To
Sh V. Srinivas, CM (PMS)
SR-II, Banglore

By Courier

पावर ग्रिड कारपॅरिशन आफ इन्डिया लिमिटेड
अभियान्त्रिकी विभाग
लागत अभियान्त्रिकी विभाग

अंतर कार्यालय ज्ञापन

प्रेषक : अ.म.प्र. (लागत अभियात्रिकी)

प्रेषित : म.प्र. (केन्द्रीय आयोजना)
Ms. Seema Gupta

प्रति : ED (SR-I) / ED (SR-II) / ED(Comml.)/ GM(TL)/ GM(SS)-Sh.R.K. Chauhan / GM(ESMD)/ DGM (SEF)-Sh. Dilip Rozekar/ DGM(CMG)- Ms. Poonam Varshney / CM(Fin)- Ms. Pratyaksha / Co. Secretary
- with one copy each of the DPR

REF : C/FR/SR/ P-227(SRSS-XIII)

DATE : September 19, 2011

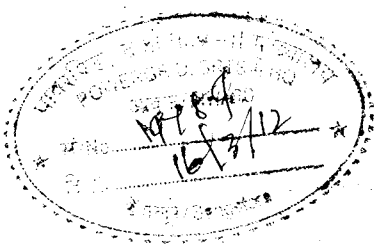
SUB: **APPROVED COPY OF DETAILED PROJECT REPORT FOR : SYSTEM STRENGTHENING – XIII IN SOUTHERN REGIONAL GRID**

The Detailed Project Report for **SYSTEM STRENGTHENING – XIII IN SOUTHERN REGIONAL GRID** has since been approved on 16.9.2011 by the CMD vide approval note dated June 20, 2011 at an estimated cost of **₹496.64 Crores** including IDC of ₹ **20.66 Crores** at **1st Qtr. 2011 price level**.

For preparation of note for Sub-Committee of the Board of Directors, please find enclosed two copies of the aforesaid report along with a copy of the approved proposal.

डी. के. सरकार
(डी. के. सरकार)

Encl. : as above



DETAILED PROJECT REPORT

for

SYSTEM STRENGTHENING – XIII IN SOUTHERN REGIONAL GRID

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POWERGRID

POWER GRID CORPORATION OF INDIA LIMITED

'(A Government of India Enterprise)

New Delhi.

June, 2011

DETAILED PROJECT REPORT

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SYSTEM STRENGTHENING – XIII IN SOUTHERN REGIONAL GRID

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SCOPE OF WORKS FOR

SYSTEM STRENGTHENING – XIII IN SOUTHERN REGIONAL GRID

A.	**Transmission Lines**	**Length (Km)**
1.0	GOOTY - MADHUGIRI 400KV D/C TRANSMISSION LINE	211
2.0	MADHUGIRI - YELAHANKA 400KV D/C (QUAD) TRANSMISSION LINE	77
B.	**Substation Works**	
1.0	400/220 KV MADHUGIRI NEW SUBSTATION	**400kV:**
		4 Nos 400KV line Bays
		2x500MVA, 400/220/33 KV, 3-ph Autotransformer with associated bays
		63 MVAR Bus Reactors - 1 nos
		Bus Reactor Bay - 1 nos
		220kV:
		6 Nos 220 KV line Bays
		2 Nos ICT Bays
		1 no BC Bay
		1 no TBC Bay
2.0	400 KV GOOTY EXTENSION SUBSTATION	2 Nos 400KV line Bays
3.0	400/220 KV YELAHANKA SUB STATION (EXTN.)	2 Nos 400KV line Bays (GIS)

PREAMBLE

This proposal covers the Detailed Project Report for *System Strengthening – XIII in Southern Regional Grid*

The total estimated cost of the project based on **1st Quarter 2011 price level** is as follows:

(Rs. in crores)

		Total cost
1.	Transmission System	475.98
2.	Interest during Construction	20.66
TOTAL		**496.64**

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ANNEXURES

Annex. No.	Description
1.0	*Abstract Cost Estimate - Summary*
1.1	*Abstract Cost Estimate - Preliminary & General Civil Works*
1.2	*Abstract Cost Estimate - Transmission Lines*
1.3	*Abstract Cost Estimate - Substation*
2.0	*Phased Fund Requirement (for Base cost)*
2.0a	*Phased Fund Requirement (for Completed cost)*
3.0	*Monthly Fixed Charges (for Base cost)*
3.0a	*Monthly Fixed Charges (for Completed cost)*
4.0	*Calculation of Interest during Construction (for Base cost)*
4.0a	*Calculation of Interest during Construction (for Completed cost)*
5.0	*Calculation of completed cost of Project*
6.0	*Indexation adopted for calculation of Completed cost*
7.0	*Copy of* 28th meeting of Standing Committee of Southern Region Transmission System Planning held on June 15, 2009, at Coorg, Karnataka and 10th & 11th meeting of SRPC held on July 2, 2009 at Tirupati & September 17, 2009 at Bangalore
8.0	*Copy of Prior Approval of Govt. under section 68 of the Electricity Act, 2003 for System Strengthening in Southern Region-XIII*
9.0	*IRRs Calculated on Completed Cost*

EXHIBITS

Exhibit No.	***Description***
1.0	System Strengthening – XIII in Southern Regional Grid
2.0	*Single Line Diagram*
3.0	*Project Implementation Schedule*

DETAILED PROJECT REPORT FOR SYSTEM STRENGTHENING – XIII IN SOUTHERN REGIONAL GRID

1.0 Introduction

In Southern Region, a number of generation projects under Central Sector like Neyveli TS-II Expn. (500 MW), Simhadri-II (1000 MW), Kalpakkam PFBR (500 MW), Vallur TPS (1500 MW), Kudankulam (2000 MW) etc, are being envisaged for commissioning during 11th plan. Further, Krishnapatnam UMPP (4000 MW) is also envisaged to be implemented by early 12th plan. All the regional constituents shall have shares from these new generating projects, which shall result in enhancement of shares of beneficiaries including Karnataka. The power from some of these generating stations is available at Gooty through various transmission lines and the power is required to be supplied to the major load centres in the state of Karnataka like Bangalore etc. To enable delivery of enhanced share of power as well as to meet growing load demand, augmentation of transmission system including establishment of new 400/220 kV substation. Madhugiri, near Bangalore in Karnataka State, is one such location identified for establishing new 400/220 kV substation, which is to be connected to Gooty and Yelahanka to feed growing power demand in and around Bangalore area as a regional strengthening scheme.

The present Detailed Project Report covers the proposal for establishment of new 400/220 kV, 2x500 MVA substation at Mahugiri alongwith Gooty - Madhugiri - Y/c line.

2.0 PROPOSED EVACUATION SYSTEM

2.1 Proposed Transmission System

The following transmission system is proposed under System Strengthening – XIII in Southern Regional Grid:

a. Establishment of new 400/220 kV substation at Madhgiri with 2x500 MVA transformers and provision of establishing a 765 Substation in future in the same switchyard.
b. Gooty – Madhugiri 400 kV D/c line
c. Madhugiri – Yelahanka 400 kV D/c Quad line
d. 1x63 MVAR bus reactor at Madhugiri 400/220 kV Substation

2.1.1 Transmission system under System Strengthening – XIII in Southern Regional Grid is shown in **Exhibit-1.0**.

2.2 Justification of the proposed system

2.2.1 The present peak demand of the State of Karnataka is of the order of 5940 MW (July, 2009) which as per the 17th EPS is projected to increase to about 8830 MW by the end of 11th plan (year 2011-12). KPTCL has indicated that area around the Bangalore is likely to experience higher load growth rate. This requires additional feeds to Bangalore to meet its growing load requirements.

