CENTRAL ELECTRICITY REGULATORY COMMISSION

3rd & 4th Floor, Chanderlok Building, 36, Janpath, New Delhi-110001

Subject: Report of the Committee to assess requirement of regional spares in compliance with the Commission's order dated 18.1.2018 in Petition No 38/TT/2017 of POWERGRID.

Petition No. 38/TT/2017 pertaining to spare ICTs and Reactors was heard on 10.1.2018. The Commission vide ROP dated 18.1.2018 at para 2 in petition no 38/TT/2017 issued the following directions:

> 2. Since the petitioner has not submitted proper reply regarding requirement of regional spares vis-à-vis their current availability, the Commission directed to submit a proper reply. The Commission further directed to set up a Committee consisting of representatives from PGCIL, NLDC and CEA under the Chairmanship of the Chief (Engineering) of the Commission to assess the requirement of regional spares including bus reactors, line reactors, ICTs, etc., present availability and other related issues and submit a comprehensive report on the requirement of spare bus reactors, line reactors, ICTs and related equipment in different regions of the country to the Commission by 9.3.2018. The Commission also observed that final tariff in the matter would be allowed only after consideration of the Report to be submitted by the Chief (Engineering) of the Commission.

The commission assigned the task of assessing the requirement of spares including ICTs and Reactors, present availability and other matters to the committee.

2. In pursuance of the subject order of the Commission, a committee comprising of members from CERC, CEA, POSOCO and POWERGRID was constituted under the Chairmanship of Chief (Engineering), CERC vide office order dated 15th March, 2018 (attached at Annexure-I).

3. The members of the Committee are:

i. S.C. Shrivastava, Chief (Engineering), CERC -- Chairman of the committee
ii. M.K. Anand, Chief (Finance), CERC -- Member
iii. Srinivas, Dy. Chief (Legal), CERC -- Member
iv. Y.K. Swarnakar, Director (PSE&TD), CEA -- Member
v. R.K. Tyagi, GM (Asset Management), POWERGRID -- Member

vi. M.M. Mehendale, DGM, POSOCO -- Member

vii. G. Ram Anjaneyulu, Assistant Chief (E), CERC -- Convener of the Committee

4. The following Terms of reference were defined for the Committee:

a) To examine the incidences of malfunction of power system devices – assessment of their failure rates, frequency and duration.

b) To estimate the requirement of spares.

c) To identify details of present available quantum of spares.

d) To enlist the existing practices of keeping and maintaining spares

e) To redefine the need and composition of spares for various voltage levels; and suggest modifications to (b) and (c), thereof.

f) To distinguish between Capital Spares and Operation & Maintenance spares i.e. to be allowed as part of capital cost along with the equipment or to be allowed as part of O&M cost.

g) To outline a policy for maintenance of spares, salvage at end of life, costs to be allowed/ disallowed in their handling, etc.

h) To examine any other related issue, if any.

5. First meeting of the committee was convened on 27th March'18. Minutes of the meeting are attached at Annexure-II. Presentation by CERC representative is at Annexure-III. Based on the deliberations in the meeting PGCIL has submitted a detailed report on 18.7.2018. The final meeting of the committee was convened on 25th Febraury'18

6. The Committee deliberated on the issue of Policy of PGCIL of maintaining and managing of the regional spares, bifurcation of spares, value and cost of spares, utilization of spares, their accounting treatment and recovery of the cost or tariff. The issues are deliberated as under:

Policy of PGCIL of maintaining and managing of the regional spares

7. Presently, the population of 3Ø/1Ø ICTs and reactors as indicated by PGCIL is 873 and 1363, respectively. The corresponding spares are kept either in Hot or Cold condition. The hot-spares are normally available at 765 kV level and are kept in standby ready

condition. At 765kV level, for every three 1Ø transformers, one transformer of 1Ø type is maintained as a hot spare. The cold spares are kept off-grid but are ready for deployment when required.

8. The overall average failure rate of transformers and reactors in 2017-18 is 1.21% and 0.89 %, respectively. The failure rate is computed considering failure data of last 25 years using the formula (∑ No of failures/ ∑ Total Equipment Year). The percentage-wise failure of transformers and reactors on account of various components is as under:-

Component name	ICT Failure Rate
Bushings	38 %
Windings	33 %
Leads	5 %
OLTC	10 %
Tap leads	6 %
Magnetic circuit	5%

9. Initial spares are minor spares required for entire project and do not comprise spare ICTs and reactors. All ICTs and reactors of AC system are covered under self-insurance. Equipment of HVDC Stations is covered under external insurance (Mega Insurance Policy).

10. The requirement of spare Transformer and Reactor are determined based on the following factors:

i. Availability of Transformer based on voltage class and MVA rating in each state
ii. Availability of Reactor based on voltage class and MVAR rating in each state
iii. Availability of Transformer based on impedance rating
iv. Based on criticality and redundancy of the system
v. Based on experience and failure History

For single phase transformer and reactor the hot spares are kept as per CEA guideline i.e. 1 single phase unit of each category for the entire sub-station or switchyard so that it can replace any of the units, whenever required.

11. Following criteria has been followed by PGCIL with regard to assessing the requirement of regional spares:

Transformer:

- For 1Ø 400kV and 765kV rated equipment – One 1Ø spare transformer for each type in each rating in each state;
- For 3Ø 400kV rated equipment where population is less than 20 nos. – One 3Ø spare transformer for each type in each state;
- For 3Ø 400kV rated equipment where population is more than 20 nos. – Atleast two 3Ø spare transformer in each state;
- For 3Ø 220kV and below rated equipment – One 3Ø spare transformer with highest MVA rating in each state;

Reactor:

- For 1Ø 400kV and 765kV rated equipment – One 1Ø spare reactor for each type in each rating in each state;
- For 3Ø 400kV rated equipment – Atleast one 3Ø spare reactor for each type in each state;
- For 3Ø 400kV rated equipment where population is more than 20 nos. – Atleast two 3Ø spare reactors in each state;

12. In view of the above, spare requirements are estimated and total estimated requirement of Transformer is 90 no's and total estimated requirement of Reactor is 70nos.

13. Against the above requirement availability of regional spares is as follows:

Sl. No	Spares available	Approved and available spares
(i)	Transformers: 72 nos. (1Ø& 3Ø -5 to 500 MVA)	RPC approved spare:35
		Spare on account of augmentation:21
		Through insurance proceeds(Procured by POWERGRID and the same are not covered under Tariff mechanism):16
(ii)	Reactors: 29 nos. (1Ø - 6.67 to 110 MVAr) (3Ø - 20 to 125 MVAr)	RPC approved spare: 11
		Spare on account of Augmentation:4
		Through insurance proceeds(Procured by POWERGRID and the same are not covered under Tariff mechanism)::14

14. To maintain the availability and reliability of the system, few Transformers have been procured as per the approval of RPC/SCM and few Transformers and Reactors have been procured, utilizing insurance fund.

15. To meet the spare requirement, Transformer removed from the service due to system augmentations are also considered as regional spare as long as, it can provide service and same can be strategically placed in the state where the deficit of spare Transformer/ Reactor is felt.

16. The maintenance policy followed for spare Transformers is same as that of installed in-service Transformers. Salvage value at the end of life is 10% of capital cost. At present there is no provision in the regulation for claiming of O&M charges for handling / maintenance of spares separately. These spares are maintained as per standard norms of POWERGRID. Cost involved for up keeping the spare is covered under O &M cost of the installed equipment.

Utilisation of Regional spares in last 5 years

17. The following numbers of spare Transformers and Reactors have been utilized in last 5 years:

Sl. No	Spare Transformer /Reactor description	No of Utilization
1	3Ø 315 MVA,400kV	8
2	1Ø 500 MVA,765kV Cold spare	1
3	1Ø 500 MVA,765kV standby spare unit	11
4	1Ø 333MVA,765kV standby spare unit	2
5	3Ø 500 MVA,400kV	5
6	1Ø 105 MVA,400kV standby spare unit	2
7	1Ø 167 MVA,400kV standby spare unit	1
8	1Ø 5MVA,132kV	1
9	1Ø 10MVA,220kV	1
10	1Ø 80 MVAR 765 kV Reactor	10
11	1Ø 110 MVAR 765 kV Reactor	5

10	3Ø 125 MVAR 420kV Reactor	5
11	3Ø 80 MVAR 420kV Reactor	6
12	3Ø 63 MVAR 420kV Reactor	3
13	3Ø 50 MVAR 420kV Reactor	3
	Total	64

Practice for inter/intra-Regional transfer and its treatment

18. With regard to Inter/Intra-regional transfer and its treatment, it is submitted that as per current practice Tariff for shifted asset is being claimed in its original petition. However, shifting cost along with additional bay equipment cost i.e. civil works/ erection & Foundation cost/bay equipment cost etc. is being claimed in new projects without taking Gross block/WDV cost of shifted asset.

