सत्यमेव जयते
MINISTRY OF POWER
Government of India

Report of Committee-A on MoP Initiative to facilitate States in Mobilization of Quality Equipment/Materials at Competitive Price Under DDUGJY & IPDS Schemes

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Executive Summary

Executive Summary

Ministry of Power (MoP) vide OM No. 44/30/2015-RE dated 14.08.2015 constituted two committees to facilitate and handhold States for mobilizing major material/equipment with Standard Technical Specification at competitive prices through a transparent bidding process under DDUGJY & IPDS. Committee-A, headed by the Chairperson, CEA, was entrusted with the task of listing out major equipment/ material, finalize technical specifications, aggregate requirement of various states and undertake vendor empanelment. Committee B, headed by Director (Projects) PGCIL, was entrusted to prepare bidding documents, carry out bid processing through e-tendering under reverse bidding mode, evaluate bids and finalize rate contracts.

Committee A deliberated on various tasks assigned to it during 4 meetings held on 22nd Aug. 2015, 28th Aug. 2015, 07th Sept. 2015 and 18th Sept. 2015. Besides, a sub-committee under GM, PGCIL was also constituted to finalize the technical specifications of high value items. The sub-committee hold 3 meetings to finalize the technical specifications. A two day workshop with the representative of states was also held to finalize the quantities of high value items.

The Committee observed that empanelment of vendors being a complex task requires finalization of pre-qualification requirements, inviting Request for Empanelment and evaluation of the proposals involving large number of vendors. To carry out this process, the laid down procedures of tendering and mandatory provisions of CVC are to be complied which will require a time more than 3 weeks given to the Committee A. Further, this activity needs setting up of a dedicated cell. It was also noted that the activity of empanelment and finalization of rate contracts are inter-related with the scope of Committee B. Therefore, in consultation with Ministry of Power (MoP), it was decided that the Committee B may be entrusted with responsibility of empanelment of vendors. Hence, Committee 'A' has deliberated on the task (i) to (iv) of ToR.

The Committee A deliberated in detail on finalization of high value items out of the sanctioned cost of IPDS/DDUGJY, their technical specifications and finalization of quantities of all high value items included in DDUGJY/IPDS.

Major High value materials, which contribute around 80% supply cost of sub transmission and distribution projects under DDUGJY/IPDS schemes, were considered while finalization of the list of major high value materials. Further, two strategies were adopted for finalization of high value item viz. calculation of %age share of various materials in per unit quantity and calculation of %age of major high value material from the DPRs of DDUGJY/IPDS. Based on the analysis & discussion, the major high value materials finalized by the

committee are Power transformers, Distribution Transformer, all type of Conductor, AB cable, UG Cable and Energy Meter.

The Standard Technical Specifications for major high value materials were already provided in Standard Bidding Documents (SBD) for DDUGJY & IPDS schemes, which are approved by Monitoring Committee. However, based on comments received from IEEMA/ITMA & committee members, the technical specifications were revisited by a sub-committee formulated under leadership of GM (QA), PGCIL and the finalized technical specifications are attached in the report. The various issues raised by IEEMA/ITMA regarding use of Amorphous core transformer, copper wound transformers and use of in build LT breaker in distribution transformers have also been discussed while finalizing the technical specification of distribution transformers.

The task regarding assessment of aggregating quantity was a complex issue due to change in submitted and approved quantities of projects under DDUGJY and IPDS schemes. Therefore, keeping in view the time constraints, a workshop was organized on 12th& 13th Sep 2015 at New Delhi with nodal officers of states utilities to finalize the quantities under DDUGJY/IPDS which was attended by 55 representatives of 32 utilities. Efforts were also made to consolidate the quantity of major materials under all sub-transmission & distribution schemes in States other than DDUGJY/IPDS like schemes under State Plan, schemes funded under World Bank/JICA etc. However, during workshop, State representatives informed that other schemes funded by other funding agencies like JICA/World Bank etc have their own agreed methodology for procurement. Hence, the States expressed their unwillingness to include those requirements under this initiative of centralized finalization of rate contract.

The tentative requirement of aggregated quantities of various high value material is given here:

S. No.	Name of Material	Unit	Aggregate Quantity proposed		
			DDUGJY	IPDS	Total
1	Power Transformer	Nos.	14,491	2,896	17,387
2	Distribution Transformer	Nos.	3,17,068	1,00,631	4,17,699
3	ACSR/AAAC Conductor	Km	8,69,521	2,46,730	11,16,251
4	11 KV / LT AB Cable	Km	1,21,965	68,464	1,90,429
5	UG Cable	Km	571	10,165	10,736
Energy Meters					
6	Single phase Meters (Whole current)	Nos	98,93,893	81,70,762	1,80,64,655
7	Three phase Meters (Whole current)	Nos	1,36,870	5,38,985	6,75,855
8	Feeder/Boundary/DT Meters	Nos	11,92,658	1,58,773	13,51,431
9	Prepaid Smart Meter in Govt. establishment	Nos.	-	99,409	99,409

The committee also included the tentative quantities of Smart Meters for the consumers having consumption more than 500 units per month and having consumption between 200 units to 500 units per month.

Report of Committee-A

Report of Committee-A

on

New Initiatives on Material Mobilization

Background:

Ministry of Power (MoP) vide their OM No. 44/30/2015-RE dated 14.08.2015 constituted two committees to facilitate and handhold States for mobilizing major material/equipment with Standard Technical Specification at competitive prices through a transparent bidding process under DDUGJY & IPDS. Committee-A headed by the Chairperson, CEA was entrusted to list out major equipment/ material, finalize technical specifications, aggregate requirement of various states and undertake vendor empanelment. Committee B headed by Director (Projects) PGCIL was entrusted to prepare bidding documents, carry out bid processing through e-tendering under reverse bidding mode , evaluate bids and finalize rate contracts.

The Copy of OM of MoP is at Annexure-I.

Composition of Committee A:

As per OM, the composition of committee A is as under:

i.	Chairperson, CEA	-	Head of the Committee
ii.	Director (Technical), REC	-	Member Secretary
iii.	Director (Commercial), PFC	-	Member
iv.	Representatives from States (Bihar, MP, UP, Gujarat, Rajasthan, Telangana & Himachal Pradesh)	-	Members
v.	Representative from IEEMA & ITMA	-	Members
vi.	Representatives from PGCIL & REC (To be nominated by respective CMDs not below the rank of General Manager)	-	Members

A representative from Central Power Research Institute (CPRI) was also invited to participate in the meetings of committee-A.

The following members/representatives were nominated by utilities /organization for the committee-A:

S. No.	Name of Organization /	Name	Designation
1	CEA	Shri Major Singh	Chairperson
2	REC	Shri P.J. Thakkar	Director(Technical)
3	PFC	Shri Avkash Saxena	Executive Director
4	Bihar	Shri S.K.P. Singh	Director (Project)
5	Gujarat	Shri H. P. Kothari	Superintendent
6	Himachal	Shri Suneel Grover	Chief Engineer
7	Madhya Pradesh	Shri Nagendra Tiwary	Executive Director
8	Rajasthan	Shri J. L. Meena	SBC(TW)
9	Telangana	Shri M. Balaraju	CGM(Purchase)
10	Uttar Pradesh	Shri Deepak Mittal	Chief Engineer (MM)
11	ITMA	Shri A. K. Kaul	Dy. Director General
12		Shri J. M. Malik	Tech. Advisor
13	IEEMA	Shri Babu Babel	President Elect.
14		Sri Raj Eswaran	Past President
15	CPRI	Shri Sudhakar Reddy	Joint Director
16	PGCIL	Shri S. K. Mishra	General Manager
17	REC	Shri G. S. Bhati	General Manager

Detailed Terms of Reference of Committee A are given hereunder:

1. To prepare and finalise list of major high value materials under sub-transmission & distribution system to be procured from empanelled agencies.

2. To prepare the standard technical specifications/ tender drawings / tender data sheet of selected major materials

3. Aggregating project wise/DISCOM wise requirement of selected major materials matching with mobilization of working agencies, completion of survey activities, seasonal acceptance, prioritization of works and availability of fronts
4. To finalize volume of materials to be tendered in a lot in line with aggregate project wise/DISCOM wise requirements

5. Centralised vendor empanelment based on manufacturers' manufacturing capacity at works, technical experience, financial capability, existing type test certification, testing facilities requirements, past performance of supplied equipment, litigation history, jobs in hand etc as required.

During the discussion with Secretary (Power) and Additional Secretary on 1st Oct 2015, it is also decided to include the requirement of Smart meters in the report of Committee A.

Summary of the deliberations/decisions of Committee A taken during various meetings

Committee A, under the chairmanship of the Chairperson, CEA, convened 4 meetings on 22nd Aug. 2015, 28th Aug. 2015, 07th Sept. 2015 and 18th Sept. 2015. The Minutes of Meetings are given at Annexure-II.

During the first meeting held on 22-8-2015, the Committee discussed 14 nos of high value items to be used in sub-transmission & distribution works under DDUGJY and IPDS. The list included Power transformers, Distribution Transformers, Overhead conductors (AAC/ACSR/AAAC) , HT & LT Breakers, Steel Poles (Rail, H-Beam, RS Joist, Steel Tubular Poles), Energy Meters, LT Distribution Board, HT and LT Power Cables, ABC Cables, Distribution Box for service connection, Capacitor Banks, Lightening Arresters, LED Bulbs & Steel structure materials etc.

After deliberation, it was decided that small value items like LT Distribution Box, GI Wires, Cable Boxes, capacitor bank, Lighting arresters, steel structure and LT Cables may not be covered in the list of high value materials as these items may be left to the states for procurement or may be covered under scope of turnkey contractors for supply. It was also noted during the first meeting that technical specifications of all the major higher value items are available in Standard Bidding Documents (SBD) of IPDS/DDUGJY schemes which were prepared after wide consultation with states and other stakeholders. However, Committee members were requested to examine these specifications and to suggest modifications, if any, in these specification based on state practices to finalise these technical specification of high value items. It was also decided to compute project wise requirements of high value major materials through on-line DPRs submitted by the states under DDUGJY & IPDS.

The Committee also deliberated on the TOR regarding empanelment of vendors for various high value materials and observed that it is a complex task which would include the finalization of pre-qualification requirements, inviting Request for Empanelment and evaluation of the proposals from large number of vendors. The committee further observed that to carry out this process, the laid down procedures of tendering and mandatory provisions of CVC are to be adopted which would require a time more than 3 weeks given to the Committee A and setting up of a dedicated cell is also needed for empanelment of vendors.

It was noted that the Committee B has been entrusted the task of finalizing the rate contract for the identified high value materials through tendering & evaluation processes, which also require the tendering process. As these two activities of empanelment of vendors and finalizing rate contract are inter-linking activities, therefore, Committee A decided that it would be appropriate if the task of empanelment of vendors by Committee A may also be assigned to committee B or else, more time (about 6 months) with separate and dedicated cell might be required to carry out the task of empanelment of vendors by committee A.

Subsequently, this matter was discussed with Secretary (Power) & Additional Secretary (Power) in MOP on 26-8-2015, in presence of Director (Projects), PGCIL & Chairman of Committee B. During the meeting, the Ministry of Power in-principle agreed for assigning the task of S. No (v) of TOR of Committee A of empanelment of venders to Committee B. Accordingly, Committee 'A' has deliberated on the task (i) to (iv).

During the second meeting held on 28-8-2015, the Committee discussed the comments received on the Technical Specifications of major high value materials from members of the Committee and ITMA. IEEMA was also requested to furnish the comments on existing Technical Specifications under DDUGJY & IPDS schemes. The finalization of quantities of major high value items was also discussed and it was decided that REC & PFC would take the concurrence of the States after compiling the quantities of major high value items through on line data of DPRs submitted by the states. During the meeting, PFC also informed the Committee that the tentative quantities of smart meters are also being collected by them in two categories. Category-1 would cover monthly energy consumption of more than 500 kWh and in Category-2 consumer having monthly energy consumption between 200-500 kWh per month.

During the third meeting of the Committee A held on 7-9-2015, the list of high value items was further reviewed and based on the %age implication of the identified high valued materials with respect to the total DPRs received under DDUGJY, the main high value material i.e Power Transformer, Distribution transformers, VCB with CT and Panels, Meters, Poles, ACSR conductors, U/G Cable & AB Cable were identified. It was informed by Metering division of IEEMA that some of the tempering features in the meters were state specific and if meters were included under high value central procurement list, it might not be advisable for all the state to purchase the fixed specification meters. It was requested not to include energy meters under central procurement list.

Various comments on Technical Specifications were received from members of ITMA and IEEMA on Power Transformers, Breakers, Energy Meters and Cables. The comments of IEEMA/ITMA etc are enclosed at Annexure-III. After

discussion, it was noted that these comments need further techno-commercial examination. Therefore, a Sub Committee was formed headed by General Manager (QA), PGCIL and comprising representative from states of Himachal Pradesh, Madhya Pradesh, IEEMA and REC. The sub-committee was entrusted with the responsibility to review & finalize the Technical Specifications after considering the comments/ suggestions of the stakeholders.

Various options were discussed to aggregate requirement of major high value materials under DDUGJY/IPDS. It was noted by Committee that DDUGJY DPRs were uploaded online but during processing and approval, proposed quantities and cost of projects were changed in majority of cases. The committee noted that considering sanction project cost, it would be impractical to take quantities of major high value materials from uploaded DPRs. Since, submission of supplementary DPRs based on sanction project costs is time taking activity, Committee decided to organize 2 day workshop in New Delhi by inviting Nodal Officers from the States to finalize the quantities.

Accordingly, a workshop was arranged on 12th& 13th Sep 2015 at New Delhi and was attended by 55 representative of 32 No of discoms/utilities of the states. During the workshop, the representative of states submitted the quantities of major high value materials under DDUGJY & IPDS schemes and other utilities submitted their quantities through e mail to REC and PFC.

During the fourth meeting of the Committee held on 18-9-2015, the list of high value items was again discussed and looking at huge volume of energy meters to be procured under DDUGJY/IPDS, the Committee decided to include energy meters under list of major high value materials. It was also decided that REC would find out the %age cost of the identified high valued materials with respect to the total cost of DPRs received under DDUGJY before including them in the final report.

Before 4th meeting of Committee A, few more comments were furnished by ITMA/IEEMA members on Technical Specifications on Power/Distribution

Transformer, HT Breakers, AB Cable, Energy Meters and Conductors. After detailed discussion and feedback from State representatives, it was decided that sub-committee earlier formed headed by GM (QA), PGCIL would again discuss the comments submitted by ITMA / IEEMA on 21-9-2105 & 22-9-2015 and representative from States having inline expertise in Technical Specifications shall also be invited to participate in the discussion. It was also decided to invite CMD, MP MKVVCL, Bhopal to participate in finalization of meter specification.

During the meeting, ITMA / IEEMA has proposed for inclusion of inbuilt LT protection system in technical specification of distribution transformer. It was informed that this matter was earlier discussed by sub-committee on 09.09.2015 and GM (QA), PGCIL opined that the deterioration of transformer oil due to quenching of arc in inbuilt MCCBs may destroy insulating properties of transformer oil which may further lead to failure of Distribution Transformer. He desired that data pertaining to deterioration of transformer oil vis-à-vis nos. of faults attended in inbuilt LT protection system should be studied and analysed before including this provision in the specification of Distribution Transformers. It was also noted that IS 1180 which is recently amended by BIS does not specify inbuilt LT protection mechanism and this type of Distribution Transformers may require a separate IS and ITMA may take up the matter with BIS to amend the existing IS or to prepare new IS for completely self-protected (CSP) transformers. After discussion, the committee decided that at this time, it may not be appropriate to include inbuilt LT protection system in the specifications of Distribution transformers.

Subsequently, meetings of the Sub-committee were held on 21-9-2015 & 22-9-2015 at PGCIL Corporate Office Gurgaon to finalize the Technical Specifications of Distribution Transformers, Power Transformers, Energy Meters and other items.

During technical discussions on meters' specifications, it was noticed that different utilities use different specifications of meters which include different

tamper features, communication technologies, warranty period & integration of new meters with existing legacy system etc. IEEMA members suggested that it would be better if meters may not be a part of high value item under central procurement, otherwise states would not be able to purchase the meters as per their requirement under the finalized rate contract. CMD, MP MKVVCL suggested that in case meters are included in the high value items, then a price band (+10 to +20%) may be allowed over and above the central procurement prices to accommodate the specific additional features. Hence, sub-committee was of opinion to either exclude meters from the list of high value items or to allow a price band over and above the central procurement prices to accommodate the state specific additional features in the meters. However, keeping in view the bulk quantities of the meters, it was decided that meters may be included under high value items and Committee B may take a view on the price band allowance up to (+) 10-20% during finalization of rate contract.

During the fourth meeting, the quantities of major items were also finalized based on the data received from the states during the workshop and through email.

The issue of use of CRGO material & Amorphous Core material and use of Aluminium and Copper material in winding of Distribution transformers was also discussed. The representations of ITMA in this context were also received. The Sub Committee constituted under GM(QA) PGCIL to finalised the technical specifications of high value items suggested that for single phase Distribution transformers of 25 KVA and below, CRGO/ Amorphous Core material and Aluminium as winding material may be used while all 3 Phase Distribution Transformers would use only CRGO core material with aluminium winding in less than 200 KVA Transformers and copper winding in above 200 KVA transformers. The committee deliberated on the issue in detail and the view of States were also taken on the matter. Many of the states informed that they use only CRGO material Distribution transformers due to lack of repairing facilities in case of failure of Amorphous Core transformers. It was also noted

that Indian standards of Amorphous Core material is still not available and is under preparation. Few States also indicated that copper wound transformers are costly than aluminium wound transformers and also theft prone. However, it was decided that it would not be appropriate to restrict the specification for one type of core material & winding material for distribution transformers as States use both type of transformers as per their requirement. After examining the matter, it was decided that the specification of Distribution transformers, as finalized by sub-committee, would be modified to include both the core material (CRGO/ Amorphous) and both winding material(Al/Cu) for distribution transformers and states may choose the appropriate transformer as per their requirement.

The point-wise deliberation and recommendation of the Committee A is as under:

1. **Identification of Major high value materials:**

The committee deliberated on length to identify major high value materials which contribute around 80% supply cost of sub transmission and distribution projects under DDUGJY/IPDS schemes. Following strategies were adopted to identify major high value materials:

a. The %age share of various materials in per unit quantity of work were computed. Quantities of major high value materials were considered in one no of power substation, distribution substation, per kilometre 11 KV / 33 KV / LT line. For this purpose, Schedule of Rates (SoR) of per unit quantities were taken for reference. After examination, the following were the observations:

S. No.	Description of unit work	Name of Material	% Amount w.r.t. total cost of unit work
Power Substation			
1	3.15 MVA and 5 MVA, 33/11 KV S/S. Expandable to 2 X 3.15 MVA and 2x5 MVA with Control room and four nos. 11 KV Outgoing Feeder with 600 KVAR Capacitor bank	Power Transformer 33/11 KV OFTC 3.15 MVA	25-28%
2		33 KV VCB, Outdoor Porcelain clad type with complete structure and accessories	8-10%
3		11 KV VCB, Outdoor Porcelain clad type with complete structure and accessories	4-6%
33 KV Line with Raccoon Conductor			
4	33 KV line on 280 kg., 9.1 Mtr. Long PCC poles with Raccoon Conductor with Average Span of 70 Mtr	AAAC Raccoon conductor 0.075 sq. Inch (80 sq.mm. Al.eq.)	52-55%
33 KV Line with Dog conductor			
5	33 KV line on 280 kg., 9.1 Mtr. Long PCC poles with DOG conductor with average span of 70 Mtr.	AAAC DOG conductor 0.10 sq. Inch (100 sq.mm. Al.eq.)	58-60%
	33 KV line on h-beams 152 x 152 mm., 37.1 kg./Mtr. 13 Mtr. Long supports with DOG conductor with average span of 70 Mtr		25-30%
Distribution Substation with 16 KVA Transformer			
6	11/0.4 KV Distribution Transformer Substation using 16 KVA 3-ph Aluminium wound DTR on 175x85mm.,11.0 mtrs. Long RS joist Pole supports	3- Phase 11/0.4 kV 16 KVA conventional 3 star rating type DTR	12-14 %
	11/0.4 KV Distribution Transformer Substation using 16 KVA 3-ph Aluminium wound DTR on 140 kg., 8.0 mtrs. Long PCC pole supports or PCC support (pole) as per state practice.		25-30 %
Distribution Transformer Substation			
7	11/0.4 KV Distribution Transformer Substation using 63 KVA Aluminium wound on 152 x 152 mm 37.1 kg/meter, 11.0 mtrs. Long H-beam pole supports.	3- Phase DTR 11/0.4 kV conventional 3 star rating type 63 kVA	45-46 %

S. No.	Description of unit work	Name of Material	% Amount w.r.t. total cost of unit work
	11/0.4 KV Distribution Transformer Substation using 63 KVA Aluminium wound DTR on on 140 kg.,8.0 mtrs. Long PCC pole supports or PCC (pole) as per state practice		55-57 %
Distribution Substation with 100 KVA Transformer			
8	11/0.4 KV Distribution Transformer Substation using 100 KVA Aluminium wound DTR on 175x85mm., 11.0 mtrs. Long RS joist Pole supports	3- Phase DTR 11/0.4 kV conventional 3 star rating type 100 kVA	38-40 %
	11/0.4 KV Distribution Transformer Substation using 100 KVA Aluminium wound DTR on on 140 kg.,8.0 mtrs. Long PCC pole supports or PCC (pole) as per state practice		55-58 %
11 KV line with conductor			
9	11 KV three phase line on 152 x 152 mm, 37.1 kg/mtr. 11 mtr. long H-Beam with ACSR 'RACCOON' Conductor average span of 70 mtr	Conductor	20-25%
	11 KV three phase line on 140 kg., 8.0 mtrs. long PCC Poles with ACSR 'RABBIT' Conductor Average Span of 83 mtr.		60-65%
	11 KV three phase line on Steel Tubular Pole 540 SP 52 (IS 2713-Part I, II, III-1980) 11 mtr. Long with ACSR 'RACCOON' Conductor average span of 50 mtr.		25-30%
	11 KV three phase line on Steel Tubular Pole 540 SP 52(IS 2713-Part-I, II, III-1980) 11 mtr. long with ACSR 'WEASEL' Conductor average span of 70 mtr.		15-20%
11 KV line with AB Cable			
10	11 KV three phase line on Steel Tubular Poles 540 SP 52 (IS 2713-Part I, II, III-1980) 11 mtr. Long with AB Cable3x95+1x80 sq.mm. Average span 50 mtr.	11 KV ARIAL BUNCH CABLE 3X95+1X80 SQMM	50-55%
LT Line with AB Cable			

S. No.	Description of unit work	Name of Material	% Amount w.r.t. total cost of unit work
11	LT Line 3 phase 5 wire on RS joist support using aerial bunched XLPE cable (3x50 Sq.mm + 1x35 sq.mm Insulated Neutral Cum Messenger +1x16 sq.mm) with maximum span of 50 meters	LT XLPE Arial Bunch Cable	30-35%
	LT Line 3 phase 5 wire on RS joist support using aerial bunched XLPE cable (3x35 sq.mm+1x35 sq.mm insulated neutral cum messenger +1x16 sq.mm) with maximum span of 50 meters		25-30%
	LT Line 3 phase 5 wire on RS joist support using aerial bunched XLPE cable (3x25 sq.mm+1x35 sq.mm insulated neutral cum messenger +1x16 sq.mm) with maximum span of 50 meters		20-25%
	LT Line 3 phase 5 wire on RS joist support using aerial bunched XLPE cable (3x16 sq.mm+1x16 sq.mm insulated neutral cum messenger +1x25 sq.mm) with maximum span of 50 meters		20-25%
	LT Line 3 phase 5 wire on PCC support using aerial bunched XLPE cable (3x50 sq.mm + 1x35 sq.mm insulated neutral cum messenger +1x16 sq.mm) with maximum span of 50 meters		50-55%
	LT Line 3 phase 5 wire on PCC support using aerial bunched XLPE cable (3x50 sq.mm + 1x35 sq.mm insulated neutral cum messenger +1x16 sq.mm) with maximum span of 50 meters		44-49%
	LT Line 3 phase 5 wire on PCC support using aerial bunched XLPE cable (3x25 sq.mm+1x35 sq.mm. insulated neutral cum messenger +1x16 sq.mm) with maximum span of 50 meters		42-47%
	LT Line 3 phase 5 wire on PCC support using aerial bunched XLPE cable (3x16 sq.mm+1x16 sq.mm. insulated neutral cum messenger +1x25 sq.mm) with maximum span		45-50%

S. No.	Description of unit work	Name of Material	% Amount w.r.t. total cost of unit work
	of 50 meters		

b. %age of major high value material was also computed from the supply value of the DPRs submitted by four States namely Bihar, Madhya Pradesh, West Bengal and Tamil Nadu under DDUGJY. Analysis was made by considering that 80% of project cost is contributed by supply of equipment and 20% cost is contributed by erection, testing and commissioning of sub-transmission and distribution works. The %age share of various key materials, based on DPR submitted by aforesaid four States under DDUGJY, is given hereunder:

Sl. No.	Major Material	Madhya Pradesh	Bihar	Tamil Nadu	West Bengal
1	Power Transformer	9%	34%	52%	8%
2	Distribution Transformer	9%	6%	0.31%	5%
3	Vacuum Circuit Breaker	1%	1%	2%	1%
4	Energy Meter (1-Phase,3-Phase,DTR & 11 KV Feeder)	7%	2%	15%	3%
5	Conductor	11%	6%	4%	11%
6	LT AB Cable	8%	0%	0.02%	8%
Total %age		**46%**	**50%**	**74%**	**36%**

The details of %age share of major materials (based on per unit rate and based on DPRs submitted under DDUGJY) are enclosed at Annexure-IV.

c. Under IPDS scheme, efforts were made to identify major key materials apart from above key materials and noted that UG cable and meters (consumer meters and system meters) contribute around 7% and 8% cost of materials respectively under IPDS. The calculation of %age share of UG cable and meters is given hereunder:

Name of Item	Qty	Total Material Cost of item	Total Sanctioned Material cost	%age share
UG cable	10200 Km	Rs 1326 cr (@ Rs 13 Lakh/ km)	Rs 19200 cr	7%
Meters	95 Lakhs	Rs 1520 cr		8%

*Assuming material cost contributes 80% of project cost of ~Rs 24,000 cr

The committee then discussed above seven high value major items viz., Power and Distribution Transformers, All type of Conductors, HT Breakers with control panel and CTs/PTs, AB/UG Cables of 33 KV, 11 KV and LT and Energy Meters to be used in DDUGJY/IPDS.

Committee also discussed substantial supply costs of poles and steel structures in sub-transmission & distribution works. It was intimated that different Technical Specifications are used for PCC/RCC poles in different states. Accordingly, pole manufacturers have developed locally to manufacture State specific poles. Since, State to State different type of supports, different dimensions of fabricated steel structure items are used, it was decided not to consider PCC/RCC and steel structure materials under major high value items.

Vacuum Circuit Breaker was also deliberated for inclusion in list of major high value materials. However, it was noted that two types (indoor & outdoor) of installation of Vacuum Circuit breakers are used in Sub-transmission & Distribution system. Considering various voltage levels, type of protection, type of relays and installation mechanism, there would be various combination which needs to be incorporated before finalizing quantity for a particular type of set of breaker for rate contract. Following may be the various type of VCBs which needs to be captured while deciding quantum of set of Vacuum Circuit Breakers:

1. Voltage Class i.e. 33 KV or 11 KV

2. DC Control Voltage i.e. 24 V, 30 V, 36 V, 40 V, 110 V etc., as per State Practice
3. Type of Relays i.e. Static or Analog. Also State Specific issue of reduction in type and quantity of spares to be looked into while finalizing type of relays.
4. Indoor breaker and outdoor breaker
5. Type of control panel – 33 KV Transformer breaker panel, 33 KV Feeder breaker panel, 11 KV Transformer breaker panel, 11 KV Feeder breaker panel, 11 KV bus coupler breaker panel
6. Indoor CTs or Outdoor CTs
7. Indoor PTs or Outdoor PTs
8. Quantum of control cable or HT cables (33 KV or 11 KV)

It was noted that State to State different practices are in use for all above material. Until all these things are properly captured, quantum of total materials is difficult to assess a particular set of breaker. Thereafter, opinion from Committee members from States was sought on whether to include Breaker including Control Panel and CTs in New Initiative under central procurement. The representatives from Bihar, Madhya Pradesh, Uttar Pradesh, Gujarat and Rajasthan and PGCIL were of opinion that the %age share of Vacuum Circuit Breaker in the total cost of project is very less (about 1-2%) so it may be excluded from list of major high value materials. Hence, Vacuum Circuit Breaker has been excluded from list of high value major materials.

Accordingly, the following high value materials have been finalized by Committee A:

i. **Power Transformers**
ii. **Distribution Transformers,**
iii. **All type of Conductors,**
iv. **AB Cables of 33 KV, 11 KV and LT**
v. **UG Cables of 33 KV, 11 KV and LT**
vi. **Energy Meters**

2. Finalisation of Standard Technical Specifications of High Value Items

It was noted by the Committee A that the Standard Technical Specifications for major high value materials have already been provided in Standard Bidding Documents (SBD) for DDUGJY & IPDS schemes. These technical specifications were prepared and approved by IMMC (Inter Ministerial Monitoring Committee) after wide consultations with the States and other stake holders during finalisation of Standard Bidding Documents for DDUGJY & IPDS schemes.

Committee 'A' received comments on specification of some of the items from members of IEEMA and ITMA which were regarding reference to old IS and old values in the specification of transformers, VCBs, cables & meters etc. To examine and finalise the specifications of major high value materials considering inputs received from ITMA/IEEMA members, it was decided to constitute a sub-committee under GM9QA) PGCIL with representatives from states of Himachal Pradesh, Madhya Pradesh, IEEMA & REC to review and finalise technical specifications of identified high value items including Power Transformer, Distribution Transformer & Vacuum Circuit Breaker, meters etc. Sub Committee hold 3 meetings and discussed various comments received from IEEMA/ITMA members and finalised technical specifications for all major high value materials. The Minutes of Meetings of the sub-committee are enclosed as Annexure-V.

During the fourth meeting of the Committee A, ITMA / IEEMA proposed for inclusion of inbuilt LT protection system in technical specification of distribution transformer. It was informed by GM(QA) PGCIL that this matter was earlier discussed by sub-committee on 09.09.2015 and it was informed that the deterioration of transformer oil due to quenching of arc in inbuilt MCCBs may destroy insulating properties of transformer oil which may further lead to failure of Distribution Transformer. It was also noted by Sub Committee that data pertaining to deterioration of transformer oil vis-à-vis nos. of faults

attended in inbuilt LT protection system is not available and require more analysed before including this provision in the specification of Dist Transformers. It was also noted that IS 1180 which is recently amended by BIS, does not specify inbuilt LT protection mechanism and this type of Distribution Transformers may require a separate IS. It was advised to ITMA to take up the matter with BIS to amend the existing IS or to prepare new IS for completely self-protected (CSP) transformers. After discussion, the committee decided that at this time, it may not be appropriate to include inbuilt LT protection system in the specifications of Distribution transformers.

During technical discussions on meters' specifications in the meeting of sub-committee on 22-9-2015 , it was noticed that different utilities use different specifications of meters on tamper features, communication technologies, warranty period and integration of new meters with existing legacy system etc. CMD, MP MKVVCL suggested that meters should not be included in the central impalement list as it would be difficult for states to purchase the fixed specification meters. He also suggested that in case meters are included in the high value items, then a price band (+10 to +20%) may be allowed over and above the central procurement prices to accommodate the state specific additional features in the meters. Hence, sub-committee was of opinion to either exclude meters from the list of high value items or to allow a price band over and above the central procurement prices to accommodate the state specific additional features in the meters. However, keeping in view the bulk quantities of the meters, it was decided that meters may be included under high value items and Committee B may take a view on the price band allowance up to (+) 10-20% during finalization of rate contract.

The issue of use of CRGO material & Amorphous Core material and use of Aluminium and Copper material in winding of Distribution transformers was also discussed. The representations of ITMA in this context were also received. The Sub Committee constituted under GM(QA) PGCIL to finalised the technical specifications of high value items suggested that for single phase Distribution

transformers of 25 KVA and below, CRGO/ Amorphous Core material and Aluminium as winding material may be used while all 3 Phase Distribution Transformers would use only CRGO core material with aluminium winding in less than 200 KVA Transformers and copper winding in above 200 KVA transformers. The committee deliberated on the issue in detail and the view of States were also taken on the matter. Many of the states informed that they use only CRGO material Distribution transformers due to lack of repairing facilities in case of failure of Amorphous Core transformers. It was also noted that Indian standards of Amorphous Core material is still not available and is under preparation. Few States also indicated that copper wound transformers are costly than aluminium wound transformers and also theft prone. However, it was decided that it would not be appropriate to restrict the specification for one type of core material & winding material for distribution transformers as States use both type of transformers as per their requirement. After examining the matter, it was decided that the specification of Distribution transformers, as finalised by sub-committee, would be modified to include both the core material (CRGO/ Amorphous) and both winding material(Al/Cu) for distribution transformers and states may choose the appropriate transformer as per their requirement.

Copy of finalised technical specifications is attached at Annexure-VI.

3. Aggregation of quantity of major high value materials

The matter related to aggregation of quantity of major high value materials under DDUGJY & IPDS schemes was discussed in detail by committee members during all the four meetings. It was noted that DPRs worth Rs 85,347 crores were submitted by states under DDUGJY on web portal, while based on the technical appraisal and availability of funds, Monitoring Committee approved DPRs worth Rs 40,204 crores only. Since the sanctioned amount of DPRs of various States was less than the amount of DPRs submitted on the online portal, the States were advised to submit supplementary DPRs based on the

approved cost. It was noted that extracting quantities of major high value materials from online portal for States wherein sanctioned amount is less than submitted DPR cost, would be a challenge and the concurrence of states is also needed in finalizing the quantities.

Keeping in view the time constraints, it was decided to organize a workshop with nodal officers of states to finalize the quantities under DDUGJY/IPDS. Accordingly, a workshop was organized on 12th& 13th Sep 2015 at New Delhi and was attended by 55 representatives of 32 utilities of the states. The list of participants in the workshop is enclosed at Annexure-VII. During the workshop, the representative of states submitted the revised quantities of major high value materials under DDUGJY & IPDS schemes. Efforts were also taken to consolidate the quantity of major materials under all sub-transmission & distribution schemes in States other than DDUGJY/IPDS but State representatives informed that other schemes funded by other funding agencies like JICA, World Bank etc have their own agreed methodology for procurement, hence, the States expressed their unwillingness to include those requirement under this initiative of centralized finalization of rate contract.

While computing aggregate quantity of materials, following methodology were used:

a. Materials required for electrification of UE villages were not included in aggregate quantity as States have been permitted to execute these works departmentally on priority using their own resources.

b. The States where sanctioned amount of DPRs is less than the amount of submitted DPRs and wherein States have not provided the quantities of major materials, tentative quantity has been considered while computing aggregate quantity of materials.

c. For States where permission has been granted by Monitoring Committee to

execute works on partial turnkey or departmental execution mode under DDUGJY Scheme have not been considered while computing quantity of materials. However, quantities for all sanctioned DPRs under IPDS have been considered, whether executed on turnkey, semi-turnkey or departmental basis, since key materials are to be procured in all cases.

d. The quantity of major high value materials by States, wherein Monitoring Committee sanctioned almost 100% proposed DPRs works, has been extracted from online portal based on DPRs submitted by them.

e. Some of the states like Gujarat & Tamil Nadu have not furnished the quantities of items stating that they had already published the tenders for DDUGJY/ IPDS projects as per the sanctioned cost and they have no requirement under central procurement.

On above methodology, summary of aggregated quantity of major materials required under DDUGJY & IPDS schemes are computed as under:-

S. No.	Name of Material	Unit	Tentative Aggregate Quantity proposed		
			DDUGJY	IPDS	Total
1	Power Transformer	Nos.	14,491	2,896	17,387
2	Distribution Transformer	Nos.	3,17,068	1,00,631	4,17,699
3	ACSR/AAAC Conductor	Km	8,69,521	2,46,730	11,16,251
4	11 KV / LT AB Cable	Km	1,21,965	68,464	1,90,429
5	UG Cable	Km	571	10,165	10,736
6	Single phase Meters (Whole current)	Nos	98,93,893	81,70,762	1,80,64,655
7	Three phase Meters (Whole current)	Nos	1,36,870	5,38,985	6,75,855
8	Feeder/Boundary/DT Meters	Nos	11,92,658	1,58,773	13,51,431
9	Prepaid Smart Meter in Govt. establishment	Nos.	-	99,409	99,409

As the above quantities are based on the tentative data furnished by States, the above quantities may vary during the actual implementation of the projects. The State-wise and rating-wise details of major materials for DDUGJY & IPDS are enclosed at Annexure-VII.

4. Aggregation of quantity of Smart Meters

During a meeting with Secretary (Power) and Additional Secretary (Power) on 1st Oct 2015, it was directed that Committee A may also assess the approximate quantities of Smart Meters under various categories of consumers. As per the data/information available in CEA in 2014, there were about 21.83 Crores of various categories of consumers in the country. Out of total of 21.83 Crores consumer base, 17.12 Crores (78.4%) were domestic consumers (8.18 Crores (37.5%) urban domestic and 8.9 Crores (40.9%) rural domestic), 1.90 Crore (8.7%) were agriculture consumers, 1.97 Crores (9%) were commercial consumers, 0.35 Crores (1.6%) were Industrial low and medium voltage consumers and 0.17 Crores (0.7%) belonged to public category viz. Public Lighting, Public Water Works and Sewage Pumping. 'Other category' of consumers (viz bulk miscellaneous, army and paramilitary establishment etc) were about 30 lakh (1.4%) including Traction consumers of 412 only.

During the meetings of the Committee A, PFC representative indicated that they had collected the data from states to work out the tentative quantities of smart meters under two categories (more than 500 Units/ month and 200-500 Units/ month). In case of some of the states, which did not furnish data, the requirement has been assessed based on the total consumers in the state.

Based on the data received by PFC, it is estimated that the requirement of smart meters would be around 1 Crores, in case the smart meters are installed for those consumer which are consuming more than 500 units / month. Additionally, 2.5 Crore more smart meters would also be required in case these meters are installed on the consumers consuming 200-500 units/ month. So, a

total of about 3.5 Crore Smart Meters would be required in case, these meters are installed for those consumers which are consuming more than 200 units/ month

It was observed by the Committee that Indian Standards (IS) of single phase whole current smart meters have recently been published by BIS but the commercial production of these meters as per IS and as per specific requirement of states may take some time. The state wise proposed quantities of Smart meters based on categories of 200-500 units/ month and more than 500 units / month are consolidated and are enclosed at Annexure-IX.

The Committee 'A' extend their sincere appreciation to the efforts made by CEA, REC, PFC, PGCIL and States in finalizing the report of the Committee.

Recommendations:

1. The list of major high value materials finalised by Committee A are given hereunder:
    i. Power Transformers
    ii. Distribution Transformers,
    iii. All type of Conductors,
    iv. AB Cables of 33 KV, 11 KV and LT
    v. UG Cables of 33 KV, 11 KV and LT
    vi. Energy Meters

2. The Technical Specification of major high value materials are enclosed with the report.

3. The aggregate quantity of major high value materials is given hereunder:

S. No.	Name of Material	Unit	Aggregate Quantity proposed		
			DDUGJY	IPDS	Total
1	Power Transformer	Nos.	14,491	2,896	17,387
2	Distribution Transformer	Nos.	3,17,068	1,00,631	4,17,699
3	ACSR/AAAC Conductor	Km	8,69,521	2,46,730	11,16,251
4	11 KV / LT AB Cable	Km	1,21,965	68,464	1,90,429
5	UG Cable	Km	571	10,165	10,736
6	Single phase Meters (Whole current)	Nos	98,93,893	81,70,762	1,80,64,655
7	Three phase Meters (Whole current)	Nos	1,36,870	5,38,985	6,75,855
8	Feeder/Boundary/DT Meters	Nos	11,92,658	1,58,773	13,51,431
9	Prepaid Smart Meter in Govt. establishment	Nos.	-	99,409	99,409

The State-wise and rating-wise quantities of major materials for DDUGJY & IPDS are enclosed at Annexure-VII.

Annexure-I

MoP's OM
on
Committees Formation
for
New Initiative on
Material Mobilisation

No.44/30/2015-RE
Government of India
Ministry of Power

Shram Shakti Bhavan,
Rafi Marg,
New Delhi-110001.

Date: 14/08/2015

Subject: Initiative to facilitate States in mobilization of quality equipments/material at competitive price under DDUGJY/IPDS.

To facilitate and handhold States in mobilizing major equipments/material with Standard Technical Specifications at competitive prices through a transparent bidding process under DDUGJY & IPDS schemes, two Committees are constituted with composition and terms of reference as indicated below:-

Committee 'A'

The committee would list out major equipments/material, finalize technical specifications, aggregate quantity requirements of various States; and undertake vendor empanelment.

The composition of the committee would be as under:-

(i)	Chairperson, CEA	-Will Head the Committee
(ii)	Director(Technical), REC	- Member Secretary
(iii)	Director (Commercial), PFC	- Member
(iv)	Representatives from States (Power Secretary/CMD, MD/Chief Engineer concerned of DISCOM) of Bihar, Madhya Pradesh, UP, Gujarat, Rajasthan, Telangana and Himachal Pradesh	- Members
(v)	Representative from IEEMA and ITMA	- Members
(vi)	Representatives from PGCIL and REC (To be nominated by respective CMDs not below the rank of General Manager)	- Members

The Committee will complete the job within 3 weeks i.e. by 5/09/2015. The detail of TOR of the Committee is at **Annex.I.**

Committee 'B'

The committee would prepare bidding documents, carry out bid processing through e-tendering under reverse bidding mode, evaluate bids and finalize rate contracts.

The composition of the committee would be as under:-

(i)	Director(Projects), PGCIL	-Chairperson
(ii)	Director(Technical), REC	- Member Secretary
(iii)	Director (Commercial), PFC	- Member
(iv)	Representatives from States (Power Secretary/CMD, MD/Chief Engineer concerned of DISCOM) of Maharahstra, Odisha, Haryana, Tamil Nadu, Jharkhand, West Bengal Chattisgarh, Gujarat, Assam and UP	- Members
(v)	Representatives from PGCIL and REC (To be nominated by respective CMDs not below the rank of General Manager)	- Members

The Committee will complete the job by 31/10/2015. The detail of TOR of the Committee is at **Annex.II.**

2. It would be mandatory for all the States to follow the technical specifications finalized by Committee 'A'. However, the States would have the option to either procure equipment/material through rate contracts finalized by Committee 'B' or of their own. Once the specifications and rate contracts for various equipments/materials are finalized, actual procurement of equipment/material may be done by the respective DISCOMs/Power Deptt. of the States through placement of the purchase orders for supply of equipments/materials based on finalized rate contracts from approved vendors. CMD, REC will oversee the activities of both the Committees.

3. The proposal has the approval of Hon'ble MOSP(I/C).

14Aug2015

(K.K.Mishra)
Deputy Secretary to the Govt. of India
kk.mishra@gov.in

Copy to

(i) Chairperson, Central Electricity Authority, Sewa Bhavan, R.K.Puram, New Delhi.
(ii) CMD, Rural Electrification Corporation Ltd., Core-IV, Scope Complex, New Delhi.
(iii) CMD, PFC, Urjanidhi, 1 Barakhamba Lane, New Delhi.
(iv) CMD, PGCIL, Plot No.2, Sector-29, Gurgaon, Haryana.
(v) Director (Technical), REC, Core-IV, Scope Complex, New Delhi.
(vi) Director (Commercial), PFC, Urjanidhi, 1 Barakhamba Lane, New Delhi.
(vii) Director (Projects), PGCIL, Gurgaon, Haryana
(viii) Secretary(Energy), Government of Bihar, Irrigation Buidling, Patna-800 015.
(ix) Pr.Secy(Energy), Govt. Of Madhya Pradesh, Mantralaya, Bhopal-462 001.
(x) Pr.Secy(Energy), Govt. of Uttar Pradesh, Lal Bahadur Shastri Bhavan (Annexe), Luchnow.
(xi) Addl.Chief Secy., Energy Deptt., Govt. of Gujarat, Sachivalya, Gandhinagar-382 010.
(xii) Secretary(Energy), Govt. of Rajasthan, Jaipur-302001.
(xiii) Pr.Secy.(Energy), R.No.359, D Block, Secretariat, Govt. of Telangana.
(xiv) Pr.Secy(Power),Govt. of Himachal Pradesh, Shimla-171 002.
(xv) Secretary(Energy), Govt. of Maharashtra, MSEP Office, Prakashgarh Building, Bandra (East), Mumbai -400 051.

(xvi) Pr. Secy, Deptt. Of Energy, Govt.of Odisha, Bhubaneswar-751 001.
(xvii) Addl. Chief Secretary, D/o Power & NCES, Govt. of West Bengal,1 Kiron Shanker Roy Road, New Sectt. Building, 7th Floor, Kolkata-700001
(xviii) Pr.Secy,(Power),Govt. of Haryana, Civil Sectt., Sector-1, Chandigarh.
(xix) Secy.(Power), Govt. of Tamil Nadu, Sectt. Chennai-600 009.
(xx) Pr.Secy(Energy), Govt. of Jharkhand, Nepal House, Doranda, Ranchi.
(xxi) Addl.Chief Secy., Depatt. Of Power & NCES, Govt. of West Bengal, 1, Kiron Shanker Roy Road, New Sectt. Building, 7th Floor, Kolkata-700 001.
(xxii) Pr.Secy.(Energy), Govt.of Chattisgarh, D.K.S.Bhavan, Mantralaya, Raipur.
(xxiii) Commissioner-cum-Secy(Power), Govt. of Assam, P.O.Assam Sachivalaya, Dispur-781 006.
(xxiv) DG, IEEMA, Rishyamook Building, 1st Floor, 85-A, Panchkuiyan Road, N.Delhi-110 001.
(xxv) DG, ITMA, 2-F CS-11, Ansal Plaza, Sector-3, Near Vaishali Metro Station (Oppo.Bhushan Street), Vaishali (Ghaziabad), UP.

Copy also forwarded to :

All the Pr.Secretary(Energy)/Secretary(Energy) of DDUGJY and IPDS States.

Copy also to: PPS to Secretary(Power)/PPS to AS(BNS)/PPS to JS&FA/PS to DS(RE)/US(RE)/US(D), MOP.

Annex-I

Terms of Reference of the Committee-A is as under:

(i) To prepare and finalise list of major high value materials under sub-transmission & distribution system to be procured from empanelled agencies.

(ii) To prepare the standard technical specifications/ tender drawings/ tender data sheet of selected major materials

(iii) Aggregating project wise/DISCOM wise requirement of selected major materials matching with mobilization of working agencies, completion of survey activities, seasonal acceptance, prioritization of works and availability of fronts

(iv) To finalize volume of materials to be tendered in a lot in line with aggregate project wise/DISCOM wise requirements

(v) Centralised vendor empanelment based on manufacturers' manufacturing capacity at works, technical experience, financial capability, existing type test certification, testing facilities requirements, past performance of supplied equipment, litigation history, jobs in hand etc as required.

(vi) Committee shall submit its report within three weeks i.e. by 5/09/2015.

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Annex-II

Terms of Reference of the Committee-B is as under:-

i. To take action for rate contract of key materials for at least 2 years period as per following:

   a. To finalise pre-qualifying requirements

   b. To invite Expression of Interest (EoI) from empanelled vendors

   c. To invite tenders through e-bidding with provision of reverse auction and splitting of supply order to 2 or more vendors in a zone.

   d. To finalise payment terms with the suppliers

   e. To finalise delivery terms with the suppliers

   f. To finalise transit insurance terms

   g. To finalise post supply guarantee terms with the suppliers

   h. To finalise Manufacturing Quality Plan (MQP), data sheet, drawing

   i. To finalise requisition for pre-dispatch inspection by suppliers

   j. To finalise mechanism for pre-dispatch inspection and issuance of dispatch instructions with the suppliers

ii. To evaluate the proposals and finalise Ex-works rate contract with bidders for a period of 2 years.

iii. To finalise Manufacturing Quality Plan (MQP)

iv. To execute an agreement with the selected agencies for rate contract and to allocate quantum of Materials State wise/DISCOM wise.

v. To coordinate with States to finalise state-wise / DISCOM wise letter of award as per rate contract on submission and acceptance of supply performance guarantee.

vi. To coordinate with States to evaluate performance of execution of supply contract.

vii. To regulate procurement of material among different States/DISCOM through rate contract as per preparedness of State/Discom to effectively utilise materials on time.

viii. Quality Assurance through pre-dispatch/in-process inspection of materials at manufacturer's works.

ix. To devise and finalise mechanism under rate contract for delivery of materials at various States / DISCOM site stores.

x. Committee shall submit its report by 31/10/2015.

*****

Annexure-II:

Minutes of Meetings

Of

Committee-A

First meeting of Committee 'A' held on 22.08.2015 in REC Board Room, New Delhi on MoP Initiative to facilitate States in mobilization of quality equipment/materials at competitive price under DDUGJY and IPDS

The first meeting of the Committee constituted by MOP to facilitate States in mobilization of quality equipment/materials at competitive price under DDUGJY and IPDS was held on 22.08.2015 in New Delhi. The list of participants is at Annex-I.

Chairman of the Committee 'A' welcomed the participants. Member Secretary of the Committee intimated details on formation of committee, Terms of Reference (ToR) and the dead line assigned to complete the assignment thereof.

Term of Reference of the Committee Á'

a. *To prepare and finalize list of major high value materials under sub-transmission & distribution system to be procured from empanelled agencies.*

b. *To prepare the standard technical specifications/ tender drawings / tender data sheet of selected major materials.*

c. *Aggregating project wise/DISCOM wise requirement of selected major materials matching with mobilization of working agencies, completion of survey activities, seasonal acceptance, and prioritization of works and availability of fronts.*

d. *To finalize volume of materials to be tendered in a lot in line with aggregate project wise/DISCOM wise requirements.*

e. *Centralized vendor empanelment based on manufacturers' manufacturing capacity at works, technical experience, financial capability, existing type test certification, testing facilities requirements, past performance of supplied equipment, litigation history.*

Thereafter, Chairperson CEA invited the participants on the approach, action plan and suggestions to complete the assigned tasks by time line of three weeks. The outline of the points discussed and views of participants are as under:

1) <u>Preparing list of high value major items under IPDS & DDUGJY:</u>

a) The representative of REC intimated that based on schedule of rates of one of the states, percentage cost share of various materials in unit length of lines or substation is computed (copy enclosed). It depicts the high value major materials in sub-transmission and distribution works. A list of such materials was presented during the discussion. It includes following items:

(1) Power as well as Distribution Transformers,
(2) Overhead conductors (AAC/ACSR/AAAC)
(3) HT & LT Breakers
(4) Steel Poles (Rail, H-Beam, RS Joist, Steel Tubular Poles)
(5) Energy Meters
(6) LT Distribution Board
(7) HT and LT Power Cables including ABC Cables
(8) Distribution Box for service connection
(9) Capacitor Banks
(10) Lightening Arresters
(11) LED Bulbs
(12) Steel structure materials

b) Based on above, comments from all the participating members were sought to finalise list of high value major materials to be considered under Rate Contract mechanism under IPDS and DDUGJY schemes. Following were the comments of members:

i) The representative of Bihar state intimated that before onset of centrally funded sub-transmission and distribution reform scheme namely APDRP, similar practice of partial turnkey execution was followed by almost all the states to execute sub-transmission and distribution works at site. This concept was changed to total turnkey execution mode. Demerits of Turnkey Execution are now available in all the states. The advantage under turnkey execution mode are day to day Project Management by the contractor, planning and mobilization of all materials under single point responsibilities to contractor. Whereas a key demerit of turnkey execution that item-wise rate are different in different projects in same discom area. He welcome the initiative taken by GoI to address this important demerit.

ii) The representative of Gujarat State stated that all types of Transformer, Conductors, Steel Poles (RS Joist, Steel Tubular and Rail), HT Cables, Capacitor Bank, HT & LT Breakers, Lightening Arrestors, and Energy Meters are to be included in the list of materials to be centrally procured. Rest of the material may allowed under the scope of partial turnkey contractors.

iii) The representative of Madhya Pradesh State stated that LT breaker, GI wire Distribution Box and Cable Box not to be considered through rate contract as there are various vendors available in the states and these items are not high value materials. He requested to include "**feeder metering equipment**" under central procurement plan.

iv) The representative of Rajasthan State opined to exclude Conductor and Energy Meter procurement through rate contract mechanism.

v) The representative of Himachal Pradesh opined to include all the suggested materials for the procurement as depicted in the list through rate contract.

vi) The representative of Utter Pradesh State intimated that all the materials in suggestive list except LT Cables may be procured through rate contract.

vii) The representative of Telangana State suggested to remove small value items like LT Distribution Box, GI Wires, Cable Boxes and LT Cables from the suggestive list of procurement through rate contract.

viii) The representative of PGCIL suggested to include only four key materials namely Power/Distribution Transformers, Overhead Conductors, HT Cables and Energy Meters in the list for procurement through rate contract. To ensure quality of balance sub-transmission and distribution materials, he also suggested to empanel all the prospective vendors but invite quote for above four items only for rate contract.

ix) The representative of PFC suggested to include meters with modem under procurement. He also suggested to include feeder metering equipment under the list.

Concluding the discussions, the committee unanimously decided to include following major materials for central procurement plan:

(1) Power and Distribution Transformers,
(2) All type of Conductors,
(3) HT Breakers with control panel and CTs/PTs,
(4) Steel Poles (RS Joist, H-Beam and Steel Tubular Poles)
(5) HT cables,
(6) AB Cables of 33 KV, 11 KV and LT
(7) Capacitor Banks,
(8) Energy Meters,
(9) Feeder Metering Equipment

2) <u>Finalization of Tech Specifications/drawings and Data sheet:</u>

The representative of REC had intimated that technical specifications of all the major higher value items are available in Standard Bidding Documents of IPDS/DDUGJY schemes. Copy of the same is available on IPDS and DDUGJY web portals. He further added that any change in these specification based on state practices may be suggested to finalize the specification to start process for finalization of rate contract.

Keeping dead line for completion period of assignment by the committee in view, it was decided by the committee members that members shall suggest any

improvement in these specifications by Wednesday i.e. 26.08.2015. In case, no suggestion (s) is received, the existing technical specifications shall be considered fit to initiate action for rate contract finalization.

3) Aggregating major high value materials requirements:

Issue related to zone wise quantities to be considered for rate contract was discussed in detailed. It was unanimously decided to ask States to submit quantities of above high value materials to be considered for procurement centrally by Wednesday i.e. by 26.08.2015.

It was also decided to compute project wise requirements of high value major materials through on-line DPRs submitted by the states under DDUGJY & IPDS. For balance projects which are yet to be sanctioned; it was intimated by REC and PFC that more than 70% IPDS and DDUGJY projects have already been sanctioned by IMMC. The list of materials against those states where DPRs are yet to be framed, are to be extrapolated to arrive at zone wise quantities of materials.

4) Empanelment of Centralized Vendor for Procuring Key Materials

Representative from REC intimated that empanelment of vendors is time taking exercise. It would involve finalization of zone-wise & item-wise pre-qualification requirements, press advertisement, detailed technical & commercial examination of offers received from prospective bidders.

Accordingly, committee discussed various sub-activities involved in empanelment of vendors, their inter-dependencies and their expected completion period in detail. Committee also discussed the ToR of committee B in relation to calling of bids to finalise the rate of contracts. Suggestion were sought from the participating members of the committee to perform empanelment of vendors in three week time period. On this matter, following was opined:

i) The representative of Bihar State was of the view that nature of work is complex and voluminous in nature. Hence, it is not possible to complete the assignment within given time frame of three weeks. He added that finalization of pre-qualification requirement and rate contract are inter-linking activities and therefore these two activities must be assigned to a single committee.

ii) Director General IEEMA and Dy. Director General ITMA opined to assign responsibilities empanelment of vendors to committee-B. However, they raised their concerned over re-constitution of committee-B as IEEMA/ITMA representation is not included in it.

iii) The representative of Gujrat had intimated that activities of empanelment and finalization of rate contract is time taking and therefore be assigned to a single committee. He also apprehended that no single vendor in our

country can manufacture and supply even 50% quantity of single item if we add demands of such material in a zone.

iv) The representative of MP felt that assigned task given by MoP is to be honored. However, he opined that assignment of empanelment and finalization of rate contract is too-time consuming works. He added that it cannot be completed within the given time frame. **He suggested to consider existing approved sub-vendors/manufacturers for finalization of rate contract. All the list of approved vendors may be collected and compiled zone-wise for empanelment and finalization of rate contract.**

Member Secretary stated that the approved vendors are capable to meet the need of state or discom only. However, while empanelling manufactures for zone wise materials, they may not be capable.

v) The representative of Uttar Pradesh State suggested that empanelment and finalization of rate contract may be taken up by Committee-B as both the activities are inter related.

vi) The representative of Rajasthan State also opined that empanelment and finalization of rate contract is time taking and same cannot be completed in the given time frame.

vii) Himachal Pradesh state representative stated that empanelment and finalization of rate contract be given to committee-B as both the activities are co-related.

viii) Telangana state representative suggested that empanelment and finalization of rate contract may be done by committee-B.

ix) The representative of PFC had informed that Standard Bidding Documents (SBD) are available and QR of SBD may be adopted for finalization of vendor as preparation of QR and finalization of vendor shall be time consuming. He further stated that technical capability may be kept in consideration while preparing PQR.

Member Secretary clarified that SBD for DDUGJY/IPDS are related to execution of works and same cannot be used for vendor finalization. Therefore, separate PQR would be needed for vendor empanelment.
Member/PFC also suggested for formation of sub-committees for zone wise evaluation of vendors without considering financial evaluation of vendor. He also suggested to seek States feedback before empanelment and finalization of rate contract.

Chairperson CEA, while concluding the discussions, mentioned that state approved vendors cannot be considered as empanelled vendors under present case. However, he agreed to consider them while finalizing empanelment of vendors. He opined that stipulated time of 3 weeks is too short to perform this activity because

various statutory procedures are to be followed while finalizing list of empanelled vendors for a material. Also, a dedicated cell for this purpose would also be required to be set up for this activity.

On further discussing the matter, Members of the committee were unanimously of the view that empanelment of vendors for various high value materials is a huge task and will not be possible within stipulated time frame of 3 weeks as per the laid procedure for tendering. It would also require a dedicated cell for this tendering & evaluation purposes. Hence, it was unanimously decided that it would be appropriate that this assignment of empanelment may be assigned to committee B or more time (about 6 months)with separate and dedicated cell may be approved to carry out the task by committee A.

5) Next meeting:

Head of committee decided that 2nd meeting of Committee members shall be held on 28.08.2015 at 5 PM in REC office.

Meeting ended with vote of thanks to the Chair.

Annexure-I

List of Participants for 1st Meeting of committee-A on 22.08.2015			
S.No.	**Name of State/CPSU**	**Name**	**Designation**
1	CEA	Shri Major Singh	Chairperson
2		Shri R. K. Verma	Chief Engineer
3		ShriVivekGoel	Director
4	REC	Shri P. J. Thakkar	Director (Technical)
5	PFC	ShriAvkashSaxena	ED (IPDS)
6	Bihar	Shri S.K.P Singh	Director (Project)
7	Gujarat	Shri H.P. Kothari	Superintendent Engineer
8		Shri K.J. Pujara	Executive Engineer
9	Himachal Pradesh	ShriPathania	Superintendent Engineer
10	Madhya Pradesh	ShriNagendraTiwary	Executive Director
11	Telengana	Shri M. Balaraju	CGM (Purchase)
12	Uttar Pradesh	Shri Deepak Mittal	Chief Engineer (MM)
13	Rajasthan	Shri J.L. Meena	Superintendent Engineer (TW)
14		ShriKacholia	Chief Engineer
15	ITMA	Shri A.K. Kaul	Dy. Director General
16		Shri J.M. Malik	Tech. Advisor
17	IEEMA	Shri Sunil Mishra	Director General
18	CPRI	ShriSudhakarReddy	Joint Director
19	PGCIL	Shri S. K. Mishra	General Manager
20		Shri K A Mohan	AGM
21		Shri A. K. Aggarwal	DGM
22	REC	Shri G.S Bhati	General Manager
23	PFC	Shri A K Shrivastava	AGM

Minutes of the Second meeting of Committee 'A' held on 28.08.2015 in REC Board Room, New Delhi on MoP Initiative to facilitate States in mobilization of quality equipment/materials at competitive price under DDUGJY and IPDS

List of participants is enclosed as Annexure.

Chairperson, CEA welcomed the participants in the second round of discussion for Committee A constituted by MOP for identification of major key materials in DDUGJY/IPDS along with their tentative quantities state wise. Chairman apprised the committee members of developments made after first meeting held on 22-8-2015. He informed that Ministry of Power has in-principle agreed to the request of extending time frame upto 6 months for the assignment of empanelling of vendors for centralized procurement of materials and the assignment shall be done by committee-B headed by PGCIL. The summary of point-wise discussion held during the meeting is as under:

1. **Identification of major materials:** Representative of REC appraised the committee that major materials identified for central procurement have already been identified in first meeting , which are as under -
   i. Power and Distribution Transformers,
   ii. All type of Conductors,
   iii. HT Breakers with control panel and CTs/PTs,
   iv. Steel Poles (RS Joist, H-Beam and Steel Tubular Poles)
   v. HT cables,
   vi. AB Cables of 33 KV, 11 KV and LT
   vii. Capacitor Banks,
   viii. Energy Meters,
   ix. Feeder Metering Equipment

2. **Comments on Technical Specification:** GM (DDUGJY), REC informed that no major comments have been received from committee members except PGCIL & ITMA.
   a. PGCIL suggested galvanizing of Steel Poles may be added in the specification. Member Secretary of the Committee requested states representative to convey their views on adaptation of galvanizing of steel poles under DDUGJY/IPDS. MP state representative stated that galvanization is the only alternative for long lasting of Steel Poles. Bihar state representative has opined that in their state poles are never galvanized rather they go for painting. HP representative opined that galvanization of steel tubular is preferable. Based on the discussion, the committee decided for use of galvanized steel poles under DDUGJY & IPDS schemes.

b. ITMA suggested minor correction in the existing technical specification of transformers in percentage impedance and to align in line with IS-1180(Part-I): 2014. Committee agreed to make the corrections in the existing technical specification. Member Secretary of the Committee emphasized that all distribution transformer specification shall conform to IS 1180(Part-1): 2014 and shall comply to quality control order on transformers including amendments issued thereof by Ministry of Heavy Industries & Public Enterprise.

   The committee sought comments of IEEMA on existing technical specifications under DDUGJY& IPDS schemes. It was decided that IEEMA will furnish comments of their members by 02.09.2015.

