guiguang Phase II DC Power Transmission	Yunguang DC Power Transmission	Nuozhadu DC Power Transmission	Xiluodu DC Power Transmission
Year	Dec 2007	June 2010	Sep 2013	June 2014
Voltage (kV)	± 500	± 800	± 800	± 500
Capacity (MW)	3000	5000	5000	6400
Length (KMs)	1194	1373	1413	2*1223 (Double circuits on the same tower is 991 KM, single circuit 2*232 KM)
Availability	$\geq 95\%$	$\geq 95\%$	$\geq 95\%$	$\geq 95\%$
Total project Cost Billion US \$	1.365	2.31	2.625	2.73

33.7.3.3 While making the comparison of cost of Matiari Lahore Project country specific factors were also considered. Furthermore, the project cost was adjusted for relevant indices to bring the cost at current price level. Due weightage was also given to relevant technical aspects including capacity and voltage level as ± 800 kV is considered a step ahead. For this purpose international benchmarks were considered.

33.7.3.4 The EPC cost claimed by petitioner was again assessed high in view of the comparison.

33.7.4 Comparison of EPC cost of Matiari Lahore Transmission line with Ningdong Shandong Project data provided by CET:

33.7.4.1 Nangdong Shandong is a Chinese Transmission Line Project having certain similarities with the Matiari-Lahore HVDC Project as it is also a $\pm 660\text{kV}$ 4000 MV Project also built by CET (same EPC contractor) but for a longer distance of 2,518 km transmission line. The size of the conductor used in



the Nangdong project is 1000mm^2 as compared to the conductor of 1250mm^2 to be used in the Matiari Lahore project.

- 33.7.4.2 The petitioner has submitted a technical and financial comparison but without adjusting for relevant indices. Below is the EPC cost comparison of the Matiari Lahore transmission line project with the EPC cost data of Ningdong Shandong project provided by CET.

Description	Claimed	Comparison with China's Ningdong Shangdong Project $\pm 660\text{kV}$ 4000 MW 2518 km	
		2010	Indexed (2016)
	US \$	US \$	US \$
Cost of converter station /MW	315,034	251,500	216,515
Cost of Transmission Line /km	566,123	471,000	377,636

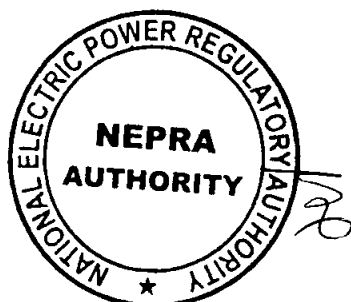
- 33.7.4.3 The Petitioner while claiming that there is not much difference of cost and has completely ignored the substantial change in prices for steel, aluminum, and electrical equipment indices. In order to make a fair comparison of the cost, necessary adjustments were made. As reflected in table above, it is noted that the claimed converter stations and transmission line cost by Petitioner for Matiari Lahore Transmission Line Project is higher as compared to the indexed cost of Ningdong Shandong Project. In addition to the adjustment for indices, due consideration was also given to availability factor, conductor type, number of towers, weather condition etc.

- 33.7.4.4 The Authority further noted that for Matiari Lahore Project in addition to cost claimed in Petition, indexation and protection for foreign currency fluctuation has also been requested by the Petitioner, which has not been specified for Ningdong Shandong project cost also.

33.7.5 Comparison of EPC cost of Matiari Lahore Transmission line with cost data obtained from manufacturers:

General Electric (GE):

- 33.7.5.1 The Authority observed that GE also has global experience in HVDC Projects. It also came to Authority's knowledge that GE has submitted their cost estimates to NTDCL for this project. Relevant information was therefore sought from GE as well.
- 33.7.5.2 GE submitted its cost estimates for the converter station with exact Project specifications of $\pm 660\text{kV}$ and 4000MW, whereas GE did not submit the cost estimates for the Transmission Line. Below is the cost comparison of Matiari Lahore converter stations with the cost estimate received from GE;



Description	Claimed in Petition	Comparison with budget estimate for GE for 660kV, 4000MW
	US \$	US \$
Cost of converter station/MW	315,034	215,000

33.7.5.3 GE also confirmed that the referred cost of both converter station is inclusive of AC yard cost for both substation along with complete provisioning for engineering, project management, manufacturing, delivery, construction and commissioning. As no estimate was received for transmission line component, therefore a complete comparison for EPC cost was not carried out. However, it was again obvious that the cost claimed by the Petitioner for the converter station was 47% more than the cost estimates for converter station provided by GE with the same specifications for the project it had already submitted to NTDCL.

ABB:

33.7.5.4 ABB is also an experienced organization on HVDC projects. Cost estimates of ABB for the converter stations obtained from its official website were also compared, which reflected the cost around US \$ 215,000/MW.

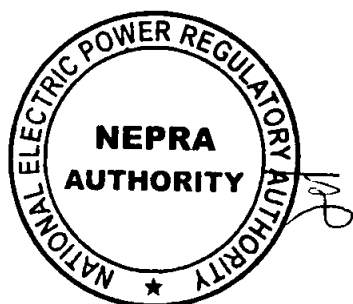
33.7.5.5 Black and Veatch a global leader in engineering, procurement and construction (EPC) services for the crucial areas of energy, water, and telecommunications prepared a document for Western Electricity Coordination Council (WECC) in 2014, entitled 'Capital Costs For Transmission and Substations' wherein the cost HVDC converter station was also less than US \$ 200,000/MW.

33.7.5.6 In view of above, the Authority observed that though a complete EPC comparison is not possible in the absence of the transmission line cost information, however, it was again evident that the cost of converter station claimed in petition as US \$ 315,034/MW is significantly high.

33.7.6 Comparison of costs with CASA-1000:

33.7.6.1 The Authority in June 2016 approved transmission tariff of CASA 1000 transmission project, which also has an HDVC segment.

33.7.6.2 Pertinent to refer that both projects have different technical specifications, as CASA has \pm 500kV, 1300MW capacity for the transmission line. These differences contribute significantly in different Project Costs including EPC due to which a direct comparison is not possible. However simple comparison of the two projects' HVDC component reflected that Matiari-Lahore EPC cost as high. The



Authority also closely observed the cost NTDCL has incorporated for converter station and transmission line in the PC-I submitted to Planning Commission of Pakistan. The Authority noted that the cost of transmission line submitted in the PC-I is US \$ 332,358/Km which is far less than US \$ 566,123/km claimed for Matiari Lahore transmission line.

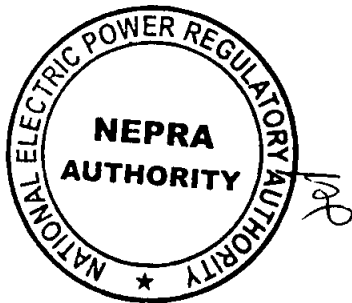
33.7.6.3 No justification or comparison was provided by the Petitioner against such high cost of transmission line in contrast to the NTDCL own submitted PC-I cost of US \$ 332,358/km for the transmission line component of CASA-1000 to be established in Pakistan territory, which is even more rough terrain compared to Matiari Lahore Transmission Line Project.

33.7.6.4 Transmission Tariff Table Comparison:

The table below incorporates the tariff component of CASA-1000 against the claimed component of Matiari Lahore Project;

Matiari-Lahore Claimed Tariff Components	Cents/kWh	Particulars CASA-1000 Tariff Components	Cents/kWh
Fixed O&M – Foreign	0.107	Project Cost (All Countries)	1.8404
Fixed O&M - ITC Local	0.057	AC Facilities Fee	0.1559
Fixed O&M - NTDCL O&M Local	0.048	DC Operator	0.6017
Land Lease	0.007	Operating Committee Costs for Account Bank, Executive Auditor	0.0464
Insurance Cost	-	Community Development Fund Contribution	0.1000
Sinosure Fee	0.014	Reserve Fund Contribution	0.1615
Debt Service	0.420		
ROE	0.211		
ROEDC	0.049		
Total	0.914	Total	2.9059

33.7.6.5 As reflected that there is significant difference in composition of Tariff. However, the petitioner has submitted a comparison carried out between the tariffs of two Projects as under:



Comparison CASA-1000 with Matiari-Lahore

	Column I Mahan - Lahore Line		Column II CASA-1000 Tariff		Reason
Transmission Tariff Distribution	Tariff		Tariff		
The Kyrgyz Republic HVAC PEC	0.0004	\$/kWh	0.498	\$/kWh	Column I is Low due high flow of Energy (100% in Mahan and 38% is assumed in CASA)
Tajikistan HVAC PEC	-	\$/kWh	0.230	\$/kWh	Cost of the AC lines is included in Mahan as it is project specific in CASA
Tajikistan HVDC PEC	0.1972	\$/kWh	0.520	\$/kWh	Column I is Low due high flow of Energy (100% in Mahan and 38% is assumed in CASA)
Afghanistan HVDC PEC	0.2239	\$/kWh	0.592	\$/kWh	Column I is Low due high flow of Energy (100% in Mahan and 38% is assumed in CASA)
Afghanistan HVAC PEC	-	\$/kWh	-	\$/kWh	Project Specific for the LDS only
Pakistan HVAC PEC	-	\$/kWh	-	\$/kWh	Project Specific for the LDS only
Pakistan HVDC PEC	0.1797	\$/kWh	-	\$/kWh	In CASA it is non eligible project cost, only considered in IIS
O&M & Insurance The Kyrgyz Republic AC Segment	-	\$/kWh	0.107	\$/kWh	Cost of the AC lines is included in Mahan as it is project specific in CASA
O&M & Insurance Tajikistan AC Segment	-	\$/kWh	0.049	\$/kWh	Cost of the AC lines is included in Mahan as it is project specific in CASA
O&M & Insurance Tajikistan DC Segment	0.0654	\$/kWh	0.173	\$/kWh	Column I is Low due high flow of Energy (100% in Mahan and 38% is assumed in CASA)
O&M & Insurance Afghanistan DC Segment	0.1019	\$/kWh	0.269	\$/kWh	Column I is Low due high flow of Energy (100% in Mahan and 38% is assumed in CASA)
O&M & Insurance Afghanistan AC Segment	-	\$/kWh	-	\$/kWh	Project Specific for the LDS only
O&M & Insurance Pakistan AC Segment	-	\$/kWh	-	\$/kWh	Project Specific for the LDS only
O&M & Insurance Pakistan DC Segment	0.0603	\$/kWh	0.159	\$/kWh	Column I is Low due high flow of Energy (100% in Mahan and 38% is assumed in CASA)
Annual Community Support Program	-	\$/kWh	0.100	\$/kWh	Project Specific for the LDS only
Common Fund Tariff	0.0176	\$/kWh	0.208	\$/kWh	Column I is Low due high flow of Energy (100% in Mahan and 38% is assumed in CASA)
Total	0.8483	\$/kWh	2.906	\$/kWh	

Note:

1. EPC cost are based on the SNC-Lavalin 15% contingencies for Pakistan and Tajikistan and 25% for Afghanistan.

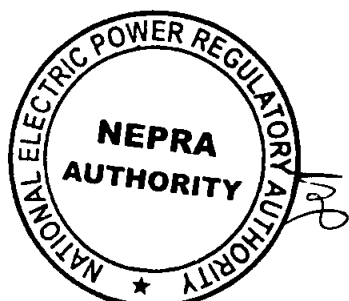
2. IDC is calculated on 6% without compounding.

The above tariff comparison does not represent a meaningful picture and the basis on which the tariff has been computed as US \$c 0.8463/kwh (claimed US \$c 0.9140/kwh).

33.7.6.6 In addition to the difference in composition of tariff components, the other distinct features between CASA-1000 & Matiari-Lahore Project tariff components are:

- The CASA-1000 tariff has been computed on the energy that will be transmitted for 5 months for 15 years only.
- The CASA-1000 tariff includes the separate components for Community Development as well as for Reserve Fund Contribution.
- The CASA-1000 transmission component includes the Project's and O&M of both AC & DC facilities whereas for Matiari Lahore project incorporates O & M for DC component only.
- CASA-1000 insurance component is expected to be high as compared to Matiari-Lahore Project since later project is in more settled area along with further security assurances provided by Government of Pakistan.
- In addition to EPC contract, the O&M component in CASA tariff is also subject to periodic change as bidding is to be held after every 3 years whereas the O&M for Matiari-Lahore Project have already been identified both for Converter Station as well as Transmission line.
- The final cost of the CASA Project are yet to be determined after bidding whereas no bidding has been carried out for Matiari-Lahore Project claimed cost.

Considering all above aspects, when removed dissimilarities, the CASA Project cost in terms of per MW works out to be lower as against the cost claimed in the instant case .




33.7.6.7 Other Characteristics distinguishing CASA-1000 with Matiari-Lahore Project:

In addition to the technical and tariff component differences, there are certain other distinct aspects also between the two transmission Projects, which have not been considered by the Petitioner in its comparison submitted;

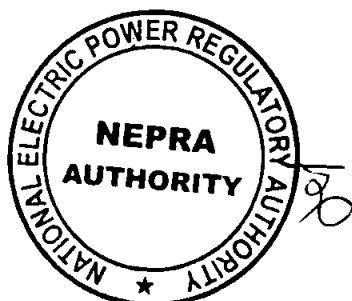
- i. In CASA-1000, Partner countries will jointly evaluate the competitive process, whereas no such arrangement exists for Matiari-Lahore Project.
- ii. In case the EPC bids are higher than the feasibility study prices of CASA-1000, the parties have right to walk away.
- iii. For CASA-1000 financiers i.e. Work bank and IDB will also review the contract award process, which is a built-in another due diligence aspect before the final figures are submitted to Regulator. Whereas no such evaluation mechanism has been specified to be carried out by stakeholders in Matiari Lahore Project.
- iv. In CASA-1000, if seller countries are unable to generate energy and are not able to make necessary measures; LD will be borne by them whereas for Matiari Lahore Transmission no specific responsibilities have been identified for ensuring the required generation and related HVAC transmission links arrangements to be consistently available.

33.7.7 In view of all above and considering the cost estimates provided by the manufacturers, financial and non-financial parameters of CASA-1000, Brazilian, Indian and Chines HVDC projects, EPC cost comparison by NTDC itself, it was observed by the Authority that the claimed EPC cost by the petitioner is high.

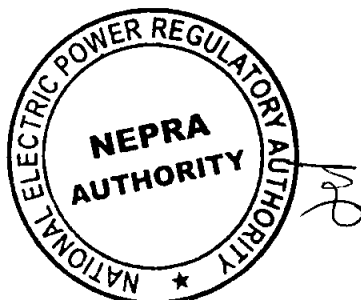
33.8 Review of Claimed Converter Station Cost:

33.8.1 A review of the cost for converter stations reflected that the extent of civil work cost claimed in different sub-heads is significantly high and also above the proportionate percentage as available from CIGRE. Likewise no particulars were available for "miscellaneous expenditure" claimed. The Authority also observed that various expenditures claimed under the head "engineering, commissioning, project management, transportation, material and spare parts etc" are high:

Details of EPC Prices - Amounts in USS		
Convertor Stations		
Item	Description	Claimed USD
	Construction and Installation of Converter Station	
A	Civil Works	188,598,136
	Installation works	63,203,960
	Mobilization, Measures and etc.	20,225,268
	The material of temporary building	4,260,000



	Subtotal	276,287,364
B	Construction and Installation of Electrodes	
	Civil Works of electrode	9,848,040
	Installation works of electrode	4,220,588
	Subtotal	14,068,628
	Supply of Materials, Equipment and Systems (including Spare Parts for warranty period)	
C	DC yard equipment	104,157,814
	Converter transformer	337,614,902
	Converter valve and cooling system	149,977,390
	AC yard equipment	54,913,101
	AC filter	22,284,706
	Converter station's Power Source	15,119,320
	Converter station's Control, Protection and Monitoring	35,724,241
	AC Protection	4,875,784
	Communication system	4,114,278
	Cable, conductor and hardwares	9,202,806
	Spare parts	15,350,478
	Electrode grounding materials	11,203,410
	Miscellaneous materials	32,544,834
	Construction equipment & Machines	12,097,031
	Testing instrument	8,263,902
	Subtotal	817,443,997
	Engineering (Basic engineering and Detail engineering)	
D	Site investigation	8,289,320
	Engineering	29,012,616
	Special subject study	4,144,660
	International Consulting Engineer (2 persons with 6 months)	1,000,000
	Subtotal	42,446,596
	Commissioning	
E	Station commission	4,332,022
	System commission	6,498,032
	Subtotal	10,830,054
	Project Management	
F	Project management cost	11,445,494
	Supervision for construction and installation	14,683,125
	Equipment supervision	3,690,000
	Factory Inspection by NTDCL	600,000
	O&M staff training	1,000,000
	Subtotal	31,418,619
G	Transportation Costs and Custom clearance	48,478,638



H	Security Control System (Installed in the NTDCL Gird System)	8,169,934
I	Foundation Treatment at Converter Station	8,651,302
J	CET Security Coverage Cost (The cost for security company. This does not include any cost and charges of the Government of Pakistan (GOP) security service)	2,343,898
	Total	2,452,634,288

33.9 **Claimed Transmission Line Cost Analysis:**

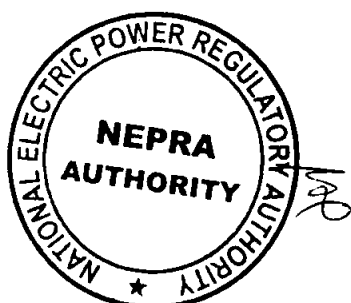
33.9.1 The component wise claimed transmission line cost is reflected below;

Detail of Transmission Line Cost		
Items	Description	Claimed
		US \$
A	Plant and Equipment Including Spare Parts	220,769,906
B	Design Services (Basic and detailed Engineering)	11,395,464
C	Installation & other services	221,834,843
D	local Transportation, Insurance and Other Incidental Services	18,239,586
E	CET Security Coverage Cost(The cost for security company. This does not Include any cost and charges of GOP security service	9,895,358
F	Project. Management	10,956,826
G	Relay Station	3,663,217
H	OPGW connection	301,471
	TOTAL	497,056,671

33.9.2 Authority also sought the cost composition of transmission line based on international projects. As per the information available from HVDC expert, the composition of the transmission lines cost includes 60% for material (which include 50% equipment, 30% structure, 20% other components) and 40% for construction and erection.