19. PGCIL has submitted that in recent petitions, shifted asset is de-capitalized in the original petition and is recapitalized at new location. They have requested to allow them to claim the shifted asset in the original petition and do final adjustment of the shifted asset in original petition/project at the time of 2014-19 truing up to avoid repetition of filing true up petitions. They have submitted that in most of the cases, tariff impact of shifted asset is very minimal and same can be adjusted at the time of 2014-19 truing up of these petitions.

Tariff recovery for assets dismantled and kept as regional spares

20. According to PGCIL, if the age of the asset dismantled is less than 15 years, the same is generally utilized i**n** new projects. However, if their age is more than 15 years, the same are kept as regional spares as stop gap arrangement in case of future failures. Further, as the transformers/ reactors are already capitalized, it continues in the books of account of the original project despite dismantling.

Cost of recovery w.r.t. repair, insurance, transportation etc. and accounting treatment in books of account.

21. Cost of repair, insurance & transportation etc. of damaged equipment is being met through SIS/ Mega Insurance claim. Therefore, the expenditure w.r.t. repair, insurance,

transportation etc. are not being booked to the capital account to the extent claim received from the insurance.

22. PGCIL has submitted the details regarding tariff claimed by them for the regional spares in different petitions and the same is enclosed at Annexure-IV.

23. POSOCO has submitted that for grid operator spares improving availability of elements are important. The Main Equipment (Three Single phase units) along with one Hot Spare unit of a transformer/Reactor for 500 KV and above, are capitalized together as single element, named Main Equipment. Main Equipment is in service whereas Hot Spare is available standby. Availability of Main Equipment, inter alia, should cover Availability of Hot spare also. Under Breakdown condition, failed unit is taken out for repairs andHot Spare comes into service as a part of Main Equipment. Repair time as stated by PGCIL is of the order of 1-2 years, in most cases. Accounting of non-availability of Hot Spare unit, therefore, may need to be looked into.

Recommendations of the Committee:

24. The Committee observes that the causes of component failures in a transmission system are mainly on account of frequent switching for voltage control, abnormal stress due to grid operating condition such as operating at high voltage than designed limit, excessive ambient temperature, Weather conditions (storms, lightning, and moisture), Ageing, Design issues and Manufacturing defects.

25. The Committee feels that a reasonable level of spares has to be maintained in order to ensure the reliability of the grid, reduce downtime, and normalize tariff and the ecological footprint. In case of failures, wherever possible, rerouting of power and shifting of load to other transformer and reactors should be done.

26. The details of failure rate of transformers and reactors submitted by PGCIL is enclosed at Annexure-V. The failure rate in case of transformers has come down from 1.15% in 2013-14 to 0.36% in 2017-18. The failure rate in case of reactors has come down from 0.93% in 2013-14 to 0.683% in 2017-18. It is observed that on the basis of failure rate of transformers and reactors as per international practice of failure rate calculations for all

voltage levels are 1.21% and 0.89%, for a period of 26 years (1992-2018) for PGCIL. Globally, the failure rate of transformers and reactors are 0.5% and 3% respectively for the period of 14 years (1996-2010). The failure rates of reactors of PGCIL are below the failure rates in countries like Canada (3.15%) and Australia (0.97%). Further, the failure rate of transformers of PGCIL in voltage level of 500 KV and above is comparable to failure rates in most of the countries.

27. The Committee notes that Clause 43(2)(a)(v) and 43(2)(b)(i) of CEA (Technical Standards for Construction of Electrical Plants and Electric Lines) Regulations, 2010, provide as follows:

> 43. Salient Technical Particulars and Requirements of Sub-stations and Switchyards
> ...
> ...
> (2) Main equipment
> (a) Power Transformers
> ...
> ...
> (v) The transformers may be single phase or three-phase type depending upon transportation constraints. In case single phase transformers are provided, one single phase transformer shall be provided as spare for the entire sub-station or switchyard so that it can replace any of the units, whenever required.
> ...
> ...
> (b) Reactive Compensation
> (i) Shunt Reactors
> Shunt reactors, wherever provided, shall comply with relevant standards in general. Shunt reactors upto 420 kV rated voltage shall have linear voltage vs. current 0/11) characteristics upto 1.5 per unit voltage. 800 kV Shunt reactors shall have linear characteristics upto 1.25 per unit voltage. If required, the neutral of the line reactors shall be grounded through adequately rated neutral grounding reactors to facilitate single phase auto-reclosure. The neutral of shunt reactors shall be insulated to 550 kV peak for lightning impulse and shall be protected by means of 145 kV class surge arresters in case of line reactors of 420kV or 800kV rated voltage. In case single phase shunt reactors are provided, then minimum one single phase unit shall be provided as spare for entire substation or switchyard.

28. As specified in CEA (Technical Standards for Construction of Electrical Plants and Electric Lines) Regulations, 2010, the spares for 1Ø equipment are to be maintained as one 1Ø unit of transformer/ reactor for the entire switchyard. PGCIL maintains the spares according to the CEA (Technical Standards for Construction of Electrical Plants and Electric

Lines) Regulations, 2010 as hot spares. These are other than the regional spares which are cold spares.

29. As per CEA regulation, there is provision for 1Ø spare transformer/ reactor. However, no such norm exists for 3 phase spares. Most of the 400 KV and below class transformers and reactors installed in POWERGRID station are of 3 phase. Considering this and keeping in view the ageing of equipment and lead time for replacement, requirement of 3Ø spares should be met after approval in RPC for the same. Any additional requirement of 1Ø cold spare transformers and reactors should also be met after approval in RPC.

30. The Committee is also of the view that the transformer or reactor taken out after its replacement by augmentation/ capacity addition should be considered as the regional spares after approval of the RPC.

31. PGCIL has worked out the requirement of regional spares based on methodology given at Para no 11. This methodology is proposed by PGCIL based on their own assessment considering international practices. Internationally different practices are followed by different utilities. In the light of above, the methodology proposed by PGCIL could be accepted. The requirement of Regional Spares submitted by PGCIL is enclosed at Annexure-VI.

32. PGCIL stated that if the age of the replaced spares is less than 15 years and the same is utilized in new projects, in such a case, the gross value of the asset replaced shall be decapitalised from the original project and capitalized in the new project. For the unrecovered cost during the time of shifting the replaced asset to the new location should also be considered for the purpose of tariff at the new location and the tariff may be claimed accordingly.

33. However, if their age is more than 15 years, the same are being kept as regional spares, if recommended by RPC as stop gap arrangement in case of future failures. Wherever a spare has been created at a particular location and proposed / being utilized as regional spare, due to augmentation by higher capacity, the spare will be decapitalized from the original project and the tariff would be discontinued till it is put to use again as per existing

practice. The dismantled asset which is to be kept as regional spare as per RPC approval should get tariff and could be suitably placed within the same region considering the need, geographical location and transportation cost. In case dismantled asset is not approved by RPC to be regional spares, the tariff should be allowed only when it is put to use. However, such denial of tariff is likely to discourage transmission licensee from agreeing to up-gradation in future and would prefer augmentation with new system which may be undue burden on beneficiaries. A call may have to be taken by the Commission on the issue.

34. The POSOCO suggestion of accounting of non-availability of hot spare units has merit. PGCIL may be advised to furnish quarterly report to POSOCO regarding non-availability of hot spares.