3. **Estimation of Major Materials Requirement including Smart meters:** Representative of PFC informs the Committee that they had compiled the data regarding tentative quantities of major items based on DPR submitted by state utilities under IPDS scheme. These tentative quantities would be sent to states for validation and states would be requested to confirm the same by Tuesday i.e. 02.09.2015. They have also collected the tentative quantities of smart meters which would also be finalized after confirmation from states.

   The representative of REC intimated that quantities of major high value materials shall be compiled from online DPRs and shall be sent to respective states for validation by 02.09.2015. The states shall be requested to validate quantities of materials by 04.09.2015, so that zone wise compilation of quantities may be finalized before the next meeting of committee.

   It was agreed that next meeting of committee shall held on 07.09.2015 at 11.00AM at REC.

   Meeting ended with vote of thanks to chair.

Annexure-I

List of Participants for 2nd meeting of Committee-A on 28.08.2015			
S.No.	**Name of State/CPSU**	**Name**	**Designation**
1	CEA	Shri Major Singh	Chairperson
2		Shri R. K. Verma	Chief Engineer
3		ShriVivekGoel	Director
4	REC	Shri P. J. Thakkar	Director (Technical)
5	PFC	ShriAvkashSaxena	Executive Director
6		ShriArun Kumar Shrivastva	AGM
7	Bihar	N.K.S Sinha	Director (Project)
8	Himachal Pradesh	ShriSuneel Grover	Chief Engineer
9	Madhya Pradesh	ShriNagendraTiwary	Executive Director
10	Telengana	Shri M. Balaraju	CGM (Purchase)
11	Uttar Pradesh	Shri Deepak Mittal	Chief Engineer (MM)
12	ITMA	Shri A.K. Kaul	Dy. Director General
13		Shri J.M. Malik	Tech. Advisor
14		Sanjay Seth	AVP (Allied Industry)
15	IEEMA	Sri Raj Eswaran	Past President
16		Smt. Anita Gupta	Dy. Director
17	CPRI	ShriSudhakarReddy	Joint Director
18	PGCIL	Shri A. K. Aggarwal	DGM
19	REC	Shri G.S Bhati	General Manager

Minutes of the Third meeting of Committee 'A' held on 7.09.2015 in REC Board Room, New Delhi on MoP Initiative to facilitate States in mobilization of quality equipment/materials at competitive price under DDUGJY and IPDS

List of participants is enclosed as Annexure-I.

Chairperson, CEA welcomed the participants in the Third round of discussion for Committee A constituted by MOP for identification of major key materials in DDUGJY/IPDS along with their tentative quantities state wise. It was noted that no representative from PFC was present during the meeting.

The summary of point-wise discussion held during the meeting is as under:-

1. List of items to be considered for rate contract were reviewed. It was decided to calculate %age implication of the identified high valued materials with respect to the total DPRs received under DDUGJY for analysis. The %age of the major items as per the analysis of the DPRs is at Annex-II

   Based on the analysis, it is noted that the %age of the main high value material with respect to the total cost of equipment (considering 80% of project cost as the cost of materials) are as under-

   Power Transformer (6.31%), Distribution transformers (7.27%), VCB with CT and Panels (1.83%), Meters (whole current) (6.70%), Poles (16.1%), ACSR conductors (16.11%), U/G Cable (3.40%) & AB Cable (26.25%).

   After discussion, it was decided to exclude capacitor bank, HT cable, Steel Tubular Poles, RS Joist, H-Beams & feeder metering equipment from the list of high value items. It was informed by Metering division of IEEMA that some of the tempering features in the meters are state specific and it may not be advisable for all the state to purchase the fixed specification meters, if meters are included under high value central procurement list. Based on the discussion, it was decided that meters may be excluded from the high value items as these may be purchased by the state as per their requirement, however, the general specifications of energy meters, as included in SBD, would be modified based on the comments received to facilitate the states to modify the specifications as per state requirements.

2. It was informed by representative of REC that various comments have been received from ITMA and members of IEEMA on Power Transformers, Breakers, Energy Meters and Cables. It was noted that these comments are to be examined in detail. Accordingly, a core group was formed

under leadership of Shri S K Mishra, GM, PGCIL comprising representative from Himachal Pradesh, Madhya Pradesh, IEEMA and REC. This committee will review the technical specifications of all equipment and would also suggest the modifications in the specifications based on the comments received by the committee on Power Transformer, Distribution Transformer & Vacuum Circuit Breaker. The core Group would complete the exercise by Monday, 14th Sept 2015 and would submit final technical specification to the Committee by 14th Sept 2015.

3. As regarding the finalization of quantities of major equipment, it was intimated by REC that 578 DPRs out of 647 DPRs under DDUGJY have been submitted worth Rs 83,692.28 crores. On the basis of technical appraisal and availability of funds, Monitoring Committee has approved DPRs worth Rs 31,524.54 Crores and DPRs worth Rs8,592.97crores are under consideration. States have to modify the DPRs based on the approved cost and after that only, the requisite quantities may be finalized.

4. It was intimated that quantities of major high value materials were computed from submitted online DPRs and were sent back to States for validation. However, States have requested for some time to prepare supplementary DPR based on project wise sanctioned amount. Accordingly, it was decided to organize 2 day workshop in New Delhi inviting Nodal Officers from the States to finalise quantities of major high value materials on 12th and 13th Sep. 2015 so that the consolidated quantities shall be finalised by Tuesday, 15th Sept. 2015. REC/PFC shall take initiative in this matter.

5. It was decided to prepare draft report of Committee 'A' on Tuesday, 15th Sept. 2015. This report shall be shared with all committee members on 16th Sept 2015.

6. Next meeting of the committee shall be held on 18th Sept 2015 at 04 PM in REC Office, New Delhi.

7. Final report of the committee shall be submitted on 21st Sept 2015.

Meeting ended with a thanks to the Chair.

List of Participants in 3rd Meeting of committee-A on 07.09.2015			
S.No.	**Name of State/CPSU**	**Name**	**Designation**
1	CEA	Shri Major Singh	Chairperson
2		Shri R. K. Verma	Chief Engineer
3		ShriVivekGoel	Director
4	REC	Shri P. J. Thakkar	Director (Technical)
5	Bihar	Shri S.K.P Singh	Director (Project)
6	Gujarat	Shri H.P. Kothari	Superintending Engineer
		Shri K.J. Pujara	Executive Engineer
7	Himachal Pradesh	ShriSuneel Grover	Chief Engineer
8	Madhya Pradesh	ShriNagendraTiwary	Executive Director
9	Telengana	Shri M. Balaraju	CGM (Purchase)
10	Uttar Pradesh	Shri Deepak Mittal	Chief Engineer (MM)
11	Rajasthan	Shri J.L. Meena	SBC (TW)
12	ITMA	Shri A.K. Kaul	Dy. Director General
13		Shri J.M. Malik	Tech. Advisor
14	IEEMA	Shri Sunil Mishra	Director General
15		Smt. Anita Gupta	Dy. Director
16		Shri Sunil Singhvi	Vice Chairman (Smart Grid)
17	CPRI	ShriSudhakarReddy	Joint Director
18	PGCIL	Shri S.K.Mishra	General Manager
19		Shri A. K. Aggarwal	DGM
19	REC	Shri G.S Bhati	General Manager

Minutes of the Fourth & Final meeting of Committee 'A' held on 18.09.2015 in REC Board Room, New Delhi on MoP Initiative to facilitate States in mobilization of quality equipment/materials at competitive price under DDUGJY and IPDS

List of participants enclosed at Annexure-I.

Chairperson, CEA welcomed the participants in the meeting. Member Secretary of the Committee and Director (Tech), REC briefed the committee on the development& progress made on the decisions taken during the 3rd meeting of the committee. It was noted that no representative of PFC attended the meeting.

Chairman of the committee stated that the committee has already taken more that the allotted time and this forth meeting would be the final meeting. The committee has to work vigorously so that the report may be submitted to MOP within next week. The summary of the discussion and decision taken in the meeting are as under-

Identification of Major materials:

It was informed that after detailed discussion during last 3 meetings, the final list of key high value major materials have already been finalised by Committee A as under:

i. Power and Distribution Transformers,
ii. All type of Conductors,
iii. HT Breakers with control panel and CTs/PTs,
iv. AB Cables of 33 KV, 11 KV and LT

Matter related to include meters in major high value material list was again discussed in detail. It was intimated by IEEMA that various States are following various specifications of meters as per their requirements for prevention of theft and data fetching mechanism. Hence, it would be appropriate to leave this item for State to procure as per their specific requirement. However, after detailed discussions and looking at huge volume of consumer meters to be procured, committee decided to include meters under list of major high value materials. It was also decided that REC would find out the %age cost of the identified high valued materials with respect to the total cost of DPRs received under DDUGJY before including these in the final report.

Finalization of Standard Technical Specifications

It was informed that a sub-committee was framed under leadership of GM (QA), PGCIL to discuss and finalize the technical specifications of Power Transformer, Distribution Transformer and Vacuum Circuit Breaker etc based on the comments furnished by ITMA / IEEMA members. The sub-Committee met on 09.09.2015 at PGCIL and discussed all issues raised by ITMA / IEEMA and finalized the specifications.

As regarding the specifications of meters, it was informed that based on the comments received from IEEMA members, the metering division of IEEMA has already examined the specifications and have furnished the revised specifications as agreed by all the IEEMA members. During discussion, GM, REC has apprised the committee that some comments have been received from CMD, MPMKVVCL, Bhopal on meters. It was decided that sub-committee headed by GM (QA), PGCIL should also see various suggestions given by IEEMA and MP to finalize the specifications of meters.

It was intimated to committee that IEEMA has again submitted suggestions on technical specifications of Power/Distribution Transformer, HT Breakers, AB Cable, Meters and Conductors till afternoon that day and these suggestions were yet to be examined. After detailed discussion and feedback from State representatives, it was decided that sub-committee earlier formed under leadership of GM (QA), PGCIL shall discuss the comments submitted by ITMA / IEEMA on 21st Sept 2015 for Power/Distribution Transformer, HT Breakers, AB Cable and Conductors specifications and on 22nd Sept 2015 for Energy Meter at PGCIL Corporate Office, Gurgaon. It was decided to invite representative from States having expertise in technical specifications of major items to participate in the discussion. It was also decided to invite CMD, MP MKVVCL, Bhopal to participate in finalization of meter specification on 22-9-2015.

ITMA / IEEMA has proposed for inclusion of inbuilt LT protection system in technical specification of distribution transformer. It was informed that this matter was earlier discussed by sub-committee on 09.09.2015and GM (QA), PGCIL opined that the deterioration of transformer oil due to quenching of arc in inbuilt MCCBs may destroy insulating properties of transformer oil which may further lead to failure of Distribution Transformer. He desired that data pertaining to deterioration of transformer oil vis-à-vis nos. of faults attended in inbuilt LT protection system should be studied and analyzed before including

this provision in the specification of Dist Transformers. It was also noted that IS 1180 which is recently amended by BIS does not specify in-built LT protection mechanism and this type of Distribution Transformers may require a separate IS. Chief Engineer (DPD), CEA opined that as per CEA regulations, Dist transformers should be as per IS and ITMA may take up the matter to amend the existing IS or to prepare new IS for completely self-protected (CSP) transformers. The committee decided that at this time, it may not be appropriate to include inbuilt LT protection system in the specifications of Distribution transformers.

Aggregation of quantity of major materials

It was informed that as decided during 3rd meeting, a consultative workshop was organized by REC & PFC inviting all the States to finalize quantities of major high value materials on 12th& 13th Sept. 2015 at New Delhi. In this workshop, representatives of various States (Copy of attendance sheet enclosed at Annex-II) have submitted requirement of high value materials under DDUGJY /IPDS. The possibility was also explored to incorporate requirement of materials pertaining to schemes being funded under JICA, World Bank etc in the states. However, States intimated that financial institution like JICA, World Bank etc enforce their own methodology for execution of work at site. Hence, States representatives have shown their inability to consider quantities under those projects. The final quantities as submitted by the states for major items under DDUGJY and IPDS are as under-

DDUGJY

S. No.	Name of Material	Unit	Aggregate Quantity proposed under DDUGJY	Aggregate Quantity proposed under IPDS	Total Quantity
1	Power Transformer	Nos.	3,233	3,247	6480
2	Distribution Transformer	Nos.	2,80,595	98,574	3,79,169
3	VCB with CT & Panel	Nos.	20,207	10,300	30,507
4	ACSR Conductor	Km	7,94,251	2,28,908	10,23,159
5	LT AB Cable	Km	1,11,539	91,175	2,02,714

However, the details of state wise quantities would be submitted with the final report.

Concluding the discussion, chairman of the committee decided that report of the committee must be prepared by Tuesday evening i.e. 22nd Sept 2015 incorporating various suggestions received from ITMA / IEEMA & States and the decisions taken by the sub-committee, thereof. These reports shall be shared with State representatives through email and the comments from States shall be invited by Thursday i.e. 24th Sept 2015 so that the Final Report may be submitted to the Ministry by Thursday i.e. 24th Sept 2015 positively. It was decided that finalized technical specification of major high value materials would be Annexure to the report along with uploading on website of DDUGJY/IPDS.

The meeting ended with a thanks to the chair.

Annexure-I

List of Participants

S.NO.	Name of State/CPSU	Name	Designation
1	CEA	Shri Major Singh	Chairperson
2		Shri R. K. Verma	Chief Engineer
3		ShriVivekGoel	Director
4	REC	Shri P.J. Thakkar	Director(Technical)
5	Himachal Pradesh	ShriSuneel Grover	Chief Engineer
6	Madhya Pradesh	ShriNagendraTiwary	Executive Director
7	Telangana	Shri M. Balaraju	CGM(Purchase)
8	Uttar Pradesh	Shri Deepak Mittal	Chief Engineer (MM)
9	Bihar	Shri S N Sinha	Resident Engineer
10	ITMA	Shri P.K. Jain	Ex. President(ITMA) / MD Kotsons Pvt. Ltd
11		Shri J. M. Malik	Tech. Advisor
13	IEEMA	Shri Sunil Mishra	Director General
14		Shri J. Pande	Sr. Director
15		Smt Anita Gupta	Dy. Director
16	CPRI	Shri Sudhakar Readdy	Joint Director
17	PGCIL	Shri S.K. Mishra	General Manager
18		Shri A.K Aggarwal	DGM
19	REC	Shri G. S. Bhati	General Manager

Annexure-II

List of Participants in workshop organized for aggregation of quantities

S. No.	Name	Designation	Name of DISCOM
1	HarhVardhan Sahu	AE	MPPKVVCL, MP
2	Raj Kumar	EEE	JBVNL, Jharkhand
3	Sant Ram Garg	Sr. Executive	HPSEBL
4	Sarat Chandra Upadhyaya	GM (Project) to RMS	NESCO, Odisha
5	Surender Kota	AGM, Work & Planning	WESCO, Odisha
6	Prabhat Kr. Mohanti	Assistant Manager CESU, BBSR	CESU, Odisha
7	S. K. Senapati	GM, Planning & Monitoring	CESU, Odisha
8	M.P Gangane	SE, MSEDCL	MSEDCL
9	S.K Roy	Addl. CE Projects	MSEDCL
10	A.C Bir	SE, Projects2	WBSEDCL
11	S. Parisaras	SM	TSECL
12	SanjibNendy	SM	TSECL
13	JN Talsaniga	DE	PGVCL, CO
14	PK Pala	Ex. Engineer	PGVCL, CO
15	Aditya Kumar	Ex. Engineer	NBPDCL
16	Md. Obaidullah	Ex. Engineer	SBPDCL
17	Ravinder Singh	SDO	DHBVNL, Hisar
18	S.K Chhabra	SE	DHBVNL, Hisar
19	S.K Sharma	AEE	UHBVNL
20	Inderjeet Singh Gill	Addl SE	PSPCL
21	O.S Bhambra	Addl SE	PSPCL
22	Parminder Singh	AEE	PSPCL
23	Nain Garg	Dy. CE	PSPCL
24	S.R Nagaraja	DGM	Project, BESCOM
25	S.K Agarawal	GM	MPPKVVCL, MP
26	SR Yemde	DGM	MPPKVVCL, MP
27	AnuvratMehrotra		PSPCL
28	Naveen Jain	XEN	JVVNL
29	A.K Singhal	XEN	JVVNL
30	AmiyaBehera	Sr. Manager	NPTI
31	Sheela M Daniel	RE, KSEBR	KSEBL, Travause house, new delhi
32	sreija R.S	Officer on special duty	KSEBL, Travause house, new delhi
33	javed Y. Dar	SE	JKPDD, Kashmir

S. No.	Name	Designation	Name of DISCOM
34	R.K Agarwal	DGM	MPMKVVCL, Bhopal
35	R.K Malviya	DGM	MPMKVVCL, Bhopal
36	T.K Sharma		UHBVN, Haryana
37	SrinivasaBabu	DGM	BESCOM, CO, Banagalore
38	AdityaKalgaonkar	Manager	MPPKVVCL, Jabalpur,M.P
39	S.K Senapathy	G.M	CESU
40	D.K Garg	C.E	MVVNL, Lucknow
41	R.K Dhiman	Addl. S.E.,	HPSEBL, ED Nalagarh, H.P
42	Y.R Saulanke	S.E	DGVCL, Gujrat
43	Sachet Parida	Manager	Feedbackinfra, OPTCL, Odisha
44	P R Gupta	Executive Engineer	UGCL, R&C Off, Mehsana Gujarat
45	CJ Rajpal	Executive Engineer	UGCL, R&C Off, Mehsana Gujarat
46	V P Singh	SE	AVVNL
47	Brajendrakumar	xen	AVVNL
48	MK Jaiswar	Sr. DE	MECON
49	Ajay Kumar	Executive Engineer	South Co Odisa
50	Dinesh R Sabw	CE	MEDCL, Mumbai
51	Satish Chand	SE	UPPCL
52	S D S Bisht	EE	UPCL, Dehradun
53	H M Patel	COA	MEVCL
54	H M Sharma	RE	APDCL
55	Deepak Mittal	CE	DVVNL

Annexure-III

Details of
Per Unit Rates
&
Weightage of
Key High Value Materials

Billing Breakup of 33/11 KV Power Substation

Description : (I) 3.15 MVA, 33/11 KV S/S. Expandable to 2 X 3.15 MVA with Control room and four nos. 11 KV Outgoing Feeder with 600 KVAR Capacitor bank

Total Cost: 9110544

S.NO.	Item Description	% amount w.r.t total cost
1	Power Transformer 33/11 KV OFTC 3150 KVA	25-28%
2	33 KV VCB, Outdoor Porcelain clad type with complete structure and accessories	8-10%
3	H- BEAM 7, 9 & 11 METER 152 X 152 MM 37.1 KG/METER	6-8%
4	11 KV VCB, Outdoor Porcelain clad type with complete structure and accessories	4-6%

Description: (II) 5 MVA, 33/11 KV S/S. Expandable TO 2 X 5 MVA with Control room and four nos. 11 KV Out going Feeder with 1500 KVAR Capacitor Bank including protection

Total Cost: 9212532.21

S.NO.	Item Description	% amount w.r.t total cost
1	Power Transformer 33/11 KV OFTC 3150 KVA	25-28%
3	33 KV VCB, Outdoor Porcelain clad type with complete structure and accessories	8-10%
4	H- BEAM 7, 9 & 11 METER 152 X 152 MM 37.1 KG/METER	6-8%
6	11 KV VCB, Outdoor Porcelain clad type with complete structure and accessories	4-6%

Billing Breakup of 33 KV Line

Description: 33 KV line on 280 kg., 9.1 Mtr. Long PCC poles with Raccoon Conductor with Average Span of 70 Mtr

Total cost: **253665**

S.no	Description	%age amount w.r.t. Total cost
1	ACSR Raccoon conductor 0.075 sq. Inch (80 sq.mm. Al.eq.)	52-55%
2	9.1 Mtr. Long PCC poles 280 kg	15-18%

Description : 33 KV line on 280 kg., 9.1 Mtr. Long PCC poles with DOG conductor with average span of 70 Mtr.

Total cost: **293345**

S.no	Description	%age amount w.r.t. Total cost

1	ACSR DOG conductor 0.10 sq. Inch (100 sq.mm. Al.eq.)	58-62%
2	9.1 Mtr. Long PCC poles 280 kg	12-15%

Discription: 33 KV line on H-beams 152 x 152 mm., 37.1 kg./Mtr. 13 Mtr. Long supports with DOG conductor with average span of 70 Mtr

Totalcost :**618754**

S.no	Description	%age amount w.r.t. Total cost
1	ACSR DOG conductor 0.10 sq. Inch (100 sq.mm. Al.eq.)	26-30%
2	H-beams 152 x 152 mm., 37.1 kg./Mtr. 13 Mtr.	53-57%

Billing Breakup DTR Substation

Description:11/0.4 KV Distribution Transformer Substation using 16 KVA 3-ph Aluminium wound DTR on 175x85mm.,11.0 mtrs. Long RS joist Pole supports

Total Cost: **185705**

SL.No.	Item Description	%age amount w.r.t. total cost
1	3- Phase DTR 11/0.4 kV conventional 3 star rating type 16 kVA	12-14 %
2	R S JOIST 11 METER 175X85MM	50-55 %

Description:11/0.4 KV Distribution Transformer Substation using 16 KVA 3-ph Aluminium wound DTR on 140 kg., 8.0 mtrs. Long PCC pole supports or PCC support (pole) as per state practice.

Total Cost: 88580

SL.No.	Item Description	%age amount w.r.t. total cost
1	3- Phase DTR 11/0.4 kV conventional 3 star rating type 16 kVA	25-30 %
2	PCC pole 140 kgs 8 mtrs. long	3-5%

Description:11/0.4 KV Distribution Transformer Substation using 63 KVA Aluminium wound on 152 x 152 mm 37.1 kg/meter, 11.0 mtrs. Long H-beam pole supports.

Total cost: 188030

SL.No.	Item Description	%age amount w.r.t. total cost
1	3- Phase DTR 11/0.4 kV conventional 3 star rating type 63 kVA	45-46 %

2	H- beam 11 meter 152 x 152 mm 37.1 kg/meter	20-22 %

Description:11/0.4 KV Distribution Transformer Substation using 100 KVA Aluminium wound DTR on 175x85mm., 11.0 mtrs. Long RS joist Pole supports.

Total cost:298177

SL.No.	Item Description	%age amount w.r.t. total cost
1	3- Phase DTR 11/0.4 kV conventional 3 star rating type 100 kVA	38-40 %
2	R S joist 11 meter 175x85mm	33-35 %

Description:11/0.4 KV Distribution Transformer Substation using 100 KVA Aluminium wound DTR on on 140 kg.,8.0mtrs. Long PCC pole supports or PCC (pole) as per state practice

Total cost: 201052

SL.No.	Item Description	%age amount w.r.t. total cost
1	3- Phase DTR 11/0.4 kV conventional 3 star rating type 100 kVA	55-58 %
2	PCC pole 140 kgs 8 mtrs long	1-2%

Billing Breakup of 11 KV Line

Description: 11 KV three phase line on 152 x 152 mm, 37.1 kg/mtr. 11 mtr. long H-Beam with ACSR 'RACCOON' Conductor average span of 70 mtr
Total Cost: 486850

S.No.	Item Description	%age amount w.r.t. total cost
1	H-Beam, 152 x 152 mm, 37.1 kg/mtr. 11 mtr. long	50-55%
2	Conductor	20-25%

Description: 11 KV three phase line on 140 kg., 8.0 mtrs. long PCC Poles with ACSR 'RABBIT' Conductor Average Span of 83 mtr.
Total Cost: 144756

S.No.	Item Description	%age amount w.r.t. total cost
1	PCC Pole 140 Kg., 8 mtrs. long	10-15%

2	Conductor	60-65%

Description: 11 KV three phase line on Steel Tubular Poles 540 SP 52 (IS 2713-Part I, II, III-1980) 11 mtr. Long with AB Cable3x95+1x80 sq.mm. average span 50 mtrs.
Total Cost: 953704

S.No.	Item Description	%age amount w.r.t. total cost
1	Steel Tubular Poles 540 SP 52 (IS 2713-Part I, II, III-1980) 11 mtr. Long	30-35%
2	11 KV ARIAL BUNCH CABLE 3X95+1X80 SQMM	50-55%

Description: 11 KV three phase line on Steel Tubular Pole 540 SP 52 (IS 2713-Part I, II, III-1980) 11 mtr. Long with ACSR 'RACCOON' Conductor average span of 50 mtr.
Total Cost: 429618

S.No.	Item Description	%age amount w.r.t. total cost
1	Steel Tubular Poles 540 SP 52 (IS 2713-Part I, II, III-1980) 11 mtr. Long	50-55%
2	Conductor	25-30%

Description: 11 KV three phase line on Steel Tubular Pole 540 SP 52(IS 2713-Part-I, II, III-1980) 11 mtr. long with ACSR 'WEASEL' Conductor average span of 70 mtr.
Total Cost: 347397

S.No.	Item Description	%age amount w.r.t. total cost
1	Steel Tubular Poles 540 SP 52 (IS 2713-Part I, II, III-1980) 11 mtr. Long	65-67%

Billing Breakup of LT Line

Description: LT Line 3 phase 5 wire on RS joist support using aerial bunched XLPE cable (3x50 Sq.mm + 1x35 sq.mm Insulated Neutral Cum Messenger +1x16 sq.mm) with maximum span of 50 meters

Total Cost: 416084.00

S.NO.	Item Description	% amount w.r.t total cost
1	RS joist 9.3 Meter 175x85mm	45-50%
2	LT XLPE Air Bunch Cable	30-35%

Description: LT Line 3 phase 5 wire on RS joist support using aerial bunched XLPE cable (3x35 sq.mm+1x35 sq.mm insulated neutral cum messenger +1x16 sq.mm) with maximum span of 50 meters

Total Cost:391354.40

S.NO.	Item Description	% amount w.r.t total cost
1	RS joist 9.3 Meter 175x85mm	47-50%
2	LT XLPE Air Bunch Cable	25-30%

Description: LT Line 3 phase 5 wire on RS joist support using aerial bunched XLPE cable (3x25 sq.mm+1x35 sq.mm insulated neutral cum messenger +1x16 sq.mm) with maximum span of 50 meters

Total Cost: 384531.50

S.NO.	Item Description	% amount w.r.t total cost
1	RS joist 9.3 Meter 175x85mm	48-53%
2	LT XLPE Air Bunch Cable	20-25%

Description: LT Line 3 phase 5 wire on RS joist support using aerial bunched XLPE cable (3x16 sq.mm+1x16 sq.mm insulated neutral cum messenger +1x25 sq.mm) with maximum span of 50 meters

Total Cost: 384531.50

S.NO.	Item Description	% amount w.r.t total cost
1	RS joist 9.3 Meter 175x85mm	47-52%
2	LT XLPE Air Bunch Cable	20-25%

Description: LT Line 3 phase 5 wire on PCC support using aerial bunched XLPE cable (3x50 sq.mm + 1x35 sq.mm insulated neutral cum messenger +1x16 sq.mm) with maximum span of 50 meters

Total Cost: 245455.00

S.NO.	Item Description	% amount w.r.t total cost
1	PCC pole 140 kgs 8 mtrs. long	12-18%
2	LT XLPE Air Bunch Cable	50-55%

Description: LT Line 3 phase 5 wire on PCC support using aerial bunched XLPE cable (3x50 sq.mm + 1x35 sq.mm insulated neutral cum messenger +1x16 sq.mm) with maximum span of 50 meters

Total Cost: 220725.40

S.NO.	Item Description	% amount w.r.t total cost
1	PCC pole 140 kgs 8 mtrs. long	15-20%
2	LT XLPE Air Bunch Cable	44-49%

Description: LT Line 3 phase 5 wire on PCC support using aerial bunched XLPE cable (3x25 sq.mm+1x35 sq.mm. insulated neutral cum messenger +1x16 sq.mm) with maximum span of 50 meters

Total Cost: 213902.50

S.NO.	Item Description	% amount w.r.t total cost
1	PCC pole 140 kgs 8 mtrs. long	15-20%
2	LT XLPE Air Bunch Cable	42-47%

Description: LT Line 3 phase 5 wire on PCC support using aerial bunched XLPE cable (3x16 sq.mm+1x16 sq.mm. insulated neutral cum messenger +1x25 sq.mm) with maximum span of 50 meters

Total Cost:213902.50

S.NO.	Item Description	% amount w.r.t total cost
1	PCC pole 140 kgs 8 mtrs. long	15-20%
2	LT XLPE Air Bunch Cable	45-50%

Weightage of Rates of high value key materials to be procured under DDUGJY Scheme

Name of State : Madhya Pradesh						
Sl.No.	**Name of key material**	**Unit**	**Total**	**Total Value of Item**	**Total Material Cost (Rs)**	**Weigtage of Material w.r.t DPR cost**
1	Power Transformer	No.	663	2,106,430,560.00	24,428,880,000	9%
2	Distribution Transformer	No.	30,995	2,305,949,527.50	24,428,880,000	9%
3	VCB	No.	1888	325,279,836.00	24,428,880,000	1%
4	Energy Meter (1-Phase, 3-Phase,DTR & 11 KV Feeder)	No.	1890573	1,647,903,600.00	24,428,880,000	7%
5	Conductor	Km.	79325	2,747,479,344.30	24,428,880,000	11%
6	LT AB Cable	Km.	20707	2,045,031,325.00	24,428,880,000	8%

Name of State : West Bengal						
Sl.No.	**Name of key material**	**Unit**	**Total**	**Total Value of Item**	**Total Material Cost (Rs)**	**Weigtage of Material w.r.t DPR cost**
1	Power Transformer	No.	748	2,865,960,088	33,927,280,000	8%
2	Distribution Transformer	No.	25141	1,564,732,275.00	33,927,280,000	5%
3	VCB	No.	1971	339,992,579	33,927,280,000	1%
4	Energy Meter (1-Phase, 3-Phase,DTR & 11 KV Feeder)	No.	1397696	1,118,201,200.00	33,927,280,000	3%
5	Conductor	Km.	102893.35	3,631,150,055	33,927,280,000	11%
6	LT AB Cable	Km.	22587	2,637,990,108	33,927,280,000	8%

Name of State : Tamil Nadu						
Sl.No.	**Name of key material**	**Unit**	**Total**	**Total Value of Item**	**Total Material Cost (Rs)**	**Weigtage of Material w.r.t DPR cost**
1	Power Transformer	No.	1158	3,994,764,180	7,707,040,000	52%
2	Distribution Transformer	No.	443	23,622,610	7,707,040,000	0%
3	VCB	No.	955	173,600,075	7,707,040,000	2%
4	Energy Meter (1-Phase, 3-Phase,DTR & 11 KV Feeder)	No.	1194914	1,168,741,600.00	7,707,040,000	15%
5	Conductor	Km.	8859	306,312,150	7,707,040,000	4%
6	LT AB Cable	Km.	15	1,753,200	7,707,040,000	0.02%

Name of State : Bihar						
Sl.No.	**Name of key material**	**Unit**	**Total**	**Total Value of Item**	**Total Material Cost (Rs)**	**Weigtage of Material w.r.t DPR cost**
1	Power Transformer	No.	4984	15,856,018,680	46,617,840,000	34%
2	Distribution Transformer	No.	70776	2,878,601,864	46,617,840,000	6%
3	VCB	No.	2517	450,530,025	46,617,840,000	1%
4	Energy Meter (1-Phase, 3-Phase,DTR & 11 KV Feeder)	No.	1023432	978,445,200.00	46,617,840,000	2%
5	Conductor	Km.	94825	2,981,551,840	46,617,840,000	6%
6	LT AB Cable	Km.	0	-	46,617,840,000	0%

~Total Material Cost is taken as 80% of Total DPR cost

Annexure-IV

Minutes of Meetings of Sub-Committee

Minutes of the meeting of held to discuss the comments regarding TS of POWER & Distribution Transformers and VCBs held on 09.09.2015 in POWERGRID, Gurgaon under MoP Initiative to facilitate States in mobilization of quality equipment/materials at competitive price under DDUGJY and IPDS

List of participants is enclosed as Annexure.
As decided in the meeting of Committee "A" held on 7.9.15 , the core group consisting of the members from POWERGRID, REC, MP , HP , ITMA and IEEMA met on 9.9.15 in POWERGRID Corporate office , Gurgaon to discuss the comments received on of POWER & Distribution Transformers and VCBs.

The following was discussed:

A. 3.15/5/6.3/8/10/12.5 MVA Power Transformers

1. Clause 1.2 Page 1& 7.4.2

Representatives of IEEMA submitted that core material need not be specified since losses have been standardized. They also reiterated that specifying a particular type of core material will increase demand for this type of material leading to higher cost. ITMA member confirmed that there is sufficient availability of HIB grade of CRGO steel and for the transformers above 3.1 5 MVA HIB grade of CRGO can be specified.

Accordingly, it was agreed to specify the HIB grade of BIS certified CRGO steel for all transformers above 3.1 5 MVA.

2. Point 22& 29, Clause 2.0

BIL for 11KV winding and bushing were discussed and it was decided to specify 75 kVp (1.2 / 50 microsecond wave shape Impulse) instead of 95 KVp.

3. Point 26, Clause 2.0

Indicated temperature rises for power transformer was discussed. POWERGRID emphasized that lower temperature rise will help in reduction of transformer failure. Therefore, it was decided that the temp rise of 40/45deg C for oil/winding for power transformers will be maintained.

4. Point 30, Clause 2.0

Material of HV & LV Conductor discussed and it was decided that it will be Electrolytic Copper only.

5. Point 31, Clause 2.0

It was decided that no current density in winding shall be specified.

6. Point 32, Clause 2.0

Polarization index was discussed. It was agreed the point, as printed, was not clear due to format of the table. It was further decided that

a) Ratio of megger values at 600 Sec : megger values at 15 Sec will not be less than 1.5
b) Ratio of megger values at 600 Sec : megger values at 60 Sec will not be more than 5

The above will be valid for all the three combinations i.e. HV to LV, HV to Earth and LV to earth

7. Point 21 of clause no-2& Clause 7.4.2

It was decided that the Maximum Flux Density in any part of the core and yoke at rated MVA, rated voltage i.e 33 KV / 11 KV and system frequency of 50 HZ shall be 1.69 Tesla instead of 1.5 Tesla as mentioned in clause 7.4.2. Accordingly, the Maximum flux density at continuous operation at 112.5% of rated voltage and system frequency shall be 1.9 Tesla. Therefore, **Point No. 21 of Cl. 2** will be changed to include **" 112.5 % of rated voltage"** instead of **"rated voltage"**

8. Clause 8.2.1.1

Short circuit test will be specified as a **"Special Test"** instead of **"Type Test** as per IS 2026.short circuit test. It was also decided that this will be a mandatory test for each design and no exception will be allowed on this issue.

9. Clause 8.2.3, point (xii).

Issued regarding tests on off load tap changer was discussed and it was decided this will be tested as per IS 2026 instead of IEC: 214/1976 and BS4571/ 1970.

Apart from above, losses and percentage impedance of power transformer were also discussed and on suggestions of representative of ITMA, it was decided to specify the same as given below

Trf. Rating (MVA)	No-load losses (Fixed loss) KW	Load losses at 75°C KW	Percentage impedance voltage on normal tap and MVA base at 75° C
3.15	3	16	7.15
5	4	23	7.15
6.3	4.6	36	7.15
8	5.5	40	8.35
10	7	50	8.35
12.5	7.5	65	10

B. Comments on Distribution Transformer:

1. Outdoor Type Single Phase Oil Immersed Distribution Transformers

It was discussed that as per present practice, the DTs are taken with 3 star rating which is equivalent to Energy Efficiency Level 1 as specified in IS 1180 Part-1/2014. It was also discussed that MoP is actively considering to revise the minimum acceptable quality to Energy Efficiency Level 3 from Level 1. In view to achieve better energy efficiency , it was decided to accept DT with Energy Efficiency Level 2 or above.

The same will also be valid for 3 phase **Distribution Transformers 11 kV/433 – 250V and 33 kV / 433-250V**

2. It was also decided to mention in TS that anything not specifically mentioned in TS will be governed by IS 1180 Part-1/2014. It was also decided that various parameters specified in TS will be checked with the values specified in IS 1180 Part-1/2014 and in case of conflict, the same shall also be revised.

3. Internal LTCB in DT: it was discussed that if a LTCB is provided internal to DT i.e oil immerged in tank, there are chance of oil contamination due to frequent operations of this LTCB which may lead to DT failure. To avoid this, it was decided to provide a LTCB/MCCB external to DT.

C. VCB:

Interrupting capacity of 1500MVA and short circuit rating of 25KA for 3 sec for both 11kv and 33kv vacuum circuit breaker is mentioned at S.No-v & viii of clause.2 . It was discussed and decided to delete Interrupting capacity parameter from specification as it is not required to specify when short circuit rating is already specified.

GIS and RMU may be required under IPDS scheme and M/s Siemens has requested to include specification of GIS and RMU in SBD.

Annexure-I

List of Participants for 1st Meeting of Sub - committee-A on 09.09.2015			
S.No.	**Name of State/CPSU**	**Name**	**Designation**
1	PGCIL	Shri B. P. Gantayat	Executive Director
2		Shri S.K. Mishra	General Manager(QA-I)
3		Shri Atul Aggarwal	DGM
4		Shri Navin Kumar Jain	AGM
		Shri Raghavendra Singh	Manager
5		Shri Richak M Das	Sr. Engineer
6	Himachal Pradesh	Shri Rajesh Kr. Pathania	SE
7	Madhya Pradesh	Shri S. P. Ingold	DGM
8	IEEMA	Shri Sunil Misra	Dy. General
		Shri J. Pande	Sr. Director
	ITMA	Shri J. M. Malik	Tech. Advisor
9	REC	Shri RanjitRanjan	Dy. Manager
10	CGL	Shri GautamTewari	AGM
		Shri Thomas Geevarghese	Manager
11	Simens	Shri O M Dighe	Manager

Minutes of the meeting of held to discuss the comments regarding TS held on 21.09.2015 in POWERGRID, Gurgaon under MoP Initiative to facilitate States in mobilization of quality equipment/materials at competitive price under DDUGJY and IPDS

<table>
<tr><th>Sr.</th><th>Cl./ pg. no</th><th>As per DDGJY Technical S</th><th>IEEMA's Recommendations</th><th>Decision of the Sub-Group</th></tr>
<tr><td colspan="5">As the onset it was decided that latest amendment would mean the latest version available as on date of bid opening.</td></tr>
<tr><td>1</td><td>cl.1.2.pg.5</td><td>The maximum flux density at normal voltage and frequency shall not be more than 1.9 Tesla.</td><td>The maximum flux density at normal voltage and frequency shall be such that it should under 10% over voltage condition not exceed 1.90 Tesla. Clause No. 2.20 of the technical specification shall be revised accordingly.</td><td>It was decided that since there is no mention of flux density in IS: 2026, the flux density for DT above 200 KVA and full range of 33/11 kV power transformers will be governed by cl no. 6.9.1 of IS: 1180 (Part 1) -2014.</td></tr>
<tr><td>2</td><td>cl.2.15.pg.6</td><td>Percentage impedance :
<table><tr><th>MVA</th><th>Impedance</th><th>Tolerance</th></tr><tr><td>3.15
5.00
6.30
8.00
10.0
12.5</td><td>6.25
7.15
7.15
8.35
8.35
10.0</td><td>+10%
No negative tolerance.</td></tr></table></td><td>For reliability point of view of the Transformer, only positive tolerance should be there. For Impedance values we should align with the IS 2026. For 12.5 MVA, 10% Impedance and for 3.15MVA 7% shall be the logical choice.</td><td>The point was discussed in the meeting dated 16.9.15 which was attended by members from IEEMA & ITMA also. It was agreed that the values as decided the values of Percentage impedance finalized in the meeting dated 16.9.15 will be followed. (Refer</td></tr>
</table>

Sr.	Cl./ pg. no	As per DDGJY Technical S	IEEMA's Recommendations	Decision of the Sub-Group
				S.No. 9 of MoM dated 16.9.15)
3	cl.2.18.pg.6	Tapping range +5% to -15% in 9 equal steps of 1.25%	For tapping range of +5% to -15%, the number of steps can be 8 (9 tap positions) with equal steps of 2.5% each. This typographical error in the SBD may please be rectified.	Proposal of IEEMA was accepted.
4	cl.7.7.4.pg.19	Table of oil parameters.	All parameters should be as per IS:335. IS: 335 is under revision and soon the revised version of IS: 335 will come. Existing table in clause 7.7.4 of page 19 may please be removed and reference to IS 335 may be given.	It was decided that the table at clause 7.7.4 shall be replaced with " The oil parameters shall be as per Table 1 on ISD:335 "
5	cl.7.9.3.pg.22	Oil preservation equipment diaphragm type is specified. i.e. Aircell/ COPS.	Sooner or later down the line, we may have to switch over to Natural Esters, so Aircell/COPS would be a good choice. For biodegradable oil filled transformers, breathers are not required,	Point was noted . However no change in TS was recommended on this account.

Sr.	Cl./ pg. no	As per DDGJY Technical S	IEEMA's Recommendations	Decision of the Sub-Group
			accordingly, Aircell/COPS (constant oil pressure system) may be considered. NO CHANGE in the specification	
6	cl.7.11.1	OLTC as-well as off load type tap changer both are specified.	Only OLTC is specified in clause 2.18 of page 6 of technical specifications. Detailed specification of OLTC may please be included in the SBD.	It was decided that details of OLTC would be included in SBD. ***(Draft specification of OLTC is attached.)***

7.	Standard Ratings in kVA-Clause no.1.5.1 of pg no.36 & cl. no. 6.1 of pg no. 40 : 6.3,7.5,10,16 & 25And 70, 95 and 125 kVA	Non-standard ratings should be avoided. All the ratings in SBD may be in line with IS: 1180(Part-1)/2014.	It was decided that ratings shall be as per cl. 6.1 of IS: 1180 (Part 1) -2014.
8.	Secondary voltage in volts- Cl. no.4.2 of pg no. 39: 230	All voltage should be as per IS 1180:Part-1/2014	It was decided that rated voltage shall be as per cl. 6.5 of IS: 1180 (Part 1) -2014
9.	Impulse voltage for 11 kV & 11/√3 kV- Cl. no. 4.3 of pg no.39 : 95 kVp	Already included in MOM, 75 kVp accepted.	As already decided in meeting dated 16.9.15, Impulse voltage at 11 kV level will be 75 kVp instead of 95 kVp. This is in line with cl. 7.4 of IS: 1180 (Part 1) -2014
10.	Bushings & Bushing rods- Cl .no.10 of pg no.41: Bushings shall be either porcelain or epoxy type	Shall be strictly in line with IS 1180:Part-1/2014	It was decided that HV Bushing shall be as per IS: 2099 and LV bushing as per IS:7421 as specified in IS: 1180 (Part 1) -2014

	Bushing rods shall be Brass/ stainless steel		
11.	Hardware exposed to external atmosphere- Cl. no. 18.5 of pg no.46 : Hot dip galvanized	Should be in line with IS 1180:Part-1/2014	It was decided to amend cl. 18.5 as follows: "All ferrous bolts, nuts and washers placed in outdoor positions shall be treated to prevent corrosion, by hot dip galvanizing, ***except high tensile steel bolts, nuts and spring washers which shall be electro-galvanized as per IS: 1367***. Appropriate precautions shall be taken to prevent electrolytic action between dissimilar metals "
12.	Acceptance tests- Cl no. 25.2 of pg no. 49 : Physical verification of core coil assembly and measurement of flux density of one unit of each rating in every inspection with reference to short circuit test report	Physical verification may be done on one unit of a lot size and lot size may be mutually agreed between user and manufacturer.	It was decided that provisions of SBD would prevail.
13.	Temperature rises- Cl no. 14 of pg no.65 : Temperature rise : Oil / wdg : 35/40°C	Temperature rises for distribution range of transformers shall be strictly as per IS: 1180-1-2014 (35/40 'C for transformers up to 200 kVA and single phase transformers) and for power transformers as per IS: 2026 Part: 2, will be 50/55° C.	It was decided that for 3 phase DT upto 2500 KVA & 1 phase DT upto 25KVA, the temperature riseshall as per cl. 8.10.1 of IS: 1180-1-2014. While for power transformers, the temperature riseshall asfinalized in the meeting dated 16.9.15***(Refer S.No. 3 of MoM dated 16.9.15)***
14.	Conductor- Cl no. 7.1.1 pg no.62: SE/DPC covered aluminium conductor for ratings up to 200 kVA	For 200 KVA, it can be Aluminum/Copper.	It was decided that for 3 phase DT upto 200 KVA & 1 phase DT upto 25KVA, the conductor will be Super enamel covered/Double paper covered Aluminium in line with Cl no. 7.1.1 with SBD. For DTs above 200 KVA and Power Transformers, the conductor will be electrolytic copper.
15.	Current transformers- Cl no. 25 of pg no.72:	Modify the clause as below. "CT's shall be provided for	It was decided that CT of suitable rating shall be

	CT's shall be provided for ratings 63 kVA and above	ratings above 200 kVA".	provided on LT side.for metering purpose. The CT requirement will also depend upon the LT current of DT and current rating of energymeter.
16.	Paint- Cl no. 19.4.ii of pg no. 69: Enamel paint	Enamel paint can be replaced with epoxy paint.	It was decided that painting of DT shall be as per table 12 (Cl 15.5) of IS: 1180-1-2014. Accordingly table on page 48 & 79 shall be deleted.
17.	Impulse voltage for 11 kV- Cl no. 2.22 of pg no.6: 95 kVp	Already included in MOM, 75 kVp accepted.	Already addressed at point No. 9 above.
18.	Temperature rises- Cl no. 2.26 of pg no.7: Temperature rise : Oil / wdg : 40/45 deg C	To keep rise as 50/55 degrees.	Already addressed at point No. 13 above.
19.	Varnish application on coil windings- Cl no. 7.6.4 of pg no.18:	This clause may be removed.	IEEMA proposal accepted . This clause will be deleted from SBD.
20.	Clause 7.9.2 Page 21-22 Contacts for Buchholz relay, OTI/WTI	Substitute mercury contacts with micro switch for OTI, WTI &Buchholz relay since Mercury is not environment friendly. Buchholz relay shall be with reed type magnetic switches. OTI and WTI shall have micro switches.	It was decided to Substitute mercury contacts with micro switch for OTI, WTI Contact for Buchholz relay will be reed type magnetic switches.

General Comments on the Standard Bid Document:-

Sr. No.	Suggestions on Power and Distribution Transformer	IEEMA's Recommendations.	Decision of the Sub-Group

Sr. No.	Suggestions on Power and Distribution Transformer	IEEMA's Recommendations.	Decision of the Sub-Group
1.	Step lap design for core laminations should be made mandatory for all transformers. The design should be minimum " 5 steps in a book". The advantages of doing this are two fold. i) No load losses reduce by upto 8% from conventional non step lap design at no extra cost to consumer resulting in huge savings at no additional cost. ii) "5 in a book step lap laminations" have to be made on CNC machines which can only use prime material and not secondary or defective or scrap crgo material.	Step lap design is always advantageous but it cannot be made mandatory for all transformers. i) No load losses can be reduced up to 3 to 4% only considering the step lap designs. NO CHANGE is suggested in the specifications.	Point was noted . However no change in TS was recommended on this account.
2.	Disagreement with the suggestion of having the MCB switch outside the box. From practical experience on the field in Gujarat and many other states, the consumer or the SEB engineer generally easily bypass the MCB switch when it is outside this generally leading to increase in overloading and failure of distribution transformers. The switch inside the enclosure would be impossible to bypass and therefore result in lower failures and prevent over loading of equipment.	MCB feature are not there in the IS 1180: Part-1/2014 version so including this feature in the SBD will create problems in BIS certification and Licensing procedures. Mr. Lakhiani suggested that there is a separate IEC standard for completely self-protected transformers. REC / PFC may be asked to advise BIS to bring out Part 3 of IS: 1180 on self-protected transformers up to 200 kVA three phase and 25 kVA single phase with mandatory internal breakers and request ministry to include this part also in Quality Control Order.	CEA/REC to take necessary action to include DT with internal LTCB in IS 1180.
3.	NL and FL Losses specified on Power transformers should be	It is good to reduce NL and FL losses on Power Transformers	Point was noted .

Sr. No.	Suggestions on Power and Distribution Transformer	IEEMA's Recommendations.	Decision of the Sub-Group
	reduced further as there is scope for reducing them by a further 10 to 15 % even as per existing norms of many utilities. We should choose the lowest losses existing amongst specifications of all utilities to ensure that the transformers specified and notified by the ministry are technically the best transformers possible to be manufactured today with existing materials and technologies and designs.	and for that we had to study what different utilities are specifying. Distribution Transformers losses are already specified in IS 1180: Part-1/2014 and the energy efficiency level 1, level 2 and level 3corresponds to star 3, 4 and 5 respectively. For Power Transformers also the same concept of 100% losses like Energy Efficiency Transformers may be adopted rather than going for break up losses at (50%) and at (100%) NO CHANGE for the time being in the specifications.	However no change in TS was recommended on this account.
4.	We should avoid specifying Hi-B CRGO Material for power transformers above 3.15 MVA and leave this option open for transformer manufacturer to choose. As India currently manufactures neither conventional nor HIB CRGO and the fact that the demand supply situation of both materials keeps changing rapidly based on global demand in my view it doesn't make sense to tie ourselves down and specify just one grade of material. Ultimately transformer designers optimize the use of materials based on core and copper and we should leave some room for technical innovations in optimizing the use of these two materials with the designers	Instead of Hi-B CRGO material for PT, M4 or better grade of CRGO may be used. To decide the grade of the material, it should be left open with the designers. M4 or better grade of prime CRGO materialbe used for Power Transformers as even for smaller Distribution Transformers the same grade can be used. Using the Hi-B grade of CRGO only helps in reduction of the losses and sticking only with Hi-B grade will create shortage/scarcity of the CRGO material and this will lead to rise in the prices, accordingly with Hi-B; M4 or better grade of prime CRGO should also be there in the bid	It was decided that for DTs the core material will be as per SBD. For power transformers, the core will be HIB as finalized in the meeting dated 16.9.15 ***(Refer S.No. 1 of MoM dated 16.9.15)***

Sr. No.	Suggestions on Power and Distribution Transformer	IEEMA's Recommendations.	Decision of the Sub-Group
	rather than leaving them with fewer choices in materials selection.	document.	
5.	For single phase transformer, the specification should be as per new IS1180(part-1) :2014. Table 6.1 of SBD may be rectified and it should be in line with IS 1180:Part-1/2014	All the losses proposed in the SBD should be in line with IS 1180: Part-1/2014.	It was decided that losses for all DTs shall be Level 2 as per IS: 1180 (table 3, table 6 & table 9). This is in line with S.No. B 1 of ***MoM dated 16.9.15***
6.	REC has considered Distribution transformers upto 200Kva for only Aluminum wound distribution transformers. In this connection ,we wish to bring to your kind attention an independent investigative study/report has been brought out by IIT ,Roorkee on behalf of Central Electricity Authority on " Performance of Aluminum wound Distribution transformers"	Failure rate has nothing to do with the Aluminum /Copper. Aluminum has better short circuit properties. REC has specified some range of DT with Aluminum which may not be disturbed.	Point was noted . However no change in TS was recommended on this account.
7.	In SBD document parallel International standard should not be specified.	IS/IEC/IEEE all are in the same line and all are homogeneous in working. Indian Standard can remain "with latest revisions thereof" added.	**It was decided that latest amendment would mean the latest version available as on date of bid opening.**
8.	The performance of transformers fitted with MCCB in a box is very poor due to theft of electricity by breaking the box and bye passing the MCCB resulting in failure of transformer due to overload. The	As MCB are not there in the IS 1180: Part-1/2014 version so including this feature in the SBD will create problems in BIS certification and Licensing procedures. There is a	CEA/REC to take necessary action to include DT with internal LTCB in IS

	transformers fitted with internal circuit breaker prevents theft of electricity and failure of transformer due to overload.	separate IEC standard for completely self-protected transformers. REC / PFC to advise BIS to bring out Part 3 of IS: 1180 on self-protected transformers up to 200 kVA three phase and 25 kVA single phase with mandatory internal breakers and request ministry to include this part also in Quality Control Order	1180.

IEEMA's Recommendation for Internal Circuit Breaker in Distribution Transformers:-

For Distribution Transformers up to 200 KVA ratings, both single phase and three phase, IEEMA recommends internal circuit breakers on LT side for Transformers.

Presently, IS 1180 Part 1/2014 is applicable for manufacturing of all types of distribution transformers up to 2.5 MVA ratings. This standard has been notified by the Department of Heavy Industry for mandatory BIS certification. Since IS 1180 part 1/2014 does not specify the LT breakers to be mounted internally, a new standard under IS 1180 series has to be prepared to take care of this requirement.

The Government may expeditiously put the activity of preparing IS: 1180(Part 3) to address to this requirement, and the same may be made mandatory requirement in all centrally funded schemes such as DDUGJY and IPDS with BIS certification. BIS may be advised to publish the standard within a specified time, as deemed fit.

Annexure-I

List of Participants for 2nd Meeting of Sub - committee-A on 21.09.2015			
S.No.	**Name of State/CPSU**	**Name**	**Designation**
1	Himachal Pradesh	Shri Rajesh Kr. Pathania	S.E
2	Maharashtra	Shri Asok .B. Khard	Executive Engineer
3	PFC	Shri Arun Kumar	AGM
4	REC	Shri RanjitRanjan	Dy. Manager
5	PGCIL	Shri Atul Kumar Aggarwal	DGM
6		Shri Navin Kumar Jain	AGM
7		Shri Raghavendra Singh	Manager

Minutes of the Sub Committee meeting regarding finalization of Technical Specifications of Energy Meters held on 22.09.2015 in POWERGRID, Gurgaon under MoP Initiative to facilitate States in mobilization of quality equipment/materials at competitive price under DDUGJY and IPDS

List of participants is enclosed as Annexure-I.

As decided in the meeting of Committee "A" held on 18.9.2015, energy meter was added in the high value items identified for empanelment keeping in view the large volume of meters. The members from CEA, POWERGRID, REC, PFC, MP , HP , Maharashtra and IEEMA attended the meeting to discuss the issue.MD, MP Madhya DISCOM was also present in the meeting.

ED (DMS), POWERGRID welcomed the participants and emphasized that meter being a sensitive item, needs detailed deliberation. The summery of discussion held in the meeting are as under-

1. Tech Specifications of meters which were included in SBD, were finalized by Metering division of IEEMA. The finalized specifications were discussed in detail. MD, MP Madhya DISCOM opined that CMRI being a 3rd party item should be made removed from the TS of energy meters and it should be left on states to customize the CMRI as per their needs. It was agreed by all the members.

2. MD, MP Madhya DISCOM emphasized that to ensure error free and regular meter reading, TS should facilitate remote reading in rural and urban areas. It was informed that they have customized the metering data as per their requirement and it should also be left to the states to choose the communication technology and associated software as per their needs as the meters have to be integrated with existing metering & billing system. In case the meter is included in the central procurement list, it may not include all the specific requirement of each state and it may be difficult for the states to integrate the new meters with the legacy system.

3. IEEMA submitted that since different utilities use different type of communication media i.e. IR, RF, GPRS, PLC, Optical etc and it would be required that separate specifications and rates may be finalized by the Committee B for each combination but it would create so many combinations which may not be possible to tendered separately. MD, MP Madhya DISCOM and other members also agreed with the same.

4. It was also opined by MD, MP Madhya DISCOM that since each utility has its own requirement, and in case, the base price was fixed under central procurement for base meters, meter manufacturers may not supply the meters at this contracted price. **For this purpose, he suggested that either the meter procurement may be left for the**

states or a price band (upto10-20% on positive side) may be allowed over and above the central procurement prices to accommodate the specific requirement of the states.

5. Maharashtra submitted that in order to read various meters, software for each make/type of meters are required to be loaded in the CMRI. They added that with increase in make of meters, the different software left a little memory of CMRI thus leaving very low space of no of meter readings. MP suggested that a standard protocol for all communication layers should be developed to read all make of meters with a single device without requiring any proprietary software.

6. IEEMA informed that each utility has specified different type of temper features also and meters have to be tailored accordingly. They insisted that temper requirement should be standardized but states have to be agreed to them.

7. Issue of Guarantee period included in the Tech. specification was also discussed. Most of the members agreed to increase the guarantee period from 12/18 months to 24/36 months from date of installation/date of supply. Maharashtra stated that as per their state practice, the guarantee period is 60 months and bring this down would not be desirable.

8. It was suggested byMD, MP Madhya DISCOM that both High& Low Level Security keys be shared by the manufactured on mandatory basis. There was no consensus among IEEMA members on the issue.

After detailed discussion, it was evolved that **No single technical specification** can cater specific requirement of all the DISCOMs/ utilities in terms of tamper features, different communication technologies, warranty period, integration of new meters with legacy system available in states and overall metering philosophy etc.

It is, therefore, recommended that the Committee "A "maybe exclude meters from the list of high value items to be empanelled because of the fact that this would involve standardization of following type of meters with various communication technologies and temper features. As per discussions, utilities may also fine it difficult to integrate the existing meters with the new meters procured with a fixed specification.

A. HT feeder which are CT & PT operated
B. 3-phase Distribution Transformer which are CT operated

C. 1-phase distribution Transformer which are CT operated
D. 3 phase whole current meters
E. Single phase whole current meter.

Annexure-I

S. No.	Name of State/CPSU	Name	Designation
1	PGCIL	Shri S K Mishra	General Manager
2	PGCIL	Shri Atul Agarwal	DGM
3	Himachal Pradesh	Shri Rajesh Kr. Pathania	SE
4	Maharashtra	Shri S.M. Rathod	
5		Shri S.V. Deshpande	
6	IEEMA	Shri J. Pande	Sr. Director
7		Shri C.P. Jain	
8	Genus Power	Shri Yathath Sharma	
9	Secure Meters	Shri Prabhakar Tanta	
10	L & T Ltd.	Shri Amarjeet Singh	
11	HPL	Shri Sandeep Tandon	
12	PFC	Shri Arun Kumar	AGM
13	CEA	Shri Vivek Goyal	Director
14	REC	Shri Ranjit Ranjan	Dy. Manager

Annexure-V

Technical specifications of Major High Value Materials

Power Transformers

1 SCOPE

1.1 This Specification provides for design, engineering, manufacture, assembly, stage inspection, final inspection and testing before dispatch, packing and delivery at destination Sub-station by road transport, transit insurance, unloading at site /stores of 3.15/5/6.3/8/10/12.5 MVA, 33/11 KV Power Transformer(s), complete with all fittings, accessories, associated equipment's, spares, 10% extra Transformer Oil, required for its satisfactory operation in any of the sub-stations of the purchaser.

1.2 The core shall be constructed either from high grade, non-aging Cold Rolled Grain Oriented (CRGO) silicon steel laminations conforming to HIB grade of BIS certified with lamination thickness not more than 0.23mm to 0.27mm or better(Quoted grade and type shall be used). The maximum flux density in any part of the cores and yoke at normal voltage and frequency shall be such that it should under 10% overvoltage condition should not be more than 1.9 Tesla. The supplier shall provide saturation curve of the core material, proposed to be used. Laminations of different grade(s) and different thickness (s) are not allowed to be used in any manner or under any circumstances.

1.3 The scope of supply includes the provision of type test. The equipment offered should have been successfully type tested within five years from date of tender and the designs should have been in satisfactory operation for a period not less than three years as on the date of order. Compliance shall be demonstrated by submitting, (i) authenticated copies of the type test reports and (ii) performance certificates from the users, specifically from Central Govt./State Govt. or their undertakings.

1.4 The Power Transformer shall conform in all respects to highest standards of engineering, design, workmanship, this specification and the latest revisions of relevant standards at the time of offer and the employer shall have the power to reject any work or material, which, in his judgment, is not in full accordance therewith. The Transformer(s) offered, shall be complete with all components, necessary for their effective and trouble free operation. Such components shall be deemed to be within the scope of supply, irrespective of whether those are specifically brought out in this specification and / or the commercial order or not.

The Engineer reserves the right to reject the transformers if on testing the losses exceed the declared losses beyond tolerance limit as per IS or the temperature rise in oil and / or winding exceeds the value, specified in technical particular or impedance value differ from the guaranteed value including tolerance as per this specification and if any of the test results do not match with the values, given in the guaranteed technical particulars and as per technical specification.

2 SPECIFIC TECHNICAL REQUIREMENTS

1	Rated MVA (ONAN rating)	3.15/5/6.3/8/10/12.5MVA
2	No. of phases	3
3	Type of installation	Outdoor
4	Frequency	50 Hz (± 5%)
5	Cooling medium	Insulating Oil (ONAN)
6	Type of mounting	On Wheels, Mounted on rails.
7	Rated voltage	
	a) High voltage winding	33KV
	b) Low voltage winding	11KV

8	Highest continuous system voltage		
	a) Maximum system voltage ratio (HV / LV)		36KV / 12 KV
	b) Rated voltage ratio (HV / LV)		33KV /11 KV
9	No. of windings		Two winding Transformers
10	Type of cooling		ONAN (Oil natural / Air natural)
11	MVA Rating corresponding to ONAN Cooling system		100%
12	Method of connection:		
	HV	:	Delta
	LV	:	Star
13	Connection symbol		Dyn 11
14	System earthing		Neutral of LV side to be solidly earthed.