33.9.3 The Authority observed that Teshmont have also pointed out that the CET's transmission line cost allocation with regards to material installation, engineering as compared to CIGRE Electra 136 shows variance. Tehmont has also highlighted that the installation cost of foundations can be completed with a mixture of skilled and unskilled workers. Only for stringing and erection skilled labour has to be used. The Authority therefore noted that the cost thus could be reduced optimally and prudently.

33.9.4 The Authority also observed that Teshmont in their report have highlighted that the price of steel used by CET for determining the tower cost is approximately US\$ 1,275 /ton whereas the latest price is



substantially reduced now to less than US \$ 700/Ton. Likewise Authority also noted that Teshmont has pointed out that the prices of aluminum used by CET for determining conductor cost is approximately US \$ 2,892 /ton which is presently around US \$ 1,600/ton.

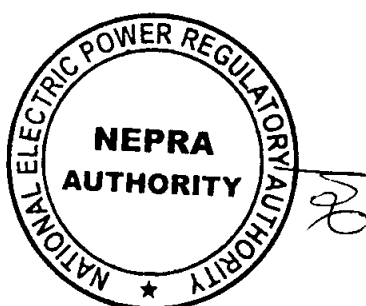
33.10 EPC estimates review by Teshmont

33.10.1 The Authority observed that the Petitioner has not submitted the outcome of any technical and financial review carried out on the “cost components” claimed therein. Authority however considered the comments of Teshmont Consultants forwarded that were engaged by NTDCL through NESPAK to review the Project technically and financially. The Authority also noted, Teshmont in their initial report issued in January 2016 had expressed that they have reviewed the claimed EPC cost in context of (a) Recently awarded HVDC projects, (b) Teshmont’s internal cost estimates data base (c) Cost provided in SNC feasibility study and (d) recent pricing information for steel and cable.

33.10.2 A brief summary of salient comments expressed by Teshmont are referred hereunder;

- The CET cost for transmission line based on the proposed conductor is 1.2 times higher. This comment by Teshmont was based on recent cable prices, reduction in cost of steel and a possible reduction that could be made in tower weight.
- The cost of various components of converter stations is ‘high’. Teshmont highlighted that various components in CET estimates for converter station are 1.35 to 2.0 times high. It was also expressed that the converter’s cost could be lower for this project due to local labour available in both China and Pakistan.
- The converter station cost are approximately 35% higher than for a similar Asian project rated at 500 kV 2000MW
- Though with relatively lesser impact, the electrode cost is claimed more than double than anticipated.
- Teshmont also compared CET’s converter station estimates with CIGRE-388 technical brochure and highlighted that cost allocation for converter, transformer, civil and mechanical works is much higher than the CIGRE values, as reflected in table below:

Equipment	Matiari-Lahore Project		CIGRE Bipole $\pm 600\text{kV}$, 3000MW
	USD	%	%
Converter Valves	238,639,851	19	22
Converter Transformers	337,614,902	27	22
DC Switchyard and Filtering	104,157,814	8	6




A handwritten signature, likely of an official, is written above the NEPRA seal.

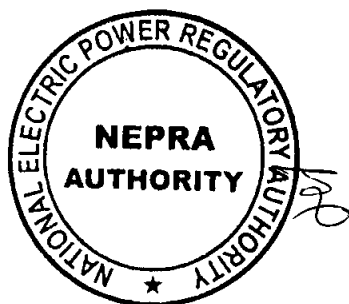
AC Switchyard and Filtering	77,197,807	6	9
Control, Protection, and Communications	44,714,303	4	8
Civil and Mechanical Works	279,795,770	23	13.5
Auxiliary Power	15,119,320	1	2.5
Project Engineering and Administration	133,173,907	11	17
Other (Security control system and security coverage)	10,513,832	1	N/A
Total	1,240,927,506	100	100

33.10.3 The Authority also gave due consideration to the CET responses to Teshmont comments and the rationales it has submitted for relatively higher EPC as submitted by Petitioner. A brief of salient responses by CET, to justify high claimed cost are:

- a. To meet high level availability requirement for this transmission line.
- b. Special design and material to meet high temperature circumstances.
- c. Box dash in equipment and noise shielding panels to meet noise limits in Pakistan.
- d. Price estimates have been based on quotation from major equipment manufacturers, which require special ,manufacturing and lead to relatively high price
- e. Optimization of loss ratio resulted by increase of voltage to be also taken into consideration.
- f. Teshmont to judge the price level not only through EPC, as CET will be responsible for O & M for 25 years (BOOT period).
- g. The HVDC equipment price of Chinese market can be deemed as benchmark for HVDC market, as China has substantial HVDC capacity over the world. Offer for transmission line price is based on the offers from manufacturer in Aug 2015.
- h. There is no justification for lesser labour cost for manufacturing in China as well as for engineering salaries to be 30% of the North American salaries.

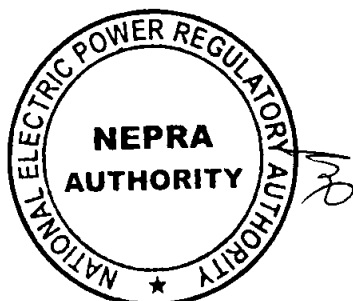
33.10.4 For relatively high price of civil and electrical works, CET in its response submitted that;

- a. Under CPEC several mega projects are under construction which needs tight supply of local material.
- b. Skilled worker and special equipment and tools from China are required to complete construction for converter stations.
- c. The prices of local material in Pakistan are relatively high and construction materials are about 300 km from the job site and supply is very tight.




- 33.10.5 The Authority gave consideration to aforementioned matters highlighted by Teshmont & the responses submitted by CET. It also observed that certain comments of CET are not tenable and are not supported with corroborative evidences for assumptions and rates it had applied in the EPC estimates submitted by Petitioner. Authority also observed that though for certain components, HVDC expertise from China are necessary but a significant cost can be reduced through various task completed by engaging skilled, semi-skilled and unskilled local employment.
- 33.10.6 The Authority gave particular consideration that Teshmont in its latest report of April 15, 2016 submitted that it has not received sufficient information to conclude that the cost of the converter station and transmission line is justified. The comments of the Teshmont are reproduced below;

"EPC cost was discussed in much detail without any significant conclusion as to why there is such a variation between the CET cost and the expected cost based on a variety of other sources. CET did not provide an itemized cost of other CET projects in Brazil and China as agreed to in the MOM dated March 31, 2016. The Brazil data was not available because of an NDA agreement. More detailed breakdown of the component costs in the EPC Price Proposal was requested during the meeting to determine what costs were considered in each category. It was noted by Teshmont that although there appears to be significant work completed, there seems to be many components of this project that remain in the feasibility stage. For example electrode sites have not been determined, valve technology has not been chosen and sufficient studies have not yet been completed to finalise equipment specifications. At this stage of the project there could be significant price variation that possibly could be included in the CET cost. Typically at the bid stage associated with a competitively procured project much of the details are finalized to allow for the most competitive bid. Expecting CET to provide a more refined cost, absent of "contingency" to cover off risk, at this stage of the project may be unrealistic. CET had also mentioned on several occasions throughout the meeting the difficulties associated with this project in Pakistan as compared to comparison projects in other countries. Teshmont understands CET's concerns and agrees that this could have impact on the cost but to what degree is unknown since the perceived degree of risk and the method for mitigation is only known by CET. It is noted however that CET has experience working in China. CET was requested to breakout additional security costs from the component prices. The transmission line costs were discussed. Optimization of the line would reduce the costs and CET was requested to undertake this initiative. Additionally, the line cost is impacted by commodity rate fluctuation. I was agreed that to rework the estimate based on recent commodity prices was impractical. Teshmont was informed that there was a mechanism in the tariff which would accomplish this. Teshmont has not received sufficient information to conclude that the cost of the converter station and transmission line is justified."



33.11 Cost comparison submitted by NTDCL:

The Authority considered the comparison which NTDCL had carried out on the claimed EPC Cost and submitted vide its correspondence No 6229-33/GM/GSC dated December 21, 2015. The table below summarizes the comparison carried out by NTDCL:

Description	Claimed Project cost	CIGRE-388	Teshmont	SNC
	US \$ (M)	US \$ (M)	US \$ (M)	US \$ (M)
Converter Station (per MW)	316,034	174,250	201,750	155,031
Transmission Line (per KM)	566,123	317,538	487,471	410,933

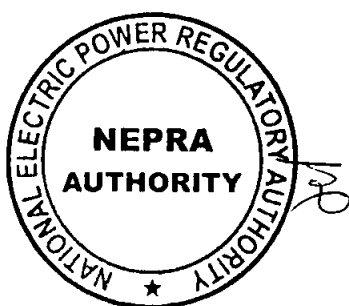
In view of the above information submitted, it was obvious that EPC cost claimed in the petition have been assessed as significantly high by NTDCL also.

33.12 Conclusion:

33.12.1 In view of the above aspects, the Authority observed that;

- The EPC cost claimed by the Petitioner is based on the estimates.
- No competitive or comprehensive comparative process has been carried by the Petitioner.
- The cost compared with the similar sized projects globally reflects that cost claimed in petition is significantly on higher side.
- The independent HVDC experts engaged, based on their vast experience on HVDC Projects globally, have also expressed that the claimed cost by Petitioner is high.
- The consultant engaged by NTDCL i.e. Teshmont in their initial report of Jan, 2016 as well as in their later report of April, 2016 have expressed that the costs are on higher side. In their latest report of April 2016 they expressed *"EPC cost was discussed in much detail without any significant conclusion as to why there is such a variation between the CET cost and the expected cost based on a variety of other sources."*
- The transmission line estimates submitted by Ministry of Water and Power to the Planning Commission, for the Pakistan component of CASA-1000 HVDC link also reflects that the costs claimed in petition is high.
- Comparison carried out by NTDCL also confirms that the EPC claimed for the Project is high.

33.12.2 In addition to above, the Authority in final conclusion on the cost gave due consideration to various related factors including but not limited to the facts that this is the first HVDC project of Country,



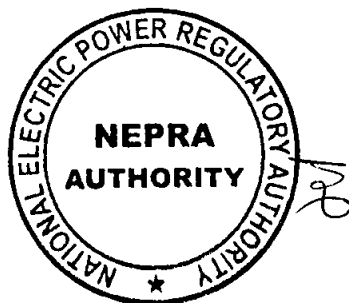
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local expertise are not widely available for convertor stations, availability factor is 98.5%, allowed losses are up to 4.3%, weather condition are different etc. Authority while approving the EPC cost, also gave consideration that various international HVDC project cost referred above have not allowed currency fluctuation indexation whereas the EPC cost being approved for this Project will be allowed this aspect, consistent to earlier decisions by Authority.

- 33.12.3 Authority, while approving the cost for Transmission line, also gave consideration to the prevailing steel, aluminum and other related commodity prices etc. Authority also considered that the cost being approved is also consistent to the cost approximation of the International HVDC Expert, which was based on his experience on various HVDC projects across the globe including countries having similarities to Pakistan.
- 33.12.4 In view of all above, the Authority after detailed deliberation and consideration approved the EPC cost as reflected in table below;

Description	Claimed EPC Cost		Approved EPC Cost	
	Per (MW/kM)	Total	Per (MW/kM)	Total
	US \$	US \$	US \$	US \$
Cost of converter station /MW	315,034	1,260,136,000	250,000	1000,000,000
Cost of Transmission Line /km	566,123	497,055,994	350,000	307,300,000
Total EPC cost for 4000 MW C.S and 878 km T.L		1,757,191,994		1,307,300,000

34. Whether the claimed duties and taxes of US \$ 106.31 million is justified?
- 34.1 The Petitioner in the petition has claimed duties of US\$ 106.31 million which includes custom duty @ 5% and Sindh Infrastructure Cess @ 1.05% of the EPC cost. Further the Petitioner has also stated that no Provincial or Federal Sales Tax, advance income tax and Federal Excise Duty on equipment imported into Pakistan or any other taxes and duties applicable on the Project have been claimed.
- 34.2 The Authority decided that consistent to its earlier decisions, the duties and/ taxes, not being of refundable nature, imposed on the relevant Company up to the commencement of its commercial operations for the import of its plant, machinery and equipment will be subject to adjustment on actuals at COD against the US \$ 79.09 million being allowed based on the approved EPC cost. All relevant verifiable documentary evidence to the satisfaction of the Authority will have to be provided accordingly for adjustment at COD.



✍

35. Whether the claimed financial charges of US\$ 58.81 million as 3.5% of total borrowings is justified or not?

35.1 The Petitioner has claimed financial charges of US\$ 58.81 million as 3.5% of the total borrowings. The claimed financial charges include the cost related to the debt financing of the project i.e. the lenders up-front fee, management fee, commitment fee, fees related to lenders technical, environmental, financial and legal consultants etc.

35.2 The Authority noted that it has allowed financial charges up to maximum 3% the total debt allowed (excluding the impact of interest during construction, sinosure fee and financial charges) in its earlier decisions for various projects. Considering that this project has similar capital structure composition, the Authority decided to allow the financial charges consistent to other projects. The Authority therefore allowed financial charges up to maximum of 3% the total debt allowed (excluding the impact of interest during construction, Sino-sure fee and financial charges) i.e. US \$ 34.58 million which will be subject to adjustment at the time of COD on the basis of actual charges upto the referred maximum allowed limit of 3% of the total debt allowed (excluding the impact of interest during construction, sinosure fees and financial charges), on production of authentic documentary evidences.

36. Whether the claimed Sinosure cost during construction and operations is justified or not?

36.1 The Petitioner stated in the petition that Chinese Banks provide financing on the provision of sinosure insurance coverage, which are of two types;

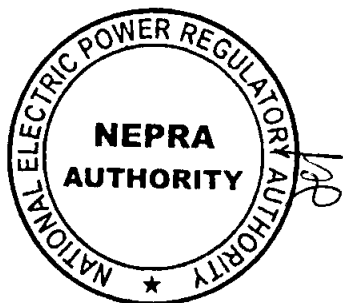
i) Sinosure Buyer Credit Policy

Upfront sinosure fee @ 7% of the total debt servicing.

ii) Sinosure Overseas Investment Policy

Sinosure fee @ 0.60% annual premium (net of taxes) payable in advance during the construction and operations period plus a commitment fee @ 0.09% (net of taxes) payable during the construction period. It was also referred that there is a 5% withholding tax applicable on the sinosure fees and hence the grossed-up sinosure fee would be 0.63% annual premium and 0.095% commitment fee. If the withholding tax changes, the percentages will accordingly be revised.