35. The Committee recommends that the methodology of spares requirement of PGCIL shall be reviewed after three years.

36. PGCIL shall submit half yearly report of utilization of Regional Spares to the CERC.

Annexure-I

सत्यमेव जयते

केन्द्रीय विद्युत विनियामक आयोग
CENTRAL ELECTRICITY REGULATORY COMMISSION

के वि वि आयोग
CERC

Sanoj Kumar Jha, IAS
Secretary

Date: 15th March, 2018

OFFICE ORDER

In pursuance of the Commission Order dated 18.1.2018 in petition No. 38/TT/ 2017 for assessing the requirement of regional spares, a Committee is hereby constituted comprising of the following members:

i. Chief (Engg), CERC - Chairperson of the Committee
ii. Representative of CEA : Member
iii. Representative of PGCIL : Member
iv. Representative of NLDC : Member
v. Chief (Finance), CERC : Member
vi. Shri Srinivas, Dy. Chief (Legal), CERC : Member
vii. G Ramanjaneyulu, Assistant Chief (Engg), CERC: Convenor of the Committee.

2. The terms of the reference of the committee inter alia include but not limited to the following:

(a) Examine the incidences of malfunction of power system devices – assessment of their failure rates, frequency and duration.
(b) Estimate the requirement of spares.
(c) Details of present available quantum of spares.
(d) Enlist the existing practices of keeping and maintaining spares
(e) Redefine the need and composition of spares for various voltage levels; and suggest modifications to (b) Distinguish between capital spares and operation & maintenance i.e. to be allowed as capitalized along with the equipment and to be allowed as part of O&M cost. (to avoid duplication) and (c), thereof.
(f) Outline a policy for maintenance of spares, salvage at end of life, costs to be allowed/ disallowed in their handling, etc.
(g) Any other

3. The committee shall submit its report within two months of issue of this order.

15/03/2018
(Sanoj Kumar Jha)

Encl: As Above

To,

As per mailing list

Copy to : JC(RA)

तीसरी मंजिल, चन्द्रलोक बिल्डिंग, 36, जनपथ, नई दिल्ली-110 001
Third Floor, Chanderlok Building, 36, Janpath, New Delhi-110 001
Phone : 91-11-2375 3915, Fax : 91-11-2375 3923, E-mail : secy@cercind.gov.in / secyskj@gmail.com

CENTRAL ELECTRICITY REGULATORY COMMISSION
3rd and 4th Floor, Chanderlok Building, 36 Janpath, New Delhi 110001

Dated the 16th March 2018

CORRIGENDUM

Para 2 (e) of the letter dated 15.3.2018 is substituted as under:

QUOTE

(e) Redefine the need and composition of spares for various voltage levels; and suggest modifications to (b) and (c), thereof.

(e1) Distinguish between Capital Spares and Operation & Maintenance spares i.e. to be allowed as part of capital cost along with the equipment and to be allowed as part of O&M cost.

UNQUOTE

(T. Rout)
Chief (Legal)

To

As per mailing list.

Annexure-II

CENTRAL ELECTRICITY REGULATORY COMMISSION

3rd & 4th floors, Chanderlok Building, 36, Janpath,New Delhi-11001

No: ENGG-38/TT/2017-CERC/P174 Dated: 13th April, 2018

Subject: Minutes of the 1st Meeting of the Committee held on 27.03.2018, to assess requirement of regional spares in compliance with the Commission's order dated 18.1.2018 in petition No.38/TT/2017

Dear Sir/Madam,

Please find enclosed herewith minutes of the 1st Meeting of the Committee held on 27.03.2018, to assess requirement of regional spares in compliance with the Commission's order dated 18.1.2018 in petition No.38/TT/2017.

Yours sincerely,

Chief (Engg)

To

1. Secretary, CEA, Sewa Bhavan, R.K.Puram, Sector-I,New Delhi-110016.
2. CMD,POWERGRID,Saudamini, Plot No 2, sector 29, Gurgaon-122001
3. CMD,POSOCO B-9(1st Floor),Qutab Instituional Area, Katwaria Sarai, New Delhi -110006

CENTRAL ELECTRICITY REGULATORY COMMISSION

3rd & 4th Floor, Chanderlok Building, 36, Janpath, New Delhi-110001

Subject: Minutes of the First Meeting of the Committee held on 27.03.2018, to assess requirement of regional spares in compliance with the Commission's order dated 18.1.2018 in Petition No 38/TT/2017.

(List of the participants is enclosed in Annexure-I)

1. The Chairperson of the Committee, Shri S.C. Shrivastava, Chief (Engg), CERC, welcomed the participants. He outlined the Terms of Reference of the committee to its members. The ToR of the committee is as under:

a) Examine the incidences of malfunction of power system devices – assessment of their failure rates, frequency and duration.

b) Estimate the requirement of spares.

c) Details of present available quantum of spares.

d) Enlist the existing practices of keeping and maintaining spares

e) Redefine the need and composition of spares for various voltage levels; and suggest modifications to (b) and (c), thereof.

e1) Distinguish between Capital Spares and Operation & Maintenance spares i.e. to be allowed as part of capital cost along with the equipment and to be allowed as part of O&M cost.

f) Outline a policy for maintenance of spares, salvage at end of life, costs to be allowed/ disallowed in their handling, etc.

f) Any other.

2. Chief (Engg), CERC asked PGCIL to apprise the members, its policy of managing regional spares. He specifically sought to know the following:

- Segregated list of region-wise spares, their value, tariff recovery
- Utilization of spares.
- The practise of intra/inter-regional transfer and its treatment.
- Cost recovery wrt repair, insurance etc. and its treatment in books of account.

- Philosophy followed for maintenance of spares

  PGCIL representative stated that they will inform the same in due course of time.

3. Representative (s) of PGCIL informed that at present it has 834 No of ICT's and 1317 No of Reactors across India including spares..

4. The spares have been classified into 3 groups, namely (i) Hot spares (ii) Cold spares (iii) Initial spares.

Around 13-14 no. of ICTs/ Reactors are kept as cold spares. The overall failure rate of ICTs and reactors in the past 25 years is 1.21% (weighted average calculated on useful life). The components most susceptible to failure in ICT's/Reactors are as under:

Component name	Percentage of failure
Bushings	38
Windings	33
Leads	5
OLTC	10
Tap leads	6
Magnetic circuit	8

5. Joint Chief (Fin) opined that 25 years is a long span to be considered for ascertaining failure rate. He opined that greater weights should be given to near past data to arrive at a more realistic figure. He asked PGCIL to submit failure data of last 5 years and ascertain failure rate on its basis. He also queried about the philosophy of maintaining spares.

6. Chief (Engg), CERC asked PGCIL to give region wise details of cold spares. He also sought to know how repair, insurance, transportation and handling were capitalized in respect of spares. He suggested that there should not be duplicity of insurance and defect liability period.

7. Joint Chief (Fin), CERC queried if there were any scheme specific ICT spares? He also informed that the normal practice w.r.t. shifting of spares is by decapitalising at original loaction and recapitalising at newlocation. However, it was observed that PGCIL has been requesting for shifting at zero cost in its petitions. He asked PGCIL to clarify the same.

8. Representatives of PGCIL informed that all transformers and reactors are covered under insurance. High risk categories like HVDC are externally insured while low risk categories are

self insured. They also informed that insurance, transportation and handling are booked as 1% of O&M and is claimed every 5 years.

9. Chief (Engg) queried whether the benefit of insurance is passed on to consumers. PGCIL representative stated that it will inform the same after confirmation.

10. With regard to reactors, PGCIL informed that the approval is obtained from RPC for bunch of reactors in a region.

11. The representative of CEA informed that CEA (technical standards for construction of electrical plants and Electrical lines) Regulations, 2010 provide for one single phase transformer to be kept on hot standby as spare for the entire sub-station or switchyard.

12. M/s PGCIL is requested to submit the following within three weeks.

(a) Information on item nos. (a) to (f) of ToR.

(b) Region wise details of cold spares. viz. Asset name , capacity, scheme, petition no in which Tariff granted and tariff details, Tariff recovered , date of removal of Asset and kept as spare , residual life

(c) Utilization of regional spares.

(d) The practise of intra/inter-regional transfer and its treatment.

(e) Method of tariff recovery for assets dismantled and kept as spares

(f) Cost recovery wrt repair, insurance, transportation etc. and accounting treatment in books of account.

(g) Philosophy followed for maintenance of spares

(h) Whether the benefit of insurance is passed on to consumers.

