

Telephones:

042-99202288 & 99202211/2186.

Fax No. : <u>042-99202159.</u>

No. <u>GMHO/CEHO/G-182/19467-69</u>

Registrar (NEPRA)

NEPRA Tower, Attaturk Avenue (East) G-5/1, Islamabad. Office of the General Manager (Hydel) Operation, WAPDA, 186 – WAPDA House, Lahore.

Dated: 28.09.2021

Subject: LICENSE PROPOSED MODIFICATION (LPM) - VI IN THE EXISTING GENERATION LICENSE NO. GL (HYDEL)/05/2004 OF WAPDA HYDROELECTRIC (CHANGE IN AUXILIARY CONSUMPTION LIMIT OF POWER STATIONS).

Ref: NEPRA's letter No. NEPRA/DG (Lic)/LAG-23/194 dated 04.01.2021.

It is apprised that WAPDA Hydroelectric holds Generation License No. GL /Hydel/05/2004 dated 03.11.2004 for Hydel Power Stations. Modification V was issued on 07.04.2020 for 24 No Hydel Power Stations with total installed capacity of 17367.96 MW.

The auxiliary consumption of each Hydel Power station was not mentioned in the Original License. While, it was included later in Schedule II of Modification II in terms of MW (F/A). Auxiliary consumption limits defined in Modification II were very reasonable and as per actual consumption (approx.). The auxiliary consumption was not mentioned in Modification III. NEPRA, later on, in Modification IV reduced auxiliary consumption in Schedule II (F/B) which is not according to normal practices being allowed to IPPs by NEPRA recently as 1.5~2 % of Installed capacity of Station. Audit has pointed out excessive auxiliary consumption of different power stations and framed Draft Paras on the matter.

In Departmental Accounts Committee (DAC) meeting dated 27~28-12.2019, the factual position was explained to the Secretary Ministry of Water Resources, being Principal Accounting Officer (PAO). A Technical Committee was constituted with approval of PAO to define the auxiliary consumption limits of all operational Power Houses of WAPDA based on present operational characteristic of the plants. The Committee submitted its report (**F/C**) and recommended that the Auxiliary Consumption Limits for Hydel Power Stations for a period of next five-years may be revised as per attached table (**F/D**). The matter was taken up with NEPRA for concurrence / approval of auxiliary limits defined by the technical committee. It was conveyed by NEPRA, vide above referred letter that WAPDA may apply for modification in its generation license for revision of auxiliary consumption limits.

On behalf of WAPDA Hydroelectric, this office now intends to file an application for License Proposed Modification (LPM-VI) No. VI, as directed by NEPRA vide its above referred letter for the revision / change in the auxiliary consumption limits of its power stations. Schedule II of Modification No. IV may be amended as per the auxiliary consumption limits determined by the technical committee [**F**/**D**].

The License Proposed Modification is accompanied with necessary attachments (**Annex-I**) as required under NEPRA Licensing (Application & Modification Procedure) Regulations 1999. Authorization Letter / Power of Attorney to file the application for Modification No. VI in the Generation License is also attached (**Annex-II**). A Cross Cheque No. 01002608 dated 21.09.2021 (HBL Pakistan McLeod Road Lahore), amounting to Rs. 275,620/- as License Modification Fee is being enclosed for further processing of the case, please.

DA/As above.

Copy to:

(Hydel) Operation Genera

- Member (Power), WAPDA House, Lahore

- General Manager (Finance) Power, WAPDA House, Lahore.

I. Text of Proposed Modification

A. NEPRA granted Generation License No. GL (Hydel)/05/2004 Modification-V to WAPDA Hydroelectric on April 07, 2020 for following twenty-four (24) Hydel Power Stations having total installed capacity of 17367.96 MW;

i.	Tarbela	3478 MW
ii.	Mangla	1000 MW
üi.	Warsak	242.96 MW
iv.	Ghazi Barotha	1450 MW
۷.	Chashma	184 MW
vi.	Renala	1.1 MW
vii.	Chichoki	13.2 MW
viii.	Nandipur	13.8 MW
ix.	Shadiwal	13.5 MW
Χ.	Rasul	22 MW
xi.	Dargai	20 MW
xii.	Chitral	1 MW
×iii.	Kurram Garhi	4 MW
xiv.	Gomal Zam	17.40 MW
XV.	Jinnah	96 MW
xvi.	Allai Khwar	121 MW
xvii.	Duber Khwar	130 MW
xviii.	Khan Khwar	72 MW
xix.	Tarbela, 4 th Extension	1410 MW
XX .	Keyal Khwar	128 MW
xxi.	Golen Gol	108 MW
xxii.	Jabban	22 MW
xxiii.	Diamer Basha	4500 MW
xxiv.	Dasu	4320 MW

Total

17367.96 MW

B. "WAPDA Hydroelectric has requested for further modification in its Generation License (Modification-VI) for revision / amendments in the auxiliary consumption limits, defined in Schedule II of Modification IV dated 09.01.2015. The revised Schedule II of Proposed Modification VI is attached.

Sr. No.	, Power Station	Installed Capacity (MW)	Auxiliary Consumption (MW)	Net Capacity (MW)
1	Hydel Power Station Tarbela	3478	4.0	3474
2	Hydel Power Station Mangla	1000	3.0	997
3	Hydel Power Station Warsak	242.96	1.0	241.96
4	Hydel Power Station Ghazi	1450	3.0	1447
5	Hydel Power Station Chashma	184	0.9	183.1
6	Hydel Power Station Renala	1.1	0.1	1
7	Hydel Power Station Chichoki	13.2	0.3	12.9
8	Hydel Power Station Nandipur	13.8	0.3	13.5
9	Hydel Power Station Shadiwal	13.5	0.3	13.2
10	Hydel Power Station Rasul	22	0.4	21.6
11	Hydel Power Station Dargai	20	0.4	19.6
12	Hydel Power Station Chitral	1	0.1	0.9
13	Hydel Power Station Kurram Garhi	4	0.1	3.9
14	Hydel Power Station Gomal Zam	17.4	0.4	17
15	Hydel Power Station Jinnah	96	0.6	95.4
16	Hydel Power Station Allai Khwar	121	0.5	120.5
17	Hydel Power Station Duber Khwar	130	0.5	129.5
18	Hydel Power Station Khan Khwar	72	0.5	71.5
19	Hydel Power Station Tarbela 4 th , Extension	1410	3.0	1407
20	Hydel Power Station Keyal Khwar	128	0.3	127.7
21	Hydel Power Station Golen Gol	108	0.3	107.7
22	Hydel Power Station Jabban	22	0.2	21.8
23	Hydel Power Station Diamer	4500	2.0	4498
24	Hydel Power Station Dasu	4320	2.0	4318
	Grand Total	17367.96	24.2	17343.76

<u>SCHEDULE-II</u> (Modified / Revised)

National Electric Power Regulatory Authority (NEPRA)

Islamabad – Pakistan

GENERATION LICENSE GL (HYDEL)/05/2004

In exercise of the Powers conferred upon the National Electric Power Regulatory Authority (NEPRA) under Section-26 of the Regulation of Generation, Transmission and Distribution of Electric Power Act, 1997 the Authority hereby modifies the Generation License granted to WAPDA (on November 03, 2004 and expiring on November 02, 2034), to the extent of changes mentioned as hereunder:

- Installed capacity mentioned in the Face Sheet may be read as 17367.96 MW;
- ii. Changes in Schedule-II attached as Modified/Revised Schedule-II.

This Modification-V	<u>/I</u> is	given	under	my	hand	this	 of
		&					
·							
Registrar							

II. The Statement of Reason in Support of Modification in Generation License

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- The auxiliary consumption of each Hydel Power station was not mentioned in the Original Generation License No GL /Hydel/05/2004 dated 03.11.2004. While, it was included later in Schedule II of Modification II dated issued on 20.06.2011 in terms of MW (Annex-I). Auxiliary consumption limits defined in Modification II were very reasonable and as per actual consumption (approx.). The auxiliary consumption was not mentioned in Modification III. NEPRA, later on, in Modification IV dated 09.01.2015 reduced auxiliary consumption in Schedule II (Annex-II) which is not according to normal practices being allowed to IPPs by NEPRA recently as 1.5~2 % of Installed capacity of Station. Audit has pointed out excessive auxiliary consumption of different power stations and framed Draft Paras on the matter.
- In Departmental Accounts Committee (DAC) meeting dated 27~28-12.2019, the factual position was explained to the Secretary Ministry of Water Resources, being Principal Accounting Officer (PAO). A Technical Committee was constituted with approval of PAO to define the auxiliary consumption limits of all operational Power Houses of WAPDA based on present operational characteristic of the plants.
- The committee has submitted its report and recommended to revise the limits of auxiliary consumption. The auxiliary consumption limits defined by the committee are placed (**Annex-III**).
- The issue of non-conformity with regards to actual auxiliary consumption limits and NEPRA's recognized auxiliary consumption values, mentioned in Modification-IV of the Generation License granted to WAPDA, shall also be addressed / settled which currently has been consuming significant efforts and resources of the Licensee unnecessarily. It will be helpful for settlement of all related Draft Paras.

III. A statement of the impact on the tariff, quality of service and performance by the licensee of its obligations under the license.