15	Percentage impedance voltage on normal tap and MVA base at 75° C corresponding to HV/ LV rating and applicable tolerances: (No negative tolerance shall be allowed)	MVA Rating	% Impedance	Tolerance %	
		3.15	6.25	10	
			5	7.15	10
		6.3	7.15	10	
		8	8.35	10	
		10	8.35	10	
		12.5	10.0	10	

16	Intended regular cyclic overloading of windings	As per IEC –76-1, Clause 4.2
17	a) Anticipated unbalanced loading	Around 10%
	b) Anticipated continuous loading of windings (HV / LV)	110 % of rated current
18	a) Type of tap changer (For3.15, 5, 6.3, 8, 10&12.5 MVA only)	On-load tap changer.
	b) Range of taping	+ 5% to – 15% in 8 equal steps of2.5% each on HV winding
19	Neutral terminal to be brought out	On LV side only
20	Over Voltage operating capability and duration	112.5 % of rated voltage (continuous)
21	Maximum Flux Density in any part of the core and yoke at rated MVA, 112.5 % of rated voltage i.e 33 KV /11 KV and system frequency of 50 HZ	1.9 Tesla

22	Insulation levels for windings: -	33KV	11KV
	a) 1.2 / 50 microsecond wave shape Impulse withstand (KVP)	170	75
	b) Power frequency voltage withstand (KVrms)	70	28

23	Type of winding insulation	
	a) HV winding	Uniform
	b) LV winding	Uniform

24	Withstand time for three phase short circuit	2 Seconds	
25	Noise level at rated voltage and frequency	As per NEMA Publication No. TR-1.	
26	Permissible Temperature Rise over ambient temperature of 40 / 45˚C		
	a) Of top oil measured by thermometer.	40˚C	
	b) Of winding measured by resistance.	45˚ C	
27	Minimum clearances in air (mm) :-	Phase to Phase	Phase to ground
	a) HV	400	320
	b) LV	280	140
28	Terminals		
	a) HV winding line end	36 KV oil filled communicating type porcelain bushings (Anti-fog type)	
	b) LV winding	12 KV porcelain type of bushing (Anti-fog type) – for outdoor 11 KV breakers	
	(11KV Power cables shall be used for extending supply to 11KV breakers in case of indoor circuit breakers. The termination of 11 KV cables on LV bushing shall be through extended copper bus bars suitable to hold power cables termination. A metallic cable termination box, completely sealed, shall be installed on LV side of the transformer in which cables shall enter from bottom gland plates.)		
29	Insulation level of bushing	HV	LV
	a) Lightning Impulse withstand (KVP)	170	75
	b) 1 Minute Power Frequency withstand voltage (KV –rms)	70	28
	c) Creepage distance (mm) (minimum)	900	300
30	Material of HV & LV Conductor	Electrolytic Copper	
31	Maximum current density for HV and LV winding for rated current	As per best practice	
32	Polarization index (HV to LV, HV to Earth & LV to earth)	IR Test = 1 minute value/ 15 secs. value will not be less than 1.5 IR Test = 10 minutes value / 1 minute value will not be more than 5 and less than 1.5	
33	Core Assembly	Boltless type	
34	Temperature Indicator		
	a) Oil	One number	
	b) Winding	One number	

35. **Losses**:- The losses shall not exceed the value given below

MVA Rating	No-load losses (Fixed loss) KW	Load losses at 75˚C KW	Percentage impedance voltage on normal tap and MVA base at 75° C
3.15	3	16	7.15
5	4	23	7.15
6.3	4.6	36	7.15
8	5.5	40	8.35

10	7	50	8.35
12.5	7.5	65	10

2.1 **MARSHALLING BOX**

A metal enclosed, weather, vermin and dust proof marshalling box fitted with required glands, locks, glass door, terminal Board, heater with switch, illumination lamp with switch etc. shall be provided with each transformer to accommodate temperature indicators, terminal blocks etc. It shall have degree of protection of IP 55 or better as per IS: 2147 (Refer Clause 3.12).

2.2 **CAPITALIZATION OF LOSSES AND LIQUIDATED DAMAGES**

Not applicable for bid evaluation purpose.

2.3 **PERFORMANCE**

i) Transformer shall be capable of withstanding for two seconds without damage to any external short circuit, with the short circuit MVA available at the terminals.

ii) The maximum flux density in any part of the core and yoke at rated Voltage and frequency shall be such that the flux density with +12.5% combined voltage and frequency variation from rated voltage and frequency shall not exceed 1.9Tesla.

iii) Transformer shall under exceptional circumstances due to sudden disconnection of the load, be capable of operating at the voltage approximately 25% above normal rated voltage for a period of not exceeding one minute and 40% above normal for a period of 5 seconds.

iv) The transformer may be operated continuously without danger on any particular tapping at the rated MVA± 1.25% of the voltage corresponding to the tapping.

v) The thermal ability to withstand short circuit shall be demonstrated by calculation.

vi) Transformer shall be capable of withstanding thermal and mechanical stress caused by any symmetrical and asymmetrical faults on any winding.

2.4 **DRAWINGS/ DOCUMENTS INCORPORATING THE FOLLOWING PARTICULARS SHALL BE SUBMITTED WITH THE BID**

a) General outline drawing showing shipping dimensions and overall dimensions, net weights and shipping weights, quality of insulating oil, spacing of wheels in either direction of motion, location of coolers, marshalling box and tap changers etc.

b) Assembly drawings of core, windings etc. and weights of main components / parts.

c) Height of center line on HV and LV connectors of transformers from the rail top level.

d) Dimensions of the largest part to be transported.

e) GA drawings / details of various types of bushing

f) Tap changing and Name Plate diagram

g) Type test certificates of similar transformers.

h) Illustrative & descriptive literature of the Transformer.

i) Maintenance and Operating Instructions.

2.5 **MISCELLANEOUS**

i) Padlocks along with duplicate keys as asked for various valves, marshalling box etc. shall be supplied by the contractor, wherever locking arrangement is provided.

ii) Foundation bolts for wheel locking devices of Transformer shall be supplied by the Contractor.

2.6 **DELIVERY**

The full quantity of the equipments shall be delivered as per the delivery schedule appended to this specification.

2.7 **SCHEDULES**

All Schedules annexed to the specification shall be duly filled by the bidder separately.

2.8 **ALTITUDE FACTOR**

If the equipment is to be installed in the hilly area, necessary correction factors as given in the Indian Standard for oil temperature rise, insulation level etc. shall be applied to the Standard Technical Parameters given above.

2.9 **NAME PLATE**

Transformer rating plate shall contain the information as given in clause 15 of IS-2026 (part-I). The details on rating plate shall be finalized during the detailed engineering. Further, each transformer shall have inscription of Employer's name. The name plate shall also include (i) The short circuit rating , (ii) Measured no load current and no load losses at rated voltage and rated frequency, (iii) measured load losses at 75° C (normal tap only), (iv) D.C resistance of each winding at 75° C.

3. SERVICE CONDITIONS

The service conditions shall be as follows: (To be confirmed by PIA as per locality of project)		
	Plain area	**Hilly area**
Maximum altitude above sea level	1000m	5000m
Maximum ambient air temperature	50° C	50° C
Maximum daily average ambient air temperature	35° C	40° C
minimum ambient air temperature	-5° C	-30° C
maximum temperature attainable by an object exposed to the sun	60 ° C	60 ° C
maximum yearly weighted average ambient temperature	32° C	32° C
maximum relative humidity	100%	100%
average number of thunderstorm days per annum (isokeraunic level)	70	70
average number of rainy days per annum	120	120
average annual rainfall	1500 mm	1500 mm
maximum wind pressure	260Kg/m²	260Kg/m²

Environmentally, the region where the equipment will be installed includes coastal areas, subject to high relative humidity, which can give rise to condensation. Onshore winds will frequently be salt laden. On occasions, the combination of salt and condensation may create pollution conditions for outdoor insulators. Therefore, outdoor material and equipment shall be designed and protected for use in exposed, heavily polluted, salty, corrosive, tropical and humid coastal atmosphere.

4 SYSTEM CONDITIONS

The equipment shall be suitable for installation in supply systems of the following characteristics.

Frequency		50 Hz± 5%
Nominal system voltages		
		33 KV
		11 KV
Maximum system voltages	33KV System	36.3 KV
	11 KV System	12 KV
Nominal short circuit level (Basing on apparent power)	33KV System	31.5KA
	11 KV System	13.1KA
Insulation levels :	33KV System	170KV (peak)
1.2/50 μ sec impulse withstand voltage	11 KV System	75 KV (peak)
Power frequency one minute withstand (wet and dry) voltage	33KV System	70KV (rms)
	11 KV System	28KV (rms)
Neutral earthing arrangements	11 KV System	Solidly earthed

5 CODES & STANDARDS

5.1 (i) The design, material, fabrication, manufacture, inspection, testing before dispatch and performance of power transformers at site shall comply with all currently applicable statutory regulations and safety codes in the locality where the equipment will be installed. The equipment shall also conform to the latest applicable standards and codes of practice. Nothing in this specification shall be construed to relieve the contractor of this responsibility.

5.2 The equipment and materials covered by this specification shall conform to the latest applicable provision of the following standards.

IS:5	Colour for ready mixed paints
IS:325	Three Phase Induction Motors
IS:335	New insulating oil for transformers, switch gears
IS:1271	Classification of insulating materials for electrical machinery and apparatus in relation to their stability in services
IS:2026(Part I to IV)	Power Transformer
IS:2071	Method of high voltage testing
IS:2099	High voltage porcelain bushings
IS:2147	Degree of protection

IS:2705	Current Transformers
IS:3202	Code of practice for climate proofing of electrical equipment
IS:3347	Dimensions for porcelain Transformer Bushings
IS:3637	Gas operated relays
IS:3639	Fittings and accessories for power Transformers
IS:5561	Electric Power Connectors
IS:6600/BS:CP"10:0	Guide for loading of oil immersed Transformers
IS:10028	Code of practice for selection, installation and maintenance of transformers, Part I. II and III
C.B.I.P. Publication	Manual on Transformers

If the standard is not quoted for any item, it shall be presumed that the latest version of Indian Standard shall be applicable to that item.

The equipment complying other internationally accepted standards, may also be considered if they ensure performance superior to the Indian Standards.

5.3 **DRAWINGS**

a) The contractor shall furnish, within fifteen days after issuing of Letter of Award. Six copies each of the following drawings/documents incorporating the transformer rating for approval.

i) Detailed overall general arrangement drawing showing front and side elevations and plan of the transformer and all accessories including radiators and external features with details of dimensions, spacing of wheels in either direction of motion, net weights and shipping weights, crane lift for un-tanking, size of lugs and eyes, bushing lifting dimensions, clearances between HV and L.V terminals and ground, quantity of insulating oil etc.

ii) Assembly drawings of core and winging and weights of main components / parts

iii) Foundation plan showing loading on each wheel land jacking points with respect to centre line of transformer.

iv) GA drawings details of bushing and terminal connectors.

v) Name plate drawing with terminal marking and connection diagrams.

vi) Wheel locking arrangement drawing.

vii) Transportation dimensions drawings.

Viii) Magnetization characteristic curves of PS class neutral and phase side current transformers, if applicable.

ix) Interconnection diagrams.

x) Over fluxing withstand time characteristic of transformer.

xi) GA drawing of marshalling box.

xii) Control scheme/wiring diagram of marshalling box.

xiii) Technical leaflets of major components and fittings.

xiiv) As built drawings of schematics, wiring diagram etc.

xv) Setting of oil temperature indicator, winding temperature indicator.

xvi) Completed technical data sheets.

xvii) Details including write-up of tap changing gear.

xviii) HV conductor bushing.

xix) Bushing Assembly.

xx) Bi-metallic connector suitable for connection to 100 mm2 up to 232 mm2 AAAC Conductor.

xxi) GA of LV cable Box.

xxii) Radiator type assembly.

b) All drawings, documents, technical data sheets and test certificates, results calculations shall be furnished.

5.4 Any approval given to the detailed drawings by the Employer's shall not relieve the contractor of the responsibility for correctness of the drawing and in the manufacture of the equipment. The approval given by the employer shall be general with overall responsibility with contractor.

6. GENERAL CONSTRUCTIONAL FEATURES

6.1 All material used shall be of best quality and of the class most suitable for working under the conditions specified and shall withstand the variations of temperature and atmospheric conditions without distortion or deterioration or the setting up of undue stresses which may impair suitability of the various parts for the work which they have to perform.

6.2 Similar parts particularly removable ones shall be interchangeable.

6.3 Pipes and pipe fittings, screws, studs, nuts and bolts used for external connections shall be as per the relevant standards. Steel bolts and nuts exposed to atmosphere shall be galvanized.

6.4 Nuts, bolts and pins used inside the transformers and tap changer compartments shall be provided with lock washer or locknuts.

6.5 Exposed parts shall not have pockets where water can collect.

6.6 Internal design of transformer shall ensure that air is not trapped in any location.

6.7 Material in contact with oil shall be such as not to contribute to the formation of acid in oil. Surface in contact with oil shall not be galvanized or cadmium plated

6.8 Labels, indelibly marked, shall be provided for all identifiable accessories like Relays, switches current transformers etc. All label plates shall be of in corrodible material.

6.9 All internal connections and fastenings shall be capable of operating under overloads and over-excitation, allowed as per specified stands without injury.

6.10 Transformer and accessories shall be designed to facilitate proper operation, inspection, maintenance and repairs.

6.11 No patching, plugging, shimming or other such means of overcoming defects, discrepancies or errors will be accepted.

6.12 Schematic Drawing of the wiring, including external cables shall be put under the prospane sheet on the inside door of the transformer marshalling box.

6.13 Painting

6.13.1 All paints shall be applied in accordance with the paint manufacturer's recommendations. Particular attention shall be paid to the following:

a) Proper storage to avoid exposure as well as extremes of temperature.
b) Surface preparation prior to painting.
c) Mixing and thinning
d) Application of paints and the recommended limit on time intervals between coats.
e) Shelf life for storage.

6.13.1.1 All paints, when applied in normal full coat, shall be free from runs, sags, wrinkles, patchiness, brush marks or other defects.

6.13.1.2 All primers shall be well marked into the surface, particularly in areas where painting is evident, and the first priming coat shall be applied as soon as possible after cleaning. The paint shall be applied by airless spray according to the manufacturer's recommendations. However, wherever airless spray is not possible, conventional spray be used with prior approval of Employer.

6.13.1.3 The supplier shall, prior to painting protect nameplates, lettering gauges, sight glasses, light fittings and similar such items.

6.13.2 **Cleaning and Surface Preparation**

6.13.2.1 After all machining, forming and welding has been completed, all steel work surfaces shall be thoroughly cleaned of rust, scale, welding slag or spatter and other contamination prior to any painting.

6.13.2.2 Steel surfaces shall be prepared by Sand/Shot blast cleaning or Chemical cleaning by Seven tank process including Phosphate to the appropriate quality.

6.13.2.3 The pressure and Volume of the compressed air supply for the blast cleaning shall meet the work requirements and shall be sufficiently free from all water contamination prior to any painting. 6.13.2.4 Chipping, scraping and steel wire brushing using manual or power driven tools cannot remove firmly adherent mill-scale and shall only be used where blast cleaning is impractical.

6.13.3 Protective Coating As soon as all items have been cleaned and within four hours of the subsequent drying, they shall be given suitable anticorrosion protection.

6.13.4 Paint Material

Followings are the type of paints that may be suitably used for the items to be painted at shop and supply of matching paint to site:

i) Heat resistant paint (Hot oil proof) for inside surface.
ii) For external surfaces one coat of Thermo Setting Paint or 2 coats of Zinc chromate followed by 2 coats of POLYURETHANE . The color of the finishing coats shall be dark admiral grey conforming to No.632 or IS 5:1961.

6.13.5 Painting Procedure

6.13.5.1 All painting shall be carried out in conformity with both specifications and with the paint manufacture's recommendations. All paints in any one particular system. Whether shop or site applied, shall originate from one paint manufacturer.

6.13.5.2 Particular attention shall be paid to the manufacture's instructions on storage, mixing, thinning and pot life. The paint shall only be applied in the manner detailed by the manufacturer e.g. brush, roller, conventional or airless spray and shall be applied under the manufacturer's

recommended conditions. Minimum and maximum time intervals between coats shall be closely followed.

6.13.5.3 All prepared steel surfaces should be primed before visible re-rusting occurs or within 4 hours whichever is sooner. Chemical treated steel surfaces shall be primed as soon as the surface is dry and while the surface is warm.

6.13.5.4 Where the quality of film is impaired by excess film thickness,(wrinkling, mud cracking or general softness) the supplier shall remove the unsatisfactory paint coatings and apply another. As a general rule, dry film thickness should not exceed the specified minimum dry film thickness by more than 25% . In all instances, where two or more coats of the same paints are specifies, such coatings may or may not be of contrasting colors.

6.13.5.5 Paint applied to items that are not be painted, shall be removed at supplier's expense, leaving the surface clean, un-stained and undamaged.

6.13.6 Damages to Paints Work

6.13.6.1 Any damage occurring to any part of the painting scheme shall be made good to the same standard of corrosion protection and appearance as that originally employed.

6.13.6.2 Any damaged paint work shall be made as follows:

a) The damaged area, together with an area extending 25mm around its boundary, shall be cleaned down to bare metal.
b) A priming coat shall immediately applied, followed by a full paint finish equal to that originally applied and extending 50mm around the perimeter of the originally damaged.

6.13.6.3 The repainted surface shall present a smooth surface. This shall be obtained by carefully chamfering the paint edges before & after priming.

6.13.7 Dry Film Thickness

6.13.7.1 To the maximum extent practicable, the coats shall be applied as a continuous film of uniform thickness and free of pores. Over-spray, skips, runs, sags and drips should be avoided. The different coats may or may not be same color.

6.13.7.2 Each coat of paint shall allowed to hardened before the next is applied as per manufacture"s recommendations.

6.13.7.3 Particular attention must be paid to full film thickness at edges.

6.13.7.4 The requirement for the dry film thickness (DFT) of paint and the material to be used shall be as given below:

Sl.No	Paint Type	Area to be painted	No of Coats	Total Dry film thickness(Min)
	Liquid paint			
	a) Zinc	Out side	02	45 micron
	Chromate(Primer)	Out side	02	35 micron
	b) POLYURETHANE			
	Paint (Finish Coat)	inside	01	35 micron
	c) Hot Oil paint			

7.0 DETAILED DESCRIPTION

7.1 Tank

7.1.1 The Transformer tank and cover shall be fabricated from high grade low carbon plate steel of tested quality. The tank and the shall be of welded construction.

7.1.2 Tank shall be designed to permit lifting by crane or jacks of the complete transformer assembly filed with oil. Suitable lugs and bossed shall be provided for this purpose.

7.1.3 All breams, flanges, lifting lugs, braces and permanent parts attached to the tank shall be welded and where practicable, they shall be double welded.

7.1.4 The main tank body of the transformer, excluding tap changing compartments and radiators, shall be capable of withstanding pressure of 760mm of Hg.

7.1.5 Inspection hole(s) with welded flange(s) and bolted cover(s) shall be provided on the tank cover. The inspection hole(s) shall be of sufficient size to afford easy access to the lower ends of the bushings, terminals etc.

7.1.6 Gaskets of nitrile rubber or equivalent shall be used to ensure perfect oil tightness. All gaskets shall be closed design (without open ends) and shall be of one piece only. Rubber gaskets used for flange type connections of the various oil compartments, shall be laid in grooves or in groove-equivalent sections on bolt sides of the gasket, throughout their total length. Care shall be taken to secure uniformly distributed mechanical strength over the gaskets and retains throughout the total length. Gaskets of neoprene and / or any kind of impregnated / bonded core or cork only which can easily be damaged by over-pressing are not acceptable. Use of hemp as gasket material is also not acceptable.

7.1.7 Suitable guides shall be provided for positioning the various parts during assemble or dismantling. Adequate space shall be provided between the cores and windings and the bottom of the tank for collection of any sediment.

7.2 Tank Cover

The transformer top shall be provided with a detachable tank cover with bolted flanged gasket joint. Lifting lugs shall be provided for removing the cover. The surface of the cover shall be suitable sloped so that it does not retain rain water.

7.3 UNDER CARRIAGE

7.3.1 The transformer tank shall be supported on steel structure with detachable plain rollers completely filled with oil. Suitable channels for movement of roller with transformer shall be space accordingly, rollers wheels shall be provided with suitable rollers bearings, which will resist rust and corrosion and shall be equipped with fittings for lubrication. It shall be possible to swivel the wheels in two directions, at right angle to or parallel to the main axis of the transformers.

7.4 CORE

7.4.1 Each lamination shall be insulated such that it will not deteriorate due to mechanical pressure and the action of hot transformer oil.

7.4.2 The core shall be constructed either from high grade, non-aging Cold Rolled Grain Oriented (CRGO) silicon steel laminations conforming to HIB grade with lamination thickness not more

than 0.23mm to 0.27mm or better(Quoted grade and type shall be used). The maximum flux density in any part of the cores and yoke at normal voltage and frequency shall not be more than 1.69 Tesla. The Bidder shall provide saturation curve of the core material, proposed to be used. Laminations of different grade(s)_ and different thickness (s) are not allowed to be used in any manner or under any circumstances.

7.4.3 The bidder should offer the core for inspection starting from the destination port to enable Employer for deputing inspecting officers for detail verification as given below and approval by the Employer during the manufacturing stage. Bidder"s call notice for the purpose should be accompanied with the following documents as applicable as a proof towards use of prime core material: The core coils, if found suitable, are to be sealed with proper seals which shall be opened in presence of the inspecting officers during core- cutting at the manufacturer's or it's sub-vendor's premises as per approved design drawing.

a) Purchase Order No. & Date.
b) Invoice of the supplier
c) Mills test certificate
d) Packing list
e) Bill of lading
f) Bill of entry certificate to customs

Core material shall be directly procured either from the manufacturer or through their accredited marketing organization of repute, but not through any agent.

7.4.4 The laminations shall be free of all burrs and sharp projections. Each sheet shall have an insulting coating resistant to the action of hot oil.

7.4.5 The insulation structure for the core to bolts and core to clamp plates, shall be such as to withstand 2000 V DC voltage for one minute.

7.4.6 The completed core and coil shall be so assembled that the axis and the plane of the outer surface of the core assemble shall not deviate from the vertical plane by more than 25mm.

7.4.7 All steel sections used for supporting the core shall be thoroughly shot or sand blasted, after cutting, drilling and welding.

7.4.8 The finally assembled core with all the clamping structures shall be free from deformation and shall not vibrate during operation.

7.4.9 The core clamping structure shall be designed to minimize eddy current loss.

7.4.10 The framework and clamping arrangements shall be securely earthed.

7.4.11 The core shall be carefully assembled and rigidly clamped to ensure adequate mechanical strength.

7.4.12 Oil ducts shall be provided, where necessary, to ensure adequate cooling inside the core. The welding structure and major insulation shall not obstruct the free flow of oil through such ducts.

7.4.13 The design of magnetic circuit shall be such as to avoid static discharges, development of short circuit paths within itself or to the earth clamping structure and production of flux component at right angle to the plane of the lamination, which may cause local heating. The supporting framework of the cores shall be so designed as to avoid the presence of pockets, which would prevent complete emptying of the tank through the drain valve or cause trapping of air during filling.

7.4.14 The construction is to be of boltless core type. The core shall be provided with lugs suitable for lifting the complete core and coil assembly. The core and coil assemble shall be so fixed in the tank that shifting will not occur during transport or short circuits.

7.4.15 The temperature gradient between core & surrounding oil shall be maintained less than 20 deg. Centigrade. The manufacturer shall demonstrate this either through test (procurement to be mutually agreed) or by calculation.

7.5 INTERNAL EARTHING

7.5.1 All internal metal parts of the transformer, with the exception of individual laminations and their individual clamping plates shall be earthed.

7.5.2 The top clamping structure shall be connected to the tank by a copper strap. The bottom clamping structure shall be earthed by one or more the following methods:

a) By connection through vertical tie-rods to the top structure.
b) By direct metal to metal contact with the tank base.
c) By a connection to the structure on the same side of the core as the main earth connection to the tank.

7.5.3 The magnetic circuit shall be connected to the clamping structure at one point only and this shall be brought out of the top cover of the transformer tank through a suitably rated insulator. A disconnecting link shall be provided on transformer tank to facilitate disconnections from ground for IR measurement purpose.

7.5.4 Coil clamping rings of metal at earth potential shall be connected to the adjacent core clamping structure on the same side as the main earth connections.

7.6 WINDING

7.6.1 Winding shall be subjected to a shrinking and seasoning process, so that no further shrinkage occurs during service. Adjustable devices shall be provided for taking up possible shrinkage in service. 7.6.2 All low voltage windings for use in the circular coil concentric winding shall be wound on a performed insulating cylinder for mechanical protection of the winding in handling and placing around the core.

7.6.2 Winding shall not contain sharp bends which might damage the insulation or produce high dielectric stresses. No strip conductor wound on edge shall have width exceeding six times the thickness.
The conductors shall be of electrolytic grade copper free from scales and burrs. The conductor insulation shall be made from high-density (at least 0.75 gm/cc) paper having high mechanical strength. The barrier insulation including spacers shall be made from high- density pre-compressed pressboard (1.1 gm/cc minimum for load bearing and 1 to 1.3 gm/cc minimum for non-load bearing) to minimize dimensional changes.

7.6.3 Materials used in the insulation and assembly of the windings shall be insoluble, non catalytic and chemically inactive in the hot transformer oil and shall not soften or the otherwise affected under the operating conditions.

7.6.4 Winding and connections shall be braced to withstand shocks during transport or short circuit.

7.6.5 Permanent current carrying joints in the windings and leads shall be welded or brazed. Clamping bolts for current carrying parts inside oil shall be made of oil resistant material which shall not be affected by acidity in the oil steel bolts, if used, shall be suitably treated.

7.6.6 Terminals of all windings shall be brought out of the tank through bushings for external connections.

7.6.6.1 The completed core and coil assemble shall be dried in vacuum at not more than 0.5mm of mercury absolute pressure and shall be immediately impregnated with oil after the drying process to ensure the elimination of air and moisture within the insulation. Vacuum may be applied in either vacuum over or in the transformer tank.

7.6.6.2 The winding shall be so designed that all coil assembles of identical voltage ratings shall be interchangeable and field repairs to the winding can be made readily without special equipment. The coils shall have high dielectric strength.

7.6.6.3 Coils shall be made of continuous smooth high grade electrolytic copper conductor, shaped and braced to provide for expansion and contraction due to temperature changes.

7.6.6.4 Adequate barriers shall be provided between coils and core and between high and low voltage coil. End turn shall have additional protection against abnormal line disturbances.

7.6.6.5 The insulation of winding shall be designed to withstand voltage stress arising from surge in transmission lines due to atmospheric or transient conditions caused by switching etc.

7.6.6.6 Tapping shall not be brought out from inside the coil or from intermediate turns and shall be so arranged as to preserve as far as possible magnetic balance of transformer at all voltage ratios.

7.6.6.7 Magnitude of impulse surges transferred from HV to LV windings by electromagnetic induction and capacitance coupling shall be limited to BILL of LV winding.

7.6.6.8 The current density adopted in all winding shall not exceed 2.4 A/mm2. The total net cross sectional area of the strip conductors for calculating current density for each winding shall be obtained after deducting the copper area lost due to rounding up of the sharp edges at the rectangular conductors.

7.7 INSULATING OIL

7.7.1 The insulating oil for the transformer shall be of EHV grade, generally conforming to IS: 335. No inhibitors shall be used in the oil.

7.7.2 The quantity of oil required for the first filling of the transformer and its full specification shall be stated in the bid. transformer shall supplied complete with all fittings, accessories and new transformer oil required for first filling plus 10% extra oil. The extra quantity of oil shall be supplied in non-returnable drums along with the oil required for the radiator banks.

7.7.3 The design and materials used in the construction of the transformer shall be such as to reduce the risk of the development of acidity in the oil.

7.7.4 The oil parameters shall be as per Table-1 of IS 335.

7.8 VALVES

i) Valves shall be of forged carbon steel upto 50mm size and of gun mental or of cast iron bodies with gun metal fittings for sizes above 50mm. They shall be of full way type with screwed ends and shall be opened by turning counter clockwise when facing the hand wheel. There shall be no oil leakage when the valves are in closed position.

ii) Each valve shall be provided with an indicator to show the open and closed positions and shall be provided with facility for padlocking in either open or closed position. All screwed valves shall be

furnished with pipe plugs for protection. Padlocks with duplicate keys shall be supplied along with the valves.

iii) All valves except screwed valves shall be provided with flanges having machined faced drilled to suit the applicable requirements, Oil tight blanking plates shall be provided for each connection for use when any radiator is detached and for all valves opening to atmosphere. If any special radiator valve tools are required the contractor shall supply the same.

iv) Each transformer shall be provided with following valves on the tank:

a) Drain valve so located as to completely drain the tank & to be provided with locking arrangement.

b) Two filter valves on diagonally opposite corners of 50mm size & to be provided with locking arrangement.

c) Oil sampling valves not less than 8mm at top and bottom of main tank & to be provided with locking arrangement.

d) One 15mm air release plug.

e) Valves between radiators and tank. Drain and filter valves shall be suitable for applying vacuum as specified in the specifications.

7.9 ACCESSORIES

7.9.1 **Bushing**

i) All porcelain used in bushings shall be homogeneous, non-porous, uniformly glazed to brown colour and free from blisters, burns and other defects.

ii) Stress due to expansion and contraction in any part of the bushing shall not lead to deterioration.

iii) Bushing shall be designed and tested to comply with the applicable standards.

iv) Bushing rated for 400A and above shall have non-ferrous flanges and hardware.

v) Fittings made of steel or malleable iron shall be galvanized

vi) Bushing shall be so located on the transformers that full flashover strength will be utilized. Minimum clearances as required for the BIL shall be realized between live parts and live parts to earthed structures.

vii) All applicable routine and type tests certificates of the bushings shall be furnished for approval.

viii) Bushing shall be supplied with bi-metallic terminal connector/ clamp/ washers suitable for fixing to bushing terminal and the Employers specified conductors. The connector/clamp shall be rated to carry the bushing rated current without exceeding a temperature rise of 550 C over an ambient of 500 C. The connector/clamp shall be designed to be corona free at the maximum rated line to ground voltage.

ix) Bushing of identical voltage rating shall be interchangeable.

x) The insulation class of high voltage neutral bushing shall be properly coordinated with the insulation class of the neutral of the low voltage winding.

xi) Each bushing shall be so coordinated with the transformer insulation that all flashover will occur outside the tank.

xii) The extended bushing bus bars shall be used for termination of 11 KV cables. LV busing shall be housed in completely sealed metallic enclosure.

xiii) Sheet steel, weather, vermin and dust proof cable box fitted with required glands, locks, glass door, terminal Board, heater with switch, illumination lamp with switch, water- tight hinged and padlocked door of a suitable construction shall be provided with each transformer to accommodate 11 KV cables etc. The box shall have slopping roof and the interior and exterior painting shall be in accordance with the specification. Padlock along with duplicate keys shall be supplied for marshaling box. The degree of protection shall be IP-55 or better. To prevent internal condensation, a metal clad heater with thermostat shall be provided. The heater shall be controlled by a MCB of suitable rating mounted in the box. The ventilation louvers, suitably padded with felt, shall also be provided. The louvers shall be provided with suitable felt pads to prevent ingress of dust. All incoming cables shall enter the kiosk from the bottom and the minimum 4mm thick, non-magnetic, gland plate shall not be less than 600 mm from the base of the box. The gland plate and associated compartment shall be sealed in suitable manner to prevent the ingress of moisture from the cable trench – **for those transformers which are used in partly indoor substation**,

7.9.2 Protection& Measuring Devices

i) Oil Conservator Tank

a) The Conservator tank shall have adequate capacity between highest and lowest visible levels to meet the requirement of expansion of the total cold oil volume in the transformer and cooling equipment.

b) The conservator tank shall be bolted into position so that it can be remove for cleaning purposes.

c) The conservator shall be fitted with magnetic oil level gauge with low level electrically insulated alarm contact.

d) Plain conservator fitted with silica gel breather.

ii) Pressure Relief Device.

The pressure relief device provided shall be of sufficient size for rapid release of any pressure that may be generated in the tank and which may result in damage of the equipment. The device shall operate at a static pressure of less than the hydraulic test pressure of transformer tank. It shall be mounted direct on the tank. A pair of electrically insulated contract shall be provided for alarm and tripping.

iii) Buchholz Relay

A double float type Buchholz relay shall be provided. Any gas evolved in the transformer shall collect in this relay. The relay shall be provided with a test cock suitable for a flexible pipe connection for checking its operation. A copper tube shall be connected from the gas collector to a valve located about 1200 mm above ground level to facilitate sampling with the transformer in service. The device shall be provided with two electrically independent potential free contracts, one for alarm on gas accumulation and the other for tripping on sudden rise of pressure.

iv) Temperature Indicator

a) Oil Temperature Indicator (OTI)

The transformers shall be provided with a micro switch contact type thermometer with 150 mm dial for top oil temperature indication. The thermometer shall have adjustable, electrically independent potential free alarm and trip contacts. Maximum reading pointer and resetting device shall be mounted in the local control panel. A temperature sensing element suitably located in a pocket on top oil shall be furnished. This shall be connected to the OTI by means of capillary tubing. Accuracy class of OTI shall be ± 1% or better. One No electrical contact capable of operating at 5 A ac at 230 volt supply.

b) Winding Temperature indicator (WTI)

A device for measuring the hot spot temperature of the winding shall be provided. It shall comprise the following.

i) Temperature sensing element.

ii) Image Coil.

iii) Micro switch contacts.

iv) Auxiliary CTS, If required to match the image coil, shall be furnished and mounted in the local control panel.

v) 150mm dial local indicating instrument with maximum reading pointer mounted in local panel and with adjustable electrically independent ungrounded contacts, besides that required for control of cooling equipment, one for high winding temperature alarm and on for trip.

vi) Calibration device.

vii) Two number electrical contact each capable of operating at 5 A ac at 230 Volt supply.

7.9.3 **Oil Preservation Equipment**

7.9.3.1 **Oil Sealing**

The oil preservation shall be diaphragm type oil sealing in conservator to prevent oxidation and contamination of oil due to contact with atmospheric moisture.

The conservator shall be fitted with a dehydrating filter breather. It shall be so designed that.

i) Passage of air is through a dust filter & Silica gel.

ii) Silica gel is isolate from atmosphere by an oil seal.

iii) Moisture absorption indicated by a change in colour of the crystals of the silica gel can be easily observed from a distance.

iv) Breather is mounted not more than 1400 mm above rail top level.

7.10 MARSHALLING BOX

i) Sheet steel, weather, vermin and dust proof marshalling box fitted with required glands, locks, glass door, terminal Board, heater with switch, illumination lamp with switch, water- tight hinged and padlocked door of a suitable construction shall be provided with each transformer to accommodate temperature indicators, terminal blocks etc. The box shall have slopping roof and the interior and exterior painting shall be in accordance with the specification. Padlock along with duplicate keys shall be supplied for marshalling box. The degree of protection shall be IP-55 or better.

ii) The schematic diagram of the circuitry inside the marshalling box be prepared and fixed inside the door under a prospone sheet.

iii) The marshalling box shall accommodate the following equipment:

a) Temperature indicators.

b) Space for accommodating Control & Protection equipment in future for the cooling fan (for ONAF type cooling, may be provided in future).

c) Terminal blocks and gland plates for incoming and outgoing cables.

All the above equipments except c) shall be mounted on panels and back of panel wiring shall be used for inter-connection. The temperature indicators shall be so mounted that the dials are not more than 1600 mm from the ground level and the door (s) of the compartment(s) shall be provided with glazed window of adequate size. The transformer shall be erected on a plinth which shall be 2.5 feet above ground level.

iv) To prevent internal condensation, a metal clad heater with thermostat shall be provided. The heater shall be controlled by a MCB of suitable rating mounted in the box. The ventilation louvers, suitably padded with felt, shall also be provided. The louvers shall be provided with suitable felt pads to prevent ingress of dust.

v) All incoming cables shall enter the kiosk from the bottom and the gland plate shall not be less than 450 mm from the base of the box. The gland plate and associated compartment shall be sealed in suitable manner to prevent the ingress of moisture from the cable trench.

7.11 TAPCHANGER

7.11.1 **ON-LOAD TAP-CHANGERS**

i) The3.15/5/6.3/8/10/12.5 MVA transformers shall be provided with On-load Taps. Specification of OLTC is attached herewith as Annexure.

ii) The Transformer with off-load tap changing gear shall have taps ranging from +5% to -15% in 8equal steps of 2.5% each on HV winding for voltage variation

iii) The tap changing switch shall be located in a convenient position so that it can be operated from ground level. The switch handle shall be provided with locking arrangement along with tap position indication, thus enabling the switch to be locked in position

7.12 FITTINGS AND ACCESSORIES

The following fittings and accessories shall be provided on the transformers:

i) Conservator with isolating valves, oil filling hole with cap and drain valve. The conservatorvessel shall be filled with constant oil pressure diaphragm oil sealing system.

ii) Magnetic type oil level gauge (150 mm dia) with low oil level alarm contacts.

iii) Prismatic/ toughened glass oil level gauge.

iv) Silica gel breather with oil seal and connecting pipe complete with first fill of activated silica gel or Alumina mounted at a level of 1300 mm above ground level.

v) A double float type Buchholz relay with isolating valve. Bleeding pipe and a testing cock, the test cock shall be suitable for a flexible (pipe connection for checking its operation). A 5mm dia. Copper pipe shall be connected from the relay test cock to a valve located at a suitable height above ground level to facilitate sampling of gas with the transformer in service. Interconnection between gas collection box and relay shall also be provided. The device shall be provided with

two electrically independent ungrounded contacts, one for alarm on gas accumulation and the other for tripping on sudden oil surge. These contacts shall be wired upto transformer marshalling box. The relay shall be provided with shut off valve on the conservator side as well as on the tank side.

vi) Pressure relief devices (including pressure relief valve) and necessary air equalizer connection between this and the conservator with necessary alarm and trip contacts.

vii) Air release plugs in the top cover.

viii) Inspection cover, access holes with bolted covers for access to inner ends of bushing etc.

ix) Winding temperature (hot spot) indicating device for local mounting complete in all respects. Winding temperature indicator shall have two set of contacts to operate at different settings :

a) To provide winding temperature high alarm

b) To provide temperature too high trip

x) Dial thermometer with pocket for oil temperature indicator with one set of alarm and one set of trip contacts and maximum reading pointer.

xi) Lifting eyes or lugs for the top cover, core and coils and for the complete transformer.

xii) Jacking pads

xiii) Haulage lugs.

xiv) Protected type mercury / alcohol in glass thermometer and a pocket to house the same.

xv) Top and bottom filter valves on diagonally opposite ends with pad locking arrangement on both valves.

xvi) Top and bottom sampling valves.

xvii) Drain valve with pad locking arrangement

xviii) Rating and connection diagram plate.

xix) Two numbers tank earthing terminals with associated nuts and bolts for connections to Employer's grounding strip. Bi-directional flagged rollers with locking and bolting device.

xx) Marshalling Box (MB)

xxi) Shut off valve on both sides of flexible pipe connections between radiator bank and transformer tank.

xxii) Cooling Accessories :

a) Requisite number of radiators provided with :-

- One shut off valve on top

- One shut off valve at bottom

- Air release device on top

- Drain and sampling device at bottom

- Lifting lugs.

b) Air release device and oil drain plug on oil pipe connectors:

xxiii) Terminal marking plates for Current Transformer and Main Transformer

xxiv) Off- Load Tap Changer

xxv) Oil Preservation Equipment

xxvi) Oil Temperature indicator

xxvii) Transformer shall be supplied with all control cable, WTI & OTI, sensing cable, glands, lugs etc (complete control).

Note :

1. The fittings listed above are indicative and any other fittings which are generally required for satisfactory operation of the transformer are deemed to be included in the quoted price of the transformer.

2. The contacts of various devices required for alarm and trip shall be potential free and shall be adequately rated for continuous, making and breaking current duties as specified.

7.13 CONTROL CONNECTIONS AND INSTRUMENT AND WIRING TERMINAL BOARD AND FUSES

i) Normally no fuses shall be used anywhere instead of fuses MCB"s (both in AC & DC circuits) shall be used. Only in cases where a MCB cannot replace a fuse due to system requirements, a HRC fuse can be accepted.

ii) All wiring connections, terminal boards, fuses MCB"s and links shall be suitable for tropical atmosphere. Any wiring liable to be in contact with oil shall have oil resisting insulation and the bare ends of stranded wire shall be sweated together to prevent seepage of oil along the wire.

iii) Panel connections shall be neatly and squarely fixed to the panel. All instruments and panel wiring shall be run in PVC or non-rusting metal cleats of the compression type. All wiring to a panel shall be taken from suitable terminal boards.

iv) Where conduits are used, the runs shall be laid with suitable falls, and the lowest parts of the run shall be external to the boxes. All conduit runs shall be adequately drained and ventilated. Conduits shall not be run at or below ground level.

v) When 400 volt connections are taken through junction boxes or marshalling boxes, they shall be adequately screened and 400 volts Danger Notice must be affixed to the outside of the junction boxes or marshalling box. Proper colour code for Red, Yellow, Blue wires shall be followed.

vi) All box wiring shall be in accordance with relevant ISS. All wiring shall be of stranded copper (48 strands) of 1100 Volt grade and size not less than 2.5 sq.mm

vii) All wires on panels and all multi-core cables shall have ferrules, for easy identifications, which bear the same number at both ends, as indicated in the relevant drawing.

viii) At those points of interconnection between the wiring carried out by separate contractors, where a change of number cannot be avoided double ferrules shall be provided on each wire. The change of numbering shall be shown on the appropriate diagram of the equipment.

ix) The same ferrule number shall not be used on wires in different circuits on the same panels.

x) Ferrules shall be of white insulating material and shall be provided with glossy finish to prevent the adhesion of dirt. They shall be clearly and durably marked in black and shall not be affected by dampness or oil.

xi) Stranded wires shall be terminated with tinned Ross Courtney terminals, claw washers or crimped tubular lugs. Separate washers shall be suited to the size of the wire terminated. Wiring shall, in general, be accommodated on the sides of the box and the wires for each circuit shall be separately grouped. Back of panel wiring shall be arranged so that access to the connecting items of relays and other apparatus is not impeded.

xii) All circuits in which the voltage exceeds 125 volts, shall be kept physically separated from the remaining wiring. The function of each circuit shall be marked on the associated terminal boards.

xiii) Where apparatus is mounted on panels, all metal cases shall be separately earthed by means of stranded (48 No.) copper wire of strip having a cross section of not less than 2 sq. mm where strip is used, the joints shall be sweated. The copper wire shall have green coloured insulation for earth connections.

xiv) All wiring diagram for control and relay panel shall preferably be drawn as viewed from the back and shall show the terminal boards arranged as in services.

xv) Terminal block rows should be spaced adequately not less than 100 mm apart to permit convenient access to external cables and terminations.

xvi) Terminal blocks shall be placed with respect to the cable gland (at a minimum distance of 200 mm) as to permit satisfactory arrangement of multicore cable tails .

xvii) Terminal blocks shall have pairs of terminals for incoming and outgoing wires. Insulating barriers shall be provided between adjacent connections. The height of the barriers and the spacing between terminals shall be such as to give adequate protection while allowing easy access to terminals. The terminals shall be adequately protected with insulating dust proof covers. No live metal shall be exposed at the back of the terminal boards. CT terminals shall have shorting facilities. The terminals for CTs should have provision to insert banana plugs and with isolating links.

xviii) All interconnecting wiring, as per the final approved scheme between accessories of transformer and marshalling box is included in the scope of this specification and shall be done by the Transformer supplier.

xix) The schematic diagram shall be drawn and fixed under a transparent prospane sheet on the inner side of the marshalling box cover.

xx) To avoid condensation in the Marshalling Box, a space heater shall be provided with an MCB and thermostat.

xxi) Suitable MV, CFL light shall be provided in the Marshalling Box for lightning purpose.

7.14 RADIO INTERFERENCE AND NOISE LEVEL

Transformers shall be designed with particular care to suppress at least the third and fifth harmonic voltages so as to minimize interference with communication circuits. Transformer noise level when energized at normal voltage and frequency shall be as per NEMA stipulations.

8 INSPECTION AND TESTING

(i) The Contractor shall carry out a comprehensive inspection and testing programme during manufacture of the transformer. This is, however, not intended to form a comprehensive programme as it is contractor"s responsibility to draw up and carry out such a programme duly approved by the Employer.

(ii) Transformer of each rating will be as per pre-type tested design.

(iii) The pre-shipment checks shall also be carried out by the contractor.

(iv) The requirements on site tests are as listed in the specifications.

(v) Certified test report and oscillograms shall be furnished to the Employer Consultants for evaluation as per the schedule of distribution of documents. The Contractor shall also evaluate the test results and rectify the defects in the equipment based on his and the Employers evaluations of the tests without any extra charges to the Employer. Manufacturer's Test Certificates in respect of all associated auxiliary and ancillary equipment shall be furnished.

(vi) The bidder shall state in his proposal the testing facilities available at his works. In case full testing facilities are not available, the bidder shall state the method proposed to be adopted so as to ascertain the transformer characteristics corresponding to full capacity.

8.1 INSPECTION

Transformers not manufactured as per Type- Tested design shall be rejected.

i) Tank and Conservator

a) Inspection of major weld.

b) Crack detection of major strength weld seams by dye penetration test.

c) Check correct dimensions between wheels, demonstrate turning of wheels, through 900 and further dimensional check.

d) Leakage test of the conservator.

ii) Core

a) Sample testing of core materials for checking specific loss, properties, magnetization characteristics and thickness.

b) Check on the quality of varnish if used on the stampings.

c) Check on the amount of burrs.

d) Visual and dimensional check during assembly stage.

e) Check on completed core for measurement of iron loss, determination of maximum flux density,

f) Visual and dimensional checks for straightness and roundness of core, thickness of limbs and suitability of clamps.

g) High voltage DC test (2 KV for one minute) between core and clamps.

iii) Insulating Material

a) Sample check for physical properties of materials.

b) Check for dielectric strength

c) Check for the reaction of hot oil on insulating materials.

iv) Winding

a) Sample check on winding conductor for mechanical and electrical conductivity.

b) Visual and dimensional checks on conductor for scratches, dent mark etc.

c) Sample check on insulating paper for PH value, electric strength.

d) Check for the bonding of the insulating paper with conductor.

e) Check and ensure that physical condition of all materials taken for windings is satisfactory and free of dust.

f) Check for absence of short circuit between parallel strands.

v) Checks Before Drying Process

a) Check condition of insulation on the conductor and between the windings.

b) Check insulation distance between high voltage connections, between high voltage connection cables and earth and other live parts.

c) Check insulating distances between low voltage connections and earth and other parts.

d) Insulating test for core earthing.

vi) Check During Drying Process

a) Measurement and recording of temperature and drying time during vacuum treatment.

b) Check for completeness of drying

vii) Assembled Transformer

a) Check completed transformer against approved outline drawing, provision for all fittings, finish level etc.

b) Jacking test on the assembled Transformer.

viii) Oil All standard tests in accordance with IS: 335 shall be carried out on Transformer oil sample before filling in the transformer.

ix) Test Report for bought out items The contractor shall submit the test reports for all bought out / sub contracted items for approval.

a) Buchholz relay

b) Sudden pressure rise relay on Main Tank

c) Winding temperature indicators (for TX capacity 5 MVA)

d) Oil temperature indicators

e) Bushings

f) Bushing current transformers in neutral (If Provided)

g) Marshalling box

h) Off Load Tap changer

i) Any other item required to complete the works.

j) Porcelain, bushings, bushing current transformers, wherever provided, winding coolers, control devices, insulating oil and other associated equipment shall be tested by the

contractor in accordance with relevant IS . If such requirement is purchased by the contractor on a sub-contract, he shall have them tested to comply with these requirements.

8.2 FACTORY TESTS

i) All standards routine tests in accordance IS: 2026 with dielectric tests corresponding as per latest amendments to IS: 2026 shall be carried out.

ii) All auxiliary equipment shall be tested as per the relevant IS. Test certificates shall be submitted for bought out items.

iii) High voltage withstand test shall be performed on auxiliary equipment and wiring after complete assembly.

iv) Following additional routine tests shall also be carried out on each transformer:

a) Magnetic Circuit Test Each core shall be tested for 1 minute at 2000 Volt DC

b) Oil leakage test on transformer

8.2.1 Type Test

8.2.1.1 The measurements and tests should be carried out in accordance with the standard specified in each case as indicated in the following table if the same tests were not conducted earlier at CPRI or any NABL accredited Laboratory on the transformers of the offered design without any cost implication on employer.

Table 6: Transformer type tests

Type Test Standard	
Temperature Rise Test	IEC 76/IS 2026/IS6600
Impulse Voltage Withstand Test, including Full Waves andChopped Waves as listed below	IEC 76/IS 2026
Noise Level Measurement	IEC 551

In accordance with IEC 76-3 the following sequence of impulses should have been/ should be applied;

- One full wave at 50% BIL;
- One full wave at 100% BIL;
- One chopped wave at 50% BIL
- Two chopped waves at 100% BIL and
- Two full waves at 100% BIL.

8.2.1.2 If the type test report(s) submitted by the bidder do not fulfil the criteria, as stipulated in this technical specification/ Bidder's offer, the relevant type test(s) has/ have to be conducted by the Bidder at his own cost in CPRI/ NABL accredited laboratory in the presence of employers representative(s) without any financial liability to employer in the event of order placed on him.

8.2.1.3 The offered transformer must be manufactured as per type tested design. A copy of type test certificate must be submitted by manufacturer to Engineer/Employer. Transformers offered without type tested however design shall not be accepted. In case manufacturer agrees for type testing of transformers, testing shall be conducted on manufacturer's cost. No claim shall be acceptable towards type testing. The transformers shall be accepted only on acceptane of type testing results by employer.

8.2.1.4 The supplier shall furnish calculations in accordance with IS: 2026 to demonstrate the Thermal ability of the transformers to withstand Short Circuit forces.

8.2.1(A) Special Test

The short circuit test shall be a mandatory test for each design shall be supplied by the manufacturer and no exception shall be allowed. The test shall be conducted as per latest standard tabled below:

Short Circuit Test	IEC 76 / IS 2026

8.2.2 STAGE INSPECTION

The supplier shall offer the core, windings and tank of each transformer for inspection by the Employers representative(s). During stage Inspection, all the measurements like diameter, window height, leg centre, stack width, stack thickness, thickness of laminations etc. for core assembly, conductor size, Insulation thickness, I.D., O.D, winding height, major and minor insulations for both H.V and L.V windings, length, breadth, height and thickness of plates of Transformer tank, the quality of fittings and accessories will be taken / determined. The supplier can offer for final inspection of the transformers subject to clearance of the stage Inspection report by the Employer.

8.2.3 Routine Tests

Transformer routine tests shall include tests stated in latest issue of IS: 2026 (Part –1). These tests shall also include but shall not be limited to the following :

(i) Measurement of winding DC resistance.

(ii) Voltage ratio on each tapping and check of voltage vector relationship.

(iii) Impedance voltage at all tappings.

(iv) Magnetic circuit test as per relevant ISS or CBIP manual or latest standard being followed.

(v) Measurement of Load losses at normal tap and extreme taps.

(vi) No load losses and no load current at rated voltage and rated frequency, also at 25% to 120 % of rated voltage in steps.

(vii) Absorption index i.e insulation resistance for 15 seconds and 60 seconds (R 60/ R 15) and polarization index i.e Insulation Resistance for 10 minutes and one minute (R 10 mt / R 1 mt).

(viii) Induced over voltage withstand test.

(ix) Separate source voltage withstand test.

(x) Tan delta measurement and capacitance of each winding to earth (with all other windings earthed) & between all windings connected together to earth.

(xi) Measurement of zero sequence impedance

(xii) Tests on off- load tap changer (fully assembled on transformer) as per IS 2026

(xiii) Auxiliary circuit tests

(xiv) Oil BDV tests

(xv) Measurement of neutral unbalance current which shall not exceed 2% of the full rated current of the transformer.

(xvi) Magnetic balance test

(xvii) Leakage test.

Six (6) set of certified test reports and oscillographs shall be submitted for evaluation prior to dispatch of the equipment. The contractor shall also evaluate the test results and shall correct any defect indicated by his and Employers evaluation of the tests without charge to the Employer.

8.4 **TANK TESTS**

a) **Oil leakage Test :**

The tank and oil filled compartments shall be tested for oil tightness completely filled with air or oil of viscosity not greater than that of insulating oil conforming to IS : 335 at the ambient temperature and applying a pressure equal to the normal pressure plus 35 KN/ m2 measured at the base of the tank. The pressure shall be maintained for a period of not less than 12 hours of oil and one hour for air and during that time no leak shall occur.

b) **Pressure Test**

Where required by the Employer, one transformer tank of each size together with its radiator, conservator vessel and other fittings shall be subjected to a pressure corresponding to twice the normal head of oil or to the normal pressure plus 35 KN / m2 whichever is lower, measured at the base of the tank and maintained for one hour.

c) **Vacuum Test**

One transformer tank of each size shall be subjected to the vacuum pressure of 60 mm of mercury. The tanks designed for full vacuum shall be tested at an internal pressure of 3.33 KN/m2 (25 mm of mercury) for one hour. The permanent deflection of flat plates after the vacuum has been released shall not exceed the value specified in C.B.I.P. Manual on Transformers (Revised 1999) without affecting the performance of the transformer.

8.5 **PRE-SHIPMENT CHECK AT MANUFACTURERS WORKS**

i) Check for proper packing and preservation of accessories like radiators, bushings, explosions vent, dehydrating breather, rollers, buchholz relay, control cubicle connecting pipes and conservator etc.

ii) Check for proper provision of bracing to arrest the movement of core and winding assembly inside the tank.

iii) Gas tightness test to conform tightness.

8.6 **INSPECTION AND TESTING AT SITE**

On receipt of transformer at site, shall be performed detailed inspection covering areas right from the receipt of material up to commissioning stage. An indicative program of inspection as envisaged by the Engineer is given below.

8.6.1 **Receipt and Storage Checks**

i) Check and record conditions of each package visible parts of the transformers etc for any damage.

ii) Check and record the gas pressure in the transformer tank as well as in the gas cylinder.

iii) Visual check of core and coils before filling up with oil and also check condition of core and winding in general.

8.6.2 **Installation Checks**

i) Inspection and performance testing of accessories like tap changers etc.

ii) Check choking of the tubes of radiators

iii) Test on oil samples taken from main tank top and bottom and cooling system. Samples should be taken only after the oil has been allowed to settle for 24 hours.

iv) Check the whole assembly for tightness, general appearance etc.

v) Oil leakage tests.

8.6.3 **Pre-Commissioning Tests**

After the transformer is installed, the following pre-commissioning tests and checks shall be done before putting the transformer in service.

i) Dry out test

ii) Megger Test

iii) DC Resistance measurement of windings

iv) Ratio test on all taps

v) Phase relationship test (Vector group test)

vi) Buchholz relay alarm & surge operation test

vii) Low oil level (in conservator) alarm

viii) Temperature Indicators

ix) Marshalling kiosk

x) Protective relays

xi) Magnetising current

xii) Tests on OLTC

8.6.4 **The following additional checks shall be made :**

i) All oil valves are incorrect position closed or opened as required

ii) All air pocket are cleared.

iii) Thermometer pockets are filled with oil

iv) Oil is at correct level in the bushing, conservator, diverter switch & tank etc.

v) Earthing connections are made.

vi) Colour of Silica gel is blue.

vii) Bushing arcing horn is set correctly and gap distance is recorded.

Viii) C T polarity and ratio is correct.

8.7 **PERFORMANCE**

The performance of the transformer shall be measured on the following aspects.

i) The transformer shall be capable of being operated without danger on any tapping at the rated KVA with voltage variations and ± 10% corresponding to the voltage of the tapping

ii) Radio interference and Noise Level

iii) The transformer shall be designed with particular attention to the suppression of third and fifth harmonics so as to minimize interference with communication circuits.

8.8 **FAULT CONDITIONS**

a) The transformer shall be capable of withstanding for two(2) seconds without damages any external short circuit to earth

b) Transformer shall be capable of withstanding thermal and mechanical stresses conveyed by symmetrical or asymmetrical faults on any winding. This shall be demonstrated through calculation as per IS : 2026.

c) Transformer shall accept, without injurious heating, combined voltage and frequency fluctuation which produce the 125% over fluxing condition for one minute and 140% for 5 seconds.

8.9 **WITNESSING OF TESTS AND EXCESSIVE LOSSES**

i) The Employer reserves the right to reject the Transformer if losses exceed the maximum specified as per Clause No 2. SPECIFIC TECHNICAL REQUIREMENTS (STANDARD CONDITIONS), item-35of this specification or if temperature rise of oil and winding exceed the values specified at item -26 of the above clause.

9 LIQUIDATED DAMAGES FOR EXCESSIVE LOSSES

There is no positive tolerance on the guaranteed losses offered by the bidder. However, the transformer(s) shall be rejected out rightly, if any of the losses i.e. no load loss or load loss or both exceed (s) the guaranteed maximum permissible loss figures quoted by the bidder in the Technical Data Schedule with the bid.

10 **SPARE PARTS**

In case the manufacturer goes out of production of spare parts, then he shall make available the drawings of spare parts and specification of materials at no extra cost to the Employer to fabricate or procure spare parts from other sources.

Mandatory Spare Parts

The suppliers shall provide the following mandatory spare s for each of Transformer supplied
1. H.V. & L.V. Bushing & Studs –Each 2 Nos
2. Bimetallic connector for H.V & L.V. Bushings – Each 2 sets

10.1 **INSTRUCTION MANUAL**

Eight sets of the instruction manuals shall be supplied at least four (4) weeks before the actual dispatch of equipment. The manuals shall be in bound volumes and shall contain all the drawings

and information required for erection, operation and maintenance of the transformer. The manuals shall include amongst other, the following particular:

a) Marked erection prints identifying the components, parts of the transformer as dispatched with assembly drawings.

b) Detailed dimensions, assembly and description of all auxiliaries.

c) Detailed views of the core and winding assembly, winding connections and tapings tap changer construction etc. These drawings are required for carrying out overhauling operation at site.

d) Salient technical particulars of the transformer.

e) Copies of all final approved drawings.

f) Detailed O&M instructions with periodical check lists and Performa etc.

10.2 **COMPLETENESS OF EQUIPMENT**

All fittings and accessories, which may not be specifically mentioned in the specification but which are necessary for the satisfactory operation of the transformer, shall be deemed to be included in the specification and shall be furnished by the supplier without extra charges. The equipment shall be complete in all details whether such details are mentioned in the specification or not, without any financial liability to the Employer under any circumstances.

11.0 **TOOLS AND TACKLES**

All the necessary tools and tackles required for normal operation & maintenance of the transformers shall be supplied by the Contractor

12.0 **COMMISSIONING**

The equipment shall be commissioned as per CBIP manual, IS: 10028 and manufacturer's recommendations. All the related drawings and manuals shall be pre-requisite for release of final payment.

ON LOAD TAP CHANGER FOR 33/11KV POWER TRANSFORMER

The tapping range of On Load Tap Changer shall be +5% to -15% in steps of 1.25% each. The no of taps shall be 17.The On Load Tap Changer shall be supplied with RTCC panel and AVR (Automatic Voltage Regulating Relay)

The Continuous current rating of the tap changer shall be based on connected winding rating and shall have liberal and ample margin. Lower rated tap changers connected in parallel are not acceptable.

The on-load tap changing equipment shall have the provision for mechanical and electrical control from a local position and electrical control from a remote position. For local mechanical operation, the operating handle shall be brought outside the tank for operation from floor level with provision to lock the handle in each tap position. Remote electrical operation shall have an AUTO-MANUAL selection at the remote location. When selected AUTO, the tap changing gear shall maintain steady voltage within practical limit on the transformers secondary bus from which the reference shall not respond to transient variation of voltage due to grid disturbance and system fault.

The required voltage relay shall not be sensitive to frequency variation and shall be suitable for sensing voltage from the secondary of potential transformers mounted on the 66KV, 33KV, or 11KV bus.

The tap changer shall be provided with over-current protection in order to prevent the tap-change operation during a short circuit, which would to greatly stress the contacts of the diverter switch. The function of protection shall be arranged as follows;

(i) Whenever over current occurs, the control circuit for commanding OLTC motor operation shall be blocked by the normally close contracts of the over current relays.

(ii) If during tap change over current occurs, the OLTC motor circuit shall be blocked through the mechanical cam switch, which is close from the very beginning to the very end of every tap change operation and to the normally open contacts of the over current relays. The stop action of the motor shall be made through the motor brake contactor.

The design of the tap changing equipment shall be such that the mechanism will not stop in any intermediate position; however, if the mechanism through faulty operation does stop in an intermediate position, the full load must be carried by the transformer without injury to the equipment. The mechanical

position indicator shall be equipped in the motor drive cubicle. The motor shall be designed to be of step control. In any case the operation shall be of step by step.

The **voltage regulating relay** shall be supplied together with the timer and under voltage relay. The signal order from the voltage regulating relay to execute the tap changer operation, when the regulating voltage is out of the voltage regulating level shall be designed to be delayed by the adjustable timer. If the control voltage abnormally falls, the movement of the tap changer shall be locked by the contact of the under voltage relay, even if the contacts of the voltage regulating relay are working.

The control circuit of the transformer shall be completely designed and provisions shall be made for parallel operation with another transformer.

The following accessories, control and selector switches and other necessary accessories shall be furnished.

Remote tap changer control board

(Placed in the control room)

- Voltmeter
- "AUTO-MANUAL" control switch
- "RAISE-LOWER" control switch
- Tap position indicator
- Tap changer operation program indicator.

Transformer Tap Changer driving mechanism control cubicle

- "REMOTE-LOCAL-TEST" selector switch
- "AUTOMATIC-MANUAL" control switch
- "RAISE-LOWER" control switch
- Tap position indicator
- Tap changer operation program indicator
- Voltmeter
- Tap change operation counter
- Means for manual operation when power supply is lost

Single Phase Oil Immersed Distribution Transformers (Outdoor Type)

1 SCOPE:

1.1 This specification covers design, engineering, manufacture, assembly, stage testing, inspection and testing before supply and delivery at site of oil immersed naturally cooled 11 kV/240 V, 11/√3 kV/240 V single phase distribution transformers for outdoor use.

1.2 The equipment shall conform in all respects to high standards of engineering, design and workmanship and shall be capable of performing in continuous commercial operation in a manner acceptable to the purchaser, who will interpret the meanings of drawings and specification and shall have the power to reject any work or material which, in his judgment is not in accordance therewith. The offered equipment shall be complete with all components necessary for their effective and trouble free operation. Such components shall be deemed to be within the scope of bidder's supply irrespective of whether those are specifically brought out in this specification and/or the commercial order or not.

1.3 The transformer and accessories shall be designed to facilitate operation, inspection, maintenance and repairs. The design shall incorporate every precaution and provision for the safety of equipment as well as staff engaged in the operation and maintenance of equipment.

1.4 All outdoor apparatus, including bushing insulators with their mountings, shall be designed so as to avoid any accumulation of water.

1.5 STANDARD RATINGS

1.5.1 Standard ratings of single phase transformers shall be 5, 10, 16 and 25 kVA.

2 STANDARDS:

2.1 The materials shall conform in all respects to the relevant Indian Standard, with latest amendments thereof unless otherwise specified herein; some of them are listed below.

2.2 Material conforming to other internationally accepted standards, which ensure equal or better quality than the standards mentioned above would also be acceptable. In case the bidder who wishes to offer material conforming to the other standards, salient points of difference between the standards adopted and the specific standards shall be clearly brought out in relevant schedule. Four copies of such standards with authentic English translations shall be furnished along with the offer.