(S.C.Srivastava)
Chief (Engg)

Meeting of a Committee to assess requirement of regional spares in compliance with the Commission's order dated 18.1.2018 in petition No. 38/TT/2017 to on 27.3.2018

S.No	Name	Designation and organization	Email	Mobile No.	Signature
1	V. SREENIVAS	Dy. chief (Legal)	V.sreenivas@nic.in	9311665380	
2	D. MURUGAN	Asst. chief (Fin.)	dmurugan@cercind.gov.in	9412239117	27/3/18
3	Harish Kumar	Associate Engg, CERC	harish.cerc@gmail.com	9050850319	
4	Gaurav Kumar	Associate Engg, CERC	Gauravkr.cerc@gmail.com	8076935790	
5	Annepu Suresh	Dy. chief (E), CERC	vibronsuresh@gmail.com	9958094777	
6	G. Ramanjaneyulu	Asst. chief (Engg), CERC.	ramcerc@gmail.com	9811555001	GR
7	Shilpa Agarwal	dt chief, Engg, CERC	shilpadce@yahoo.com	9650992600	
8	PK Awasthi	Dy. Chief (Fin) CERC	pkawasthi@cercind.gov.in		
9	A. V. Shukla	Dy. Chief (Trans) CERC	avshukla@cercind.gov.in		
10	Y. K. Swasnkar	Director, CEA	Ykswasnkar@nic.in	9810327346	
11	M.M. Mehendale	DGM, POSOCO	mehendale@posoco.in	9422811701	
12	R. K. Tyagi	GM, POWERGRID	TYAGIR@POWERGRIDNOIDA.COM	9873549040	
13	RAKESH PRASAD	GM, Commn, POWERGRID	rakeshp@powergridindia.com	9910378003	
14	J. MAZUMDER	GM, Commn, POWERGRID	jeebanandn@powergridindia.com	9873549043	
15	Jiten Das	DGM, AM, POWERGRID.	jiten@powergridindia.com	9434739354	

7/18

16	Shashi Bhushan	Dy. Mgr. (AM), POWERGRID	Shashi.bhushan@powergrid india.com	9717890985	शशि भूषण
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Meeting on 27.03.2018
Requirement of Regional Spares

Engineering Division, CERC

Terms of the Reference of the Committee

a) Examine the incidences of malfunction of power system devices – assessment of their failure rates, frequency and duration.

b) Estimate the requirement of spares.

c) Details of present available quantum of spares.

d) Enlist the existing practices of keeping and maintaining spares

e) Redefine the need and composition of spares for various voltage levels; and suggest modifications to (b) and (c), thereof.

e1) Distinguish between Capital Spares and Operation & Maintenance spares i.e. to be allowed as part of capital cost along with the equipment and to be allowed as part of O&M cost.

f) Outline a policy for maintenance of spares, salvage at end of life, costs to be allowed/ disallowed in their handling, etc.

g) Any other.

Need for Policy on Initial spares

- During the Tariff period 2014-19 it was observed that PGCIL in a number of petitions has claimed Tariff for Spare ICTs, Conversion of existing ICTs into spares upon replacement with higher capacity ICTs . Similar is the case with bus and line reactors.
- Lack of availability of transparent data on spares leads to confusion wrt their utilization and finances.
- In case of shifting of assets from one transmission project to another transmission project, de-capitalisation of the Assets.

  The Commission vide provisional order dated 5.10.2017 in petition No 176/TT/2017 directed the petitioner to submit the following:

  k) A comprehensive list of regional spares including Bus Reactors, Line Reactors, ICT etc. their gross value, year of purchase and Petition No. in which Tariff was claimed/granted. Requirement of regional spares vis-à-vis their current availability status;

  In response the petitioner has submitted the following:

Need for Policy on Initial spares

- The Commission vide provisional order dated 5.10.2017 in petition No 58/TT/2017 directed the petitioner to submit the following:

  k) A comprehensive list of regional spares including Bus Reactors, Line Reactors, ICT etc. their gross value, year of purchase and Petition No. in which Tariff was claimed/granted. Requirement of regional spares vis-à-vis their current availability status;

  In response the petitioner has submitted the following:

Sl.No	Asset Description	DOCO	Petition No	Year of Purchase	Gross Value as on 31.03.2014
1	400kV 80MVAr Spare Reactor at Gooty	01.01.2013	145/TT/2016	2012	472.42
2	400/220kV, 315MVA ICT at Hyderabad	01.03.2013	145/TT/2016	2012	1112.18
3	3X167MVA, 400/220KV ICTs at Somanhalli	02.07.1986	58/TT/2017	1986	25.16 (Net value)
4	4X167MVA, 400/220KV ICTs at Somanhalli	28.02.1990	58/TT/2017	1990	31.48 (Net value)
5	1x50MVAr 400/220kV Bus reactor at Narendra	01.01.2008	58/TT/2017	2008	
6	2X315MVA, 400/220KV ICTs at Narendra S/s	01.11.2005	5/2010	2005	
7	1x500MVA, 765/400kV ICTs at Thiruvalam	28.03.2017	58/TT/2017	2017	

Sl.No	Asset Description	DOCO	Petition No	Year of Purchase	Gross Value as on 31.03.2014
1	400kV 80MVAr Spare Reactor at Gooty	01.01.2013	145/TT/2016	2012	472.42
2	400/220kV, 315MVA ICT at Hyderabad	01.03.2013	145/TT/2016	2012	1112.18
3	3X167MVA, 400/220KV ICTs	02.07.1986	Current Petition		
4	4X167MVA, 400/220KV ICTs	28.02.1990	Current Petition		
5	1x50MVAr 400/220kV Bus reactor	01.01.2008	Current Petition		

A comprehensive list of regional spares including Bus Reactors, Line Reactors, ICT etc. their gross value, year of purchase and Petition No. in which Tariff was claimed/granted. Requirement of regional spares vis-à-vis their current availability status; (Petition No: 38/TT/2017)

Description	Total No. of Population	Total No. of Spare procured & capitalized	Spare utilized	RPC approved Spare availability	Project Name	Location of spare ICT	DOCO	Petition no in which the ICT filed
400/220 kV ICT	73	4	2*	4	Spare ICT & Reactor Projects	Biharshariff S/S	01.07.2012	37/TT/2017
						Jamsedpur S/s	01.07.2012	
						Durgapur S/s	01.03.2013	
						Ruorkela S/s	01.04.2013	
765/400 kV ICT	42	2	0	2	ERSS IX	New Ranchi S/S	Not commissioned yet	Not filed yet
					ERSS XII	Angul S/s	Not commissioned yet	
220/132 kV ICT	20	2	0	2	Spare ICT & Reactor Projects	Siliguri S/s	01.06.2013	37/TT/2017
						Purnea S/s	01.09.2013	
132/33 kV ICT	4	1	0	1		Gangtok S/s	20.04.2015	215/TT/2015

Issues for deliberation

- **With regard to Spare ICT's and Reactors:**
  i. How many ICT's are required at Regional level.
  ii. Criteria for maintaining spare ICT's and Reactors
  iii. Criteria for utilizing spare ICT's
  iv. Treatment of Tariff for spare ICT's
- **With regard to Initial Spares:**
  i. Stand alone basis
  ii. Regional basis
  iii. Financial treatment