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- As for quality of service and performance is concerned, WAPDA Hydroelectric is already maintaining highest level of performance and quality of services which can be confirmed from the plant availability factor of existing Hydel Power Stations. The same spirit will be followed in future as well.
- Through this modification, the notional capacity (fixed) charge figure shall remain the same as the total installed capacity in MWs of WAPDA Hydroelectric will be same as 17367.96 MW. <u>Similarly, the total tariff in Rs/kWh shall remain the</u> <u>same</u>, if computed for the same amount of costs & expenditures considered while computing the tariff on the basis of total installed total capacity of 17367.96 MW.
- After this modification, WAPDA's desired performance delivery levels shall be stretched and become compatible with industry standards. Furthermore, the issue of non-conformity with regards to actual auxiliary consumption limits and NEPRA's recognized auxiliary consumption values, mentioned in Modification-IV of the Generation License granted to WAPDA, shall also be addressed / settled which currently has been consuming significant efforts and resources of the Licensee unnecessarily.



Pakistan Water and Power Development Authority

Telephones:	042-99202288 &	Office of the General Manager
	040.00000150	(Hydel) Operation, WAPDA. 186 – WAPDA House, Lahore.
No. GMHO/CEH	018-197-1PM/24550	SZ Dated: 15.12.2021
Registrar (NEPP		
NEFRA Tower	Attaturk Alvende (East	
is-cillaamata Siidam INOHI	а. Ision or tarrei a s th extens	ION HYDROPOWER PROJECT

(1530 MW) IN APPLICATION FOR LICENSE PROPOSED MODIFICATION (LPM) - VI IN THE EXISTING GENERATION LICENSE NO. GL (HYDEL)/05/2004 OF WAPDA HYDROELECTRIC.

It is apprised that WAPDA Hydroelectric holds Generation License No. GL /Hydel/05/2004 dated 03.11.2004 for Hydel Power Stations. Modification V was issued on 07.04.2020 for 24 No Hydel Power Stations with total installed capacity of 17387.96 MW.

WAPDA has submitted an application for License Proposed Modification (VI) in its Generation License for the revision / change in the auxiliary consumption limits of its power stations, vide letter dated 28.09.2021 (Annex-I), being processed by NEPRA.

Now WAPDA also intends to include Tarbela 5th Extension Hydropower Project (1530 MW) in its Generation License, as per directives of NEPRA, vide letter dated 15.10.2021 through License Proposed Modification. It is proposed that the same may be included in the already submitted application for License Proposed Modification (VI), instead of submitting separate application of LPM for said purpose to avoid unnecessary working / delay.

After inclusion of Tarbela 5th Extension Hydropower Project (1530 MW), the total installed capacity of WAPDA Hydroelectric, in Generation License will be increased from 17,367.96 MW (24 No Power Stations) to 18,897.96 MW (25 No Power Stations).

Following documents for Tarbela 5th Extension Hydropower Project are attached;

- i. Due Diligence Report (Annex-II)
- ii. Location Map of the Project and Project Layout Plan (Annex-III).
- ili. Single Line Diagram of the Power House & Station Auxiliary SLD (Annex-IV)
- iv. Text of Proposed Modification and Revised Schedule II (Annex-V)

Authorization Letter / Power of Attorney to include Tarbela 5th Extension Hydropower Project (1530 MW) in the existing application for Modification No. VI in the Generation License is also attached (Annex-VI). A Cross Cheque No. 01002952 dated 08.12.2021, amounting to Rs. 1.183,813/- (as difference of Fee) as License Modification Fee, has already been submitted to NEPRA vide letter dated 08.12.2021 (Annex-VII), please.

DA/As above.

Copy to:

General Manage/ (Hydel

- Member (Power), WAPDA House, Lahore.
- General Manager (Finance) Power, WAPDA House, Lahore

TARBELA 5TH EXTENSION HYDROPOWER PROJECT

1	Location	Tarbela 5th Extension Project is located on the Indus River 110 km from Islamabad and falls under jurisdiction of Swabi and Haripur districts of Khyber Pakhtunkhwa province Pakistan.				
		Туре	Tota	l Capacity	No. of Units	
2	Plant	Storage	15	530MW	03 (each of capacity 510MW)	
		Maximum	!	<u>N</u>	linimum	
3	Head	135 m	:		70.5 m	
	Technology	F	rancis, vertic	ai shaft type		
		No.	Length		Dia	
i		Tunnel -5 (Tarbela Tunnel-5		At Intake	At Penstock	
5	Tunnel	designated as irrigation tunnel, is being converted into power tunnel without affecting irrigation release capabilities).	3675 ft	45 ft	36 ft	
6	Minimum expected useful life of the Generation Facility	30 Years				
7	Peaking/Base Operation	Generally, during High Flow per flow period, it will be utilized fo	iod, it will be r peaking.	operated for Base	load whereas during low	
		Generator Voltage	Power Facto	or		
	Plant	18KV (±, 5%)	0.9 (Lagging	5)		
8	Characteristics	Frequency = 50 Hz (± 5%)	Automatic (Systems DC	Control: Control ar S and SCADA syste	nd Instrumentation (C&I) m.	
9	Length of Transmission Lines	Length of the Transmission line is 50 KM approximately. In addition to this, a 500kV single circuit interconnector will also be constructed between Tarbela 5th Extension and Tarbela 1-4 switchyard having length of 2.8km approximately. The 50km transmission line (T/L) will be 500 kV Double Circuit (D/C) T/L on quad-bundled Drake conductor from Tarbela 5th Ext. HPP Substation to Islamabad West Substation.				
10	500KV Circuit Breaker	The circuit breakers shall be 50 mechanism. Provision shall be r each breaker.	0 kV SF6 type made for a 3-	operated by a spr phase, 400 V supp	ing charged drive ly to drive the motor on	

STATION AUXILIARY CONSUMPTION OF TARBELA 5TH EXTENSION HYDROPOWER PROJECT

The actual Auxiliary Consumption will be available after commissioning of 1st unit in May 2024

Dir(Mech,)TSEP



Project Layout Plan





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I. Text of Proposed Modification

A. NEPRA granted Generation License No. GL (Hydel)/05/2004 Modification-V to WAPDA Hydroelectric on April 07, 2020 for following twenty-four (24) Hydel Power Stations having total installed capacity of 17367.96 MW;

Ē.	Taroeia	김 교 7종 삼가),
-:	Mang a	12223422
••••	, arsa	242.96 MM
IV.	Ghazi Barotha	1480 MW -
V.	Chashma	184 MW
vl.	Renala	1.1 MW
vii.	Chichoki	13.2 MV
viii.	Nandipur	13.8 MVV
ix.	Shadiwal	13.5 MW
Х.	Rasul	- 22 MW
xi.	Dargai	20 MW
XII.	Chitrai	1 MW
Xiii.	Kurram Garhi	4 MW
xiv.	Gornal Zam	17.40 MW
XV.	Jinnah	96 MW
xvi.	Allai Khwar	121 MW
xvii.	Duber Khwar	130 MW
xviii.	Khan Khwar	72 MW
xix.	Tarbela, 4 th Extension	1410 MW
XX.	Keyal Khwar	128 MW
xxi.	Golen Gol	108 MW
xxii.	Jabban	22 MW
xxiii.	Diamer Basha	4500 MW
xxiv.	Dasu	4320 MW

Total

17367.96 MW

B. "WAPDA Hydroelectric has requested for further modification in its Generation License (Modification-VI) for revision / amendments in the auxiliary consumption limits, defined in Schedule II of Modification IV dated 09.01.2015 and inclusion of Tarbela 5th Extension Hydropower Project (1530 MW). The revised Schedule II of Proposed Modification VI is attached.

Sr. No.	Power Station	Installed Capacity (MW)	Auxiliary Consumption (MW)	Net Capacity (MW)
-	rryde-Power Station Tarbeia	3478	4.0	3474
	Hydel Power Station Mangia			22
2	Hyde Power Station Warsak	1-1 23	م الل ب	241,98
<u>+</u>	Hyde, Power Station Ghaz.	1450		4 <u>4</u> 7
5	Hydel Power Station Chashma	184	0.9	183.1
6	Hydel Power Station Renala	1.1	0.1	1
7	Hydel Power Station Chichcki	13.2	0.3	12.9
8	Hyde! Power Station Nandipur	13.8	0.3	13.5
9	Hydel Power Station Shadkva'	13.5	0.3	13.2
10	Hyde, Power Station Rasul	22	0.4	21.6
11	Hydel Power Station Dargai	20	0.4	19.6
12	Hydel Power Station Chitral	1	0.1	0.9
13	Hydel Power Station Kurram Garhi	4	0.1	3.9
14	Hydel Power Station Gomal Zam	17.4	0.4	17
15	Hydel Power Station Jinnah	96	0.6	95.4
16	Hydel Power Station Allai Khwar	121	0.5	120.5
17	Hydel Power Station Duber Khwar	130	0.5	129.5
18	Hydel Power Station Khan Khwar	72	0.5	71.5
19	Hydel Power Station Tarbela 4 th , Extension	1410	3.0	1407
20	Hydel Power Station Keyal Khwar	128	0.3	127.7
21	Hydel Power Station Golen Gol	108	0.3	107.7
22	Hydel Power Station Jabban	22	0.2	21.8
23	Hydel Power Station Diamer	4500	2.0	4498
24	Hydel Power Station Dasu	4320	2.0	4318
25	Hydel Power Station Tarbela 5 th Extension	1530	<u>4</u>	1526
	Grand Total	18,897.95	28.2	18,869.76

<u>SCHEDULE-II</u> (Modified / Revised)

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Subject: APPROVAL OF MEMBER (POWER) FOR LICENSEE PROPOSED MODIFICATION (LPM) REGARDING CHANGE / REVISION IN AUXILIARY CONSUMPTION OF HYDEL POWER STATIONS IN GENERATION LICENSE OF WAPDA HYDROELECTRIC

Para 1~20 may be perused

21.