2.2.2 Therefore, establishment of a 400/220kV, 2x500 MVA substation at Madhugiri has been planned to provide additional feed to Bangalore through proposed Madhugiri - Yelahanka 400kV D/c quad line and also connected through Gooty - Madhugiri 400kV D/c line. Further, provision has been kept for establishment of a 765/400kV

substation in future in the same switchyard, which shall facilitate a high capacity corridor from Salem towards Narendra & Western region to export/import power from/to neighboring regions depending upon surplus/deficit conditions in SR.

2.2.3 The above scheme has been discussed and agreed in 28th meeting of Standing Committee of Southern Region Transmission System Planning held on June 15, 2009, at Coorg, Karnataka and 10th & 11th meeting of SRPC held on July 2, 2009 at Tirupati & September 17, 2009 at Bangalore respectively for taking this scheme as a Regional System Strengthening Scheme.

2.2.4 Accordingly, the transmission system under System Strengthening - XIII in Southern Regional Grid comprises of following transmission elements :

a. Establishment of new 400/220 kV substation at Madhugiri with 2x500 MVA transformers and provision of establishing a 765/400kV substation in future in the same switchyard.
b. Gooty – Madhugiri 400kV D/c line
c. Madhugiri – Yelahanka 400kV D/c quad line
d. 1x63 MVAR bus reactor at Madhugiri 400/220kV substation

3.0 PROJECT OBJECTIVES

The objective of the project is to provide transmission arrangement so as to enable delivery of enhanced share of power as well as to meet growing load demand in Andhra Pradesh, Karnataka, Kerala, Tamil Nadu and Pondicherry.

3.1 PROJECT HIGHLIGHTS

a.	Project	:	System Strengthening – XIII in Southern Regional Grid
b.	Beneficiary States/UT	:	Andhra Pradesh, Karnataka, Kerala, Tamil Nadu and Pondicherry
c.	Transmission System	:	a. Establishment of new 400/220 kV substation at Madhugiri with 2x500 MVA transformers and provision of establishing a 765/400kV substation in future in the same switchyard. b. Gooty – Madhugiri 400 kV D/c c. Madhugiri – Yelahanka 400 kV D/c quad line d. 1x63 MVAR Bus Reactor at Madhugiri 400/220kV substation
d.	Project Cost	:	**Rs. 496.64 Crores** at 1st **Quarter 2011** Price Level (including **IDC of Rs. 20.66 Crores**)
e.	Monthly Fixed Charges	:	**Rs. 763.25 Lakhs** on Base Cost **Rs. 885.79 Lakhs** on Projected Completed Cost
f.	Commissioning Schedule	:	The Transmission System is scheduled to be commissioned within **32 months** from the date of Investment Approval.

3.2 SCOPE OF WORK

The present Feasibility Report covers transmission system which includes following scope of work:

Transmission lines

a) Gooty – Madhugiri 400 kV D/c line – **211km**

b) Madhugiri - Yelahanka 400 kV D/c Quad line – **77km**

Substations

a. Establishment of new 400/220 kV substation at Madhugiri

This would be new substation owned by POWERGRID and shall have provision for establishment of 765/400kV substation in future in the same switchyard and also to accommodate following under this project:

i. 2 number 400 kV line bays for Gooty – Madhugiri 400 kV D/c line
ii. 2 number 400 kV line bays for Madhugiri – Yelahanka 400 kV D/c quad line
iii. 2 number 400 kV transformer bays for 2x500 MVA transformers
iv. 1 number 400 kV reactor bay for 1x63 MVAR Bus Reactor
v. 2 number 220 kV transformer bays for 2x500 MVA transformers
vi. 6 number 220 kV line bays for 220 kV feeders of Karnataka

b. Extension of 400/220 kV substation at Gooty

This is an existing substation owned by POWERGRID and shall have provision to accommodate following under this project:

i. 2 number 400 kV line bays for Gooty – Madhugiri 400 kV D/c line

c. Extension of 400/220 kV GIS substation at Yelahanka

This substation is under implementation by POWERGRID and shall have provision to accommodate following under this project:

i. 2 number 400 kV line bays (GIS) for Madhugiri – Yelahanka 400 kV D/c quad line

4.0 BENEFICIARIES

The beneficiaries of this project are constituents of Andhra Pradesh, Karnataka, Kerala, Tamil Nadu and Pondicherry. The transmission system has been discussed and agreed in 28th meeting of Standing Committee of Southern Region Transmission System Planning held on June 15, 2009, at Coorg, Karnataka and 10th & 11th meeting of SRPC held on July 2, 2009 at Tirupati & September 17, 2009 at Bangalore respectively for taking this scheme as a Regional System Strengthening Scheme.

4.1 APPROVAL UNDER SECTION 68 OF THE ELECTRICITY ACT, 2003

4.1.1 Prior approval of the Government of India under Section 68 of the Electricity supply) Act, 2003 for the subject scheme has been obtained vide MOP's letter dated 03.12.2009 (copy enclosed at **ANNEXURE – 8.0**).

5.0 PROJECT STRATEGY

Being a Central Sector Regional transmission project, POWERGRID had undertaken and evolved the various elements of this transmission scheme in consultation with CEA keeping in view the present and future load requirement of Southern, Western & Northern Regions.

6.0 LEGAL FRAMEWORK

It is proposed to execute the above entire transmission scheme as per provisions contained in the Indian Electricity Act, 2003 and the rules made there-under and the Electricity (Supply) Act, 1910 and 1948, in so far as these are applicable.

7.0 ENVIRONMENTAL IMPACT ASSESSMENT

7.1 Forest involvement / Clearance

As per the practice, preliminary route selection is done by POWERGRID based on such documents as the Forest Atlas and the Survey of India maps using "bee" line method, followed by field verification through walk over survey. All possible steps are taken to avoid the route alignment through forests. In cases where it becomes unavoidable due to the geography of terrain, the alignment is made in such a way that the route through the forests is the barest minimum.

For selection of optimum route, following points are taken into consideration:

(i) The route of the proposed transmission line does not involve any human rehabilitation.
(ii) Any monument of cultural or historical importance is not getting affected.
(iii) The route does not create any threat to the survival of any community.
(iv) It does not affect any Public-Utility Services like Playground, School, Other establishments, etc.
(v) It does not pass through any sanctuaries, National Park, etc.
(vi) It does not infringe with areas of natural resources.

As per the preliminary assessment based on Forest Atlas, top sheet and walk over survey of the area, certain forest stretches are likely to be encountered for this Transmission system comprising of the following line:

NAME OF TRANSMISSION LINE	FOREST INVOLVEMENT (Approx. area in Ha)
a) Gooty – Madhugiri 400 kV D/c Quad line	1 Ha
b) Madhugiri –Yelahanka 400 kV D/c Quad line	1 Ha

However, exact involvement of forest stretch shall be known only after detailed survey and finalization of route alignment.