3 SERVICE CONDITIONS:

Indian Standards	Title	InternationalStandards
IS -2026	Specification for Power Transformers	IEC 76
IS 1180 (Part-I): 2014	Outdoor Type Oil Immersed Distribution Transformers upto and including 2500kVA, 33kV-Specification	
IS 12444	Specification for Copper wire rod	ASTM B-49
IS-335	Specification for Transformer/Mineral Oil	IEC Pub 296
IS-5	Specification for colors for ready mixed paints	
IS -104	Ready mixed paint, brushing zinc chromate, priming	
IS-2099	Specification for high voltage porcelain bushing	
IS-649	Testing for steel sheets and strips and magnetic	

	circuits	
IS- 3024	Cold rolled grain oriented electrical sheets and strips	
IS - 4257	Dimensions for clamping arrangements for bushings	
IS - 7421	Specification for Low Voltage bushings	
IS - 3347	Specification for Outdoor Bushings	DIN 42531 to 33
IS - 5484	Specification for Al Wire rods	ASTM B - 233
IS - 9335	Specification for Insulating Kraft Paper	IEC 554
IS - 1576	Specification for Insulating Press Board	IEC 641
IS - 6600	Guide for loading of oil Immersed Transformers	IEC 76
IS - 2362	Determination of water content in oil for porcelain bushing of transformer	
IS - 6162	Paper covered Aluminum conductor	
IS - 6160	Rectangular Electrical conductor for electrical machines	
IS - 5561	Electrical power connector	
IS - 6103	Testing of specific resistance of electrical insulating liquids	
IS - 6262	Method of test for power factor and dielectric constant of electrical insulating liquids	
IS - 6792	Determination of electrical strength of insulating oil	
IS - 10028	Installation and maintenance of transformers.	

3.1 The distribution transformers to be supplied against this specification shall be suitable for satisfactory continuous operation under the following climatic conditions as per IS 2026 (Part-I).

i)	Location	:	At various locations in the country
ii)	Max ambient air temperature (^{0}C)	:	50
iii)	Minimum ambient air temperature (^{0}C)	:	-5
iv)	Maximum Average daily ambient air temperature (^{0}C)	:	40
v)	Maximum Yearly weighted average ambient temperature (^{0}C)	:	32
vi)	Maximum altitude above mean sea level (metres)	:	To be specified by user

Note:

1. The climatic conditions specified above are indicative and can be changed by the user as per requirements

2. The equipment shall generally be for use in moderately hot and humid tropical climate, conducive to rust and fungus growth unless otherwise specified.

4 PRINCIPAL PARAMETERS:

4.1 The Transformer shall be suitable for outdoor installation with single phase, 50 Hz, 11 kV systems in which the neutral is effectively earthed and they should be suitable for service under fluctuations in supply voltage up to plus 12.5% to minus 12.5%.

4.2 The transformer shall conform to the following specific parameters. Rated HV side value (11 kV or 11/√3 kV) shall be specified in the detailed bill of quantity by purchaser.

Sl.No	ITEM	SPECIFICATION
1.	System voltage(max)	7/ 12 kV
2.	Rated voltage HV Rated voltage LV	11/√3 or 11 kV 240 V*
3.	Frequency	50 Hz +/- 5%
4.	No. of Phases	Single
5.	Type of cooling	ONAN

4.3 INSULATION LEVELS

Voltage (Volts)	Impulse Voltage (kV Peak)	Power Frequency (kV)
433	-	3
11000	95	28

5 TECHNICAL REQUIREMENTS:

5.1 CORE MATERIAL:

5.1.1 Transformer core shall be wound core type construction using new and high quality cold rolled grain oriented (CRGO) steel with heat resistant insulating coating or Amorphous metal.

5.1.2 The bidder should offer the core for inspection and approval by the purchaser during manufacturing stage.

5.1.3 The transformer shall be suitable for over fluxing (due to combined effect of voltage and frequency) upto12.5% without injurious heating. The operating flux density shall be such that there is a clear safe margin over the over fluxing limit of 12.5%.

5.1.4 No-load current shall not exceed 3% of full load current and will be measured by energizing the transformer at rated voltage and frequency. Increase of 12.5% of rated voltage shall not increase the no-load current by 6% of full load current.

5.2 WINDINGS MATERIALS:

5.2.1 HV and LV windings shall be wound from Aluminum/Copper conductors covered with double paper/enamel. The inter layer insulation shall be of nomex/epoxy resin dotted kraft paper.

5.2.2 Proper bonding of inter layer insulation with the conductor shall be ensured. Test for bonding strength to be conducted.

5.2.3 The core coil assembly shall be dried in an oven. The type of winding shall be indicated in the tender. Whether LV windings are of conventional type or foil wound shall be indicated.

5.2.4 Dimensions of winding coils are very critical. Dimensional tolerances for winding coils shall be within limits as specified in guaranteed technical particulars (GTP).

5.2.5 The core coil assembly shall be securely held in position to avoid any movement under short circuit conditions.

5.2.6 Joints in the winding shall be avoided. However, if jointing is necessary the joints shall be properly brazed and the resistance of the joints shall be less than that of parent conductor. In case of foil windings, welding of leads to foil can be done within the winding.

5.3 WINDING CONNECTION AND TERMINAL ARRANGEMENTS:

5.3.1 For 11 kV transformers both ends of primary winding shall be brought out through HV bushings. For 11/√3 kV transformers, neutral end of the primary HV winding shall be brought out for connecting to 'Neutral' supply wire through 1.1 kV bushings. There shall be provision for connecting 'Neutral' terminal, to local 'Earth' by way of a tinned Copper strip ofadequate sizeand
dimension. The secondary winding shall be connected to two LV bushings.

5.4 OIL:

5.4.1 The insulating oil shall comply with the requirements of IS 335.Use of recycled oil is not acceptable. The specific resistance of the oil shall not be less than $2.5x10^{12}$ ohm-cm at 27 ^{0}C when tested as per IS 6103.

5.4.2 Oil shall be filtered and tested for break down voltage (BDV) and moisture content before filling

5.4.3 The design and all materials and processes used in the manufacture of the transformer, shall be such as to reduce to a minimum the risk of the development of acidity in the oil.

6 LOSSES:

6.1 The bidder shall guarantee individually the no-load loss and load loss without any positive tolerance. The bidder shall also guarantee the total losses (no load + load lossesat 75 ^{0}C) at the 50% of rated load and total losses at 100% of rated shall not exceed the maximum total loss values given in Table-9 of IS 1180(Part-1):2014.

6.2 The maximum allowable losses at rated voltage and rated frequency permitted at 75 ^{0}C for 11/0.433 kV transformers can be chosen by the utility as per **Table-9 for ratings 5,10, 16, 25kVA** as per **Energy Efficiency Level-2 specified in IS 1180 (Part-1): 2014** for single phase distribution transformers.

6.2 The above losses are maximum allowable and there would not be any positive tolerance. Bids with higher losses than the above specified values would be treated as non-responsive. However, the manufacturer can offer losses less than above stated values. The utility can evaluate offers with losses lower than the maximum allowable losses on total owning cost basis in accordance with methodology given in Annex-I.

7 PERCENTAGE IMPEDANCE:

7.1 The percentage impedance of single-phase transformers at 75 ^{0}C for different ratings upto 25 kVA shall be as per Table 9 of IS 1180(Part-1):2014.

8 TEMPERATURE RISE:

8.1 The temperature rise over ambient shall not exceed the limits given below in accordance with IS 2026 (Part-2):

8.2 Top oil temperature rise measured by thermometer : 35^{0}C

8.3 Winding temperature rise measured by resistance method : 40^{0}C

8.4 Bids not conforming to the above limits of temperature rise will be treated as non-responsive.

9 PENALTY FOR NON PERFORMANCE

9.1 During testing at supplier's works if it is found that the actual measured losses are more than the values quoted by the bidder, the purchaser shall reject the transformer and he shall also have the right to reject the complete lot.

9.2 Purchaser shall reject the entire lot during the test at supplier's works, if the temperature rise exceeds the specified values.

9.3 Purchaser shall reject any transformer during the test at supplier's works, if the impedance values differ from the guaranteed values including tolerance and if they do not meet the requirements of clause 7.1

10 BUSHINGS:

10.1 The bushings shall be either porcelain or epoxy type and shall conform to the relevant standards specified. Polymer insulator bushings conforming with relevant IEC can also be used.

10.2 For HV, 12 kV class bushings shall be used and for LV, 1.1 kV class bushings shall be used.

10.3 The terminal arrangement shall not require a separate oil chamber not connected to oil in the main tank.

10.4 The HV bushings shall be fixed to the top cover of the transformer and the LV bushings shall be fixed to transformer on sides and in the same plane.

10.5 The bushing rods and nuts shall be of brass/stainless steel.

10.6 The HV bushings shall not have arcing horns.

10.7 Bushings shall be marked with manufacturer's name, month and year of manufacture.

11 BUSHING TERMINALS:

11.1 HV terminal shall be designed to directly receive ACSR conductor upto 7/2.59 mm (without requiring the use of lug) and the LV terminals shall be suitable for directly receiving LT cables (aluminum) ranging from 10 Sq mm to 25 Sq mm both in vertical and horizontal position and the arrangements should be such as to avoid bimetallic corrosion. Terminal connectors must be type tested as per IS 5561.

12 TANK:

12.1 The oil volume inside the tank shall be such that even under the extreme operating conditions, the pressure generated inside the tank does not exceed 0.4 kg/sq. cm positive or negative. There must be sufficient space from the core to the top cover to take care of oil expansion.

12.2 The tank cover shall have plasticized surface at the top to guard against bird faults. Alternately, suitable insulating shrouds shall be provided on the bushing terminals.

12.3 The Transformer tank shall be of robust construction round/rectangular in shape and shall be built up of tested CRCA/Mild Steel Sheet.

12.4 The tank shall be capable of withstanding a pressure of 1 kg/cm^2 (g) and a vacuum of 760 mm of Hg for 30 minutes without any permanent deflection (Air pressure test shall be conducted as per IS -1180(Part-I):2014.

12.5 The L - seam joint, C - seam joint and all fittings and accessories shall be oil tight and no deflection / bulging should occur during service.

12.6 Manufacturer should carry out the all the welding operations as per the relevant ASME standards and submit a copy of the welding procedure and welder performance qualification certificates to the Purchaser.

12.7 The circular bottom plate edges of the tank should be folded upward, for at least 25 mm, to have sufficient overlap with vertical sidewall of the transformer.

12.8 The Transformer tank and the top cover shall be designed in such a manner as to leave no external pockets in which water can lodge.

12.9 Tank shall have permanent lugs for lifting the transformer bodily and there shall be facilities for lifting the core coil assembly separately.

12.10 The transformer shall be provided with two mounting lugs suitable for fixing the transformer to a single pole by means of 2 bolts of 20 mm diameter as per ANSI C 57.12.20-1988.

12.11 Both mounting lugs are made with steel of minimum 5 mm thickness.

12.12 Jump proof lips shall be provided for upper mounting lug.

12.13 Mounting lug faces shall be in one plane.

12.14 Minimum Oil level mark shall be embossed inside the tank (at 25^0 C).

12.15 The top cover shall be fixed to the tank through clamping only.

12.16 HV bushing pocket shall be embossed to top side of the top cover so as to eliminate ingress of moisture and water.

12.17 The edges of the top cover shall be formed, so as to cover the top end of the tank and gasket.

12.18 Nitrile/ polyurethane /neoprene rubber gaskets' conforming to latest IS 4253 part-II shall be provided between tank and top cover.

12.19 The gaskets shall be continuous i.e. without any joint.

13 TANK SEALING:

13.1 The space on the top of the oil shall be filled with dry air or nitrogen. The nitrogen plus oil volume inside the tank shall be such that even under extreme operating conditions, the pressure generated inside the tank does not exceed 0.4 kg/sq. cm positive or negative. The nitrogen shall

conform to commercial grade of the relevant standards.

14 SURFACE PREPARATION AND PAINTING:

14.1 GENERAL

14.1.1 All paints, when applied in a normal full coat, shall be free from runs, sags, wrinkles, patchiness, brush marks or other defects.

14.1.2 All primers shall be well marked into the surface, particularly in areas where painting is evident, and the first priming coat shall be applied as soon as possible after cleaning. The paint shall be applied by airless spray according to manufacturer's recommendations.

14.2 CLEANING ANDSURFACE PREPARATION:

14.2.1 After all machining, forming and welding has been completed, all steel work surfaces shall be thoroughly cleaned of rust, scale, welding slag or spatter and other contamination prior to any painting. Steel surfaces shall be prepared by Shot blast cleaning (IS 9954) to grade Sa. 2.5 of ISO 8501-1 or chemical cleaning including phosphating (IS 3618).

14.2.2 The pressure and volume of the compressed air supply for blast cleaning shall meet the work requirements and shall be sufficiently free from all water contamination to ensure that the cleaning process is not impaired.

14.2.3 Chipping, scraping and steel wire brushing using manual or power driven tools cannot remove firmly adherent mill-scale and shall only be used where shot blast cleaning is impractical. Manufacturer shall indicate such location, for purchaser's information, in his offer.

14.3 PROTECTIVE COATING:

As soon as all items have been cleaned and within four hours of the subsequent drying, they shall be given suitable anti-corrosion protection.

14.4 PAINT MATERIAL:

Following are the types of paint that may be suitably used for the items to be painted at shop and supply of matching paint to site:

14.4.1 Heat resistant paint (Hot oil proof) for inside surface / varnish.

14.4.2 For external surfaces one coat of Thermo Setting paint or 1 coat of epoxy primer followed by 2 coats of polyurethene base paint. These paints can be either air-drying or stoving.

14.4.3 In case of highly polluted area, chemical atmosphere or at a place very near the sea coast, paint as above with one intermediate coat of high build MIO (Micaceous iron oxide) as an intermediate coat may be used to give a total dry film thickness of 150 to 180 microns.

14.5 PAINTING PROCEDURE:

14.5.1 All prepared steel surfaces should be primed before visible re-rusting occurs or within 4 hours, whichever is sooner. Chemical treated steel surfaces shall be primed as soon as the surface is dry and while the surface is still warm.

14.5.2 Where the quality of film is impaired by excess film thickness (wrinkling, mud cracking or general softness) the supplier shall remove the unsatisfactory paint coating and apply another. In all instances where two or more coats of the same paint are specified, such coatings may or may not be of contrasting colours.

14.5.3 **DAMAGED PAINTWORK:**

14.5.4 Any damage occurring to any part of a painting scheme shall be made good to the same standard of corrosion protection and appearance as that was originally employed.

14.5.5 Any damaged paint work shall be made good as follows:

14.5.6 The damaged area, together with an area extending 25 mm around its boundary, shall be cleaned down to bare metal.

14.5.7 A priming coat shall be immediately applied, followed by a full paint finish equal to that originally applied and extending 50 mm around the perimeter of the original damage.

14.5.8 The repainted surface shall present a smooth surface. This shall be obtained by carefully chamfering the paint edges before and after priming.

14.6 DRY FILM THICKNESS:

14.6.1 To the maximum extent practicable the coats shall be applied as a continuous film of uniform thickness and free of pores. Over spray, skips, runs, sags and drips should be avoided. The different coats may or may not be of the same colour.

14.6.2 Each coat of paint shall be allowed to harden before the next is applied as per manufacturer's recommendation.

14.6.3 Particular attention must be paid to full film thickness at edges.

14.6.4 The requirements for the dry film thickness (DFT) of paint and the materials to be used shall be as given below :

Sl. No.	Paint Type	Area to be painted	No. of coats	Total dry film thickness (minimum)
1.	Thermo setting paint	inside	01	30 microns
		outside	01	60 microns
2.	**Liquid paint**			
	a) Epoxy (primer)	outside	01	30 microns
	b) Polyurethene base (Finish coat)	outside	02	25 microns each
	c)Hot oil paint / Varnish	inside	01	35 / 10 microns

14.7 TESTS:

- The painted surface shall be tested for paint thickness.
- The painted surface shall pass the cross hatch adhesion test and impact test as routine test, Salt spray and Hardness test as type test as per the relevant ASTM standards.

Note: Supplier shall guarantee the painting performance requirement for a period of not less than 5 years.

15 RATING AND TERMINAL PLATES:

15.1 Each transformer shall be provided with rating plate made of anodized aluminum/stainless steel material securely fixed on the outer body, easily accessible, showing the information given in Fig.2 of IS 1180(Part-1):2014 for single phase transformers. The entries on the rating plates shall be indelibly marked by engraving.

15.2 Each transformer shall be provided with a terminal marking plate in accordance with Fig.5 of IS 1180(Part-1):2014. The rating and terminal marking plates may be combined into one plate at the option of manufacturer.

15.3 The distribution transformer be marked with the Standard Mark and the use of Standard Mark is governed by the provisions of Bureau of Indian Standards Act, 1986 and the Rules and regulations made thereunder.

16 PRESSURE AND VACCUM REQUIREMENTS:

16.1 Single phase transformers up to 25kVA, the transformer tank shall be of roboust construction, round in shape shall be capable of withstanding a pressure of 100kPa and a vacuum of 760 mm of mercury.

17 FITTINGS:

17.1 The following standard fittings shall be provided :

17.1.1 Two earthing terminals with earthing symbol.

17.1.2 Lifting lugs for the complete transformer as well as for core and winding assembly.

17.1.3 HV side neutral groundingstrip(where one of the bushing terminal is connected to earth).

17.1.4 Rating and terminal marking plates.(Non detachable type)

17.1.5 Metal oxide lightning arrester 9 kV, 5kA.

17.1.6 Pressure relief device or self-ventilating cover

17.1.7 Circuit Breaker operating mechanism.

17.1.8 Oil immersed LT circuit breaker (If internal), along with operating rod.

17.1.9 HV fuse links.

17.1.10 Signal light.

17.1.11 HV bushings.

17.1.12 LV bushings.

17.1.13 HV and LV terminal connectors.

17.1.14 Top cover fixing clamps.

17.1.15 Mounting lugs - 2 Nos.

17.1.16 Bird guard.

17.1.17 LV earthing arrangement.

17.1.18 Any other fitting necessary for satisfactory performance of the product.

18 FASTENERS:

18.1 All bolts, studs, screw threads, pipe threads, bolt heads and nuts shall comply with the appropriate Indian Standards for metric threads, or the technical equivalent.

18.2 Bolts or studs shall not be less than 6 mm in diameter except when used for small wiring terminals.

18.3 All nuts and pins shall be adequately locked.

18.4 Wherever possible bolts shall be fitted in such a manner that in the event of failure of locking resulting in the nuts working loose and falling off, the bolt will remain in position.

18.5 All ferrous bolts, nuts and washers placed in outdoor positions shall be treated to prevent corrosion, by hot dip galvanising, except high tensile steel bolts and spring washers which shall be electro-galvanised/ plated. Appropriate precautions shall be taken to prevent electrolytic action between dissimilar metals.

18.6 Each bolt or stud shall project at least one thread but not more than three threads through the nut, except when otherwise approved for terminal board studs or relay stems. If bolts and nuts are placed so that they are inaccessible by means of ordinary spanners, special spanners shall be provided.

18.7 The length of the screwed portion of the bolts shall be such that no screw thread may form part of a shear plane between members.

18.8 Taper washers shall be provided where necessary. Protective washers of suitable material shall be provided front and back or the securing screws.

19 11 kV LIGHTNING ARRESTORS:

High surge capacity 9 kV, 5 kA Distribution class type lightning arrestor conforming to IS 3070 Part III shall be mounted on the transformer clamped securely to the tank, to protect the transformer and associated line equipment from the occasional high voltage surges resulting from lightning or switching operations. The earthing terminal of the lightning arrestors shall be connected solidly to the transformer tank earthing terminal. Lightning arrestors with polymer insulators in conformance with relevant IEC can also be used.

20 OVER LOAD CAPACITY:

20.1 The transformer shall be suitable for loading as per latest IS 6600.

21 TESTS:

21.1 All the equipment offered shall be fully type tested by the bidder as per the relevant standards including the additional type tests mentioned at clause 23.The type test must have been conducted on a transformer of same design **during the last five years** at the time of bidding. The bidder shall furnish four sets of type test reports along with the offer. Offers without type test reports will be treated as non-responsive.

21.2 Special tests other than type and routine tests, as agreed between purchaser and bidder shall

also be carried out as per the relevant standards

21.3 The test certificates for all routine and type tests for the transformers and also for the bushings and transformer oil shall be submitted with the bid.

21.4 The procedure for testing shall be in accordance with IS 1180(Part-1): 2014/2026 as the case may be except for temperature rise.

21.5 Before dispatch each of the completely assembled transformer shall be subjected to the routine tests at the manufacturers works.

22 ROUTINE TESTS:

22.1 Ratio, polarity tests.

22.2 No load current and losses at service voltage and normal frequency.

22.3 Load losses at rated current and normal frequency.

22.4 Impedance Voltage test.

22.5 Resistance of windings cold (at or near the test bed temperature).

22.6 Insulation resistance.

22.7 Induced over voltage withstand test.

22.8 Separate source voltage withstand test.

22.9 Breaker coordination test.

22.10 Oil sample test (one sample per lot) to comply with IS 1866.

22.11 Air pressure test on empty tank as per IS 1180

23 TYPE TESTS TO BE CONDUCTED ON ONE UNIT:

In addition to the tests mentioned above following tests shall be conducted:

23.1 Temperature rise test for determining the maximum temperature rise after continuous full load run. The ambient temperature and time of test should be stated in the test certificate.

23.2 Impulse voltage withstand test: As per IS 2026 part-III. Basic insulation level (BIL) for 11 kV shall be 95 kV peak instead of 75 kV.

23.3 Air pressure test: As per IS 1180 (Part-I):2014.

23.4 Short circuit withstand test: Thermal and dynamic ability.

23.5 Oil samples (Post short circuit and temperature rise test)

23.6 Noise level measurement.

23.7 Permissible flux density and over fluxing withstand test.

23.8 Type test certificates for the tests carried out on prototype of same specifications shall be

submitted along with the bid.

23.9 The purchaser may select the transformer for type tests randomly.

23.10 Short Circuit Test and Impulse Voltage Withstand Test: The purchaser intends to procure transformers designed and successfully tested for short circuit and impulse test. In case the transformers proposed for supply against the order are not exactly as per the tested design, the supplier shall be required to carry out the short circuit test and impulse voltage withstand test at their own cost in the presence of the representative of the purchaser.

23.11 The supply shall be accepted only after such test is done successfully, as it confirms on successful withstand of short circuit and healthiness of the active parts thereafter on un-tanking after a short circuit test.

23.12 Apart from dynamic ability test, the transformers shall also be required to withstand thermal ability test or thermal withstand ability will have to be established by way of calculations.

23.13 It may also be noted that the purchaser reserved the right to conduct short circuit test and impulse voltage test in accordance with the IS, afresh on each ordered rating at purchaser's cost, even if the transformers of the same rating and similar design are already tested. This test shall be carried out on a transformer to be selected by the purchaser either at their works when they are offered in a lot for supply or randomly from the supplies already made to purchaser's Stores. The findings and conclusions of these tests shall be binding on the supplier.

24 TESTS AT SITE:

24.1 The purchaser reserves the right to conduct all tests on transformer after arrival at site and the manufacturer shall guarantee test certificate figures under actual service conditions.

25 ACCEPTANCE TESTS:

25.1 The transformers shall be subjected to the following routine/ acceptance test in the presence of purchaser's representative at the place of manufacture before despatch without any extra charges. The testing shall be carried out in accordance with IS 1180, Part-1 (2014) and IS 2026. Checking of mass, dimensions, fitting and accessories, tank sheet thickness, oil quality, material, finish and workmanship as per GTP/QA plan and contract drawings.

25.2 Physical verification of core coil assembly and measurement of flux density of one unit of each rating, in every inspection with reference to short circuit test report.

25.3 All tests as specified in clause 22.

26 INSPECTION:

26.1 In respect of raw material such as core stampings, winding conductors, insulating paper and oil, supplier shall use materials manufactured/supplied by standard manufacturers and furnish the manufacturers' test certificate as well as the proof of purchase from the manufacturers (excise gate pass) for information of the purchaser. The bidder shall furnish following documents along with their offer in respect to the raw materials :

26.1.1 Invoice of supplier.

26.1.2 Mill's certificate.

26.1.3 Packing List.

26.1.4 Bill of landing.

26.1.5 Bill of entry certificate by custom.

26.2 To ensure about the quality of transformers, the inspection shall be carried out by the purchaser's representative at following stages:

26.2.1 Online anytime during receipt of raw material and manufacture/ assembly whenever the purchaser desires.

26.2.2 When the raw material is received, and the assembly is in process in the shop floor.

26.2.3 At finished stage i.e. transformers are fully assembled and are ready for despatch.

26.3 After the main raw-materials i.e. core and coil materials and tanks are arranged and transformers are taken for production on shop floor and a few assembly have been completed, the firm shall intimate the purchaser in this regard, so that an officer for carrying out such inspection could be deputed, as far as possible within seven days from the date of intimation. During the stage inspection a few assembled core shall be dismantled (only in case of CRGO material) to ensure that the CRGO laminations used are of good quality. Further, as and when the transformers are ready for despatch, an offer intimating about the readiness of transformers, for final inspection for carrying out tests as per relevant IS and as in clauses above, shall be sent by the firm along with routine test certificates. The inspection shall normally be arranged by the purchaser at the earliest after receipt of offer for pre-delivery inspection.

26.4 In case of any defect/defective workmanship observed at any stage by the purchaser's inspecting officer; the same shall be pointed out to the firm in writing for taking remedial measures. Further processing should only be done after clearance from the Inspecting officer/purchaser.

26.5 All tests and inspection shall be carried out at the place of manufacture unless otherwise specifically agreed upon by the manufacturer and purchaser at the time of purchase. The manufacturer shall offer the inspector representing the purchaser all reasonable facilities, without charges, to satisfy him that the material is being supplied in accordance with this specification. This will include stage inspection during manufacturing stage as well as active part inspection during acceptance tests.

26.6 The manufacturer shall provide all services to establish and maintain quality of workmanship in his works and that of his sub-contractors to ensure the mechanical/electrical performance of components, compliance with drawings, identification and acceptability of all materials, parts and equipment as per latest quality standards of ISO 9000.

26.7 Along with the bid the manufacturer shall prepare Quality Assurance Plan (QAP) identifying the various stages of manufacture, quality checks performed at each stage and the customer hold points. The document shall also furnish details of method of checking, inspection and acceptance standards/values and get the approval of purchaser or his representative before proceeding with manufacturing. However, purchaser or his representative shall have the right to review the inspection reports, quality checks and results of manufacturer's in house inspection department which are not customer hold points and the manufacturer shall comply with the remarks made by purchaser or his representative on such reviews with regards to further testing, rectification or rejection etc. Manufacturer should submit the list of equipment for testing along with latest calibration certificates to the purchaser.

26.8 Purchaser shall have every right to appoint a third party inspection to carry out the inspection

process. The purchaser has the right to have the test carried out at his own cost by an independent agency wherever there is a dispute regarding the quality of supply. Purchaser has right to test 1% of the supply selected either from the stores or field to check the quality of the product. In case of any deviation purchaser has every right to reject the entire lot or penalise the manufacturer, which may lead to blacklisting among other things.

27 QUALITY ASSURANCE PLAN:

27.1 The bidder shall invariably furnish following information along with his bid, failing which his bid shall be liable for rejection. Information shall be separately given for individual type of material offered.

27.2 Statement giving list of important raw materials, names of sub-suppliers for the raw materials, list of standards according to which the raw materials are tested, list of test normally carried out on raw materials in presence of bidder's representative and copies of test certificates.

27.3 Information and copies of test certificates as above in respect of bought out accessories.

27.4 List of manufacturing facilities available.

27.5 Level of automation achieved and list of areas where manual processing exists.

27.6 List of areas in manufacturing process, where stage inspections are normally carried out for quality control and details of such tests and inspections.

27.7 List of testing equipment available with the bidder for final testing of equipment along with valid calibration reports shall be furnished with the bid. Manufacturer shall posses 0.1 accuracy class instruments for measurement of losses.

27.8 Quality assurance plan with hold points for purchaser's inspection.

27.9 The successful bidder shall within 30 days of placement of order, submit following information to the purchaser.

27.9.1 List of raw materials as well as bought out accessories and the names of sub-suppliers selected from those furnished along with offer.

27.9.2 Type test certificates of the raw materials and bought out accessories.

27.10 The successful bidder shall submit the routine test certificates of bought out accessories and central excise passes for raw material at the time of routine testing.

28 DOCUMENTATION:

28.1 Completely dimensioned drawings indicating general arrangement and details of fittings, clearances and winding details shall accompany the tender.

28.2 Drawings of internal constructional details and fixing details of coils should also be indicated. Tank dimensions, position of fittings, clearances between leads within the transformer, core grade of laminations, distance of core centers, area of conductor bare and with insulation. No. of coils, No. of turns per coil material of bushing metal parts etc., shall also be furnished with tender.

29 PACKING and FORWARDING:

29.1 The packing shall be done as per the manufacturer's standard practice.
However, he should ensure the packing is such that, the material should not get damaged during transit by rail/road.

29.2 The marking on each package shall be as per the relevant IS.

30 GUARANTEE:

31.1 The manufacturers of the transformer shall provide a guarantee of 36 months from the date of receipt at the stores of the Utility or 24 months from the date of commissioning, whichever is earlier. In case the DT fails within the guarantee period the purchaser will immediately inform the supplier who shall take back the failed DT within 15 days from the date of the intimation at his own cost and replace/repair the transformer within forty five days of date of intimation with a roll over guarantee.

31.2 The outage period i.e. period from the date of failure till unit is repaired/replaced shall not be counted for arriving at the guarantee period.

31.3 In the event of the supplier's inability to adhere to the aforesaid provisions, suitable penal action will be taken against the supplier, which may inter alia include blacklisting of the firm for future business with the purchaser for a certain period.

Annex-I

Methodology for computing total owning cost

TOC = IC + (A xWi) + (B xWc)		
Where,		
TOC	=	Total Owning Cost
IC	=	Initial cost including taxes of transformer as quoted by the manufacturer
A factor	=	Cost of no load losses in Rs/watt
B factor	=	Cost of load losses in Rs/watt
Wi	=	No load losses quoted by the manufacturer in watt
Wc	=	Load losses quoted by the manufacturer in watt

The "A" and "B" factors capture the net present value of energy losses based on hours of operations, cost of energy (electrical tariff), equipment life (years of expected service) and cost of money (rate of return).

Capitalised cost of no load losses/w = A factor

$$\text{A Factor} = {}^{H\,x}\quad \frac{Ec}{1000} \times \frac{(1+r)^n - 1}{r(1+r)^n}$$

Capitalised cost of load losses/w = B factor = A factor x LLF

Capitalised cost of transformer = IC + (A x Wi) + (B x Wc)

where

i) H = No. of service hours per year of the distribution transformer = 8400 hours.

ii) r = Rate of interest = prime lending rate

iii) Ec = Average energy cost (Rs/kWH) at 11 kV/33 kV kV for the utility.

iv) n = Life of the transformer in years = 25 years

v) LLF = Loss Load factor = 0.3 LF+ 0.7 LF^2, where LF is the load factor
LF for rural areas = 0.5

LF for urban areas= 0.7

Schedule IA

GUARANTEED TECHNICAL PARTICULARS FOR COMPLETELY SELF PROTECTED DISTRIBUTION TRANSFORMERS

Sl.No.	Description	6.3 kVA	10 kVA	16 kVA	25 kVA
1.	Name of the manufacturer and place of manufacture				
2.	Continuous maximum rating as per this specification.				
3.	Normal ratio of transformer				
4.	Method of connection HV/LV				
5.	Maximum current density in Windings : 1. HV (A/sq mm) 2. LV (A/sq mm)				
6.	Maximum hot spot temperature ^{0}C. (Ambient air temperature on which above is based) ^{0}C.				
7.	Maximum temperature : ^{0}C				
	(a) Maximum observable oil temperature (ambient air temperatureon which above is based)				
	b) Maximum winding temperatureat an ambient temperature of				
8.	No-load losses at rated voltage (watt)				
9.	Full load losses at 75 ^{0}C (watt)				
10.	Total losses at 100% load (watt)				
11.	Total losses at 50% load (watt)				
12.	Efficiency at normal voltage :				
	(i) Unity Power Factor (a) At 50% load (b) At 75% load (c) At full load				
	(ii) 0.8 Power Factor (a) At 50% load (b) At 75% load (c) At full load				
13.	Regulation as percentage of normal voltage :				

(a) At unity power factor
(b) At 0.8 power factor lagging

14. Percentage impedance voltage at normal ratio between HV and LV windings

15. Type of transformers, CRGO/ amorphous type

16. Type of Insulation used in
HV Windings
LV Windings

17. Type of insulation used in
Core bolts
Core bolt washers
End plates
Core lamination

18. Impulse withstand test voltage level (kV)
HV Windings LV Windings

19. Characteristics of transformer oil

20. Total content of oil in litres

21. Whether transformer will be transported with oil?

22. Type of transformer tank

23. Approximate overall dimensions

a) Height mm
b) Length mm
c) Width mm

Tank dimensions

a) Diameter mm
b) Height mm

24. Mass of insulated conductor

HV (minimum) kg
LV (minimum) kg

25. Mass of core (minimum) kg (CRGO or amorphous metal)

26. Mass of complete transformer arranged for transport (kg)

Schedule IB

ADDITIONAL DETAILS

Sl. No.	**Description**	
1.	Core grade	
2.	Core dimensions	mm
3.	Gross core area	cm^2
4.	Net Core area	cm^2
5.	Flux density	Tesla
6.	Mass of Core	kg
7.	Loss per kg of core at the specified flux density	watt
8.	Core window height	mm
9.	Center to center distance of the core	mm
10.	No. of LV Turns	
11.	No. of HV turns	
12.	Size of LV Conductor bare/ covered (dia)	mm
13.	Size of HV conductor bare/covered (dia)	mm
14.	No. of parallels	
15.	Current density of LV winding	A/sq mm
16.	Current density of HV winding	A/sq mm
17.	Mass of the LV winding for Transformer	kg
18.	Mass of the HV winding for Transformer	kg
19.	No. of of LV Coils/phase	
20.	No. of HV coils . phase	
21.	Height of LV Windings	mm
22.	Height of HV winding	mm
23.	ID/OD of LV winding HV	mm
24.	ID/OD of LV winding	mm
25.	Size of the duct in LV winding	mm
26.	Size of the duct in HV winding	mm
27.	Size of the duct between HV and LV	mm
28.	HV winding to LV clearance	mm
29.	HV winding to tank clearance	mm
30.	Calculated impedance	%
31.	HV to earth creepage distance	mm
32.	LV to earth creepage distance	mm

Schedule II

SOURCE OF MATERIALS/PLACES OF MANUFACTURE, TESTING AND INSPECTION

Sl. No.	Item	Source of Material	Place of Manufacture	Place of testing and inspection
1.	Laminations			
2.	Aluminium/Copper			
3.	Insulated winding wires			
4.	Oil			
5.	Press boards			
6.	Kraft paper			
7.	MS plates/Angles/Channels			
8.	Gaskets			
9.	Bushing HV/LV			
10.	Paints			
11.	Lightning Arrestors			
12	Current Transformer			

3-Phase Distribution Transformers 11 or 33 kV/415-240V (Outdoor Type)

1. **SCOPE:**

i) This specification covers design, engineering, manufacture, assembly, stage testing, inspection and testing before supply and delivery at site of oil immersed, naturally cooled 3-phase 11 kV/433 - 250 V and 33 kV/433-250 V distribution transformers for outdoor use.

ii) The equipment shall conform in all respects to high standards of engineering, design and workmanship and shall be capable of performing in continuous commercial operation, in a manner acceptable to the purchaser, who will interpret the meanings of drawings and specification and shall have the power to reject any work or material which, in his judgment is not in accordance therewith. The offered equipment shall be complete with all components necessary for their effective and trouble free operation. Such components shall be deemed to be within the scope of bidder's supply irrespective of whether those are specifically brought out in this specification and / or the commercial order or not.

iii) The transformer and accessories shall be designed to facilitate operation, inspection, maintenance and repairs. The design shall incorporate every precaution and provision for the safety of equipment as well as staff engaged in operation and maintenance of equipment.

iv) All outdoor apparatus, including bushing insulators with their mountings, shall be designed so as to avoid any accumulation of water.

2 STANDARD RATINGS:

The standard ratings shall be 16, 25, 63, 100,160, 200, 250, 315, 400, 500, 630, 1000, 1250, 1600, 2000 and 2500 kVA for 11 kV distribution transformers and 100, 160, 200, 315, 400, 500, 630, 1000, 1250, 1600,2000, 2500 kVA for 33 kV distribution transformers.

3 STANDARDS:

3.1 The major materials used in the transformer shall conform in all respects to the relevant/specified Indian Standards and international Standards with latest amendments thereof as on bid opening date, unless otherwise specified herein. Some of the applicable Indian Standards are listed as hereunder:

3.2

Indian Standards	Title	International Standards
IS -2026	Specification for Power Transformers	IEC 76
IS 1180 (Part-I): 2014	Outdoor Type Oil Immersed Distribution Transformers upto and including 2500kVA, 33kV-Specification	
IS 12444	Specification for Copper wire rod	ASTM B-49
IS-335	Specification for Transformer/Mineral Oil	IEC Pub 296
IS-5	Specification for colors for ready mixed paints	
IS -104	Ready mixed paint, brushing zinc chromate, priming	
IS-2099	Specification for high voltage porcelain bushing	
IS-649	Testing for steel sheets and strips and magnetic circuits	
IS- 3024	Cold rolled grain oriented electrical sheets and strips	
IS - 4257	Dimensions for clamping arrangements for bushings	
IS - 7421	Specification for Low Voltage bushings	
IS - 3347	Specification for Outdoor Bushings	DIN 42531 to 33
IS - 5484	Specification for Al Wire rods	ASTM B - 233
IS - 9335	Specification for Insulating Kraft Paper	IEC 554
IS - 1576	Specification for Insulating Press Board	IEC 641
IS - 6600	Guide for loading of oil Immersed Transformers	IEC 76

IS - 2362	Determination of water content in oil for porcelain bushing of transformer	
IS - 6162	Paper covered Aluminium conductor	
IS - 6160	Rectangular Electrical conductor for electrical machines	
IS - 5561	Electrical power connector	
IS - 6103	Testing of specific resistance of electrical insulating liquids	
IS - 6262	Method of test for power factor and dielectric constant of electrical insulating liquids	
IS - 6792	Determination of electrical strength of insulating oil	
IS - 10028	Installation and maintenance of transformers.	

4 SERVICE CONDITIONS:

4.1 The Distribution Transformers to be supplied against this Specification shall be suitable for satisfactory continuous operation under the following climatic conditions as per IS 2026 (Part - I).

i)	Location	:	At various locations in the country
ii)	Maximum ambient air temperature (^{0}C)	:	50
iii)	Minimum ambient air temperature (^{0}C)	:	-5
iv)	Maximum average daily ambient air temperature (^{0}C):		40
v)	Maximum yearly weighted average ambient temperature(^{0}C)	:	32
vi)	Maximum altitude above sea level (Meters)	:	To be specified by the user

Note:

1. The climatic conditions specified above are indicative and can be changed by the user as per requirements.

2. The equipment shall generally be for use in moderately hot and humid tropical climate, conducive to rust and fungus growth unless otherwise specified.

5 PRINCIPAL PARAMETERS:

5.1 The transformers shall be suitable for outdoor installation with three phase, 50 Hz, 11 kV or 33 kV system in which the neutral is effectively earthed and they should be suitable for service with fluctuations in supply voltage upto plus 12.5% to minus 12.5%.

(i) The transformers shall conform to the following specific parameters :

Sl.No.	Item	11 kV Distribution Transformers	33 kV Distribution Transformers
1	System voltage (Max.)	12 kV	36 kV
2	Rated Voltage (HV)	11 kV	33 kV
3	Rated Voltage (LV)	433 - 250 V*	433 - 250 V*
4	Frequency	50 Hz +/- 5%*	50 Hz +/- 5%
5	No. of Phases	Three	Three
6	Connection HV	Delta	Delta
7	Connection LV	Star (Neutral brought out)	Star (Neutral brought out)
8	Vector group	Dyn-11	Dyn-11
9	Type of cooling	ONAN	ONAN

*The voltage level can be specified as 433/415-250 volts as per the requirements of the purchaser.

Audible sound levels (decibels) at rated voltage and frequency for liquid immersed distribution transformers shall be as below (NEMA Standards):

kVA rating	Audible sound levels (decibels)
0-50	48
51-100	51
101-300	55
301-500	56
750	57
1000	58
1500	60
2000	61
2500	62

6. TECHNICAL REQUIREMENTS:

6.1.1 CORE MATERIAL

6.1.2.1 The core shall be stack / wound type of high grade Cold Rolled Grain Oriented or Amorphous Core annealed steel lamination having low loss and good grain properties, coated with hot oil proof insulation, bolted together and to the frames firmly to prevent vibration or noise. The core shall be stress relieved by annealing under inert atmosphere if required. The complete design of core must ensure permanency of the core loss with continuous working of the transformers. The value of the maximum flux density allowed in the design and grade of lamination used shall be clearly stated in the offer.

6.1.2.2 The bidder should offer the core for inspection and approval by the purchaser during manufacturing stage.

6.1.2.3 The transformers core shall be suitable for over fluxing (due to combined effect of voltage and frequency) up to 12.5% without injurious heating at full load conditions and shall not get saturated. The bidder shall furnish necessary design data in support of this situation.

6.1.2.4 No-load current up to 200kVA shall not exceed 3% of full load current and will be measured by energising the transformer at rated voltage and frequency. Increase of 12.5% of rated voltage shall not increase the no-load current by 6% of full load current.

or

No-load current above 200kVA and upto 2500kVA shall not exceed 2% of full load current and will be measured by energising the transformer at rated voltage and frequency. Increase of 12.5% of rated voltage shall not increase the no-load current by 5% of full load current.

7 WINDINGS:

(i) Material:

7.1.1 HV and LV windings shall be wound from Super Enamel covered /Double Paper covered Aluminum / Electrolytic Copper conductor.

7.1.2 LV winding shall be such that neutral formation will be at top.

7.1.3 The winding construction of single HV coil wound over LV coil is preferable.

7.1.4 Inter layer insulation shall be Nomex /Epoxy dotted Kraft Paper.

7.1.5 Proper bonding of inter layer insulation with the conductor shall be ensured.
Test for bonding strength shall be conducted.

7.1.6 Dimensions of winding coils are very critical. Dimensional tolerances for winding coils shall be within limits as specified in Guaranteed Technical Particulars (GTP Schedule I).

7.1.7 The core/coil assembly shall be securely held in position to avoid any movement under short circuit conditions.

7.1.8 Joints in the winding shall be avoided. However, if jointing is necessary the joints shall be properly brazed and the resistance of the joints shall be less than that of parent conductor. In case of foil windings, welding of leads to foil can be done within the winding.

8 TAPPING RANGES AND METHODS:

8.1.1 No tapping shall be provided for distribution transformers up to 100 kVA rating.

8.1.2 For ratings above 100 kVA and up to 500 kVA, tappings shall be provided, if required by the purchaser, on the higher voltage winding for variation of HV voltage within range of (+) 5.0 % to (-) 10% in steps of 2.5%.

8.1.3 For ratings greater than 500 kVA, tapping shall be provided on the higher voltage winding for variation of HV voltage within range of (+) 2.5% to (-) 5.0 % in steps of 2.5%.

8.1.4 Tap changing shall be carried out by means of an externally operated self-position switch and when the transformer is in de-energised condition. Switch position No.1 shall correspond to the maximum plus tapping. Each tap change shall result in variation of 2.5% in voltage. Arrangement for pad locking shall be provided. Suitable aluminum anodized plate shall be fixed for tap changing switch to know the position number of tap.

9 OIL:

9.1 The insulating oil shall comply with the requirements of IS 335. Use of recycled oil is not acceptable. The specific resistance of the oil shall not be less than 35 $X10^{12}$ ohm-cm at 27°C when tested as per IS 6103.

9.2 Oil shall be filtered and tested for break down voltage (BDV) and moisture content before filling.

9.3 The oil shall be filled under vacuum.

9.4 The design and all materials and processes used in the manufacture of the transformer, shall be such as to reduce to a minimum the risk of the development of acidity in the oil.

10 INSULATION LEVELS:

Sl. No.	Voltage (kV)	Impulse Voltage (kV Peak)	Power Frequency Voltage (kV)
1	0.433	-	3
2	11	75	28
3	33	170	70

11 LOSSES:

11.1 The transformer of HV voltage up to 11kV,the total losses(no-load + load losses at 75 ^{0}C) at 50% of rated load and total losses at 100% of rated load shall not exceed the maximum total loss values given in Table-3 upto 200kVA & Table-6 for ratings above 200kVA of IS 1180(Part-1):2014.

11.2 The maximum allowable losses at rated voltage and rated frequency permitted at 75 ^{0}C for 11/0.433 kV transformers can be chosen by the utility as per **Table-3 upto 200kVA** and **Table-6 for ratings above 200kVA** as per **Energy Efficiency Level-2 specified in IS 1180 (Part-1):2014** for all kVA ratings of distribution transformers.

11.3 The above losses are maximum allowable and there would not be any positive tolerance. Bids with higher losses than the above specified values would be treated as non-responsive. However, the manufacturer can offer losses less than above stated values. The utility can evaluate offers with losses lower than the maximum allowable losses on total owning cost basis in accordance with methodology given in Annex-I.

12 TOLERANCES:

12.1 No positive tolerance shall be allowed on the maximum losses displayed on the label for both 50% and 100% loading values.

13 PERCENTAGE IMPEDANCE:

The percentage impedance of transformers at 75 ^{0}C for different ratings upto 200 kVA shall be as per Table 3 and for ratings beyond 200 kVA shall be as per Table 6 of IS 1180(Part-1):2014.

14 Temperature rise: The temperature rise over ambient shall not exceed the limits given below:

14.1 Top oil temperature rise measured by thermometer :35 ^{0}C

14.2 Winding temperature rise measured by resistance method :40 ^{0}C

14.3 The transformer shall be capable of giving continuous rated output without exceeding the specified temperature rise. Bidder shall submit the calculation sheet in this regard.

15 PENALTY FOR NON PERFORMANCE:

15.1 During testing at supplier's works if it is found that the actual measured losses are more than the values quoted by the bidder, the purchaser shall reject the transformer and he shall also have the right to reject the complete lot.

15.2 Purchaser shall reject the entire lot during the test at supplier's works, if the temperature rise exceeds the specified values.

15.3 Purchaser shall reject any transformer during the test at supplier's works, if the impedance values differ from the guaranteed values including tolerance.

16 INSULATION MATERIAL:

16.1 Electrical grade insulation epoxy dotted Kraft Paper/Nomex and pressboard of standard make or any other superior material subject to approval of the purchaser shall be used.

16.2 All spacers, axial wedges / runners used in windings shall be made of pre-compressed Pressboard-solid, conforming to type B 3.1 of IEC 641-3-2. In case of cross-over coil winding of HV all spacers shall be properly sheared and dovetail punched to ensure proper locking. All axial wedges / runners shall be properly milled to dovetail shape so that they pass through the designed spacers freely. Insulation shearing, cutting, milling and punching operations shall be carried out in such a way, that there should not be any burr and dimensional variations.

17.1 TANK:

- Transformer tank construction shall conform in all respect to clause 15 of IS 1180(Part-1):2014.
- The internal clearance of tank shall be such, that it shall facilitate easy lifting of core with coils from the tank without dismantling LV bushings.
- All joints of tank and fittings shall be oil tight and no bulging should occur during service.
- Inside of tank shall be painted with varnish/hot oil resistant paint.
- The top cover of the tank shall be slightly sloping to drain rain water.
- The tank plate and the lifting lugs shall be of such strength that the complete transformer filled with oil may be lifted by means of lifting shackle.
- Manufacturer should carry out all welding operations as per the relevant ASME standards and

submit a copy of the welding procedure and welder performance qualification certificates to the customer.

i) PLAIN TANK:

17.2.1 The transformer tank shall be of robust construction rectangular/octagonal/round/ elliptical in shape and shall be built up of electrically tested welded mild steel plates of thickness of 3.15 mm for the bottom and top and not less than 2.5 mm for the sides for distribution transformers upto and including 25 kVA, 5.0 mm and 3.15 mm respectively for transformers of more than 25 kVA and up to and including 100 kVA and 6 mm and 4 mm respectively above 100 kVA. Tolerances as per IS1852 shall be applicable.

17.2.2 In case of rectangular tanks above 100 kVA the corners shall be fully welded at the corners from inside and outside of the tank to withstand a pressure of 0.8 kg/cm^2 for 30 minutes. In case of transformers of 100 kVA and below, there shall be no joints at corners and there shall not be more than 2 joints in total.

17.2.3 Under operating conditions the pressure generated inside the tank should not exceed 0.4 kg/ sq. cm positive or negative. There must be sufficient space from the core to the top cover to take care of oil expansion. The space above oil level in the tank shall be filled with dry air or nitrogen conforming to commercial grade of IS 1747.

(i) The tank shall be reinforced by welded flats on all the outside walls on the edge of the tank.

(ii) Permanent deflection: The permanent deflection, when the tank without oil is subjected to a vacuum of 525 mm of mercury for rectangular tank and 760 mm of mercury for round tank, shall not be more than the values as given below:

(All figures are in mm)

Horizontal length of flat plate	Permanent deflection
Up to and including 750	5.0
751 to 1250	6.5
1251 to 1750	8.0
1751 to 2000	9.0

17.2.4 The tank shall further be capable of withstanding a pressure of 0.8kg/sq.cm and a vacuum of 0.7 kg/sq.cm (g) without any deformation.

17.2.5 The radiators can be tube type or fin type or pressed steel type to achieve the desired cooling to limit the specified temperature rise.

17.3 CORRUGATED TANK:

17.3.1 The bidder may offer corrugated tanks for transformers of all ratings.

17.3.2 The transformer tank shall be of robust construction corrugated in shape and shall be built up of tested sheets.

17.3.3 Corrugation panel shall be used for cooling. The transformer shall be capable of giving continuous rated output without exceeding the specified temperature rise. Bidder shall submit the calculation sheet in this regard.

17.3.4 Tanks with corrugations shall be tested for leakage test at a pressure of 0.25kg/ sq cm measured at the top of the tank.

17.3.5 The transformers with corrugation should be provided with a pallet for transportation, the dimensions of which should be more than the length and width of the transformer tank with corrugations.

18 CONSERVATOR:

(i) Transformers of rating 63 kVA and above with plain tank construction, the provision of conservator is mandatory. For corrugated tank and sealed type transformers with or without inert gas cushion, conservator is not required.

(ii) When a conservator is provided, oil gauge and the plain or dehydrating breathing device shall be fitted to the conservator which shall also be provided with a drain plug and a filling hole [32 mm (1¼")] normal size thread with cover. In addition, the cover of the main tank shall be provided with an air release plug.

(iii) The dehydrating agent shall be silica gel. The moisture absorption shall be indicated by a change in the colour of the silica gel crystals which should be easily visible from a distance. Volume of breather shall be suitable for 500g of silica gel conforming to IS 3401 for transformers upto 200 kVA and 1 kg for transformers above 200 kVA .

(iv) The capacity of a conservator tank shall be designed keeping in view the total quantity of oil and its contraction and expansion due to temperature variations. The total volume of conservator shall be such as to contain10% quantity of the oil. Normally 3% quantity the oil shall be contained in the conservator.

(v) The cover of main tank shall be provided with an air release plug to enable air trapped within to be released, unless the conservator is so located as to eliminate the possibility of air being trapped within the main tank.

(vi) The inside diameter of the pipe connecting the conservator to the main tank should be within 20 to 50 mm and it should be projected into the conservator so that its end is approximately 20 mm above the bottom of the conservator so as to create a sump for collection of impurities. The minimum oil level (corresponding to -5 ^{0}C) should be above the sump level.

19 SURFACE PREPARATION AND PAINTING:

(i) GENERAL

19.1.1 All paints, when applied in a normal full coat, shall be free from runs, sags, wrinkles, patchiness, brush marks or other defects.

19.1.2 All primers shall be well marked into the surface, particularly in areas where painting is evident and the first priming coat shall be applied as soon as possible after cleaning. The paint shall be applied by airless spray according to manufacturer's recommendations. However, where ever airless spray is not possible, conventional spray be used with prior approval of purchaser.

19.2 CLEANING AND SURFACE PREPARATION:

a) After all machining, forming and welding has been completed, all steel work surfaces shall be thoroughly cleaned of rust, scale, welding slag or spatter and other contamination prior to any painting.

b) Steel surfaces shall be prepared by shot blast cleaning (IS9954) to grade Sq. 2.5 of ISO 8501-1 or chemical cleaning including phosphating of the appropriate quality (IS 3618).

c) Chipping, scraping and steel wire brushing using manual or power driven tools cannot remove firmly adherent mill-scale. These methods shall only be used where blast cleaning is impractical. Manufacturer to clearly explain such areas in his technical offer.

19.3 PROTECTIVE COATING:

19.3.1 As soon as all items have been cleaned and within four hours of the subsequent drying, they shall be given suitable anti-corrosion protection.

19.4 PAINT MATERIAL:

i) Following are the types of paint which may be suitably used for the items to be painted at shop and supply of matching paint to site:
Heat resistant paint (Hot oil proof) for inside surface

ii) For external surfaces one coat of thermo setting powder paint or one coat of epoxy primer followed by two coats of synthetic enamel/polyurethene base paint. These paints can be either air drying or stoving.

iii) For highly polluted areas, chemical atmosphere or for places very near to the sea coast, paint as above with one coat of high build Micaceous iron oxide (MIO) as an intermediate coat may be used.

19.5 PAINTING PROCEDURE:

i) All prepared steel surfaces should be primed before visible re-rusting occurs or within 4 hours, whichever is sooner. Chemical treated steel surfaces shall be primed as soon as the surface is dry and while the surface is still warm.

ii) Where the quality of film is impaired by excess film thickness (wrinkling, mud cracking or general softness) the supplier shall remove the unsatisfactory paint coating and apply another coating. As a general rule, dry film thickness should not exceed the specified minimum dry film thickens by more than 25%.

19.6 DAMAGED PAINTWORK:

(i) Any damage occurring to any part of a painting scheme shall be made good to the same standard of corrosion protection and appearance as that was originally applied.

(ii) Any damaged paint work shall be made good as follows:

19.6.2.1 The damaged area, together with an area extending 25 mm around its boundary, shall be cleaned down to bare metal.

19.6.2.2 A priming coat shall be immediately applied, followed by a full paint finish equal to that originally applied and extending 50 mm around the perimeter of the original damage.

19.6.2.3 The repainted surface shall present a smooth surface. This shall be obtained by carefully chamfering the paint edges before and after priming.

19.7 DRY FILM THICKNESS:

19.7.1 To the maximum extent practicable the coats shall be applied as a continuous film of uniform thickness and free of pores. Overspray, skips, runs, sags and drips should be avoided. The different coats may or may not be of the same colour.

19.7.2 Each coat of paint shall be allowed to harden before the next is applied as per manufacturer's recommendation.

19.7.3 Particular attention must be paid to full film thickness at the edges.

19.7.4 The requirements for the dry film thickness (DFT) of paint and the materials to be used shall be as given below:

Sl. No.	Paint type	Area to be painted	No. of coats	Total dry film thickness (min.) (microns)
1.	Thermo setting powder paint	inside outside	01 01	30 60
2.	**Liquid paint**			
	a) Epoxy (primer)	outside	01	30
	b) P.U. Paint (Finish coat)	outside	02	25 each
	c) Hot oil paint/ Varnish	inside	01	35/10

19.8 TESTS FOR PAINTED SURFACE:

19.8.1 The painted surface shall be tested for paint thickness.

19.8.2 The painted surface shall pass the cross hatch adhesion test and impact test as acceptance tests and Salt spray test and Hardness test as type test as per the relevant ASTM standards.

Note: Supplier shall guarantee the painting performance requirement for a period of not less than 5 years.

20 BUSHINGS:

20.1 The bushings shall conform to the relevant standards specified and shall be of outdoor type. The bushing rods and nuts shall be made of brass material 12 mm diameter for both HT and LT bushings. The bushings shall be fixed to the transformers on side with straight pockets and in the same plane or the top cover for transformers above 100 kVA. For transformers of 100 kVA and below the bushing can be mounted on pipes. The tests as per latest IS 2099 and IS 7421 shallbe
conducted on the transformer bushings.

20.2 For 33 kV, 52 kV class bushings shall be used for transformers of ratings 500 kVA and above. And for transformers below 500 KVA, 33 kV class bushings, for 11 kV, 17.5 kV class bushings and for 0.433 kV, 1.1 kV class bushings shall be used.

20.3 Bushing can be of porcelain/epoxy material. Polymer insulator bushings conforming with relevant IEC can also be used.

20.4 Bushings of plain shades as per IS 3347 shall be mounted on the side of the
Tank and not on top cover.

20.5 Dimensions of the bushings of the voltage class shall conform to the Standards specified and dimension of clamping arrangement shall be as per IS 4257

20.6 Minimum external phase to phase and phase to earth clearances of bushing terminals shall be as follows:

Voltage	Clearance	
	Phase to phase	Phase to earth
33 kV	350mm	320mm
11 kV	255mm	140mm
LV	75mm	40mm

The clearances in case of cable box shall be as below:

Voltage	Clearance	
	Phase to phase	Phase to earth
33 kV	350mm	220mm
11 kV	130mm	80mm
LV	25mm	20mm

20.7 Arcing horns shall be provided on HV bushings.

20.8 Brazing of all inter connections, jumpers from winding to bushing shall have cross section larger than the winding conductor. All the Brazes shall be qualified as per ASME, section – IX.

20.9 The bushings shall be of reputed make supplied by those manufacturers who are having manufacturing and testing facilities for insulators.

20.10 The terminal arrangement shall not require a separate oil chamber not connected to oil in the main tank.

21 TERMINAL CONNECTORS:

21.1 The LV and HV bushing stems shall be provided with suitable terminal connectors as per IS 5082 so as to connect the jumper without disturbing the bushing stem. Connectors shall be with eye bolts so as to receive conductor for HV. Terminal connectors shall be type tested as per IS 5561.

22 LIGHTNING ARRESTORS:

22.1 9 kV, 5 kA metal oxide lightning arrestors of reputed make conforming to IS 3070 Part-III, one number per phase shall be provided.(To be mounted on pole or to be fitted under the HV bushing with GI earth strip 25x4 mm connected to the body of the transformer with necessary clamping arrangement as per requirement of purchaser.) Lightening arrestors with polymer insulators in conformance with relevant IEC can also be used.

23 CABLE BOXES:

23.1 In case HV/LV terminations are to be made through cables the transformer shall be fitted with suitable cable box on 11 kV side to terminate one 11kV/ 3 core aluminium conductor cable up to 240 sq. mm. (Size as per requirement).

The bidder shall ensure the arrangement of HT Cable box so as to prevent the ingress of moisture into the box due to rain water directly falling on the box. The cable box on HT side shall be of the split type with faces plain and machined and fitted with Neo-k-Tex or similar

quality gasket and complete with brass wiping gland to be mounted on separate split type gland plate with nut-bolt arrangement and MS earthing clamp. The bushings of the cable box shall be fitted with nuts and stem to take the cable cores without bending them. The stem shall be of copper with copper nuts. The cross section of the connecting rods shall be stated and shall be adequate for carrying the rated currents. On the HV side the terminal rod shall have a diameter of not less than 12 mm. The material of connecting rod shall be copper. HT Cable support clamp should be provided to avoid tension due to cable weight.

23.2 The transformer shall be fitted with suitable LV cable box having non-magnetic material gland plate with appropriate sized single compression brass glands on LV side to terminate 1.1 kV/single core XLPE armoured cable (Size as per requirement).

24 TERMINAL MARKINGS:

High voltage phase windings shall be marked both in the terminal boards inside the tank and on the outside with capital letter 1U, 1V, 1W and low voltage winding for the same phase marked by corresponding small letter 2u, 2v, 2w. The neutral point terminal shall be indicated by the letter 2n. Neutral terminal is to be brought out and connected to local grounding terminal by an earthing strip.

25 CURRENT TRANSFORMERS:

25.1 CT's shall be provided for transformers of rating 63 kVA and above and if required by purchaser for ratings below 63 kVA on secondary side.

25.2 Current transformer shall be mounted inside the tank or outside with suitable marshalling box on LV side of the transformer.

25.3 The current transformers shall comply with IS 2705.

25.4 All secondary leads of bushing mounted CT's shall be brought to a terminal box near each bushing.

25.5 The CT terminals shall have shorting facility.

25.6 CT should not get saturated upto 200% of rated current.

25.7 CT shall have the following parameters

Parameter	Value
Accuracy class	0.5
Burden	20 VA
Application	Metering
ISF	5

26.1 The following standard fittings shall be provided :

i. Rating and terminal marking plates, non-detachable.

ii. Earthing terminals with lugs - 2 Nos.

iii. Lifting lugs for main tank and top cover

iv. Terminal connectors on the HV/LV bushings (For bare terminations only).

v. Thermometer pocket with cap - 1 No.

vi. Air release device

vii. HV bushings - 3 Nos.

viii. LV bushings - 4 Nos.

ix. Pulling lugs

x. Stiffener

xi. Radiators - No. and length may be mentioned (as per heat dissipation calculations)/ corrugations.

xii. Arcing horns or 9 kV, 5 kA lightning arrestors on HT side - 3 No.

xiii. Prismatic oil level gauge.

xiv. Drain cum sampling valve.

xv. Top filter valve

xvi. Oil filling hole having p. 1- ¼ '' thread with plug and drain plug on the conservator.

xvii. Silicagel breather

xviii. Base channel 75x40 mm for up to 100 kVA and 100 mmx50 mm above 100 kVA, 460 mm long with holes to make them suitable for fixing on a platform or plinth.

xix. 4 No. rollers for transformers of 200 kVA and above.

xx. Pressure relief device or explosion vent.

27 FASTENERS:

27.1 All bolts, studs, screw threads, pipe threads, bolt heads and nuts shall comply with the appropriate Indian Standards for metric threads, or the technical equivalent.

27.2 Bolts or studs shall not be less than 6 mm in diameter except when used for small wiring terminals.

27.3 All nuts and pins shall be adequately locked.

27.4 Wherever possible bolts shall be fitted in such a manner that in the event of failure of locking resulting in the nuts working loose and falling off, the bolt will remain in position.

27.5 All ferrous bolts, nuts and washers placed in outdoor positions shall be treated to prevent corrosion, by hot dip galvanising, except high tensile steel bolts and spring washers which shall be electro-galvanised/plated. Appropriate precautions shall be taken to prevent electrolytic action between dissimilar metals.

27.6 Each bolt or stud shall project at least one thread but not more than three threads through the nut, except when otherwise approved for terminal board studs or relay stems. If bolts and nuts are placed so that they are inaccessible by means of ordinary spanners, special spanners shall be provided.

27.7 The length of the screwed portion of the bolts shall be such that no screw thread may form part of a shear plane between members.

27.8 Taper washers shall be provided where necessary.

27.9 Protective washers of suitable material shall be provided front and back of the securing screws.

28 OVERLOAD CAPACITY:

28.1 The transformers shall be suitable for loading as per IS 6600.

29 LIGHTNING ARRESTORS:

29.1 9 kV, 5 kA metal oxide lightning arrestors Distribution class type of reputed make as per relevant standard , one number per phase shall be provided to be fitted under the HV bushing with GI earth strip 25x4 mm connected to the body of the transformer with necessary clamping arrangement

30 TESTS:

30.1 All the equipment offered shall be fully type tested by the bidder or his collaborator as per the relevant standards including the additional type tests.
The type test must have been conducted on a transformer of same design **during the last five years** at the time of bidding. The bidder shall furnish four sets of type test reports along with the offer. Offers without type test reports will be treated as non-responsive.