A DAC meeting was held on 27~28.12.2019 in which most of the paras related to Hydel Power Stations were about Excessive Auxiliary Consumption / Unmetered Consumption. Accordingly, DAC directed to constitute a Technical Committee to probe into the matter of Excessive Auxiliary Consumption / Unmetered Consumption at different WAPDA Hydel Power Stations. After approval of PAO, a Technical Committee was constituted vide letter dated: 23.01.2020 (F/A). The Committee submitted its report (F/B) and recommended that the limits for Hydel Power stations regarding Auxiliary Consumption for a period of next five-years may be revised as per attached table (F/C).

- 22. NEPRA was requested for concurrence / approval of the revised auxiliary consumption limits defined by Technical Committee, vide letter dated 01.10.2020 (**F/D**). In response, NEPRA conveyed (**F/E**) that to make any change in Generation License, WAPDA may file an application for modification in Generation License. NEPRA was requested (**F/F**) to provide LPM Fee & Procedures for said modification in Generation License.
- 23. Now NEPRA has conveyed (**F/G**) that during tariff petition of WAPDA Hydroelectric for FY 2020-21, it was directed by NEPRA Authority that Mohmand Dam Hydropower Project may also be included in Generation License of WAPDA. Therefore, WAPDA may file LPM application for Mohamand Dam Hydropower Project and in the same application, the revised auxiliary consumption limits may be incorporated.
- 24. The advice of General Manager Finance (Power) was sought regarding inclusion of Mohmand Dam Hydropower Project in Generation License of WAPDA Hydroelectric. In response, General Manager Finance (Power) recommended that Mohmand Dam is a multipurpose project with significant benefits attributable to Water Sector. Therefore, honoring the directions of NEPRA, Capital works on Mohmand Dam are currently being executed from GoP PSDP Grants for which WAPDA didn't claim anything in Tariff. WAPDA will apply for inclusion of Mohmand Dam in its Generation License through separate LPM at appropriate time after fully utilizing GoP Grants (Para-13).
- 25. In view of above, it is proposed that WAPDA may apply for LPM in Generation License for revision of Auxiliary Consumption Limit only. The fee for said modification is as under;
 - Modification Fee (Generation) Up to 20 MW: Rs. 300,000/-
 - Applicable Fee after Indexation: Rs. 300,000 * [144.89 / 145.09] = Rs. 299,587/-

In view of above, the case is submitted for the following:-

Operation

- i. Approval of Member (Power) for submission of application for License Proposed Modification (VI) in Generation License No. GL (Hydel)/05/2004 of WAPDA Hydroelectric for revision in Auxiliary Consumption Limit, as proposed by the Technical Committee.
- ii. Sending the case to Manager (A&F) Hydel for issuance of cheque of LPM Fee amounting to **Rs. 299,587/-** in favor of NEPRA for aforementioned modification, please

Director (Hydel) Operatio

27. Chief Engineer

28.

26.

General Manager (Hwdel) Operation / Member (Power)

⊀vdel)

approved. Case file activ pl.

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Generation Licence Water & Power Development Authoniv (WAPDA) Wapda House Labore

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SCH	EDU	LE-II

Sr. No.	Power Station	Instailed Capacity (MW)	Auxiliary Consumption (MW)	Net Capacity (MW)
1.	Hydel Power Station Tarbela	3478.00	16.00	3462.00
2.	Hydel Power Station Mangla	1000.00	25.00	975.00
3.	Hydel Power Station Warsak	242.96	5.50	237.46
4.	Hydel Power Station Ghazi Brotha	1450.00	18.00	1432.00
5.	Hydel Power Station Chashma	184.00	1.50	182.50
6.	Hydel Power Station Renala	1.10	0.014	1.086
7.	Hydel Power Station Chichoki	13.20	1.50	11.70
8.	Hydel Power Station Nandipur	13.80	0.70	13.10
9.	Hydel Power Station Shadiwal	13.50	0.40	13.10
10.	Hydel Power Station Rasul	· 22.00	2.32	19.68
11.	Hydel Power Station Dargai	20.00	0.05	19.95
12.	Hydel Power Station Chitral	1.00	0.003	0.997
13.	Hydel Power Station Kurram Garhi	4.00	0.30	3.70
14.	Hydel Power Station Gomal Zam	17.00	0.70	16.30
15.	Hydel Power Station Jinnah Hydel	96.00	2.00	94.00
16.	Hydel Power Station Allai Khwar	121.00	0.50	120.50
17.	Hydel Power Station Duber Khwar	130.00	0.50	129.50
18.	Hydel Power Station Khan Khwar	72.00	0.70	71.30
	Grand Total	6879.56	75.687	6803.873



Page 2 cf 2 of Schedule-II (Modification-II) .

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Generation Licence Water & Power Development Authority (WAPDA) Wapda House Lahore

SCHEDULE-II

(Modified/Revised)

Sr. No.	Power Station	Installed Capacity (MW)	Auxiliary Consumption (MW)	Net Capacity (MW)
1.	Hydel Power Station Tarbela	3478	1.3	3,476.70
2.	Hydel Power Station Mangla	1000	1.1	998.90
3.	Hydel Power Station Warsak	242.96	0.8	242.16
4.	Hydel Power Station Ghazi Brotha	. 1450	1.1	1,448.90
5.	Hydel Power Station Chashma	184	0.8	183.20
6.	Hydel Power Station Renala	1.1	0.1	1.00
7.	Hydel Power Station Chichoki	13.2	0.2	13.00
8.	Hydel Power Station Nandipur	13.8	0.2	13.60
9.	Hydel Power Station Shadiwal	13.5	0.2	13.30
10.	Hydel Power Station Rasul	22	0.2	21.80
11.	Hydel Power Station Dargai	20	0.2	19.80
12.	Hydel Power Station Chitral	1	0.1	0.90
13.	Hydel Power Station Kurram Garhi	4	0.1	3.90
14.	Hydel Power Station Gomal Zam	17.40	0.3	17.10



Page 2 of 3 of Modified/Revised Schedule-II (Modification-IV)

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Generation Licence Water & Power Development Authority (WAPDA) Wapda House Lahore

Hydel Power Station Dasu	4320	2	4,318.00
Hydel Power Station Diamer Basha	4500	2	4,498.00
Hydel Power Station Jabban	22	0.2	21.80
Hydel Power Station Golen Gol	106	0.3	105.70
Hydel Power Station Keyal Khwar	122	0.3	121.70
Hydel Power Station Tarbela, 4 th Extension	1410	0.8	1,409.20
Hydel Power Station Khan Khwar	72	0.3	71.70
Hydel Power Station Duber Khwar	130	0.3	129.70
Hydel Power Station Allai Khwar	121	0.3	120.70
Hydel Power Station Jinnah Hydel	96	0.5	95.50
	Hydel Power Station Jinnah HydelHydel Power Station Allai KhwarHydel Power Station Duber KhwarHydel Power Station Khan KhwarHydel Power Station Tarbela, 4th ExtensionHydel Power Station Keyal KhwarHydel Power Station Golen GolHydel Power Station JabbanHydel Power Station JabbanHydel Power Station JabbanHydel Power Station Diamer BashaHydel Power Station Dasu	Hydel Power Station Jinnah Hydel96Hydel Power Station Allai Khwar121Hydel Power Station Duber Khwar130Hydel Power Station Khan Khwar72Hydel Power Station Khan Khwar72Hydel Power Station Tarbela, 4th Extension1410Hydel Power Station Keyal Khwar122Hydel Power Station Golen Gol106Hydel Power Station Jabban22Hydel Power Station Jabban22Hydel Power Station Diamer Basha4500Hydel Power Station Dasu4320	Hydel Power Station Jinnah Hydel960.5Hydel Power Station Allai Khwar1210.3Hydel Power Station Duber Khwar1300.3Hydel Power Station Khan Khwar720.3Hydel Power Station Khan Khwar720.3Hydel Power Station Tarbela, 4th Extension14100.8Hydel Power Station Golen Gol1060.3Hydel Power Station Golen Gol1060.3Hydel Power Station Golen Gol20.2Hydel Power Station Diamer Basha43202

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Page 3 of 3 of Modified/Revised Schedule-II (Modification-IV)



PAKISTAN WATER AND POWER DEVELOPMENT AUTHORITY



والمراجع المراجع والمنقومة المراجع والمنافع والمراجع والمراجع والمراجع والمراجع والمراجع والمراجع والمراجع

TECHNICAL REPORT REGARDING EXCESSIVE AUXILIARY CONSUMPTION, UNMETERED CONSUMPTION AND GENERATION LOSS AT DIFFERENT WAPDA HYDEL POWER STATIONS

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for its auxiliary consumption despite the fact that its auxiliary metered consumption in terms of percentage is lowest among the hydel power stations and is merely 0.16% of energy generated. With the ageing of Power station, the quantum of maintenance/ rehabilitation works increases and this in turns affects the auxiliary consumption of a power plant. The committee, therefore, after scrutinizing all these facts recommends the following limits for Hydel Power stations regarding their metered auxiliary consumption for a period of next five-years.