36.2 The Petitioner stated that it has yet to obtain the sinosure coverage and tariff will be adjusted at COD based on actual sinosure policy and fee. However the Petitioner considered the Sinosure Overseas Investment Policy for the purpose of tariff calculation and has claimed US \$ 21.26 million and



US \$ 11.15 million (for the first year) as sinosure fee calculated on the basis of below mentioned formula for construction and operations period respectively;

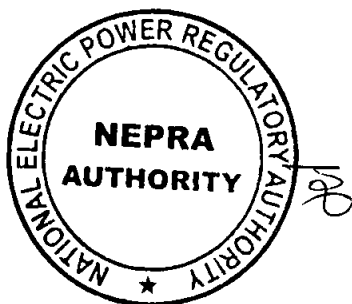
(a) During Construction Period

Annual Sinosure Cost during Construction for each year = [(Current outstanding debt principle at start of year + proposed debt drawdown during the year + expected IDC accumulation up till the end of current year)*annual premium @ 0.63%] + [remaining undrawn debt amount at end of year*commitment fee @ 0.095%]

(b) During Operations Period

Yearly Sinosure Cost During operations = [(Current outstanding debt principle at start of the year + Expected interest payments during the current year)*Annual premium @ 0.63%]

- 36.3 The Authority noted that in a recent Chinese sponsored projects including those under CPEC, the sinosure fee has allowed the maximum of 0.60% per annum (exclusive of tax) with withholding tax allowed as pass through as per actuals at COD. Whereas, for upfront fee the Authority had allowed sinosure fee not exceeding the limit of 7% of total debt.
- 36.4 Consistent to earlier decisions, the Authority allowed sinosure fee upto the maximum limit of 7% in case of upfront and 0.60% in case of annual sinosure fee with directions to better negotiate the sinosure cost considering this is a CPEC prioritized project with additional assurances and arrangement which are normally not available to other Projects.
- 36.5 The Sinosure cost considering to be paid on annual basis for the construction period as per the above formula, works out to be US \$ 13.80 million during the construction period. The Sinosure fee will be adjusted at COD based on actual Sinosure policy obtained by the Petitioner but within the limit i.e. 7% of the total debt in case of sinosure buyer credit policy or 0.60% as annual premium in accordance with the formula mentined above.
- 36.6 Similarly, the Sinosure fee during the operations as per the Sinosure investment policy computes to US \$ 7.99 million for the first year which will be subject to annual indexation as per the above mentioned formula based on the submission of documentary evidences for the Sinosure overseas investment policy.
- 36.7 The Authority also decided that consistent to earlier decisions, if the relevant company is required to make payment of Withholding Tax on Overseas Investment Insurance Fee (sinosure fee) the same shall



be allowed as pass through cost in tariff based on actual cost upon production of verifiable documentary evidence to the satisfaction of Authority.

37. Whether the claim for insurance cost during construction phase and operation phase is justified or not?

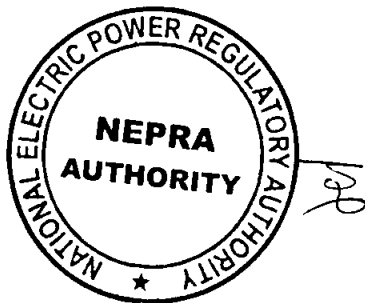
37.1 The Petitioner in the petition did not specify any cost of insurance and referred that it will obtain insurance as per the lenders requirement and different project documents during the Terms of the Transmission Service Agreement (TSA). The Petitioner also referred that in order to ascertain a prudent and justified assumption for insurance cost an internationally renowned insurance broker MARSH and McLennan has been appointed to conduct a study.

37.2 Subsequently, in June 2016, the Petitioner submitted the report of MARSH & McLennan. The Petitioner also forwarded the claimed insurance cost of US\$ 19.3 million (1.1% of the EPC cost) during construction phase and US\$ 21.09 million (1.2% of the EPC cost) during the operation phase. Accordingly, the resulting claimed insurance component was Rs. 0.0623/kWh with resulting claimed leveled tariff of Rs. 1.0153/kWh.

37.3 Keeping in view the above, the Authority decided to allow the insurance cost upto the cap of 1% of the EPC cost. Moreover in view of road shows held in Beijing from 6th to 7th January 2016 and London from 2nd to 3rd March 2016 wherein MARSH & McLennan have referred that positive response was received from well accredited Insurance Companies, the Authority directed that insurance cost to be further negotiated with the Chinese & other International Companies. Considering that the project is a CPEC prioritized project and the Cooperation Agreement between NTDCL and SGCC, has incorporated that Government of Pakistan will be responsible for the security of work site, staff, equipment and materials and operating assets from feasibility study till the BOOT period completion.

37.4 In view of above, Authority approved insurance cost upto maximum limit of 1% of the assessed EPC cost which works out to be US \$ 13.07 million and will be subject to adjustment at the time of COD on actual prudently negotiated cost. Likewise thereafter insurance cost will be annually adjusted based on the submission of documentary evidences within the confines of 1% approved.

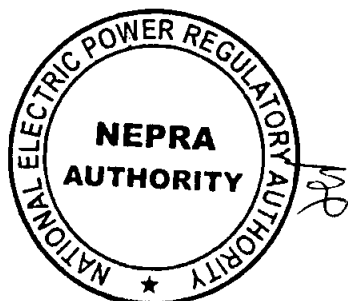
37.5 For insurance premium denominated in foreign currency (i.e. US \$), insurance cost component of tariff will be adjusted on account of US\$/PKR exchange rate variation on annual basis. Further, insurance component of the reference tariff will be adjusted as per actually incurred prudent costs, subject to maximum of 1% of the EPC cost, on annual basis upon production of authentic documentary evidence by the relevant company.



38. Whether the claimed IDC of US\$ 108.67 million is justified or not?

- 38.1 The Petitioner has claimed an amount of US\$ 108.67 million on account of interest during the project construction period (hereinafter referred to as "IDC"). According to the information provided by the Petitioner, the IDC has been calculated on the basis of construction period of 27 months with the 65% drawdown in year 1, 30% in year 2 and remaining 5% in year 3, at interest rate of 5.20% (six months LIBOR 0.45% plus spread of 4.75%) based on foreign financing. The Petitioner submitted that the IDC has been calculated based on the foreign financing and on quarterly basis. However Petitioner also referred that there may be local financing in local currency for which a KIBOR rate of 8.50% and spread of 3.50% per annum has been indicated. The Petitioner further submitted that the spread on the foreign financing in case of Sinasure overseas investment policy would be 4.75% and in case of sinasure buyer credit policy the loan spread over LIBOR would be 4.5%.
- 38.2 Authority observed that in the recent tariff determinations for similar capital structure compositions, the Authority has allowed 6 months LIBOR plus a spread of 4.5%, whereas in case of local financing the Authority has been allowing 6 month KIBOR with a spread of 3%. Authority also gave due consideration that there is a high initial investment in the Project with future financial risks investments comparatively lesser. Consistent to earlier decisions, the Authority allowed 6 months LIBOR plus spread of 4.5% on foreign financing and in case of local financing allowed 6 months KIBOR plus a spread of 3%.
- 38.3 Accordingly, the assessed IDC considering 100% foreign financing works out to be US\$ 88.62 million. The referred IDC amount will be adjusted at COD on the basis of actual debt draw downs (within the overall debt allowed by the Authority at COD), actual PKR/US\$ exchange rate variation for foreign loan denominated in US \$ and actual interest rates not exceeding the limit of 6 months LIBOR per annum plus 4.50% for foreign financing and 6 months KIBOR plus 3% for local financing, during the project construction period being allowed by the Authority.
- 38.4 The Authority while approving above directed to make efforts to better negotiate financing terms, considering that this is a CPEC prioritized project with certain assurances which are normally not available to other projects. The Authority further decided to allow the Petitioner the benefit of interest saving below 3% (in case of local financing) and 4.50% (in case of foreign financing to the extent of 40% i.e. 0.02%. Authority also decided that for better financing terms arranged, the overall impact of reduction in debt servicing will be shared on yearly basis in the following ratio;

NTDCL/Relevant Agency: ITC= 60:40



39. Whether the claimed NTDC Development Costs of US 15.21 Million is justified or not?

39.1 The Petitioner submitted that NTDC is also carrying out certain activities relating to the development of this HVDC Transmission Line project. The Petitioner claimed US\$ 15.21 million as NTDC Development Cost for Matiari-Lahore Project. The Petitioner referred that the claimed amount includes costs related to site survey, load flow studies, environmental studies, land lease costs, crop compensation, Right of Way compensation will have to be incurred by NTDC which will be later reimbursed by SGCC/CET to NTDC.

39.2 In response to the information direction to justify the cost, the Petitioner later submitted following breakup of the NTDC Development Cost claimed;

<u>Particulars</u>	<u>Amount (Rs in million)</u>
Right of Way Compensation	900
NTDC Development Cost i.e. Site Survey, Load flow studies, Environmental Studies etc.	100
Land Lease Cost (Converter Station)	573.75
Total Cost (PKR) Equivalent US\$ 15.21 million (Exchange Rate of Rs.103.50)	1,573.75

39.3 The Petitioner stated that it has estimated right of way cost of Rs. 900 million by considering the actual rates paid by NTDC in year 2009 for 500kV circuit line from Jamshoro-Moro-Rahim Yar Khan and for Moro to Dadu which was Rs. 0.25 million per Km and therefore for this tariff petition it has assumed the rate of Rs. 1.00 million per Km for ROW compensation. However the Petitioner later, did not substantiate and justify its claimed costs and also did not provide the district wise rate applied and total land to be acquired in each district for the purpose.

39.4 The Petitioner also did not specify the rate and area it has determined for the land lease cost of Rs. 573.75 Million claimed for the converter stations to be established at both ends of this HVDC transmission line.

39.5 The Commentator (Government of Sindh) during hearing held on March 24, 2016 raised concerns about the plan of getting public support in the right of way acquisition and whether employment opportunities shall be given to the people of Sindh to improve the social economical class of those



people. The Petitioner submitted that employment aspect will be addressed as the HVDC project will provide employment opportunities for local community in Sindh during the construction and operation period. However, the Petitioner did not specify the employment that will be generated in other province (s).

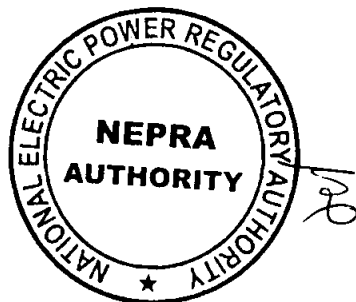
39.6 Keeping in view the limited information provided by the Petitioner with no corroborative justification provided for applying a high standard ROW compensation rate across various districts, the Authority is of the view that the claimed cost is a broad rough estimation instead of realistically evaluated cost for the ROW compensation and land lease. The Authority directed to acquire land lease and pay ROW Compensation at justified rates giving due consideration to related factors and type of land etc. The Authority therefore approved a cumulative amount of US\$ 12 Million as NTDCL Development Cost which will be adjusted at the time of COD based on actual cost incurred against this approved amount. Moreover, the cost specific to this project will not be admissible to be claimed by NTDCL in any other tariff petition submitted to the Authority.

40. Whether the claimed Non EPC cost of US \$ 32.92 million is justified?

40.1 The Petitioner has requested the Non-EPC cost of US\$ 32.92 million for the project. The Petitioner submitted breakup of the Non-EPC as under:

Sr.No.	Description	US\$ million
1	Fixed Assets/Vehicles/Office Equipments	2.8848
2	Housing/Office rental expenses	0.8280
3	Additional Security - other than GOP	0.8348
4	Feasibility Study	5.4000
5	Permits, License and Company Formation	0.8696
6	Project Administration Cost	2.7813
7	Advisors and Consultants	7.8896
8	HR Costs	8.7959
9	Travelling Costs	0.5040
10	Others	2.1334
	Total	32.9214

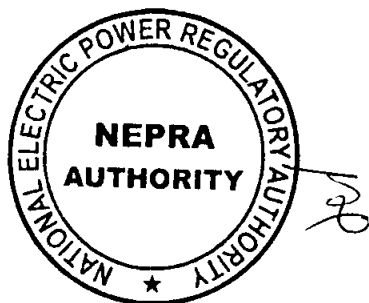
In response to the information direction, the Petitioner submitted breakup of certain major components of claimed costs heads referred in the table above.



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- 40.2 The Authority considered the cost claimed for Advisors and Consultants' as high particularly in view of the fact that tariff petition has been submitted by PPIB as one window facilitator. Accordingly, the Authority decided to allow a cost upto US\$ 4.5 Million for "Advisors and Consultants".
- 40.3 The Authority also considered the claimed HR Cost of US\$ 8.795 million and observed that only 22% of the claimed amount relates to local hiring. The Authority considered that no justified rationale has been provided for such limited local hiring for a project company. The Authority therefore approved the claimed cost of US\$ 8.795 million with the directions to ensure at least 50% of the amount spent towards local employment.
- 40.4 Against the claimed cost of US\$ 5.4 million for feasibility study, the Authority observed that NTDCL has already carried out the feasibility for this Project in 2013. The Authority also considered that the Petitioner has submitted that the feasibility study conducted by Central Southern China Electric Power Design Institute for sites, corridors and related system studies. The Authority noted the studies as carried out by the referred institute are yet to be provided to Petitioner as well as to NTDCL. The Authority decided to allow the claimed cost of US\$ 5.4 Million subject to immediate submission of studies conducted to NTDCL. This claimed cost will be accordingly verified based on endorsement of relevance of studies by NTDCL along with evidence of payment made to the referred Institute.
- 40.5 The Non-EPC cost of US\$ 29.53 Million as approved by the Authority is reflected in table below:

Sr.No.	Description	US\$ million
1	Fixed Assets/Vehicles/Office Equipment	2.8848
2	Housing/Office rental expenses	0.8280
3	Additional Security - other than GOP	0.8348
4	Feasibility Study	5.4000
5	Permits, License and Company Formation other	3.0030
6	Project Administration Cost	2.7813
7	Advisors and Consultants	4.5000
8	HR Costs	8.7959
9	Travelling Costs	0.5040
	Total	29.5318




41. The total allowed project cost by the Authority is tabulated below:

Matiari-Lahore Transmission Line Project		
S.No	Description	Assessed
		US \$ million
i.	Total EPC Cost	1,307.30
ii.	Non EPC Costs	29.54
iii.	Financial Charges	34.58
iv.	NTDC Development Cost	12.00
v.	Insurance during construction	13.07
vi.	Sinosure fee	13.81
vii.	Taxes	79.09
viii.	Interest During Construction	88.62
	Total Project Cost	1,578.02

42. Whether the proposed/claimed Capital Structure and spread claimed for the project is justified?

42.1 The Petitioner submitted that it has claimed the tariff with a debt to equity structure of 80 : 20 as the Authority has been allowing tariff based on debt to equity structures in the range from 70 : 30 to 80:20.

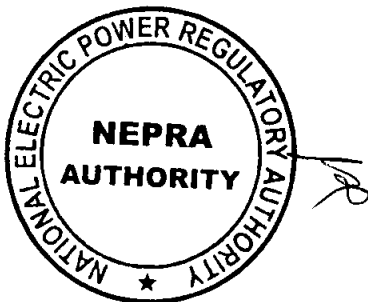
42.2 The Authority approved the claimed debt to equity structure of 80:20 along with the submitted debt drawn downs and equity injections projections.

43. Is the assumption that Withholding Tax on dividends shall be considered as a pass-through item justified?

The Petitioner requested to allow the withholding tax on dividend as a pass through item as the same has been allowed in TSA. The Authority considered that in the recent tariff determination it has not allowed the Withholding Tax on dividends as pass through item. Accordingly consistent to its recent decisions, the Authority did not approve the referred assumption of the Petitioner.

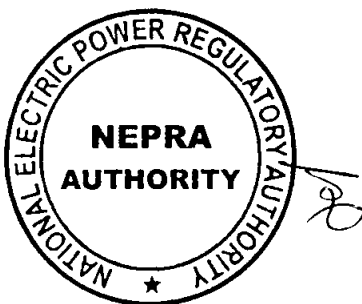
44. Whether the construction period of 27 month is reasonable?

44.1 The Petitioner proposed a project construction period of 27 months from construction start to Commercial Operation date (COD). The Authority after consideration approved claimed construction period of 27 months with directive for a critical path analysis.