Annexure-IV

STATE	MVA Rating and phase	Voltage	Main Equipment Installed in number	Spares RPC Spare	Asset Name	Capacity	Project/ Sheme	Petition no.	Tariff Details	Tariff Recovered	Date of Removal, if applicable	Residual Life
A	B	C	D	F								
ANDHRA PRADESH	1Ø-500MVA	765/400	27									
	3Ø-500MVA	400/220	5									
	3Ø-315MVA	400/220	9	1	Hyderabad	315	SCM & RPC approved project					
	1Ø-105MVA	400/220	7									
ARUNACHAL PRADESH	3Ø-50MVA,	220/132	3	1	50MVA, 132/33kV, ICT (Spare) at Nirjuli Substation	50	North Eastern Region Strengthening Scheme-VII (NERSS-VII)	D. 152/2018	Order yet to be received			
	3Ø-10MVA	132/33	2	1	1X16 MVA,132/33kV,3 phase spare Transformer at Nirjuli	16		532/TT/2014				
	1Ø-5MVA	132/33	13	1	1X5MVA, 132/33kV, 1-ph Spare ICT at Ziro SS	5 MVA	Provision of Spare Transformers and Reactor in North-Eastern Regio	497/TT/2014	Tariff approved vide order dated 02.11.2015 in petition no 497/TT/2014		NA	NA
ASSAM	1Ø-105MVA	400/220	12									
	3Ø-160MVA	220/132	3	1	160MVA, 220/132kV, ICT (Spare) at Kopili Substation	160	North Eastern Region Strengthening Scheme-VII (NERSS-VII)	D. 152/2018	Order yet to be received			
	3Ø-200MVA	400/132	3	1	200MVA, 400/132kV Spare ICT at 400kV Silchar Substation	200	North Eastern Region Strengthening Scheme-VII (NERSS-VII)	D. 152/2018	Order yet to be received			
	3Ø-315MVA	400/220	2	1	315MVA, 400/220kV, ICT (Spare) at Misa Substation	315	North Eastern Region Strengthening Scheme-VII (NERSS-VII)	D. 152/2018	Order yet to be received			
	3Ø-50MVA,	220/132	2									

Bihar	1Ø-500MVA	765/400	15									
	3Ø-100MVA	220/132	5									
	3Ø-10MVA	132/33	2									
	3Ø-160MVA	220/132	1									
	3Ø-200MVA	400/132	4									
	3Ø-315MVA	400/220	13	1	1 no. 315 MVA, 400/220 Kv, 3-ph Transformer at Biharshariff	160 MVA	Provision for spare ICTs and Reactors for Eastern, Northern, Southern and Western Region	37/TT/2017	Approved in petition 37/TT/2017	Recoverd through petition 37/TT/2017	NA	NA
	3Ø-500MVA	400/220	6									
Chhattisgarh	1Ø-500MVA	765/400	68									
	3Ø-315MVA	400/220	8	1	315 MVA, 400/220/33 kV 3-phase Spare ICT at Raipur sub-station	315 MVA 400/220/33kV	provision of Spare ICTs and Reactors in Western Region	564/TT/2014	ORDER DATED 08.03.2016	ORDER DATED 08.03.2016	NA	NA
DELHI	1Ø-500MVA	765/400	13	1	765/400 KV,500MVA, single phase Auto Transformer as spare ICT at Jhatikra S/S	500 MVA	Spare Transformer for 765/400KV ICTs in NR	247/TT/2017	Order yet to be received			
	3Ø-315MVA	400/220	2									
	3Ø-500MVA	400/220	2									
GOA	3Ø-315MVA	400/220	3									
GUJARAT	1Ø-500MVA	765/400	7									
	3Ø-315MVA	400/220	17	1	315 MVA, 400/220/33 kV 3-phase Spare ICT at Dehgam sub-station	315 MVA 400/220/33kV	provision of Spare ICTs and Reactors in Western Region	564/TT/2014	Tariff approved vide ORDER DATED 08.03.2016		NA	NA
	3Ø-500MVA	400/220	2									
	1Ø-150MVA	400/220	3									
	1Ø-333MVA	765/400	7	1	765/400 KV, 333MVA, single phase Auto Transformer as spare ICT at Bhiwani S/S	333 MVA	Spare Transformer for 765/400KV ICTs in NR	247/TT/2017	Order yet to be received			

HARYANA	3Ø-315MVA	400/220	24	1	315 MVA 400/220/ kV Spare Inter Connecting Transformer at 400/220 kV Hisar Substation	315 MVA	Provision of Spare ICT's and Reactors for Eastern,Northern,Southern and Western Region	200/TT/2015	Tariff approved vide order dated 19.02.2016 in petition no 200/TT/2015		NA	NA
	3Ø-500MVA	400/220	9									
HP	1Ø-105MVA	400/220	16									
	3Ø-315MVA	400/220	3									
J&K	1Ø-105MVA	400/220	29									
	3Ø-315MVA	400/220	2									
Jharkhand	1Ø-500MVA	765/400	7	1	Procurement of one 500 MVA, Single phase unit of 765/400 kV ICT for Eastern Region to be stationed at Gaya Sub-station (diverted to Ranchi)	500 MVA	ERSS IX	38/TT/2017	Not commissioned	NA	NA	NA
	3Ø-160MVA	220/132	2									
	3Ø-315MVA	400/220	8	1	1 no. 315 MVA, 400/220 Kv, 3-ph Transformer at Jamshedpur substation	315 MVA	Provision for spare ICTs and Reactors for Eastern, Northern, Southern and Western Region	37/TT/2017	Approved in petition 37/TT/2017	Recoverd through petition 37/TT/2017	NA	NA
KARNATAKA	1Ø-167MVA	400/220	7									
	1Ø-500MVA	765/400	7	1	Procurement of 01 Nos. 500MVA, 765/400kV Regional Spare ICTs at Raichur	500	System strengthening-XXIII	58/TT/2017	Order yet to be received			
	3Ø-315MVA	400/220	10									
	3Ø-500MVA	400/220	8									
KERALA	3Ø-315MVA	400/220	9									
	1Ø-500MVA	765/400	40									
	3Ø-250MVA	400/220	1									

MAHARASHTRA	3Ø-315MVA	400/220	13	1	315 MVA, 400/220/33 kV 3-phase Spare ICT at Pune sub-station	315 MVA 400/220/33kV	provision of Spare ICTs and Reactors in Western Region	564/TT/2014	Tariff Approved vide ORDER DATED 08.03.2016		NA	NA
	3Ø-500MVA	400/220	2									
MANIPUR	3Ø-50MVA	132/33	2									
MP	1Ø-333MVA	765/400	14									
	1Ø-500MVA	765/400	39									
	3Ø-315MVA	400/220	23	1	315 MVA, 400/220/33 kV 3-phase Spare ICT at Jabalpur sub-station	315 MVA 400/220/33kV	provision of Spare ICTs and Reactors in Western Region	564/TT/2014	Tariff Order approved vide ORDER DATED 08.03.2016		NA	NA
	3Ø-500MVA	400/220	3									
NAGALAND	1Ø-10MVA	220/132	7									
	1Ø-33.33MVA	220/132	4									
	3Ø-100MVA	220/132	2	1	1X100MVA, 220/132 kV, 3-phase Spare ICT at Dimapur SS	100 MVA	Provision of Spare Transformers and Reactor in North-Eastern Regio	497/TT/2014	Tariff approved vide order dated 02.11.2015 in petition no 497/TT/2014		NA	NA
ODISHA	1Ø-105MVA	400/220	7									
	1Ø-500MVA	765/400	20	2	02 Nos of spare ICT at Angul and jharsugura S/s	500MVA	ERSS XII	Not filed	NA	NA	NA	NA
	3Ø-160MVA	220/132	2	1	1 no. 160 MVA, 220/160 Kv, 3-ph Transformer at Baripara (shifted to Purnea)	160 MVA	Provision for spare ICTs and Reactors for Eastern, Northern, Southern and Western Region	37/TT/2017	Approved in petition 43/TT/2013	Recoverd through petition 43/TT/2013	NA	NA
	3Ø-315MVA	400/220	12	1	1 no. 315 MVA, 400/220 Kv, 3-ph Transformer at Rourkela	315 MVA	Provision for spare ICTs and Reactors for Eastern, Northern, Southern and Western Region	37/TT/2017	Approved in petition 37/TT/2017	Recoverd through petition 37/TT/2017	NA	NA
	3Ø-500MVA	400/220	3									