7.2 Social Issues/R&R measures

As per the prevailing law, land below transmission line is not required to be acquired and only land for sub station is acquired in the range of 20 to 30 hectare of land for each substation depending upon the type and voltage level.

Even for this 20 to 30 hectare land, POWERGRID try to locate sub station on Government land as far as possible and in the absence of Government land, private land is acquired. POWERGRID has developed an Indigenous People (Tribal) Development Plan (IPDP), which ensures that affected people receive culturally compatible social and economic benefits for any adverse effects.

POWERGRID has developed its Environmental and Social Policy & Procedure (ESPP), which inter-alia outlines its commitment to deal with environmental and social issues related to its Transmission projects through NGOs, public interaction. In order to minimize / mitigate impact of land acquisition and to provide adequate rehabilitation / resettlement for people displaced / affected by our projects, POWERGRID's ESPP envisages a progressive policy on Resettlement & Rehabilitation (R&R).

In the instant project approx. 130 acre of land for construction of new Substation at Madhugiri has been identified. To meet the cost of R&R measures, a provision of Rs. 200 Lakhs has been kept for Madhugiri Substation.

8.0 ON-GOING INITIATIVES

POWERGRID has in-house developed infrastructure/software capabilities and computer aided facilities for Planning, Design, Operation and Maintenance of transmission system. Before planning a transmission system, various system studies like Load flow, Stability, Short-Circuit, etc. are undertaken keeping in view the existing system, present and future load flow requirements and the most optimal transmission system either associated with generation projects or Grid strengthening projects, is evolved with bare minimum redundancy required. Further, Design studies are undertaken for selection of major system and equipment parameters for transmission system upto 800KV level.

System Strengthening – XIII in Southern Regional Grid has been designed in the most optimal manner based on the various studies as mentioned above. The system and equipment parameters are chosen keeping in view the present trend in technology. The conductors are selected such that the losses in them due to internal resistance as well as due to external effects are bare minimum. The bus bar materials and the clamps and connectors are chosen meeting the stringent international requirements so that there is least loss of energy in them. The transformers and other switchgears are also suitably selected and evaluated before award itself for most efficient operation from thermal and loss efficiency point of view. The energy thus saved is energy transmitted to the beneficiaries. This is a major step in energy conservation as the energy saved on account of losses is construed as energy generated.

9.0 TECHNOLOGY ISSUES

9.1 Salient features of 420 & 220 KV Sub station Equipment and facilities

The design and specification of substation equipment are to be governed by the following factors:

9.1.1 Insulation Coordination

420 KV System would be designed to limit the Switching over voltage to 2.5p.u and is expected to decay to 1.5p.u in 5 to 6 cycles. Consistent with these values and protective levels provided by lightning arrestors, the following insulation levels are proposed to be adopted for 420 KV & 245KV systems:

		420 KV	245 kV
a.	Full Wave Impulse withstand voltage for: - Transformer and reactors - for Other Equipment	 1300 kVP 1550 kVP	 950 kVP 1050 kVP
b.	Switching surge withstand voltage	1050 kVP	
c.	Minimum creepage distance	10500 mm	6125 mm
d.	Max. fault current	40 kA 50kA-Madhugiri S/s	40 KA
e.	Duration of fault	1 Sec	1 Sec
f.	Corona extinction voltage	320kV rms	156kV rms

To control the steady state, transient and dynamic overvoltage to specified levels, compensation equipment shall be provided.

9.1.2 Steady State Stability

The Steady State Stability is the ability of a system, to return/remain in the state of equilibrium when subjected to a small or gradual change of disturbances. The steady state stability limit is the maximum power that can flow through some lines in the system when the entire or part of the system to which the stability limit refers is subjected to a small disturbance without loss of its stability.

The steady state stability is usually quantified by measuring the relative angular displacement (also called as swing curve) between the two buses (nodes) in a network when a small disturbance is applied somewhere into the system.

In an integrated power system consisting of large number of generator, load and line etc., a maximum relative angular separation of about 30 deg. between the two buses may be assumed to be acceptable (safest) limit for maintaining the steady state stability of the system. Angular separation for different alternatives have been studied and found to be in order.

9.1.3 Switching Schemes

It is essential that the system should remain secured even under conditions of major equipment or bus-bar failure. Sub-stations being the main connection points have large influence on the security of the system as a whole. The selection of the bus switching scheme is governed by the various technical and other related factors. One & Half breaker bus scheme has been considered for 400kV

substation, Double Main & Transfer bus scheme for the 220kV side and Double Main scheme for 400kV GIS substation due to their merits in terms of reliability, security, operational flexibility and ease of maintenance of equipments.

The following switching schemes have been considered for 400/220kV Madhugiri substation:

Substation	400 KV Side	220 KV Side
Madhugiri 400/220KV (New) Substation	One & Half Breaker	Double Main & Transfer
Gooty 400kV Substation (Extn.)	One & Half Breaker	—
Yelahanka 400kV GIS S/s(Extn.)	Double Main	—

9.1.4 400/220KV Substation equipments:

The switchgear shall be designed and specified to withstand operating conditions and duty requirements. Further, 400kV & 220kV switchgear shall be of conventional type air insulated switchgear due to economy and availability of suitable land.

GIS Substation Equipment:

GIS (Gas Insulated Switchgear) shall be in accordance to IEC: 62271-203. The switchgear shall be designed and specified to withstand operating conditions and duty requirements. specified to withstand operating conditions and duty requirements.

9.1.4.1 Power Transformer

Power transformers shall conform to IEC: 60076 in general. These transformers shall generally have OLTC with a range of ±5.5%, the range and requirement of which shall be finalized based on the system requirement. The air core reactance shall be of the order of 20%. Tertiary windings shall be provided for large auto transformers, which shall be capable of being loaded to one third of transformer loading. Insulation level of tertiary winding shall not be less than maximum transferred surge from HV/MV winding to tertiary winding.

9.1.4.2 Circuit Breakers

Circuit breakers shall in general comply to IEC 62271-100 & IEC-60694 and shall be of SF6 Type. The rated break time shall not exceed 40 ms for 420 KV and 60 ms for 245 KV circuit breakers. Circuit breakers shall be provided with single phase and three phase auto reclosing. The Circuit breakers controlling 420 KV & 220kV lines wherever required shall be provided with pre insertion closing resistor of about 400 ohms with 8 ms insertion time. The short line fault capacity shall be same as the rated capacity and this is proposed to be achieved without use of opening resistors.

9.1.4.3 Isolators

The isolators shall comply to IEC 62271-102 in general. Isolators shall be double break type keeping in view the bus switching schemes proposed. Isolators shall be motor operated. Earth switches are provided at various locations to facilitate maintenance. Main blades and earth blades shall be interlocked and interlock shall be fail safe type. All earth switches shall be motor operated type.

9.1.4.4 Current Transformers

Current Transformers shall comply to IEC 60044-1 in general. All ratios shall be obtained by secondary taps. Current transformers shall have five secondaries for 400 KV. The burden and knee point voltage shall be in accordance with the requirements of the system including possible feeds for telemetry.

9.1.4.5 Capacitor Voltage Transformers

Voltage transformers shall comply with IEC 60044-5 in general. These shall have three secondaries out of which two shall be used for protection and one for metering. Accuracy class for protection core shall be 3 P and for metering core shall be 0.2. The voltage transformers on lines shall be suitable for Carrier Coupling. The Capacitance of CVT shall be 4400/8800 pF depending on PLCC requirements.