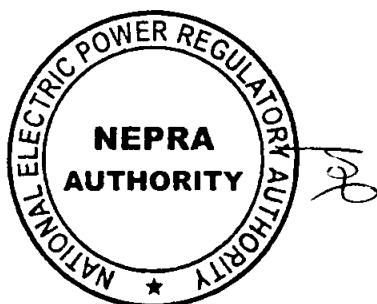


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45. Whether the IRR of 17% guaranteed under Cooperation agreement is justified for a transmission Project, particularly with GOP providing guarantee for securing payment obligation also?
- 45.1 The Petitioner has claimed an IRR of 17% for this HVDC line project. The Petitioner submitted that the rationale for claiming IRR of 17% is that the project is based on the same structure normally existing for IPPs. The Petitioner further submitted that IRR of 17% has also been agreed in the Cooperation Agreement signed between NTDCL and State Grid Cooperation of China (SGCC)/CET. Further justifying this claim of 17%, the Petitioner submitted that the high risks are associated with this project, being first of its kind in Pakistan on BOOT basis and having transmission line length of 878 kms unlike an IPP being within a boundary.
- 45.2 The Authority observed that the return offered is based on systematic and related risk associated with the Project. Normally the systematic risk of transmission companies are not considered alike generation companies and globally a significant difference is also prevalent between the two activities of generation and transmission.
- 45.3 The Authority observed that globally the risk profile of the transmission line is considered more similar to that of distribution business. The Authority noted that presently equity returns being allowed to the distribution companies is 16.6%. Accordingly after due deliberation, the Authority decided to allow a 17% return considering this project is the first HVDC transmission line venture in Pakistan and can be allowed a return slightly above the return offered to already running setup of DISCOs.
- 45.4 The Authority also directed that Return on Equity (ROE) and Return on Equity During Construction (ROEDC) will be adjusted at COD on the basis of actual equity injections (within the overall equity allowed by the Authority at COD) during the project construction period approved by the Authority.
46. Whether the claimed O&M cost of US\$ 76.81 million is justified or not?
- 46.1 The Petitioner has claimed US\$ 76.81 million for annual O&M cost for the project. The Petitioner in support of its claim submitted a draft O&M Contract wherein many important sections were blank.
- 46.2 Following breakup of O&M claimed cost has been provided by the Petitioner:



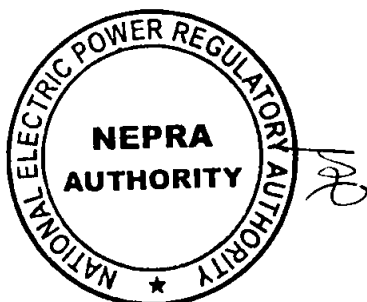
Description	Fixed O&M Cost-Foreign	Fixed O&M Cost - ITC Local	Total
	US\$	US\$	US\$
Converter Stations			
O&M Cost for Subcontractor			
Pay & Allowance	5,881,917.00	1,519,452.00	7,401,369.00
Spare Parts and tools	2,059,601.00	1,244,974.00	3,304,575.00
Schedule Maintenance	2,903,528.00	1,170,596.00	4,074,124.00
Administration and others	4,561,982.00	8,165,364.00	12,727,346.00
Sub Total O&M Cost for Subcontractor	15,407,028.00	12,100,386.00	27,507,414.00
O&M Cost for Project Com.			
Unschedule Maintenance	5,288,812.00	-	5,288.00
Overhaul	11,139,608.00	588,235.00	11,727,843.00
Sub Total O&M Cost for the Project Com.	16,428,420.00	588,235.00	17,016,655.00
Sub Total Converter Station	31,835,448.00	12,688,621.00	44,524,069.00
Transmission Line			
O&M Cost for Project Co.			
Specialized Tools and Instrument	650,000.00	325,000.00	975,000.00
Spare Parts	1,772,995.00	886,498.00	2,659,493.00
Offshore goods transportation expenses	102,335.00	-	102,335.00
Training	200,000.00	200,000.00	400,000.00
Supervision of Transmission line and others	-	655,375.00	655,375.00
Sub Total O&M Cost for Project Co.	2,725,330.00	2,066,873.00	4,792,203.00
Sub Total Transmission Line	2,725,330.00	2,066,873.00	4,792,203.00
Operating Cost for Project Co.			
Fixed Assets/Vehicles/Office Equipment	-	1,100,404.00	1,100,404.00
Housing/Office rental expenses	-	353,780.00	353,780.00
Salary (Pakistan Staff)	-	684,270.00	684,270.00
Local Administration Cost	-	1,751,478.00	1,751,478.00
Consultant Cost	-	1,013,482.00	1,013,482.00
Security Cost	-	294,817.00	294,817.00
Salary and Traveling Cost (Chinese Staff)	2,839,360.00	-	2,839,360.00
Bank Account Management Fee	215,000.00	-	215,000.00
Sub Total Operating Cost for Project Co.	3,054,360.00	5,198,231.00	8,252,591.00
Grand Total	37,615,138.00	19,953,725.00	57,568,863.00



- 46.3 In addition to the above 57.57 million the Petitioner has submitted that pursuant to the cooperation agreement dated April 04, 2015 NTDCL will take the responsibility of maintenance of Transmission line for which purpose a separate company will be established by NTDCL. The Petitioner has claimed annual budget for this company to be US\$ of 16.78 million which cumulate the annual claimed of O&M to US\$ 76.81 million as summarized table below;

Operation Expenses	Amount (US \$ Million)
Fixed O&M Foreign	37.62
Fixed O&M – ITC Local	19.95
Fixed O&M-NTDCL O&M Local	16.78
Land Lease	2.46
Total	76.81

- 46.4 The Petitioner submitted that the warranty period confirmed by EPC contractor shall be 1 year for the transmission line and 3 years for the converter stations. The same was also considered by the Authority while allowing the O & M claimed cost.
- 46.5 The Petitioner also submitted for the transmission line segment, during the warranty period, the transmission line shall be operated and maintained by the O&M Company (NTDCL's subsidiary) to perform these services. However, if the equipment and material failed due to the reason of design, manufacture and installation, the EPC contractor shall be responsible to replace the parts and install the material and equipment at its own costs. If due to reasons other than these, the O&M Company shall be responsible for the repairing and the project company shall provide the spare parts and special tools in accordance with arrangements in the O&M agreement.
- 46.6 For the converter stations, Petitioner submitted that during the warranty period, the converter station's operation and maintenance service shall be provided by the CET. However, if the equipment and material fail due to the reason of design, manufacture and installation during warranty period, the EPC contractor shall be responsible to replace the parts and install the material and equipment at its costs. If due to reasons other than these, the O&M Company/Project Company shall be responsible for the replacement and the Project Company shall provide the spare parts and special tools in accordance with arrangement of the O&M agreement. The Authority observed that the Petitioner has referred that in initial five years all principal employees will be Chinese, which has a direct impact on O & M claimed. The draft O & M Agreement submitted is incomplete on various important components.
- 46.7 The Authority observed that the Petitioner has not been able to justify such a high claimed O&M. Moreover Petitioner also did not submit the maintenance schedule which has to be developed and duly



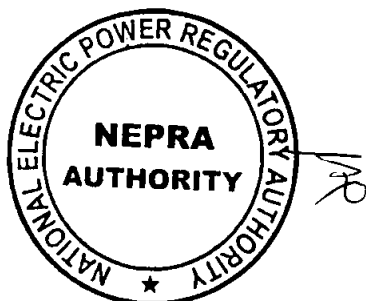
agreed with NTDCL. The Authority also observed that considering "scheduled maintenance" cost claimed, a substantially high "unscheduled maintenance" cost and annual 'overhaul' cost has also been claimed which seem contrary to each other. Moreover such high O&M cost also negate the purpose of having the HVDC technology.

- 46.8 The Authority verified the claim O&M cost from other precedence and sources available. The foremost was the cost indicated by SNC Lavalin in its Feasibility Report which had proposed the O&M cost for converter station to be 2% of its cost and likewise 1.5% for transmission line. Moreover the Authority also observed that as per the information available from international HVDC experts, the global experience on HVDC Projects also reflect the annual O&M around to be 2% of the total investment.
- 46.9 The Authority also observed that the O&M cost for converter stations also includes Chinese employees for a prolonged initial period of 5 years. The local hiring has been indicated to increase lately causing not only a high O&M cost but also restraining the timely capacity building of local staff on HVDC technology.
- 46.10 The Authority after close deliberation decided to allow O&M cost of US\$ 41.9 million with the maximum ceiling 2.5% of total assessed project cost. This approved cost is with the direction that Petitioner should ensure maximum local employment cost for converter stations over the entire BOOT period of 25 years. Authority also directed the O & M contracts to be submitted as soon as these are formally entered into.
- 46.11 The Authority also directed annual lease cost to be negotiated for better rates. The table below summarizes the O & M cost approved.

Operation Expenses	Amount (US \$ Million)
Fixed O&M Foreign	14.80
Fixed O&M - ITC Local	7.85
Fixed O&M0 NTDCL O&M Local	16.78
Land Lease	2.46
Total	41.90

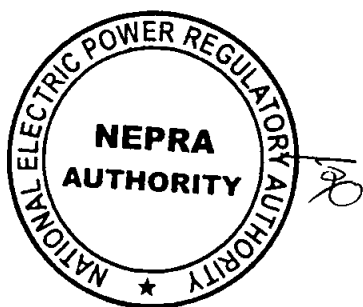
47. Whether the claimed losses of 4.3% are justified?

Please refer para 49.4.



48. **Legal Issues:**

- 48.1 The commentator during hearing raised concerns that under which law PPIB has submitted the tariff petition.
- 48.2 Additionally, Anwar Kamal Law Associates (AKLA) also raised that;
- i. The Tariff Petition has been filed by the Private Power Infrastructure Board (PPIB). NEPRA needs to answer under which capacity PPIB has submitted this Tariff Petition and why is NEPRA entertaining it?
 - ii. Under the Transmission Policy 2015, there are two modes, i.e. competitive bidding or upfront tariff, for the award of tariff to the private party investing in the power transmission sector then under what mode tariff is claimed?
- 48.3 The Petitioner in response to the comments/objections of the parties submitted that Section 5(2)(q) of PPIB Act 2012 empowers PPIB to perform any other function or exercise of any other power as may be incidental or consequential for the performance of any of its functions or the exercise of any of its powers or as may be entrusted by the Federal Government to meet the objects of PPIB Act. Petitioner submitted that, it may kindly be noted that PPIB has been established to function as one window facilitator in relation to implementing the power policies, the development and implementation of Power projects and related infrastructure, promote, encourage, facilitate investment in power sector, inter-alia, in the private sector and to provide for matters connected therewith or incidental thereto. Accordingly, the tariff petition has been filed in accordance with powers conferred upon by PPIB Act, 2012 read with NEPRA Act, 1997 and NEPRA Tariff (Standard and Procedures) Rules, 1998.
- 48.4 With regard to the Transmission Policy, 2015 the Petitioner responded that the competitive bidding or upfront tariff modes provided in the Transmission Policy, 2015 relates to the award of the Project and has no relevance to filing of tariff petition by PPIB, which has been filed in accordance with the empowerment provided by PPIB Act and has to be determined by NEPRA in accordance with NEPRA Act and NEPRA Tariff (Standard and Procedures) Rules 1998. However, it is submitted that the award of project to private sector investor will be dealt separately in accordance with the Policy 2015 once tariff has been determined by NEPRA and notified by the Federal Government in the official Gazette.
- 48.5 The Authority considered the aforementioned issues and response of the Petitioner and the Authority is of the view that the instant petition has been filed under rule 3 of NEPRA Tariff (Standards and Procedures) Rules, 1998 under which any person interested in the tariff may file a petition with the Authority for determination of Tariff. PPIB being an interested person has filed the instant petition.



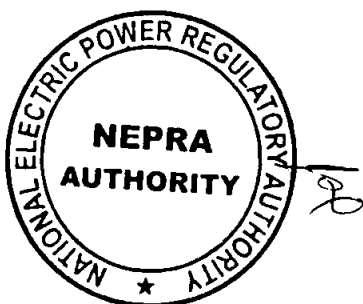
Therefore, in exercise of powers given under NEPRA Act and rules & regulations made thereunder, the instant petition is maintainable.

- 48.6 The Petitioner was asked to provide approval/ authorization from Board of Directors for filling the instant petition by PPIB. PPIB communicated vide its reply dated 29-06-2016 that it has obtained authorization for filling the instant petition in 105th meeting of PPIB Board and also provided extracts of the aforesaid meeting on July 29, 2016. PPIB claims that the submission of tariff petition was approved by Secretary (W&P) and Chairman PPIB board/Minister for Water & Power. Subsequently, PPIB Board ratified the filing of the tariff petition before NEPRA by PPIB for ± 660 HVDC Matiari-Lahore Transmission Project and to perform all actions deemed appropriate and necessary or incidental in relation thereto.

49. **Technical Issues:**

Following Technical issues were framed by the Authority, to be responded by the Petitioner during the hearing. Most of the technical issues were not responded by the Petitioner during the hearing, which the Petitioner was directed vide subsequent letters and in subsequent meetings. The response of the Petitioner was received on June 30, 2016. The issues are discussed here under:

- 49.1 **Have the issues highlighted by Teshmont Consultants addressed? If yes, what changes have been proposed in the project design and cost?**
- 49.1.1 The Petitioner submitted that CET has already received Teshmont's report and reviewed all the questions. CET has a different point of view against Teshmont on some of the issues as CET believes that such suggestions do not comply with the conditions in Pakistan such as erection of guyed tower instead of self-support towers, electrode and electrode line and EPC price of converter station being 35% higher.
- 49.1.2 The Petitioner also submitted that CET is of the view that most of the HVDC and UHVDC projects are in China and most of the main equipment is manufactured in China, therefore China market price can fairly represent international market price. CET believes that Teshmont has not considered the fact that major HVDC equipment is only available from limited manufacturers such as ABB, Siemens and Alstom and all these manufacturers are manufacturing in China major HVDC equipment, hence the Chinese market price reflected in the cost of this HVDC project is also the international market price.
- 49.1.3 The Petitioner submitted that there is no major change in the design and technical specification of the project except some reactive power compensation equipment (SVC) at receiving end as highlighted by Teshmont. CET submitted more system studies as per requirement of Teshmont . These studies were



reviewed by Teshmont and there was an exchange of comments/replies on the system studies results. The Petitioner referred that Teshmont has mentioned the risk regarding the capability of NTDCL system to transfer 4000 MW through HVDC line in certain scenarios without additional mitigation measures and has asked for the identification of the potential upgrades / measures to mitigate the risk. The Petitioner has submitted that CET, in general, has intimated that the Project is currently at feasibility stage and the necessary / required studies will be carried out during detailed design stage after award of contract. NTDCL is of the opinion that some mitigation measures reinforcement may be required to strengthen its network after these detailed studies are completed.

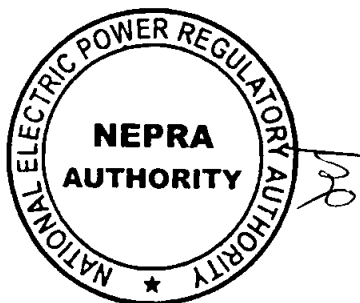
49.1.4 The Authority notes that Teshmont Consultants has raised various issues regarding Tower Design, Conductor Selection, Insulator selection, Converter Valve, Fault Level Analysis, Power Flow Contingency Analysis, Reactive Power Support and Switching Studies, Effective Short Circuit Ratio Evaluation etc. Most of the issues have been addressed by CET during the meeting held on 11 – 14 April, 2016 in Beijing, China. The three parties (CET, NTDCL & Teshmont) agreed on the issues and hence the issues are now stand closed.

49.2 Whether the option of HVDC instead of HVAC is justifiable? What is the outcome of any economic and financial evaluation carried out?

49.2.1 The Petitioner has submitted that NTDCL engaged independent consultant SNC-Lavalin to conduct feasibility study for transmission of power from the proposed new generation projects from South to North. SNC- Lavalin in its final report dated March 2013 proposed $\pm 600\text{kV}$ HVDC technology (instead of HVAC) for South to North bulk power transfer after economic and financial analysis. Further, it was agreed in the meeting held in Beijing dated 11th – 14th April 2016 between NTDCL and its consultants Teshmont and CET that ± 660 transmission line from Matiari – Lahore is a feasible option due to its techno-financial viability.

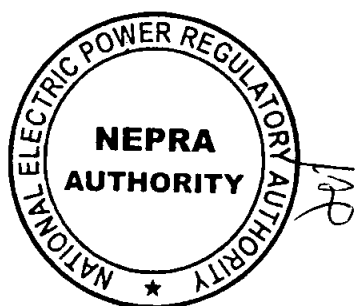
49.2.2 The Authority has reviewed the feasibility report conducted by SNC Lavalin regarding comparison between HVAC & HVDC project. The Authority also reviewed various reports on HVDC projects worldwide such as:

- a. A paper published by IEEE titled “Comparative Evaluation of HVDC and HVAC Transmission Systems” in 2007.
- b. An Advisory Support Report on “HVDC Transmission” prepared by Dual Consulting for World Bank in May, 2016.
- c. A report titled “Capital Costs for Transmission & Substations” prepared by Black & Veatch for Western Energy Coordinating Council in February 2014.