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12.1

Sr. No.	Power Station	Existing Allowed by NEPRA (MW)	Recommended by Committee (MW)
1	Tarbela (1 ~ 14)	1.3	4.0
. 2	Ghazi Barotha	1.1	3.0
3	Tarbela 4th Ext.	0.8	3.0
4	Mangla	1.1	3.0
5	Warsak	0.8	1.0
6	Chashma	0.8	0.9
7	Duber Khwar	0.3	0.5
8.	Allai Khwar	0.3	0.5
9	Golan Gol	0.3	0.3
10	Jinnah	0.5	0.6
11	Khan Khwar	0.3	0.5
12	Jabban	0.2	0.2
13	Rasul	0.2	0.4
14	Dargai	0.2	0.4
15	Gomal Zam	0.3	0.4
16	Nandi Pur	0.2	0.3
17	Shadiwal	0.2	0.3
18	Chichoki	0.2	0.3
19	Kurram Garhi	0.1	0.1
20	Renala	0.1	0.1
21	Chitral	0.1	0.1
22	Keyal Khwar	0.3	0.3
23	Dia Mer Bhasha	2.0	2.0
24	Dasu	2.0	2.0

As far as the unmetered auxiliary consumption is concerned, the committee noticed that these are within the limits set in the PC-1 and not a single power station is crossing these limits. All the power losses as explained in aforementioned para-5 of

TECHNICAL REPORT REGARDING EXCESSIVE AUXILIARY CONSUMPTION, UNMETERED CONSUMPTION AND GENERATION LOSS AT DIFFERENT WAPDA HYDEL POWER STATIONS POINTED OUT BY AUDIT IN DRAFT PARAS OF FY 2017-18 & PDP OF FY 2019-20

1. INTRODUCTION:

A Technical Committee, comprising of five WAPDA Hydel Engineers, was constituted after obtaining concurrence of Ministry of Water Resources, Islamabad, conveyed vide Section Officer (HP) letter dated 14.02.2020 & subsequent approval of Member (Power) vide office order No. GMHO/CEHO/G-6/G-45/1521-28 dated 23.01.2020 (PUC) to probe into the matter regarding excessive auxiliary consumption, unmetered consumption and generation loss at different WAPDA Hydel Power Stations pointed out by Audit in Draft Paras of the FY 2017-18 & Proposed Draft Paras of FY 2019-20. Mr. Muhamad Tariq (RE Mangla) vide letter No. GMHO/CEHO/G-6/G-45/3206-16 dated 13.02.2020 (F/A) was nominated as Member of the Technical Committee in place of Mr. Karim Nawaz SE (SHPS) Mangla due to his Management training schedule at WASC. Henceforth, Technical Committee stands out as detailed below:

1.	Mr. Asif Jan	General Manager (Coord) Power	Convener
2.	Mr. Abdul Sattar Afridi	Chief Engineer (Hydel) Warsak	Member
З.	Mr. Muhamad Tariq	RE Mangla	Member
4.	Mr. Hameed-ullah Khan	RE(Elect) Tarbela	Member
5.	Mr. Fahad Rafi	Senior Engineer Tarbela	Member

2. TERMS OF REFERENCE (TORs):

- To check reasons of Auxiliary Consumption beyond limits specified in NEPRA Modification-IV, Schedule-II.
- b. Causes and justification for un-metered energy consumption at Power Stations.
- c. Rationalize auxiliary consumption limits by duly excluding residential and other than Power House electricity requirements.
- d. Causes of generation loss and fix responsibility (if any).
- e. Revision of forced outage limits (if required).

3. BACKGROUND:

prevailing E-form of these hydel power stations, consumption is calculating as difference of energy produced at station (MKWH generated) and net energy sold to NTDC. Thus station consumption (as calculated in E-form) if compared with Station metered Auxiliary consumption depicts a vast difference. This unmetered auxiliary consumption was mostly pointed out by audit. The other portion which was emphasized by Audit is forced outages of generating units at different Power stations.

Consequently, a technical committee was constituted in order to study & scrutinized the pointed draft paras of the FY 2017-18 & proposed draft paras of FY 2019-20 pertaining to aforesaid metered and unmetered auxiliary consumption & forced outages of generating units. Accordingly, the aforesaid DP's and PDP's are categorized as per TOR's given below:

- i. Auxiliary consumption beyond limits (PDP# 66,120,251,419,513 & 536)
- ii. Unmetered consumption at power stations (PDP# 65,240 & 321)
- iii. Generation loss due to faults (PDP# 121,290,384 & 430)

Sr. No.	PARA	Contents	HPS	Description of Para	Financial Implication (MPKR)	Reply by Station
1.	PDP # 66 / (2019-20)	Auxiliary Consumption	Mangla	Loss of revenue due to excessive auxiliary consumption beyond Nepra's approved limit	2.28	Furnished
2.	PDP # 120/ (2019-20)	Station Consumption	Warsak	Loss due to excess power station consumption	1.39	Furnished
3.	PDP # 251/ (2019-20)	Auxiliary Consumption	Jinnah	Loss due to excess auxiliary consumption against the permissible limit in PC-I	3.17	Furnished
4.	PDP #419/ (2019-20)	Auxiliary Consumption	Tarbela	Loss due to excessive auxiliary consumption beyond Nepra's approved limit –	24.95	Furnished
5.	PDP # 513	Station Consumption	Chashma	Loss due to excess power consumption - Rs. 0.551 million	0.638	Furnished
6.	PDP # 536 (2019-20)	Station Consumption	Gomal Zam	Loss due to excess power station consumption	7.41	Furnished
7.	PDP # 65/ (2019-20)	Station Consumption	Mangla	Loss of revenue due to power station consumption	117.84	Furnished
8.	PDP#240/ (2019-20)	Station Consumption	Besham	Loss of revenue due to unmetered power station consumption	3.55	Furnished
9.	PDP # 321/ (2019-20)	Station Consumption	Chashma	Unjustified unmetered power station consumption excluding auxiliaries	4.02	Furnished
10.	PDP # 121/ (2019-20)	Forced Outages	Warsak	Regarding generation loss due to forced outages-	3.43	Furnished
11.	PDP # 290/ (2019-20)	Less Generation	Jinnah	Loss due to less generation from running hours as compared to approved PC-I	293.37	Furnished
12.	PDP # 384/ (2019-20)	Forced Outages	Chashma	Generation loss due to forced outages	97.40	Furnished
13.	PDP # 430/ (2019-20)	Forced Outages	Ghazi Barotha	Loss of revenue due to forced outages	14.13	Furnished

4. PROCEEDINGS:

The first meeting of the Technical Committee was held on 11.03.2020 in the office of GM (Coord) Power. All the points related to TOR's mentioned above were discussed. The officers of the committee were assigned specific stations as detailed below for collection of data and analyzing it in light of the TOR's.

- 1. Mr. Abdul Sattar Afridi Hydel North Region
- 2. Mr. Muhamad Tariq Mangla and Small Hydel stations associated
- 3. Mr. Hameed-ullah Khan Tarbela P/S, Barotha P/S and 3HHP Besham
- Mr. Fahad Rafi Chashma, Jinnah and Gomal Zam P/S.

Additional paras of DAC meeting on 27th and 28th Feb 2020 were also discussed and made part of the committee proceedings. G.M (Coord) Power instructed each member officer to plan visit of allocated stations prior to next meeting scheduled on 19.03.2020 at 1000hrs in office of GM (Coord) Power.

Second meeting of the Technical Committee was held on 19.03.2020 in the office of GM (Coord) Power. In continuation to previous discussions collected data was thoroughly studied, scrutinized & short comings were listed. The committee also discussed preparation of draft report before the next meeting which was scheduled on 03.04.2020. However, due to the outspread of COVID19 pandemic, the committee working was hampered and delayed. Due to the lock down in the country movement and meetings were not possible and so decided to keep progressing through email/ WhatsApp for exchange of data and completion of report.

Initially the committee concentrated on the above mentioned Paras but later on it was decided to consider the metered Auxiliary consumption, un-metered auxiliary consumption and outages of all Hydel stations being operated by WAPDA so as to settle the issue permanently.

5. METERED AND UNMETERED AUXILIARY CONSUMPTION:

Hydropower plants capture the energy of falling water to generate electricity. A turbine convert the kinetic energy of falling water into mechanical energy, which a generator converts into electrical energy. Hydro plants range in size from "micro" that generates only a few MWs to giant dams that provide electricity to millions of people.

The design of the hydro power plant depends upon the quantity & head of water availability. The simplest formula to understand the working/general principal of a hydro unit is as under:

Power (KW) = (Height of Dam in feet) x (River Flow in cubic ft./ sec) x (Efficiency) / 11.8

Whereas: 11.8 is the conversion constant of feet and seconds into kilowatts

Efficiency of generating plant depends upon the energy consumed in auxiliary equipment (metered & unmetered) and amount of losses sustained at different levels, noticeable however is transformation losses sustained in power transformers.

Auxiliary equipment of a Hydro Power Plant can be categorized as follows:

- a) Auxiliaries directly associated with units termed as "Unit auxiliaries"
- b) Auxiliaries indirectly associated with units termed as "Common auxiliaries".
- c) Auxiliaries not associated with units but otherwise required like Lighting/ HVAC loads etc.