30.2 Special tests other than type and routine tests, as agreed between purchaser and bidder shall also be carried out as per the relevant standards.

30.3 The requirements of site tests are also given in this clause.

30.4 The test certificates for all routine and type tests for the transformers and also for the bushings and transformer oil shall be submitted with the bid.

30.5 The procedure for testing shall be in accordance with IS1180 (Part-1) :2014 /2026 as the case may be except for temperature rise test.

30.6 Before dispatch each of the completely assembled transformers shall be subjected to the routine tests at the manufacturer’s works.

31 ROUTINE TESTS:

31.1 Ratio, polarity, phase sequence and vector group.

31.2 No Load current and losses at service voltage and normal frequency.

31.3 Load losses at rated current and normal frequency.

31.4 Impedance voltage test.

31.5 Resistance of windings at each tap, cold (at or near the test bed temperature).

31.6 Insulation resistance.

31.7 Induced over voltage withstand test.

31.8 Separate source voltage withstand test.

31.9 Neutral current measurement-The value of zero sequence current in the neutral of the star winding shall not be more than 2% of the full load current.

31.10 Oil samples (one sample per lot) to comply with IS 1866.

31.11 Measurement of no load losses and magnetizing current at rated frequency and 90%, 100% and 110% rated voltage.

31.12 Pressure and vacuum test for checking the deflection.

32 TYPE TESTS TO BE CONDUCTED ON ONE UNIT:

In addition to the tests mentioned in clause 30 and 31 following tests shall be conducted:

32.1 Temperature rise test for determining the maximum temperature rise after continuous full load run. The ambient temperature and time of test should be stated in the test certificate.

32.2 Impulse voltage test: with chopped wave of IS 2026 part-III. BIL for 11 kV shall be 95 kV peak instead of 75 kV

32.3 Short circuit withstand test: Thermal and dynamic ability.

32.4 Air Pressure Test: As per IS – 1180 (Part-1):2014.

32.5 Magnetic Balance Test.

32.6 Un-balanced current test: The value of unbalanced current indicated by the ammeter shall not be more than 2% of the full load current.

32.7 Noise-level measurement.

32.8 Measurement of zero-phase sequence impedance.

32.9 Measurement of Harmonics of no-load current.

32.10 Transformer tank shall be subjected to specified vacuum. The tank designed for vacuum shall be tested at an internal pressure of 0.35 kg per sq cm absolute (250 mm of Hg) for one hour. The permanent deflection of flat plates after the vacuum has been released shall not exceed the values specified below:

Horizontal length of flat plate (in mm)	**Permanent deflection (in mm)**
Upto and including 750	5.0
751 to 1250	6.5
1251 to 1750	8.0
1751 to 2000	9.0

32.11 Transformer tank together with its radiator and other fittings shall be subjected to pressure corresponding to twice the normal pressure or 0.35 kg / sq.cm whichever is lower, measured at the base of the tank and maintained for an hour. The permanent deflection of the flat plates after the excess pressure has been released, shall not exceed the figures for vacuum test.

32.12 Pressure relief device test: The pressure relief device shall be subject to increasing fluid pressure. It shall operate before reaching the test pressure as specified in the above class. The operating pressure shall be recorded.
The device shall seal-off after the excess pressure has been released.

32.13 **Short Circuit Test and Impulse Voltage Withstand Tests**: The purchaser intends to procure transformers designed and successfully tested for short circuit and impulse test. In case the transformers proposed for supply against the order are not exactly as per the tested design, the supplier shall be required to carry out the short circuit test and impulse voltage withstand test at

their own cost in the presence of the representative of the purchaser.

32.13.1 The supply shall be accepted only after such test is done successfully, as it confirms on successful withstand of short circuit and healthiness of the active parts thereafter on un-tanking after a short circuit test.

32.13.2 Apart from dynamic ability test, the transformers shall also be required to withstand thermal ability test or thermal withstand ability will have to be established by way of calculations.

32.13.3 It may also be noted that the purchaser reserves the right to conduct short circuit test and impulse voltage withstand test in accordance with the IS, afresh on each ordered rating at purchaser cost, even if the transformers of the same rating and similar design are already tested. This test shall be carried out on a transformer to be selected by the purchaser either at the manufacturer's works when they are offered in a lot for supply or randomly from the supplies already made to purchaser's stores. The findings and conclusions of these tests shall be binding on the supplier.

32.13.4 Type test certificates for the tests carried out on prototype of same specifications shall be submitted along with the bid. The purchaser may select the transformer for type tests randomly.

33 ACCEPTANCE TESTS:

33.1 **At least 10% transformers of the offered lot (minimum of one)** shall besubjected to the following routine/ acceptance test in presence of purchaser's representative at the place of manufacture before dispatch without any extra charges. The testing shall be carried out in accordance with IS:1180 (Part-1): 2014 and IS:2026.

33.2 Checking of weights, dimensions, fitting and accessories, tank sheet thickness, oil quality, material, finish and workmanship as per GTP and contract drawings.

33.3 Physical verification of core coil assembly and measurement of flux density of one unit of each rating, in every inspection with reference to short circuit test report

33.4 Temperature rise test on one unit of the total ordered quantity

34 TESTS AT SITE:

The purchaser reserves the right to conduct all tests on transformer after arrival at site and the manufacturer shall guarantee test certificate figures under actual service conditions.

35 INSPECTION:

35.1 In respect of raw material such as core stampings, winding conductors, insulating paper and oil, supplier shall use materials manufactured/supplied by standard manufacturers and furnish the manufacturers' test certificate as well as the proof of purchase from these manufacturers (excise gate pass) for information of the purchaser. The bidder shall furnish following documents along with their offer in respect of the raw materials:

i. Invoice of supplier.

ii. Mill's certificate.

iii. Packing list.

iv. Bill of landing.

v. Bill of entry certificate by custom.

36 INSPECTION AND TESTING OF TRANSFORMER OIL:

36.1 To ascertain the quality of the transformer oil, the original manufacturer's tests report should be submitted at the time of inspection. Arrangements should also be made for testing of transformer oil, after taking out the sample from the manufactured transformers and tested in the presence of purchaser's representative.

36.2 To ensure about the quality of transformers, the inspection shall be carried out by the purchaser's representative at following two stages:-

36.2.1 Online anytime during receipt of raw material and manufacture/ assembly whenever the purchaser desires.

36.2.2 At finished stage i.e. transformers are fully assembled and are ready for dispatch.

36.3 The stage inspection shall be carried out in accordance with **Annexure-II.**

36.4 After the main raw-material i.e. core and coil material and tanks are arranged and transformers are taken for production on shop floor and a few assembly have been completed, the firm shall intimate the purchaser in this regard, so that an officer for carrying out such inspection could be deputed, as far as possible within seven days from the date of intimation. During the stage inspection a few assembled core shall be dismantled to ensure that the laminations used are of good quality. Further, as and when the transformers are ready for despatch, an offer intimating about the readiness of transformers, for final inspection for carrying out tests as per relevant IS shall be sent by the firm along with Routine Test Certificates. The inspection shall normally be arranged by the purchaser at the earliest after receipt of offer for pre-delivery inspection. The proforma for pre delivery inspection of Distribution transformers is placed at **Annex- III**.

36.5 In case of any defect/defective workmanship observed at any stage by the purchaser's Inspecting Officer, the same shall be pointed out to the firm in writing for taking remedial measures. Further processing should only be done after clearance from the Inspecting Officer/ purchaser.

36.6 All tests and inspection shall be carried out at the place of manufacture unless otherwise specifically agreed upon by the manufacturer and purchaser at the time of purchase. The manufacturer shall offer the Inspector representing the Purchaser all reasonable facilities, without charges, to satisfy him that the material is being supplied in accordance with this specification. This will include Stage Inspection during manufacturing stage as well as Active Part Inspection during Acceptance Tests.

36.7 The manufacturer shall provide all services to establish and maintain quality of workman ship in his works and that of his sub-contractors to ensure the mechanical /electrical performance of components, compliance with drawings, identification and acceptability of all materials, parts and equipment as per latest quality standards of ISO 9000.

36.8 Purchaser shall have every right to appoint a third party inspection to carry out the inspection process.

36.9 The purchaser has the right to have the test carried out at his own cost by an independent agency wherever there is a dispute regarding the quality supplied. Purchaser has right to test 1% of the supply selected either from the stores or field to check the quality of the product. In case of any deviation purchaser have every right to reject the entire lot or penalize the manufacturer, which may lead to blacklisting, among other things.

37 **QUALITY ASSURANCE PLAN:**

37.1 The bidder shall invariably furnish following information along with his bid, failing which his bid shall be liable for rejection. Information shall be separately given for individual type of equipment offered.

37.2 Statement giving list of important raw materials, names of sub-suppliers for the raw materials, list of standards according to which the raw materials are tested, list of tests normally carried out on raw materials in the presence of bidder's representative, copies of test certificates.

37.3 Information and copies of test certificates as above in respect of bought out accessories.

37.4 List of manufacturing facilities available.

37.5 Level of automation achieved and list of areas where manual processing exists.

37.6 List of areas in manufacturing process, where stage inspections are normally carried out for quality control and details of such tests and inspection.

37.7 List of testing equipment available with the bidder for final testing of equipment along with valid calibration reports. These shall be furnished with the bid. Manufacturer shall posses 0.1 accuracy class instruments for measurement of losses.

37.8 Quality Assurance Plan (QAP) withhold points for purchaser's inspection.

37.9 The successful bidder shall within 30 days of placement of order, submit following information to the purchaser :

37.9.1 List of raw materials as well as bought out accessories and the names of sub-suppliers selected from those furnished along with offer.

37.9.2 Type test certificates of the raw materials and bought out accessories.

37.9.3 The successful bidder shall submit the routine test certificates of bought out accessories and central excise passes for raw material at the time of routine testing.

38 DOCUMENTATION:

38.1 The bidder shall furnish along with the bid the dimensional drawings of the items offered indicating all the fittings.

38.2 Dimensional tolerances.

38.3 Weight of individual components and total weight.

38.4 An outline drawing front (both primary and secondary sides) and end-elevation and plan of the tank and terminal gear, wherein the principal dimensions shall be given.

38.5 Typical general arrangement drawings of the windings with the details of the insulation at

each point and core construction of transformer.

38.6 Typical general arrangement drawing showing both primary and secondary sides and end-elevation and plan of the transformer.

39 PACKING AND FORWARDING:

39.1 The packing shall be done as per the manufacturer's standard practice.
However, it should be ensured that the packing is such that, the material would not get damaged during transit by Rail / Road / Sea.

39.2 The marking on each package shall be as per the relevant IS.

40 GUARANTEE

41.1 The manufacturers of the transformer shall provide a guarantee of 24 months from the date of receipt at the stores of the Utility or 18 months from the date of commissioning, whichever is earlier. In case the distribution transformer fails within the guarantee period the purchaser will immediately inform the supplier who shall take back the failed DT within 15 days from the date of the intimation at his own cost and replace/repair the transformer within forty five days of date of intimation with a roll over guarantee.

41.2 The outage period i.e. period from the date of failure till unit is repaired/ replaced shall not be counted for arriving at the guarantee period.

41.3 In the event of the supplier's inability to adhere to the aforesaid provisions, suitable penal action will be taken against the supplier which may inter alia include blacklisting of the firm for future business with the purchaser for a certain period.

41 SCHEDULES:

42.1 The bidder shall fill in the following schedule which will be part of the offer. If the schedule are not submitted duly filled in with the offer, the offer shall be liable for rejection.

Schedule-A : Guaranteed Technical Particulars

Schedule-B : Schedule of Deviations

42 DEVIATIONS :

43.1 The bidders are not allowed to deviate from the principal requirements of the Specifications. However, the bidder is required to submit with his bid in the relevant schedule a detailed list of all deviations without any ambiguity. In the absence of a deviation list in the deviation schedules, it is understood that such bid conforms to the bid specifications and no post-bid negotiations shall take place in this regard.

43.2 The discrepancies, if any, between the specification and the catalogues and / or literatures submitted as part of the offer by the bidders, shall not be considered and representations in this regard shall not be entertained.

43.3 If it is observed that there are deviations in the offer in guaranteed technical particulars other than those specified in the deviation schedules then such deviations shall be treated as deviations.

43.4 All the schedules shall be prepared by vendor and are to be enclosed with the bid.

Annex-I

METHODOLOGY FOR COMPUTING TOTAL OWNING COST

TOC = IC + (A x Wi) + (B x Wc)

Where,

TOC = Total Owning Cost

IC = Initial cost (including taxes) of transformer as quoted by the manufacturer

A factor = Cost of no load losses in Rs/watt

B factor = Cost of load losses in Rs /watt

Wi = No load losses quoted by the manufacturer in watt

Wc = Load losses quoted by the manufacturer in watt

The "A" and "B" factors capture the net present value of energy losses based on hours of operation, cost of energy (electrical tariff), equipment life (years of expected service) and cost of money (rate of return).

i) Capitalised cost of no load losses/watt = A factor

$$\text{A factor} = {}^{H\,x}\quad \frac{Ec}{1000} \times \frac{(1+r)^n - 1}{r(1+r)^n}$$

ii) Capitalised cost of load losses/watt = B factor = A factor x LLF

iii) Capitalised cost of transformer = IC + (A x Wi) + (B x Wc)

where

i) H = No. of service hours per year of the distribution transformer =8400 hr.

ii) r = Rate of interest = prime lending rate (in per unit)

iii) Ec = Average Energy cost (Rs/kWH) at 11 kV for the utility. For 33 kV Distribution Transformers average cost of energy at 33 kV level may be taken

iv) n = Life of the transformer in years = 25 years

v) LLF = Loss Load factor = 0.3 LF+ 0.7 LF^2, where LF is the load factor

LF for rural areas = 0.5

LF for urban areas = 0.7

Annexure – II

PROFORMA FOR STAGE INSPECTION OF DISTRIBUTION TRANSFORMERS

(A) GENERAL INFORMATION:

1. Name of firm : M/s.
2. Order No. and Date :
3. Rating-wise quantity offered :
4. Details of offer
   a) Rating
   b) Quantity
   c) Serial Numbers
5. Details of last stage inspected lot:
   a) Total quantity inspected
   b) Serial Numbers
   c) Date of stage inspection
   d) Quantity offered for final inspection of
      (a) above with date

(B) **Availability of material for offered quantity** :

Details to be filled in

(C) **Position of manufacturing stage of the offered quantity** :

a) Complete tanked assembly
b) Core and coil assembly ready
c) Core assembled
d) Coils ready for assembly
   (i) HV Coils
   (ii) LV Coils

Note: (i) A quantity of more than 100 Nos. shall not be entertained for stageinspection.

(ii) The stage inspection shall be carried out in case :-

(a) At least 25% quantity offered has been tanked and

(b) core coil assembly of further at least 30% of the quantity offered has been completed.

(iii) Quantity offered for stage inspection should be offered for final Inspection within 15 days from the date of issuance of clearance for stage inspection, otherwise stage inspection already cleared shall be liable for cancellation.

Sl. No	Particulars	As offered	As observed	Deviation and Remarks
(D)	**Inspection of Core**: (I) **Core Material** (1) Manufacturer's Characteristic Certificate in respect of grade of lamination used. (Please furnish test certificate)			
	(2) Remarks regarding Rusting and smoothness of core.			
	(3) Whether laminations used for top and bottom yoke are in one piece.			
	(II) **Core Construction** :			
	(1) No. of Steps			
	(2) Dimension of Steps			

	Step No.	1	2	3	4	5	6	7	8	9	10	11	12
	As offered:												
	W mm												
	T mm												
	As found:												
	W mm												
	T mm												

	(3) Core Dia (mm)		
	(4) Total cross Section area of core		
	(5) Effective cross Sectional area of core		
	(6) Clamping arrangement		
	(i) Channel Size		
	(ii) Bolt size and No.		
	(iii) Tie Rods size and No.		
	(iv) **Painting**		
	(a) Channels		
	(b) Tie Rods		
	(c) Bolts		

	(7) Whether top yoke is cut for LV connection.			
	(8) If yes, at 7 above, whether Reinforcement is done.			
	(9) Size of Support Channels provided for Core base and bottom yoke (Single piece of channels are only acceptable) .			
	(10) Thickness of insulation provided between core base and support channel.			
	(11) core length (leg center to leg center)			
	(12) Window height			
	(13) Core height			
	(14) Core weight only (without channels etc.)			
(E)	**INSPECTION OF WINDING**			
	(I) Winding material			
	(1) Material used for			
	(a) HV winding			
	(b) LV winding			
	(2) Grade of material for			
	(a) HV winding			
	(b) LV winding			
	3) Test certificate of manufacturer (enclose copy) for winding material of:			
	(a) HV			
	(b) LV			
	(II) CONSTRUCTIONAL DETAILS (1) Size of Cross Sectional area of conductor for :			
	(a) HV winding			

	(b) LV winding			
	(2) Type of insulation for conductor of :			
	a) HV winding			
	(b) LV winding			
	(3) Diameter of wire used for delta formation (mm)			
	(4) Diameter of coils in:			
	a) LV winding			
	i) Internal dia (mm)			
	ii) Outer dia (mm)			
	b) HV winding			
	i) Internal dia (mm)			
	ii) Outer dia (mm)			
	(5) Current Density of winding material used for :			
	(a) HV			
	(b) LV			
	(6) Whether neutral formation on top.			
	(7) HV Coils/ Phase			
	a) Number			
	b) Turns / coil			
	c) Total turns			
	(8) LV Coils/ Phase			
	a) Number			
	b) Turns / coil			
	c) Total turns			
	(9) Method of HV Coil Joints			
	(10) Total weight of coils of			

	a) LV winding (kg)			
	b) HV winding (kg)			
(F)	**INSULATION MATERIALS :**			
	(I) **MATERIAL :**			
	1) Craft paper			
	a) Make			
	b) Thickness (mm)			
	c) Test Certificate of manufacturer (enclose copy).			
	2) Press Board			
	a) Make			
	b) Thickness (mm)			
	c) Test Certificate of manufacturer (enclose copy).			
	3) Material used for top and bottom yoke and insulation			
	(II) **Type and thickness of material used :** (mm)			
	a) Between core and LV			
	b) Spacers			
	c) Inter layer			
	d) Between HV and LV winding			
	e) Between phases			
	f) End insulation			
(G)	**CLEARANCES :** (mm)			
	(I) **Related to core and windings**			
	1) LV to Core (Radial) 2) Between HV and LV (Radial)			
	3) (i) Phase to phase between HV Conductor			

	(ii) Whether two Nos. Press Board each of minimum 1 mm thick provided to cover the tie rods.			
	4) Thickness of locking spacers between LV coils (mm)			
	5) Axial wedges between HV and LV coils / phase (Nos.)			
	6) No. of radial spacers per phase between HV coils			
	7) Size of duct between LV and HV winding (mm)			
	(II) **Between core - coil assembly and tank : (mm)**			
	1) Between winding and body:			
	a) Tank lengthwise			
	b) Tank Breadth wise			
	2) Clearance between top cover and top yoke upto 100 kVA and between top cover and top most live part of tap changing switch for 200 kVA and above.			
(H)	**TANK** : (I) **Constructional details** : 1) Rectangular shape 2) Thickness of side wall (mm) 3) Thickness of top and bottom plate (mm) 4) Provision of slopping top cover towards HV bushing.			

Sl. No	Particulars	As offered	As observed	Deviation and Remarks
	5) Tank internal dimensions (mm)			
	a) Length			
	b) Breadth			
	c) Height			
	(i) On LV side			
	(ii) On LV side			
	(II) **General details** :			
	1) Inside painted by varnish/ oil corrosion resistant paint (please specify which type of coating done).			
	2) Gasket between top cover and tank			
	i) Material			
	ii) Thickness (mm)			
	iii) Jointing over laps (mm)			
	3). Reinforcement of welded angle (specify size and No. of angle provided) on side walls of tank.			
	4) Provision of lifting lugs:			
	a) Numbers			
	b) Whether lugs of 8 mm thick MS Plate provided			
	c) Whether reinforced by welded plates edge wise below the lug upto re- enforcing angle of the tank done.			
	5) Pulling lug of MS Plate			
	a) Nos.			
	b) Thickness (mm)			
	c) Whether provided on breadth side or length side			
	6) Provision of air release plug			
	7) Provision of galvanized GI Nuts Bolts with 1 No. Plain and 1 No. spring washer.			
	8) Deformation of length wise side wall of tank when subject to:			
	a) Vacuum of (-) 0.7 kg/sq cm for 30 minutes.			

Sl. No	Particulars	As offered	As observed	Deviation and Remarks
	b) Pressure of 0.8 kg/sq cm for 30 minutes.			
(I)	**RAIDATORS** :			
	1. Fin Radiators of 1.25 mm thick sheet			
	a) Dimension of each fin (LxBxT)			
	b) Fins per radiator			
	c) Total No. of radiators			
	2. Verification of manufacturer's test certificate regarding Heat dissipation (excluding Top and Bottom) in w/sq m			
	3. Verification of position of radiator with respect to bushing.			
(J)	**CONSERVATOR** :			
	1. Dimensions (L x D) (in mm)			
	2. Volume (m^3)			
	3. Inside dia of Conservator tank pipe (mm)			
	4. Whether conservator outlet pipe is projected approx. 20 mm inside the conservator tank.			
	5. Whether arrangement made so that oil does not fall on the active parts.			
	6. Whether die cast metal oil level gauge indicator having three positions at (- 5° C, 30 ° C and 98 °C) is provided .			
	7. Whether drain plug and filling hole with cover is provided.			
	8. Inner side of the conservator Tank painted with-			
(K)	**BREATHER** :			
	1. Whether Die cast Aluminium body breather for silica gel provided.			
	2. Make			
	3. Capacity			

Sl. No	Particulars	As offered	As observed	Deviation and Remarks
(L)	**TERMINALS** :			
	1. Material whether of Brass Rods/ Tinned Copper.			
	a) HV			
	b) LV			
	2. Size (dia in mm)			
	a) HV			
	b) LV			
	3. Method of Star connection formed on LV side of 6mm thick (Should use Al./Cu. Flat bolted/ brazed with crimped lugs on winding alternatively for 63 and 100 kVA ratings brazing is done covered with tubular sleeve duly crimped). - Please state dimensions of Al/ Cu flat or tubular sleeve used. (mm)			
	4. Method of Connection of LV winding to LV Bushing (end of winding should be crimped with lugs (Al/Cu) and bolted with bushing stud).			
	5. Method of Connection of HV winding to HV bushing (Copper joint should be done by using silver brazing alloy and for Aluminium, brazing rod or with tubular connector crimped at three spots).			
	6. Whether SRB Ptube/insulated paper used for formation of Delta on HV.			
	7. Whether Empire sleeves used on the portion of HV winding joining to HV bushing.			
	8. Whether neutral formation is covered with cotton tape			
(M)	**BUSHINGS** :			
	1. Whether HV bushings mounted on side walls. 2. Whether sheet metal pocket used for mounting bushing			

	(pipe are not acceptable)			
	a) H V			
	b) L V			
	3. Whether arrangement for studs for fitting of HV Bushing are in diamond shape (so that Arcing Horns are placed vertically).			
	4. Position of mounting of LV bushings.			
	5. Bushing Clearance: (mm)			
	a) LV to Earth			
	b) HV to Earth			
	c) Between LV Bushings			
	d) Between HV Bushings			
(N)	**TANK BASE CHANNEL /**			
	ROLLERS :			
	1. Size of channel (mm)			
	2. Whether channels welded across the length of the tank			
	3. Size and type of roller (mm)			
(O)	**OIL :**			
	1. Name of supplier			
	2. Break down voltage of oil: (kV)			
	i) Filled in tanked transformer			
	ii) In storage tank (to be tested by Inspecting Officer).			
	3. Supplier's test certificate(enclose copy)			
(P)	**ENGRAVING :**			
	1. Engraving of Sl. No. and name of firm.			
	i) On bottom of clamping channel of core-coil assembly.			
	ii) On side wall and top cover of tank along with date of despatch.			
(Q)	i) MS plate of size 125x125 mm welded on width side of stiffner			
	ii) Following details engraved (as per approved GTP):			
	(a) Serial Number			
	(b) Name of firm			
	(c) Order No. and Date			
	(d) Rating			
	(e) Name of Inspecting Officer			
	(f) Designation			
	(g) Date of dispatch			
(R)	**NAME PLATE DETAILS :**			
	Whether Name Plate is as per approved drawing			
(S)	**Colour of Transformer**			
	1. Tank body with dark Green colour			
	2. Conservator with white colour			
(T)	**CHECKING OF TESTING FACILITIES:**			
	(Calibration certificate also to be checked for its validity)			
	TESTS :			

	1. No Load Current			
	2. No Load Loss			
	3. % Impedance			
	4. Load Losses			
	5. Insulation Resistance Test			
	6. Vector Group Test (phase relationship)			
	7. Ratio and Polarity test relationship			
	8. Transformer Oil Test (Break Down Voltage)			
	9. Magnetic Balance			
	10. Measurement of winding resistance (HV and LV both)			
	11. Induced over voltage withstand test (Double voltage and Double frequency)			
	12. Separate source power frequency withstand test at 28 kV for HV and 3 kV for LV (one minute).			
	13. Air pressure/ Oil leakage Test			
	14. Vacuum test			
	15. Unbalanced current test			
	16. Temperature rise (Heat Run) test.			
(U)	We have specifically checked the following and found the same as per G.T.P./deviations observed as mentioned against each:			
	i) Rustlessness of CRGO laminations used			
	ii) Core steps			
	iii) Core area			
	iv) Core weight			
	v) Winding cross sectional area			
	a) LV			
	b) HV			
	vi) Weight of windings			
	vii) Clearance between winding and wall of tank (mm)			
	a) Length-wise			
	b) Breadth-wise			
	viii) Clearance between top of yoke/ top most live part of tap changer to tank cover.			
	ix) Details of Neutral formation			
	x) Connections to bushings:			
	a) LV			
	b) HV			
	xi) Slope of tank top			
	xii) Position of mounting of bushings			

ACSR CONDUCTOR

1. SCOPE

This section covers design, manufacture, testing before dispatch, packing, supply and delivery for destination of Kms of "WEASEL" " RABBIT", "RACOON", "DOG", and "PANTHER" ACSR Conductor of size 6/1/2.59mm, 6/1/3.35mm, 6/1/4.09 mm, 6/4.72mm, 7/1.57mm and 30/7/3.00mm

2. STANDARDS

The Conductor shall also comply in all respects with the IS: 398(Part-II)-1996 with latest amendments unless otherwise stipulated in this specification or any other International Standards which ensure equal or higher quality material.

The ACSR Conductor shall also conform to the following standards.

Sl. No.	Indian Standards	Title	International
1	IS:209-1979	Specification for Zinc	BS-3436-1961
2	IS:398-1996	Specification for aluminum conductors for overhead transmission purposes.	
	Part-II	Aluminum conductors	IEC-209-1966
		Galvanized steel reinforced	BS-215(Part-II)
3	IS:1521-1972	Method of Tensile Testing of Steel wire	ISO/R89-1959
4	IS:1778-1980	Reels and Drums for Bare conductors	BS-1559-1949
5	IS:1841-1978	E.C. Grade Aluminum rod produced by rolling	
6	IS:2629-1966	Recommended practice for Hot Dip Galvanizing of iron and steel	
7	IS:2633-1986	Method of testing uniformity of coating of zinc coated articles.	
8	IS:4826-1968	Galvanized coatings on round steel wires.	ASTM A472-729
9	IS:5484-1978	E.C. Grade Aluminium rod produced by continuous casting and rolling.	
10	IS:6745-1972	Methods of determination of weight of zinc-coating of zinc coated iron and steel articles	BS-443-1969

Offersconforming to standards other than IS-398 shall be accompanied by the English version of relevant standards in support of the guaranteed technical particulars to be furnished as per format enclosed.

3. GENERAL TECHNICAL REQUIREMENTS

The General Technical Requirements are given in Section-II. The Conductor shall conform to these technical requirements.

The Bidder shall furnish guaranteed technical particulars in Section-III.

3.1. **MATERIALS/WORKMANSHIP**

3.1.1. The material offered shall be of best quality and workmanship. The steel coredaluminum conductor strands shall consist of hard drawn aluminium wire manufactured from not less than 99.5% pure electrolytic aluminium rods of E.C. grade and copper content not exceeding 0.04%. They shall have the same properties and characteristics as prescribed in IEC: 889-1987. The steel wire shall be made from material produced either by the acid or basic open hearth process or by electric furnace process or basic oxygenprocess. Steel wire drawn from Bessemer process shall not be used.

3.1.2. The steel wires shall be evenly and uniformly coated with electrolytic high grade, 99.95% purity zinc complying with the latest issue of IS-209 for zinc. The uniformity of zinc coating and the weight of coating shall be in accordance with Section-II and shall be tested and determined according to the latest IS-2633 or any other authoritative standard.

3.1.3. The steel strands shall be hot dip galvanized and shall have a minimum zinc coating of 250 gm/sq.m after stranding. The coating shall be smooth, continuous, and of uniform thickness,free from imperfections and shall withstand minimum three dips after stranding in standard preece test. The steel strands shall be preformed and postformed in order to prevent spreading of strands in the event of cutting of composite core wire. The properties and characteristics of finished strands and individual wires shall be as prescribed in IEC: 888-1987.

4. CONDUCTOR PARAMETERS

The Parameters of individual strands and composite steel coredaluminumconductor, shall be in accordance with the values given in Section-II.

Creep in a conductor is attributed partly due to settlement of strands and partly due to non-elastic elongation of metal when subjected to load. The manufacturer of conductor shall furnish the amount of creep which will take place in 10, 20, 30, 40 and 50 years along with the supporting calculations. The calculations should be based on everyday temperature of 32 ºC and everyday tension of 25% of UTS of conductor of 11/33 KV Lines.

5. TOLERANCES

The tolerances on standard diameter of Aluminum and Steel wires shall be as detailed in specific technical requirements.

The cross-section of any wire shall not depart from circularity by more than an amount corresponding to the tolerance on the standard diameter.

The details of diameters, lay ratios of Aluminum and steel wires shall be in accordance with the Section-II "Technical Requirements".

6. SURFACE CONDITIONS

All aluminum and steel strands shall be smooth, and free from all imperfections, spills/and splits. The finished conductor shall be smooth, compact, uniform and free from all imperfections including spills and splits, die marks, scratches, abrasions, scuff marks, kinks (protrusion of wires), dents, pressmarks, cut marks, wire cross-over, over-riding looseness, pressure and/or unusual bangle noise on tapping, material inclusions, white rust, powder formation or black spots (on account of reaction with trapped rain water etc.,), dirt, grit, etc. The surface of conductor shall be free from points, sharp edges, abrasions or other departures from smoothness or uniformity of surface contour that would increase radio interference and corona losses. When subjected to tension upto 50% of the ultimate strength of the conductor, the surface shall not depart from the cylindrical form nor any part of the component parts or strands move relative to each other in such a way as to get out of place and disturb the longitudinal smoothness of the conductor.

7. JOINTS IN WIRES

7.1. **Aluminum wires**

During stranding, no aluminum wire welds shall be made for the purpose of achieving the required conductor length.

No joint shall be permitted in the individual aluminum wires in the outer most layer of the finished Conductor. However, joints in the 12 wire & 18 wire inner layer of the conductor are permitted but these joints shall be made by the cold pressure butt welding and shall be such that no two such joints shall be within 15 meters of each other in the complete stranded conductor.

7.2. **Steel wires**

There shall be no joints in finished steel wires forming the core of the steel reinforced aluminum conductor.

8. STRANDING

The wires used in construction of the stranded conductor, shall, before stranding, satisfy all requirements of IS-398 (Part-II) 1996.

In all constructions, the successive layers shall be stranded in opposite directions. The wires in each layer shall be evenly and closely stranded round the underlying wire or wires. The outer most layer of wires shall have a right hand lay. The lay ratio of the different layers shall be within the limits given under Section-II.

9. PACKING

9.1. The conductor shall be supplied in non-returnable strong wooden drums provided with lagging of adequate strength constructed to protect the conductor against any damage and displacement during transit, storage and subsequent handling and stringing operations in the field. The drums shall generally conform to IS-1778-1980 and latest version except as otherwise specified hereinafter. The conductor drums shall be adequate to wind one standard length of 2500 meters of WEASEL/RABIT/RACOON/DOG/PANTHERACSR conductor.

9.2. The drums shall be suitable for wheel mounting and for letting off the conductor under a minimum controlled tension of the order of 5KN. The conductor drums shall be provided with necessary clamping arrangements so as to be suitable for tension stringing of power conductor.

9.3. The bidders should submit their drawings of the conductor drums along with the bid. After placement of letter of intent the Manufacturer shall submit four copies of fully dimensioned

drawing of the drum for Employer's approval. After getting approval from the Employer, Manufacturer shall submit 30 more copies of the approved drawings for further distribution and field use.

9.4. All wooden components shall be manufactured out of seasoned soft wood free from defects that may materially weaken the component parts of the drums. Preservative treatment for anti-termite/anti fungus shall be applied to the entire drum with preservatives of a quality which is not harmful to the conductor.

9.5. All flanges shall be 2-ply construction with 64 mm thickness. Each ply shall be nailed and clenched together at approximately 90 degrees. Nails shall be driven from the inside face of the flange, punched and then clenched on the outer face. Flange boards shall not be less than the nominal thickness by more than 2 mm. There shall not be less than 2 nails per board in each circle.

9.6. The wooden battens used for making the barrel of the conductor shall be of segmental type. These shall be nailed to the barrel supports with at least two nails. The battens shall be closely butted and shall provide a round barrel with smooth external surface. The edges of the battens shall be rounded or chamfered to avoid damage to the conductor.

9.7. Barrel studs shall be used for construction of drums. The flanges shall be holed and the barrel supports slotted to receive them. The barrel studs shall be threaded over a length on either end, sufficient to accommodate washers, spindle plates and nuts for fixing flanges at the required spacing.

9.8. Normally, the nuts on the studs shall stand protruded of the flanges. All the nails used on the inner surface of the flanges and the drum barrel shall be countersunk. The ends of the barrel shall generally be flushed with the top of the nuts.

9.9. The inner cheek of the flanges and drum barrel surface shall be painted with bitumen based paint.

9.10. Before reeling, card board or double corrugated or thick bituminized waterproof bamboo paper shall be secured to the drum barrel and inside of flanges of the drum by means of a suitable commercial adhesive material. The paper should be dried before use. Medium grade craft paper shall be used in between the layers of the conductor. After reeling the conductor the exposed surface of the outer layer of conductor shall be wrapped with thin polythene sheet across the flanges to preserve the conductor from dirt, grit and damage during transportation and handling and also to prevent ingress of rain water during storage/transport.

9.11. A minimum space of 75 mm shall be provided between the inner surface of the external protective lagging and outer layer of the conductor. Outside the protective lagging, there shall be minimum of two binders consisting of hoop iron/galvanised steel wire. Each protective lagging shall have two recesses to accommodate the binders.

9.12. Each batten shall be securely nailed across grains as far as possible to the flange edges with at least 2 nails per end. The length of the nails shall not be less than twice the thickness of the battens. The nail shall not protrude above the general surface and shall not have exposed sharp edges or allow the battens to be released due to corrosion.

9.13. The conductor ends shall be properly sealed and secured with the help of U-nails on one side of the flanges.

9.14. Only one standard length of conductor shall be wound on each drum. The method of lagging to be employed shall be clearly stated in the tender.

9.15. As an alternative to wooden drum Bidder may also supply the conductors in non-returnable

painted steel drums. The painting shall conform to IS:9954-1981,reaffirmed in 1992. Wooden/ steel drum will be treated at par for evaluation purpose and accordingly the Bidder should quote the package.

10. LABELLING AND MARKING

The drum number shall be branded or gauged or stencilled into the flange. An arrow shall be marked on the sides of the drum, together with the words "Roll this way". Each drum shall have the following information provided on the outside of the flange stencilled with indelible ink.

i) Manufacturer's name and address.
ii) Contract/Specification number.
iii) Size and type of conductor.
iv) Net weight of the conductor.
v) Gross weight of the conductor and drum.
vi) Length of the conductor.
vii) Position of the conductor end.
viii) Drum and lot number.
ix) Name and address of the consignee.
x) Month and year of manufacture.
xi) The drum may also be marked with standard specification as per which the conductor is manufactured.

11. STANDARD LENGTHS

11.1. The standard length of the conductor shall be 2500 metres. Bidder shall indicate the standard length of the conductor to be offered by them. A tolerance of plus or minus 5% on the standard length offered by the bidder shall be permitted. All lengths outside this limit of tolerance shall be treated as random lengths.

11.2. Random lengths will be accepted provided no length is less than 70% of the standard length and total quantity of such random length shall not be more than 10% of the total quantity order. When one number random length has been manufactured at any time, five (5) more individual lengths, each equivalent to the above random length with a tolerance of +/-5% shall also be manufactured and all above six random lengths shall be dispatched in the same shipment. At any point, the cumulative quantity supplied including such random lengths shall not be more than 12.5% of the total cumulative quantity supplied including such random lengths. However, the last 20% of the quantity ordered shall be supplied only in standard length as specified.

11.3. Bidder shall also indicate the maximum single length, above the standard length, he can manufacture in the guaranteed technical particulars of offer. This is required for special stretches like river crossing etc. The Employer reserves the right to place orders for the above lengths on the same terms and conditions applicable for the standard lengths during the pendency of the Contract.

12. QUALITY ASSURANCE PLAN

A Quality Assurance Plan including customer hold points covering the manufacturing activities of the material shall be required to be submitted by the tenderer to the Employer along with the tender. The Quality Assurance Plan after the same is found acceptable, will be approved by the Employer.

The contractor shall follow the approved Quality Assurance Plan in true spirit. If desired by the Employer, he shall give access to all the documents and materials to satisfy the Employer that the Quality Assurance Plan is being properly followed.

13. TESTING

13.1. SELECTION OF TEST SAMPLES FOR TYPE TESTS

13.1.1. The samples shall be taken from a continuous length of conductor and subjected to all the tests specified in clause 14.

13.2. SELECTION OF TEST SAMPLES FOR ACCEPTANCE TESTS

13.2.1. Before dispatch from the works individual wire and finished steel coredaluminum conductor shall be subjected to the tests as specified in IS:398 or any other authoritative standard.

13.2.2. Sample for individual wires for test shall be taken before stranding from outer ends of not less than ten per cent of the spools in the case of aluminum wire and ten per cent of the wire coils in the case of steel wires. If samples are taken after stranding, they shall be obtained by cutting 1.2 meters from the outer ends of the finished conductor from not more than 10 per cent of the finished reels.

13.2.3. The routine tests shall be same as acceptance test and shall be carried out on each coil.

14. TESTS

The following tests shall be carried out on sample/samples of conductor.

14.1 Type Tests

(i) Visual examination
(ii) Measurement of diameters of individual aluminum and steel wires.
(iii) Measurement of lay ratio of each layer
(iv) Breaking load test
(v) Ductility test
(vi) Wrapping test
(vii) Resistance test on aluminum wires.
(viii) DC resistance Test on Composite Conductor.
(ix) Galvanizing test
(x) Surface condition test
(xi) Stress Strain test
(xii) Procedure qualification test on welded joint of Aluminum Strands.

NOTE:-The type test reports shall not be older than FIVE years and shall be valid up to expiry of validity of offer.
The above additional lists if not conducted earlier, shall be done under the subject project package at no extra cost.

14.2 Acceptance tests and Routine tests

(ii) Visual and dimensional check on drum.
(iii) Visual examination
(iv) Measurement of diameters of individual aluminum and steel wires.
(v) Measurement of lay ratio of each layer
(vi) Breaking load test
(vii) Ductility test
(viii) Wrapping test
(ix) Resistance test on aluminum wires.
(x) DC resistance Test on Composite Conductor.
(xi) Galvanizing test

14.3 Tests During Manufacture

The following tests during manufacture shall be carried out.

(i) Chemical analysis of zinc used for galvanising,
(ii) Chemical analysis of aluminum used for making aluminumstrands,
(iii) Chemical analysis of steel used for making steel strands,

14.4 Visual examination

The conductor shall be examined visually for good workmanship and general surface finish of the conductor. The conductor drums shall be rewound in the presence of Inspecting Officer. The Inspector will initially check for Scratches, Joints etc., and that the conductor shall generally conform to the requirements of the specifications/IS 398(Part-II)-1996.

14.5 Measurement of diameters of individual Aluminum and Steel Wires.

The diameters of individual Aluminum and Steel Wires shall be checked to ensure that they conform to the requirements of this specification.

14.6 Measurement of lay-ratios

The lay-ratios of each layer of the conductor shall be measured and checked to ensure that they conform to the requirements of this specification and IS:398 (Part-II)-1996.

14.7 Breaking load test

a) **Breaking load test on complete conductor.**

Circles perpendicular to the axis of the conductor shall be marked at two places on a sample of conductor of minimum 5m length between fixing arrangement suitably fixed on a tensile testing machine. The load shall be increased at a steady rate upto 50% of minimum specified UTS and held for one minute. The circles drawn shall not be distorted due to relative movement of strands. Thereafter the load shall be increased at steady rate to 100% of UTS and held for one minute. The Conductor sample shall not fail during this period. The applied load shall then be increased until the failing load is reached and the value recorded.

b) **Breaking load test on individual Aluminum and Galvanized steel wires.**

This test shall be conducted on both Aluminum and Galvanized steel wires. The breaking load of one specimen cut from each of the samples taken shall be determined by means of suitable tensile testing machine. The load shall be applied gradually and the rate of separation of the jaws of the testing machine shall be not less than 25 mm/min. and not greater than 100 mm. / min. The ultimate breaking load of the specimens shall be not less than the values specified in the Section-II.

14.8 Ductility Test

For the purpose of this test both torsion and elongation tests shall be carried out on galvanized steel wires only.

14.9 Torsion Test

One specimen cut from each of the samples taken shall be gripped in two vices exactly 15 cms. apart. One of the vices shall be made to revolve at a speed not exceeding one revolution per second and the other shall be capable of moving longitudinally to allow for contraction or expansion during testing. A small tensile load not exceeding 2 (two)

percent of the breaking load of the wire shall be applied to the samples during testing. The test shall be continued until fracture occurs and the fracture shall show a smooth surface at right angles to the axis of the wire. After fracture, the specimen shall be free from helical splits. The sample shall withstand a number of twists equivalent to not less than 18 on length equal to 100 times the diameter. When twisted after stranding the number of complete twists before fracture occurs shall be not less than 16 on a length equal to 100 times the diameter of the wire. In case test sample length is less or more than 100 times the stranded diameter of the strand, the minimum number of twists will be proportioned to the length and if number comes in the fraction then it will be rounded off to the next higher whole number. The fracture shall show a smooth surface at right angles to the axis of the wire.

14.10 Elongation Test

The elongation of one specimen cut from each of the samples taken shall be determined. The specimen shall be straightened by hand and an original gauge length of 200 mm. shall be marked on the wire. A tensile load shall be applied as described in 1.1.4.6.2.1 and the elongation shall be measured after the fractured ends have been fitted together. If the fracture occurs outside the gauge marks, or within 25 mm. of either mark and the required elongation is not obtained, the test shall be disregarded and another test conducted. When tested before stranding, the elongation shall be not less than 4 percent and when tested after stranding, the elongation shall be not less than 3.5 percent.

14.11 Wrapping Test

This test shall be conducted on both Aluminum and Galvanized steel wires.

14.11.1 Aluminum wires

One specimen cut from each of the samples of aluminum wires shall be wrapped round a wire of its own diameter to form a close helix of 8 turns. Six turns shall then be unwrapped and closely wrapped in the same direction as before. The wire shall not break or show any crack.

14.11.2 Galvanized steel wires

One specimen cut from each of the samples of galvanized steel wire taken shall be wrapped round a mandrel of diameter equal to 4 times the wire diameter to form a close helix of 8 turns. Six turns shall then be unwrapped and again closely wrapped in the same direction as before. The wire shall not break.

14.12 Resistance Test

This test shall be conducted on aluminum wires only, conforming to procedure as per IEC:889. The electrical resistance of one specimen of aluminum wire cut from each of the samples taken shall be measured at ambient temperature. The measured resistance shall be corrected to the value corresponding to 20 degrees C. by means of following formula.

$$R_{20} = R_T \times \frac{1}{1 + \text{alpha} \times (T-20)}$$

Where

R_{20} = Resistance corrected at 20 degrees C.

R_T = Resistance measured at T degrees C.

alpha = Constant mass temperature coefficient ofresistance 0.004.

T = Ambient temperature during measurement

This resistance calculated to 20 degrees C. shall be not more than the maximum value specified in section-II.

14.13 Galvanizing Test

This test shall be conducted on galvanized steel wires only. The uniformity of Zinc coating and the weight of coating shall be in accordance with IS 4826-1979.

14.14 Surface Condition Test

A sample of the finished conductor for use in 11/33 KV system having a minimum length of 5 meters with compression type dead end clamps compressed on both ends in such manner as to permit the conductor to take its normal straight line shape, shall be subjected to a tension of 50 percent of the UTS of the conductor. The surface shall not depart from its cylindrical shape nor shall the strands move relative to each other so as to get out of place or disturb the longitudinal smoothness of conductor. The measured diameter at any place shall be not less than the sum of the minimum specified diameters of the individual aluminum and steel strands as indicated in Section-II.

14.15 Stress-Strain Test

The test is contemplated only to collect the creep data of the conductor from the manufacturer. A sample of conductor of minimum 10 meters length shall be suitably compressed with dead end clamps.

15. TEST SET-UP

15.1. The test sample shall be supported in a trough over its full length and the trough adjusted so that theconductor will not be lifted by more than 10mm under tension. This shall be ascertained by actual measurement.

15.2. The distance between the clamp and the sleeve mouth shall be monitored with callipers during the test to ensure that, after the test, it does not change by more than 1mm + 0.1mm from the value before the test.

15.3. The conductor strain shall be evaluated from the measured displacements at the two ends of the gauge length of the sample. The gauge reference targets shall be attached to the clamps which lock the steel and aluminum wires together. Target plates may be used with dial gauges or displacement transducers and care shall be taken to position the plates perpendicular to the conductor. Twisting the conductor, lifting it and moving it from side-to-side by the maximum amounts expected during the test should introduce no more than 0.3mm error in the reading.

16. TEST LOADS FOR COMPLETE CONDUCTOR

The loading conditions for repeated stress-strain tests for complete conductor shall be as follows:

16.1. 1KN load shall be applied initially to straighten the conductor. The load shall be removed after straightening and then the strain gauges are to be set At zero tension.

16.2. For non-continuous stress-strain data, the strain readings at 1KN intervals at lower tensions and 5 KN intervals above 30% of UTS shall be recorded.

16.3. The sample shall be reloaded to 30% of UTS and held for 1 hour. Readings are to be noted after 5, 10, 15, 30, 45 and 60 minutes during the hold period. The load shall be released then after the hold period.

16.4. The sample shall be reloaded to 50% of UTS and held for 1 hour. Readings are to be noted after 5, 10, 15, 30, 45 and 60 minutes during the hold period. The load shall be released then after the hold period.

16.5. Reloading upto 70% of UTS shall be done and held for 1 hour. Readings are to be noted after 5, 10, 15, 30, 45 and 60 minutes. The load shall be released.

16.6. Reloading upto 85% of UTS shall be done and held for 1 hour. Readings are to be noted after 5, 10,15, 30, 45 and 60 minutes and the load shall be released then.

16.7. Tension shall be applied again and shall be increased uniformly until the actual breaking strength is reached. Simultaneous readings of tension and elongation shall be recorded upto 90% of UTS at the intervals described under Clause 16.6.

17. TEST LOADS FOR STEEL CORE ONLY

The loading conditions for repeated stress-strain tests for the steel core of ACSR shall be as follows:

17.1. The test shall consist of successive applications of load applied in a manner similar to that for the complete conductor at 30%, 50%, 70% and 85% of UTS.

17.2. The steel core shall be loaded until the elongation at the beginning of each hold period corresponds to that obtained on the complete conductor at 30%, 50%, 70% and 85% of UTS respectively.

18. STRESS-STRAIN CURVES

The design stress-strain curve shall be obtained by drawing a smooth curve through the 0.5 and 1 hour points at 30%,50% and 70% of UTS loadings. The presence of any aluminum slack that can be related to any observed extrusion entering the span from the compression dead ends shall be removed from the lower ends of the design curves. Both the laboratory and standard stress-strain curves shall be submitted to the Employeralongwith test results. The stress-strain data obtained during the test shall be corrected to the standard temperature i.e. 20 deg.C.

19. DC RESISTANCE TEST ON COMPOSITE CONDUCTOR

On a conductor sample of minimum 5m length, two contact clamps shall be fixed with a pre-determined bolt torque. The resistance of the sample shall be measured by a Kelvin double bridge by placing the clamps initially zero meter and subsequently one meter apart. The test shall be repeated at least five times and the average value recorded. The value obtained shall be corrected to the value at 20 deg C as per clause no. 12.8 of IS:398 (Part-II)-1982/1996.The corrected resistance value at 20 deg.C shall conform to the requirements of this specification.

20. PROCEDURE QUALIFICATION TEST ON WELDED ALUMINUM STRANDS.

Two Aluminum wires shall be welded as per the approved quality plan and shall be subjected to tensile load. The breaking strength of the welded joint of the wire shall not be less than the guaranteed breaking strength of individual strands.

21. CHEMICAL ANALYSIS OF ALUMINUM AND STEEL

Samples taken from the Aluminum and Steel ingots / coils/ strands shall be chemically/ spectrographicallyanalyzed. The same shall be in conformity with the requirements stated in this specification.

22. CHEMICAL ANALYSIS OF ZINC

Samples taken from the zinc ingots shall be chemically / spectrographically analysed.The same shall be in conformity with the requirements stated in this specification.

23. VISUAL AND DIMENSIONAL CHECK ON DRUMS

The drums shall be visually and dimensionally checked to ensure that they conform to the requirements of this specification.

24. REJECTION AND RETEST

24.1. In case of failure in any type test, the Manufacturer is either required to manufacture fresh sample lot and repeat all the tests successfully once or repeat that particular type test three times successfully on the sample selected from the already manufactured lot at his own expenses. In case a fresh lot is manufactured for testing then the lot already manufactured shall be rejected.

24.2. If samples are taken for test after stranding and if any selected reel fails in the retest, the manufacturer may test each and every reel and submit them for further inspection. All rejected material shall be suitably marked and segregated.

25. CHECKING AND VERIFICATION OF LENGTH OF CONDUCTOR

The contractor should arrange for inspection by the representative of the Employer specially authorised for this purpose. At least 50% of the total number of drums of conductor subject to minimum of two taken at random should be checked to ascertain the length of conductor. Arrangements should be made available in the works of the manufacturer for transferring the conductor from one reel to another at the same time measuring the length of the conductor so transferred by means of a meter.

26. ADDITIONAL TESTS

The Employer reserves the right of having at his own expenses any other test(s) of reasonable nature carried out at Bidder's premises, at site, or in any other standard Laboratory in addition to the aforesaid type, acceptance and routine tests to satisfy himself that the materials comply with the specifications.

27. TESTING EXPENSES

27.1. The breakup of the testing charges for the type tests specified shall be indicated separately.

27.2. Bidder shall indicate the laboratories in which they propose to conduct the type test. They shall ensure that adequate facilities are available in the laboratories and the tests can be completed in these laboratories within the time schedule guaranteed by them.

27.3. The entire cost of testing for the acceptance and routine tests and tests during manufacture specified herein shall be treated as included in the quoted unit price of the conductor, except for the expenses of the inspector/Employer's representative.

27.4. In case of failure in any type test, if repeat type tests are required to be conducted then

all the expenses for deputation of Inspector/Employer's representative shall be deducted from the contract price. Also if on receipt of the Manufacturer's notice of testing, the Employer's representative does not find 'plant' to be ready for testing, the expenses incurred by the Employer for redeputation shall be deducted from contract price.

28. TEST REPORTS

28.1. Copies of type test reports shall be furnished in at least six copies alongwith one original. One copy will be returned duly certified by the Employer only after which the commercial production of the material shall start.

28.2. Record of Routine test reports shall be maintained by the Manufacturer at his works for periodic inspectionby the Employer's representative.

28.3. Test certificates of Tests during manufacture shall be maintained by the Manufacturer. These shall be produced for verification as and when desired by the Employer.

29. TEST FACILITIES

The following additional test facilites shall be available at the Manufacturer's works:

(i) Calibration of various testing and measuring equipment including tensile testing machine, resistance measurement facilities, burette, thermometer, barometer,etc.

(ii) Standard resistance for calibration of resistance bridges.

(iii) Finished Conductor shall be checked for length verification and surface finish on separate rewinding machine at reduced speed(variable from 8 to 16 meters per minute).The rewinding facilities shall have appropriate clutch system and be free of vibrations, jerks etc with traverse laying facilities.

30. INSPECTION

30.1. The Employer's representative shall, at all times, be entitled to have access to the works and all places of manufacture where conductor shall be manufactured and the representative shall have full facilities for unrestricted inspection of the Bidder's works, raw materials and process of manufacture and conducting necessary tests as detailed herein.

30.2. The Bidder shall keep the Employer informed in advance of the time of starting and of the progress of manufacture of conductor in its various stages so that arrangements can be made for inspection.

30.3. The contractor will intimate the Employer about carrying out of the tests at least 45 days in advance of the scheduled date of tests during which the Employer will arrange to depute his representative/s to be present at the time of carrying out of the tests. Six (6) copies of the test reports shall be submitted.

30.4. No material shall be dispatched from its point of manufacture before it has been satisfactorily inspected and tested, Unless the inspection is waived off by the employer in writing. In the later case also, the conductor shall be dispatched only after satisfactory testing for all tests specified herein has been completed and approved by the employer.

30.5. The acceptance of any quantity of material shall in no way relieve the Bidder of any of his responsibilities for meeting all requirements of the specification, and shall not prevent subsequent rejection if such material is later found to be defective.

30.6. At least 50% of the total number of drums subject to minimum of two in any lot put up for inspection, shall be selected at random to ascertain the length of conductor by the following method:

"At the works of the manufacturer of the conductor, the conductor shall be transferred from one drum to another at the same time measuring its length with the help of a graduated pulley and Cyclometer. The difference in the average length thus obtained and as declared by the Bidder in the packing list shall be applied to all the drums if the conductor is found short during checking".

31. SCHEDULE OF DEVIATIONS/VARIATIONS

If the tenderer has any exceptions to any of the clause/s laid down in this specification, these should beclearly stated in the schedule of deviations / variations.

SECTION - II

SPECIFIC TECHNICAL REQUIREMENTS

1. SCOPE

This section of the specification covers climatic and isoceraunic conditions, specific technical particulars, schedule of requirements & desired deliveries, for conductor for 11/33 kV lines.

2. CLIMATIC & ISOCERAUNIC CONDITIONS TO BE SPECIFIED BY EMPLOYER

2.1Maximum Temperature

a) Conductor °C.

2.2Minimum Temperature °C.

2.3 i)Max. ambient temperature °C

ii) Mean annual / every day temperature °C

2.4Basic wind speed m/s

2.5Relative humidity

i) Maximum %

ii) Minimum %

2.6Average Rainfall (Max.) mm per annum

2.7a)Rainy months May to Sept.

15 Rainy days in a year (days)

2.8 Average number of thunder storm

2.9 Altitude varying from sea level

2.10Basic horizontal Seismic Co-efficient(horizontal)

Basic vertical Seismic Co-efficient

2.11System Particulars

a) Line Voltage (kV)

b) Highest System Voltage (kV)

c) Number of Circuits

d) Frequency HZ

e) Neutral

f) Short circuit level (KA)

3. SPECIFIC TECHNICAL REQUIREMENTS

CONDUCTOR: 1. Conductor: Rabbit/Raccoon/Dog/Weasel/Panther ACSR 2. IS applicable: IS-398 (part-II) 1996 latest revision					
3. Wire Diameter	**Rabbit**	**Raccoon**	**Dog**	**Weasel**	**Panther**
Aluminium (mm)	6/3.35	6/4.06	6/4.72	6/2.59	30/3.00
Steel(mm)	1/3.35	1/4.09	7/1.57	1/2.59	7/3.00
4. Number of strands:					
Steel centre		1	1	1	1
1st steel layer	-		6		6
1st Aluminium layer	6	6	6	6	12
2nd Aluminium layer					18
5. Sectional Area of Aluminium (sq. mm.)	52.88	78.83	105	31.61	212.1
6. Total Sectional	61.7	91.97	118.5	36.88	261.5

Area(sq.mm.)					
7. Overall diameter(mm)	10.05	12.27	14.15	7.77	21
8. Approximate weight(Kg./Km.)	10.05	12.27	14.15	7.77	21
9. Calculated D.C rersistance at 20 degrees C., maximum. (Ohms/Km)	0.552	4.371	2.2792	0.9289	0.139
10. Ultimate tensile strength (KN)	18.25	26.91	32.41	11.12	89.67
11. Final modulas of elasticity (GN/sq.m)	79	79	75	79	80
12. Coefficient of linear expansion x 10-6 per◦C	19.1	19.1	19.8	19.1	17.8
13. Lay ratio	Max Min	Max Min	Max Min	Max Min	Max Min
Steel core 6 wire layer			28 13		28 13
AluminiumIst layer	14 10	14 10	14 10	14 10	14 10
2nd layer					16 10

14. Technical Particulars

a. Diameter-mm	Rabbit		Raccon		Dog		Weasel		Panther	
	Al	**Steel**	**Al**	**Steel**	**Al**	**Steel**	**Al**	**Steel**	**Al**	**Steel**
Standard(mm)	3.35	3.35	4.09	4.09	1.57	4.72	2.59	2.59	3.00	3.00
Maximum (mm)	3.42	3.38	4.17	4.13	1.60	4.77	2.64	2.62	3.06	3.03
Minimum (mm)	3.28	3.32	4.01	4.05	1.54	4.67	2.54	2.56	2.94	2.97
b. Cross-sectional area of	8.814	8.814	13.14	13.14	1.936	17.50	5.269	5.269	7.069	7.069

	nominal diameter wire ($mm^{2)}$										
c.	Weight (Kg./Km)	68.75	23.82	102.48	35.51	15.10	47.30	41.09	14.24	55.13	19.11
d.	Min. breaking load (KN)										
	Before stranding	11.58	1.43	17.27	2.08	2.70	2.78	6.92	0.89	9.29	1.17
	After Stranding	11.00	1.36	16.4	1.98	2.57	2.64	6.57	0.85	8.83	1.11
e.	D.C resistance at 20°C min. (Ohm/Km)	-3.265		-2.194		1.65		-5.49		-4.079	

15. Zinc coating of steel core:

(i) Number of 1 minute dips: 3

(ii) Minimum weight of Zinc: 260 gms/sqm Coating

(iii) Process of Galvanizing: Hot dip.

(iv) Quality of Zinc : IS-209/1979 or latest edition.

16. Joints in strands

16.1 Steel : Not permitted

16.2 **Aluminium:** No joint shall be permitted in the Aluminum wires in the outer most layer of the ACSR conductor. But permitted in the inner layers such that no two such joints are within 15 meters of each other in the complete stranded conductor.

15. Chemical composition of high carbon steel wire:

Element	**% Composition**
i) Carbon	0.5 to 0.85
ii) Manganese	0.5 to 1.10
iii) Phosphorus	Not more than 0.035
iv) Sulphur	Not more than 0.045
v) Silicon	0.10 to 0.35

SCHEDULE OF LINE MATERIALS AND DESIRED DELIVERIES

POWER CONDUCTOR

Sl. No.	MATERIAL Description	Quantity (KM)	Destination Site	Delivery to commence delivery from the 15th month of date of Award
	16/1/3.35 mm			KM per month

	'Rabbit' ACSR			
	Conductor			
	26/1/3.35 mm			KM per month
	'Racoon' ACSR			
	Conductor			
	36/4.72+7/1.57 mm			KM per month
	'Dog' ACSR Conductor			
	430/7/2.59 mm			KM per month
	'weasel' ACSR			
	Conductor			
	530/7/3.00 mm			KM per month
	'panther' ACSR			
	Conductor			

AAA CONDUCTOR

1.0 TECHNICAL DESCRIPTION OF AAAC CONDUCTOR

1.1 DETAILS OF CONDUCTORS

1.1.1 **The AAAC Conductors shall generally conform to IS: 398 (Part-IV), IEC:104-1987 except where otherwise specified herein.**

1.1.2 **The details of the AAAC Conductors of various sizes are given in the enclosed Table-I**

1.2 WORKMANSHIP

1.2.1 **All the Al-alloy strands shall be smooth, uniform and free from all imperfections, such as spills and splits, die marks, scratches, abrasions, etc., after drawing and also after stranding.**

1.2.2 **The finished conductor shall be smooth, compact, uniform and free from all imperfections including kinks (protrusion of wires), scuff marks, dents, pressmarks, cut marks, wire cross over, over riding, looseness (wire being dislocated by finger/hand pressure and/or unusual bangle noise on tapping), material inclusions, white rust, powder formation or black spot (on account of reaction with trapped rain water etc.), dirt, grit etc.**

1.3 JOINTS IN WIRES

1.3.1 **1No joint shall be permitted in any layer of finished conductor.**

1.4 STRANDING

In all constructions, the successive layers shall be stranded in opposite directions. The wires in each layer shall be evenly and closely stranded round the underlying wire or wires. The outer most layer of wires shall have a right hand lay. The lay ratio shall be as follow.

Number of wires	3/6 Wire layer	12 Wire layer	18 Wire layer

in conductor	Min	Max	Min	Max	Min	Max
3	10	14	-	-	-	-
7	10	14	-	-	-	-
19	10	16	10	14	-	-
37	10	17	10	16	10	14

1.5 TOLERANCES

The manufacturing tolerances in diameter of individual aluminium alloy strand shall be as per **Table-I**.

1.6 MATERIALS

1.6.1 ALUMINUM ALLOY

The wire shall be of heat treated aluminum, magnesium silicon alloy having a composition appropriate to the mechanical & electrical properties as specified in IS 398(Part-4).

The Aluminum Alloy strands drawn from heat treated aluminium alloy redraw rods conforming to Type B as per IEC:104-latest amendment. The chemical composition of redrawn rods shall conform to IS 1997-91, as given below:

Elements	*Percent*
Si	0.50-0.90
Mg	0.60-0.90
Fe	0.50 max
Cu	0.10 max
Mn	0.03 max
Cr	0.03 max
Zn	0.10 max
B	0.06 max
Other Element (Each)	0.03 max
Other Element (Total)	0.10 max
Al	Remainder

1.7 STANDARD LENGTH

1.7.1 **The standard length of the conductor shall be 2000 meters. Contractor shall indicate the standard length of the conductor to be offered by them. A tolerance of +/-5% on the standard length offered by the Bidder shall be permitted. All lengths outside this limit of tolerance shall be treated as random lengths.**

1.7.2 **Random lengths will be accepted provided no length is less than 70% of the standard length and the total quantity of such random lengths shall not be more than 10% of the total quantity ordered.**

1.7.3 Bidder shall also indicate the maximum single length, **above the standard length, he can manufacture in the guaranteed technical particulars of offer. The Owner reserves the right to place orders for the above lengths on the same terms and conditions applicable for the standard lengths during the execution of the Contract.**

1.8 TESTS AND STANDARDS

The following tests to be conducted for AAAC conductors shall conform to IS 398(Part -IV) 1979 and IEC 888 & 889.