- 49.2.3 It is observed that for transmission line projects having length of 500-600 km and above, HVDC is preferred due to technical and financial viability. Based on the feasibility report submitted by the Petitioner, literature studied on solution of HVAC or HVDC and various reports on HVDC projects worldwide and feasibility study reports of HVDC Projects worldwide, the response of the Petitioner on the said issue is accepted by the Authority.
- 49.3 What is the rationale and criteria for the selection of ± 660 kV HVDC? Considering the huge price differential between ± 660 kV & ± 500 kV what is the outcome of any technical and financial evaluation carried out?
- 49.3.1 The Petitioner responded that the rationale and criteria for selection of 660 kV HVDC in Pakistan is based upon;
- As recommended by SNC Lavalin study conducted in March 2013
 - Longitudinal and narrow corridor from South to North
 - Bulk coal based and nuclear generation in south
 - Large load centers near mid Country
 - Lower losses as compared to 500 kV
- 49.3.2 The Petitioner has submitted that on the basis of aforementioned reasons a high capacity transmission line is required in the long term scenario with ± 660 kV and 4000 MW transmission capacity. Teshmont in its latest report dated April 15, 2016 has also endorsed the ultimate conclusion that a 660kV/4000MW HVDC transmission link appears to be a feasible option. However, Teshmont referred that a final confirmation is to be based on additional load flow analysis that will be completed by CET.
- 49.3.3 The Petitioner also submitted a comparison of 500 kV HVDC and ± 660 kV HVDC claimed cost as shown hereunder:

Particulars	± 660 kV, 4000MW, 878km	± 500 kV, 3000MW, 878km
	US \$ million	US \$ million
EPC Cost		
-Converter Stations	1,260	866
-Transmission Line	497	497
Total EPC cost	1,757	1,363
*Other Project Costs	343.38	278.06
Total Project Cost	2,100.38	1,641.06
O & M Cost	74	58



Levelized Tariff (US Cent/kWh)	0.9140	0.9520
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*Some of the other project cost components such as Taxes, financial charges, Sinosure fee and IDC are linked with the EPC cost.

- 49.3.4 The Petitioner also provided the sensitivity of the Levelized Transmission Service Charges (TSC) based on the availability factor as under;

Particulars	± 660 kV, 4000MW, 878km	± 500 kV, 3000MW, 878km
100% (8,760 Hrs)	0.9140	0.9520
79.9% (7,000 Hrs)	1.1438	1.1914
68.5% (6,000 Hrs)	1.3344	1.3899
57.1% (5,000 Hrs)	1.6013	1.6679

- 49.3.5 According to the Petitioner, the additional cost due to allowed system losses of 4.3% in scenario A i.e. ± 660 kV would be US c 0.3539/kWh and US c 0.430/kWh for scenario B i.e. for ± 500 kV based on utilization of 100% of the designed transmission capability dispatch.

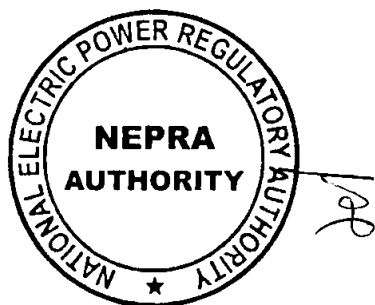
- 49.3.6 The Petitioner submitted that the ± 660 kV, 4000 MW is the most economical option due to;
- Lower levelized TSC
 - Cost saving of US c 0.705/kWh because of lower system losses of 4.3% as compared to 5.1% under scenario B

- 49.3.7 The Petitioner submitted that CET has changed the voltage level from 600KV to 660 KV on the following grounds.

- The voltage level of 600KV and 660 KV is the same category with no significant changes on the technology and installation level.
- CET has a reference project of 660 KV in china for over 5 years' smooth operations.
- The voltage level increase from 600KV to 660 KV will increase the detail investment however it will lower the loss rate with more saving of the energy produced.

- 49.3.8 In addition a report on "Impacts of HVDC Lines on the Economics of HVDC Projects" published by CIGRE in 2008 has also been considered by the Authority. Having analyzed the report, the Authority believes that for a length of 878 km from Matiari – Lahore, ± 660 kV HVDC line is more viable/suitable option than ± 500 kV. The following table is presented in support of the above:

Voltage (kV)	For 750 km	For 1,500 km	For 3,000 km
± 300	<1,550 MW	<1,100 MW	<850 MW
± 500	1,550 – 3,050 MW	1,100 – 2,200 MW	850 – 1,800 MW
± 600	3,050 – 4,500 MW	2,200 – 3,400 MW	1,800 – 2,500 MW
± 800	>4,500 MW	>3,400 MW	>2,500 MW



- 49.3.9 Certain other justifications for preferring HVDC over HVAC are also noted including the following:
- The power transmission capability of HVDC technology is high as compared to the HVAC technology.
 - HVDC technology requires no additional investment for faster control of active/reactive power as compared to HVAC system.
 - HVDC technology does not contribute in increasing fault levels as much as an HVAC system does.

49.3.10 In view of the technical explanation and justifications provided by the Petitioner, the review and analysis by the Authority on the issue, the response of the Petitioner is accepted.

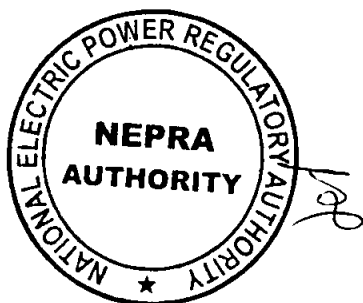
49.4 What are the major differences in design from the earlier parameters proposed by SNC-Lavalin in its feasibility study?

49.4.1 SNC- Lavalin recommended $\pm 660\text{kV}$ DC to transfer 4000MW, with the conductor $6 \times 1250\text{mm}^2$ in the feasibility study. As the conclusion of feasibility study by CET, the solution of $\pm 660\text{kV}$ to transfer 4000MW is the optimal choice for Pakistan Power system scheme. Considerations to the requirement of system losses, the conductor recommended was $4 \times 1250 \text{ mm}^2$. Based on Technical and financial comparison of conductor $6 \times 1520 \text{ mm}^2$ and $4 \times 1250 \text{ mm}^2$, the conductor 4×1250 is found to be more economical as compared to other options.

Loss comparison between SNC Lavalin Proposal and CET proposal		
Loss ratio	SNC Lavalin	HVDC Project
Converter station	1.50%	1.62% (Aligned with CIGRE 388)
Transmission Line	2.4% For $6 \times 1,520 \text{ mm}^2$ Conductor	2.59% For $4 \times 1,250 \text{ mm}^2$ Conductor (Aligned with CIGRE 388)

49.4.2 The cost comparison provided by SNC Lavalin and CET is as below:

Sr.#	Description	EPC Cost of CET (MUSD)	EPC Cost of SNC Price Level 2013 (MUSD)
1	Transmission line (878 km)	476	352
2	Convertor and grounding station (2 x 4000 MW)	1242	535
	Sub-total	1718	957



✍

Escalation @ 2.5% per annum for 3 years		72
Total EPC Cost (2016)	1718	1029

49.4.3 The Authority analyzed the data provided by CET and it is noted that CET proposed following three options of conductors for Transmission of power for Matiari – Lahore Project:

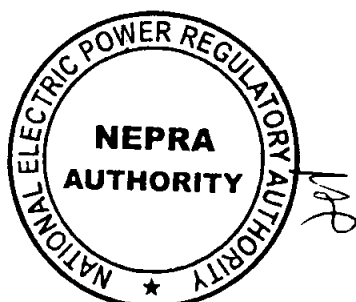
Sr. No	Conductor Size	Conductor Type	Losses (%)	Cost (USD) According to EPC Price Proposal (September 2015)
1	6 x 900 mm ²	6 x JL/G3A – 900/40	4.1	529,093,351
2	4 x 1250 mm ²	4 x JL1/G2A – 1250 /70.	4.3	476,244,185
3	4 x 1000 mm ²	4 x JL/G3A – 1000/45	5.0	410,915,180

49.4.4 It is observed by the Authority that the cost of 4 x 1000 mm² conductor is found to be lowest of all the available options but the losses are on higher side. Losses of the conductors 6 x 900 mm² and 4 x 1250 mm² are comparable while the cost of 4 x 1250 mm² conductor is relatively less than the losses of 6 x 900 mm² conductor.

49.4.5 The Petitioner submitted that overall losses of 4.3% for by poll operations to be allowed against the conductor 6 x 1250mm². The Authority considered the SNC Lavalin report which had referred converter station losses to be 1.5% and transmission lines losses to be 2.4%. The Authority also considered the technical views expressed by Teshmont which had proposed 3% transmission line losses and 1.5% for converter station losses. The Authority also compared the claimed losses in context of CIGRE standards, which states that for each converter station 0.81% loss is considered reasonable, for two (02) converter stations at Matiari and Lahore the total of 1.62% and for the transmission line losses of 2.59% are considered reasonable, hence total losses for HVDC Project work out as 4.21%. which also indicated reasonableness of the line losses claimed.

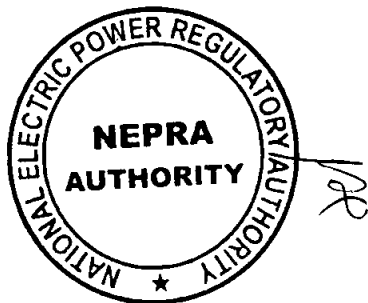
49.4.6 The Authority also considered the available information of the losses for other HVDC project globally as reflected in table below;

Losses of HVDC T/L in the World Project					
Project	Capacity	EPC/Consulting Conductor	Route (Length) Km	Line Losses (%)	
Itaipu ±600kV HVDC (Brazil)	3150 MW	Teshmont (Canada)	805	3.91	
Pacific Intertie ±600kV HVDC (USA)	2000 MW	ASEA (ABB)	1360	6.73	



Three Georges Shanghai $\pm 500\text{kV}$ HVDC (Brazil)	3000 MW	ABB & SIMENS	1100	6.6
Ningdong $\pm 600\text{kV}$ HVDC (China)	4000 MW	SGCC	1300	4.6

- 49.4.7 In view of above, the Authority believes that the basis given for the selection of conductor and loss calculation by the Petitioner is acceptable. Hence, the Authority approved the claimed transmission losses of 4.3%.
- 49.5 As referred in Cooperation agreement, has NTDCL carried out interconnection studies, including load flows, short circuit and transient stability studies for the Project.
- 49.5.1 HVDC is a new technology in Pakistan. Therefore, NTDCL provided all the base cases of future scenarios and other required data to CET to carry out load flow, short circuit and transient stability study for the project.
- 49.5.2 Accordingly, CET prepared relevant required reports upon NTDCL's request for NEPRA to review.
- 49.5.3 NTDCL has engaged Teshmont Consultants Canada, an experienced consulting firm in HVDC technology, for the review of the reports/work done submitted by CET. In this regard, a joint meeting held in Beijing, China from April 11 – 14, 2016 in which representatives of CET, NTDCL, NESPAK and Teshmont participated. It was decided in the meeting that CET will make its final technical recommendation on May 10, 2016 and the same have been forwarded to Teshmont for their final recommendations / comments.
- 49.5.4 The worst case scenarios have already been highlighted in the feasibility reports. These studies will be further reviewed and updated in due course.
- 49.5.5 Because part of the input information for design and technical parameter has not been finalized, the relevant research and study will be completed after all input information is available in the future. For example, the SSO study requires the detailed information of generation units at Matiari end.
- 49.5.6 The Authority is of the view that since some studies are in process as mentioned above, therefore completion of these studies is important for the design and technical parameters finalization.

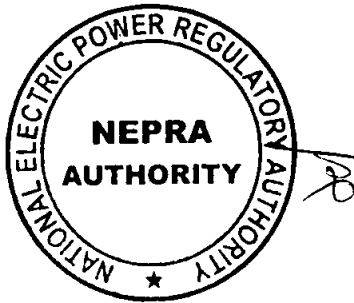



- 49.6 Is the Petitioner and NTDCL satisfied with load flow studies carried out by SGCC/CET for this project in view of future generation and load centers? And Whether N-1 contingency has been made available for this transmission line?
- 49.6.1 The Petitioner informed that NTDCL reviewed the reports submitted by CET in 2015 and provided its comments. The petitioner also referred that NTDCL has carried out load flow studies and was also part of the meetings held in Beijing from April 11-14, 2016. Some of the studies are undergoing and will be submitted once completed. NTDCL is also reviewing the report of CET submitted and provided its comments accordingly. Moreover, NTDCL has also asked CET to address the comments of the Teshmont regarding studies for the HVDC project, as part of the input information for studies pertaining to design and technical parameters.
- 49.6.2 Petitioner also replied that no major changes have been made after the additional system studies carried out in May and June 2016. However, it was mentioned that NTDCL is of the opinion that some mitigation measures and reinforcement may be required to strengthen its network after these detailed studies are completed, as proposed by Teshmont also. It was also referred that NTDCL will initiate a separate study project shortly for the installation of Power system stabilizer and series/shunt compensation to enhance the power transfer capacity of its entire transmission network.
- 49.6.3 The Authority noted that NTDCL views and on the studies conducted by CET which are either still in process or yet to be completed. Similarly requirement of additional studies has also been noted by the Authority. A brief on the adequacy of such studies noted is as under;

"Adequacy of Studies"

The scenario studied by CET corresponds to the summer peak load of 2018, which, corresponds to the condition of maximum system short circuit level and including some 500 kV NTDCL investments/reinforcements in the grid. However, to demonstrate robustness of the project, the worst system conditions should be addressed, which means, minimum short circuit power scenario must be assessed with enough generation in the South to transmit the 4000 MW and minimum generation in Lahore (receiving end of the HVDC line). Both NTDCL and CET are directed to perform these studies on priority.

Further studies and assessment are also required by the designer on different modes of operation of HVDC link. The following Table provides different modes of operation which need to be considered.



Operational Modes suggested (for both power flows directions)	Requirements
Bipolar with Rated Voltage	A
Bipolar with Reduced DC Voltage (from 70% to 95%)	B
Monopolar with Rated Voltage (metallic return)	A
Monopolar with Rated Voltage (earth return)	A
Monopolar with Reduced Voltage (metallic return)	B
Monopolar with Reduced Voltage (earth rddetern)	B
Low Ambient Continuous Overload (bipolar or monopolar)	B
Long Term Overload (bipolar or monopolar, metallic or earth return)	B
Short Term Overload (bipolar or monopolar, metallic or earth return)	B

A – Must meet the harmonic performance that deals with individual limits of harmonic distortions of voltage, at the point of common coupling and respect the limits of exchange of reactive power, considering the unavailability of any AC Filter sub-bank throughout the power band of the DC link, up to the rated power.

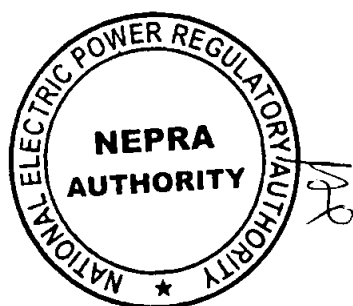
B – Must meet the harmonic performance that deals with individual limits of harmonic distortions of voltage, at the point of common coupling, and respect the limits of exchange of reactive power with all AC Filter sub-banks available.

NTDCL is required to seek necessary assurances from CET and confirm in respect of the following:

Limits of reactive power exchange between the HVDC link and the AC system were not clearly defined by NTDCL to be contemplated by CET in its reactive power equipment design. CET has used its own assumptions that may not be representative of the reality and therefore not adequately represented in studies impact upon the grid.

Apparently, the overcurrent stresses upon transformer and valves, have been calculated with regard to the envisaged maximum short circuit level of the system, and not considering the maximum current capability of the circuit breakers to be installed (presumably 63 kA). As the system should stand for a minimum of 30 years of operation, it is recommended that CET re-calculates the overcurrent stresses under the circuit breaker capability conditions.

The AC voltage variation due to switching in and out reactive power individual elements (sub-groups or sub-banks) could reach 6 %. Good practice in HVDC project is to limit those variations up



to 3%. CET has also stated that the proposed project adopted 2% of voltage variation. This inconsistency needs to be clarified and confirmed by CET.

In the stability study carried out by CET, the cases of DC pole or bipole blocking results in some level of load shedding. NTDCL should verify whether such criteria are in compliance with the Pakistan Grid Code and applicable N-1 conditions.

Teshmont has claimed the reactive power limits utilized by CET, possibly, are in excess to what NTDCL system could contribute or absorb. This issue should be verified by NTDCL to confirm the results are acceptable as a pre-requisite to agreeing the technical feasibility and signing the Agreement.

Teshmont requires the full documentation in English and an accurate list of spare parts. CET should supply this information as a pre-requisite to NTDC signing the Agreement.