Detail study of the Power stations design reveal that almost 95% of the unit auxiliary equipment are fed from the auxiliary transformers in a Power plant and are, therefore, metered auxiliary consumption. However, the excitation load of the generator in 99% of Power Plants are branched out prior to Auxiliary transformer and is, therefore, unmetered consumption.

It is worth mentioning here that the Auxiliary consumption of a station cannot be directly linked with the installed capacity of the station. The auxiliary consumption will depend upon the equipment installed & the layout of the Power station. A station of lesser installed capacity may have a higher percentage of Auxiliary consumption and vice versa.

As per NEPRA Schedule-II, each WAPDA Hydel Power station is allowed a specific auxiliary load in terms of MW to be consumed as station metered auxiliary (**F/B**). The present E-form of WAPDA Hydel Power Plants calculate station consumption as difference of energy produced at station (MKWH generated) and net energy sold to NTDC. The station consumption (as calculated in E-form) if compared with Station metered Auxiliary consumption has a vast difference which is pointed out by audit at different Power stations. In this regard it may be noted that station consumption is not only metered auxiliary but is the sum of metered/ unmetered auxiliaries and losses sustained in the Power Plant till the point of exit of energy from switchyard. For better understanding single line diagrams of a Tarbela, Ghazi Barotha, Mangla, Warsak, Chashma, 3-HHP Besham, Jinnah Hydro Power Stations are attached at (**F/C**) indicating connection of unit auxiliary transformer, excitation transformer and location of measuring current transformers.

In the above preface, the technical committee as per TORs started its proceedings by comparing the metered auxiliary consumption of each power plant with the NEPRA allowed limits. Unmetered auxiliary consumption & losses are segregated as per available data in power plants for comparison with E-form value of Station total consumption. Station wise detail is as under:

i. Power Station Tarbela:

As per NEPRA Schedule-II, average auxiliary consumption of 1.3 MW is allowed to Tarbela Units (1-14). Scrutiny of auxiliary record for the last 10 years revealed that Tarbela Power station is constantly consuming auxiliary power in excess of allowed limit. The power plant being the biggest in the country have installed capacity of 3478 MW and contribute around 14 billion units per annum to the national grid. The station consumption allowed as per PC-1 of project (completed in four phases) is between 2~2.5% of installed capacity. However, the station metered consumption at present is around 0.16% and total station consumption (metered/ unmetered & losses) is round 0.7% of energy generated.

The metered auxiliary consumption of the Power plant is expected to increase in coming years from existing figure due to aging of plant and rehabilitation works in pipeline on mechanical/ electrical sides and average auxiliary consumption is expected to rise to 4 MW in the coming 5-years which in terms of percentage shall be around 0.25% of energy generated.

Regarding the unmetered consumption and losses sustained in Power Plant, committee scrutinized the data for last five years. For calculating energy consumed in excitation of generator field winding, the log sheets were scrutinized and average figure of each month was calculated. It may be noted that actual consumption is on real time values while calculation made by the committee is on average values, therefore, point to point matching was not possible. Similarly, for calculating energy losses of the station during a fiscal year attention is only focused on transformer losses being main contributor and loss sustained in generator bus ducts, switchyard is ignored. The calculation thus made revealed that station consumption as per E-form is justified and below 1% of energy generated in any year as against PC-1 figure of 2.5%. Detail calculations are attached at (F/D).

ii. Ghazi Barotha Power Station:

As per NEPRA Schedule-II, average auxiliary consumption of 1.1 MW is allowed to Ghazi Barotha Power Plant. Scrutiny of auxiliary record for the last 5 years revealed that GB Power station is consuming auxiliary power within allowed limit. The power plant having installed capacity of 1450 MW contribute around 6.5 billion units per annum to the national grid. The station metered consumption at present is around 0.15% and total station consumption (metered/ unmetered & losses) is round 1.1% of energy generated. However, it may be noted that station/ auxiliary (metered) consumption of E-form is inclusive of colony feeder, which is around 0.042%. this depicts that if colony feeder is excluded then average consumption for metered auxiliary is around 0.11% and total station consumption (metered/ unmetered & losses) is round 1.05%. It is to be further highlighted that GBHP has synchronization scheme at low voltage which means that the power transformers remain energize irrespective of unit's operation.

Metered auxiliary consumption of Power plant is not expected to increase massively in coming years from existing figure but due to aging slight increase in

auxiliary figure cannot be ruled out. It is expected that metered auxiliary consumption shall remain within 3 MW in the coming 5-years which in terms of percentage shall be around 0.25% of energy generated.

Regarding the unmetered consumption and losses sustained in Power Plant, the committee scrutinized the data available for last five years. For calculating the energy consumed in excitation of generator field winding, log sheets were scrutinized and average figure of each month was calculated. It may be noted that actual consumption is on real time values while the calculation made by the committee is on average values, therefore, point to point matching were not possible. As stated above GBHP Power transformers are constantly energized and thus the transformer losses consume a handsome portion. The calculation thus made revealed that station consumption as per E-form is justified. Detail calculations are attached at (F/E).

iii. 3-HHP Besham

Chief Engineer Besham is controlling three Power plants, the committee visited all three of them and collected data which is as per following details:

a. Allai Khwar HPP:

As per NEPRA Schedule-II, average auxiliary consumption of 0.3 MW is allowed to Allai HPP. Scrutiny of auxiliary record for the last 5 years revealed that Power station is consuming auxiliary power within allowed limit. The power plant having installed capacity of 121 MW generate around 0.4 billion units per annum. The station average metered consumption at present is around 0.25% of energy generated.

Metered auxiliary consumption of Power plant is not expected to increase immensely in coming years from existing figure but due to aging slight increase in auxiliary figure cannot be ruled out. It is expected that metered auxiliary consumption shall rise to a maximum figure of 0.5 MW against present allowed of 0.3 MW in the coming five years. Detail calculations are attached at (F/F).

b. Khan Khwar HPP:

As per NEPRA Schedule-II, average auxiliary consumption of 0.3 MW is allowed to KK HPP. Scrutiny of auxiliary record for the last 5 years revealed that Power station is consuming auxiliary power almost within allowed limit. The power plant having installed capacity of 72 MW generate around 0.13~0.20 billion units per annum. The station average metered consumption at present is around 0.25% of energy generated.

Metered auxiliary consumption of Power plant is not expected to increase massively in coming years from existing figure, a slight increase in auxiliary figure due to ageing/ maintenance work may be taken in to account in next five years. It is expected that metered auxiliary consumption may rise to a maximum figure of 0.5 MW against the present allowed of 0.3 MW. Detail calculations are attached at (F/G).

c. Duber Khwar HPP:

As per NEPRA Schedule-II, average auxiliary consumption of 0.3 MW is allowed to Allai HPP. Scrutiny of auxiliary record for the last 5 years revealed that Power station is consuming auxiliary power within allowed limit. The power plant having installed capacity of 130 MW generate around 0.52 billion units per annum. The station average metered consumption at present is around 0.2% and total average station consumption (metered/ unmetered & losses) is round 0.6% of energy generated.

Metered auxiliary consumption of Power plant is not expected to increase in coming years from existing figure but due to aging slight increase in auxiliary figure cannot be ruled out. It is expected that metered auxiliary consumption shall rise to a maximum figure of 0.5 MW against the present allowed of 0.3 MW in the next five years.

Regarding the unmetered consumption and the losses sustained in Power Plant, the committee scrutinized the data available for last five years. Excitation data has been calculated from log sheets and average figures are considered instead of real time values. Similarly, for calculating the losses of the station during a fiscal year attention is only focused on Power transformer losses being main contributor. The calculation thus made revealed that station consumption as per E-form is justified and below 1% of energy generated in any year. Detail calculations are attached at (F/H).

iv. Chashma Power Station:

Chashma is a run-of-river hydel power station. In view of low head plant eight bulb type turbines have been installed utilizing available head of 4 meters to 13 meters. The power plant having installed capacity of 184 MW generate around 1.03 billion units per annum.

As per NEPRA Schedule-II, average auxiliary consumption of 0.8 MW is allowed at Chashma HPS. In PC-1 of project allowed auxiliary consumption is 2%. Whereas station metered auxiliary energy consumption for last five years & at present is around 0.6% and total station auxiliary energy consumption (metered/ unmetered & losses) is around 0.9% of energy generated. Furthermore, due to aging of plant and in view of current rehabilitation works at Unit-8 & Unit-2 metered average auxiliary consumption, is likely to increase up to 0.9 MW which in terms of percentage shall be around 0.77% of energy generated and probably station will withstand this value for upcoming five years.

In order to calculate the inherent power loss at hydro power station, namely transformation losses, committee has compiled the relevant available data of last five years. On the basis of which, more or less realistic determination of unmetered auxiliary energy is acquired. Thus, firstly to determine the static excitation requirement of station, exciter losses are computed from the scrutiny of last five-year log sheets and average figure of each month is picked up. Secondly, Power transformer losses are computed from the available technical parameters.

Aftermath figures revealed that station consumption as per E-form is justified and below 1.5% of energy generated in any year against PC-1 figure of 2%. Detail calculations are attached at (F/I).

v. Jinnah HPS:

Jinnah is also a run-of-river hydel power station. In view of low head plant eight pit type turbines have been installed utilizing available head of 3 meters to 8 meters. The power plant having installed capacity of 96 MW generate around 0.23 billion units per annum.