9.1.4.6 Surge Arresters

Station class current limiting, heavy duty gapless type Surge arresters conforming to IEC 60099-4 in general shall be provided. The rated voltage of Surge arrester and other characteristics are chosen in accordance with system requirements. Surge arresters shall be provided near line entrances, transformers and 400 KV buses so as to achieve proper insulation coordination. These shall be fitted with pressure relief devices and diverting ports suitable for preventing shattering of porcelain housing providing path for the flow of rated currents in the event of arrestors failure.

9.1.4.7 Shunt Reactors

Shunt Reactors, wherever provided, shall comply to IEC: 60076 in general. 420 kV Shunt reactors shall have linear characteristics upto 1.5 p.u. voltage. These should be ONAN Cooled. The neutral of line reactors shall be grounded through adequately rated neutral grounding reactors to facilitate single phase recloser against trapped charges. The neutral of 420 kV class shunt reactors shall be insulated to 550 kV peak for lightning impulse and shall be protected by means of 145 KV Class surge arresters.

9.1.5 Substation Support facilities

Certain facilities required for operation & maintenance of substations as described below shall be provided in new substation and in existing substation they have already been provided and would be extended, wherever required.

9.1.5.1 AC & DC power supplies

For catering to the requirements of three phase & single phase AC supply and DC supply for various substation equipment the following arrangement is envisaged:-

i) For LT Supply, at each new Substation, 1 no. 8000 kVA 33/0.433 kV LT Transformer to be connected with ICT tertiary & 1 no. 800 kVA 11/0.433 kV LT Transformer shall be connected with SEB supply.

ii) 2 Nos. batteries of 220 V for control & protection and 2 Nos. 48 V batteries for PLCC would be provided at each new Substation. Each battery would have a boost and trickle charger.

iii) Suitable AC & DC distribution boards and associated LT Switchgear would be provided at new Substation.

iv) In new Substation, 1 no. 500 KVA DG set shall be provided.

9.1.5.2 Fire Fighting System

Fire fighting system in general conforms to fire insurance regulations of India. The fire fighting system is proposed with both AC motor & diesel engine driven pumps. Automatic heat actuated emulsifying system is proposed for transformers & reactors. In addition for alarm system based on heat/smoke detectors are proposed to be installed at sensitive points in a substation e.g. Main Control Room, MCC Room etc. Further, adequate water hydrants and portable fire extinguishers shall be provided in the substations.

9.1.5.3 Oil evacuating, filtering, testing & filling apparatus

To monitor the quality of oil for satisfactory performance of transformers, shunt reactors and for periodical maintenance necessary oil evacuating, filtering, testing and filling apparatus would be provided at new substations. Oil tanks of adequate capacities for storage of pure and impure transformer oil would be provided.

9.1.5.4 Lighting & communication

Adequate normal & emergency AC & DC lighting shall be provided in the control room of the substation. The switchyards shall also be provided with adequate lighting. A telephone exchange of 24 lines shall be provided at new substations as means of effective communication between various buildings of the substation.

9.1.5.5 Control Room

Substation control room would be provided to house the telemetry equipments and recording equipments, AC & DC distribution boards, DC batteries, etc. Air Conditioning will be provided in the building as functional requirements.

9.1.6 Protection & Control

The state of art protection system based on numerical technology has been provided to minimize the damage to the equipment in the event of fault for Transformers, Reactors, Transmission lines and Bus bars. These protective relays are with self diagnostic feature and conforming to latest IEC 61850 for communication purposes for communicating the detailed list of events recoded by

these relays in the event of fault or any abnormal conditions. Normally all these relays are equipped with in built fault recorder which can record the analogue as well as digital information for analysis of fault.

Protective Relaying System

The protective relaying system proposed to be provided for transmission lines, auto-transformers and bus bars to minimize the damage to the equipments in the events of faults and abnormal conditions, is dealt in this section.

Transmission Lines

400 kV lines shall have MAIN-I and MAIN-II protection as three zone distance type with carrier aided inter-tripping feature. All 400 kV lines shall also be provided with two stages over voltage protection.

Further, all 400 kV lines shall be provided with single and three phase auto-reclosing facility to allow reclosing of circuit breakers in case of transient faults. These lines shall also be provided with distance to fault locators to identify the location of fault on transmission lines.

420 kV Reactors

Reactor shall be provided with the following protections:

i) Differential protection.
ii) Restricted earth fault protection
iii) Back-up impedance protection.

Besides, these reactors shall also be provided with Bucholz relay, protection against oil and winding temperatures & pressure relief device.

Bus bar Protection

The high speed bus bar differential protection which is essential to minimize the damage and maintain system stability at the time of bus bar faults shall be provided for 400 KV and 220 KV buses. Bus bar protection scheme shall be such that it operates selectively for each bus and incorporate necessary features required for ensuring security. The scheme shall have the provision for future expansion. For existing substations, the existing bus bar protection shall be augmented wherever required.

Local Breaker Back up Protection

This shall be provided for each 420 kV & 220 kV breaker and will be connected to de-energize the affected stuck breaker from both sides.

Time synchronization equipment

Time synchronization equipment complete in all respect including antenna, cable, processing equipment required to receive time signal through GPS or from National Physical Laboratory(NPL) through INSAT shall be provided.

Substation Automation System

For all the new substations, state of art Substation Automation System (SAS) conforming to IEC-61850 has been provided. The distributed architecture has been used for Substation Automation system where the controls are provided through bay control unit and bay control units are provided bay wise for voltage level 220kV and above. All bay control units as well as protection units are normally connected through an optical fiber high speed network. The control and monitoring of substation elements such as circuit breaker, disconnector, resetting of relays etc. are being done from Human Machine Interface(HMI) from the control room. SAS is equipped with the facility of remote operation. By providing remote HMI and suitable communication link, the substation can be controlled from a remote location.

The functions of control, annunciation, disturbance recording, event logging and measurement of electrical parameters shall be integrated in Substation Automation System. The Automation System shall be provided with the facility of communication and control for remote end operation. In existing Substations where Substation automation is not provided, control functions shall be done through control panels.

9.1.7 PLCC

Power line carrier communication (PLCC) equipment complete for speech transmission, line protections, and data channels shall be provided on each 420 KV & 220 KV transmission line. The protections for transmission line and the line compensating equipment shall have hundred percent back up communication channels. The PLCC equipment shall in brief include the following:
Coupling device, line traps, carrier terminals, protection couplers, HF cables, trunk selectors, automatic exchange, and maintenance and testing instruments.

Coupling devices shall be suitable for 4400/8800 pF for 420 kV CVTs and for phase to phase coupling. The pass band of coupling devices shall have sufficient margin for adding communication channel in future if required. Necessary protection devices for the safety of personnel and low voltage part against power frequency voltages and transient over voltage shall also be provided. The line traps shall be broad band tuned suitable for blocking the complete range of carrier frequencies.

Line Trap shall have the necessary protective devices such as lightning arresters for the protection of tuning device and shall be equipped with corona rings. The carrier terminals shall be of single side - band (SSB) amplitude modulation (AM) type and shall have 4KHz band width. Decoupling network consisting of line traps and coupling capacitors may also be required at certain substation in case of extreme frequency congestion.