PUNJAB	1Ø-500MVA	765/400	8									
	3Ø-315MVA	400/220	12	1	315 MVA, 400/220 kV ICT at Ludhiana	315	Spare ICT scheme for Northern Region	191/TT/2015	Tariff approved vide order dated 26.02.2016 in petition no 191/TT/2015		NA	NA
	3Ø-500MVA	400/220	7	1								
RAJASTHAN	1Ø-500MVA	765/400	12									
	3Ø-200MVA	400/132	1									
	3Ø-315MVA	400/220	19	1	315 MVA 400/220 kV Spare Transformer at BhiwadiNeemara	315	provision of spare ICT's and Reactors in Eastern, Northern, Southern & Western Regions	124/TT/2016	Tariff approved vide order dated 26.10.2016 in petition no 124/TT/2016		NA	NA
				1	500 MVA 400/220 kV Spare Transformer at Neemara	500	Augemntation f Transformer Part-A	362/TT/2014	Tariff approved vide order dated 21.03.2016 in petition no 362/TT/2016		NA	NA
	3Ø-500MVA	400/220	5									
SIKIM	1Ø-105MVA	400/220	9									
	3Ø-100MVA	220/132	2									
	3Ø-50MVA	132/66	2	1	01 Nos of 50 MVA, 132/66 kV, 3-PH ICT at Gangtok S/s	50MVA	Provision for spare ICTs and Reactors for Eastern, Northern, Southern and Western Region	215/TT/2015	Approved in petition 215/TT/2015	Recoverd through petition 215/TT/2015	NA	NA
TAMILNADU	1Ø-500MVA	765/400	7	1	Procurement of 01 Nos. 500MVA, 765/400kV Regional Spare ICTs at Thiruvalam	500	System strengthening-XXIII	58/TT/2017	Order yet to be received			
	3Ø-315MVA	400/220	22									
	3Ø-500MVA	400/220	6									
	1Ø-500MVA	765/400	9									

TELANGANA	3Ø-315MVA	400/220	8	1	315 MVA 400/220kv Spare Transformer	315	Provision of Spare ICTs and Reactors for Southern Region	145/TT/2016	Tariff approved vide order dated 21.10.2016 in petition no 145/TT/2016		NA	NA
	3Ø-500MVA	400/220	1									
TRIPURA	3Ø-5MVA	132/33	1									
	1Ø-105MVA	400/220	4									
	1Ø-333MVA	765/400	3									
	1Ø-500MVA	765/400	57	2	1X500MVA, 765/400kV Transformer as spare ICT at Agra & Fatehpur	500 MVA	Spare Transformer for 765/400KV ICTs in NR	247/TT/2017	Order yet to be received			
	3Ø-100MVA	220/132	3									
	3Ø-140MVA	400	2									
	3Ø-200MVA	220/132	2									
UP	3Ø-315MVA	400/220	27	2	315 MVA, 400/220 kV ICT at Mandola	315	Spare ICT scheme for Northern Region	191/TT/2015	Tariff approved vide order dated 26.02.2016 in petition no 191/TT/2015		NA	NA
					315 MVA 400/220/ kV Spare Inter Connecting Transformer at 400/220 kV Lucknow Substation	315	Provision of Spare ICT's and Reactors for Eastern,Northern,Southern and Western Region	200/TT/2015	Tariff approved vide order dated 19.02.2016 in petition no 200/TT/2015		NA	NA
	3Ø-500MVA	400/220	11									
UTTARAKHAND	1Ø-33.33MVA	220/132	6									
	3Ø-100MVA	220/132	2									
	3Ø-315MVA	400/220	2									
	3Ø-100MVA	220/132	2									
	3Ø-160MVA	220/132	4	1	1 no. 160 MVA, 220/160 Kv, 3-ph Transformer at Siliguri	160 MVA	Provision for spare ICTs and Reactors for Eastern, Northern, Southern and Western Region	37/TT/2017	Approved in petition 37/TT/2017	Recoverd through petition 37/TT/2017	NA	NA

WB	3Ø-315MVA	400/220	14	1	1 no. 315 MVA, 400/220 Kv, 3-ph Transformer at Durgapur	315 MVA	Provision for spare ICTs and Reactors for Eastern, Northern, Southern and Western Region	37/TT/2017	Approved in petition 37/TT/2017	Recoverd through petition 37/TT/2017	NA	NA
	3Ø-50MVA	220/132	1									
	3Ø-500MVA	400/220	2									
Total Transf.			**868**	**37**								

Annexure-V

Failure data of Transformer

	2017-18	2016-17	2015-16	2014-15	2013-14
Total Installed	834	801	735	666	608
Failed	3	3	4	3	7
%age failure	0.36	0.374	0.54	0.45	1.15

Failure data of Rector

	2017-18	2016-17	2015-16	2014-15	2013-14
Total Installed	1317	1274	1151	1060	859
Failed	9	9	8	3	8
%age failure	0.683	0.706	0.695	0.28	0.93

Annexure-VI

Table-I(A): Transformer Details

STATE	MVA Rating and phase	Voltage	Total Transformer unit	Spares						Remarks
				Spare Qty required	RPC Spare	Spare on account of Augmentation	Insurance proceeds	Total Spare	Balspare Qty.	
A	B	C	D	E	F	G	H	I	J	
ANDHRA PRADESH	1Ø-500MVA	765/400	27	1				0	-1	
	3Ø-500MVA	400/220	5	1			1	1	0	* Under procurement(N.P.Kunta)
	3Ø-315MVA	400/220	9	1	1			1	0	Hyderabad
	1Ø-105MVA	400/220	7	1				0	-1	
ARUNACHAL PRADESH	3Ø-50MVA,	220/132	3	1	1			1	0	Nirjuli
	3Ø-10MVA	132/33	2	1	1			1	0	Nirjuli(16 MVA)
	1Ø-5MVA	132/33	13	1	1			1	0	Ziro
ASSAM	1Ø-105MVA	400/220	12	1				0	-1	
	3Ø-160MVA	220/132	3	1	1			1	0	Kopili
	3Ø-200MVA	400/132	3	1	1			1	0	Sichar
	3Ø-315MVA	400/220	2	1	1			1	0	Misa/Balipara
	3Ø-50MVA,	220/132	2	1				0	-1	
Bihar	1Ø-500MVA	765/400	15	1			1	1	0	Gaya
	3Ø-100MVA	220/132	5	1		3		3	2	Purina
	3Ø-10MVA	132/33	2					0	0	
	3Ø-160MVA	220/132	1					0	0	
	3Ø-200MVA	400/132	4	1			1	1	0	Banka
	3Ø-315MVA	400/220	13	1	1	1		2	1	Biharsharif(RPC),Purina and Kept at Muzafarpur(SA)
	3Ø-500MVA	400/220	6	1			1	1	0	* under procurement for Patna
Chhattisgarh	1Ø-500MVA	765/400	68	1				0	-1	
	3Ø-315MVA	400/220	8	1	1			1	0	Raipur
DELHI	1Ø-500MVA	765/400	13	1	1			1	0	Jhatikara
	3Ø-315MVA	400/220	2	1			1	1	0	1 spare GIS Type(Maharanibagh kept at Ballabhgarh)

STATE	MVA Rating and phase	Voltage	Total Transformer unit	Spares						Remarks
				Spare Qty required	RPC Spare	Spare on account of Augmentation	Insurance proceeds	Total Spare	Balspare Qty.	
A	B	C	D	E	F	G	H	I	J	
	3Ø-500MVA	400/220	2	1			1	1	0	1 spare GIS Type(Maharanibagh)
GOA	3Ø-315MVA	400/220	3	1				0	-1	
GUJARAT	1Ø-500MVA	765/400	7	1				0	-1	
	3Ø-315MVA	400/220	17	1	1			1	0	Dehgam
	3Ø-500MVA	400/220	2	1				0	-1	
HARYANA	1Ø-150MVA	400/220	3	1				0	-1	
	1Ø-333MVA	765/400	7	1	1			1	0	Spare yet to be supplied at Bhiwani
	3Ø-315MVA	400/220	24	2	1	1	1	3	1	1 Spare Hissar(RPC),1 spare GIS Type Gurgaon(O&M),1 Ballabhgarh(SA)
	3Ø-500MVA	400/220	9	1			1	1	0	1 spare GIS Type at Manesar
HP	1Ø-105MVA	400/220	16	1				0	-1	
	3Ø-315MVA	400/220	3	1				0	-1	
J&K	1Ø-105MVA	400/220	29	1				0	-1	
	3Ø-315MVA	400/220	2	1				0	-1	
Jharkhand	1Ø-500MVA	765/400	7	1	1			1	0	Spare yet to be supplied at Ranchi
	3Ø-160MVA	220/132	2					0	0	
	3Ø-315MVA	400/220	8	1	1			1	0	Jamshedpur
KARNATAKA	1Ø-167MVA	400/220	7	1		7		7	6	Somanahalli
	1Ø-500MVA	765/400	7	1	1			1	0	Spare yet to be supplied at Raichur
	3Ø-315MVA	400/220	10	1				0	-1	
	3Ø-500MVA	400/220	8	1			1	1	0	* under procurement`Somanahalli
KERALA	3Ø-315MVA	400/220	9	1				0	-1	
MAHARASHTRA	1Ø-500MVA	765/400	40	1				0	-1	
	3Ø-250MVA	400/220						0	0	
	3Ø-315MVA	400/220	13	1	1		1	2	1	1 spare GIS Type Navi Mumbai,1 Pune(RPC)