As per NEPRA Schedule-II, average auxiliary consumption of 0.5 MW is allowed at Jinnah HPS. Whereas as per last 05-year station record average metered consumption at present is around 1.18% and total station auxiliary energy consumption (metered/unmetered & losses) is around 2.45% of energy generated. However, it may be noted that station/ auxiliary (metered) consumption of E-form is inclusive of colony feeder, which is around 0.22%. this depicts that if colony feeder is excluded then average consumption for metered auxiliary is around 0.96% and total station consumption (metered/ unmetered & losses) is round 2.23%. It is to be further highlighted that Jinnah HPS has synchronization scheme at low voltage which means that the power transformers remain energize irrespective of unit's operation besides one step up power transformer is used for 02 generating units. Also as per PC-1 of project allowed auxiliary consumption is 2~2.5%. Furthermore, in view of current rehabilitation works & future major overhauling of units, metered auxiliary consumption, is likely to increase slightly up to 0.6 MW and probably station will withstand this value for upcoming five years.

In order to calculate the inherent power loss at hydro power station, namely transformation losses, committee has compiled the relevant available data of last five years. On the basis of which, more or less realistic determination of unmetered auxiliary energy is acquired. Thus, firstly to determine the static excitation requirement of station, exciter losses are computed from the scrutiny of last five-year log sheets and average figure of each month is picked up. Secondly, Power transformer losses are computed from the available technical parameters. As already stated that at Jinnah HPS Power transformers are constantly energized and thus the transformer losses consume a handsome portion. Consequently resultant figures revealed that station consumption as per E-form is justified and below 2.5% of energy generated in any year. Detail calculations are attached at (F/J).

vi. Gomal Zam HPS:

As per NEPRA Schedule-II, average auxiliary consumption of 0.3 MW is allowed to Gomal Zam HPS. Scrutiny of auxiliary record of 04years revealed that Power station is consuming auxiliary power almost within allowed limit. The power plant having installed capacity of 17 MW generate around 0.035~0.09 billion units per annum. The station average metered consumption at present is around 0.24% of energy generated. Auxiliary power loss as per 1st revised PC-1 is 2.11%.

Metered auxiliary consumption of Power plant is not expected to increase immensely in coming years from existing figure but due to certain rehabilitation works slight increase in auxiliary figure cannot be ruled out. It is expected that metered auxiliary consumption shall rise to a maximum figure of 0.4 MW in the coming five years. Detail calculations are attached at (F/K).

vii. Mangla Power Station:

As per NEPRA Schedule-II, average auxiliary consumption of 1.1 MW is allowed to Mangla Units (1-10). Scrutiny of auxiliary record for the last 10 years revealed that Mangla Power station is constantly consuming auxiliary power in excess of allowed limit. The power plant being the 3rd largest in the country have installed capacity of 1000 MW which will be enhanced to 1310 MW after refurbishment which is under progress. Mangla Power Station contributes around 5.3 billion units per annum to the National Grid. The station metered consumption is around 0.20% and total station consumption (metered/ unmetered & losses) is around 2.2% of energy generated.

The metered auxiliary consumption of the Power plant is expected to increase in coming years from existing figure due to aging of plant and rehabilitation/ refurbishment of generating Units and allied equipment which is in progress and average auxiliary consumption is expected to rise to 3 MW in the coming 5-years which in terms of percentage shall be around 0.49% of energy generated.

Regarding the unmetered consumption and the losses sustained in Power Plant, the data for a selected fiscal year was scrutinized. For calculating energy consumed in excitation of generator field winding, the log sheets were scrutinized and average figure of each month was calculated. It may be noted that actual consumption is on real time values while calculation made is on average values, therefore, point to point matching may not be possible. Similarly, for calculating energy losses of the station during a fiscal year attention is only focused on transformer losses being main contributor and losses on interconnection lines (about Km length) between Power House to Switchyard while loss sustained in generator bus ducts, switchyard is ignored. The calculation thus made revealed that station consumption as per E-form is justified. Detail calculations are attached at (F/L).

viii. Mangla Small Hydel Power Stations:

a. Rasul Hydel Power Station

Rasul Power Station was commissioned in July, 1952 having total installed capacity of 22MW which is located on Upper Jhelum Canal (UJC) near Rasul Village at distance of 150 Km South East from Islamabad in district Mandi Bahaudin Punjab. It is the First Hydel Power Project of Pakistan after independence. NEPRA's allowed limit for auxiliary consumption for Rasul Hydel Power Station is 0.2 MW. Scrutiny of the station reports revealed that metered auxiliary

consumption of the station remained within the permissible limit of 0.2 MW. However, average auxiliary consumption (metered & unmetered) of last 5 years comes out to be 0.335 MW. Due to the aging and possible refurbishment of the power station enhancement is proposed in auxiliary consumption up to 0.4 MW. Justification of enhancement is given in tabulated data attached (F/M).

b. Shadiwal Hydel Power Station

HPS Shadiwal has been installed & commissioned during the year 1961 at Upper Jhelum Canal (UJC) near the village Shadiwal at about 15 KM west of Gujrat City. Installed capacity of the Power Plant is 13.5 MW (2x6.75). NEPRA's allowed limit for auxiliary consumption for Shadiwal Hydel Power Station is 0.2 MW and actual average auxiliary consumption of last 5 years comes out to be 0.11 MW. The enhancement proposed in auxiliary consumption is 0.3 MW. Justification of enhancement is given in tabulated data attached (F/N).

c. Nandipur Hydel Power Station

Nandipur Hydel Power Station was commissioned in 1963, having three Gen. Units of 4.6 MW each hence the total capacity of the plant is 13.8 MW it is situated on Upper Chenab Canal near Nandipur village at a distance of about 10 Km from Gujranwala on Gujranwala- Sialkot road. NEPRA's allowed limit for auxiliary consumption for Nandipur Hydel Power Station is 0.2 MW but actual average auxiliary consumption of last 5 years comes out to be 0.209 MW. Hence enhancement proposed in auxiliary consumption is 0.3 MW. Justification of enhancement is given in tabulated data attached (F/O).

d. Chichoki Hydel Power Station

Hydel Power Station Chichoki has been installed and commissioned during the year 1959 near the village Joyanwalla at about 20Km from Sheikhupura city, having installed capacity of 13.2MW. NEPRA's allowed limit for auxiliary consumption for Chichoki Hydel Power Station is 0.2 MW and the actual average auxiliary consumption of last 5 years comes out to be 0.140 MW. The enhancement proposed in auxiliary consumption is 0.3 MW. Justification of enhancement is given in tabulated data attached (F/P).

e. Renala Hydel Power Station

Renala Power Station was commissioned in 1925 and is located near Renala City, Distt. Okara about 109 Km from Lahore, Punjab on Lower Bari Doab Canal (LBDC) off taking from Head Balloki. Power station installed capacity is 1.1 MW i.e. 05 Machines of 0.220 MW each. The type of turbine is horizontal Francis. Renala Power Station feeds Electricity through one radial 11 KV Feeder (EHKL), which falls under the jurisdiction of LESCO, to nearby village 1/AL, 12/AL, LESCO offices, grid station colony and WAPDA colony through colony feeder. NEPRA's allowed limit for auxiliary consumption for Renala Hydel Power Station is 0.1 MW and average auxiliary consumption of last 5 years comes out to be 0.004 MW. Hence no enhancement is required for Renala Power Station (**F/Q**).

ix. Warsak Power Station:

Warsak Power Station is located on River Kabul at about 30KM from Peshawar. The project was completed in two phases. In the 1st phase four generating Units each of 40 MW were commissioned in 1960 of total 160 MW and in 2nd phase two additional generating units each of 41.48 MW capacity were added in 1980-81.

As per NEPRA Schedule-II, average auxiliary consumption of 0.8 MW is allowed to Warsak Power Station. Scrutiny of auxiliary record for the last 5 years (2014-2019) revealed that Warsak Power station is constantly consuming auxiliary power consumption in its allowed limits except in the financial year 2014-15 which was 6.74%. High percentages of the energy consumed in auxiliary for the year 2014-15 were brought several time in the notice of NTDC TSG. Meter testing/ sealing committee visited Warsak Power Station in Nov-2015 to resolve this outstanding issue and finally after their visit the issue was resolved. The power plant being the oldest plant contribute around more than 0.95 billion units per annum to the national grid. The station metered consumption at present is around 0.13% and total station consumption (metered/ unmetered & losses) is round 0.254% of energy generated which falls within the allowed NEPRA limit. Being one of the oldest power station an increase of 0.2 MW in the existing limit is recommended for the station to accommodate the needs of future maintenance requirements.

Regarding the unmetered consumption and the losses sustained in Power Plant, data of last five years was scrutinized. For calculating energy consumed in excitation of generator field winding, the log sheets were scrutinized and average figure of each month was calculated. Similarly, for calculating energy losses of the station during a fiscal year attention is only focused on transformer losses being main contributor and loss sustained in generator bus ducts, switchyard is ignored. Station consumption as per E-form is justified and below 1% of energy generated in any year. Details are attached at (F/R).

x. Warsak Small Hydel Power Stations:

a. Golan Gol Hydel Power Station:

The Unit No.1 of Golan Gol Hydel Power Station was commissioned in 23.01.2018 and remaining two units were commissioned in October-2019.