9.1.8 Control Concept

All the EHV breakers in substation/switching stations shall be controlled and synchronized from the switchyard control room and remote control centre. Each breaker would have two sets of trip circuits which would be connected to separately fused DC supplies for greater reliability. All the isolators shall have control from remote/local whereas the earth switches shall have local control only.

9.2 Salient features of Transmission Lines

The salient features of the proposed transmission lines are given here under:

The primary consideration for design and estimation of transmission line is walk over survey conducted for the transmission lines by POWERGRID. Type of terrain, forest stretches, crossings etc. to be encountered by the transmission line has been taken into consideration while estimating the quantities.

9.2.1 400 KV AC (Twin/Quad) Transmission Line

9.2.1.1 The Wind Zone

The weight of tower will vary in an ascending order from wind zone 1 to wind zone 6 as the transverse load on the tower considered owing to the wind pressure increases in the same pattern. The identification of wind zone is based on the wind zone map given in IS: 875 (part-I) 1987 and the past experience in the region.

The transmission lines fall under wind zone - 2 (39 m/s) as per IS: 875 and it shall be designed accordingly.

9.2.1.2 Design Criteria

The design parameters proposed to be adopted for the transmission line are generally based on the report of standardization committee of CEA and stipulations of relevant Indian Standards. Quad and Twin bundle conductors have been considered for the design of transmission lines as per requirements of the identified system.

9.2.1.3 Line Configuration

Double ckt (D/C) 400 KV line shall have vertical configuration of conductors. For double circuit line configuration shall have I,I.

9.2.1.4 Towers

Self supporting latticed bolted steel towers, fabricated from structural steel angle section shall be used. Tower components and bolts & nuts shall be hot dip galvanized.

Normally, the following four types of double circuit tower shall be used in these lines.

i) DA type suspension towers for upto 2 degree angle of deviation.

ii) DB type tension towers for upto 15 degree angle of deviation.

iii) DC type tension towers for upto 30 degree angle of deviation.

iv) DD type tension towers for upto 60 degree angle of deviation and suitable for dead end condition. These may also be used for terminal locations.

The standard extensions normally used for various types of towers are as follows:

DA & DD : 3m, 6m, 9m, 18m, 25m
DB & DC : 3m, 6m, 9m

In addition to the above, special towers, for major river crossing, power line crossing and the places where the terrain is particularly different, such as approach to the sub-station, forest stretches etc. shall also be used. All towers shall be designed in accordance with latest edition of IS-802 and considering necessary improvements and reinforcements evolved as per suggestions/recommendations of CEA's expert committee based on the experience of previous tower failures in the country.

Structural steel sections used in towers shall be of High Tensile (HT) steel & Mild Steel (MS) of requisite quality as per IS-2062 or equivalent International Standards.

9.2.1.4.1 Foundations

Tower Foundations are generally pad & chimney type and typically classified as Dry, Wet, Partially submerged(PS), Fully Submerged (FS), Wet Black Cotton (WBC), Sandy, Dry Fissured Rock (DFR), Wet Fissured Rock (WFR), Submerged Fissured Rock (SFR), Hard Rock etc. depending upon type of soil encountered and designed accordingly based on relevant Indian standards and CBIP guidelines. For river crossing locations & soils having poor bearing capacity, wherever required, pile/well type foundations are used.

Types of soil encountered by the transmission lines are generally mixed dry, wet, wet black cotton type in the plain terrain and dry fissured rock, wet fissured rock & hard rock in the hilly terrain. The requirements of the foundations are considered in accordance with the type of soil.

9.2.1.4.2 Revetment and benching

Wherever hilly and/or undulated stretch shall be encountered revetment & benching shall be provided as per site conditions.

9.2.1.5 Conductors

Conventional ACSR type conductors have been considered based on system requirements as these are most common type of conductors with proven technology having low cost & easy availability.

For 400 KV Quad lines, Quad 'Moose' ACSR conductors (54/3.53 Aluminium and 7/3.53 mm steel) of overall diameter 31.77 mm shall be used per phase. The sub-conductor spacing will be 457 mm.

For 400 KV AC lines, twin ACSR 'MOOSE' conductor (54/3.53 Aluminium and 7/3.53 mm steel) of overall diameter 31.77 mm shall be used per phase. The horizontal sub-conductor spacing will be 450 mm as it has been found the most optimum with respect to line inductance and line loss characteristics.

9.2.1.6 Earthwire

Two 7/3.66 mm galvanized steel earthwire shall be used on the lines so that it can withstand two successive lightning stroke of 150 kA. Shielding angles of 20 deg is considered for transmission lines.

9.2.1.7 Grounding

The tower footing resistance shall be kept below 10 ohms. Pipe type or counterpoise earthing shall be used to bring the tower footing resistance down to acceptable level.

9.2.1.8 Insulator and Hardware Fittings

High strength glazed electro porcelain / toughened glass disc insulators shall be used. The following types of insulator strings along with hardware fittings shall be used:

1. 400 KV TRANSMISSION LINE WITH QUAD ACSR MOOSE CONDUCTOR

Sl. No.	Type of string	Size of disc insulators (mm)	Minimum creepage distance of each disc (mm)	No. of disc	Electro-mechnical strength of insulator disc(KN)	Mechanical strength of insulator string along with hardware fittings (KN)
a)	Double 'I' suspension	255x145 or 280x145	370	2x23	120	2 x 120
b)	Single 'I' suspension Pilot	255x145 or 280x145	370	23	120	120
c)	Quadruple Tension	280x170	370	4 x 23	160	4 x 160
d)	Single Tension	255x145 or 280x145	370	24	120	120

2. 400 KV TRANSMISSION LINE WITH TWIN ACSR MOOSE CONDUCTOR

Sl. No.	Type of string	Size of disc insulators (mm)	Minimum creepage distance of each disc (mm)	No. of disc	Electro-mechnical strength of insulator disc(KN)	Mechanical strength of insulator string along with hardware fittings (KN)
a)	Single 'I' suspension	255x145 or 280x145	370	23	120	120
b)	Single 'I' suspension Pilot	255x145 or 280x145	370	23	120	120
c)	DoubleTension	280x170	370	2x 23	160	2 x 160

Note: i) Equivalent porcelain long rod insulators may be used.

ii) For polluted stretches of the line composite long rod insulators may also be used.

Items (a) and (c) are mostly used for suspension and tension towers respectively. Item (b) is used in transposition towers. Item (b) also shall be used in heavy angle towers(DC & DD types) to restrict jumper movement. Suitable hardware fittings shall be used for attachment of the insulators with the tower at one end and also for supporting the conductors at the other end. Corona control rings or grading rings will be used for improving corona and RIV performance as well as to improve the voltage distribution across the insulators discs. The voltage across any disc shall not exceed 9 % in case of suspension type and 10 % in case of tension type of the line to earth voltage. This will reduce aging and also minimize radio interference.