STATE	MVA Rating and phase	Voltage	Total Transformer unit	Spares						Remarks
				Spare Qty required	RPC Spare	Spare on account of Augmentation	Insurance proceeds	Total Spare	Balspare Qty.	
A	B	C	D	E	F	G	H	I	J	
	3Ø-500MVA	400/220	2	1				0	-1	
MANIPUR	3Ø-50MVA,	132/33	2	1				0	-1	
MP	1Ø-333MVA	765/400	14	1			1	1	0	Spare yet to be supplied Bina
	1Ø-500MVA	765/400	39	1			1	1	0	Indore
	3Ø-315MVA	400/220	23	2	1			1	-1	Jabalpur
	3Ø-500MVA	400/220	3	1				0	-1	
NAGALAND	1Ø-10MVA	220/132	7					0	0	
	1Ø-33.33MVA	220/132	4					0	0	
	3Ø-100MVA	220/132	2	1	1			1	0	Dimapur
ODISHA	1Ø-105MVA	400/220	7	1				0	-1	
	1Ø-500MVA	765/400	20	1	2			2	1	Angul,Jharsuguda
	3Ø-160MVA	220/132	2	1	1			1	0	Baripada
	3Ø-315MVA	400/220	12	1	1			1	0	Rourkela
	3Ø-500MVA	400/220	3	1				0	-1	
PUNJAB	1Ø-500MVA	765/400	8	1				0	-1	
	3Ø-315MVA	400/220	12	1	1			1	0	Ludhiana
	3Ø-250MVA	400/220	2	0	0	0		0	0	CERC had already decapped
	3Ø-500MVA	400/220	7	1			1	1	0	Under procurement at Malerkotla
RAJASTHAN	1Ø-500MVA	765/400	12	1				0	-1	
	3Ø-200MVA	400/132	1	1				0	-1	
	3Ø-315MVA	400/220	19	1	1			1	0	Bhiwadi
	3Ø-500MVA	400/220	5	1	1			1	0	Neemrana
SIKIM	1Ø-105MVA	400/220	9	1				0	-1	
	3Ø-100MVA	220/132	2	1				0	-1	
	3Ø-50MVA,	132/66	2	1	1			1	0	Gangtok
TAMILNADU	1Ø-500MVA	765/400	7	1	1			1	0	Tiruvalem
	3Ø-315MVA	400/220	22	2				0	-2	
	3Ø-500MVA	400/220	6	1			1	1	0	* Under procurement

STATE	MVA Rating and phase	Voltage	Total Transformer unit	Spares						Remarks
				Spare Qty required	RPC Spare	Spare on account of Augmentation	Insurance proceeds	Total Spare	Balspare Qty.	
A	B	C	D	E	F	G	H	I	J	
TELANGANA	1Ø-500MVA	765/400	9	1				0	-1	
	3Ø-315MVA	400/220	8	1	1			1	0	Hyderabad
	3Ø-500MVA	400/220	1	1				0	-1	
TRIPURA	3Ø-5MVA	132/33	1					0	0	
UP	1Ø-105MVA	400/220	4	1				0	-1	
	1Ø-333MVA	765/400	3	1				0	-1	
	1Ø-500MVA	765/400	57	1	2		1	3	2	Agra, Fatehpur(RPC),Lucknow(O&M)
	3Ø-100MVA	220/132	3	1		2		2	1	Raibareilly)
	3Ø-140MVA	400	2	1				0	-1	
	3Ø-200MVA	220/132	2	1				0	-1	
	3Ø-315MVA	400/220	27	2	2	2		4	2	Mandola,Lucknow(RPC),2 nos. Mandola(SA)
	3Ø-500MVA	400/220	11	1			1	1	0	Mandola
UTTARAKHAND	1Ø-33.33MVA	220/132	6	1				0	-1	
	3Ø-100MVA	220/132	2	1				0	-1	
	3Ø-315MVA	400/220	2	1				0	-1	
WB	3Ø-100MVA	220/132	2	1		2		2	1	Birpara, Siliguri
	3Ø-160MVA	220/132	4	1	1			1	0	Siliguri
	3Ø-315MVA	400/220	14	1	1	3		4	3	Durgapur(RPC),Maithon-2, Malda-1(SA)
	3Ø-50MVA,	220/132	1					0	0	
	3Ø-500MVA	400/220	2	1				0	-1	
Total Transf.			**875**	**90**	**35**	**21**	**16**	**72**	**-18**	

Table-I(B): Abstract for Rating wise Transformer details

Rating	Qty available	Qty required	Spare Qty available	Bal. Qty.	Remarks
1Ø-500MVA,765kV	336	15	11	-4	3 number yet to be supplied
1Ø-333MVA,765kV	24	3	2	-1	2 number yet to be supplied
3Ø-500MVA,400kV	72	15	9	-6	*5 number under procurement and yet to be supplied
3Ø-315MVA,400kV	262	27	26	-1	
3Ø-200MVA,400kV	8	3	2	-1	*1 under procurement
1Ø-105MVA,400kV	84	7	0	-7	
1Ø-150MVA,400kV	3	1	0	-1	
1Ø-167MVA,400kV	7	1	7	6	All these 6 Transformers are of age 28 to 30 Years. These Transformers are spared due to augmentation
3Ø-140MVA	2	1	0	-1	Under procurement
3Ø-250MVA	2	0	0	0	
3Ø-200MVA,220kV	2	1	0	-1	
3Ø-160MVA,220kV	12	3	3	0	
3Ø-100MVA,220kV	16	6	8	2	
3Ø-50MVA,220kV	6	2	1	-1	
1Ø-33.33MVA,220kV	10	1	0	-1	
1Ø-10MVA,220kV	7		0	0	
3Ø-50MVA,132/66kV	2	1	1	0	
3Ø-50MVA,132/33kV	2	1	0	-1	
3Ø-10MVA, 132kV	4	1	1	0	
1Ø-5MVA,132kV	13	1	1	0	
3Ø-5MVA	1	0	0	0	
	875	**90**	**72**	-18	

Table-II(A):Reactor Details

STATE	CAPACITY	VOLTAGE	Total	Spare Qty required	RPC Spare	Spare on account of Augmentation	Insurance proceeds	Total Spare	Balspare Qty.	Place
A	B	C	D	E	F	G	H	I	J	
ANDHRA PRADESH	1Ø-110MVAR	765	3	1				0	-1	
	1Ø-80MVAR	765	53	1	1			1	0	Gooty
	3Ø-125MVAR	420	1					0	0	
	3Ø-80MVAR	420	6	1			1	1	0	Vizag
	3Ø-63MVAR	420	9	1				0	-1	
	3Ø-50MVAR	420	17	1	3			3	2	NagarjunaSagar, Cuddapa
	1Ø-16.67MVAR	420	3					0	0	
ARUNACHAL PRADESH	1Ø-6.67MVAR	145	11					0	0	
ASSAM	3Ø-80MVAR	420	5	1	1			1	0	Bongaingaon
	3Ø-63MVAR	420	16	1	2			2	1	Bongaingaon, Balipara
	3Ø-50MVAR	420	10	1				0	-1	
	3Ø-20MVAR	145	1					0	0	
BIHAR	1Ø-110MVAR	765	10	1	1			1	0	Sasaram
	1Ø-80MVAR	765	11	1				0	-1	
	3Ø-125MVAR	420	12	1			1	1	0	Purnia
	3Ø-80MVAR	420	6	1				0	-1	
	3Ø-63MVAR	420	15	1				0	-1	
	3Ø-50MVAR	420	7	1				0	-1	
	1Ø-16.67MVAR	420	9					0	0	
Chhattisgarh	1Ø-110MVAR	765	21	1				0	-1	
	1Ø-80MVAR	765	62	1				0	-1	
	3Ø-125MVAR	420	3					0	0	
	3Ø-50MVAR	420	11	1				0	-1	
	3Ø-63MVAR	420	8	1				0	-1	