1.8.1 TYPE/PERIODIC

The following tests shall be conducted on samples of each type of conductor :

(a)	UTS test on stranded conductor	)	Annexure-A
(b)	DC resistance test on stranded conductor	)	

1.8.2 ACCEPTANCE TESTS

(a)	Visual check for joints scratches etc. and length measurement of	)	Annexure - A

conductor by rewinding)

(b) Dimensional check on)

Al-alloy strands

(c) Check for lay-ratio)
)

(d) Elongation test) Annexure - A
)

(e) Breaking load/tensile test on)
Aluminum alloy strands)
)

(f) DC resistance test on)

Aluminum alloy strands)

(g) Wrap test on) IEC 104, IEC 1089

Aluminum alloy strands

(h) Visual and dimensional)

check on drum) IS:1778-1980

1.8.3 ROUTINE TEST

(a) Check to ensure that there are no joints.

(b) Check that there are no cuts, fins etc. on the strands.

(c) Check that drums are as per Specification.

(d) All acceptance test as mentioned above to be carried out on each coil.

1.8.4 TESTS DURING MANUFACTURE

(a) Chemical analysis of)

Aluminum alloy used for)
making strands) Annexure-A

1.8.5 TESTING EXPENSES

i) The type test charges for the conductor should be quoted in the relevant schedule of Bid Proposal Sheets.

ii) Contractor shall indicate the laboratories in which they propose to conduct the type tests. They shall ensure that adequate facilities are available in the laboratories and the tests can be completed in these laboratories within the time schedule guaranteed by them.

iii) In case of failure in any type test, the Contractor is either required to manufacture fresh sample lot and repeat all the tests successfully once or repeat that particular type test three times successfully on the sample selected from the already manufactured lot at his own expenses. In case a fresh lot is manufactured for testing, then the lot already manufactured shall be rejected.

iv) The entire cost of testing for the acceptance and routine tests and Tests during manufacture specified herein shall be treated as included in the quoted unit price of conductor, except for the expenses of the inspector/Owner's representative.

v) In case of failure in any type test, if repeat type tests are required to be conducted, then all the expenses for deputation of Inspector/Owner's representative shall be deducted from the contract price. Also if on receipt of the Contractor's notice of testing, the Owner's representative does not find 'The material or testing facilities' to be ready for testing the expenses incurred by the Owner for re-deputation shall be deducted from contract price.

1.8.6 ADDITIONAL TESTS

i) The Owner reserves the right of having at his own expenses any other test(s) of reasonable nature carried out at Contractor’s

premises, at site or in any other place in addition to the aforesaid type, acceptance and routine tests to satisfy himself that the materials comply with the Specifications.

ii) The Owner also reserves the right to conduct all the tests mentioned in this specification at his own expense on the samples drawn from the site at Contractor's premises or at any other test centre. In case of evidence of non-compliance, it shall be binding on the part of Contractor to prove the compliance of the items to the technical specifications by repeat tests, or correction of deficiencies, or replacement of defective items all without any extra cost to the Owner.

1.8.7 SAMPLE BATCH FOR TYPE TESTING

i) The Contractor shall offer material for selection of samples for type testing only after getting Quality Assurance Plan approved from Owner's Quality Assurance Deptt. The sample shall be manufactured strictly in accordance with the Quality Assurance Plan approved by Owner.

ii) The Contractor shall offer at least three drums for selection of sample required for conducting all the type tests.

iii) The Contractor is required to carry out all the acceptance tests successfully in presence of Owner's representative before sample selection.

1.8.8 TEST REPORTS

i) Copies of type test reports shall be furnished in at least six copies along with one original. One copy will be returned duly certified by the Owner only after which the commercial production of the material shall start.

ii) Record of routine test reports shall be maintained by the Supplier at his works for periodic inspection by the Owner's representative.

iii) Test Certificates of tests during manufacture shall be maintained by the Contractor. These shall be produced for verification as and when desired by the Owner.

1.9 INSPECTION

1.9.1 **The Owner's representative shall at all times be entitled to have access to the works and all places of manufacture, where conductor shall be manufactured and representative shall have full facilities for unrestricted inspection of the Contractor's works, raw materials and process of manufacture for conducting necessary tests as detailed herein.**

1.9.2 **The Contractor shall keep the Owner informed in advance of the time of starting and of the progress of manufacture of conductor in its various stages so that arrangements can be made for inspection.**

1.9.3 **No material shall be dispatched from its point of manufacture before it has been satisfactorily inspected and tested, unless the inspection is waived off by the Owner in writing. In the latter case also, the conductor shall be dispatched only after satisfactory testing for all tests specified herein have been completed.**

1.9.4 **The acceptance of any quantity of material shall in no way relieve the Contractor of any of his responsibilities for meeting all requirements of the Specification, and shall not prevent subsequent rejection if such material is later found to be defective.**

1.9.5 TEST FACILITIES

The following additional test facilities shall be available at the Contractor's works:

i) Calibration of various testing and measuring equipment including tensile testing machine, resistance measurement facilities, burette, thermometer, barometer etc.

ii) Standard resistance for calibration of resistance bridges.

iii) Finished conductor shall be checked for length verification and surface finish on separate rewinding machine at reduced speed (variable from 8 to 16 meters per minute). The rewinding facilities shall have appropriate clutch system and free of vibrations, jerks etc. with traverse laying facilities.

1.10 PACKING

1.10.1 **The conductor shall be supplied in returnable, strong, wooden drums provided with lagging of adequate strength, constructed to protect the conductor against any damage and displacement during transit, storage and subsequent handling and stringing operations in the field. The Contractor shall be responsible for any loss or damage during transportation handling and storage due to improper packing. The drums shall generally conform to IS:1778-1980, except as otherwise specified hereinafter.**

1.10.2 **The drums shall be suitable for wheel mounting and for letting off the conductor under a minimum controlled tension of the order of 5 KN.**

1.10.3 **The Contractor should submit their proposed drum drawings along with the bid.**

1.10.4 **The Contractor may offer more than one length of the conductor in a single drum.**

1.10.5 **All wooden components shall be manufactured out of seasoned soft wood free from defects that may materially weaken the component parts of the drums. Preservative treatment shall be applied to the entire drum with**

preservatives of a quality, which is not harmful to the conductor.

1.10.6 **The flanges shall be of two ply construction with a total thickness of 64 mm with each ply at right angles to the adjacent ply and nailed together. The nails shall be driven from the inside face flange, punched and then clenched on the outer face. Flange boards shall not be less than the nominal thickness by more than 2mm. There shall not be less than 2 nails per board in each circle. Where a slot is cut in the flange to receive the inner end of the conductor the entrance shall be in line with the periphery of the barrel.**

1.10.7 **The wooden battens used for making the barrel of the conductor shall be of segmental type. These shall be nailed to the barrel supports with at least two nails. The battens shall be closely butted and shall provide a round barrel with smooth external surface. The edges of the battens shall be rounded or chamfered to avoid damage to the conductor.**

1.10.8 **Barrel studs shall be used for the construction of drums. The flanges shall be holed and the barrel supports slotted to receive them. The barrel studs shall be threaded over a length on either end, sufficient to accommodate washers, spindle plates and nuts for fixing flanges at the required spacing.**

1.10.9 **Normally, the nuts on the studs shall stand protruded of the flanges. All the nails used on the inner surface of the flanges and the drum barrel shall be counter sunk. The ends of barrel shall generally be flushed with the top of the nuts.**

1.10.10 **The inner cheek of the flanges and drum barrel surface shall be painted with a bitumen based paint.**

1.10.11 **Before reeling, card board or double corrugated or thick bituminous water-proof bamboo paper shall be secured to the drum barrel and inside of flanges of the drum by means of a suitable commercial adhesive material. The paper**

should be dried before use. After reeling the conductor, the exposed surface of the outer layer of conductor shall be wrapped with water proof thick bituminous bamboo paper to preserve the conductor from dirt, grit and damage during transport and handling.

1.10.12 **A minimum space of 75 mm for conductor shall be provided between the inner surface of the external protective lagging and outer layer of the conductor. Outside the protective lagging, there shall be minimum of two binders consisting of hoop iron/ galvanized steel wire. Each protective lagging shall have two recesses to accommodate the binders.**

1.10.13 **Each batten shall be securely nailed across grains as far as possible to the flange, edges with at least 2 nails per end. The length of the nails shall not be less than twice the thickness of the battens. The nails shall not protrude above the general surface and shall not have exposed sharp, edges or allow the battens to be released due to corrosion.**

1.10.14 **The nuts on the barrel studs shall be tack welded on the one side in order to fully secure them. On the second end, a spring washer shall be used.**

1.10.15 **A steel collar shall be used to secure all barrel studs. This collar shall be located between the washers and the steal drum and secured to the central steel plate by welding.**

1.10.16 **Outside the protective lagging, there shall be minimum of two binder consisting of hoop iron/ galvanized steel wire. Each protective lagging shall have two recesses to accommodate the binders.**

1.10.17 **The conductor ends shall be properly sealed and secured with the help of U-nail on the side of one of the flanges to avoid loosening of the conductor layers during transit and handling.**

1.10.18 **As an alternative to wooden drum Contractor may also supply the conductors in non-returnable painted steel drums. After preparation of steel surface according to IS : 9954, synthetic enamel paint shall be applied after application of one coat of primer. Wooden/Steel drum will be treated at par for evaluation purpose and accordingly the Contractor should quote in the package.**

1.11 MARKING

Each drum shall have the following information stenciled on it in indelible ink along with other essential data :

a. Contract/Award letter number.
b. Name and address of consignee.
c. Manufacturer's name and address.
d. Drum and lot number
e. Size and type of conductor
f. Length of conductor in meters
g. Arrow marking for unwinding
h. Position of the conductor ends
i. Number of turns in the outer most layer.
j. Gross weight of drum after putting lagging.
k. Average weight of the drum without lagging.
l. Net weight of the conductor in the drum.
m. Month and year of manufacture of conductor

The above should be indicated in the packing list also.

1.12 VERIFICATION OF CONDUCTOR LENGTH

The Owner reserves the right to verity the length of conductor after unreeling at least Two (2) percent of the drums in a lot offered for inspection.

For the balance drums, length verification shall be done by the owner based on report/certification from Manufacturer/Contractor.

1.13 STANDARDS

1.13.1 **The conductor shall conform to the following Indian/International Standards, which shall mean latest revisions, with amendments/changes adopted and published, unless specifically stated otherwise in the Specification.**

1.13.2 **In the event of the supply of conductor conforming to standards other than specified, the Bidder shall confirm in his bid that these standards are equivalent to those specified. In case of award, salient features of comparison between the standards proposed by the Contractor and those specified in this document will be provided by the Contractor to establish their equivalence.**

Sl. No.	Indian Standard	Title	International Standards
1.	IS:398 (Part-IV)	Aluminum Alloy stranded conductor	IEC : 208-1966 BS-3242-1970
2	IS : 9997-1988	Aluminum Alloy Redraw Rods	IEC 104-1987
3	IS : 1778-1980	Reels and Drums for Bare Conductors	BS:1559-1949

ANNEXURE-A

1.0 TESTS ON AAAC CONDUCTORS

1.1 UTS Test on Stranded Conductor

Circles perpendicular to the axis of the conductor shall be marked at two places on a sample of conductor of minimum 5 m length between fixing arrangement suitably fixed on a tensile testing machine. The load shall be increased at a steady rate upto 50% of minimum specified UTS and held for one minute. The circles drawn shall not be distorted due to relative movement of strands. Thereafter the load shall be increased at steady rate to minimum UTS and held for one minute. The Conductor sample shall not fail during this period. The applied load shall then be increased until the failing load is reached and the value recorded.

1.2 D.C. Resistance Test on Stranded Conductor

On a conductor sample of minimum 5m length two contact-clamps shall be fixed with a predetermined bolt torque. The resistance shall be measured by a Kelvin double bridge by placing the clamps initially zero meter and subsequently one meter apart. The test shall be repeated at least five times and the average value recorded. The value obtained shall be corrected to the value at 20°C as per IS:398-(Part-V)-1982. The resistance corrected at 20^{0}C shall conform to the requirements of this Specification.

1.3 CHEMICAL ANALYSIS OF ALUMINIUM ALLOY

Samples taken from the Aluminium alloy ingots/coils/strands shall be chemically/spectrographically analyzed. The same shall be in conformity to the requirements stated in this Specification.

1.4 VISUAL AND DIMENSIONAL CHECK ON DRUMS

The drums shall be visually and dimensionally checked to ensure that they conform to the requirements of this Specification.

1.5 VISUAL CHECK FOR JOINTS, SCRATCHES ETC.

Conductor drums shall be rewound in the presence of the Owner. The Owner shall visually check for scratches, joints etc. and that the conductor generally conforms to the requirements of this Specification. **Two percent (2%)** drums from each lot shall be rewound in the presence of the Owner's representative.

1.6 DIMENSIONAL CHECK ON ALUMINUM ALLOY STRANDS

The individual strands shall be dimensionally checked to ensure that they conform to the requirement of this Specification.

1.7 CHECK FOR LAY-RATIOS OF VARIOUS LAYERS

The lay-ratios of various layers shall be checked to ensure that they conform to the requirements of this Specification.

1.8 TORSION AND ELONGATION TESTS ON ALUMINUM ALLOY STRANDS

The test procedures shall be as per clause No. 10.3 of IEC : 888. In torsion test, the number of complete twists before fracture shall not be less than 18 on a length equal to 100 times the standard diameter of the strand. In case test sample length is less or more than 100 times the stranded diameter of the strand, the minimum number of twists will be proportioned to the length and if number comes in the fraction then it will be rounded off to next higher whole number. In elongation test, the elongation of the strand shall not be less than 4% for a gauge length of 250 mm.

1.9 CHECK ON BARREL BATTEN STRENGTH OF DRUMS

The details regarding barrel batten strength test will be discussed and mutually agreed to by the Contractor & Owner in the Quality Assurance Programme.

1.10 Breaking Load Test on Individual Aluminium Alloy Wires

The test shall be conducted on Aluminum alloy wires. The breaking load of one specimen cut from each of the samples taken shall be determined by means of suitable tensile testing machine. The load shall be applied gradually **Si** the jaws of the testing machine shall be not less than 25 mm/min. and not greater than 100 mm./ min. The ultimate breaking load of the specimens shall be not less than the values specified in the Specification.

1.11 RESISTANCE TEST ON ALUMINUM ALLOY WIRE

The test shall be conducted on aluminium alloy wires only, conforming to procedure as per IEC: 889. The electrical resistance of one specimen of aluminium wire cut from each of the samples taken shall be measured at ambient temperature. The measured resistance shall be corrected to the value corresponding to 20 degree C. by means of following formula.

$$R_{20} = R_T \frac{1}{1+\text{alpha} \times (T-20)}$$

Where

R20 = Resistance corrected at 20 degrees C.

RT = Resistance measured at T degrees C.
alpha = Constant mass temperature coefficient of resistance 0.004.
T = Ambient temperature during measurement
This resistance calculated to 20 degrees C. shall be not more than the maximum value specified in the specification.

Table-1

Details of parameters of AAA conductor

S.N.	Parameter	Squirrel	Weasel	Rabbit	Raccon	DOG	wolf	Panther
1	Total sectional area of conductor (sqmm)	22	34	55	80	100	173	232
2	(No of Al strand/dia in mm)	7/2.00	7/2.50	7/3.15	7/3.81	7/4.26	19/3.40	19/3.94
3	Overall diameter (mm)	6	7.5	9.45	11.43	12.78	17	19.7
4	approx mass (kg/km)	60.16	94	149.2	218.26	272.86	474.02	636.67
5	Resistance at 20 deg cel (ohms/km)	1.541	0.99	0.621	0.425	0.339	0.1969	0.1471
6	approx calculated breaking load (kN)	6.45	10.11	16.03	23.41	29.26	50.54	68.05
7	Final modulus of Elasticity, GN/sqm (kg/sq cm)	0.6324 x 10 (pwr 6)	0.6324 x 10	0.6324 x 10	0.6324 x 10	0.6324 x 10	0.612x10	0.612x10
8	Coefficient of linear Expansion/°C	23.0 X10 (pwr -6)	23.0 X10	23.0 X10	23.0 X10	23.0 X10	23.0 X10	23.0 X10
9	Details of Aluminium							

S.N.	Parameter	Squirrel	Weasel	Rabbit	Raccon	DOG	wolf	Panther
	Strands							
a	Minimum breaking load of the strand before stranding (kN)	0.97	1.52	2.41	3.52	4.4	2.8	3.77
b	Minimum breaking load of the strand after stranding (kN)	0.92	1.44	2.29	3.34	4.18	2.66	3.58
c	Maximum DC resistance of strands at 20 deg C (ohms/km)	10.653	6.845	4.29	2.938	2.345	3.677	2.746
d	Mass (kg/km)	8.482	13.25	21.04	30.78	30.48	24.51	32.92
e	Diameter							
i	Nominal	2.0	2.50	3.15	3.81	4.26	3.40	3.94
ii	Maximum	2.02	2.53	3.18	3.85	4.30	3.43	3.98
iii	Minimum	1.98	2.47	3.12	3.77	4.22	3.37	3.90

AERIAL BUNCHED CABLES FOR 33kV LINES

SCOPE:

This specification covers requirements of XLPE insulated, 33 kV Aerial Bunched Cables for overhead lines.

1. Qualifying Requirement of AB Cable Manufacturer/Supplier

2. The manufacturer should have manufactured, successfully type tested and supplied at least one hundred (100) kms of 33 kV or above voltage grade XLPE armoured and/or AB Cable in the last five (5) years as on the date of bid opening.

2. **COMPOSITION OF THE CABLE**

The Composite cable shall comprise three single-core cables twisted around a bare aluminium alloy messenger wire, which will carry the weight of the cable.

3. **RATED VOLTAGE**

The rated voltage of the cables shall be 33 kV and the maximum operating voltage shall be 36 kV.

4. **APPLICABLE STANDARDS**

Unless otherwise stipulated in this Specification, the following standards shall be applicable:

i) IS: 7098 (part-II) – 1985 – Cross linked Polyethylene Insulated PVC Sheathed Cables.
ii) IS:9130-1984-Conductors for Insulated Cables
iii) IS: 398 (Part-IV) – 1979 – Aluminium Alloy Conductors.

5. **DETAILS OF SINGLE CORE CABLE**

5.1 The cable conductors shall be or round standard and compacted aluminium, of nominal cross sectional area 95 mm2.

5.2 **Conductor Screen**

The conductor screen shall be of extruded semi-conducting cross linked polyethylene compound of thickness as per relevant IS.

5.3 **Insulation**

The Insulation shall be of extruded cross linked polyethylene (XLPE) of nominal insulation thickness as per relevant IS and its properties shall conform to IS:7098 (Part-II).

5.4 **Insulation Screen**

The insulation screen shall comprise extruded semi-conducting compound and/or semi-conducting tape.

5.5 **Metallic Screen**

The metallic screen shall consist of aluminium tape/sheath.

5.6 **Outer Sheath**

The outer sheath shall be black polyethylene.

6. **MESSENGER (NEUTRAL CONDUCTOR)**

6.1 The bare messenger wire shall be of 120 mm2 (nominal area) aluminium alloy, generally conforming to IS:398 (Part IV) – 1979, comprising multi strands and shall be suitably compacted to have smooth round surface to avoid damage to the outer insulating sheath of single-core phase cables twisted around the messenger.

6.2 There shall be no joints in any wire of the stranded messenger conductor except those made in the base rod or wire before finally drawing.

7. **TESTS**

7.1 The following tests shall be carried out on the single-core cables as per IS-7098 (Part-II).

7.1.1 Type Tests

a) Tests on conductor:

i) Tensile test

ii) Wrapping test

iii) Resistance test

b) Tests for thickness of insulation and sheath

c) Physical tests for insulation:

i) Tensile strength and elongation at break

ii) Agency in air oven

iii) Hot test
iv) Shrinkage test
v) Water absorption

d) Tests for outer sheath:

i) Tensile strength and elongation at break

ii) Ageing in air oven

iii) Shrinkage test
iv) Hot deformation
v) Bleeding and blooming test.

e) Partial discharge test
f) Bending test
g) Dielectric Power factor test:
i) As a function of voltage
ii) As a function of temperature
h) Insulation resistance test
g) Heating cycle test
k) High voltage test
l) Flammability test

7.1.2 Acceptance Test

a) Tensile Test

b) Wrapping Test

c) Conductor resistance test

d) Test for thickness of insulation and sheath

e) Hot set test for insulation

f) Tensile strength and elongation at break test for insulation and sheath

g) Partial discharge test

h) High voltage test

i) Insulation resistance (volume resistivity) test

7.1.3 Routine Tests

a) Conductor resistance test

b) Partial Discharge Test

c) High voltage test

7.2 The following tests shall be carried out on the bare messenger wire in accordance with IS:398 (Part-IV).

Type Tests/Acceptance Test

a) Breaking Load Test (on finished wire
b) Elongation Test
c) Resistance Test

8. PACKING AND MARKING

8.1 Packing

Cables shall be supplied in returnable wooden drums conforming to IS: 10418. The standard length of the bunched cable in each drum shall be 250 meters (+/-) 10%. Other lengths may be acceptable subject to the approval of employer/purchaser.

8.2 Marketing

The Cable drum shall carry the information as per the requirements of IS: 7098 (Part-II).

8.3 Suitable identification marks shall be given on the outer sheath to clearly distinguish three phases of the bunched cable.

AERIAL BUNCHED CABLES FOR 11kV LINES

SCOPE : This specification covers requirements of XLPE insulated, 11kV Aerial Bunched Cables for overhead lines.

1.0 Qualifying Requirement of AB Cable Manufacturer/Supplier

The manufacturer should have manufactured, successfully type tested and supplied at least one hundred (100) kms of 11k V or above voltage grade XLPE armoured and/or AB cable in the last five (5) years as on the date of bid opening.

2. **COMPOSITION OF THE CABLE**

The composite cable shall compose three single-core cables twisted around a bare aluminium alloy messenger wire, which will carry the weight of the cable.

3. **RATED VOLTAGE**

The rated voltage of the cables shall be 6.35 kV/11kV and the maximum operating voltage shall be 12 kV

4. **APPLICABLE STANDARDS**

Unless otherwise stipulated in this specification, the following standards shall be applicable:

i) IS:7098 (part-II) – 1985 – Cross linked Polyethylene Insulated PVC Sheathed Cables
ii) IS:8130-1984-Conductors for Insulated Cables
iii) IS:398 (Part-IV) – 1979 – Aluminium Alloy Conductors

5. **DETAILS OF SINGLE CORE CABLE**

5.1 The cable conductors shall be of round, stranded and compacted aluminium of nominal cross sectional area 35 mm2 and 70 mm2. Corresponding nominal conductor diameter and number of wires in the conductor shall be as given in clause 5.7.

5.2 **Conductor Screen**

The conductors screen shall be of extruded semi-conducting cross linked polyethylene compound of thickness not less than 0.5 mm.

5.3 **Insulation**

The Insulation shall be of extruded cross linked polyethylene (XLPE) or nominal insulation thickness 3.6 mm and its properties shall conform to IS:7098 (Part II).

5.4 **Insulation screen**

The Insulation screed shall comprise extruded semi-conducting compound and/or semi-conducting tape. Thickness of the screen shall be not less than 0.6 mm.

5.5 **Metallic Screen**

The metallic screen shall consist of aluminium tape/sheath of thickness not less than 0.2 mm.

5.6 **Outer Sheath**

The outer sheath shall be black polyethylene. The nominal thickness of sheath shall be 1.8mm and it shall conform to the technical requirements of ST-3 of EIC-502

5.7 **Dimensional and Electrical Data**

The Dimensional and Electrical Data for single –core cable is given below:

S.No.	Description	Nominal are of conductors	
		35 mm^2	70mm^2
I.	Nominal conductor diameter(mm)/No. of wires in conductor	6.8/6	10/12
II.	Approx over dia of cable (mm)	22	25
III.	Max D.C. resistance at 20^0c Ohm/Km	0868	.443
IV.	Max SC current for 1 Sec. KA	3.4	6.7
V.	Max continuous load (amps)	106	156

Note: Due to limitation of short circuit current rating, it is recommended that 70mm^2 cable is used the base line for the first 4-5kms from the 33/11kV substation and thereafter the lower size of cable i.e. 35mm^2 can be used depending upon the line loading .Normally the current loading of 70mm^2 cable should not exceed 145amps and that of 35mm2 cable as 95 amps .For a maximum ambient temperature of 50^0C.

6. **MESSENGER (NEUTRAL CONDUCTOR)**

6.1 The bare messenger wire shall be of 70 mm2 (nominal area) aluminium alloy, generally conforming to IS:398 (Part IV) – 1979, comprising of seven(7) strands and shall be suitably compacted to have smooth round surface to avoid damage to the outer insulating sheath of single-core phase cables twisted around the messenger.

6.2 There shall be no joints in any wire of the stranded messenger conductor except those made in the base rod or wire before finally drawing.

6.3 The technical characteristics of messenger wire shall be as follows:

i.	Nominal sectional area(mm^2)	70
ii.	Nos. of wire	7
iii.	Nominal dia of wires /compacted conductor (approx.)mm	3.5/10
iv.	Approx. Mass kg/Km	184
v.	D.C resistance at 20^oC Ohm/Km	0.493
vi.	Breaking load(KN)	20
vii.	Modulus of elasticity (approx) KN/mm^2	59
viii.	Coefficient of linear expansion	$23X10^{-6}$oC

Note: the value of item v above is to be guaranteed. A tolerance of (-) 5% is permissible on the value in item vi above.

7. **DESIGNATION AND PARAMETER OF FINISHED CABLES**

The designation and parameter of finished cables are given in the following table:

S.No.	Designation	Complete bunched cables	
		Overall dia approx mm	Total mass(Approx.)Kg/Km
I.	3 x 35+70	53	1450
II.	3 x 70+70	59	1900

Note: the first part of the designation refers to the number and size of phase conductor and the second to the size of messenger wire .The sizes shown represent the nominal cross sectional area in mm.

8. TESTS

8.1 The following tests shall be carried out on the single-core cables as per IS-7098 (Part-II).

8.1.1 **Type Tests**

a) Tests on conductor:

i) Tensile test

ii) Wrapping test

iii) Resistance test

b) Tests for thickness of insulation and sheath

c) Physical tests for insulation:

i) Tensile strength and elongation at break

ii) Agency in air oven

iii) Hot test
iv) Shrinkage test
v) Water absorption

d) Tests for outer sheath:

i) Tensile strength and elongation at break

ii) Ageing in air oven

iii) Shrinkage test
vi) Hot deformation
vii) Bleeding and blooming test.
e) Partial discharge test
f) Bending test
g) Dielectric Power factor test:
i) As a function of voltage
ii) As a function of temperature
h) Insulation resistance test
g) Heating cycle test
k) High voltage test
l) Flammability test

8.1.2 **Acceptance Test**

a) Tensile Test

b) Wrapping Test

c) Conductor resistance test

d) Test for thickness of insulation and sheath

e) Hot set test for insulation

f) Tensile strength and elongation at break test for insulation and sheath

g) Partial discharge test

h) High voltage test

i) Insulation resistance (volume resistivity) test

8.1.3 **Routine Tests**

a) Conductor resistance test

b) Partial Discharge Test

c) High voltage test

8.2 **The following tests shall be carried out on the bare messenger wire in accordance with IS:398 (Part-IV).**

Type Tests/Acceptance Test

d) Breaking Load Test (on finished wire
e) Elongation Test
f) Resistance Test

9. **PACKING AND MARKING**

9.1 **Packing**

Cables shall be supplied in returnable wooden drums conforming to IS: 10418. The standard length of the bunched cable in each drum shall be 1000 meters (+/-) 10%. Other lengths may be acceptable subject to the approval of employer/purchaser.

9.2 **Marketing**

The Cable drum shall carry the information as per the requirements of IS: 7098 (Part-II).

9.3 Suitable identification marks shall be given on the outer sheath to clearly distinguish t hree phases of the bunched cable.

XLPE Power Cables (11kV & 33 kV)

SECTION I

STANDARD TECHNICAL REQUIREMENT

1.0 SCOPE:

This section covers the standard technical requirements of design, manufacturing, testing, packing and dispatching of 11 kV and 33 kV XLPE HT Power Cable.

2.0 APPLICABLE STANDARDS

The materials shall conform to the latest editions of the following Indian/International Standards :

IS 7098 Part 2 : 1985 XLPE insulated PVC sheathed cables For working voltages from 3.3 kV up to and including 33 kV

IS 5831 : 1984 PVC Insulation and Sheath of electric Cables

IS 8130:1984 Conductors for insulated electric cables and flexible cords. IS 613:1984 Copper rods and bars for electrical purposes.

IS 3975:1988 Mild steel wires, formed and tapes for armouring of cable. IS 10810:1984 Method of tests for cables.

IEEE-383:1974 Standard for type test of class IE electric cables, field splices, and connections for nuclear power generating stations.

ASTM-D2843,1993 Standard test method for density of smoke from burning or decomposition of plastics.

ASTM-D2863, 1991 Standard test method for measuring minimum oxygen concentration to support candle - like combustion of plastics (oxygen index).

NEMA-WC5,1992 Thermoplastic Insulated Wire and cable for the transmission and distribution of Electrical Energy.

IEC:754 Test on gases evolved during combustion of electric cables -

(Part-1):1994 Determination of the amount of halogen acid gas evolved during combustion of polymeric materials taken from cables.

IEC:332 Test on electric cables under fire conditions

(Part I):1993 Test on a single vertical insulated wire or cable. IS 3961 Recommended current rating for cables -

(Part II):1967 PVC insulated and PVC sheathed heavy duty cables.

IS 10418:1982 Drums for electric cables.

3.0 GENERAL REQUIREMENTS

All cables shall be suitable for high ambient, high humid tropical Indian Climatic conditions. Cables shall be designed to withstand the mechanical, electrical and thermal stresses under the unforeseen steady state and transient conditions and shall be suitable for proposed method of installation.

Conductor shall be of uniform, of good quality, free from defects Aluminium copper.

Insulation shall be Cross Linked Polyethylene (XLPE) .

For 33 kV and 11 kV cables, conductor screen and insulation screen shall both be extruded, semi-conducting compound and shall be applied along-with XLPE insulation in a single operation by triple extrusion process. Method of curing for 33 kV cable shall be "Dry curing/ gas curing " only, whereas for 11 kV and 3.3 kV cables it shall be "Dry curing/ gas curing / Steam curing".

Extruded Semi-conducting screening and metallic screening of copper tape shall be generally as per IS 7098 (Part-II) with latest amendments. The semi conducting compound shall be suitable for the operating temperature of the cable and compatible with the insulating material.

The insulation screen shall be an extruded layer of black semi-conducting compound and continuously covers the whole area of insulation. The semi-conducting screens should be effectively cross linked to achieve 90 ◦ C cable rating. The contact surface between insulation and insulation screen shall be smooth and free from protrusion and irregularities.

The interface between insulation and insulation screen shall be free of any voids. Insulation screen shall be strippable type.

The metallic screen shall consist of a layer of copper cable applied in helical form.

Inner sheath - All armoured and multi-core un-armoured cables shall have distinct extruded inner PVC sheath of black colour.

Armouring - Material for armour for Single Core Cable shall be Aluminum wire. For Multicore cable it shall be GS wire / flat.

Armouring shall be as per relevant IS and it shall have minimum 90% coverage.

Breaking Load of the joints shall be minimum 95% of the normal armour.

Outer Sheath – It shall be of black colour PVC (type ST2 as per IS 5831) with Cable size and Voltage grade embossed on it. Sequential marking shall be at every 1 (one) Meter distance. Word "FRLS" shall also be embossed on it at every 5 (Five) meter distance.

FRLS Properties - All cable shall be Flame Retardant, Low Smoke (FRLS) type. Outer sheath shall have the following properties –

Acid Gas Generation – Max 20% (as per IEC 754-1)

Smoke density rating: 60% (As per ASTMD 2843)

Flammability test - As per Swedish chimney test F3 as per SEN 4241475

As per IEC 332 part-3 (Category B)

Minimum bending radius shall be 10 D

Repaired cables shall not be acceptable.

4.0 CURRENT RATING OF CABLES

1) Normal current rating shall not be less than that covered by IS 3961. Vendor shall submit data in respect of all cables in the prescribed format.

2) Tables given de-rating factors for various conditions of cable installation including the following, for all types of cables shall be furnished.

- Variation in ambient air temperature. - Variation in ground temperature.
- Depth of laying.
- Cables laid in the ground - Cables laid in trench
- Cables laid in ducts - Soil resistivity.
- Grouping of cables.

3) The value of short circuit withstand current ratings of all cables shall be indicated for a short circuit for 1 second duration and should also specify the maximum temperature during short circuit.

4) The following factors shall also be accounted for, while specifying the maximum short circuit withstand of the cables.

5) Deformation of the insulation, due to thermo-mechanical forces produced by the short circuit conditions, can reduce the effective thickness of insulation.

6) Conductor and core screens can be adversely affected with loss of screening effect. Likewise the thermal properties of the outer sheath material can be the limitation.

7) It is essential that the accessories which are used in the cable system with mechanical and/or soldered connections are suitable for the temperature adopted for the cables.

8) Formula for calculating short circuit current for different duration or curve showing short time current v/s time for different sizes of cables shall be furnished by vendor.

5.0 CABLE DRUMS

5.1 Cables shall be supplied in non-returnable wooden or steel drums of heavy construction and drum shall be properly seasoned, sound and free from defects. Wood preservative shall be applied to the entire drum.

5.2 All Power Cables shall be supplied in drum length of 1000 m. Each drum shall contain one continuous length of cable. Owner shall have the option of rejecting cable drums with shorter lengths. The cable length per drum is allowed a tolerance of ±5%. The tolerance allowed on total quantity of each size is as given below.

3.1 50 meters for cable length upto 10 kms.
3.2 100 meters for cable length more than 10 kms. and up to 20 kms.
3.3 150 meters for cable length more than 20 kms.

Where the ordered quantity is not multiple of 1000 m and the incremental quantity is very small, the same may be included in one of the drums. Otherwise, an additional length for the incremental quantity will be supplied.

5.3 A layer of water proof paper shall be applied to the surface of the drums and over the outer most cable layer.

5.4 A clear space of at least 40mm shall be left between the cables and the logging.

5.5 Each drum shall carry manufacturer's name, purchaser's name, address and contract number, item number and type, size and length of the cable, net and gross weight stenciled on both sides of drum. A tag containing the same information shall be attached to the leading end of the cable. An arrow and suitable accompanying wordings shall be marked on one end of the reel indicating the direction in which it

should be rolled.

5.6 Packing shall be sturdy and adequate to protect the cables, from any injury due to mishandling or other conditions encountered during transportation, handling and storage. Both cable ends shall be sealed with PVC/Rubber caps so as to eliminate ingress of water during transportation and erection.

6.0 TESTS

6.1 Type Tests

The following shall constitute type tests:

i) Tests on conductor

   a. Annealing test (for copper)
   b. Tensile tests (for aluminium)
   c. Wrapping tests (for aluminium)
   d. Resistance test

ii) Tests for armouring wires/strips

iii) Test for thickness of insulation and sheath

iv) Physical tests for insulation

   a. Tensile strength and elongation at break
   b. Ageing in air oven
   c. Hot test
   d. Shrinkage test
   e. Water absorption (gravimetric)

v) Physical tests for out sheath

   a. Tensile strength and elongation at break
   b. Ageing in air oven
   c. Hot test
   d. Shrinkage test

vi) Bleeding and blooming tests (for outer sheath)

vii) Partial discharge test

viii) Bending test

ix) Dielectric power factor test

   a. As a function of voltage

b. As a function of temperature

x) Insulation resistance (volume receptivity) tests

xi) Heating cycle test

xii) Impulse withstand test

xiii) High voltage test

xiv) Flammability test

6.2 Acceptance tests

The following shall constitute acceptance tests:

a. Annealing test (for copper)

b. Tensile test (for aluminium)

c. Wrapping tests (for aluminium)

d. Conductor resistance test,

e. Test for thickness of insulation

f. Hot set test for insulation,

g. Tensile strength and elongation at break test for insulation and sheath

h. Partial discharge test (for screened cables only)

i. High voltage test and

j. Insulation resistance (volume resistively) test

6.3 Routine test

The following shall constitute routine tests:

i) Conductor resistance test
ii) Partial discharge test (for screened cables only) and
iii) High voltage tests.

6.4 Optional tests

Cold impact tests for outer sheath (IS:5831-1984) shall constitute the optional tests.

SECTION II

SPECIFIC TECHNICAL REQUIREMENTS AND QUANTITIES.

1.0 SCOPE

This section of the specification covers project information, site condition, desired Technical parameters and quantity of XLPE Cable.

1.1 Project Information

a. Customer :
b. Engineer/Consultant :
c. Project Location :
d. Transport facilities
   i) Nearest Railway station : /Gauge
   ii) Distance from site :
e. Access Roads :

1.2 SITE CONDITIONS

(i) Ambient air temp. (max.) °C :
(ii) Ambient air temp. (min.) °C :
(iii) Design ambient temp. °C :

1.2.1 Relative humidity for design : purposes
1.2.2 Height above mean sea level in : meters
1.2.3 Earth quake data

i) Seismic zone : IS:1893-84
ii) Seismic acceleration : As per IS 2.2.4

1.2.4 Wind data
Site Wind Pressure Kgf/m^2 : As per IS 2.3

1.3 System Particulars

a.	Line Voltage (kV)	11/33
b.	Highest System Voltage (kV)	12/36
c.	Number of Circuits	1
d.	Frequency	HZ50
e.	Neutral	effectively earthed

f.	Short circuit level (KA)	22.77 KA, 31.8KA / 22.5KA,45KA

1.4 **SPECIFIC TECHNICAL REQUIREMNTS**

Technical Parameters of the cable shall be as follows:

S. No.	PARTICULAR	Unit	DATA	DATA
1	Rated Voltage	kV	6.35/11	19.0/33
2	Type of Insulation	-	XLPE	XLPE
3	Single core/ Multi core	-	Single/Three core	Single/Three core
4	Armoured / Unarmoured	-	Armoured	Armoured
5	Material of Conductor	-	Aluminium/Copper	Aluminium/Copper
6	System	-	11 kV Earthed	33 kV Earthed
7	Highest System Voltage	kV	12	36
8	Conductor size	sq. mm	120, 150, 185, 240, 300	150, 185, 240, 300, 400
9	Material		Stranded Aluminium/copper	Stranded Aluminium/copper
10	Shape of Conductor		Circular	Circular
11	Short Circuit Current	kA	13.12 , 18.35 for 3 secs.	13.12, 26.24 for 3 secs
12	Power Frequency Withstand Voltage	KV rms	28	70
13	Lightning Impulse Withstand Voltage	kVp	75	170
14	Continuous Withstand Temperature	Deg C	90	90
15	Short Circuit withstand Temperature	Deg C	250	250
16	Oxygen Index		Min 29 (as per ASTMD 2863)	Min 29 (as per ASTMD 2863)
17	Acid Gas Generation		Max 20% (as per IEC 754-1)	Max 20% (as per IEC 754-1)
18.	Smoke Density		60% (As per ASTMD	60% (As per

	Generation		2843)	ASTMD 2843)
19.	Flammability Test		As per Swedish Chimney test	As per Swedish Chimney test

SECTION-III
GUARANTEED TECHNICAL PARTICULARS

Sl. No.	Item Particulars	Unit
1	Manufacturers Name & Address	
2	Country of manufacturer	
3	Type of cable	
4	Applicable standards for manufacturing	
5	Applicable standards for testing	
6	Rated voltage	kV
7	Maximum service voltage	kV
8	Maximum continuous current carrying capacity per cable when lain in air at an ambient air temperature of 50 deg. (single core cables solid bonded)	A
9	Maximum continuous current carrying capacity per cale when lain in ground at a depth of 1.0 m (ground temp. 40 deg. C and soil thermal resistivity of 150 deg.c/watt/cm max. Conductor temp. 90 deg. C) (single core cables solid bonded)	A
10	Maximum continuous current carrying capacity per cable when drawing into duct./pipes (single core cables solid bonded)	A
11	Maximum continuous current carrying capacity per cable when lain in covered RCC trenches at an ambient temperature of 50 Deg. C laying conditions to be specified (Single core cables solid bonded)	A
12	Short circuit withstand capacities for 1 second of (With a conductor temperature of 90 Deg. C at the commencement	
i)	Conductor	KA
ii)	Screen	KA
iii)	Armour	KA
13	Conductor	
i)	Material & Grade	
ii)	Nominal cross – sectional area	sq.mm
iii)	No. of strands	
iv)	Diameter of each strand (Nominal)	mm
v)	Max. DC resistance of conductor at 20 Deg. C	ohm/km
vi)	Max. AC resistance of conductor at 90 Deg. C	ohm/km
14	Reactance of cable at normal frequency (Approx)	ohm/km
15	Electrostatic capacitance at normal frequency	mircorfarads

		per km
16	Charging current	
17	Loss tangent at normal frequency at Uo	
18	Conductor screen	
i)	Material	
ii)	Nominal thickness	mm
19	XLPE Insulation	
i)	Composition	
ii)	Type of curing	
iii)	Thickness of insulation (nominal)	mm
iv)	Tolerance on thickness	mm
v)	Dielectric constant at normal frequency	
vi)	Specific insulation resistance at 20 deg. C	ohm/km
vii)	Min. Volume resistivity at 20 deg. C	
viii)	Min. volume resistivity at 90 deg. C	
ix)	Min. Tensile strength	kg/sq.cm
x)	Min. Elongation percentage at rapture	%
xi)	Identification of cores	
20	1.2/50 microsecond impulse wave withstand voltage	kVp
21	5 min. power frequency withstand voltage	kV
22	Max. Dielectric stress at the conductor	kV/cm
23	Max. Dielectric stress at the conductor screen	kV/cm
24	Insulation screen	
i)	Material	
ii)	Extruded/wrapped	
iii)	Nominal thickness	mm
iv)	Colour	
25	Metallic screen	
i)	Material / composition	
ii)	Nominal radial thickness / dia	
26	Nominal diameter over metallic screen	mm
27	Nominal radial clearance allowed under metal sheath	mm
28	Type and material of filler	
29	Armour	
i)	Material and type	
ii)	Dia	

ENERGY METER

1.1 GENERAL

This Chapter describes the common requirement for static energy meter required for HT feeder, 3-Phase Distribution Transformer, 1-Phase Distribution Transformer, Single Phase whole current meter.

Necessary software for downloading the data through CMRI and uploading to computer shall be provided. No cost shall be charged for providing the software by the manufacturer to Owner.

The seals & sealing specifications are given in *Annexure A*

All meter shall have BIS certification mark. Valid BIS license must be submitted along with the bid.

1.2 STANDARDS APPLICABLE

Unless otherwise specified elsewhere in this specification, the performance & testing of the meters shall conform to the following Indian/International standards with updated and latest amendments/revisions thereof.

Sl.No.	Standard No.	Title
1.	IS 14697-1999	AC Static Watt-hour Meters for active energy Class0.5 & 0.2
2.	IS 12063	Specification for degree of protection
3.	IS 14772	Specification for boxes for enclosure of electrical accessories
4.	IS 13779/1999	AC Static Watthour Meters for active energy Class 1.0 & 2.0
5.	CBIP Report No.-325	Specification for AC Static Electrical Energy Meters
6.	CBIP Technical Report No. 111	Specification for common meter reading instrument
7.	IS:9000	Basic environment testing procedure for electric and electronic item
8.	IS:15959 with latest amendment	Data Exchange for Electricity Meter Reading, tariff & load control – Companion Specification

1.3 CLIMATIC CONDITION

The meter should be able to perform satisfactorily in moderately hot and humid climate, conducive to rust and fungus growth as specified in Section-I. The climate conditions are also prone to wide variations in the ambient conditions. The meter shall work satisfactorily even under lightning conditions and also the meter performance and life shall not be affected due to smoke present in the atmosphere.

* The specifications are applicable for meter installation upto an altitude of 2200 meter above mean sea level. For meters to be used for an altitude of above 2200 MSL necessary corrections shall have to be carried out in BIL and one minute power frequency with stand voltage capability as per relevant standard.

1.4 SUPPLY SYSTEM

Type of meter	Input Voltage	Input Current	Burden	Type /Phase	Starting Current	Accuracy
HT Feeder meter	3 x 110 volt phase to phase	1A / 5A	1.5 Watts/phase or 10 VA/phase for voltage circuit and 1 VA phase for each current circuit	3 phase 4 wire	0.1 % of basic	0.5
3-phase DT meter	415±20% phase to phase	5A	1.5 Watts/phase or 10 VA/phase for voltage circuit and 1 VA phase for each current circuit	3 phase 4 wire	0.1 % of basic	0.5
1-phase DT meter	240+20% -30% phase to neutral	5A	1.5 Watts/phase or 10 VA/phase for voltage circuit and 1 VA phase for each current circuit	1 phase 2 wire	0.1 % of basic	0.5
1-phase consumer meter	240 V Phase to neutral	5-30A, 10-60A	1.5 Watts/phase or 8 VA/phase for voltage circuit and 4 VA phase for each current circuit	1 phase 2 wire	0.4 % of basic	1.0
3-phase consumer meter	3x 240 V Phase to neutral	10-60A	1.5 Watts/phase or 8 VA/phase for voltage circuit and 4 VA phase for each current circuit	3 phase 4 wire	0.4 % of basic	1.0

1.5 POWER FACTOR RANGE

The meter shall be suitable for full power factor range from Zero (lag) to Unity to Zero (lead).

1.6 POWER SUPPLY VARIATION

Energy meter along with its accessories shall withstand following extreme operating conditions.

Voltage : 70% to 120 % of V ref

Frequency : 50 ± 5% Hz

The manufacturer can also offer meters, which can withstand higher variations.

1.7 MAXIMUM CONTINUOUS CURRENT

The maximum continuous current in meters shall be the current at which the meter purports to meet the accuracy requirement of the specification.

1.8 CALLIBERATION

The meter should be only factory calibrated and no modification of calibration should be possible at site to ensure non tampering of meter at site.

1.9 COMMUNICATION CAPABILITY

The Meter shall be provided with a galvanically isolated optical communication port and communication capability as per IS 15959, so that it can be easily connected to a CMRI for data transfer.

1.10 NAME-PLATE MARKING OF THE METER

The marking on every meter shall be in accordance with relevant clauses of standard.Every meter shall have name plate beneath the meter cover such that the name plate cannot be accessed without opening the meter cover and without breaking the seals of the meter cover and the name plate shall be marked distinctly and indelibly. The basic marking on the meter nameplate shall be as follows:

a) –DDUGJY/IPDS
b) Manufacturer's name & trade mark
c) Type Designation
d) No. of phases & wires
e) Serial number
f) Month and Year of manufacture
g) Reference Voltage
h) Rated secondary Current of CT, if applicable
i) Reference Standard as applicable
j) Principal unit(s) of measurement
k) Meter Constant
l) Class index of meter
m) Property of <Name of owner>
n) Purchase Order No. & Date
o) Guarantee period

1.11 CALIBRATION AND TEST OUTPUT

The meter should have test output accessible from the front and be capable of being monitored with suitable testing equipment. The operation indicator must be visible from the front. Test output device shall be provided in the form of one common/separate LED for KWh and KVARh as applicable with provision of selecting the parameter being tested. The test output device should have constant pulse rate in terms of pulse/unit energy.

The meter shall be tested, calibrated and sealed at works before dispatch. Further, no modification or calibration shall be possible at site by any means.

The resolution of the test output shall be sufficient to enable the static current test in less than 10 minutes.

1.12 GUARANTEE

Manufacturer shall undertake a guarantee to replace the meters upto a period of 24 months from the date of installation or 36 months from date of supply, whichever is earlier. The meters, which are found defective/inoperative at the time of installation, or became inoperative/defective within the guarantee period shall be replaced by manufacturer within two months from receipt of report for such defective/inoperative meters.

2.0 3 PHASE 4 WIRE 0.5 CLASS ENERGY METER FOR FEEDER

2.1 GENERAL & CONSTRUCTIONAL REQUIREMENTS

2.1.1 Meters shall be designed and constructed in such a way so as to avoid causing any danger during use and under normal conditions. However, the following should be ensured.

a) Personal safety against electric shock

b) Personal safety against effects of excessive temperature.

c) Protection against spread of fire

d) Protection against penetration of solid objects, dust & water

e) Detection against fraud

f) Detection against pilferage

2.1.2 The meter shall be designed with latest technology. The meter circuit should be housed in a safe, high grade engineering plastic / polycarbonate casing, which is of projection mounting type and isdust/moisture proof, conforming to IP-51. .

2.1.3 All insulating material used in the construction of meters shall be non-hygroscopic, non-ageing and of tested quality. All parts that are likely to develop corrosion shall be effectively protected against corrosion during operating life by providing suitable protective coating.

2.1.4 The meter shall be supplied with a terminal block cover. The meter base, meter cover, terminal block and shall be made of high grade fire resistant non-flammable reinforced, polycarbonate (not bakelite) or equivalent high grade engineering plastic and have terminal holes with sufficient size to accommodate insulation of the conductors, meeting the requirement of CBIP technical report CBIP325.

2.1.5 The terminal block cover should be separately sealable at two places and housed at the bottom of the meters and once sealed should prevent unauthorized tampering.

2.1.6 The terminal block should have sufficient insulating properties, mechanical strength and should have tin or nickel plated solid brass terminals with two fixing screws per terminal. The terminals should be designed to withstand high overload.

2.1.7 The meter should not get damaged or substantially influenced by the electromagnetic disturbances and electrostatic discharges caused by harmonics, voltage dips and short interruptions, transients, DC and AC magnetic field as per IS 14697

2.1.8 The meter shall have an operation indication device such as a blinking LED. The operation indicator shall be visible from the front of the meter and capable of being monitored conveniently with suitable testing equipment.

2.1.9 The meter shall conform to the degree of protection IP 51 but without suction in the meter as per IS: 12063for protection against ingress of dust, moisture and vermin’s.

2.1.10 The meter-base, meter cover, terminal block and terminal cover shall be made of, high grade, fire resistant, reinforced, non-flammable, polycarbonate or equivalent high grade and good quality engineering plastic.

2.1.11 The meter cover shall have transparent window or shall be transparent for easy reading of all the displayed values/parameters, name plate details and observation of operation indicator.

2.1.12 The terminal block, the terminal cover and the meter case shall ensure reasonable safety against the spread of fire. They should not be ignited by thermic overload of live parts in contact with them.

2.1.13 The meter shall have tin/nickel plated brass terminals. The terminals shall have suitable construction with barriers and cover to provide firm and safe connection of current and voltage leads of stranded copper conductors or copper reducer type terminal ends (thimbles).

2.1.14 The manner of fixing the conductors to the terminal block shall ensure adequate and durable contact such that there is no risk of loosening or undue heating. Screw connections transmitting contact force and screw fixing which may be loosened and tightened several times during the life of the meter shall be such that the risk of corrosion resulting from contact with any other metal part is minimized. Electrical connections shall be so designed that contact pressure is not transmitted through insulating material. The clearance and creepage distance shall conform to relevant clause of IS 14697:1999/CBIP technical report No.325.

2.1.15 The meter shall be compact in design. The entire and construction shall be capable of withstanding stresses likely to occur in actual service and rough handling during transportation. The meter shall be convenient to transport and immune to shock and vibration during transportation and handling.

2.1.16 The meter shall have a design life to operate satisfactory for 10 years under normal electrical condition and guaranteed life of 24months from the date of installation against manufacturing and design defects. The meters found defective with in guaranteed period shall be replaced by manufacturer free of cost within two months of intimation.

2.1.17 The meter shall be provided with accurate quartz crystal based real time clock and calendar with the accuracy limit as per relevant standards. Meter shall have provision to synchronise the meter time with standard time through CMRI with proper security system.

2.1.18 The integration period shall be set as 30 minutes and subsequently can be changedusing CMRI.

2.1.19 Vendor will give one copy of all the software's (meter reading software for CMRI, software for uploading data from CMRI to computer).

2.1.20 It should be possible to check the healthiness of phase voltages by displaying all the voltages on the meter display.

2.1.21 The Meter should have appropriate facilities to be read in absence of Power Supply.

2.1.22 The meter should work accurately irrespective of phase sequence of the mains supply.

2.1.23 The meter should remain powered up and functional even when either any two phases or phase & neutral are available to the meter

2.1.24 The meter shall record forwarded active energy, even if one or more CT"s are reversed. The current vector direction shall always be considered as positive (import) for computation of energy and shall be added in main active energy register.

2.1.25 Data Security: The Meter shall have multilevel password for data protection and security as per IS 15959. The meter data retrieval shall be possible through authenticated CMRI. The meter shall support the event of change of TOD register timings / no. of TOD registers, demand integration period and /or setting the meter time through authenticated transaction and shall be logged as an event. The transaction events shall be available for viewing at BCS end.

2.1.26 The meter data shall be retrievable through CMRI and will be downloaded in the Base computer software for viewing, analysing and printing. The meter data downloaded at BCS end should be in user-friendly formats. The manufacturer shall supply the required software for base computer system. The base computer software shall have the facility to convert the required data (For billing, Energy Audit, tamper analysis purpose) in to xml format. This data should be possible to be used as input data for any other software to generate desired reports as per the utility requirement.

2.1.27 The meter shall have radio interference suppression such that it should not generate noise, which could interfere with the other equipment as per IS 14697.

2.1.28 The meter shall have three fixing holes, one at the top and two at the bottom. The top hole shall be provided at the back of the meter so that holding screw is not accessible to the consumer after fixing the meters. The lower fixing screws shall be provided under the sealed terminal cover. The requisite fixing screws shall be supplied with each meter.

2.2 SEALING OF METER

Reliable sealing arrangement should be provided to make the meter tamper proof and avoid fiddling or tampering by unauthorized persons. For this, at least two no. of seals on meter body, two no. of seals on meter terminal cover and one no. of seal on each communication port shall be provided. All the seals shall be provided in front side only. Please refer Annexure A for specification for sealing system.

2.3 CONNECTION DIAGRAM & TERMINAL MARKINGS

The terminals shall be marked properly on terminal block for giving external connections. A diagram of connections should be provided inside the cover of terminal block. The terminal cover shall be extended such that when it is placed in position it is not possible to approach the connections or connecting wires. The terminals and the screws shall be suitable to carry upto 150% of Imax safely. The terminals shall have suitable construction with barriers and covers to provide secure and safe connections.

2.4 REMOTE READOUT FACILITY, COMMUNICATION CAPABILITY

The meter also shall have a sealable RS-232 / RS-485 communication port conforming to IS 15959 protocol to communicateto central location.

2.5 SOFTWARE

Licensed copies of the software (meter reading software for CMRI, software for downloading/uploading data from CMRI to computer) shall be made available and shall be installed on each common meter reading instrument (CMRI) and Base computer by the manufacturer. *Software shall be provided to owner by the manufacturer free of cost*.

Common Meter Reading Instrument (CMRI) would be loaded with user-friendly software (MS-DOS 5.0 or higher version compatible) for reading, downloading meter data and Time of Day (TOD) programming in the meter.

Windows based *user interactive* Software for receiving data from CMRI and downloading instructions from base computer to CMRI. This software should have, amongst other requirements, features and facilities as described later in this specification, the facility to convert meter reading data into a user definable DBF (Access) or spreadsheet orASCIIformat or any other format for integrating with the Employer's billing system as desired/required by the

utility. Here again an "Export wizard" or similar utility shall be available whereby user can select file format, the variable data to export, the field width selection of each variable so that it may be possible for the user to integrate the same with the user's billing data and process the selected data in desired manner.

The software shall have the flexibility to generate the following sets of reports.

- Load survey reports
- Tamper reports

Tamper reports to include for a pre-determined duration or month wise, tamper count, tamper duration and tamper history for each of the meters.

2.5.1 Vendor will provide soft copy of all the software in CD form along with the meters supplied.

2.5.2 Vendor to install & demonstrate working of software programmes of other meter manufacturers on the CMRI's to be supplied with this package

The specification of CMRI are presented as Annexure B

2.6 DISPLAY

A real time quartz clock shall be used in the meter for maintaining time and calendar date. The maximum drift shall not exceed 5 minutes per year. The uncertainty of setting initial time shall not exceed ± 30 Seconds with respect to Indian standard time (Ref NPL New Delhi).

Facility for adjustment of real time shall be provided through CMRI with proper security.

The meter shall have a minimum 7 digits, 7segment display of liquid crystal display (LCD). The minimum digit height shall be 7 mm. Provision shall be made to read consumption in either whole units or decimal multiples. .

The display shall remain on the screen till operator presses button for subsequent display or 10 sec whichever is earlier.

The meter should have non-volatile memory, so that the registered parameters will not be affected by loss of power. The non-volatile memory should have a minimum retention time of 10 years under unpowered condition.

2.7 DISPLAY SEQUENCE

The meter shall display the required parameters in two different modes as follows:

A. Auto Display Mode

Display test (LCD Segment check)

- Real time & date
- Active energy forwarded
- Reactive energy lag
- Reactive energy lead

- Apparent energy
- Maximum Demand forwarded
- MD occurrence date and time
- MD reset count
- Instantaneous average 3 ϕ PF
- Instantaneous frequency
- Phase voltages R,Y,B
- Phase currents R,Y,B
- Cumulative power on hours of current month

B. Push Button Mode

All above & the following

- Present CT status
- Last occurrence tamper ID
- Date and time of last tamper occurrence
- Last restoration tamper ID
- Date and time of last tamper restoration
- Cumulative tamper count
- TOD Register [Active forwarded energy (8 Nos)]
- TOD Register [Apparent forwarded energy (8 Nos)]
- TOD Register [Apparent forward MD (8 Nos)]□
- Cumulative power on hours

C. Download Parameters with CMRI

All above including following

- Energy registers
- Billing registers
- TOD Registers
- Load survey data
- Tamper and fraud (all event details with date and time)
- History of monthly Energy, Maximum Demand, Average power factor for the last 12 months

2.8 MAXIMUM DEMAND REGISTER

The maximum demand is to be monitored during each demand interval set with 15 / 30 minutes integration and the maximum of these in a month shall be stored. Whenever MD is reset the maximum demand value so registered shall be stored along with date and time. The registered demand and the number of times the MD is reset shall also be displayed and the information stored.

2.9 MAXIMUM DEMAND RESET

Facility for auto reset of MD at 00.00 hrs of first of every month shall be provided for which minimum 30 years calendar shall be programmed by the manufacturer.

The meter shall display the maximum demand reset count.

2.10 LOAD SURVEY CAPABILITY

Load survey shall be available for at least 35 days with 30 minutes load survey integration period for following parameters. Vendor shall provide necessary facility to transfer data through CMRI.

a. kWh forwarded

b. kVAh forwarded

c. kVARh lag/lead

d. Voltage Phase wise

e. Current Phase wise

In addition meter should have facility for daily profile for active and apparent energy.

The load survey data, abnormality event information and instantaneous parameters data shall all be retrievable through the meter's communication port from a common meter reading instrument (CMRI and shall be transferred (downloaded) to a PC with user friendly Windows based software to get complete details in numerical and/or graphic form. The necessary feature shall be available in the software used for uploading data from CMRI to computer and shall be provided by the manufacturer with complete details.

The meter shall have sufficient non-volatile memory for recording history of energy parameters for last twelve billing cycles (Bill date shall be 00 hrs of the 1st date of the calendar month by default – programmable) and information should be made available at the BCS end:

2.11 TIME-OF-DAY (TOD) TARIFF/DEMAND

The meter should have provision of registering the time-of- day energy and maximum demand. It shall be possible to define TOD register for active forwarded, apparent forwarded energy type.

The meter should have in-built capacity to define up to eight (8) time zones through operation of CMRI .The change of the TOD time-period(s) or changing number of TOD zones should be possible through CMRI with special authenticated command from the software used for uploading data from CMRI to computer so that only authorised person(s) can make such changes.

2.12 SELF DIAGNOSTIC FEATURE

2.12.1 The meter shall be capable of performing complete self diagnostic check to monitor the circuits for any malfunctioning to ensure integrity of data memory location at all times. The meter shall have indications for unsatisfactory/nonfunctioning/malfunctioning of the following:

a) Real Time and Date
b) All display segments as per the requirement

2.12.2 While installing the meter, it should be possible to check the correctness of Current and Voltage Transformer connections to the meter and their polarity from the functioning of the meter for different voltage injections with the help of vector/phasor diagrams. For this purpose a suitable software for field diagnosis of meter connections with the help of Meter Reading Instrument should be supplied.

2.13 TAMPER & FRAUD PROTECTION

The meter shall function properly under following common abnormal conditions:

1. Phase sequence reversal	The meter shall keep working accurately irrespective of the phase sequence of the supply.
2. Current reversal/CT polarity reversal	The meter shall log energy in forward direction even if the current is flowing in reverse direction in one or more phases.
3 External magnetic influence	The meter shall comply to influence of external magnetic field (AC Electro Magnet or DC Magnet) as per IS 14697

Beside this the meter should have features to detect the occurrence and restoration of, at least, the following common abnormal events:

i. Missing Potential & Potential imbalance: The meter shall be capable of detecting and recording occurrence and restoration with date and time the cases of Potential failure which could happen due to disconnection of potential leads (one or two), failure of phase line fuse from the Potential Transformer primary side. Meter shall also detect and log cases of voltage unbalance (5% for more than 5 minutes) of voltages.

ii. Voltage High / Voltage Low: In case the average 3 phase voltage remains less (below 0.75Vref by default) than or above (above 1.15Vref by default) for a predefined period (30 minutes by default), the meter shall log such incidences with date & time. This abnormal condition shall be logged only when all the three-phase voltage is available.

iii. Current imbalance: The meter shall be capable of detecting and recording occurrence and restoration with date and time of Current unbalance (30% or more for more than 15 minutes).

iv. Current Circuit Open: The meter shall be capable of detecting and recording occurrences and restoration of opening of any one or two phases of current circuit which can happen due to intentional / accidental disconnection of current circuits. The meter shall be able to log abnormality conditions in current open event like CT leads burns, loose connection, CT winding open etc in the meter memory. No load condition should not be recorded in meter memory as a Current circuit open event.

v. Power on/off: The meter shall be capable to record power on /off events in the meter memory. All potential failure should be recorded as power off event.

The meter shall record the total duration of the above abnormalities, time and date of their occurrences & restorations with a snap shot of electrical conditions viz. Voltage , current ,PF etc

Logic for calculation of voltage and current imbalance shall be furnished by the tenderer.