9.2.1.9 Line Accessories

i) **Mid span compression joint for conductor/ earthwire**

Mid span compression joint suitable for conductor/ earthwire shall be used for joining two lengths of conductor / earthwire. The minimum slipping strength of the joint after compression shall not be less than 95 % of the UTS of conductor / earthwire.

ii) **Repair sleeve for conductor**

Repair sleeve shall be used only for repairing not more than two strands broken in the outer layer of conductor. It shall be of compression type in two parts with provision of seat sliding of keeper piece.

iii) **Flexible copper bond for earthwire**

Flexible copper bonds shall be used for good electrical continuity between the earthwire and the tower. Two bonds per suspension tower & four bonds (two for each earthwire) per tension tower shall be used.

iv) **Vibration damper for earthwire**

Stockbridge vibration dampers shall be used to reduce the maximum dynamic strain caused by aeolian vibrations to a value of 150 micro-strain.

v) **Spacers/SpacerDamper**

Twin/Quad bundle spacers shall be used for the bundle lines to reduce vibrations and maintain sub-conductor spacing under all working conditions. Rigid spacer for jumpers shall be used at all tension towers.

vi) **Suspension/Tension clamps for earthwire**

Suitable suspension/tension clamps shall be used for attachment of earthwire at suspension/tension towers.

vii) **T-connectors**

Compression type T-connectors shall be used for conductor jumpering at transposition towers wherever required.

9.2.1.10 River Crossings

Special towers shall be used for major river crossings where the span is more than 600 mtrs with anchor towers on either end of river crossing span.

9.2.1.11 Power line, Railway line, Road and P&T line crossing

The transmission lines shall be crossing power lines, railway lines roads and P&T lines for which suitable extensions of towers shall be used.
The standard extension normally used for various types of towers are as follows:

A/DA & D/DD : 3m, 6m, 9m, 18m, 25m
B/DB & C/DC : 3m, 6m,9m

In addition to the above body extension, suitable leg extension/ Chimney extension shall also be provided in the hilly terrain, wherever required, to reduce the benching.

10.0 TOWNSHIP

In a substation, township Quarters of different categories like B, C & D types are provided as per the norms of DPE and these Quarters are allotted to various categories of employees as per norms of DPE. The different type of buildings like administrative building, shopping complex, primary school, recreation center, guest house, etc. are also provided as per norms of BPE. The township is generally provided within the substation area. Some temporary stores/warehousing are proposed to be constructed for storing substation materials, it is also proposed to construct some houses to accommodate erection personnel, operation and maintenance staff. Detail engineering and construction drawing shall as per MNW of the project. Other facilities of substation township like roads, water supply, sewer line, telephone lines, electricity supply, etc. are provided as per the requirement of the project. The provision of Quarters &or the future expansion is also considered in the township estimates.

11.0 MANAGEMENT ARRANGEMENTS

11.1 Organisational set up

In POWERGRID the 'Organisational Concept' has been given due importance and the basic structure of organisation has been made with a view to achieve the following objectives:

i) To group related functions together to have clearly defined 'Roles' for the relevant 'functional heads'.
ii) To have well defined 'Responsibility & Authority' centres in the structure.
iii) To have well defined 'communication channels' and optimum 'span of control' in the organisation.
iv) To have optimum manpower.
v) To have decentralisation of activities as far as possible.

At the first level in the organization, Corporate Centre will be planning, monitoring and controlling the objectives and activities of the organisation. At the second level, the Regional HQs will be playing the role of controlling the activities in the

regions and will report to Corporate Centre. In POWERGRID, 7 regions have been identified as NR-I, NR-II, SR-I, SR-II, WR-I, WR-II, ER-I, ER-II & NER, and these regions will be headed by GM/ED. At the third level in the structure, the Substation Groups will be controlling the activities of the respective Substation and associated lines under that Group and will report to the Regional HQs. The Groups will consist of basic working units such as sub station Construction/maintenance, line construction/maintenance. The Groups will have both service and technical functions, to cater the basic functional requirements.

11.1.1 Project Management

The project of transmission system will be planned, implemented, monitored and controlled through Integrated Project Management and Control System (IPMCS).

IPMCS uses PERT/CPM technique as the basic management tool. For effective project planning and review, three tier level of planning and review have been adopted.

Level-I :

Planning is done by the Corporate Monitoring Group, a central planning cell, which is in the form of an overall project schedule called the Master Network, for the project which forms the basis for all subsequent planning and monitoring of the activities. This covers broadly all the packages of project and indicates activities of engineering, contracts, manufacturing, erection and commissioning. The Master Network is prepared using computerised techniques which subsequently helps in comparing the actual progress of the project with the scheduled progress. This gives indication of the likely critical areas and helps in preventing the same, thereby resulting in smoother implementation. The Master Network also acts as a source for the planning to be done at Level - II & Level - III.

Level-II :

Planning is done package-wise and is worked out and finalised with the respective contractor/vendor during the pre-award stage. Level II networks are made within the milestones identified in the project Master Network (L-I).

Level-III :

Plans deal with elaborate schedules and weekly/monthly rolling plans which are prepared for activities of engineering, supply (as the case may be) & field activities. These form the basis of monitoring by the various functions.

The system envisages monthly review of the level II programmes with contractors and at field on a weekly basis. A site monthly progress report is sent to the head office having four sections, i.e.

i) Project completion trend

ii) Salient achievements for the month

iii) Programme for next month

iv) Areas needing attention of top management

11.1.2 Project Implementation Review

As on March 2011, POWERGRID operates about 82,355 ckt. kms. of transmission lines and 135 Sub-stations with a transformation capacity of about

93,050 MVA. POWERGRID has team of dedicated experts in the field of substation and Transmission Line Engg. equipped with state-of-the-art technology, software capabilities and computer aided facilities for Planning, Design, Operation and Maintenance of transmission system. It has a well established system of continuous feedback from the field and upgrade the system accordingly.

Based on the feedback as well as in pursuit to economize the cost and implementation period, its experts are vigorously pursuing the standardization of Transmission Line designs, substation/switchyard layouts, schemes, technical parameters of equipment, etc.

POWERGRID has developed a project monitoring system matching with the organization structure, complexity / intricacies involved in the project implementation and Management information system. The system calls for increasing details of planning in all facets of functioning such as engineering, contracts, site and corresponding levels of monitoring and control; for generating a management summary report to the top management. This management summary report highlights the project completion trends, actions being taken/to be taken for the attention of the top management on exceptional basis of critical areas.

Further, the monitoring system envisages a regular total project review called project review meeting (PRM). This review meeting is headed by the Regional in-charge with representation from all functions viz. Contracts, Engineering, Field, Personnel, Finance, Corporate Monitoring Group, etc. The participants discuss project critical, project interface problems and project completion trends, etc.

From the discussions held during the PRM emanates a status report and also an exception report put up to the Chief Executive and Directors which highlights extremely critical areas needing immediate attention and assistance required. Once in three months the PRM is held at Corporate Centre. These discussions help in identifying the critical areas and seeking decisions for speedy project implementation.

12.0 MEANS OF FINANCE AND PROJECT BUDGET

12.1 Project Cost Estimate

12.1.1 The estimated cost of the project based on **1st Quarter 2011 price level** is as follows:

(Rs. in crores)

		Total cost
1.	Transmission System	475.98
2.	Interest during Construction	20.66
	TOTAL	**496.64**

The abstract cost estimate for Transmission Line and Substation are given at **ANNEXURE - 1.0**. The break-up of the cost estimate for civil works, transmission lines and substations are given at **ANNEXUREs - 1.1, 1.2** and **1.3** respectively.