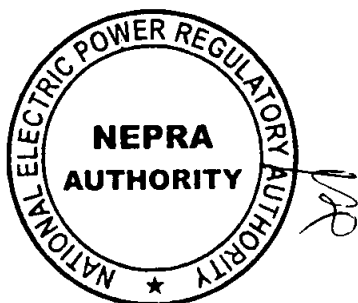
CET must comply with Pakistan Grid Code in all relevant aspects (harmonics, AC Filter design, load shedding, stability criteria etc.) and not the Chinese standards.

NTDCL should pursue that CET study results does not require generation curtailment and/or load shedding as a result of an N-1 event.

Within the System Stability study, the results so far presented of power swings close to 60 degrees are not acceptable to demonstrate the technical feasibility of the 4000 MW transmission. CET proposal to address this issue is for NTDCL to change the protection setting of the power plants does not seem reasonable. Moreover, CET has obtained these results with maximum short circuit levels, and with the new cases to be run with minimum short circuit level, the power swing result may be even worse.

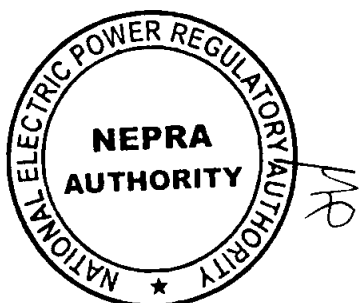
CET has proposed to evaluate the reverse power flow capability to only 50% of rated power. To provide flexibility in operations specifically completion of power generation projects in the South a reverse power level of 80% could be considered. CET may meet this requirement."

- 49.7 Has the Petitioner taken into account the proposed RLNG based and coal based generation plants near load center in North in finalizing the design of line?
- 49.7.1 The Petitioner stated that as CPPA in Pakistan has either signed or in the process of signing the PPA for all the coal power projects being set up in South, NTDCL is obligated to evacuate power and provide interconnection facilities timely and hence NTDCL has to evacuate power from South to North

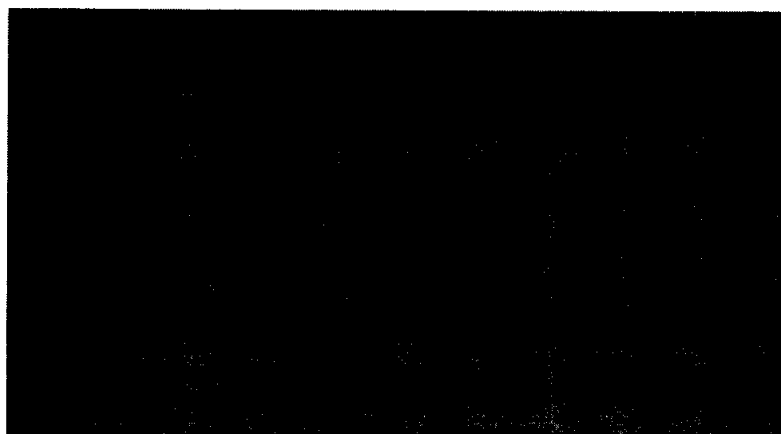


in any case and requires infrastructure for the same. Even if the RLNG and coal based plants in north come online earlier run at full capacity, evacuation of power may be reduced from South in that period depending on economic order. However, as the demand increases, the total power will be required in any case. It is also pertinent to note that the cost of electricity from power plants in South will be lowered compared to power plants in Punjab because of coal transportation costs.

- 49.7.2 This issue is already explained in the previous issue under the head "Adequacy of Studies".
- 49.8 **Is the proposed non-penalized 1.5% non-availability period rationale in view of international practices for an HVDC Line?**
- 49.8.1 The Petitioner mentioned that as per CIGRE, the converter station's designed scheduled outage is 1%, forced outage is 0.5%. According to SNC- Lavalin report, the design value of unavailability of converter station is also 1.5%, the allowed unavailability is 2%. So 1.5% unavailability is the general international practice for the design of converter station all over the world.
- 49.8.2 The Petitioner explained that in Para 23 of the Guidelines of the Transmission Policy 2015 by the Government of Pakistan, TSC will be based on 100% availability with 1.5% non – penalized maintenance outages, which is inclusive of both converter stations and transmission line outages.
- 49.8.3 The Raigarh to Pugalur HVDC of India with a transmission capacity of 6000 MW, its Forced Energy Availability Rate is 0.7% and Energy Availability Rate is 97%.
- 49.8.4 CET is of the opinion that the guaranteed value for this project is very strict and even stricter than the CIGRE statistical data and reasonable allowed unavailability should be 3% (Availability of 97%).
- 49.8.5 The Petitioner stated that the system losses for 2 converter stations as described in CIGRE 388 – chapter 5.4.3.10 is 1.62%. Transmission line losses as described in CIGRE-388 – chapter 4.11.3 is 2.59%. For this project the guaranteed loss ratio is 4.3% (including converter station and T – Line). Teshmont's report shows that loss ratio below 5% is appropriate.
- 49.8.6 The Authority is of the view that since the CIGRE standard – 388 is internationally adopted, therefore the response of the Petitioner is acceptable.
- 49.9 **Has the impacts including estimated losses worked out if the referred Generation Project are not able to produce the anticipated production determined for transmission?**
- 49.9.1 The Petitioner responded that there are two (2) types of losses in HVDC project, (i) converter station losses, (ii) transmission line losses. If the power generation from the referred coal projects is lower than



the anticipated production, both the converter station losses as well as transmission line losses will be in line with the following line loss curve.



49.9.2 The Petitioner informed that because the transmission cost of HVDC project is based on 4000MW no matter how many power is actually transmitted. Even take the power losses into consideration, Lahore station could receive the largest amount of electricity in the condition of 100% rating operation status, thus the cost in HVDC transmission line per 1 kWh electric power is the lowest. The calculation process as shown below:

49.9.2.1 Pre-condition

1. The price of electric power from power plant is 8US cents per kWh
2. The TSC of HVDC project is 0.914 US cent x 4000 MW x transferring time

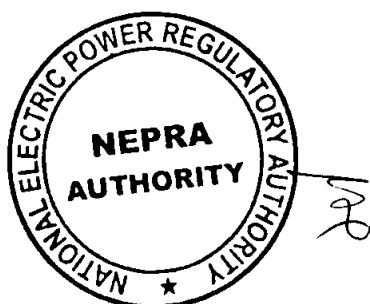
49.9.2.2 Case 1:

If the time period is one (1) hour, the HVDC operates in the condition of 100% rating capacity, the loss ration of the project is 4.3 % while the temperature is 25 °C. Thus within 1 hour:

- The electric power of Matiari converter station is 4000 MWh:
- The electric power of Lahore converter station is 4000 MWh x (1-4.3%) = 3828 MWh;
- In consideration of power losses of HVDC project, for those electric power of 3828 MWh in Lahore converter station, the cost per kWh is as follows:

$$\frac{(4000000\text{kW} \times 1\text{h} \times 8\text{US cent/kWh} + 0.914\text{US cents} \times 4000000 \text{ KW} \times 1\text{h})}{3828000\text{kWh}}$$

$$= 9.3 \text{ US cents}$$



So the cost per kWh of electricity on the transmission line is as follow:

$$9.3 \text{ US cents} - 8 \text{ US cents} = 1.3 \text{ US cents}$$

49.9.2.3 CASE 2:

With 1 hour, the HVDC project operates in the condition of 50% nominal power, the loss ratio of the project is 2.8% while the temperature is 25°C . Thus within 1 hour:

- The electric power of Matiari converter station is 2000 MWh;
- The electric power of Lahore converter station is $2000 \text{ MWh} \times (1 - 2.8\%) = 1944 \text{ MWh}$;
- Considered the power losses of HVDC project, for those electric power of 1944 MWh in Lahore converter station, the cost per kWh is as follows:

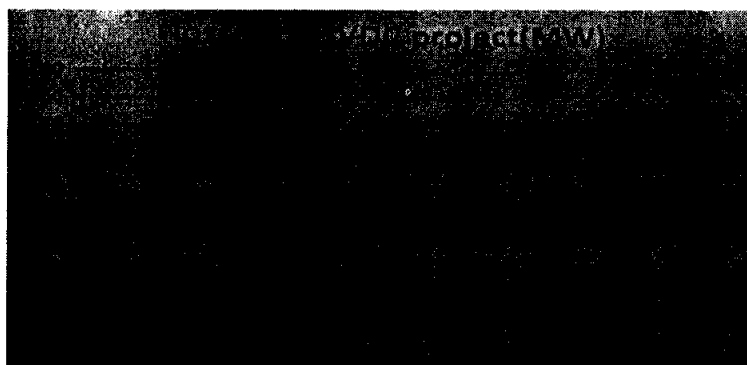
$$\frac{(2000000 \text{ kW} \times 1 \text{ h} \times 8 \text{ US cent/kWh} + 0.914 \text{ US cents} \times 4000000 \text{ KW} \times 1 \text{ h})}{1944000 \text{ kWh}}$$

$$= 10.11 \text{ US cents}$$

So the cost per kWh of electricity on the transmission line is as follow:

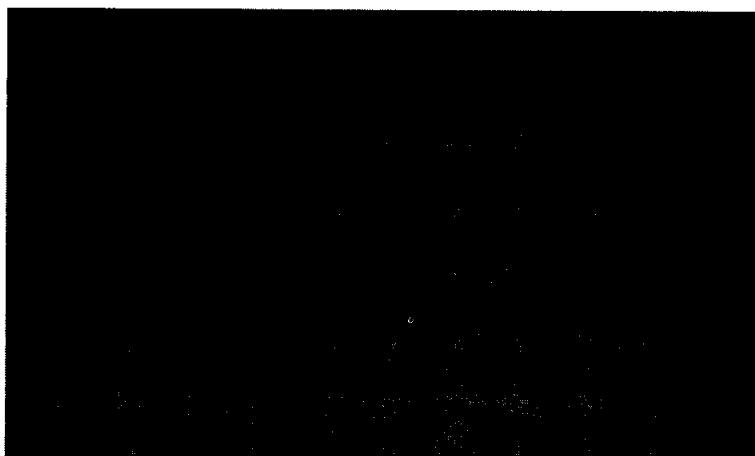
$$10.11 \text{ US cents} - 8 \text{ US cents} = 2.11 \text{ US cents}$$

49.9.3 Considering the loss, in the condition of 100% rated power transmission, the cost per kilowatt hour in the HVDC project is less than in the condition of 50% rated power transmission.

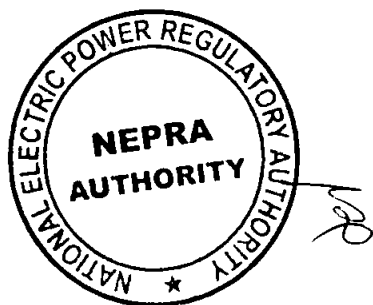


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- 49.9.4 The Authority notes that due to the behavior of Bipole Operation of HVDC System, the receiving end station could receive maximum amount of power when it operates on 100% rated capacity at the maximum assessed losses with lowest cost per unit of transmitted electricity. In case of partial loading of the maximum rated capacity, the receiving end station will receive partial power although with lesser loss ratio but the cost per unit of transmitted electricity would be on higher side.
- 49.9.5 The Authority is of the view the calculations submitted by the Petitioner on this issue are found consistent with the behavior of Bipole Operation mentioned above therefore the response of the Petitioner is accepted.
- 49.10 What is the basis of selection of tower design? Including its optimization for ROW cost. Is the design and cost of Towers and Cable rationale and justified?
- 49.10.1 The Petitioner responded that the tower design of self-supporting tower for Matiari – Lahore HVDC project has taken into account the cost of land. The self-supporting tower occupies less land and has high safety factor The basis of selection of tower design including:
- Great importance of Matiari – Lahore $\pm 660\text{kV}$ HVDC project.
 - Guyed tower is vulnerable to damage / sabotage.
 - No reference project in Pakistan and nearby countries using guyed tower.
 - HVDC experiences in developing countries.
 - More maintenance work for guyed tower.
- 49.10.2 The Authority observed that Guyed towers need more maintenance work than self-supporting towers resulting in very high maintenance cost. There is also a great risk of being stolen and damage, the guyed towers are not suitable for Matiari – Lahore Project. In addition, literature on comparison of



guyed towers with Self-supporting towers has also been reviewed which supports the arguments of CET.

49.10.3 The Authority also noted that this issue has also been discussed and concluded between the parties (Teshmont, CET & NTDCL). Therefore the response of the Petitioner is accepted.

49.11 **Has the reliability of Transmission networks in line with the requirements of NEPRA Performance Standards (Transmission) Rule – 2005 been evaluated and confirmed?**

49.11.1 The Petitioner ensured that Matiari – Lahore HVDC Project shall comply with the requirements of NEPRA Performance Standards (Transmission) Rules – 2005.

49.11.2 The Authority noted that the existing reliability indices in NEPRA Performance Standard Transmission Rules may not be directly applicable to HVDC transmission system. Therefore while accepting the response of the Petitioner, there is a need for revision in the Performance Standards & Codes to address HVDC operations.

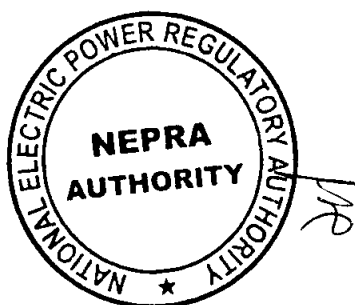
49.12 **What international Standards will be complied for type/make/model number of equipment/ materials & how their compliance will be monitored and ensured?**

49.12.1 The Petitioner stated that in accordance with the Cooperation Agreement, it is already agreed by the parties that the Engineering, Construction and O&M of facility will be performed according to IEC and/or IEEE, and/or Chinese Standards (GB) as per TSA. NTDCL is in the process of hiring owner's engineer to monitor the HVDC project in accordance with the agreed specifications. The list of international standard has been provided.

49.12.2 The Authority considered the detailed list of standards provided by the Petitioner and the response of the Petitioner on this issue is accepted.

49.13 **Does NTDCL have required capacity to carry out O&M Operations for the HVDC Transmission Line?**

49.13.1 Since the Petitioner did not respond on this issue, the Authority requires that details on organization and quality of work force involved, be provided as early as possible by NTDCL.



49.14 Whether need for additional reactive support is foreseen and whether it is included in scope of work and costs.

49.14.1 Reactive configuration of converter station for different operation modes in future years has been considered by CET. According to CET, the HVDC project does not absorb or supply reactive power from/to the system.

49.14.2 In view of the information provided by the Petitioner and study of relevant literature, the response of the Petitioner is accepted by the Authority.

49.15 Whether critical path analysis carried out for the project including readiness of HVAC system?

49.15.1 The Petitioner responded that NTDCL is obliged to construct its HVAC transmission network for transferring power through HVDC Link prior to commissioning of HVDC. NTDCL generally does not carry out critical path analysis for its projects.

49.15.2 The Authority noted that the response of the Petitioner is self-explanatory.

49.16 How will integration with HVAC be ensured and whether NPCC would be ready for the new scenario? Are training of NPCC and other professionals' part of the project?

49.16.1 The Petitioner submitted that the Grid code of Pakistan will be followed. The HVDC project will be integrated with the HVAC system. NPCC and CET have already communicated with each other about technical aspects of the project and CET will provide training and relative technical support to NPCC to ensure NPCC can possess the ability to manage the HVDC project.

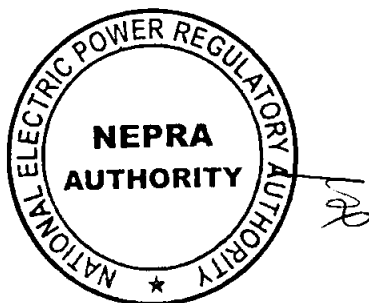
49.16.2 The Authority noted that the response of the Petitioner is self-explanatory.

49.17 How will the proposed tower design minimize the land acquisition and ROW costs?

As per the information provided by the Petitioner, the weight of self-supporting tower is relatively higher than guyed tower. However, the guyed towers occupy more land which increases the cost of ROW. The arguments submitted by the Petitioner are logical and hence accepted by the Authority.

49.18 Estimated timeline for ROW acquisition by NTDCL along with breakup of the cost claimed.

49.18.1 The Petitioner submitted that CET has already provided the working schedule of land acquisition and ROW and the same schedule will be followed for implementation. Estimated cost for land acquisition



and ROW has been provided in the tariff petition under NTDCL development cost. It is considered on case to case basis and compensation for loss of trees, crops etc. is given at site. However, it is pertinent to mention here that the Petitioner did not submit the estimated timelines and the segment wise cost breakup.