As per NEPRA Schedule-II, average auxiliary consumption of 0.3 MW is allowed to Golan Gol Power Station. Scrutiny of auxiliary record for the last 2 years revealed that Golan Gol Power Station is consuming auxiliary power within allowed limit. The station metered consumption at present is around 1.68% which falls within the allowable NEPRA limit for Golan Gol Power Station.

The station metered auxiliary consumption of the station as per annual E- form is justified. Thus no increase in the said NEPRA allowance is recommended for Golan Gol P/Station. Details attached at (F/S).

b. Jabban Power Station:

Jabban Power Station is run-of-river power plant having installed capacity of 22 MW commissioned in 2013. As per PC-I total auxiliary & station consumption taken as 1.5% of the total annual energy i.e. 126Gwh.

As per NEPRA Schedule-II, average auxiliary consumption of 0.2 MW is allowed to Jabban Power Station. Scrutiny of auxiliary record for the last 5 years (2014-2019) revealed that Jabban Power station is constantly consuming auxiliary power with in its allowed limits. The station metered consumption at present is 0.9% of energy generated thus station consumption as per E-form is justified. No increase in the limit of Station consumption is proposed for Jabban Power Station. Detail attached at (F/T).

c. Dargai Power Station:

Dargai Power Station is run of river power Station of 20 M.W capacity commissioned in 1951. The Power House has completed 68 years of successful operation and now its rehabilitation is under consideration. De-rated capacity of Power House is 18 M.W.

As per NEPRA Schedule-II, 0.2 MW of auxiliary is allowed to Dargai Power Station. Scrutiny of auxiliary consumption record of last 5 years verifies that metered auxiliary consumption remained less than 0.4% of total generation which is below the allowed limit. Due to aged / inaccurate energy meters of generating units, the unmetered auxiliary consumption cannot be calculated at Dargai Power Station. However, during commencement of rehabilitation (if carried out units wise) the

auxiliary consumption is expected to increase. The station consumption of auxiliary power is expected to be in the tune of 0.4 MW, hence it is proposed that NEPRA allowed limit may be revised. Details attached at (F/U).

d. Kurram Garhi Power Station:

Kurram Garhi Hydel Power Station was commissioned in 1957 by the Irrigation Department Bannu of K.P.K. Later on, it was handed over to Wapda on 05.10.1961. Its generating capacity is 4 M.W having four units each having a capacity of 01 M.W.

As per NEPRA Schedule-II, average auxiliary consumption of 0.1 MW is allowed to Kurram Garhi Power Station. Scrutiny of auxiliary record for the last 5-years (2014-2019) revealed that Kurram Power station is constantly consuming auxiliary power within its allowed limits and hence no increase is proposed. Detail attached at (F/V).

e. Chitral Hydel Power Station:

The existing 1.0 MW Chitral Hydel Power Station is located on the right bank of Lutkho River, 5 Km upstream of Chitral City. The project was commissioned in 1975 by diverting the flows of Lutkho River through 3.72 Km long channel and installing 02 units of 200 KW & 02 units of 300 KW each. The Power generated

from Chitral Hydel Power Station is supplied to Chitral city through 11 kV Transmission line.

As per NEPRA Schedule-II, average auxiliary consumption of 0.1 MW is allowed to Chitral Power Station. Scrutiny of auxiliary record for the last 5 years (2014-2019) revealed that Chitral power station is constantly consuming auxiliary within its allowed limits. The station metered consumption at present is 0.17% of energy generated thus station consumption is justified. Detail attached at (F/W).

6. FORCED OUTAGE LIMITS AND CAUSES OF GENERATION LOSS:

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As per TORs set for the committee, the forced outage limits of Hydel station are to be examined and recommendations regarding their suitability or revision is to be submitted.

The scheduled outage, forced outage and total outage hours for WAPDA Hydel Power Stations in practice as per NEPRA Schedule-2 Annex-1 is attached at (F/X). The forced outage of 100 Hours is allowed as if the full capacity in MW of a power station (all units) remain out simultaneously. In case of stage or staggered outage of individual units the outage time in hours will be worked out on weighted capacity basis. It may be pointed out that as per mentioned schedule Warsak Power station is allowed 200 Hours as forced instead of 100 hours.

The committee studied the records for last five years of power stations and gathered data regarding the outage of units and it was revealed that almost all Hydel Power plants are coping up activities within the allowed outage hours except the activities like major rehabilitation of generating units. Furthermore, there are incidents where the outage hours are violated but these incidents are very rare and has certain reasons beyond the control of Power Station management like hiring of services other than WAPDA formations or involvement of a foreign expert etc. In GBHP for the year 2018-19 the allowed outage quota of 4500 Hours was violated and the power station availed 4578.74 hours in total. The main reason for the same is the damage to the stator winding of Unit-1. Such nature of fault did not occur in GBHP before and to arrange the material & services for the requisite repair, the power station management crossed the limit of allowed quota of outage hours. However, it may be noticed that no spillover/ wastage of water occurred during the period and further the excess outage of 78.74 hours may be adjusted in the previous year where the GBHP consumed only 3684.51 hours against allowed 4500 Hours. Record of all other Power stations is attached at (F/Y).

The design of hydel power plant is gigantic and dismantling/ assembling require ample time. Further the spare and services in case of major rehabilitation are mostly arranged from OEM (foreign countries). Warsak, Mangla, Tarbela and even Chashma, Jinnah & Gomal Power Plants are in zone of major rehabilitation works. The small hydel

associated with Mangla & Warsak are even older and need complete revival of machinery. Keeping in view the condition of hydel power plants and the rehabilitation works taken in hand or in pipe line within the next five years the committee after discussing the matter with Plant management & mutual consultation consider it necessary to revise the outage hour schedule for the next five years besides allowing a special period for overhaul/major rehabilitation activities. However, while considering the proposed revision the make, type and capacity of the power plant is also kept in consideration. It has been mutually agreed that forced outage hours be increased to a figure of 300 hours as against 100 Hours per generating unit. In addition, a special overhaul period may be allowed to different Power plants to schedule their major works/rehabilitation amicably.

Outage of a unit or Power station due to hydrology constraints of IRSA and system constraints shall not be considered as scheduled or forced outage but shall be treated as available (Standby). Further, for any type of scheduled activity at generating unit, it is also recommended that if scheduled outage hours are available on credit then these shall be utilized on priority rather than exhausting the forced outage hours of the plant. Lastly, the actual time of shutdown where unit is not available for power generation shall be considered as "outage" and not the approved period of shutdown.

7. RECOMMENDATIONS/ CONCLUSION:

The committee started its proceedings in reference to the observations taken by audit from time to time in different Wapda hydel power stations. The TORs of the committee are based on these observations and initially the committee concentrated on these Paras but later on it was decided to consider the metered Auxiliary consumption, unmetered auxiliary consumption and outages of all Hydel stations being operated by WAPDA so as to settle the issue permanently. The working of the committee was on regular basis till its 2nd meeting of 19.03.2020, afterwards the restrictions of COVID-19 pandemic has badly affected the data collection and meetings of committee and discussion on various key issues.

Following are the technical recommendations of the committee:

i. The Auxiliary consumption figures were fairly high in NEPRA Modification-II, Schedule-II till year 2010-11 for instant the value allowed for Tarbela was 16 MW similarly the allowance allowed for Mangla was 25 MW followed by Ghazi Barotha which was 18 MW. Later on the limit was reduced to existing values under practice. As stated earlier, the metered/ unmetered consumption of different Power stations except Tarbela are generally in limits of existing NEPRA Modification-IV, Schedule-II. Tarbela being the largest power plant was somehow not given the due allowance

for its auxiliary consumption despite the fact that its auxiliary metered consumption in terms of percentage is lowest among the hydel power stations and is merely 0.16% of energy generated. With the ageing of Power station, the quantum of maintenance/ rehabilitation works increases and this in turns affects the auxiliary consumption of a power plant. The committee, therefore, after scrutinizing all these facts recommends the following limits for Hydel Power stations regarding their metered auxiliary consumption for a period of next five-years.

Sr. No.	Power Station	Existing Allowed by NEPRA (MW)	Recommended by Committee (MW)
1	Tarbela (1 ~ 14)	1.3	4.0
2	Ghazi Barotha	1.1	3.0
3	Tarbela 4th Ext.	0.8	3.0
4	Mangla	1.1	3.0
5	Warsak	0.8	1.0
6	Chashma	0.8	0.9
• 7	Duber Khwar	0.3	0.5
8.	Allai Khwar	0.3	0.5
9	Golan Gol	0.3	0.3
10	Jinnah	0.5	0.6
11	Khan Khwar	0.3	0.5
12	Jabban	0.2	0.2
13	Rasul	0.2	0.4
14	Dargai	0.2	0.4
15	Gomal Zam	0.3	0.4
16	Nandi Pur	0.2	0.3
17	Shadiwal	0.2	0.3
18	Chichoki	0.2	0.3
19	Kurram Garhi	0.1	0.1
20	Renala	0.1	0.1
21	Chitral	0.1	0.1
22	Keyal Khwar	0.3	0.3
23	Dia Mer Bhasha	2.0	2.0
24	Dasu	2.0	2.0

As far as the unmetered auxiliary consumption is concerned, the committee noticed that these are within the limits set in the PC-1 and not a single power station is crossing these limits. All the power losses as explained in aforementioned para-5 of

this report contribute to this head and being part of their technical design cannot be avoided in any case.

ii. The outage limits are also studied by the committee in detail and to get a fair idea data of last five years were collected from all Hydel power stations. As explained earlier the power stations are coping up with the allowed limits to major extent except for the activities like major rehabilitation of generating units. Moreover, incidents exits where these limits are crossed but these have concrete reasons which are beyond the control of Power Station management. The committee after taking a realistic view of the power stations environments, quantum of rehabilitation works, bottlenecks in operation of units and OEM endorsed maintenances recommends the following outage schedules for all power stations during a period of next five-years.