12.2 Basis of Cost Estimate

The detailed cost estimates for the civil works for Transmission Line and substation has been given at **ANNEXUREs - 1.1.1, 1.1.2, 1.1. 3**. and **1.1.4.**

The estimated cost of the project as on **1st Quarter 2011 price level** works out to **Rs. 496.64 crores** including an IDC of **Rs. 20.66 crores.** Unit rates for 400 KV Transmission Line and 400/220kV Substation Work has been considered from ***Schedule of Rates*** (which has been prepared based on latest LOAs) for **1st Quarter 2011** Price level.

As the Transmission Line and Substation portion (excluding Transformers, Reactors and bay extension at Yelahanka) is proposed to be funded by The World Bank, Excise Duty has not been considered while working out the cost estimate. The cost estimate for the remaining portion (Transformers, Reactors and bay extension at Yelahanka) is inclusive of Excise Duty @ 10.30% and CST @ 2.0% (as funding for supply of equipment is proposed to be done through Domestic Sources). F&I @ 4% for have been considered in the Estimate. Customs Duty @ 20.941% and handling charges thereafter @ 2% has been considered on imported items for GIS extension at Yelahanka.

12.3 Project Overheads

The following overheads have been charged on to the cost of the transmission system as a percentage of the equipment cost:

		For Tr. Lines & Substations
i)	Incidental Expenditure During Construction	10.75% (excluding Afforestation cost)
ii)	Contingencies	3.00% (excluding Afforestation cost)

12.4 Funding arrangement

12.4.1 Phased Fund Requirement

The anticipated year wise fund requirement for the project including interest during construction is given below:

YEAR	(Rs in Crores) TOTAL
2010 – 2011	20.77
2011 – 2012	9.72
2012 – 2013	99.09
2013 – 2014	230.12
2014 – 2015	136.94
Total	**496.64**

12.4.2 Mode of Financing

The project is proposed to be funded through World Bank Loan – PSDP-IV, POWERGRID's Internal Resources (IR) and through domestic borrowings/bonds.

The equity component **(30%)** is proposed to be met through Internal Resources (IR) and the loan component **(70%)** through World Bank Loan and domestic borrowings/bonds.

12.5 Interest during Construction

Based on the assumption that the project is being financed from loan and equity in the ratio of **70:30** and the equity component is being released simultaneously along with the loan component, the interest during construction works out to **Rs. 20.66 crores**. The interest rate for the loan amount has been considered **@ 7.0%** for World Bank Loan and **@ 10.5%** for domestic funding. The details of calculation are furnished in **ANNEXURE - 4.0**. Transmission system under Strengthening – XIII in Southern Regional Grid is scheduled to be commissioned within **32 months** from the date of Investment Approval.

The interest during construction would however be based on the actual financial structure of the project and applicable terms of interest on loan(s), etc.

12.6 Monthly Fixed Charges

Considering the interest on World Bank Loan @ 7.0% and on Domestic Loan @ 10.5%, return on equity @ 15.5%, depreciation @ 0% for land, 3.34 % for building, 5.28% for transmission lines & substations and 6.33% for PLCC, O&M charges@ Rs. 0.828 Lakhs per km for 400kV D/C line, @ Rs. 1.241 Lakhs per km for 400kV D/C (Quad) line, @ Rs. 69.21 Lakhs per 400kV bay, @ Rs. 48.44 Lakhs per 220kV bay, Debt:Equity ratio 70:30, interest on working capital @ 13.0%, the tentative monthly fixed charges work out as **Rs. 763.25 Lakhs** on Base Cost and **Rs. 885.79 Lakhs** on Projected Completed Cost (**ANNEXURE - 3.0**).

12.7 Completion Cost

The completion cost of the project is expected to be **Rs. 592.18 crores** including an IDC of **Rs. 23.24 crores**. The above cost has been worked out based on the average movement of WPI (80% weightage) and CPI (20% weightage) for the preceding 12 month period as per guide lines dated 06.08.1997. Details of calculation are enclosed at **ANNEXURE - 5.0**. The abstract cost estimate for completed cost is enclosed at **ANNEXURE - 1.0a**. The phased fund requirement and calculation for IDC for completed cost are enclosed at **ANNEXURES – 2.0a** and **5.0** respectively.

12.8 IRR Calculation

The Project IRR, Equity IRR and Economic IRR on Projected Completed Cost have been calculated for the project and the same is tabulated below:-

	For Completed Cost
Project IRR	10.69%
Equity IRR	16.29%
Economic IRR	11.77%

The details of calculation are furnished in **Annexure – 9.0.**

13.0 TIME FRAME

System Strengthening – XIII in Southern Regional Grid is scheduled to be commissioned within **32 months** from the date of Investment Approval. (Implementation schedule is given at **EXHIBIT - 3.0**).

14.0 RISK ANALYSIS

Revenue Risk

The capital cost of the transmission system comprises of i) an equity component and ii) a loan component. This is recovered through the annual transmission charges consisting of return required for the equity, an interest for the loan component together with the depreciation charges, the O & M charges and interest on working capital from the beneficiaries as per Notification in proportion to the benefits derived by them. These are recovered in monthly fixed charges from the beneficiaries. In addition to annual charges Income Tax, FERV and incentives, etc. as per notification would also be payable.

The Bulk Power Transmission Agreement (BPTA) which covers the payments for transmission charges for all the existing projects as well as those that may be included in future after approval by CEA already exists.

Regulatory Risk

BPTAs have the provision that the transmission tariff for new / existing transmission assets commissioned as well as the additional tariff payable due to additional capitalization from year to year, etc. shall be computed by POWERGRID based on norms / methodology followed in the GOI notification dated 16.12.97 in accordance with the norms to be specified by the Central Electricity Regulatory Commission (CERC) as amended from time to time.

Environmental Risk

Transmission line projects are environmentally friendly and do not involve any disposal of solid effluents and hazardous substance in land, air and water. Moreover, in forest areas trees are felled below each conductor to facilitate stringing. On completion of construction only one such strip is maintained for O&M purpose. Therefore the actual loss of forest is restricted to some selected area only. However, as per the requirement of Forest (Conservation) Act, 1980 approval of Ministry of Environment & Forests, Govt of India for diversion of forest land shall be taken before construction of line and compensatory afforestation shall be done on double the area of degraded forest land to compensate the loss of vegetation, due to diversion of forest land if there is any after detailed survey.

Legal / Contractual Risks

Not foreseen.

Project Management Risks

Not foreseen.

14.0 PROJECT MONITORING

As on March 2011, POWERGRID operates about 82,355 ckt. kms. of transmission lines and 135 Sub-stations with a transformation capacity of about 93,050 MVA. POWERGRID has team of dedicated experts in the field of substation and Transmission Line Engg. equipped with state-of-the-art technology, software capabilities and computer aided facilities for Planning, Design, Operation and Maintenance of transmission system. It has a well established system of continuous feedback from the field and upgrade the system accordingly.

Based on the feedback as well as in pursuit to economize the cost and implementation period, its experts are vigorously pursuing the standardization of Transmission Line designs, substation/switchyard Layouts, schemes, technical parameters of equipment, etc.

POWERGRID has developed a project monitoring system matching with the organization structure, complexity / intricacies involved in the project implementation and Management information system. The system calls for increasing details of planning in all the facets of functions such as engineering, contracts, site and corresponding levels of monitoring and control, for generating a management summary report to the top management. This management summary report highlights the project completion trends, actions being taken/to be taken for the attention of the top management on exceptional basis of critical areas.