49.18.2 The Authority directs the petitioner to provide the relevant information as early as possible.

49.19 **Compliance status with Pakistan Environmental Protection Agency (PEPA) Act 1997.**

49.19.1 EIA was conducted by NESPAK and was submitted to EPA Sindh and EPA Punjab. However, no NOC has been provided by the Petitioner.

49.19.2 On above matter the Authority directed the Petitioner to provide relevant reports, studies and approvals at the earliest.

49.20 **Status of approval taken for ROW from concerned Provincial and related Authorities?**

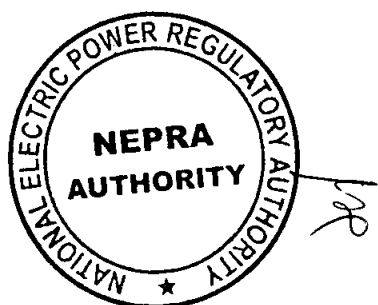
49.20.1 Public hearing for Sindh part has been conducted and it is expected that NOC will be obtained shortly. However, EPA Punjab is still in process and NOC will be obtained in two months. The Petitioner referred that the approval of Sindh Government and Punjab Government has not yet been submitted by the Petitioner.

49.20.2 On above issues the Authority directs the Petitioner to provide relevant reports, studies and approvals as early as possible.

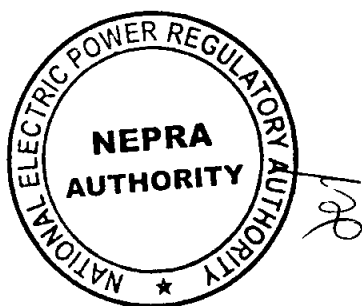
49.21 **Has the EIA and IPSA report prepared for this transmission line as specified in Cooperation Agreement?**

49.21.1 The Petitioner submitted that these reports have been prepared by NESPAK. However, the copies have not been submitted.

49.21.2 On above issue the Authority directs the Petitioner to provide relevant reports, studies and approvals as early as possible.



- 49.22 Allied cost of A.C. lines along with additional cost estimated to be borne for system stability with proposed induction of HVDC.
- 49.22.1 The Petitioner submitted that after submission of results of studies mentioned at aforementioned reply to the Question no. xxvi, the consultant (Teshmont) will be able to confirm whether or not additional mitigation measures would be required for stability of HVAC system with proposed induction of HVDC. NTDCL is going to conduct a study separately this year through international consultants to determine reactive power compensation and Power System Stabilizers to enhance its system stability in future scenarios. In the opinion of NTDCL, no additional AC lines may be required with this. The CET's recent report submitted on 10-05-2016 has been forwarded to Teshmont for review.
- 49.22.2 The Authority noted that the response of the Petitioner is self-explanatory. Any further studies to be carried out by NTDCL shall be expedited, and completed as early as possible.
- 49.23 Whether pollution level in different zones along the corridor have been considered in the selection of insulator, their design and number, if yes, provide details.
- 49.23.1 The Petitioner submitted that CET has completed contamination investigation report, which is in Chinese Language for transmission line, the conclusion of the report will be the basis for detail engineering.
- 49.23.2 The Authority noted that the response of the Petitioner is self-explanatory. Any further studies to be carried out by NTDCL shall be expedited, and completed as early as possible.
- 49.24 In case the HVDC line delayed what will be the alternate sources/option available to evacuate power from upcoming power plants.
- 49.25 The Petitioner submitted that NTDCL is of the view that alternate option is available to evacuate partial power for an interim period from the upcoming coal projects from South of Pakistan, however, it is not possible to have an alternate line to evacuate 4,000 MW from such power projects.
- 49.26 The Authority noted that the response of the Petitioner is self-explanatory. Any further studies to be carried out by NTDCL shall be expedited, and completed as early as possible.



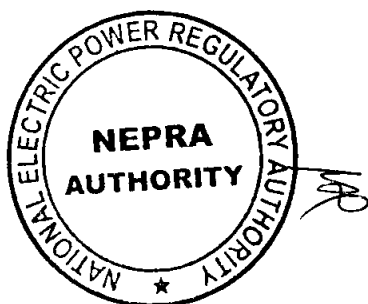
50. Directions to the Petitioner and NTDCL

Furtherance to the above, Authority also observed that the tariff being awarded cannot be isolated from various important responsibilities which have to complement and supplement this tariff. Authority therefore directed following aspects to be addressed by Petitioner and NTDCL:

- i. Since it is the first HVDC project of the Country, it needs to be ensured that there is a reliable and robust power transmission corridor fully integrated with the power generation projects at the sending end and fully capable of receiving at the Lahore converter station. It should be ensured that generation power of 4000 MW is timely and consistently available for this transmission line. It is important that clear responsibilities are identified and defined in this regards.
- ii. Copy of the complete O & M contracts, to be provided to Authority after signing.
- iii. Both, technical and financial capability of NTDCL should be ensured with regards to various obligations being entrusted for this HVDC transmission line.
- iv. TSA and IA and related other legal covenants should incorporate and consider technology transfer and indigenous capacity development for this and future HVDC projects. Specifically training to NPCC to be ensured.
- v. All required system studies should be completed by the EPC contractor and NTDCL.
- vi. Necessary contingency planning should be carried out for this HVDC Transmission Line as it has envisaged significant energy transmission from South to load centers.
- vii. Compliance should be ensured with grid code and NEPRA Performance Standard (Transmission) Rules, 2005.
- viii. Minimum possible transmission line length should be ensured giving due consideration to future transmission plans, social and environment aspect. Among other benefits, it will also reduce the construction cost, land cost and associated maintenance and security costs.
- ix. NTDCL to ensure mitigation measures for reinforcement to strengthen its network after completion of detailed studies.
- x. Petitioner and NTDCL should ensure maximum local employment for converter stations over the entire BOOT period of 25 years.
- xi. The security related costs claimed as part of this Project Cost should not duplicate the amount and security measures as assured to CPEC Projects.

51. ORDER

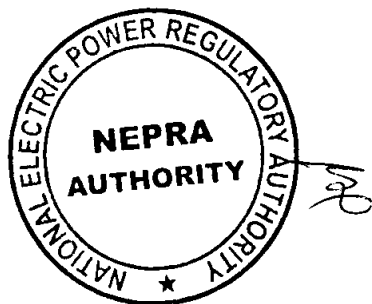
The Authority hereby determines and approves following reference Transmission Tariff/Transmission Service Charge (TSC) under section 7 read with section 31(4) of Regulation of Generation, Transmission and Distribution of Electric Power Act, 1997 and Rule 16 of NEPRA Tariff (Standards



and Procedures) Rules, 1998 in the matter of Tariff Petition filed by the Private Power Infrastructure Board (PPIB) for $\pm 660\text{kV}$ 4000 MW HVDC Matiari-Lahore Transmission Line Project:

Tariff Components	Year 1-10 Rs/kWh	Year 11-25 Rs/kWh	Indexation
O&M-ITC			
Foreign	0.0441	0.0441	PKR/US\$, US CPI
Local	0.0234	0.0234	CPI – General
NTDCL-O & M Local	0.0500	0.0500	CPI – General
Land Lease	0.0073	0.0073	As per actual
Insurance	0.0390	0.0390	Annually as per actual up to 1% of EPC Cost, PKR/US\$
Sino-sure Fee	As per Annex-I		As per actual upto 0.60% of the (outstanding debt at the start of the year plus accrued interest payment during the year)
Debt service	0.4974	-	LIBOR, PKR/US\$
Return on equity	0.1599	0.1766	PKR/US\$
Return on equity during construction	0.0290	0.0290	PKR/US\$

- i. The reference TSC is based on 100% availability with 1.5% annual non-penalized maintenance outages.
- ii. The reference PKR/Dollar rate has been assumed at Rs. 104.40
- iii. The above Tariff is applicable to the qualified Independent Transmission Company (ITC) as declared by PPIB for a period of twenty (25) years commencing from the date of the COD.
- iv. Sinore Fee on outstanding balance of Debt and interest at gross rate of 0.60% has been allowed for each applicable year as indicated in the reference tariff table attached herewith as Annex-II.
- v. The Tariff is calculated on the basis of Build Own Operate and Transfer (BOOT) basis. The Project will be transferred to NTDCL upon the expiry of the term of the TSA signed between NTDCL and ITC.

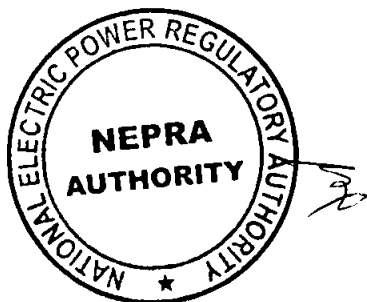



- vi. All invoicing and payment terms are assumed to be in accordance with the TSA which will be signed between NTDC and ITC.
- vii. Redemption of equity has been allowed after 10 years of commercial operations of the Transmission Line.
- viii. All the TSC payment to ITC will be made in Pak Rupee.
- ix. The impact of losses shall be allowed on the basis of units transmitted.
- x. The component wise tariff is indicated at Annex-I.
- xi. Debt Servicing Schedule is attached as Annex-II.

The following indexations shall be applicable to the reference tariff;

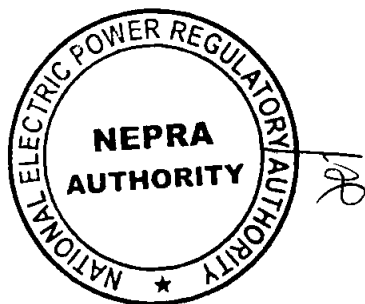
I. One Time Adjustments

- a. Duties and/or taxes, not being of refundable nature, imposed on ITC in relation to its transmission business up to the commencement of its commercial operations for the import of its plant, machinery and equipment will be subject to adjustment at actual on COD, as against US \$ 79.09 million allowed now, upon production of verifiable documentary evidence to the satisfaction of the Authority.
- b. NTDC development cost which includes right of way compensation, land lease cost and cost of site survey, load flow studies and environmental studies will be adjusted on the basis of actual up to maximum limit of US \$ 12 Million as allowed by the Authority on verifiable documentary evidence at COD. The cost specific to this project will not be admissible to be claimed by NTDC in any other tariff petition submitted to the Authority.
- c. Insurance during construction will be adjusted as per actual, subject to maximum limit of 1% of the adjusted and approved EPC cost, on production of authentic documentary evidence at the time of COD tariff adjustment.
- d. Financial charges will be adjusted at COD on the basis of actual, up to a maximum of 3% of the total debt allowed (excluding the impact of interest during construction, Sinosure fees and financial charges), on production of authentic documentary evidence.





- e. Sinasure Fee, applicable on debt and accrued interest thereon (IDC) during the project construction period will be adjusted at COD on the basis of actual subject to the maximum allowed limit and payments terms as approved by the Authority, on account of variation in PKR/US\$ exchange rate during the project construction period, based on documentary evidence to be provided by ITC.
- f. If ITC is required to make payment of Withholding Tax on Overseas Investment Insurance Fee (Sinasure Fee) on interest part of debt during the project construction period of 27 months and debt repayment period of ten years after COD, the same shall be allowed as pass through cost in tariff based on actual upon production of verifiable documentary evidence to be provided by ITC.
- g. The cost of feasibility study will be allowed up to maximum of US\$ 5.4 Million subject to timely submission of studies to NTDC for endorsement of cost and relevance of studies. In addition, the evidence of payments made to the Institute carrying out the feasibility study will have to be also provided for verification at the time of COD.
- h. Interest during Construction (IDC) will be adjusted at COD on the basis of actual debt composition, variation in PKR/US\$, debt drawdown (not exceeding the amount allowed by the Authority) and applicable 6-months LIBOR/KIBOR during the project construction period allowed by the Authority.
- i. Principal repayment and the cost of debt will be adjusted at COD as per the actual borrowing composition and variation in LIBOR/ KIBOR at relevant dates during the project construction period
- j. In case, the spread on LIBOR/KIBOR is agreed at lower than 450/300 basis points, the benefit of such reduction in rate will be adjusted in proportion of 40% to ITC and 60% to the consumer through necessary adjustment in tariff at COD.
- k. Return on Equity (ROE) and Return on Equity During Construction (ROEDC) will be adjusted at COD on the basis of actual equity injections and PKR/US\$ exchange rate variation (within the overall equity allowed by the Authority at COD) during the project construction period as allowed by the Authority.
- l. The specific items of project cost paid in foreign currency (i.e. US\$) will be adjusted at COD on account of actual variation in exchange rate over the reference PKR/US\$ exchange rate of Rs. 104.40 on production of verifiable documentary evidence to the satisfaction of the Authority.
- m. The reference tariff table shall be revised at COD while taking into account the above adjustments. The ITC shall submit its request to the Authority within 90 days of COD for necessary adjustments in tariff.



II. Pass-Through Items

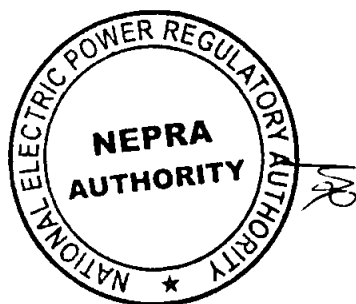
- a. No provision for Income Tax has been accounted for in the tariff. If ITC is obligated to pay any tax in relation to its transmission business, the exact amount paid by ITC may be reimbursed by the NTDCL to ITC on production of original receipts. This payment may be considered as pass-through payment (as Rs./kWh) spread over a 12 months period in addition to fixed charges proposed in the Reference Tariff. Furthermore, in such a scenario, ITC may also submit to the NTDCL details of any tax shield savings and the NTDCL will deduct the amount of these savings from its payment to the Petitioner on account of taxation.
- b. If ITC is required to make payment of Withholding Tax on Sinusure Fee and Debt Servicing component of tariff, the same shall be treated as Pass Through cost of ITC.
- c. Any such, Excise Duty or other Duty, Levy, Charge, Surcharge or Other Impositions applicable on the ITC (whether federal or provincial) not considered in the Tariff will be Pass-Through under the TSA.
- d. No provision for the payment of Workers Welfare Fund and Workers Profit Participation has been made in the tariff. In case, the ITC has to pay any such fund, that will be treated as pass through item in the TSA.
- e. As security is the responsibility of GoP as mentioned above in this document, no extensive security costs have been assumed. If such costs apply, these will be treated as pass-through item in the TSA.

III. Indexations:

The following indexation shall be applicable to the reference tariff;

i. Indexation applicable to O&M

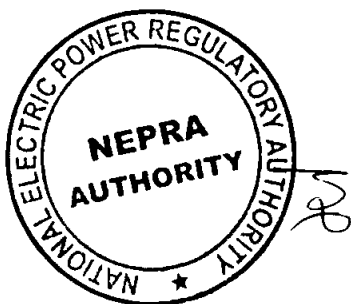
The local part of ITC-O&M cost and NTDCL O & M will be adjusted on account of Inflation (CPI) and ITC-O&M foreign will be adjusted on account of variation in Rupee/Dollar exchange rate and US CPI. Quarterly Adjustment for local inflation, foreign inflation and exchange rate variation will be made on 1st July, 1st October, 1st January & 1st April respectively on the basis of latest available information with respect to CPI - General (notified by the Pakistan Bureau of Statistics), US CPI (notified by US bureau of labor statistics) and revised TT & OD Selling rate of US Dollar as notified by the National Bank of Pakistan. The mode of indexation will be as follows:



$$\begin{aligned} F-O\&M-ITC_{(FRE)} &= F-O\&M-ITC_{(FRE)} * US\ CPI_{(REV)} / US\ CPI_{(REF)} * ER_{(REV)} / ER_{(REF)} \\ F-O\&M-ITC_{(LRE)} &= F-O\&M-ITC_{(LRE)} * CPI - G_{(REV)} / CPI - G_{(REF)} \\ F-O\ \&\ M-NTDCL_{(LRE)} &= F-O\&M-NTDCL_{(LRE)} * CPI - G_{(REV)} / CPI - G_{(REF)} \end{aligned}$$

Where:

$F-O\&M-ITC_{(FRE)}$	=	The revised applicable Fixed O&M foreign component of the fixed charges of Independent Transmission Company indexed with US CPI and US \$/PKR fluctuation. CPI – General
$F-O\&M-ITC_{(LRE)}$	=	The revised applicable Fixed O&M Local component of the fixed charges of Independent Transmission Company indexed with CPI - General
$F-O\ \&\ M-NTDCL_{(LRE)}$	=	The revised applicable Fixed O&M Local component of the fixed charges of NTDCL indexed with CPI – General
$F-O\&M-ITC_{(FRE)}$	=	The reference Fixed O&M foreign component of the fixed charges of Independent Transmission Company for the relevant period
$F-O\&M-ITC_{(LRE)}$	=	The reference Fixed O&M local component of the fixed charges of Independent Transmission Company for the relevant period
$F-O\ \&\ M-NTDCL_{(LRE)}$	=	The reference Fixed O&M local component of the fixed charges for NTDCL for the relevant period
$CPI - G_{(REV)}$	=	The Revised Consumer Price Index (General)
$CPI - G_{(REF)}$	=	207.30, Reference Consumer Price Index (General) of June, 2016 as notified by the Pakistan Bureau of Statistics
$US\ CPI_{(REV)}$	=	The Revised US Consumer Price Index (All Urban Consumers) notified by US Bureau of Labor Statistics.
$US\ CPI_{(REF)}$	=	241.38, Reference US CPI notified by the Bureau of Labor Statistics (All Urban Consumers) for the month of June, 2016.
$ER_{(REV)}$	=	The Revised TT & OD selling rate of US dollar as notified by the National Bank of Pakistan
$ER_{(REF)}$	=	104.4 The reference TT & OD selling rate of US dollar as notified by the National Bank of Pakistan




ii. Adjustment for LIBOR variation

The interest part of fixed charge component will remain unchanged throughout the term except for the adjustment due to exchange rate variation and variation in 6- month LIBOR, while spread on LIBOR (4.50%) remaining the same, according to the following formula

$$\Delta I = P_{(REV)} * (LIBOR_{(REV)} - 1.1442\%) / 2$$

Where:

ΔI = The variation in interest charges applicable corresponding to variation in 6-month LIBOR. ΔI can be positive or negative depending upon whether $LIBOR_{(REV)} >$ or $< 1.1442\%$. The interest payment obligation will be enhanced or reduced to the extent of ΔI for each period under adjustment applicable on bi-annual basis.