The meter shall keep records for the minimum last 250 events (occurrence + restoration) for above of abnormal conditions. It shall be possible to retrieve the abnormal event data along-with all related snap- shots' data through the meter's optical port with the help of a CMRI and download the same to the BCS where it shall be available for viewing. All this information shall be made available in simple and easily understandable format.

2.14 TAMPER LOGIC

Properly designed meter event logic should be provided. There shall be separate compartments for logging of potential related event, current related event and power on/off event. The bidder should explain the events details in each compartment under their offer.

The logging of various events in each compartment should be as under:

Once one or more compartments have become full, the last event pertaining to the same compartment will be entered and the earliest (first one)-event should disappear. Thus, in this manner each succeeding event will replace the earliest recorded event, compartment wise. Events of one compartment/category should overwrite the events of their own compartment/category only.

A properly defined meter tamper logic should be provided. The tamper logic should be capable of discriminating the system abnormalities from source side and load side and it should not log/record tamper due to source side abnormalities.

There shall be three separate compartments for logging of different types of tampers as per IS 15959.

2.15 TESTS

Unless specifically waived off all acceptance tests shall be witnessed by the Employer.

2.15.1 Type Test

Energy Meters offered shall be fully type tested as per IS 14697& IS 15959 with latest amendments at any of the NABL accredited test laboratories.

Type test certificate shall not be older than 3 years from the date of bid submission. Bid shall not be accepted without valid type test certificate.

2.15.2 Acceptance Test

Acceptance test shall be carried out as per IS 14697.

2.15.3 Routine Test

All routine tests as specified in IS 14697 shall be carried out on each individual meter.

2.16 OTHER SALIENT FEATURES

2.16.1 It should be possible to check the healthiness of phase voltages by displaying all the voltages on the meter display.

2.16.2 The meter shall have provision of reading through communication port in the absence of power.

2.16.3 The meter should work accurately irrespective of phase sequence of the mains supply.

2.16.4 The meter should remain powered up and functional even when either of the two phases or one phase along with neutral is available to meter.

2.16.5 The meter casing arrangement shall be break to open type.

3.0 Three Phase, Four Wire, 0.5 Class, Energy Meter for 3-Phase Distribution Transformer

3.1 CT REQUIREMENT

The Meter shall be supplied with four nos of C.T's with primary current capacity as required for its intended use. Since the meters are to be used with external CT of suitable ratio please refer CT specification provided separately.

Alternatively meters with Integrated CT complying with IS 13779 for outdoor installation shall be acceptable.

3.2 DISPLAY

The Three phase meters shall be capable to measure &display parameters as given below. The meter should have provision for automatic recording of cumulative kWh at 24 hrs on the last day of the month for each calendar month and same should go to memory.

The digitally measured and processed value shall be displayed through LCD having minimum six digits to read upto one-tenth of kWh. The minimum character height shall not be less than 7 mm.

The Meter should have appropriate facilities to be read in absence of Power Supply.

3.3 AUTO SCROLL DISPLAY

i) Cumulative kWh

ii) Instantaneous Voltages

iii) Instantaneous Currents

iv) CummulativekVah

v) Instantaneous pf phase-wise

vi) Power on hours

3.4 DISPLAY PARAMETERS (PUSH BUTTON)

The display of following parameters shall be continuously scrolling one after another thru Push Button. The scrolling time for each display parameters for minimum of 10 secs..

i) Cumulative active Energy (kWh) for each calendar month for previous Six months.
ii) Cumulative apparent energy (kVAh) for each calendar month for previous Six months
iii) Maximum demand (MD) in apparent for last billing month
iv) Maximum demand (MD) in apparent for current month
v) Tamper Data :
   a) Present status of Tamper
   b) Date & time of last tamper occurrence & tamper identification.
   c) Date & time of last tamper removal.
   d) Cumulative tamper occurrence count.

3.5 LOAD SURVEY CAPABILITY & BILLING POINT REQUIREMENTS

Meter shall have load survey capabilities as per table 28 of IS 15959.

The predefined date and time for registering the billing parameters of kWh, kVAh, PF and kVA MD as well as Tamper Count and Power-On hours readings shall be 00.00 hours of the first day of each calendar (billing) month. All billing parameters shall be transferred to billing registers and shall be displayed on auto cyclic display mode referred to as "BILLING PARAMETERS".

3.6 INTERFACE BETWEEN METER AND CMRI

The interface between a meter and CMRI shall be with a flexible cable of adequate length having suitable female connector. This cable shall be supplied along with meter. **TAMPER &FRAUD PROTECTION**

The meter registration shall be immune to reversal in current direction. The meter shall have following anti-tamper features and shall record forward under the following conditions:

a) Potential failure: The meter shall be capable of detecting and recording occurrences and restoration of potential failure (one phase/two phases) which can happen due to intentional / accidental disconnection of potential leads. The meter should also record event as a potential failure, when one phase line fuse failure from the main side.

b) Current Circuit Bypass: The meter shall be capable of detecting and recording occurrences and restoration of CT circuit bypass.

c) Current Circuit Open: The meter shall be capable of detecting and recording occurrences and restoration of opening of any one or two phases of current circuit which can happen due to intentional / accidental disconnection of current circuits. No load condition should record in meter memory as a Current circuit open event.

d) Current Unbalance: The meter shall be capable of detecting and recording occurrences and restoration of current unbalance as an event. The above information should be possible to download from the meter through hand held unit and available at BCS end. The current unbalance more than 30 % should be recorded as an event in the meter memory.

e) Voltage Unbalance: The meter shall be capable of detecting and recording occurrences and restoration of voltage unbalance as an event. The voltage unbalance more than 30 % should be recorded as an event in the meter memory.

f) The meter shall comply to influence of external magnetic field (AC Electro Magnet or DC Magnet) as per IS 14697.

All types of abnormality event with date and time shall be available in the meter memory on first-in, first-out basis as per IS 15959. It shall be possible to retrieve the event data along-with all related snap- shots' data through the meter's optical port with the help of a CMRI and download the same to the BCS where it shall be available for viewing. All this information shall be available in simple and easily understandable format.

3.7 NON INFLAMMABILITY

The terminal block, the terminal cover and the case shall ensure reasonable safety against spread of fire. They shall not be ignited by thermic over load of live parts in contact with them. To comply with this these parts shall fulfill the conditions of the glow wire test as per IS 14697.

3.8 CONSTRUCTIONAL REQUIREMENTS

Meters shall be designed and constructed in such a way so as to avoid causing any danger during use and under normal conditions. The following should be ensured:-

i. Personal safety against electric shock

ii. Protection against spread of fire.

iii. Protection against effects of excessive temperature.

iv. Protection against penetration of solid objects, dust & water

v. Protection against fraudulence

vi. Protection against pilferage

vii. Meter base and meter cover shall be break to open type

3.9 METER CASE

The meter should be housed in a safe, high grade engineering polycarbonate meter casing of projection mounting type and is dust, vermin and moisture proof, with enclosure having degree of protection conforming to IP-51 as per IS 14697. The meter case shall seal the meter such that the internal parts of meter are accessible only after breaking the seals of meter cover.

All insulating material used in the construction of meters shall be non-hygroscopic, non-ageing and of tested quality. All parts that are likely to develop corrosion shall be effectively protected against such corrosion during operating life by providing suitable protective coating.

3.10 COVER

The cover shall be transparent, made of UV stabilized polycarbonate / engineering plastic material, which would enable easy reading the display. It should not fade in course of time and become opaque causing inconvenience for reading.

The cover shall permit clear view of the register.

3.11 TERMINAL AND TERMINAL BLOCK

The meter terminal block and terminal cover shall ensure safety against the spread of fire. They should not be ignited by overload of live parts in contact with them. To comply with this, these parts shall fulfill the conditions of the glow wire test as per IS 14697.

The terminal block cover shall be fixed to the meter terminal block by at least one screw. The terminal block cover shall be provided with minimum one seal.

The meter terminal block and terminal cover shall be moulded type and made of high grade non-hygroscopic, fire retardant, low tracking, reinforced poly-carbonate (not bakelite) or equivalent high grade engineering plastic which should form an extension of the meter case and have terminal holes and shall be of sufficient size to accommodate the insulation of the conductors. The terminals shall be of suitable rating to carry 150% of Imax and made of electro-plated (or tinned brass). Terminals shall be of adequate size so as to ensure proper tightening of the cable and shall be of replaceable type.

3.12 TERMINATION

The terminals shall have suitable construction with barriers to provide firm and safe connection of current and voltage leads of stranded copper conductors or copper reducer type terminal ends (thimbles).

The manner of fixing the conductors to the terminal block shall ensure adequate and durable contact such that there is no risk of loosening or undue heating. Screw connections shall be such that the risk of corrosion resulting from contact with any other metal part is minimized. Electrical connections shall be so designed that contact pressure is not transmitted through insulating material. The meter shall have a design life of 10 years against design defects. The Manufacturer shall stand 24months Guaranteefrom date of installation on the meter against any kind of failure/defects/mal-operation within above period. Meter shall be replaced by manufacturer free of cost within two months of intimation by owner / Employer.

3.13 CONNECTION DIAGRAM

Each meter shall be indelibly marked with a connection diagram which shall be provided on the terminal block cover. In case any special precautions need to be taken at the time of testing the meter, the same may be indicated along with circuit diagram. The meter terminals shall also be marked and this marking should appear in the above diagram.

3.14 TERMINAL ARRANGEMENT

Three phase: The terminal arrangement and connection diagram shall be marked in accordance with clause 7.2 of IS 14697.Terminal arrangement shall be in sequence : Ir(in), Vr, Ir(out), Iy(in), Vy, Iy(out), Ib(in), Vb, Ib (out), Neutral (in),Vn, Neutral(out)

3.15 SEALING OF METER

Reliable sealing arrangement should be provided to make the meter tamper evidence and avoid fiddling or tampering by unauthorized persons by way of providing adequate no. of seals on meter, meter terminal cover, wherever necessary. All the seals shall be provided in front side only. Rear side sealing arrangement will not be acceptable.

The manufacturer shall provide minimum two seals for the meter at the factory after calibration and testing. The meter cover shall have provision for placing minimum two nos. additional seals by the Employer. The manual switch and the terminal block cover shall be provided with minimum one seal each.

The holes for sealing wire shall be minimum 2 mm dia.

3.16 ELECTRO-MAGNETIC COMPATIBILITY AND INTERFERENCE

The meter shall remain un-influenced with EMI/EMC interference. The meter shall withstand impulse voltage test of 6 kV as per IS 14697-1999. It shall also withstand ac high voltage test as per IS 14697.

3.17 TESTS

3.17.1 Routine & Acceptance Tests : All routine & acceptance tests shall be carried out as stipulated in IS 14697.

3.17.2 Type Tests

Energy Meters offered shall be fully type tested as per IS 14697 & IS 15959 with latest amendments at any of the NABL accredited test laboratories.

Type test certificate shall not be older than 3 years from the date of bid submission. Bid shall not be accepted without valid type test certificate.

4.0 SINGLE PHASE, TWO WIRE, ACCURACY CLASS 0.5,ENERGY METER FOR SINGLE PHASE DISTRIBUTION TRANSFORMER

4.1 CT EQUIREMENT

The Meter shall be supplied with C.T with primary current capacity required for its intended use.

4.2 Since the meters are to be used with external CT of suitable ratio please refer CT specification provided separately. **DISPLAY**

The Single phase meters shall be capable to measure & display parameters as given below. The meter should have provision for automatic recording of cumulative kWh at 24 hrs on the last day of the month for each calendar month and same should go to memory.

The digitally measured and processed value shall be displayed through LCD having minimum six digits to read upto one-tenth of kWh. The minimum character height shall not be less than 7 mm.

The Meter should have appropriate facilities to be read in absence of Power Supply.

4.3 AUTO SCROLL DISPLAY

i) Cumulative kWh

ii) Instantaneous Voltage

iii) Instantaneous Current

iv) CumulativekVAh

v) Instantaneous pf

vi) Power on hours

4.4 DISPLAY PARAMETERS (PUSH BUTTON)

The display of following parameters shall be continuously scrolling one after another thru Push Button. The scrolling time for each display parameters for minimum of 10 secs.

i) Cumulative active Energy (kWh) for each calendar month for previous Six months.
ii) Cumulative apparent energy (kVAh) for each calendar month for previous Six months
iii) Instantaneous voltage, current, frequency, load in kW
iv) Maximum demand (MD) in active &apparent for last billing month
v) Maximum demand (MD) in active &apparent for current month
vi) Tamper Data :
    a. Present status of Tamper
    b. Date & time of last tamper occurrence & tamper identification.
    c. Date & time of last tamper removal.
    d. Cumulative tamper occurrence count.

4.5 LOAD SURVEY CAPABILITY & BILLING POINT REQUIREMENTS

Following load survey parameters for 35 days for 30 minute shall be logged:

- Active energy
- Apparent energy
- Voltage

The predefined date and time for registering the billing parameters of kWh, kVAh, PF and kVA MD as well as Power-On hours readings shall be 00.00 hours of the first day of each calendar (billing) month. All billing parameters shall be transferred to billing registers and shall be displayed on auto cyclic display mode referred to as "BILLING PARAMETERS".

In addition meter should have facility for daily profile for active and apparent energy.

4.6 INTERFACE BETWEEN METER AND CMRI

The interface between a meter and CMRI shall be with a flexible cable of adequate length having suitable female connector.

4.7 TAMPER & FRAUD PROTECTION

The meter shall be capable of recording correctly in following anti-tamper condition:

i. The meter shall be capable of recording energy correctly even if input and output terminals are interchanged. Also the meter shall record correctly even if phase and neutral are interchanged.
ii. The registration must occur whether input phase/neutral wires are connected properly or they are interchanged at the input terminals.
iii. Performance of the meter should comply to IS 14697/CBIP report 325 under influence of external DC/AC magnetic field..
iv. The meter shall withstand phase-to-phase voltage between phase and neutral terminals for at least 30 minutes.

Minimum one hundred fifty (100) events (including occurrence & restoration) of all types of abnormality event with date and time shall be available in the meter memory on first-in, first-out basis. It shall be possible to retrieve the event data along-with all related snap- shots' data through the meter's optical port with the help of a CMRI and download the same to the BCS where it shall be available for viewing. All this information shall be available in simple and easily understandable format.

4.8 SELF DIAGONISTIC FEATURES

The contractor shall provide details of self diagnostics features available and indication on the single phase meter for unsatisfactory / non-functioning of the following:

i) Time and date
ii) Real time clock battery
iii) Non Volatile memory

4.9 NON INFLAMMABILITY

The terminal block, the terminal cover and the case shall ensure reasonable safety against spread of fire. They shall not be ignited by thermic over load of live parts in contact with them. To comply with this these parts shall fulfill the conditions of the glow wire test as per IS 14697.

4.10 CONSTRUCTIONAL REQUIREMENTS

4.10.1 Meters shall be designed and constructed in such a way so as to avoid causing any danger during use and under normal conditions. However, the following should be ensured:-

i. Personal safety against electric shock
ii. Protection against spread of fire
iii. Protection against penetration of solid objects, dust & water
iv. Protection against fraudulence
v. Protection against pilferage
vi. Meter base and meter cover should be ultrasonically welded

4.10.2 Meter Case:

The meter should be housed in a safe, high grade engineering polycarbonate meter casing of projection mounting type and is dust, vermin and moisture proof, with enclosure having degree of protection conforming to IP-51. The meter case shall seal the meter such that the internal parts of meter are accessible only after breaking the seals of meter cover. The meter case shall have provision with deep cut for hanging the meter.

All insulating material used in the construction of meters shall be non-hygroscopic, non-ageing and of tested quality. All parts that are likely to develop corrosion shall be effectively protected against such corrosion during operating life by providing suitable protective coating

4.10.3 COVER:

The cover shall be transparent, made of UV stabilized polycarbonate material, which would enable easy reading the display. It should not fade in course of time and become opaque causing inconvenience for reading.

The cover shall permit clear view of the register.

4.11 TERMINAL AND TERMINAL BLOCK

The meter terminal block and terminal cover shall ensure safety against the spread of fire. They should not be ignited by overload of live parts in contact with them. To comply with this, these parts shall fulfill the conditions of the glow wire test as per IS 14697.

The terminal block cover shall be fixed to the meter terminal block by at least one screw. The terminal block cover shall be provided with minimum one seal.

The meter terminal block and terminal block cover shall be moulded type and made of high grade non-hygroscopic, fire retardant, low tracking, reinforced poly-carbonate (not bakelite) or equivalent high grade engineering plastic which should form an extension of the meter case and have terminal holes and shall be of sufficient size to accommodate the insulation of the conductors.

The terminals shall be of suitable rating to carry 150% of I_{max} and made of tin/nickel plated brass. Terminals shall be of adequate size so as to ensure proper tightening of the cable..

4.12 TERMINATION

The terminals shall have suitable construction with barriers to provide firm and safe connection of current and voltage leads of stranded copper conductors or copper reducer type terminal ends (thimbles).

The manner of fixing the conductors to the terminal block shall ensure adequate and durable contact such that there is no risk of loosening or undue heating. Screw connections shall be such that the risk of corrosion resulting from contact with any other metal part is minimized. Electrical connections shall be so designed that contact pressure is not transmitted through insulating material.

4.13 CONNECTION DIAGRAM

Each meter shall be indelibly marked with a connection diagram which shall be providedon the terminal block cover. The meter terminals shall also be marked and this marking should appear in the above diagram.

4.14 TERMINAL ARRANGEMENT

Single phase: Connecting terminals of current and voltage shall be in following sequence: Phase (in), Neutral (in), Neutral (out), phase (out).

4.15 SEALING OF METER

Reliable sealing arrangement should be provided to make the meter tamper evidence and avoid fiddling or tampering by unauthorized persons by way of providing adequate no. of seals on meter, meter terminal cover, wherever necessary. All the seals shall be provided in front side only. Rear side sealing arrangement will not be acceptable.

The manufacturer shall provide minimum one seal for the meter at the factory after calibration and testing. The meter cover shall have provision for placing minimum one additional seal by the Employer. The Terminal block cover shall be provided with minimum one seal.

The holes for sealing wire shall be minimum 2 mm dia.

4.16 ELECTRO-MAGNETIC COMPATIBILITY AND INTERFERENCE

The meter shall remain un-influenced with EMI/EMC interference. The meter shall withstand impulse voltage test of 6 kV as per IS 14697-1999. It shall also withstand ac high voltage test **as per above IS.**

4.17 TESTS

4.17.1 Routine & Acceptance Tests: All routine tests shall be carried out r and acceptance tests as stipulated in IS: 14697.

4.17.2 Type Tests

Energy Meters offered shall be fully type tested as per IS 14697 with latest amendments at any of the NABL accredited test laboratories.

Bid shall not be accepted without valid type test certificate.

5.0 SINGLE PHASE WHOLE CURRENT STATIC ENERGY METER OF CLASS 1.0 FOR CONSUMER

5.1 SCOPE

The static whole current meter shall offer current range of -5-30A, 10-60A (first digit indicates the Basic Current & second digit indicates the Maximum Current of the respective meters) for tariff purposes, as per requirement given in this specification.

5.2 Running at no load

When voltage at 115% of Vref is applied and no current flows in the current circuit, the test output of the meter shall not produce more than one pulse.

GENERAL & CONSTRUCTIONAL REQUIREMENTS

5.2.1 Meter Shall bear BIS mark

5.2.2 Meters shall be designed and constructed in such a way so as to avoid causing any danger during use and under normal conditions. However, the following should be ensured:-

a) Personal safety against electric shock
b) Personal safety against effects of excessive temperature
c) Protection against spread of fire
d) Protection against penetration of solid objects, dust & water
e) Protection against fraudulence
f) Protection against pilferage
g) Meter base and meter cover break open type

The accuracy of the meter shall not be affected with the application of abnormal voltage / frequency generating device such as spark discharge of minimum 35 kV. The meter shall be tested by feeding the output of the device to meter in any of the following manner for 10 minutes.

1. On any of the phase or neutral terminals.
2. On any connecting wires of the meter (Voltage discharge with 0-10 mm spark gap).
3. At any place in load circuit.

The accuracy of the meter shall be checked before and after the application of above device.

5.2.3 The meter shall be designed with latest technology and shall be manufactured using SMT (Surface Mount Technology) components. Power supply and voltage divider circuits may be of PTH Technology. The meter shall be housed in a safe, high grade engineering plastic/polycarbonate meter block casing and which is of projection mounting type and is dust/moisture proof, conforming to IP-51.

5.2.4 All insulating material used in the construction of meters shall be on-hygroscopic, non-ageing and of tested quality. All parts that are likely to develop corrosion shall be effectively protected against corrosion throughout during operating life by providing suitable protective coating.

5.2.5 The meter shall have an operation indication device such as a blinking LED. The operation indicator shall be visible from the front window and capable of being monitored conveniently with suitable testing equipment.

5.2.6 The meter shall conform to the degree of protection IP 51 as per IS:12063 for protection against ingress of dust, moisture and vermins.

5.2.7 The meter shall be supplied with a terminal block cover. The meter terminal block and terminal cover shall be made of high grade, fire resistant, reinforced, non-flammable, polycarbonate or equivalent high grade and good quality engineering plastic.

5.2.8 The meter terminal block and terminal block cover shall ensure safety against the spread of fire. They should not be ignited by thermic overload of live parts in contact with them.

5.2.9 The meter block shall be of transparent, high grade engineering plastic for easy reading of all the displayed values/parameters, name plate details and observation of operation indicator. The transparency of the box shall remain un-influenced with the environmental conditions.

5.2.10 The terminal block shall be made of high grade non-hygroscopic, fire retardant, low tracking, fire resistant, reinforced poly-carbonate (not bakelite) or equivalent high grade engineering plastic which should form an extension of the meter case and have terminal holes and shall be of sufficient size to accommodate the insulation of the conductors, meeting the requirement of IS 13779: 1999.

5.2.11 The terminals shall have suitable construction with barriers to provide firm and safe connection of current and voltage leads of stranded copper conductors or copper reducer type terminal ends (thimbles).

5.2.12 The manner of fixing the conductors to the terminal block shall ensure adequate and durable contact such that there is no risk of loosening or undue heating. Screw connections transmitting contact force and screw fixing which may be loosened and tightened several times during the life of the meter shall be such that the risk of corrosion resulting from contact with any other metal part is minimized. Electrical connections shall be so designed that contact pressure is not transmitted through insulating material. The internal diameter of the terminal holes shall be 5.5 mm for 5-30A and 8.5mm for 10-60A meter. The clearance and creepage distance shall conform to relevant clause of IS 13779:1999.

5.2.13 The meter shall be compact in design. The meter block unit shall be capable of withstanding stresses likely to occur in actual service and rough handling during transportation. The meter shall be convenient to transport and immune to shock and vibration during transportation and handling.

5.2.14 The meter shall have minimum two fixing holes. The top hole shall be provided at the back of the meter so that holding screw is not accessible to the consumer after fixing the meters. The lower fixing screws shall be provided under the sealed terminal cover. The requisite fixing screws shall be supplied with each meter.

5.2.15 The meter shall be provided with adequate protection against damage by high current/short circuit current.

5.2.16 The meter shall work satisfactory as per IS 13779under presence of various influencing conditions like external Magnetic Field, Electromagnetic Field, Radio Frequency Interference, Vibrations, harmonic Distortion, Voltage/Frequency Fluctuations, electromagnetic High Frequency Fields etc. The meter shall be capable of recording even in case of application by fraudulent means any of the tempering methods. The Meter shall have following anti-tamper features :

i. The meter shall be capable of recording energy correctly even if input and output terminals are interchanged. Also the meter shall record correctly even if phase and neutral are interchanged.

ii. The meter shall register energy correctly even when the load is not terminated back to the meter and instead current is drawn through a local earth under the conditions:-

a) When phase and neutral are connected correctly.
b) When phase and neutral wires are interchanged at the input terminals.

iii. The registration must occur whether input phase/neutral wires are connected properly or they are interchanged at the input terminals.

iv. Performance of the meter should not be affected under influence of external DC/AC magnetic field of high intensity as mentioned in IS 13779/CBIP report 325.

v. The meter shall be factory calibrated and shall be sealed suitably before dispatch.

vi. The meter shall withstand phase-to-phase voltage between phase and neutral terminals for at least 30 minutes.

vii. The Meter shall record even when the Neutral is removed or opened from both ends (source & load) and when phase and Neutral are interchanged. When neutral is removed meter should start recording energy for current of 1 amp and above.

viii. The meter shall be able to log in the memory in case the meter cover is opened.

The meter shall be capable of recording the following tamper events in memory (minimum 5 each) with date and time stamp along with snapshots of V, I, PF and Kwh as per IS 15959.

-Neutral Missing

- Magnet Tamper (if applicable)

- Cover open tamper (occurrence only)

5.3 SEALING OF METER

All meter shall be sealed by the manufacturer at its works. In addition to the seal provided by the manufacturer at its works, reliable sealing arrangement should be provided to make the meter tamper evidence and avoid fiddling or tampering by unauthorized persons by way of providing adequate no. of seals on meter, meter terminal cover, wherever necessary. The meter cover shall be sealable to the meter base with at least 2 nos. seals. Also terminal cover shall have provision for sealing with at least one seal. All the seals shall be provided in front side only. Rear side sealing arrangement will not be acceptable. Please refer Annexure- for specification for sealing system.

5.4 DISPLAY

5.4.1 The measured value(s) shall be displayed on a Liquid Crystal display (LCD) register. The height of the digit shall be minimum 7 mm. The KWh energy registration shall take place with 6 complete digits. The display shall have backlit capability for easy reading.

5.4.2 The data should be stored in non-volatile memory (NVM). The non-volatile memory should retain data for a period of not less than 10 years under un-powered condition. Battery back-up memory will not be considered as NVM.

5.4.3 The register shall be able to record and display starting from zero, for a minimum of 1500 hours, the energy corresponding to rated maximum current at reference voltage and unity power factor. The register should not roll over in between this duration.

5.4.4 In addition to providing serial number of the meter on the display plate, the meter serial number shall also be programmed into meter memory for identification through communication port for CMRI/meter reading print out.

5.5 DISPLAY SEQUENCE

The meter shall display the required parameters in two different modes as follows:

Apart from this in case of cover open the same shall be displayed on the meter.

A) Auto Display Mode:

The following parameters hereinafter referred to as "Billing Parameters" (B.P) shall be displayed in an auto-cycle mode, in the following sequence:-

1. LCD Test
2. Real Time
3. Date
4. Cumulative Active energy (forwarded) reading (kWh)
5. Last Bill Active Forwarded energy
6. Instantaneous Load (KW)
7. Last Bill Maximum demand (kW)

Each parameter shall be on meter display for 10 seconds.

B) Push Button Mode:-

In addition to the auto display mode parameters, the following parameters shall be displayed on pressing the push button

1. LCD Test
2. Real Time
3. Date
4. Instantaneous voltage, current
5. Maximum demand kW for Current month
6. Supply Frequency
7. Instantaneous PF

The meter shall also be capable of offering a high resolution display which shall enable conducting of dial testing by the user in the shortest possible time and as a minimum, the meter shall be capable of offering a resolution of 4 digits after decimal (and 2 digits before decimal) for the high resolution KWh display.

5.6 MAXIMUM DEMAND REGISTRATION & RESET

Meter shall continuously monitor & calculate the average maximum demand for each demand interval time of 30 minutes and maximum of these in a calendar month shall be stored along with date and time when it occurred. The maximum demand shall automatically reset at 24:00 hrs. of the last date of each calendar month for which minimum 30 years calendar shall be programmed by the manufacturer.

The integration period by default shall be set as 30 minutes and programmable as per IS 15959.

The billing purpose parameters (active forwarded energy, maximum demand in kW) shall be registered and shall be available for a minimum period of atleast 6 month.

5.7 LOAD PROFILE RECORDING

The meter shall be capable of monitoring and recording load profile information for KW demand for every 30 minutes interval for at least 35 days duration. The load profile shall be configurable as per IS 15959.

5.8 SELF DIAGNOSTIC FEATURE

The meter shall be capable of performing complete self diagnostic check to monitor integrity of data memory location at all time. The meter shall have indication for unsatisfactory /nonfunctioning /malfunctioning of the following:

a) Time and date on meter display
b) All display segments on meter display
c) Real Time Clock (RTC) status in meter reading prints out at BCS end

5.9 CMRI/BCS REQUIREMENTS

The communication protocol of the meter shall be as per IS 15959 with latest amendment. The Common Meter Reading Instrument (CMRI) should be capable of being loaded with user friendly software (MS-DOS 5.0 or higher version compatible) for reading/downloading meter data. Windows based Base Computer Software (BCS) shall be provided for receiving data from CMRI and downloading instructions from base computer software to CMRI.

This BCS should have, amongst other requirements, features and facilities described later in this specification, the facility to convert meter reading data into user definable xml file format so that it may be possible for the user to integrate the same with the user's billing data and process the selected data in desired manner. All the data available in the meter including energy, MD, and history data should be convertible to user defined xml file format for integration with third party software. The vendor shall supply necessary base computer software for reading / viewing of meter data and converting to user defined xml files formats. The user shall have the flexibility to select the parameters to be converted into xml file. The vendor shall also supply the necessary CMRI software.

5.10 DISPLAY POWER UP IN ABSENCE OF MAINS SUPPLY

The meter shall have the provision of providing the display of billing parameters in absence of main supply through internal battery..

5.11 CONNECTION DIAGRAM & TERMINAL MARKINGS

The connection diagram of the meter shall be clearly shown on the meter. The meter terminals shall also be marked and this marking should appear in the above diagram.

5.12 ELECTRO-MAGNETIC COMPATIBILITY AND INTERFERENCE

The meter shall remain un-influenced with EMI/EMC interference. The meter shall withstand impulse voltage test of 6 kV as per IS 13779-1999.

5.13 TESTS

Unless specifically waived off all acceptance tests shall be witnessed by the Employer.

5.13.1 Type Tests

Energy Meters offered shall be fully type tested as per IS 13779& IS 15959 with latest amendments at any of the NABL accredited test laboratories.

Type test certificate shall not be older than 3 years from the date of bid submission. Bid shall not be accepted without valid type test certificate.

5.13.2 Acceptance Test

Acceptance test shall be carried out as per IS 13779.

5.13.3 Routine Tests

All routine tests as per IS 13779 shall be carried out.

Annexure-A

SPECIFICATION OF POLY CARBONATE SEALS REQUIRED FOR SEALINGOF SINGLE / POLY PHASE METERS

1.01 Seal should be made of polycarbonate & should not be affected by boiling water & acid.

1.02 The seal should withstand temperature up to 147 ° C.

1.03 Seal should be available in Clear / Red / Blue / Yellow / Amber / Green / Grey colour and should be transparent.

1.04 Every seal should have 6" long, 20 gauge, twisted strand stainless steel wire.

1.05 Seal should have facility to print mono gram / name of company

1.06 Every Seals should have a unique seven-digit number. Numbers shall be printed on seal including the anchor cap-using laser marking which shall not be erased using any tool or by any chemical reaction. Both the seven digit seal numbers should be visible separately after closing the seal.

1.07 Seals should have tamper proof, internal " anchor " locking mechanism that permanently secures the wire upon closing. The mechanism should be designed in such a way that its original position can't be restored after any effort of tamper or breaking of seals

1.08 Sealing mechanism shall be designed in such a way that it can be sealed without using any pliers or tools.

1.09 Seal should be constructed of two parts, first the main body (female type) & second the anchor (male type) having locking mechanism. Both the part should be designed in such a way that once the seal is closed the two parts can't be separated.

1.010 Seal should be patented. Copy of patent shall be submitted along with offer.

1.011 Packaging: Seals shall be supplied in packet of 100 seals. Each packet shall be labelled for following information

- Client Name
- Purchase order number &date
- Serial number range in the form of bar coding.

1.012 Seals shall be provided with tracking & recording software. The software shall have following features

- Software should have facility of defining the system controller
- Facility to enter serial number of seals with the help of bar code scanner.
- Receiving of seal in the system and with authentication like signature.
- Facility to identify the concern who is responsible for receiving of seals and nominated by system supervisor.
- Provision to define different type of seals for various uses.
- Software should have facility of report generation for inventory & issue records.
- Facility to track for relevant data for individual seal entered in the system.

Annexure-B

TECHNICAL SPECIFICATION FORCOMMON METER READING INSTRUMENT (CMRI)

This specification covers supply and delivery of Common Meter Reading Instrument (CMRI) for reading (uploading) the data of different make of meters and to have a capability to dump (download) the same to the base computer system. The CMRI shall have memory / space to reside software of reading at least 3 different makes of electronic meters as specified by Employer.

A. Portable Common Meter Reading Instrument (CMRI)

These shall be tailor-made for tapping all data stored in the memory of electronic meters of type, three phase 3wire, three phase 3 wire HT/LT Tri-vector meters, whole current meters, single phase meter, and faithfully transferring it to the local PC in the BCS. Each device shall be supplied complete with

i) a lead with optical head for coupling it to the meter,

ii) a lead for plugging it to a personal computer;

iii) an internal battery for powering the devices;

iv) a case for safely carrying it about

v) a battery charger

The total arrangement shall be such that one (1) operator can carry out the whole operation himself, in about five (5) minutes per meter.

B. The CMRI shall have a key for starting the data tapping from the coupled meter's memory, a key to start data transfer to the PC, and a lamp, which would light up on completion of data collection, remain 'on' while the data is held in the device and would go 'off' when all data has been transferred to the PC. Data tapping operation shall not erase the data from the meter's memory, or effect the meter operation in any way. The memory of the CMRI shall get automatically cleared when the data has been transferred to the PC only then the CMRI shall accept data from another meter. CMRIs shall also have the necessary provision for meter clock correction. CMRIs should have adequate memory, to host application software, for enabling downloading of meter data of 3 makes of meters.

C. The Contractor shall provide the necessary software which would enable a local IBM-Compatible PC to (i) accept the data from the CMRI and store it in its memory, (ii) display the collected data on PC's screen, with forward/backward rolling, (iii) print out the data collected from one or more meters, starting from a certain date and time, as per operator's instructions, (iv) transmit the collected data through an appropriate communication link to the central computer, starting from a certain date and time, as per operator's instructions, and (v) store the collected data on a floppy disc.

D. The above software shall further ensure that absolutely no tampering (except total erasures) of the collected metering data is possible during its handling by the PC. The software shall be suitable for the commonly available PCs, and shall be supplied to SEB in a compatible form to enable its easy loading into the PCs available (or to be installed by the SEB) at the various substations/ locations in the circle.

E CMRI should be compatible with Low Power Radio module to be provided by the bidder for receiving the data from the meter to the CMRI/Hand Held UNIT and ultimately transferring to BCS &vice versa for loading required instructions to the meters.

F. CMRI should conform to CBIP Technical Report No. 111with latest amendments with Level (2) IP 67 protection and following climatic condition & standards

1.0 Standards

The CMRI shall confirm in all respects to the following standards.

i) CBIP Technical Report no. 111 – Specification for common Meter reading Instrument.
ii) IEC – 529 – Degree of Protection provided by enclosures
iii) IS : 12063 : 1987 – Classification of Degree of Protection provided by enclosures of electrical items
iv) IS 9000: 1979 – Basic environmental testing procedure for electronic & electronic items.
v) IEC – 1000 – Electromagnetic compatibility
vi) IEC – 1000-4-2 : 1995 – Electrostatic discharge immunity test
vii) IEC – 1000–4-3 : 195 – Radiated, radio – frequency electromagnetic field immunity test, Magnetic immunity test
viii) CISPAR 22 – Limits and method of measurement of radio disturbance characteristics of information technology equipment.

2.0 Climatic Conditions:

The detail climatic condition is specified in Section-I.

3.0 Principal Parameter

For downloading data from electronic meters of type, single phase,230 V, whole current, three phase 415 V Whole current ,three phase 415 V,CT operated, 33kV,11kV,HT Trivector CT,PT operated meters. The offered meter reading device should be portable, compact and battery powered. It's memory shall be adequate to enabling transfer of data from three makes of meters equipped with suitable communication port and transferring them on to a base computer system such as an IBM compatible PC or an external peripheral & vice-versa.

The offered CMRI should have capacity compatible to read minimum 20 meters for billing & tamper data but without load survey and minimum 10 meters for billing and tamper data with load survey.

CMRI shall be able to display phase / vector diagram of phase current, phase voltage with respective phase angles and phase sequence of voltage at SITE when these data are read from the meter.

4.0 GENERAL TECHNICAL REQUIREMENT:

Physical Characteristics:

i. Size:

CMRI should be handy, lightweight and small in size for ease of portability.

ii. Enclosure:

CMRI casing shall be of electrical insulating material of high thermal stability and mechanical strength. Its degree of protection confirms to IP 67 LEVEL *(2)* as per IS 12063 / IEC-529.The enclosure should be solvent resistant and shall be provided with a suitable holding Strap for proper gripping.

iii. Ruggedness: CMRI is able to withstand harsh field environment without physical damage or loss of data.
iv. Display: The display of CMRI is having the following characteristics.

a) Easy readability in varying ambient light conditions.

b) 4 lines and 20 characters per line on the screen

c) The size of the character shall be 4 mm

d) The contrast and intensity control to get a clear display in varying ambient light.

v. Key Board: The keyboard of the CMRI is having the following attributes.

a) Long operation life i.e. minimum 100000 operations (typical).

b) Feedback for key press acknowledgement to user.

c) Legible and non-fading keypad imprints for all alphanumeric characters/symbols.

d) Each English alphabet shall have a separate key.

vi. Input / Output ports (I/O Ports) :

The CMRI shall be having two serial input/output Ports, one port shall be serial port RS 232C compatible. Another optional port can be used for convenience of connecting peripherals such as bar-code reader, printer, battery charger, loader charger etc.

The offered CMRI shall be able to provide power supply for optical sensor used for meter reading applications.

5.0 Physical interface:

i. Interface between meter and CMRI:

The interface between a meter and CMRI shall consist of 2 parts.

a) Meter optical sensor terminating in to a 9 pin D type male connector with a cable of 500 mm +/- 10 mm. Length.

b) The interface between a meter and the offered CMRI shall be with a flexible shielded cable of length 1500mm +/-10mm having 9 pin D-type female connector with electrical circuit. This cable shall be supplied along with CMRI. The two ends of the cable is stress relieved.

Interface between CMRI and Base computer station:

Suitable flexible shielded cable of sufficient length for communication between CMRI and base computer station shall be provided. This communication shall be serial RS232C. On the base

computer station end of the cable a 9 pin D-type female connector shall be provided. The two ends of the cable are stress relieved.

This cable shall also be supplied along with the CMRI.

6.0 Hardware and Software requirement:

i. Operating system :

To facilitate use of various meters, specific MRI programs in one CMRI, MS DOS version 5.0 or higher system shall be used. The facility to upgrade the BIOS/OS by a CMRI manufacturer shall be available without exposing the hardware of the CMRI.

The additional program necessary to transfer application programs with serial port shall be provided.

ii. Memory:

a) The CMRI shall be having a minimum memory capacity of 3 MB Static RAM (SRAM) with battery backup and upgradeable.

b) BIOS/OS on FLASH memory / EEPROM MEMORY

iii. Communication:

The CMRI shall be able to communicate for-

a) Down loading / up loading data from / to the meter
b) Uploading / downloading data to / from the Base computer station
c) CMRI shall be capable to read bar code information using a bar code scanner from barcodes of ac static \ electromechanical electricity meters by using appropriate scanner and bar code soft ware.
d) CMRI shall support flexible baud rate ranging from 300 Baud to 19200 (or higher) Baud rates to cater communication needs stated above.

iv. Real time clock :

A real time clock is provided in the CMRI, which have the following features:

Power requirement: The clock shall have a minimum of 15 days battery backup.

Calendar: The clock shall have 20 years calendar.

Time drift: The time drift shall be negligible and shall not exceed 20 seconds per day.

v. Time Setting Facility:

The CMRI shall have the facility to get its time set from Base computer station. Proper security for this is ensured using password

vi. Power supply (Battery) for CMRI:

The CMRI shall have the following features for its power requirements:

a) The CMRI shall be powered by rechargeable battery housed within its enclosure.

b) The average capacity of charged battery shall be sufficient to communicate with meters and base computer station for at least :

i) 6 hours while communicating through optical interface of meters and

ii) 8 hours without powering Input / Output ports for optical interface.

c) To reduce the equipment down time and inventories, there shall be provision to charge the CMRI battery without being removed from the equipment. A suitable battery charger for charging of CMRI battery shall be provided.

d) There would be a provision for AUTO POWER SAVE, which force the instrument in the power saving mode in case of no activity within 5 minutes.

e) The battery used for data retention in SRAM would have a minimum of 3 years backup capacity.

f) The CMRI would have battery low indication and automatic cutoff to avoid further drain of the battery.

7.0 Communication Protocol and Software

Software:

a) The following software shall be provided in the offered CMRI.

i) Operating system compatible to MS DOS 5.0 or (latest versionver 7.0).
ii) Necessary software for loading application programs via a serial port for uploading and down loading between CMRI and Base computer Station (BCS)

b) i. Provision for loading the software into the CMRI of the specific makes of the meters, for the purpose of reading and programming of the specific make(s) of static meters, such Software shall be provided by respective meter manufacturers.

ii. BCS software accepting data from CMRI, processing generating reports and downloading instruction from BCS to CMRI.

c) Special Requirement:

The offered CMRI shall have provision for storing the third party software and can also be loaded for special applications such as manual meter reading, data entry through keyboard of CMRI, printing, display of balance memory etc.

d) The CMRI shall have facility to draw/display vector diagram of the electrical conditions existing at site to check the healthiness of the connections.

e) The CMRI shall have provision to read the energy registers so that accuracy testing can be done at site with standards calibrating equipments.

f) The CMRI shall have the provision to read the various instantaneous electrical parameters at site like voltages, current, PF, phase angles, power (kW, KVAr, and KVA) frequency etc.

g) The CMRI shall have facility to estimate the memory space available before reading the meter.

8.0 DATA SECURITY

The meter manufacturers are responsible for maintaining the security of the data extracted from the meters using manufacturer specific algorithm in the software up to down loading to BCS.

9.0 CMRI shall be type tested as per clause 5 of CBIP Technical Report No. 111.

10.0 Acceptance Tests for CMRI and PC Software

All CMRI after final assembly and before dispatch from Bidder's/Manufacturer's works shall be duly tested to verify that they are suitable for supply to the Employer. In particular, each and every CMRI shall be subjected to the following acceptance test:

(i) Functional Checks
(ii) Downloading Meter Data from the Meter(s)
(iii) Compatibility with PC software
(iv) Downloading the meter data on PC
(v) Functioning of advance and retard time commands
(vi) Per meter downloading time verification
(vii) Capacity of CMRI for data storage

Annexure-VI

List of Participants of Workshop on New initiative on material mobilization

आरईसी REC
असीमित ऊर्जा, अनन्त संभावनाएं
Endless energy. Infinite possibilities.

रूरल इलेक्ट्रीफिकेशन कारपोरेशन लिमिटेड
Rural Electrification Corporation Limited
(भारत सरकार का उद्यम) / (A Government of India Enterprise)
Regd. Office: Core-4, SCOPE Complex, 7 Lodhi Road, New Delhi 110 003
Tel: +91-11-4102 0101 Fax: +91.11.2436 0644 E-mail: reccorp@recl.nic.in
CIN : L40101DL1969GOI005095 Website: www.recindia.nic.in

REC/DDUGJY/Material/Committee-A/2015/ 10093 Dated: 10.09.2015

To
CMDs/MDs
(All State Power Utilities)

Sub: Nomination of Participants for attending two day workshop on 12.09.2015 & 13.09.2015 for finalization of quantity of major materials to be procured under DDUGJY scheme-reg.

Sir/Madam,
As you are aware that Ministry of Power has constituted a committee-A headed by chairperson CEA for enlisting of major materials and estimation & finalization of quantities of major materials that shall be considered for central procurement under DDUGJY scheme. Committee-A in its 3rd meeting held on 07.09.2015 has decided to invite all state representatives to finalise the quantity of major high value Sub-Transmission & Distribution materials. Further, on 08.09.2015, MOP has further decided that quantities to be aggregated will include estimated quantities of major high values Sub-Transmission & Distribution materials to be executed under DDUGJY, IPDS or any other state/central funded scheme. Accordingly, two day workshop on 12.09.2015 & 13.09.2015 at Tagore Hall, SCOPE Convention Centre, SCOPE Complex, New Delhi from 10.30AM is being organized by REC. In this workshop, participants are expected to finalize the quantities of major high value materials during their stay in Delhi.

It is therefore, requested to depute a participant(s) [max.- 2nos.] from your discom/state not below the rank of SE/Addl. CE who are involved in Project/DPR formulation of DDUGJY scheme to attend the workshop in respect of your discom/state.

With regards,

Yours sincerely,

(P J Thakkar)
Director (Technical)

Copy to:
1. Pr. Secretaries/Secretaries (Energy/Power)- for favor of kind information.
2. ZM/CPM- to pursue state power utilities to nominate participants for attending the aforesaid workshop.

List of Participants in workshop organized for aggregation of quantities

S. No.	Name	Designation	Name of DISCOM
1	HarhVardhanSahu	AE	MPPKVVCL, MP
2	Raj Kumar	EEE	JBVNL, Jharkhand
3	Sant Ram Garg	Sr. Executive	HPSEBL
4	Sarat Chandra Upadhyaya	GM (Project) to RMS	NESCO, Odisha
5	Surender Kota	AGM, Work & Planning	WESCO, Odisha
6	Prabhat Kr. Mohanti	Assistant Manager CESU, BBSR	CESU, Odisha
7	S. K. Senapati	GM, Planning & Monitoring	CESU, Odisha
8	M.P Gangane	SE, MSEDCL	MSEDCL
9	S.K Roy	Addl. CE Projects	MSEDCL
10	A.C Bir	SE, Projects2	WBSEDCL
11	S. Parisaras	SM	TSECL
12	SanjibNendy	SM	TSECL
13	JN Talsaniga	DE	PGVCL, CO
14	PK Pala	Ex. Engineer	PGVCL, CO
15	Aditya Kumar	Ex. Engineer	NBPDCL
16	Md. Obaidullah	Ex. Engineer	SBPDCL
17	Ravinder Singh	SDO	DHBVNL, Hisar
18	S.K Chhabra	SE	DHBVNL, Hisar
19	S.K Sharma	AEE	UHBVNL
20	Inderjeet Singh Gill	Addl SE	PSPCL
21	O.S Bhambra	Addl SE	PSPCL
22	Parminder Singh	AEE	PSPCL
23	Nain Garg	Dy. CE	PSPCL
24	S.R Nagaraja	DGM	Project, BESCOM
25	S.K Agarawal	GM	MPPKVVCL, MP
26	SR Yemde	DGM	MPPKVVCL, MP
27	AnuvratMehrotra		PSPCL
28	Naveen Jain	XEN	JVVNL
29	A.K Singhal	XEN	JVVNL
30	Amiya Behera	Sr. Manager	NPTI
31	Sheela M Daniel	RE, KSEBR	KSEBL, Travause house, new delhi
32	sreija R.S	Officer on special duty	KSEBL, Travause house, new delhi
33	javed Y. Dar	SE	JKPDD, Kashmir
34	R.K Agarwal	DGM	MPMKVVCL, Bhopal
35	R.K Malviya	DGM	MPMKVVCL, Bhopal

S. No.	Name	Designation	Name of DISCOM
36	T.K Sharma		UHBVN, Haryana
37	SrinivasaBabu	DGM	BESCOM, CO, Banagalore
38	Aditya Kalgaonkar	Manager	MPPKVVCL, Jabalpur,M.P
39	S.K Senapathy	G.M	CESU
40	D.K Garg	C.E	MVVNL, Lucknow
41	R.K Dhiman	Addl. S.E.,	HPSEBL, ED Nalagarh, H.P
42	Y.R Saulanke	S.E	DGVCL, Gujrat
43	Sachet Parida	Manager	Feedbackinfra, OPTCL, Odisha
44	P R Gupta	Executive Engineer	UGCL, R&C Off, Mehsana Gujarat
45	CJ Rajpal	Executive Engineer	UGCL, R&C Off, Mehsana Gujarat
46	V P Singh	SE	AVVNL
47	Brajendrakumar	xen	AVVNL
48	MK Jaiswar	Sr. DE	MECON
49	Ajay Kumar	Executive Engineer	South Co Odisa
50	Dinesh R Sabw	CE	MEDCL, Mumbai
51	Satish Chand	SE	UPPCL
52	S D S Bisht	EE	UPCL, Dehradun
53	H M Patel	COA	MEVCL
54	H M Sharma	RE	APDCL
55	Deepak Mittal	CE	DVVNL

Annexure-VII

Aggregate Quantity under DDUGJY& IPDS Schemes

Aggregate Quantity of High Value Key Materials to be procured under DDUGJY Scheme

S. No.	Name of key material	Rating	Unit	Aggregate Quantity Proposed under DDUGJY
1	Power Transformer	1 MVA	No	-
		1.6 MVA	No	17
		2.5 MVA	No	-
		3 MVA	No	2
		3.15 MVA	No	3,656
		5 MVA	No	9,374
		6.3 MVA	No	853
		8 MVA	No	3
		10 MVA	No	524
		12.5 MVA	No	62
		20 MVA	No	-
Total Power Transformer :				**14,491**
2	Distribution transformer	5/6 KVA(1-PH)	No	9,659
		10 KVA(1-PH)	No	4,675
		10 KVA(3-PH)	No	41
		16 KVA(1-PH)	No	23,877
		16 KVA(3-PH)	No	3,262
		25 KVA(3-PH)	No	2,00,282
		63 KVA (3-PH)	No	43,918
		100 KVA (3-PH)	No	30,942
		200 KVA (3-PH)	No	-
		250 KVA (3-PH)	No	406
		315 KVA (3-PH)	No	4
		450 KVA (3-PH)	No	2
Total Distribution Transformer :				**3,17,068**

Aggregate Quantity of High Value Key Materials to be procured under DDUGJY Scheme

S. No.	Name of key material	Rating	Unit	Aggregate Quantity Proposed under DDUGJY
3	**Single phase Energy Meter (whole current)**	5 to 30 A	No	96,31,374
	Three phase Energy Meter (whole current)	5 to 30 A	No	1,35,543
	Single phase Energy Meter (whole current)	5 to 60 A	No	2,54,304
	DTR Meter	5 to 60 A	No	11,64,311
	Feeder Meter	5 to 60 A	No	28,347
	Single phase Energy Meter (whole current)	10 to 60 A	No	8,215
	Three phase Energy Meter (whole current)	5 to 60 A	No	1,327
Total Energy Meter				**1,12,23,421**
4	**ACSR conductor**	Squirrel (20 sqmm)	Km	5.50
		Weasel (30 sqmm)	Km	1,82,992.81
		Rabbit (50 sqmm)	Km	5,71,470.60
		Racoon (75 sqmm)	Km	23,609.35
		Dog (100 sqmm)	Km	74,842.15
		Wolf (150 sqmm)	Km	550.00
		Panther (200 sqmm)	Km	2,664.00
Total ACSR Conductor				**8,56,134.41**
5	**AAAC conductor**	Weasel - 30 sq mm	Km	438.78
		Weasel - 34 sq mm	Km	1,799.90
		Rabbit - 55 sq mm	Km	6,714.46

Aggregate Quantity of High Value Key Materials to be procured under DDUGJY Scheme

S. No.	Name of key material	Rating	Unit	Aggregate Quantity Proposed under DDUGJY
		Racoon - 80 sq mm	Km	523.91
		Dog - 100 sq mm	Km	3,846.53
		Wolf- 148 sq mm	Km	63.00
		Panther 232 sqmm	Km	-
Total AAAC Conductor				**13,386.58**
6	**UG cable (XLPE CABLE 33 KV ARMOURED)**	3C x 400 sqmm	Km	1
		3X300 SQMM	Km	94
	UG cable (XLPE CABLE 11 KV ARMOURED)	3X300 SQMM	Km	111
		3X240 SQMM		8
		3X120 SQMM	Km	27
		3X185 SQMM	Km	330
Total UG Cable				**570**
7	**11 KV AB Cable**	3C x 50 sqmm	Km	-
		3C x 95 sqmm	Km	976.45
		3C x 120 sqmm	Km	36.00
		3C x 185 sqmm	Km	3,625.65
		3C x 200 sqmm	Km	0.43
Total 11 kV Cable				**4,638.53**
8	**LT AB Cable**	3X95+1X70+1X16	Km	6,970.00
		3X95+1X70+1X120	Km	25.35
		3X35+1X16+1X16	Km	-
		3X50+1X35+1X16	Km	54,321.12
		3X35+1X35+1X16	Km	5,278.13
		3X25+1X35+1X16	Km	10,030.00
		3X16+1X16+1X25	Km	14.10
		2X16+25	Km	2.50

Aggregate Quantity of High Value Key Materials to be procured under DDUGJY Scheme

S. No.	Name of key material	Rating	Unit	Aggregate Quantity Proposed under DDUGJY
		2X35+1X16	Km	2,039.37
		2X25+1X16	Km	12,454.73
		1X16+1X25	Km	195.55
		3X50+1X50	Km	2,507.80
		3X95+1X70	Km	4,394.00
		3X120+1X70+1X25	km	-
		1X25+25	Km	14,994.00
		3X120+1X95	Km	4,100.00
Total LT AB Cable :				**1,17,326.65**

State wise aggregate Quantity Proposed under DDUGJY									
S. No.	Name of key material	Rating	Unit	Andhra Pradesh		Arunachal Pradesh	Assam	Bihar	Chhatisgarh
				EPDCL	SPDCL	Power Deptt.	APDCL		CSPDCL
1	Power Transformer	1 MVA	No						
		1.6 MVA	No						
		2.5 MVA	No						
		3 MVA	No						
		3.15 MVA	No	2	0				
		5 MVA	No	97	2348			4966	
		6.3 MVA	No						
		8 MVA	No						
		10 MVA	No					18	
		12.5 MVA	No						
		20 MVA	No						
				99	**2348**	**0**	**0**	**4984**	**0**
2	Distribution transformer	5/6 KVA(1-PH)	No						
		10 KVA(1-PH)	No						
		10 KVA(3-PH)	No						
		16 KVA(1-PH)	No	64					
		16 KVA(3-PH)	No						2189
		25 KVA(3-PH)	No	110				70621	4683
		63 KVA (3-PH)	No	11				91	11
		100 KVA (3-PH)	No	9				64	
		200 KVA (3-PH)	No						
		250 KVA (3-PH)	No						
		315 KVA (3-PH)	No						
		450 KVA (3-PH)	No						
				194	**0**	**0**	**0**	**70776**	**6883**
3	Single phase Energy Meter whole current)	5 to 30 A	No	766				947204	44293
	Three phase Energy Meter (whole current)	5 to 30 A	No					53486	
	Single phase Energy Meter (whole current)	5 to 60 A	No						
	DTR Meter	5 to 60 A	No	3000	2941			22217	807
	Feeder	5 to 60 A	No	200	208			543	3382

State wise aggregate Quantity Proposed under DDUGJY									
S. No.	**Name of key material**	**Rating**	**Unit**	**Andhra Pradesh**		**Arunachal Pradesh**	**Assam**	**Bihar**	**Chhatisgarh**
				EPDCL	**SPDCL**	**Power Deptt.**	**APDCL**		**CSPDCL**
	Meter								
	Single phase Energy Meter (whole current)	10 to 60 A	No						
	Three phase Energy Meter (whole current)	5 to 60 A	No						
Total Energy Meter				**3966**	**3149**	**0**	**0**	**1023450**	**48482**
4	**ACSR conductor**	Squirrel (20 sqmm)	Km						
		Weasel (30 sqmm)	Km						13570
		Rabbit (50 sqmm)	Km					66351	23556.93
		Racoon (75 sqmm)	Km					606	
		Dog (100 sqmm)	Km					13571	3300
		Wolf (150 sqmm)	Km						
		Panther (200 sqmm)	Km					448	
Total ACSR conductor				**0**	**0**	**0**	**0**	**80976**	**40426.93**
5	**AAAC conductor**	Weasel - 30 sq mm	Km						
		Weasel - 34 sq mm	Km	1799.9					
		Rabbit - 55 sq mm	Km	4352.6					
		Racoon - 80 sq mm	Km						
		Dog - 100 sq mm	Km	2030.4					
		Wolf- 148 sq mm	Km						
		Panther 232 sqmm	Km						
				8182.9	**0**	**0**	**0**		**0**
6	**UG Cable (XLPE CABLE 33 KV ARMOURED)**	3C x 400 sqmm	Km						
		3X300 SQMM	Km					55	
	UG Cable (XLPE CABLE 11	3X300 SQMM	Km						
		3X240 SQMM	Km						
		3X120 SQMM	Km						

State wise aggregate Quantity Proposed under DDUGJY									
S. No.	Name of key material	Rating	Unit	Andhra Pradesh		Arunachal Pradesh	Assam	Bihar	Chhatisgarh
				EPDCL	SPDCL	Power Deptt.	APDCL		CSPDCL
	KV ARMOURED)	3X185 SQMM	Km					12.97	
Total UG Cable				**0**	**0**	**0**	**0**	**67.97**	**0**
7	LT Cable (XLPE Cable Armoured)	3.5x400 SQMM	kms.						
		3.5x240 SQMM	kms.						
		3.5x95 SQMM	kms.						
		3.5x70 SQMM	kms.						
		3.5x50 SQMM	kms.						
				0	**0**	**0**	**0**		**0**
8	11 KV AB Cable	3C x 50 sqmm	Km						
		3C x 95 sqmm	Km						
		3C x 120 sqmm	Km						
		3C x 185 sqmm	Km					141	
		3C x 200 sqmm	Km					0.4326	
Total 11 kV Cable				**0**	**0**	**0**	**0**	**141.4326**	**0**
9	LT AB Cable	3X95+1X70+1X16	Km						
		3X95+1X70+1X120	Km						
		3X35+1X16+1X16	Km						
		3X50+1X35+1X16	Km						
		3X35+1X35+1X16	Km						
		3X25+1X35+1X16	Km						
		3X16+1X16+1X25	Km						
		2X16+25	Km	2.5					
		2X35+1X16	Km						
		2X25+1X16	Km	40.73					
		1X16+1X25	Km						
		3X50+1X50	Km						
		3X95+1X70	Km						
		3X120+1X70+1X25	km						
		1X25+25	Km						
		3X120+1X95	Km						
				43.23	**0**	**0**	**0**		**0**

State wise aggregate Quantity Proposed under DDUGJY									
S. No.	Name of key material	Rating	Unit	Goa	Haryana		Himachal Pradesh	J & K	Jharkhand
					UHVBNL	DHVBNL	HPPCL	JKPDCL	JBVNL
1	Power Transformer	1 MVA	No						
		1.6 MVA	No				17		
		2.5 MVA	No						
		3 MVA	No						
		3.15 MVA	No				31	98	
		5 MVA	No						285
		6.3 MVA	No				4	127	
		8 MVA	No						
		10 MVA	No		58	6	2	89	0
		12.5 MVA	No		62				
		20 MVA	No						
				0	**120**	**6**	**54**	**314**	**285**
2	Distribution transformer	5/6 KVA(1-PH)	No						
		10 KVA(1-PH)	No						
		10 KVA(3-PH)	No					1	
		16 KVA(1-PH)	No				1		
		16 KVA(3-PH)	No			203	1	23	
		25 KVA(3-PH)	No		6500	185	84	1572	50920
		63 KVA (3-PH)	No		3000	363	85	3533	
		100 KVA (3-PH)	No		4500		24	441	
		200 KVA (3-PH)	No						
		250 KVA (3-PH)	No				2	1	
		315 KVA (3-PH)	No					1	
		450 KVA (3-PH)	No						
				0	**14000**	**751**	**197**	**5572**	**50920**
	Single phase Energy Meter whole current)	5 to 30 A	No		90000	51387	131652	391890	895584
	Three phase Energy Meter (whole current)	5 to 30 A	No						
	Single phase Energy Meter (whole current)	5 to 60 A	No						
	DTR Meter	5 to 60 A	No	322	35000	36130	416	7699	13742
	Feeder	5 to 60 A	No		1000	1115	18	819	885

State wise aggregate Quantity Proposed under DDUGJY									
S. No.	**Name of key material**	**Rating**	**Unit**	**Goa**	**Haryana**		**Himachal Pradesh**	**J & K**	**Jharkhand**
					UHVBNL	**DHVBNL**	**HPPCL**	**JKPDCL**	**JBVNL**
	Meter								
	Single phase Energy Meter (whole current)	10 to 60 A	No						
	Three phase Energy Meter (whole current)	5 to 60 A	No						
Total Energy Meter				**322**	**126000**	**88632**	**132086**	**400408**	**910211**
4	**ACSR conductor**	Squirrel (20 sqmm)	Km				5.5		
		Weasel (30 sqmm)	Km				772	21375	14373
		Rabbit (50 sqmm)	Km		6500	9872	4155	13235	19548
		Racoon (75 sqmm)	Km		3500	7355	234		
		Dog (100 sqmm)	Km		1468	530	230	3297	1644
		Wolf (150 sqmm)	Km		550				
		Panther (200 sqmm)	Km		6			636	
Total ACSR conductor				**0**	**12024**	**17757**	**5396.5**	**38543**	**35565**
5	**AAAC conductor**	Weasel - 30 sq mm	Km						
		Weasel - 34 sq mm	Km						
		Rabbit - 55 sq mm	Km						
		Racoon - 80 sq mm	Km						
		Dog - 100 sq mm	Km						
		Wolf- 148 sq mm	Km						
		Panther 232 sqmm	Km						
				0	**0**	**0**	**0**	**0**	**0**
6	**UG Cable (XLPE CABLE 33 KV ARMOURED)**	3C x 400 sqmm	Km						
		3X300 SQMM	Km		4				
	UG Cable (XLPE CABLE 11 KV ARMOURED)	3X300 SQMM	Km						
		3X240 SQMM	Km						
		3X120 SQMM	Km						
		3X185 SQMM	Km		45				
Total UG Cable				**0**	**49**	**0**	**0**	**0**	**0**
7	**LT Cable (XLPE Cable**	3.5x400 SQMM	kms.						
		3.5x240 SQMM	kms						

State wise aggregate Quantity Proposed under DDUGJY									
S. No.	Name of key material	Rating	Unit	Goa	Haryana		Himachal Pradesh	J & K	Jharkhand
					UHVBNL	DHVBNL	HPPCL	JKPDCL	JBVNL
	Armoured)		.						
		3.5x95 SQMM	kms.						
		3.5x70 SQMM	kms.						
		3.5x50 SQMM	kms.						
				0	**0**	**0**	**0**	**0**	**0**
9	**11 KV AB Cable**	3C x 50 sqmm	Km						
		3C x 95 sqmm	Km				15.45	195	
		3C x 120 sqmm	Km						
		3C x 185 sqmm	Km						
		3C x 200 sqmm	Km						
Total 11 kV Cable				**0**	**0**	**0**	**15.45**	**195**	**0**
10	**LT AB Cable**	3X95+1X70+1X16	Km						
		3X95+1X70+1X120	Km				25.35		
		3X35+1X16+1X16	Km						
		3X50+1X35+1X16	Km					1257	17805
		3X35+1X35+1X16	Km					93	
		3X25+1X35+1X16	Km						
		3X16+1X16+1X25	Km						
		2X16+25	Km						
		2X35+1X16	Km						
		2X25+1X16	Km					65	
		1X16+1X25	Km						
		3X50+1X50	Km		1250		10.8		
		3X95+1X70	Km		2100	1134			
		3X120+1X70+1X25	km						
		1X25+25	Km						
		3X120+1X95	Km		4100				
				0	**7450**	**1134**	**36.15**	**1415**	**17805**