STATE	CAPACITY	VOLTAGE	Total	Spare Qty required	RPC Spare	Spare on account of Augmentation	Insurance proceeds	Total Spare	Balspare Qty.	Place
A	B	C	D	E	F	G	H	I	J	
	3Ø-80MVAR	420	6	1				0	-1	
DELHI	1Ø-110MVAR	765	4	1				0	-1	
	1Ø-80MVAR	765	8	1				0	-1	
GOA	3Ø-50MVAR	420	1					0	0	
GUJARAT	1Ø-80MVAR	765	10	1				0	-1	
	3Ø-125MVAR	420	3					0	0	
	3Ø-50MVAR	420	11	1				0	-1	
	3Ø-63MVAR	420	4					0	0	
	3Ø-80MVAR	420	2					0	0	
HARYANA	1Ø-80MVAR	765	17	1				0	-1	
	3Ø-125MVAR	420	9	1			2	2	1	Kurukshetra
	3Ø-50MVAR	420	13	1				0	-1	
	3Ø-63MVAR	420	1					0	0	
	3Ø-80MVAR	420	6	1				0	-1	
HIMACHAL PRADESH	3Ø-125MVAR	420	1					0	0	
	3Ø-50MVAR	420	3					0	0	
	3Ø-63MVAR	420	2					0	0	
	3Ø-80MVAR	420	3					0	0	
J&K	3Ø-125MVAR	420	1					0	0	
	3Ø-50MVAR	420	3					0	0	
	3Ø-63MVAR	420	3					0	0	
	3Ø-80MVAR	420	2					0	0	
Jharkhand	1Ø-110MVAR	765	4	1				0	-1	
	1Ø-16.67MVAR	420	3					0	0	
	1Ø-80MVAR	765	9	1				0	-1	
	3Ø-125MVAR	420	5	1				0	-1	
	3Ø-50MVAR	420	5	1		1		1	0	Jamshedpur
	3Ø-63MVAR	420	1					0	0	
	3Ø-80MVAR	420	5	1				0	-1	

STATE	CAPACITY	VOLTAGE	Total	Spare Qty required	RPC Spare	Spare on account of Augmentation	Insurance proceeds	Total Spare	Balspare Qty.	Place
A	B	C	D	E	F	G	H	I	J	
	3Ø-50MVAR	420	2					0	0	
Karnataka	1Ø-80MVAR	765	10	1			1	1	0	Raichur
	3Ø-125MVAR	420	5	1				0	-1	
	3Ø-50MVAR	420	4			1		1	1	Narendra
	3Ø-63MVAR	420	11	1				0	-1	
	3Ø-80MVAR	420	1					0	0	
KERALA	3Ø-125MVAR	420	1					0	0	
	3Ø-50MVAR	420	2					0	0	
	3Ø-63MVAR	420	4					0	0	
MADHYA PRADESH	1Ø-80MVAR	765	171	1			1	1	0	Bina
	3Ø-125MVAR	420	20	1	1		1	2	1	Itarsi &Khandwa
	3Ø-50MVAR	420	57	1				0	-1	
	3Ø-63MVAR	420	19	1		1		1	0	Bina
	3Ø-80MVAR	420	7	1			1	1	0	
	3Ø-93.2MVAR	420	2					0	0	
MAHARASHTRA	1Ø-110MVAR	765	21	1			1	1	0	Wardha
	1Ø-16.67MVAR	420	3					0	0	
	1Ø-80MVAR	765	63	1			1	1	0	Solapur
	3Ø-125MVAR	420	1					0	0	
	3Ø-50MVAR	420	21	1				0	-1	
	3Ø-63MVAR	420	9	1				0	-1	
	3Ø-80MVAR	420	5	1	1			1	0	Wardha
MANIPUR	3Ø-20MVAR	245	1					0	0	
MIZORAM	3Ø-20MVAR	145	1					0	0	
Odisha	1Ø-110MVAR	765	7	1				0	-1	
	1Ø-16.67MVAR	420	3					0	0	
	1Ø-80MVAR	765	30	1				0	-1	
	3Ø-125MVAR	420	10	1			1	1	0	Angul
	3Ø-50MVAR	420	7	1		1		1	0	Rourkela

STATE	CAPACITY	VOLTAGE	Total	Spare Qty required	RPC Spare	Spare on account of Augmentation	Insurance proceeds	Total Spare	Balspare Qty.	Place
A	B	C	D	E	F	G	H	I	J	
	3Ø-63MVAR	420	5	1				0	-1	
	3Ø-80MVAR	420	4		1			1	1	Rourkela
PUNJAB	1Ø-80MVAR	765	14	1				0	-1	
	3Ø-125MVAR	420	2					0	0	
	3Ø-50MVAR	420	5	1				0	-1	
	3Ø-63MVAR	420	4					0	0	
	3Ø-80MVAR	420	2					0	0	
RAJASTHAN	1Ø-80MVAR	765	7	1				0	-1	
	3Ø-125MVAR	420	5	1				0	-1	
	3Ø-50MVAR	420	20	1				0	-1	
	3Ø-63MVAR	420	2					0	0	
	3Ø-80MVAR	420	6	1			1	1	0	Bhiwadi
SIKKIM	3Ø-31.5MVAR	245	2					0	0	
TAMILNADU	1Ø-80MVAR	765	7	1				0	-1	
	3Ø-125MVAR	420	3					0	0	
	3Ø-50MVAR	420	18	1				0	-1	
	3Ø-63MVAR	420	23	1				0	-1	
	3Ø-80MVAR	420	3					0	0	
TELANGANA	1Ø-80MVAR	765	12	1				0	-1	
	3Ø-50MVAR	420	4					0	0	
	3Ø-63MVAR	420	3					0	0	
TRIPURA	3Ø-20MVAR	145	1					0	0	
UP	1Ø-110MVAR	765	44	1				0	-1	
	1Ø-16.67MVAR	420	6					0	0	
	1Ø-80MVAR	765	84	1			1	1	0	Lucknow
	3Ø-125MVAR	420	18	1			1	1	0	Fatehpur
	3Ø-25MVAR	245	1					0	0	
	3Ø-50MVAR	420	31	1				0	-1	
	3Ø-63MVAR	420	12	1				0	-1	

STATE	CAPACITY	VOLTAGE	Total	Spare Qty required	RPC Spare	Spare on account of Augmentation	Insurance proceeds	Total Spare	Balspare Qty.	Place
A	B	C	D	E	F	G	H	I	J	
	3Ø-80MVAR	420	13	1				0	-1	
UTTARAKHAND	3Ø-125MVAR	420	2					0	0	
	3Ø-25MVAR	245	3					0	0	
WB	1Ø-16.67MVAR	420	9					0	0	
	3Ø-125MVAR	420	9	1				0	-1	
	3Ø-50MVAR	420	9	1				0	-1	
	3Ø-63MVAR	420	9	1				0	-1	
	3Ø-80MVAR	420	8	1				0	-1	
Grand Total			**1363**	**70**	**11**	**4**	**14**	**29**	**-41**	

Table-II(B): Abstract for Rating wise Reactor details

Rating	Voltage Rating	Qty. Installed	Qty required	Spare Qty available	Bal Qty.
1Ø-110MVAR	765kV	114	8	2	-6
1Ø-80MVAR	765kV	568	16	5	-11
3Ø-125MVAR	420kV	111	9	7	-2
3Ø-80MVAR	420kV	90	11	6	-5
3Ø-63MVAR	420kV	160	11	3	-8
3Ø-50MVAR	420kV	261	15	6	-9
3Ø-93.2MVAR	420kV	2		0	0
1Ø-16.67MVAR	420kV	36		0	0
3Ø-31.5MVAR	245kV	2		0	0
3Ø-25MVAR	245kV	4		0	0
3Ø-20MVAR	245kV	1		0	0
3Ø-20MVAR	132kV	3		0	0
1Ø-6.67MVAR	132kV	11		0	0
Total		**1363**	**70**	**29**	-41