$P_{(REV)}$ = Is the outstanding principal (as indicated in the attached debt service schedule to this order at Annex-II) on a Bi-annual basis at the relevant calculations dates.

iii. Sino-sure:

In case of Overseas Investment Insurance Policy, ITC will be allowed annual indexation in the reference tariff component of sinosure fee based on the submission of documentary evidences upto the maximum allowed limit of 0.60% of the outstanding debt plus accrued interest payment during the year. Further, the tariff component of Sinosure Fee will also be adjusted on account of variation in PKR/US\$ exchange rate variation on annual basis.

iv. Return on Equity and Return on Equity During Construction

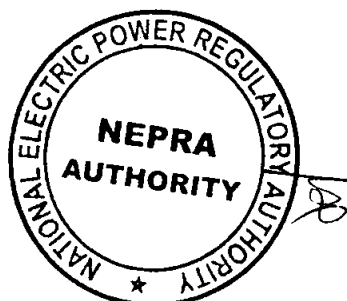
The Return on Equity (ROE) and Return on Equity during Construction (ROEDC) components of tariff will be adjusted for variation in PKR/US\$ exchange rate on the basis of revised TT & OD selling rate of US Dollar notified by the National Bank of Pakistan according to the following formula;

$$ROE_{(REV)} = ROE_{(REF)} \times ER_{(REV)} / ER_{(REF)}$$

$$ROEDC_{(REV)} = ROEDC_{(REF)} \times ER_{(REV)} / ER_{(REF)}$$

Where:

$ROE_{(REV)}$ = The revised ROE component of the tariff expressed in Rs/kWh



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$ROE_{(REF)}$	=	The reference ROE component of the tariff expressed in Rs/kWh
$ROEDC_{(REV)}$	=	The revised ROEDC component of the tariff expressed in Rs/kWh
$ROEDC_{(REF)}$	=	The reference ROEDC component of the tariff expressed in Rs/kWh
$ER_{(REV)}$	=	The revised US\$/PKR exchange rate as notified by the National Bank of Pakistan
$ER_{(REF)}$	=	The reference exchange rate of PKR 104.4=1 US\$

v. Insurance:

Insurance cost component of tariff, in case insurance is denominated in foreign currency, will be adjusted on account of PKR/US\$ exchange rate variation at COD and thereafter on an annual basis at actual subject to the maximum of 1% of the EPC cost on production of verifiable documentary evidence by ITC, according to the following formula:

$$Ins_{(REV)} = Ins_{(REF)} * ER_{(REV)} / ER_{(REF)}$$

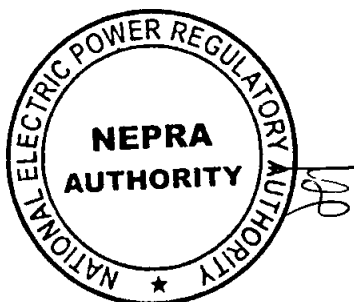
Where:

$Ins_{(REV)}$	=	Revised Insurance cost component of tariff adjusted with the exchange rate variation (PKR/US\$)
$ER_{(REV)}$	=	The revised US\$/PKR exchange rate as notified by the National Bank of Pakistan
$ER_{(REF)}$	=	The reference exchange rate of PKR 104.4=1 US\$

vi. Land Lease:

Land Lease component of tariff will be adjusted on annual basis on production of verifiable documentary evidence by ITC.

IV. Adjustment on account of inflation, US CPI, foreign exchange rate variation and LIBOR variation will be approved and announced by the Authority within fifteen working days after receipt of the Petitioner's request for adjustment in tariff in accordance with the requisite indexation mechanism stipulated herein.



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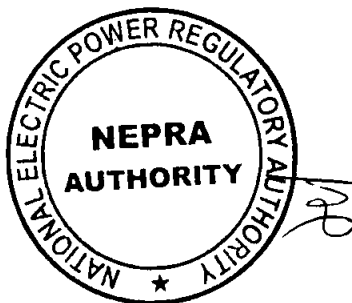
52. Directions to the Petitioner and NTDCL

The Authority directed following aspects to be addressed by Petitioner and NTDCL:

- xii. Since it is the first HVDC project of the Country, it needs to be ensured that there is a reliable and robust power transmission corridor fully integrated with the power generation projects at the sending end and fully capable of receiving at the Lahore converter station. It should be ensured that generation power of 4000 MW is timely and consistently available for this transmission line. It is important that clear responsibilities are identified and defined in this regards.
- xiii. Copy of the complete O & M contracts, to be provided to Authority after signing.
- xiv. Both, technical and financial capability of NTDCL should be ensured with regards to various obligations being entrusted for this HVDC transmission line.
- xv. TSA and IA and related other legal covenants should incorporate and consider technology transfer and indigenous capacity development for this and future HVDC projects. Specifically training to NPCC to be ensured.
- xvi. All required system studies should be completed by the EPC contractor and NTDCL.
- xvii. Necessary contingency planning should be carried out for this HVDC Transmission Line as it has envisaged significant energy transmission from South to load centers.
- xviii. Compliance should be ensured with grid code and NEPRA Performance Standard (Transmission) Rules, 2005.
- xix. Minimum possible transmission line length should be ensured giving due consideration to future transmission plans, social and environment aspect. Among other benefits, it will also reduce the construction cost, land cost and associated maintenance and security costs.
- xx. NTDCL to ensure mitigation measures for reinforcement to strengthen its network after completion of detailed studies.
- xxi. Petitioner and NTDCL should ensure maximum local employment for converter stations over the entire BOOT period of 25 years.
- xxii. The security related costs claimed as part of this Project Cost should not duplicate the amount and security measures as assured to CPEC Projects.

V. Eligibility criteria and Terms and Conditions of Tariff:

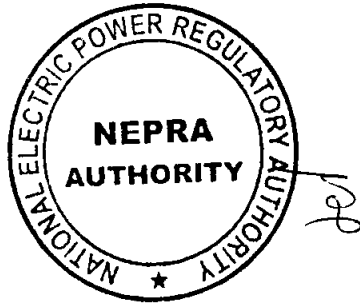
- a. Upon issuance of LOI/LOS to the relevant Special Purpose Transmission Company (SPTC) by relevant agency, SPTC shall be required to approach NEPRA for the grant of Special Purpose Transmission License (SPTL) along with a request for the approval of tariff as per relevant provisions of NEPRA Act, Rules and Regulations.



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- b. The TSA and IA should clearly set out related terms and conditions including financial, technical and performance specifications as per international standards for an HVDC Transmission Line.
 - c. The Petitioner/PPIB shall be required to decide clearly the responsibility structure for construction, operations, maintenance for the project.
 - d. All requirements of the Pakistan Environmental and Protection Agency (PEPA) Act 1997 relating to environmental protection environmental impact and social assessment shall be required to be ensured by the Petitioner at the time of issuing LOS to the related entity/organization including NOCs from respective Provincial Authorities of Sindh and Punjab.
 - e. PPIB shall ensure that all technical studies which are in progress are finalized to the satisfaction of NTDCL. NTDCL shall provide a certificate to the effect that it is satisfied with the results of such studies and all concerns identified under "Adequacy of Studies" para no 49.6.3 have been fully addressed.
 - f. The TSC will be paid only if Transmission Line is available for dispatch of energy to its committed power transmitting capacity, except for defined and agreed force majeure events.
 - g. Pre-COD energy transmission is allowed on terms and conditions to be mutually agreed and mentioned in Transmission Service Agreement (TSA). The transmission service charge however should not exceed the rates as approved by the Authority in this tariff determination.
- VI. The order along with, reference tariff table and debt servicing schedule as attached thereto are recommended for notification by the Federal Government in the official gazette in accordance with Section 31(4) of the Regulation of Generation, Transmission and Distribution of Electric Power Act, 1997.

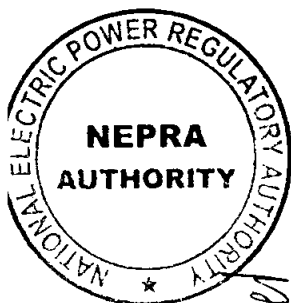


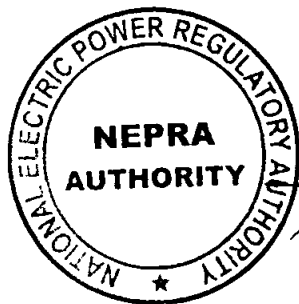
REFERENCE TARIFF TABLE												
Year	O&M				Total O&M	Insurance	Return on Equity	ROEDC	Loan Repayment	Interest Charges	Sinasure	Tariff
	Foreign	Local ICT	Local NTDC	Land								
	Rs. / kWh	Rs. / kWh	Rs. / kWh	Rs. / kWh	Rs. / kWh	Rs. / kWh	Rs. / kWh	Rs. / kWh	Rs. / kWh	Rs. / kWh	Rs. / kWh	Rs. / kWh
1	0.0441	0.0234	0.0500	0.0073	0.1249	0.0390	0.1599	0.0290	0.2891	0.2083	0.0238	0.8739
2	0.0441	0.0234	0.0500	0.0073	0.1249	0.0390	0.1599	0.0290	0.3056	0.1917	0.0220	0.8721
3	0.0441	0.0234	0.0500	0.0073	0.1249	0.0390	0.1599	0.0290	0.3231	0.1742	0.0200	0.8701
4	0.0441	0.0234	0.0500	0.0073	0.1249	0.0390	0.1599	0.0290	0.3416	0.1557	0.0180	0.8681
5	0.0441	0.0234	0.0500	0.0073	0.1249	0.0390	0.1599	0.0290	0.3612	0.1362	0.0158	0.8659
6	0.0441	0.0234	0.0500	0.0073	0.1249	0.0390	0.1599	0.0290	0.3818	0.1155	0.0135	0.8636
7	0.0441	0.0234	0.0500	0.0073	0.1249	0.0390	0.1599	0.0290	0.4037	0.0937	0.0111	0.8612
8	0.0441	0.0234	0.0500	0.0073	0.1249	0.0390	0.1599	0.0290	0.4268	0.0705	0.0086	0.8586
9	0.0441	0.0234	0.0500	0.0073	0.1249	0.0390	0.1599	0.0290	0.4512	0.0461	0.0058	0.8559
10	0.0441	0.0234	0.0500	0.0073	0.1249	0.0390	0.1599	0.0290	0.4771	0.0203	0.0030	0.8531
11	0.0441	0.0234	0.0500	0.0073	0.1249	0.0390	0.1766	0.0290	-	-	-	0.3695
12	0.0441	0.0234	0.0500	0.0073	0.1249	0.0390	0.1766	0.0290	-	-	-	0.3695
13	0.0441	0.0234	0.0500	0.0073	0.1249	0.0390	0.1766	0.0290	-	-	-	0.3695
14	0.0441	0.0234	0.0500	0.0073	0.1249	0.0390	0.1766	0.0290	-	-	-	0.3695
15	0.0441	0.0234	0.0500	0.0073	0.1249	0.0390	0.1766	0.0290	-	-	-	0.3695
16	0.0441	0.0234	0.0500	0.0073	0.1249	0.0390	0.1766	0.0290	-	-	-	0.3695
17	0.0441	0.0234	0.0500	0.0073	0.1249	0.0390	0.1766	0.0290	-	-	-	0.3695
18	0.0441	0.0234	0.0500	0.0073	0.1249	0.0390	0.1766	0.0290	-	-	-	0.3695
19	0.0441	0.0234	0.0500	0.0073	0.1249	0.0390	0.1766	0.0290	-	-	-	0.3695
20	0.0441	0.0234	0.0500	0.0073	0.1249	0.0390	0.1766	0.0290	-	-	-	0.3695
21	0.0441	0.0234	0.0500	0.0073	0.1249	0.0390	0.1766	0.0290	-	-	-	0.3695
22	0.0441	0.0234	0.0500	0.0073	0.1249	0.0390	0.1766	0.0290	-	-	-	0.3695
23	0.0441	0.0234	0.0500	0.0073	0.1249	0.0390	0.1766	0.0290	-	-	-	0.3695
24	0.0441	0.0234	0.0500	0.0073	0.1249	0.0390	0.1766	0.0290	-	-	-	0.3695
25	0.0441	0.0234	0.0500	0.0073	0.1249	0.0390	0.1766	0.0290	-	-	-	0.3695
Levelized Tariff	0.0441	0.0234	0.0500	0.0073	0.1249	0.0390	0.1653	0.0290	0.2438	0.0929	0.0108	0.7056

The reference TSC is based on 100% power transmitting capacity with 1.5% annual non-penalized maintenance outages.

Exchange Rate 1 US \$ = 104.4 PKR

Levelized Tariff @ 10% works out to be US Cents 0.6759/kWh





Annex-II

DEBT SERVICING SCHEDULE								
Period	Foreign Debt					Annual Principal Repayment	Annual Interest	Annual Debt Servicing
	Principal	Repayment	Mark UP	Balance	Total Debt Service			
	US \$	US \$	US \$	US \$	US \$	Rs./kWh	Rs./kWh	Rs./kWh
1	1,262,414,026	47,837,959	35,626,586	1,214,576,067	83,464,545	0.2891	0.2083	0.4974
2	1,214,576,067	49,187,994	34,276,551	1,165,388,073	83,464,545			
3	1,165,388,073	50,576,128	32,888,417	1,114,811,945	83,464,545	0.3056	0.1917	0.4974
4	1,114,811,945	52,003,437	31,461,108	1,062,808,508	83,464,545			
5	1,062,808,508	53,471,026	29,993,519	1,009,337,482	83,464,545	0.3231	0.1742	0.4974
6	1,009,337,482	54,980,032	28,484,513	954,357,450	83,464,545			
7	954,357,450	56,531,623	26,932,922	897,825,826	83,464,545	0.3416	0.1557	0.4974
8	897,825,826	58,127,002	25,337,543	839,698,824	83,464,545			
9	839,698,824	59,767,405	23,697,141	779,931,419	83,464,545	0.3612	0.1362	0.4974
10	779,931,419	61,454,100	22,010,445	718,477,319	83,464,545			
11	718,477,319	63,188,397	20,276,148	655,288,922	83,464,545	0.3818	0.1155	0.4974
12	655,288,922	64,971,636	18,492,909	590,317,286	83,464,545			
13	590,317,286	66,805,201	16,659,344	523,512,085	83,464,545	0.4037	0.0937	0.4974
14	523,512,085	68,690,511	14,774,035	454,821,574	83,464,545			
15	454,821,574	70,629,025	12,835,520	384,192,549	83,464,545	0.4268	0.0705	0.4974
16	384,192,549	72,622,247	10,842,298	311,570,302	83,464,545			
17	311,570,302	74,671,720	8,792,825	236,898,582	83,464,545	0.4512	0.0461	0.4974
18	236,898,582	76,779,030	6,685,515	160,119,552	83,464,545			
19	160,119,552	78,945,811	4,518,734	81,173,741	83,464,545	0.4771	0.0203	0.4974
20	81,173,741	81,173,741	2,290,804	0	83,464,545			

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