State wise aggregate Quantity Proposed under DDUGJY									
S. No.	Name of key material	Rating	Unit	Karnataka	Kerala	Madhya Pradesh	MAHARASHTRA	Manipur	Meghalaya
				BESCOM	KSEBL		MSEDCL	Power Deptt.	MeSEB
1	Power Transformer	1 MVA	No						
		1.6 MVA	No						
		2.5 MVA	No						
		3 MVA	No						
		3.15 MVA	No						
		5 MVA	No			663	295		
		6.3 MVA	No						
		8 MVA	No						
		10 MVA	No				22		
		12.5 MVA	No						
		20 MVA	No						
				0	**0**	**663**	**317**	**0**	**0**
2	Distribution transformer	5/6 KVA(1-PH)	No						
		10 KVA(1-PH)	No						
		10 KVA(3-PH)	No						
		16 KVA(1-PH)	No						
		16 KVA(3-PH)	No						
		25 KVA(3-PH)	No	1655		10053	952		
		63 KVA (3-PH)	No	1300		13724	1866		
		100 KVA (3-PH)	No	150		7204	11084		
		200 KVA (3-PH)	No						
		250 KVA (3-PH)	No			13	104		
		315 KVA (3-PH)	No			1	0		
		450 KVA (3-PH)	No						
				3105	**0**	**30995**	**14006**	**0**	**0**
	Single phase Energy Meter whole current)	5 to 30 A	No	8500		1799712	395364		
	Three phase Energy Meter (whole current)	5 to 30 A	No			82057			
	Single phase Energy Meter (whole	5 to 60 A	No						

State wise aggregate Quantity Proposed under DDUGJY									
S. No.	Name of key material	Rating	Unit	Karnataka	Kerala	Madhya Pradesh	MAHARASHTRA	Manipur	Meghalaya
				BESCOM	KSEBL		MSEDCL	Power Deptt.	MeSEB
	current)								
	DTR Meter	5 to 60 A	No	108057	24877	8657	2080		3931
	Feeder Meter	5 to 60 A	No	4367	135	999	311		
	Single phase Energy Meter (whole current)	10 to 60 A	No						
	Three phase Energy Meter (whole current)	5 to 60 A	No						
Total Energy Meter				**120924**	**25012**	**1891425**	**397755**	**0**	**3931**
4	ACSR conductor	Squirrel (20 sqmm)	Km				0		
		Weasel (30 sqmm)	Km	750		87	29916		
		Rabbit (50 sqmm)	Km	3300	244	75578	81922		
		Racoon (75 sqmm)	Km	0	77	24	0		
		Dog (100 sqmm)	Km			3636	14468		
		Wolf (150 sqmm)	Km						
		Panther (200 sqmm)	Km				1102		
Total ACSR conductor				**4050**	**321**	**79325**	**127408**	**0**	**0**
5	AAAC conductor	Weasel - 30 sq mm	Km						
		Weasel - 34 sq mm	Km						
		Rabbit - 55 sq mm	Km						
		Racoon - 80 sq mm	Km						
		Dog - 100 sq mm	Km						
		Wolf- 148 sq mm	Km						
		Panther 232 sqmm	Km						
				0	**0**	**0**	**0**	**0**	**0**
6	UG Cable (XLPE CABLE 33 KV ARMOURED)	3C x 400 sqmm	Km						
		3X300 SQMM	Km						
	UG Cable	3X300 SQMM	Km						

State wise aggregate Quantity Proposed under DDUGJY									
S. No.	Name of key material	Rating	Unit	Karnataka	Kerala	Madhya Pradesh	MAHARASHTRA	Manipur	Meghalaya
				BESCOM	KSEBL		MSEDCL	Power Deptt.	MeSEB
	(XLPE CABLE 11 KV ARMOURED)	3X240 SQMM	Km						
		3X120 SQMM	Km						
		3X185 SQMM	Km						
Total UG Cable				**0**	**0**	**0**	**0**	**0**	**0**
7	LT Cable (XLPE Cable Armoured)	3.5x400 SQMM	kms.						
		3.5x240 SQMM	kms.						
		3.5x95 SQMM	kms.						
		3.5x70 SQMM	kms.						
		3.5x50 SQMM	kms.						
				0	**0**		**0**	**0**	**0**
9	11 KV AB Cable	3C x 50 sqmm	Km						
		3C x 95 sqmm	Km						
		3C x 120 sqmm	Km						
		3C x 185 sqmm	Km						
		3C x 200 sqmm	Km						
Total 11 kV Cable				**0**	**0**		**0**	**0**	**0**
10	LT AB Cable	3X95+1X70+1X16	Km				3874		
		3X95+1X70+1X120	Km						
		3X35+1X16+1X16	Km						
		3X50+1X35+1X16	Km	616		9445			
		3X35+1X35+1X16	Km			25			
		3X25+1X35+1X16	Km			8563			
		3X16+1X16+1X25	Km						
		2X16+25	Km						
		2X35+1X16	Km			14			
		2X25+1X16	Km			2660			
		1X16+1X25	Km						
		3X50+1X50	Km						
		3X95+1X70	Km				500		
		3X120+1X70+1X25	km				0		
		1X25+25	Km						
		3X120+1X95	Km						
				616	**0**	**20707**	**4374**	**0**	**0**

State wise aggregate Quantity Proposed under DDUGJY									
S. No.	Name of key material	Rating	Unit	Mizoram	Nagaland	Odisha			Punjab
				Power Deptt.	Power Deptt.	CESU	NESCO	SOUTHCO	PSEB
1	Power Transformer	1 MVA	No						
		1.6 MVA	No						
		2.5 MVA	No						
		3 MVA	No						
		3.15 MVA	No			1		6	
		5 MVA	No			10	19	13	
		6.3 MVA	No						
		8 MVA	No					2	
		10 MVA	No			8			
		12.5 MVA	No						
		20 MVA	No						
				0	**0**	**19**	**19**	**21**	**0**
2	Distribution transformer	5/6 KVA(1-PH)	No						
		10 KVA(1-PH)	No						68
		10 KVA(3-PH)	No			1			
		16 KVA(1-PH)	No			2			
		16 KVA(3-PH)	No			6			
		25 KVA(3-PH)	No			1489	586	1	63
		63 KVA (3-PH)	No			1430	168	520	782
		100 KVA (3-PH)	No			814	437	371	2084
		200 KVA (3-PH)	No						
		250 KVA (3-PH)	No			2	2	261	0
		315 KVA (3-PH)	No					2	
		450 KVA (3-PH)	No						
				0	**0**	**3744**	**1193**	**1155**	**2997**
	Single phase Energy Meter whole current)	5 to 30 A	No			576489	4,89,094	656028	
	Three phase Energy Meter (whole current)	5 to 30 A	No						
	Single phase Energy Meter	5 to 60 A	No						254304

State wise aggregate Quantity Proposed under DDUGJY									
S. No.	Name of key material	Rating	Unit	Mizoram	Nagaland	Odisha			Punjab
				Power Deptt.	Power Deptt.	CESU	NESCO	SOUTHCO	PSEB
	(whole current)								
	DTR Meter	5 to 60 A	No			20000	20000	23776	
	Feeder Meter	5 to 60 A	No			500	500	668	
	Single phase Energy Meter (whole current)	10 to 60 A	No						
	Three phase Energy Meter (whole current)	5 to 60 A	No						261
Total Energy Meter				**0**	**0**	**596989**	**509594**	**680472**	**254565**
4	ACSR conductor	Squirrel (20 sqmm)	Km						
		Weasel (30 sqmm)	Km						
		Rabbit (50 sqmm)	Km			933.25	131		1487
		Racoon (75 sqmm)	Km			1696	2,692		7034
		Dog (100 sqmm)	Km			1022	1,127		0
		Wolf (150 sqmm)	Km						
		Panther (200 sqmm)	Km			34	418		
Total ACSR conductor				**0**	**0**	**3685.25**	**4368**	**0**	**8521**
5	AAAC conductor	Weasel - 30 sq mm	Km					438.78	
		Weasel - 34 sq mm	Km						
		Rabbit - 55 sq mm	Km					2361.862	
		Racoon - 80 sq mm	Km					523.9095	
		Dog - 100 sq mm	Km					1816.126	
		Wolf- 148 sq mm	Km					63	
		Panther 232 sqmm	Km						
				0	**0**	**0**	**0**	**5203.6775**	**0**
6	UG Cable (XLPE CABLE 33 KV ARMOURED)	3C x 400 sqmm	Km						
		3X300 SQMM	Km						
	UG Cable	3X300 SQMM	Km						

State wise aggregate Quantity Proposed under DDUGJY									
S. No.	Name of key material	Rating	Unit	Mizoram	Nagaland	Odisha			Punjab
				Power Deptt.	Power Deptt.	CESU	NESCO	SOUTHCO	PSEB
	(XLPE CABLE 11 KV ARMOURED)	3X240 SQMM	Km						
		3X120 SQMM	Km						
		3X185 SQMM	Km				8		
Total UG Cable				**0**	**0**	**0**	**8**	**0**	**0**
7	LT Cable (XLPE Cable Armoured)	3.5x400 SQMM	kms.						
		3.5x240 SQMM	kms.						
		3.5x95 SQMM	kms.						
		3.5x70 SQMM	kms.						
		3.5x50 SQMM	kms.						
				0	**0**	**0**	**0**	**0**	**0**
9	11 KV AB Cable	3C x 50 sqmm	Km						
		3C x 95 sqmm	Km					766	
		3C x 120 sqmm	Km						
		3C x 185 sqmm	Km						
		3C x 200 sqmm	Km						
Total 11 kV Cable				**0**	**0**	**0**	**0**	**766**	**0**
10	LT AB Cable	3X95+1X70+1X16	Km						
		3X95+1X70+1X120	Km						
		3X35+1X16+1X16	Km						
		3X50+1X35+1X16	Km				1,575	598.38	
		3X35+1X35+1X16	Km				26		
		3X25+1X35+1X16	Km						
		3X16+1X16+1X25	Km						
		2X16+25	Km						
		2X35+1X16	Km					5.47	
		2X25+1X16	Km						
		1X16+1X25	Km						
		3X50+1X50	Km			1166			77
		3X95+1X70	Km			600			60
		3X120+1X70+1X25	km						
		1X25+25	Km			233			
		3X120+1X95	Km						
				0	**0**	**1999**	**1601**	**603.85**	**137**

State wise aggregate Quantity Proposed under DDUGJY										
S. No.	Name of key material	Rating	Unit	Rajasthan			Sikkim	Telangana	Tripura	Uttarakhand
				JDVVNL	AVVNL	JVVNL	Power Deptt.		TSECL	UPCL
1	Power Transformer	1 MVA	No							
		1.6 MVA	No							
		2.5 MVA	No							
		3 MVA	No							2
		3.15 MVA	No	3289	99	130				
		5 MVA	No	8	8					4
		6.3 MVA	No	0						
		8 MVA	No	0						1
		10 MVA	No	0						2
		12.5 MVA	No	0						
		20 MVA	No	0						
				3297	**107**	**130**	**0**	**0**	**0**	**9**
2	Distribution transformer	5/6 KVA(1-PH)	No	6866	2793					
		10 KVA(1-PH)	No	3219	1388					
		10 KVA(3-PH)	No	0	39					
		16 KVA(1-PH)	No	14403	6564	2694				
		16 KVA(3-PH)	No	40	800					
		25 KVA(3-PH)	No	148	1107				105	5000
		63 KVA (3-PH)	No	0	628	2357			61	130
		100 KVA (3-PH)	No	0	171					185
		200 KVA (3-PH)	No	0						
		250 KVA (3-PH)	No	0	1					20
		315 KVA (3-PH)	No	0						
		450 KVA (3-PH)	No	0						2
				24676	**13491**	**5051**	**0**	**0**	**166**	**5337**
	Single phase Energy Meter whole current)	5 to 30 A	No		309006	380532			165660	170745
	Three phase Energy Meter (whole current)	5 to 30 A	No							
	Single phase Energy Meter (whole current)	5 to 60 A	No							

State wise aggregate Quantity Proposed under DDUGJY										
S. No.	Name of key material	Rating	Unit	Rajasthan			Sikkim	Telangana	Tripura	Uttarakhand
				JDVVNL	AVVNL	JVVNL	Power Deptt.		TSECL	UPCL
	DTR Meter	5 to 60 A	No					290772	2786	
	Feeder Meter	5 to 60 A	No	2000	3000	3562		1338		
	Single phase Energy Meter (whole current)	10 to 60 A	No							
	Three phase Energy Meter (whole current)	5 to 60 A	No							1029
Total Energy Meter				**2000**	**312006**	**384094**	**0**	**292110**	**168446**	**171774**
4	ACSR conductor	Squirrel (20 sqmm)	Km	0						
		Weasel (30 sqmm)	Km	63875.8	3023.2	7031			134.09	3000.00
		Rabbit (50 sqmm)	Km	0	2163	42916				9000.00
		Racoon (75 sqmm)	Km	334						0.00
		Dog (100 sqmm)	Km	455	2898	3625				85.00
		Wolf (150 sqmm)	Km	0						
		Panther (200 sqmm)	Km	0						20.00
Total ACSR conductor				**64664.8**	**8084.2**	**53572**	**0**	**0**	**134.09**	**12105**
5	AAAC conductor	Weasel - 30 sq mm	Km							
		Weasel - 34 sq mm	Km							
		Rabbit - 55 sq mm	Km							
		Racoon - 80 sq mm	Km							
		Dog - 100 sq mm	Km							
		Wolf- 148 sq mm	Km							
		Panther 232 sqmm	Km							
				0	**0**	**0**	**0**	**0**	**0**	**0**
6	UG Cable (XLPE CABLE 33 KV ARMOURED)	3C x 400 sqmm	Km							1.00
		3X300 SQMM	Km							

State wise aggregate Quantity Proposed under DDUGJY										
S. No.	Name of key material	Rating	Unit	Rajasthan			Sikkim	Telangana	Tripura	Uttarakhand
				JDVVNL	AVVNL	JVVNL	Power Deptt.		TSECL	UPCL
	UG Cable (XLPE CABLE 11 KV ARMOURED)	3X300 SQMM	Km							7.00
		3X240 SQMM	Km							8.00
		3X120 SQMM	Km							5.00
		3X185 SQMM	Km							3.00
Total UG Cable				**0**	**0**	**0**	**0**	**0**	**0**	**23**
7	LT Cable (XLPE Cable Armoured)	3.5x400 SQMM	kms.							20.00
		3.5x240 SQMM	kms.							0.00
		3.5x95 SQMM	kms.							0.00
		3.5x70 SQMM	kms.							20.00
		3.5x50 SQMM	kms.							5.00
				0	**0**	**0**	**0**	**0**	**0**	**45**
9	11 KV AB Cable	3C x 50 sqmm	Km							
		3C x 95 sqmm	Km							
		3C x 120 sqmm	Km							
		3C x 185 sqmm	Km							3484.65
		3C x 200 sqmm	Km							
Total 11 kV Cable				**0**	**0**	**0**	**0**	**0**	**0**	**3484.65**
10	LT AB Cable	3X95+1X70+1X16	Km							3000.00
		3X95+1X70+1X120	Km							
		3X35+1X16+1X16	Km							
		3X50+1X35+1X16	Km	132.74	21.26				92.59	
		3X35+1X35+1X16	Km	0	200.13	350				4500.00
		3X25+1X35+1X16	Km	1462.9	4.1					
		3X16+1X16+1X25	Km		14.1					
		2X16+25	Km							
		2X35+1X16	Km	1836					183.9	
		2X25+1X16	Km	9654.36		34.64				
		1X16+1X25	Km							
		3X50+1X50	Km		4					
		3X95+1X70	Km							
		3X120+1X70+1X25	km							
		1X25+25	Km	6903	7858					
		3X120+1X95	Km							
				19989	**8101.59**	**384.64**	**0**	**0**	**276.49**	**7500**

State wise aggregate Quantity Proposed under DDUGJY									
S. No.	Name of key material	Rating	Unit	Uttar Pradesh				West Bengal	Total
				PuVVNL	PVVNL	MVVNL	DVVNL	WBSEDCL	
1	Power Transformer	1 MVA	No						0
		1.6 MVA	No						17
		2.5 MVA	No						0
		3 MVA	No						2
		3.15 MVA	No						3656
		5 MVA	No	148	156	149	205		9374
		6.3 MVA	No					722	853
		8 MVA	No						3
		10 MVA	No	122	53	14	104	26	524
		12.5 MVA	No						62
		20 MVA	No						0
				270	**209**	**163**	**309**	**748**	**14491**
2	Distribution transformer	5/6 KVA(1-PH)	No						9659
		10 KVA(1-PH)	No						4675
		10 KVA(3-PH)	No						41
		16 KVA(1-PH)	No				149		23877
		16 KVA(3-PH)	No						3262
		25 KVA(3-PH)	No	11910	5191	6295	7520	13532	200282
		63 KVA (3-PH)	No	16	2951	19	1056	9816	43918
		100 KVA (3-PH)	No		1609		2	1793	30942
		200 KVA (3-PH)	No						0
		250 KVA (3-PH)	No						406
		315 KVA (3-PH)	No						4
		450 KVA (3-PH)	No						2
				11926	**9751**	**6314**	**8727**	**25141**	**317068**
	Single phase Energy Meter whole current)	5 to 30 A	No	199452	192200	157617	180540	1397659	96,31,374
	Three phase Energy Meter (whole current)	5 to 30 A	No						135543
	Single phase Energy	5 to 60 A	No						254304

State wise aggregate Quantity Proposed under DDUGJY									
S. No.	Name of key material	Rating	Unit	Uttar Pradesh				West Bengal	Total
				PuVVNL	PVVNL	MVVNL	DVVNL	WBSEDCL	
	Meter (whole current)								
	DTR Meter	5 to 60 A	No	100000	100000	100000	114504	122597	1164311
	Feeder Meter	5 to 60 A	No	500	500	600	685	512	28347
	Single phase Energy Meter (whole current)	10 to 60 A	No	0		8215			8215
	Three phase Energy Meter (whole current)	5 to 60 A	No					37	1327
Total Energy Meter				**299952**	**292700**	**266432**	**295729**	**152085**	**11223421**
4	ACSR conductor	Squirrel (20 sqmm)	Km						5.5
		Weasel (30 sqmm)	Km	93.04		164.73	261.95	24566	182992.81
		Rabbit (50 sqmm)	Km	16782.69	51887.00	24586.23	45136.50	72186	571470.6
		Racoon (75 sqmm)	Km				0	57.35	23609.35
		Dog (100 sqmm)	Km	2324.24	5540.00	6079.58	3458.33	6084	74842.15
		Wolf (150 sqmm)	Km						550
		Panther (200 sqmm)	Km					0	2664
Total ACSR conductor				**19199.97**	**57427**	**30830.54**	**48856.78**	**102893.35**	**856134.41**
5	AAAC conductor	Weasel - 30 sq mm	Km						438.78
		Weasel - 34 sq mm	Km						1799.9
		Rabbit - 55 sq mm	Km						6714.46
		Racoon - 80 sq mm	Km						523.91
		Dog - 100 sq mm	Km						3846.53
		Wolf- 148 sq mm	Km						63
		Panther 232 sqmm	Km						0
				0	**0**	**0**	**0**	**0**	**13386.58**
6	UG Cable (XLPE CABLE 33 KV ARMOURE	3C x 400 sqmm	Km						1.00
		3X300 SQMM	Km		24		10.5		94

State wise aggregate Quantity Proposed under DDUGJY									
S. No.	Name of key material	Rating	Unit	Uttar Pradesh				West Bengal	Total
				PuVVNL	PVVNL	MVVNL	DVVNL	WBSEDCL	
	D)								
	UG Cable (XLPE CABLE 11 KV ARMOURED)	3X300 SQMM	Km	9.24	15	15.48	64.62		111
		3X240 SQMM	Km						8
		3X120 SQMM	Km		22				27
		3X185 SQMM	Km	51.56	85	40.83	83.76		330
Total UG Cable				**60.8**	**146**	**56.31**	**158.88**	**0**	**571**
7	LT Cable (XLPE Cable Armoured)	3.5x400 SQMM	kms.						20.00
		3.5x240 SQMM	kms.						0
		3.5x95 SQMM	kms.						0
		3.5x70 SQMM	kms.						20
		3.5x50 SQMM	kms.						5
				0	**0**	**0**	**0**	**0**	**45**
9	11 KV AB Cable	3C x 50 sqmm	Km						0
		3C x 95 sqmm	Km						976.45
		3C x 120 sqmm	Km		36				36
		3C x 185 sqmm	Km						3625.65
		3C x 200 sqmm	Km						0.43
Total 11 kV Cable				**0**	**36**	**0**	**0**	**0**	**4638.53**
10	LT AB Cable	3X95+1X70+1X16	Km		96				6970
		3X95+1X70+1X120	Km						25.35
		3X35+1X16+1X16	Km						0
		3X50+1X35+1X16	Km	10.15	110	26.34	128.66	22503	54321.12
		3X35+1X35+1X16	Km					84	5278.13
		3X25+1X35+1X16	Km						10030
		3X16+1X16+1X25	Km						14.1
		2X16+25	Km						2.5
		2X35+1X16	Km						2039.37
		2X25+1X16	Km						12454.73
		1X16+1X25	Km	35.41		42.38	117.76		195.5475
		3X50+1X50	Km						2507.8
		3X95+1X70	Km						4394
		3X120+1X70+1X25	km						0
		1X25+25	Km						14994
		3X120+1X95	Km						4100
				45.56	**206**	**68.72**	**246.4175**	**22587**	**117326.6475**

Aggregate Quantity of High Value Key Materials to be procured under IPDS Scheme			
S. No.	**Name of Material**	**Units**	**Aggregate Quantity Proposed under IPDS**
1	Power Transformers of 1.6 MVA	No.	4
2	Power Transformers of 2.5 MVA	No.	2
3	Power Transformers of 3.15 MVA	No.	108
4	Power Transformers of 5 MVA	No.	1,246
5	Power Transformers of 6.3 MVA	No.	44
6	Power Transformers of 8 MVA	No.	503
7	Power Transformers of 10 MVA	No.	854
8	Power Transformers of 12 MVA	No.	28
9	Power Transformers of 12.5 MVA	No.	7
10	Power Transformer 66/11KV, 15 MVA	No.	44
11	Power Transformers of 16 MVA	No.	14
12	Power Transformers of 20 MVA	No.	14
13	Power Transformers of 25 MVA	No.	28
Total		**No.**	**2,896**
1	Distribution Transformers of 5 KVA	No.	14
2	Distribution Transformers of 10 KVA	No.	89
3	Distribution Transformers of 15 KVA	No.	25
4	Distribution Transformers of 16 KVA	No.	1,059
5	Distribution Transformers of 25 KVA	No.	10,523
6	Distribution Transformers of 40 KVA	No.	5,250
7	Distribution Transformers of 63 KVA	No.	10,091
8	Distribution Transformers of 100 KVA	No.	43,120
9	Distribution Transformers of 150 KVA	No.	12
10	Distribution Transformers of 160 KVA	No.	3,511
11	Distribution Transformers of 200 KVA	No.	13,530
12	Distribution Transformers of 250 KVA	No.	5,172
13	Distribution Transformers of 315 KVA	No.	4,029
14	Distribution Transformers of 400 KVA	No.	2,980
15	Distribution Transformers of 500 KVA	No.	660
16	Distribution Transformers of 630 KVA	No.	543
17	Distribution Transformers of 990 KVA	No.	23
Total		**No.**	**100,631**
1	Conductors (ACSR/AAAC/AAC) - 2.59sq mm	Km.	138
2	Conductors (ACSR/AAAC/AAC) - 3.35 sq mm	Km.	301
3	Conductors (ACSR/AAAC/AAC) - 30 sq mm We	Km.	12,726
4	Conductors (ACSR/AAAC/AAC) - 34 sq mm	Km.	7,852
5	Conductors (ACSR/AAAC/AAC) - 50 sq mm R	Km.	96,770
6	Conductors (ACSR/AAAC/AAC) - 55 sq mm	Km.	24,142
7	Conductors (ACSR/AAAC/AAC) - 80 sq mm Rac	Km.	14,711
8	Conductors (ACSR/AAAC/AAC) - 100 sq mm D	Km.	71,903
9	Conductors (ACSR/AAAC/AAC) - 135 sq mm	Km.	149
10	Conductors (ACSR/AAAC/AAC) - 150 sq mm Wo	Km.	14,811
11	Conductors (ACSR/AAAC/AAC) - 200 sq mm P	Km.	1,961
12	Conductor ACSR (20/30/50 mm sq.) with AAAC 7/4.26 mm sq. (or ACSR 100 mm^2)	Km.	1,265
Total		**Km.**	**246,730**
1	LT Aerial Bunched Cables (various sizes)	Km.	54,605

Aggregate Quantity of High Value Key Materials to be procured under IPDS Scheme			
S. No	**Name of Material**	**Units**	**Aggregate Quantity Proposed under IPDS**
Total		**Km.**	**54,605**
1	HT Aerial Bunched Cables (Various Sizes)	Km.	**13,859**
Total		**Km.**	**13,859**
1	HT UG Cables (Various Sizes)		**10,165**
Total		**Km.**	**10,165**
1	Energy Meters (Feeder/Boundary/DT)	No.	158,773
2	Energy Meters (1 Phase Consumers)	No.	8,170,762
3	Energy Meters (3 Phase Consumers)	No.	538,985
4	Prepaid / smart meters in Govt. establishment	No.	99,409
5	Feeder Metering	No.	included in item-1
Total		**Km.**	**8,967,929**

State wise aggregate Quantity Proposed under IPDS Scheme							
S. No.	Name of Material	AP		Bihar		CHG	Goa
		APEPDCL	SPDCAPL	NBPDCL	SBPDCL	CSPDCL	ED
1	Power Transformers of 1.6 MVA					2	
2	Power Transformers of 2.5 MVA						
3	Power Transformers of 3.15 MVA	0	0	0	0	48	
4	Power Transformers of 5 MVA	49	53	34	8	74	
5	Power Transformers of 6.3 MVA						
6	Power Transformers of 8 MVA	26	60	0	0	0	
7	Power Transformers of 10 MVA			67	123		
8	Power Transformers of 12 MVA	0	0	0	0	0	
9	Power Transformers of 12.5 MVA						
10	Power Transformer 66/11KV, 15 MVA						
11	Power Transformers of 16 MVA						
12	Power Transformers of 20 MVA	0	0	0	0	0	
13	Power Transformers of 25 MVA						
	Total	**75**	**113**	**101**	**131**	**124**	**0**
1	Distribution Transformers of 5 KVA						
2	Distribution Transformers of 10 KVA						
3	Distribution Transformers of 15 KVA						
4	Distribution Transformers of 16 KVA					22	
5	Distribution Transformers of 25 KVA	6	0	0	0	132	
6	Distribution Transformers of 40 KVA	455	0				
7	Distribution Transformers of 63 KVA	259	105	172	0	1110	
8	Distribution Transformers of 100 KVA	869	920	1203	462	1687	
9	Distribution Transformers of 150 KVA						
10	Distribution Transformers of 160 KVA	639	189				
11	Distribution Transformers of 200 KVA			2550	1060	662	
12	Distribution Transformers of 250 KVA						
13	Distribution Transformers of 315 KVA	61	90	271	1031	10	
14	Distribution Transformers of 400 KVA						
15	Distribution Transformers of 500 KVA			20	50		
16	Distribution Transformers of 630 KVA						
17	Distribution Transformers of 990 KVA						
	Total	**2289**	**1304**	**4216**	**2603**	**3623**	**0**
1	Conductors (ACSR/AAAC/AAC) - 2.59sq mm						
2	Conductors (ACSR/AAAC/AAC) - 3.35 sq mm						
3	Conductors (ACSR/AAAC/AAC) - 30 sq mm We			1275	1481		
4	Conductors (ACSR/AAAC/AAC) - 34 sq mm	356	505				

State wise aggregate Quantity Proposed under IPDS Scheme							
S. No.	Name of Material	AP		Bihar		CHG	Goa
		APEPDCL	SPDCAPL	NBPDCL	SBPDCL	CSPDCL	ED
5	Conductors (ACSR/AAAC/AAC) - 50 sq mm R			4990	5090	5030	
6	Conductors (ACSR/AAAC/AAC) - 55 sq mm	3128	1710				
7	Conductors (ACSR/AAAC/AAC) - 80 sq mm Rac					273	
8	Conductors (ACSR/AAAC/AAC) - 100 sq mm D	984	602	2014	1636	1634	
9	Conductors (ACSR/AAAC/AAC) - 135 sq mm					149	
10	Conductors (ACSR/AAAC/AAC) - 150 sq mm Wo			2254	2542		
11	Conductors (ACSR/AAAC/AAC) - 200 sq mm P						
12	Conductor ACSR (20/30/50 mm sq.) with AAAC 7/4.26 mm sq. (or ACSR 100 mm^2)						
	Total	**4467**	**2817**	**10534**	**10749**	**7086**	**0**
1	LT Aerial Bunched Cables (Various Sizes)	28	101	2423	2255	3261	
	Total	**28**	**101**	**2423**	**2255**	**3261**	**0**
1	HT Aerial Bunched Cables (Various Sizes)	**0**	**89**	**239**	**411**	**70**	**0**
	Toal	**0**	**89**	**239**	**411**	**70**	**0**
1	HT UG Cables (Various Sizes)	**0**	**33**	**86**	**327**	**23**	**0**
	Total	**0**	**33**	**86**	**327**	**23**	**0**
1	Energy Meters (Feeder/Boundary/DT)	2400	5936	5521	2464	2453	1610
2	Energy Meters (1 Phase Consumers)	413113	0	99901	113999	…..	51700
3	Energy Meters (3 Phase Consumers)	13028	0	9594	8939	…..	
4	Prepaid / smart meters in Govt. establishment						
5	Feeder Metering						
	Total	**428541**	**5936**	**115016**	**125402**	**2453**	**53310**

State wise aggregate Quantity Proposed under IPDS Scheme										
S. No.	Name of Material	Gujarat				Haryana		HP	J & K	JHK
		DGVCL	MGVCL	PGVCL	UGVCL	DHBVN	UHBVN	HPSEBL	JKPDCL	JBVNL
1	Power Transformers of 1.6 MVA							2		
2	Power Transformers of 2.5 MVA									
3	Power Transformers of 3.15 MVA								2	0
4	Power Transformers of 5 MVA									73
5	Power Transformers of 6.3 MVA							2	25	
6	Power Transformers of 8 MVA									
7	Power Transformers of 10 MVA			8		5		0	65	50
8	Power Transformers of 12 MVA									0
9	Power Transformers of 12.5 MVA					1				
10	Power Transformer 66/11KV, 15 MVA	20	24							
11	Power Transformers of 16 MVA									
12	Power Transformers of 20 MVA	14								0
13	Power Transformers of 25 MVA									
	Total	**34**	**24**	**8**	**0**	**6**	**0**	**4**	**92**	**123**
1	Distribution Transformers of 5 KVA	0	14							
2	Distribution Transformers of 10 KVA		49		40					
3	Distribution Transformers of 15 KVA									
4	Distribution Transformers of 16 KVA		81	35				6	0	
5	Distribution Transformers of 25 KVA	65	118		5	2		54	1275	51
6	Distribution Transformers of 40 KVA									
7	Distribution Transformers of 63 KVA	39	12	1457		3	39	90	140	162
8	Distribution Transformers of 100 KVA	165	352	1528	119	751	274	227	698	1183
9	Distribution Transformers of 150 KVA									
10	Distribution Transformers of 160 KVA									
11	Distribution Transformers of 200 KVA	120		770	48	1341	211			1331
12	Distribution Transformers of 250 KVA							213	331	
13	Distribution Transformers of 315 KVA				19					
14	Distribution Transformers of 400 KVA						14	30	61	
15	Distribution Transformers of 500 KVA				15					262
16	Distribution Transformers of 630 KVA							19	0	

State wise aggregate Quantity Proposed under IPDS Scheme										
S. No.	Name of Material	Gujarat				Haryana		HP	J & K	JHK
		DGVCL	MGVCL	PGVCL	UGVCL	DHBVN	UHBVN	HPSEBL	JKPDCL	JBVNL
17	Distribution Transformers of 990 KVA									
	Total	**389**	**626**	**3790**	**246**	**2097**	**538**	**639**	**2505**	**2989**
1	Conductors (ACSR/AAAC/AAC) - 2.59sq mm									
2	Conductors (ACSR/AAAC/AAC) - 3.35 sq mm									
3	Conductors (ACSR/AAAC/AAC) - 30 sq mm We								481	1573
4	Conductors (ACSR/AAAC/AAC) - 34 sq mm	4								
5	Conductors (ACSR/AAAC/AAC) - 50 sq mm R					2841	71	706	3709	4691
6	Conductors (ACSR/AAAC/AAC) - 55 sq mm	200	2033	518						
7	Conductors (ACSR/AAAC/AAC) - 80 sq mm Rac					10	382	54		
8	Conductors (ACSR/AAAC/AAC) - 100 sq mm D	40	661	138	92				1162	3454
9	Conductors (ACSR/AAAC/AAC) - 135 sq mm									
10	Conductors (ACSR/AAAC/AAC) - 150 sq mm Wo					124			650	1970
11	Conductors (ACSR/AAAC/AAC) - 200 sq mm P								344	14
12	Conductor ACSR (20/30/50 mm sq.) with AAAC 7/4.26 mm sq. (or ACSR 100 mm²)							1265		
	Total	**244**	**2694**	**656**	**92**	**2975**	**453**	**2026**	**6347**	**11702**
1	LT Aerial Bunched Cables (Various Sizes)		2835	2050	684	279	563	240	2577	1728
	Total	**0**	**2835**	**2050**	**684**	**279**	**563**	**240**	**2577**	**1728**
1	HT Aerial Bunched Cables (Various Sizes)	**1506**	**3280**	**157**	**397**	**412**	**26**	**180**	**346**	**0**
	Toal	**1506**	**3280**	**157**	**397**	**412**	**26**	**180**	**346**	**0**
1	HT UG Cables (Various Sizes)	**0**	**454**	**696**	**0**	**272**	**5**	**1**	**3**	**164**
	Total	**0**	**454**	**696**	**0**	**272**	**5**	**1**	**3**	**164**
1	Energy Meters (Feeder/Boundary/DT)		6801	3995	803	7	114	823	4619	3467
2	Energy Meters (1 Phase Consumers)	370000	254465	254643	72581		37652	46881	125865	126470
3	Energy Meters (3 Phase Consumers)	360	5377	427	2845		3051	763	2819	3337
4	Prepaid / smart meters in Govt. establishment	350	2631	13277					460	
5	Feeder Metering									
	Total	**37710**	**269274**	**272342**	**76229**	**7**	**40817**	**48467**	**133763**	**133274**

State wise aggregate Quantity Proposed under IPDS Scheme									
S. No.	Name of Material	Karnataka					Kerala	Maharashtra	
		BESCOM	CESCOM	GESCOM	HESCOM	MESCOM	KSEBL	MESDCL	BEST
1	Power Transformers of 1.6 MVA								
2	Power Transformers of 2.5 MVA								
3	Power Transformers of 3.15 MVA							0	
4	Power Transformers of 5 MVA			8	2		4	158	
5	Power Transformers of 6.3 MVA								
6	Power Transformers of 8 MVA						2	99	
7	Power Transformers of 10 MVA						8		
8	Power Transformers of 12 MVA							3	5
9	Power Transformers of 12.5 MVA								
10	Power Transformer 66/11KV, 15 MVA								
11	Power Transformers of 16 MVA						7		
12	Power Transformers of 20 MVA							0	
13	Power Transformers of 25 MVA								
	Total	**0**	**0**	**8**	**2**	**0**	**21**	**260**	**5**
1	Distribution Transformers of 5 KVA								
2	Distribution Transformers of 10 KVA								
3	Distribution Transformers of 15 KVA								
4	Distribution Transformers of 16 KVA								
5	Distribution Transformers of 25 KVA	164		10	43	66			
6	Distribution Transformers of 40 KVA								
7	Distribution Transformers of 63 KVA	362	1695	233	445	809		381	
8	Distribution Transformers of 100 KVA	1011	967	637	731	75	747	3668	
9	Distribution Transformers of 150 KVA								
10	Distribution Transformers of 160 KVA						66		
11	Distribution Transformers of 200 KVA							3481	
12	Distribution Transformers of 250 KVA	329		0	4		57		
13	Distribution Transformers of 315 KVA							845	
14	Distribution Transformers of 400 KVA								
15	Distribution Transformers of 500 KVA	30					9		
16	Distribution Transformers of 630 KVA							500	24
17	Distribution Transformers of 990 KVA		23						
	Total	**1896**	**2685**	**880**	**1223**	**950**	**879**	**8875**	**24**

State wise aggregate Quantity Proposed under IPDS Scheme									
S. No.	Name of Material	Karnataka					Kerala	Maharashtra	
		BESCOM	CESCOM	GESCOM	HESCOM	MESCOM	KSEBL	MESDCL	BEST
1	Conductors (ACSR/AAAC/AAC) - 2.59sq mm								
2	Conductors (ACSR/AAAC/AAC) - 3.35 sq mm								
3	Conductors (ACSR/AAAC/AAC) - 30 sq mm We	72	132	90			3350		
4	Conductors (ACSR/AAAC/AAC) - 34 sq mm								
5	Conductors (ACSR/AAAC/AAC) - 50 sq mm R	7497	1513	2046	7152	4779	6959	4933	
6	Conductors (ACSR/AAAC/AAC) - 55 sq mm								
7	Conductors (ACSR/AAAC/AAC) - 80 sq mm Rac						1639	5005	
8	Conductors (ACSR/AAAC/AAC) - 100 sq mm D							5576	22
9	Conductors (ACSR/AAAC/AAC) - 135 sq mm								
10	Conductors (ACSR/AAAC/AAC) - 150 sq mm Wo								
11	Conductors (ACSR/AAAC/AAC) - 200 sq mm P								
12	Conductor ACSR (20/30/50 mm sq.) with AAAC 7/4.26 mm sq. (or ACSR 100 mm^2)								
	Total	**7569**	**1645**	**2136**	**7152**	**4779**	**11948**	**15515**	**22**
1	LT Aerial Bunched Cables (Various Sizes)	205	393	1732	145		444	1965	
	Total	**205**	**393**	**1732**	**145**	**0**	**444**	**1965**	**0**
1	HT Aerial Bunched Cables (Various Sizes)	**285**	**461**	**419**	**0**	**0**	**684**	**212**	**0**
	Toal	**285**	**461**	**419**	**0**	**0**	**684**	**212**	**0**
1	HT UG Cables (Various Sizes)	**483**	**62**	**80**	**0**	**0**	**278**	**2953**	
	Total	**483**	**62**	**80**	**0**	**0**	**278**	**2953**	**0**
1	Energy Meters (Feeder/Boundary/DT)	3961	1126	1275	975	3343	2730	14180	
2	Energy Meters (1 Phase Consumers)	33354	113510	107485	350734	192659	461309	535652	4500
3	Energy Meters (3 Phase Consumers)	706	7709	1982	22227	13951	37986	53104	
4	Prepaid / smart meters in Govt. establishment						20095		
5	Feeder Metering								
	Total	**38021**	**122345**	**110742**	**373936**	**209953**	**522120**	**602936**	**4500**

State wise aggregate Quantity Proposed under IPDS Scheme									
S. No.	Name of Material	MP			Punjab	Puducherry	Rajasthan		
		MPMKVVCL	MPPoKVVCL	MPPsKVVCL	PSPCL	Pudu	AVVNL	JDVVNL	JVVNL
1	Power Transformers of 1.6 MVA								
2	Power Transformers of 2.5 MVA								
3	Power Transformers of 3.15 MVA	0	0	0			14	33	1
4	Power Transformers of 5 MVA	20	61	2			116	85	87
5	Power Transformers of 6.3 MVA								
6	Power Transformers of 8 MVA	1	27	10			30	9	55
7	Power Transformers of 10 MVA	1							
8	Power Transformers of 12 MVA	0	0	0				0	
9	Power Transformers of 12.5 MVA								
10	Power Transformer 66/11KV, 15 MVA								
11	Power Transformers of 16 MVA								
12	Power Transformers of 20 MVA	0	0	0				0	
13	Power Transformers of 25 MVA								
	Total	**22**	**88**	**12**	**0**	**0**	**160**	**127**	**143**
1	Distribution Transformers of 5 KVA								
2	Distribution Transformers of 10 KVA								
3	Distribution Transformers of 15 KVA								
4	Distribution Transformers of 16 KVA						215		
5	Distribution Transformers of 25 KVA		275			15	3	8	
6	Distribution Transformers of 40 KVA								
7	Distribution Transformers of 63 KVA	51		44				230	71
8	Distribution Transformers of 100 KVA	929	1436	1137	2660		724	1033	636
9	Distribution Transformers of 150 KVA								
10	Distribution Transformers of 160 KVA						202	79	1272
11	Distribution Transformers of 200 KVA	98	255	641	866	30			
12	Distribution Transformers of 250 KVA						10	164	
13	Distribution Transformers of 315 KVA	16	38	231			115	321	508
14	Distribution Transformers of 400 KVA								
15	Distribution Transformers of 500 KVA							68	

State wise aggregate Quantity Proposed under IPDS Scheme									
S. No.	Name of Material	MP			Punjab	Puducherry	Rajasthan		
		MPMKVVCL	MPPoKVVCL	MPPsKVVCL	PSPCL	Pudu	AVVNL	JDVVNL	JVVNL
16	Distribution Transformers of 630 KVA								
17	Distribution Transformers of 990 KVA								
	Total	**1094**	**2004**	**2053**	**3526**	**45**	**1269**	**1903**	**2487**
1	Conductors (ACSR/AAAC/AAC) - 2.59sq mm								
2	Conductors (ACSR/AAAC/AAC) - 3.35 sq mm								
3	Conductors (ACSR/AAAC/AAC) - 30 sq mm We			1210			278	56	
4	Conductors (ACSR/AAAC/AAC) - 34 sq mm								
5	Conductors (ACSR/AAAC/AAC) - 50 sq mm R	220		1832		19	655	1904	1682
6	Conductors (ACSR/AAAC/AAC) - 55 sq mm								
7	Conductors (ACSR/AAAC/AAC) - 80 sq mm Rac	8			669				
8	Conductors (ACSR/AAAC/AAC) - 100 sq mm D	248	3923	3824	1384		2255	1242	1876
9	Conductors (ACSR/AAAC/AAC) - 135 sq mm								
10	Conductors (ACSR/AAAC/AAC) - 150 sq mm Wo	2							
11	Conductors (ACSR/AAAC/AAC) - 200 sq mm P	92					311	66	60
12	Conductor ACSR (20/30/50 mm sq.) with AAAC 7/4.26 mm sq. (or ACSR 100 mm²)								
	Total	**570**	**3923**	**6866**	**2053**	**19**	**3498**	**3269**	**3618**
1	LT Aerial Bunched Cables (Various Sizes)	1223	2638	3328	541	8	1254	151	814
	Total	**1223**	**2638**	**3328**	**541**	**8**	**1254**	**151**	**814**
1	HT Aerial Bunched Cables (Various Sizes)	**42**	**1709**	**23**	**0**	**0**	**0**	**0**	**91**
	Toal	**42**	**1709**	**23**	**0**	**0**	**0**	**0**	**91**
1	HT UG Cables (Various Sizes)	**14**	**69**	**13**	**349**	**14**	**23**	**577**	**523**
	Total	**14**	**69**	**13**	**349**	**14**	**23**	**577**	**523**
1	Energy Meters (Feeder/Boundary/DT)	1098	143	**5211**	1266	4	1637	9265	1895
2	Energy Meters (1 Phase Consumers)	145553	147203	**236670**	16245	30000	159700	92068	3905
3	Energy Meters (3 Phase Consumers)	13338	10999	**6620**		5000	595	9428	4830
4	Prepaid / smart meters in Govt. establishment						1597		
5	Feeder Metering								
	Total	**159989**	**158345**	**248501**	**17511**	**35004**	**163529**	**110761**	**10630**

State wise aggregate Quantity Proposed under IPDS Scheme										
S. No.	Name of Material	Sikkim	Telengana		TamilNadu	UP				
		Sikkim	NPDCTL	SPDCTL	TNG&DC	DVVNL	PuVVNL	MVVNL	PsVVNL	Kesco
1	Power Transformers of 1.6 MVA									
2	Power Transformers of 2.5 MVA									
3	Power Transformers of 3.15 MVA							0		
4	Power Transformers of 5 MVA		40			33	91	114	64	3
5	Power Transformers of 6.3 MVA									
6	Power Transformers of 8 MVA		15	21	125			0		
7	Power Transformers of 10 MVA					22	106	7	107	54
8	Power Transformers of 12 MVA		0	20						
9	Power Transformers of 12.5 MVA									
10	Power Transformer 66/11KV, 15 MVA									
11	Power Transformers of 16 MVA				7					
12	Power Transformers of 20 MVA				0			0		
13	Power Transformers of 25 MVA									
	Total	**0**	**55**	**41**	**132**	**55**	**197**	**121**	**171**	**57**
1	Distribution Transformers of 5 KVA									
2	Distribution Transformers of 10 KVA									
3	Distribution Transformers of 15 KVA		25							
4	Distribution Transformers of 16 KVA		9		691					
5	Distribution Transformers of 25 KVA		185	14	6966					
6	Distribution Transformers of 40 KVA				4795					
7	Distribution Transformers of 63 KVA		227		1567	19	67			
8	Distribution Transformers of 100 KVA		668	3040	963	1550	232	743		
9	Distribution Transformers of 150 KVA									
10	Distribution Transformers of 160 KVA		109	890						
11	Distribution Transformers of 200 KVA				11					
12	Distribution Transformers of 250 KVA				2	515	348	342	2358	60
13	Distribution Transformers of 315 KVA			160						
14	Distribution Transformers of 400 KVA						121		1700	1000
15	Distribution Transformers of 500 KVA			70						
16	Distribution Transformers of 630 KVA									

State wise aggregate Quantity Proposed under IPDS Scheme										
S. No.	Name of Material	Sikkim	Telengana		TamilNadu	UP				
		Sikkim	NPDCTL	SPDCTL	TNG&DC	DVVNL	PuVVNL	MVVNL	PsVVNL	Kesco
17	Distribution Transformers of 990 KVA									
	Total	0	1223	4174	14995	2084	768	1085	4058	1060
1	Conductors (ACSR/AAAC/AAC) - 2.59sq mm									
2	Conductors (ACSR/AAAC/AAC) - 3.35 sq mm									
3	Conductors (ACSR/AAAC/AAC) - 30 sq mm We				2717	5	6			
4	Conductors (ACSR/AAAC/AAC) - 34 sq mm		3499	3489						
5	Conductors (ACSR/AAAC/AAC) - 50 sq mm R				18927	1				
6	Conductors (ACSR/AAAC/AAC) - 55 sq mm		7899	8587						
7	Conductors (ACSR/AAAC/AAC) - 80 sq mm Rac				6125	1				155
8	Conductors (ACSR/AAAC/AAC) - 100 sq mm D		186	441	1487	6494	968	5937	12574	958
9	Conductors (ACSR/AAAC/AAC) - 135 sq mm									
10	Conductors (ACSR/AAAC/AAC) - 150 sq mm Wo									
11	Conductors (ACSR/AAAC/AAC) - 200 sq mm P						71			773
12	Conductor ACSR (20/30/50 mm sq.) with AAAC 7/4.26 mm sq. (or ACSR 100 mm^2)									
	Total		11584	12516	29256	6502	1045	5937	12574	1885
1	LT Aerial Bunched Cables (Various Sizes)		254	291	168	2380	885	2773	1312	557
	Total		254	291	168	2380	885	2773	1312	557
1	HT Aerial Bunched Cables (Various Sizes)	0	0	155	101	0	0	0	400	0
	Toal	0	0	155	101	0	0	0	400	0
1	HT UG Cables (Various Sizes)	0	0	143	309	590	183	30	240	137
	Total	0	0	143	309	590	183	30	240	137
1	Energy Meters (Feeder/Boundary/DT)		1603	6925	38507	7515	262	71	2285	
2	Energy Meters (1 Phase Consumers)		85967	42500	198192	149648	65018	0		1500
3	Energy Meters (3 Phase Consumers)			3060	272293	1564	7000	0		500
4	Prepaid / smart meters in Govt. establishment					22684				
5	Feeder Metering									
	Total	0	87570	52485	2292722	181411	72280	71	2285	2000

State wise aggregate Quantity Proposed under IPDS Scheme							
S. No.	Name of Material	UK	WB	Assam	Manipur	Nagaland	Tripura
		UPCL	WBSDCL	APDCL	Power Deptt.	Power Deptt.	TSECL
1	Power Transformers of 1.6 MVA						
2	Power Transformers of 2.5 MVA			2			
3	Power Transformers of 3.15 MVA	1		4	5		0
4	Power Transformers of 5 MVA	14		45	1		0
5	Power Transformers of 6.3 MVA		17				
6	Power Transformers of 8 MVA	9					1
7	Power Transformers of 10 MVA	19	183	29			
8	Power Transformers of 12 MVA						0
9	Power Transformers of 12.5 MVA						
10	Power Transformer 66/11KV, 15 MVA	0					
11	Power Transformers of 16 MVA						
12	Power Transformers of 20 MVA	0					0
13	Power Transformers of 25 MVA						
	Total	**43**	**200**	**80**	**6**	**0**	**1**
1	Distribution Transformers of 5 KVA						
2	Distribution Transformers of 10 KVA						
3	Distribution Transformers of 15 KVA						
4	Distribution Transformers of 16 KVA						
5	Distribution Transformers of 25 KVA	38					
6	Distribution Transformers of 40 KVA						
7	Distribution Transformers of 63 KVA	70		3	24		
8	Distribution Transformers of 100 KVA	231	6823	778	132		240
9	Distribution Transformers of 150 KVA						
10	Distribution Transformers of 160 KVA						
11	Distribution Transformers of 200 KVA						
12	Distribution Transformers of 250 KVA	32		235	11		
13	Distribution Transformers of 315 KVA						
14	Distribution Transformers of 400 KVA	7					
15	Distribution Transformers of 500 KVA						
16	Distribution Transformers of 630 KVA						
17	Distribution Transformers of 990 KVA						
	Total	**378**	**6823**	**1016**	**167**	**0**	**240**
1	Conductors (ACSR/AAAC/AAC) - 2.59sq mm						
2	Conductors (ACSR/AAAC/AAC) - 3.35 sq mm						69
3	Conductors (ACSR/AAAC/AAC) - 30 sq mm We						
4	Conductors (ACSR/AAAC/AAC) - 34 sq mm						

State wise aggregate Quantity Proposed under IPDS Scheme							
S. No.	Name of Material	UK	WB	Assam	Manipur	Nagaland	Tripura
		UPCL	WBSDCL	APDCL	Power Deptt.	Power Deptt.	TSECL
5	Conductors (ACSR/AAAC/AAC) - 50 sq mm R	306	9214				
6	Conductors (ACSR/AAAC/AAC) - 55 sq mm						
7	Conductors (ACSR/AAAC/AAC) - 80 sq mm Rac	390					
8	Conductors (ACSR/AAAC/AAC) - 100 sq mm D	834	8905		137		7
9	Conductors (ACSR/AAAC/AAC) - 135 sq mm						
10	Conductors (ACSR/AAAC/AAC) - 150 sq mm Wo		5529				
11	Conductors (ACSR/AAAC/AAC) - 200 sq mm P	40			38		
12	Conductor ACSR (20/30/50 mm sq.) with AAAC 7/4.26 mm sq. (or ACSR 100 mm^2)						
	Total	**1569**	**23648**	**0**	**175**	**0**	**76**
1	LT Aerial Bunched Cables (Various Sizes)	639	8554	542	784		
	Total	**639**	**8554**	**542**	**784**	**0**	**0**
1	HT Aerial Bunched Cables (Various Sizes)	**150**	**1795**	**78**	**0**	**0**	**99**
	Toal	**150**	**1795**	**78**	**0**	**0**	**99**
1	HT UG Cables (Various Sizes)	**11**	**633**	**23**	**0**	**0**	**0**
	Total	**11**	**633**	**23**	**0**	**0**	**0**
1	Energy Meters (Feeder/Boundary/DT)	53	267	109	653	757	**3913**
2	Energy Meters (1 Phase Consumers)	3616	1309532	50017	0	61200	**20482**
3	Energy Meters (3 Phase Consumers)	185	1000	2058	0	6800	**4110**
4	Prepaid / smart meters in Govt. establishment				35460		**2855**
5	Feeder Metering						
	Total	**3854**	**1310799**	**52184**	**36113**	**68000**	**31360**

State wise aggregate Quantity Proposed under IPDS Scheme									
S. No.	Name of Material	ArP	Delhi			Odisha				Total
		Power Deptt.	BRPL	BYPL	TDPL	CESU	NESCO	Southco	Wesco	
1	Power Transformers of 1.6 MVA									4
2	Power Transformers of 2.5 MVA									2
3	Power Transformers of 3.15 MVA									108
4	Power Transformers of 5 MVA	2							5	1246
5	Power Transformers of 6.3 MVA									44
6	Power Transformers of 8 MVA						10		3	503

State wise aggregate Quantity Proposed under IPDS Scheme										
S. No.	Name of Material	ArP	Delhi			Odisha				Total
		Power Deptt.	BR PL	BY PL	TD PL	CE SU	NES CO	Sout hco	Wes co	
7	Power Transformers of 10 MVA									854
8	Power Transformers of 12 MVA									28
9	Power Transformers of 12.5 MVA						1		5	7
10	Power Transformer 66/11KV, 15 MVA									44
11	Power Transformers of 16 MVA									14
12	Power Transformers of 20 MVA									14
13	Power Transformers of 25 MVA		13	9	6					28
	Total	**2**	**13**	**9**	**6**	**0**	**11**	**0**	**13**	**2896**
1	Distribution Transformers of 5 KVA									14
2	Distribution Transformers of 10 KVA									89
3	Distribution Transformers of 15 KVA									25
4	Distribution Transformers of 16 KVA									1059
5	Distribution Transformers of 25 KVA				987				41	10523
6	Distribution Transformers of 40 KVA									5250
7	Distribution Transformers of 63 KVA	121			84					10091
8	Distribution Transformers of 100 KVA	97			96		663		35	43120
9	Distribution Transformers of 150 KVA	12								12
10	Distribution Transformers of 160 KVA				65					3511
11	Distribution Transformers of 200 KVA	55								13530
12	Distribution Transformers of 250 KVA	21			140					5172
13	Distribution Transformers of 315 KVA	1			59				253	4029
14	Distribution Transformers of 400 KVA				47					2980
15	Distribution Transformers of 500 KVA								136	660
16	Distribution Transformers of 630 KVA									543
17	Distribution Transformers of 990 KVA									23
	Total	**307**	**0**	**0**	**1478**	**0**	**663**	**0**	**465**	**100631**
1	Conductors (ACSR/AAAC/AAC) - 2.59sq mm	138								138
2	Conductors (ACSR/AAAC/AAC) - 3.35 sq mm	232								301
3	Conductors (ACSR/AAAC/AAC) - 30 sq mm We									12726
4	Conductors (ACSR/AAAC/AAC) - 34 sq mm									7852

State wise aggregate Quantity Proposed under IPDS Scheme										
S. No.	Name of Material	ArP	Delhi			Odisha				Total
		Power Deptt.	BRPL	BYPL	TDPL	CESU	NESCO	Southco	Wesco	
5	Conductors (ACSR/AAAC/AAC) - 50 sq mm R									96770
6	Conductors (ACSR/AAAC/AAC) - 55 sq mm							67		24142
7	Conductors (ACSR/AAAC/AAC) - 80 sq mm Rac									14711
8	Conductors (ACSR/AAAC/AAC) - 100 sq mm D							207		71903
9	Conductors (ACSR/AAAC/AAC) - 135 sq mm									149
10	Conductors (ACSR/AAAC/AAC) - 150 sq mm Wo						893	847		14811
11	Conductors (ACSR/AAAC/AAC) - 200 sq mm P						153			1961
12	Conductor ACSR (20/30/50 mm sq.) with AAAC 7/4.26 mm sq. (or ACSR 100 mm²)									1265
	Total	**370**	**0**	**0**	**0**	**0**	**1047**	**1121**	**0**	**246730**
1	LT Aerial Bunched Cables (Various Sizes)	48					551		1003	54605
	Total	**48**	**0**	**0**	**0**	**0**	**551**	**0**	**1003**	54605
1	HT Aerial Bunched Cables (Various Sizes)	**0**	**0**	**0**	**33**	**0**	**0**	**0**	**8**	13859
	Toal	**0**	**0**	**0**	**33**	**0**	**0**	**0**	**8**	13859
1	HT UG Cables (Various Sizes)	**0**	**24**	**66**	**166**	**0**	**110**	**0**	**1**	10165
	Total	**0**	**24**	**66**	**166**	**0**	**110**	**0**	**1**	10165
1	Energy Meters (Feeder/Boundary/DT)	0					2491		4997	158773
2	Energy Meters (1 Phase Consumers)	22544					40745		71254	8170762
3	Energy Meters (3 Phase Consumers)	0							1400	538985
4	Prepaid / smart meters in Govt. establishment									99409
5	Feeder Metering									0
	Total	**22544**	**0**	**0**	**0**	**0**	**43236**	**0**	**77651**	**8967929**

Annexure-VIII

Household Consumption Details

Smart meters-Household consumption details

Sl No	Name of Utility	No of Consumers with consumption between 200-500 units				No of Consumers with consumption >500 units			
		Dom	Comm	Ind	Total	Dom	Comm	Ind	Total
1	APEPDCL	281866	30780	4823	317469	28431	25666	15777	69874
2	APSPDCL	506640	57339	0	563979	54090	44939	28225	127254
3	NBPDCL	68016	8720	1379	78115	22400	11538	4035	37973
4	SBPDCL	41165	4984	4151	50300	14575	6188	8991	29754
5	CSPDCL, Chhattisgarh	371344	33409	0	404753	103588	29570	12413	145571
6	Goa PD	98542	16340	0	114882	23683	12628	2507	38818
7	PGVCL	186788	35266	21816	243870	49019	26525	44037	119581
8	DGVCL	462431	137584	incl in comm	600015	121327	127175	incl in comm	248502
9	MGVCL	223974	23742	8710	256426	36683	18695	14486	69864
10	UGVCL	132250	32601	incl in comm	164851	16911	40307	incl in comm	57218
11	UHBVN	31500	199335	0	230835	39149	23393	18456	80998
12	DHBVN	550757	73714	12818	637289	348771	38183	54738	441692
13	Jharkhand	146955	13770		160725	33235	10055	3495	46785
14	BESCOM	465663	66050	25176	556889	45296	53643	32416	131355
15	CESCOM	25374	5315	1514	32203	2299	4289	1895	8483
16	GESCOM	58870	5905	2033	66808	8712	4845	1826	15383
17	HESCOM	43321	9211	6855	59387	4665	7375	5351	17391
18	MESCOM	39908	5741	1134	46783	4337	4790	1457	10584
19	Kerala	452217	1352231	10	1804458	21080	85868	1796	108744
20	MP(East Discom)	211440	29058	14956	255454	35492	20249	10537	66278
21	MP(Central Discom)	287132	27402	0	314534	48171	21933	13442	83546
22	MP(West Discom)	282167	38596	16060	336823	42544	27784	16471	86799
23	MSEDCL	2057391	227168	67746	2352305	301002	151575	122193	574770
24	BEST	196,515	55,942	1,602	254059	50,535	50,420	3,735	104690
25	NESCO	78414	12249	1454	92117	13717	8651	2035	24403
26	WESCO	125450	9109	1267	135826	16510	8202	2812	27524
27	SouthCo	75331	7721	737	83789	11877	5822	1667	19366
28	CESU	210,606	23,028	8,382	242016	79,217	22,211	10,064	111492
29	PSPCL, Punjab	566875	117058	0	683933	1694445	121450	92733	1908628
30	AVVNL	54917	7322	0	62239	25628	9153	72800	107581
31	JaVVNL	285449	35293	0	320742	66320	29191	22497	118008
32	JoVVNL	280419	30949	0	311368	255718	24860	25097	305675
33	Tamil Nadu	2839635	240877	101499	3182011	468369	212820	135415	816604
34	TSNPDCL	104,690	17091	3570	125351	8,373	14691	5870	28934

Smart meters-Household consumption details

Sl No	Name of Utility	No of Consumers with consumption between 200-500 units				No of Consumers with consumption >500 units			
		Dom	Comm	Ind	Total	Dom	Comm	Ind	Total
35	TSSPDCL	839131	102177	0	941308	82477	76638	20185	179300
36	MVVNL				0				0
37	PuVVNL *	211753	27791	1935	241479	90995	33549	4021	128565
38	PaVVNL	541422	53961	11920	607303	162371	41539	27370	231280
39	DVVNL				0				0
40	Kesco				0				0
41	WBSEDCL	346151	64057	0	410208	25023	51463	38894	115380
42	DPL, Durgapur				0				0
43	Assam	109210	13947	763	123920	25266	11615	1240	38121
44	Aruna. Pradesh				0				0
45	Manipur				0				0
46	Meghalaya				0				0
47	Mizoram				0				0
48	Nagaland	1636	276	215	2127	4857	818	639	6314
49	Sikkim				0				0
50	Tripura				0				0
51	HP	150183	11432	1796	163411	27736	9771	3566	41073
52	J & K	310111	20328	3638	334077	18691	14197	7455	40343
53	Uttrakhand	379475	25222	1810	406507	175421	24191	7081	206693
54	Delhi				0				0
55	Chandigarh				0				0
56	Puducherry				0				0
Total		**14733084**	**3310091**	**329769**	**18372944**	**470906**	**156846 5**	**899720**	**7177191**
Estimation for missing data **		**5324014**	**874259**	**92929**	**6291203**	**187337 9**	**510513**	**249514**	**2633406**
Grand total		**20057098**	**4184350**	**422699**	**24664147**	**658238 5**	**207897 8**	**114923 4**	**9810597**

Remarks:-

* Only for RAPDRP towns

** Estimation considered as following :-

20 Delhi equiv to 3 time of Uttarakhand, Other NE states equiv to Assam

21 Bal Discom of UP equiv to 1.5 times additional

22 Additional 20% added to arrive consolidated figure