		Existing	Schedule Outage (Hours)			Foread	Recommended		
Unit Type	Station	Outages by NEPRA (Hours)	Annual Mtce:	Monthly Mtce:	Mtce: Works	Total	Outage (Hours)	by Committee Total Outages (Hours)	Overhaul (Month)
	Warsak	2100	1000	72	428	1500	300	1800	
	Khan Khwar (Units 1 ~ 2)	900	720	72	308	1100	300	1400	
Vertical Francis/	Rasul	900	528	72	308	908	300	1208	
Kaplan	Gomai Zam	900	720	72	308	1100	300	1400	6
MW	Nandipur	900	528	72	308	908	300	1208	
	Shahdiwal	900	528	. 72	308	908	300	1208	
	Chichoki	900	528	72	308	908	300	1208	
	Tarbela	900	720	72	308	1100	300	1400	
Vertical Francis/	Ghazi Barotha	900	720	72	308	1100	300	1400	٩
51 MW	Mangla	1100	720	72	308	1100	300	1400	5
& above	Tarbela 4th Ext. Project	900	720	72	308	1100	300	1400	
	Jabban	900	540	72	308	920	300	1220	4
Horizon	Durgai	1100	540	72	308	920	300	1220	
tai Francis/ Kaplan	Kurram Garhi	900	528	72	308	908	300	1208	
0-6 MW	Renala	1100	528	72	308	908	300	1208	
	Chitrai	900	528	72	308	908	300	1208	
Horizon	Chashma	900	720	72	308	1100	300	1400	
Francis/ Kaplan 7 MW & above	Jinnah	900	720	72 '	308	1100	300	1400	12
Pelton	Golen Gol	900	720	72	308	1100	300	1400	
0-50 MW	Khan Khwar (Unit No.03)	900	720	72	308	1100	300	1400	6
Pelton Wheel	Duber Khwar	900	720	72	308	1100	300	1400	6
& above	Allai Khwar	900	720	72	308	1100	300	1400	

The committee also discussed the rehabilitation of hydel units which require prolong outages and shall in turn consume the outages hours allowed for a particular station. There are two ways to resolve the matter;

- Either the units which are rehabilitated are de-commissioned with NEPRA/ CPPAG. After completion of rehabilitation unit is re-commissioned or
- The rehabilitation of the unit is to be treated as special outage and not to be counted towards the outage allowance of that particular station.

In the opinion of the committee, the first option is more logical and viable keeping in view the tariff involved (fixed and variable). However, final decision to be taken by Competent Authority.

iii. Based on the working and details/ justifications attached in this report, the committee also recommends the following:

	Sr. No,	PARA	Contents	HPS	Description of Para	Financial Implication (MPKR)	Recommendation By committee
	1.	PDP # 66/ 2019-20	Auxiliary Consumption	Mangla	Loss of revenue due to excessive auxiliary consumption beyond Nepra's approved limit-	2.28	Each PDP is replied by the concerned Power station in detail. After scrutiniy of records at
	2.	PDP # 120/ 2019 - 20	Station Consumption	Warsak	Loss due to excess power station consumption-	1.39	relevant stations relating to auxiliary consumption, the
	3.	PDP # 251/ 2019-20	Auxiliary Consumption	Jinnah	Loss due to excess auxiliary consumption against the permissible limit in PC-I –.	3.17	committee is of the opinion that auxiliary consumption/ loss
	4.	PDP # 419/ 2019-20	Auxiliary Consumption	Tarbela	Loss due to excessive auxiliary consumption beyond Nepra's approved limit –	24.95	sustained by power plant are according to their design specifications and can not be
	5.	PDP # 513	Station Consumption	Chashma	Loss due to excess power consumption - Rs. 0.551 million	0.638	technically avoided. A perpetual Power plant is not practically
	6.	PDP # 536 (2019-20)	Station Consumption	Gomal Zam	Loss due to excess power station consumption	7.41	possible. All Power stations are putting their utmost efforts to
	7.	PDP # 65/ 2019-20	Station Consumption	Mangla	Loss of revenue due to power station consumption	117.84	maintain Auxillairy consumptions
	8.	PDP # 240 / 2019-20	Station Consumption	Besham	Lost of revenue due to unmetered power station consumption	3.55	proposed by committee, revision in NEPRA addemdum-III is also
ł	9.	Para # 321/ (2019-20)	Station Consumption	Chashma	Unjustified unmetered power station consumption excluding auxiliaries	4.02	permantantly. Settlements of Paras are recommended by the committee.

Sr. No.	PARA	Contents	HPS	Description of Para	Financial Implication (MPKR)	Recommendation By committee	
10.	PDP # 121/2019- 20	Forced Outages	Warsak	Regarding generation loss due to forced outages-	3.43	Each PDP is addressed/ repied by the concerned Power Plant with relevants details/ justification. Due to ageing of Hydel Power stations the maintenance / fault occurrence	
11.	PDP # 290/2019- 20	Less Generation	Jinnah	Loss due to less generation from running hours as compared to approved PC-I	293.37	considerable time in fixing due to its gigantic structure. Moreover, spares in case of severe fault occurrence are arranged from OEM (foreign) and require ample time to complete codal formalities.	
12.	Para # 384(2019- 20)	Forced Outages	Chashma	Generation loss due to forced outages -	97.40	Even OEM Engineer if required on site require approx. 8-12 weeks to obtain all clearances and travelling. Revision of Outage hours llimits are proposed by the committee and it is expected that	
13.	PDP # 430/2019- 20	Forced Outages	Ghazi Barotha	Loss of revenue due to forced outages-	14.13	few instances which has occurre in the past regarding violation of limits shall not happen in future Settlementt of PDPs ar recommended.	

The audit paras of DAC, PDP # 43, 1606, 1792, 1793, 1632, 1695, 1745 are of similar nature as discussed above hence based on the aforesaid details/ justifications settlement of these PDP's are also recommended.

The committee while working on the preparation of this report has tried its best to scrutinize available data/records regarding observations set as per TORs. While setting the new limits for auxiliary consumption and outage hours, committee tried to adopt realistic approach and consider all ground realities so that assigned TORs may be addressed in a better manner for a period of next five years. All above recommendations/ revisions of the committee may be re-assessed periodically (after each five years) to adopt any further changes, if required at that time.

Submitted please.

Mr. 🖗 ahad Rafi Sr. Engineer Tarbela Member

Mr. Hameed-ullah Khan R.E (Elect.) Tarbela Member

Mr. Muhamad Tariq R.E Mangla Member

Mr. Asif Jan G.M (Coord) Power Convener

Mr. Abdul Sattar Afridi C.E (Hydel) Warsak Member

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	Fax No. :	<u>042-99202159.</u> /	186 - WAPDA House, Lahore.
•	No. <u>GMHO/CE</u>	HOIG-6/G-45/1521-28	Dated: 23.01.2020
		OFFICE ORDER	

After concurrence of Ministry of Water Resources, Islamabad, conveyed vide Section Officer (HP) letter dated 14-01-2020, a Technical Committee comprising the following Officers is hereby constituted to probe into the matter regarding excessive auxiliary consumption, unmetered consumption and generation loss at different WAPDA Hydel Power Stations pointed out by Audit in Draft Paras of the FY 2017-18 & Proposed Draft Paras of FY 2019-20;

1.	Mr. Asif Jan	General Manager (Coord) Power	Convener
2.	Mr. Abdul Sattar Afridi	Chief Engineer (Hydel) North Warsak	Member
3.	Mr. Karim Nawaz	SE (SHPS) Mangla	Member
4.	Mr. Hameedullah	RE (Elect) Tarbela Power Station	Member
5.	Mr. Fahad Rafi	Senior Engineer Tarbela Power Station	Member

Terms of Reference (TORs):

rakistan

- a. To check the reasons of Auxiliary Consumption beyond limits specified.
- b. Causes and justification for un-metered energy consumption.
- c. Causes of generation loss and fix responsibility if any.
- d. Recommendations for any revised auxiliary consumption limits.
- e. Revision of forced outage limits (if required).

The committee is directed to submit the report within one month.

This issues with the approval of Member (Power).

23-01-2020

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Chief Engineer (Hydel) Operation For General Manager (Hydel) Operation

Copy to:

- Chief Engineer (Power) Tarbela.
- Chief Engineer (Power) Mangla
- Chief Engineer (Hydel) North Warsak.
- Director General Audit, Sunny View, Lahore.
- Chief Auditor (SAL) WAPDA, 47-L, Gulberg III, Near Kalma Chowk Lahore.
- Section Officer (HP) Ministry of Water Resources Islamabad.
- SO to Chairman WAPDA, WAPDA House, Lahore.
- APS to Member(Power)