Further, the monitoring system envisages a regular total project review called project review meeting (PRM). This review meeting is headed by Regional in-charge with representation from all functions viz. Contracts, Engineering, Field, Personnel, Finance, Corporate Monitoring Group, etc. The participants discuss project critical, project interface problems and project completion trends, etc.

From the discussions held during the PRM emanates a status report and also an exception report put up to the Chief Executive and Directors which highlights extremely critical areas needing immediate attention and assistance required. Once in three months the PRM is held at Corporate Centre. These discussions help in identifying the critical areas and seeking decisions for speedy project implementation.

15.0 PAST RECORD OF SUCCESSFUL PROJECT IMPLEMENTATION

The above transmission system has been evolved, carrying out detailed studies by using latest available power system analysis software (PSS/E), and the proposed system is considered to be adequate to transfer power to the respective beneficiaries with reliability and security. Regarding achieving its objective in the stipulated time frame, it is to mention that POWERGRID has in-house expertise in all specialized areas of transmission with systems upto 800KV AC, ±500KV HVDC, Gas Insulated Sub-Stations, Static VAR Compensation, Series Capacitors, FACTS (Flexible AC Transmission System), Controlled Shunt reactors etc.

POWERGRID, since its formation has commissioned many large size and difficult transmission projects. Majority of such projects have been completed on or ahead of schedule.

As on March 2011, POWERGRID operates about 82,335 ckt. kms. of transmission lines and 135 Sub-stations with a transformation capacity of about 92,735 MVA. POWERGRID has maintained the transmission system's availability at over **99%** consistently. A few of the major projects commissioned during last three years include

- East - North Inter connector and Northern Region Transmission System associated with Tala HEP
- Kahalgaon Stage-II (Phase-I) Transmission System
- Kahalgaon Stage-II (Phase-II) Transmission System
- Transmission System associated with North-West Trans Corridor
- RAPP 5 & 6 Transmission System
- SIPAT Transmission System Stage – I
- Vindhyachal - III Transmission System
- SIPAT - II Transmission System
- SIPAT - II Supplementary Transmission System
- Upgradation of Transfer Capacity of Talcher - Kolar HVDC Bipole to 2500MW.

In recognition of POWERGRID's excellence in areas of its operations as above, POWERGRID has been rated as "Excellent" many times since 1993-94 in achieving the MoU targets with Ministry of Power. POWERGRID is also a recipient of Prime Minister's MoU Award consecutively for many years for being amongst top ten PSUs.

16.0 SUSTAINABILITY

16.1 System Design Philosophy

The power evacuation system is designed in the most optimum manner such that losses in the system are minimal. The system and equipment parameters are chosen according to the present trends in technology, the conductors available are such that the losses in them due to internal resistance as well as due to external effects such as corona and RIV are bare minimum. The busbar materials and the clamps and connectors are chosen after meeting the stringent international requirements so that there is least loss of energy in them. The transformers, reactors and other switchgear are also similarly selected and evaluated before award itself for most efficient operation from thermal loss and efficiency.

16.2 System Operation Philosophy

The power flow in a particular line varies due to demand variation, failure of equipment, line faults, etc. For the system to be stable and to use optimised resources, it is very important to record the power flow at each and every time. This necessitates the monitoring of operation of the system on a three shift basis.

16.3 System Maintenance Philosophy

The maintenance management system in vogue in POWERGRID aims at keeping the system under stable conditions while ensuring minimum maintenance cost and safety of equipment and personnel. The maintenance management schedule

detailed work specification covering all maintenance jobs permit to work system, long term maintenance planning meeting for about 30 minutes for finalising maintenance schedule for next 24 hours and resolution of interface problems between departments. These meetings are supplemented by meeting of HODs for one hour on alternate days to accelerate the decision making process and to lay down the priorities and guidelines for maintenance work during next 72 hours.

16.3.1 Spare parts Management System

The primary objective of spare part management system will be to ensure timely availability of proper spare parts for efficient maintenance of the substations and lines without excessive build-up on non-moving and slow moving inventory. The spare parts management system for this project will cover the following areas:

a) Proper codification of all spares and consumables
b) Spare parts indenting and procurement policy
c) Ordering of critical mandatory and recommended spares
d) Judicious fixation of inventory levels and ordering levels for spare parts based on our experience in other projects.
e) Development of more than one source wherever practicable.

16.3.2 Training of personnel

The expertise available with the country is adequate to cover maintenance of Transmission Line and sub station EHV equipments, etc. Also available technical expertise within POWERGRID is adequate to cover operation and maintenance requirements of equipments. Hence, training in these areas can be arranged by POWERGRID's training facility with the help of training officers, equipment suppliers and consultants, site commissioning personnel as well as POWERGRID's own specialists.

16.3.3 O & M Manuals

a) Adequate O & M manuals will be distributed to all concerned as per the policy of the company.
b) O & M manuals will be available to all concerned prior to commissioning of substations and transmission lines to avoid problems in preparation of commissioning documents as well as proper installation & commissioning of equipment.

16.3.4 Special tools and tackles

Two unused sets of special tools and tackles shall be provided for installation, commissioning and proper maintenance of equipment

ANNEXURES

ANNEXURE - 1.0

ABSTRACT COST ESTIMATE

(BASE COST)

SYSTEM STRENGTHENING - XIII IN SOUTHERN REGIONAL GRID

(Cost updated to 1st Quarter 2011 price level)

Sl. No.	DESCRIPTION	AMOUNT (Rs. in Crs.)
A	Preliminary Survey & Soil Investigation (Annex.- 1.1)	0.39
B	Land Acquisition for Substation and R & R Compensation (Annex. - 1.1)	23.78
C	Cost of Compensation for Transamission Lines (Annex. - 1.1)	
	i) Compensation towatds Crop, Tree & PTCC	4.32
	ii) Compensation towards Forest	0.23
D	**Civil Works (Annex. 1.1)**	
	i) Infrastructure for substations	12.60
	ii) Non Residential Buildings	3.25
	iii) Colony for Trans. Lines & Substations	7.01
E	**Equipment Cost**	
	a) Trans.Lines (Annex.-1.2)	276.65
	b) Sub-Stations (Annex.-1.3)	87.81
F	**Sub Total (A to E)**	**416.03**
G	Incidental Expenditure During Construction **@ 10.75% of [F - C(ii)]**	44.70
H	Contingencies @ 3% of [F - C(ii)]	12.47
I	Centages & Contingencies @ 8% on Compensatory Afforestation (considering Rs.45,000 per Ha for **2.0 Ha**)	0.01
J	Customs Duty @ 20.941% (including 2% handling charges)	2.77
	Sub Total (A to J)	**475.98**
K	Interest During Construction(IDC)	20.66
	GRAND TOTAL	**496.64**

Note:

1. Loan has been assumed to be available from The World Bank and from Domestic sources.
2. Interest rate on Loan has been considered @ 7% for World Bank Loan & 10.5% for Domestic Loan subject to actuals.
3. Debt:Equity ratio has been considered as 70:30.
4. **The project is scheduled to be commissioned within 32 months progressively from the date of investment approval. However, for the purpose of phasing of funds, the Investment approval has been assumed on 01.10.2011.**

Foreign Exchange component in above in equivalent Rs.Crores = **12.96**

Customs Duty @ 20.941% and handling charges @ 2% thereon have been considered for all Imported Equipment

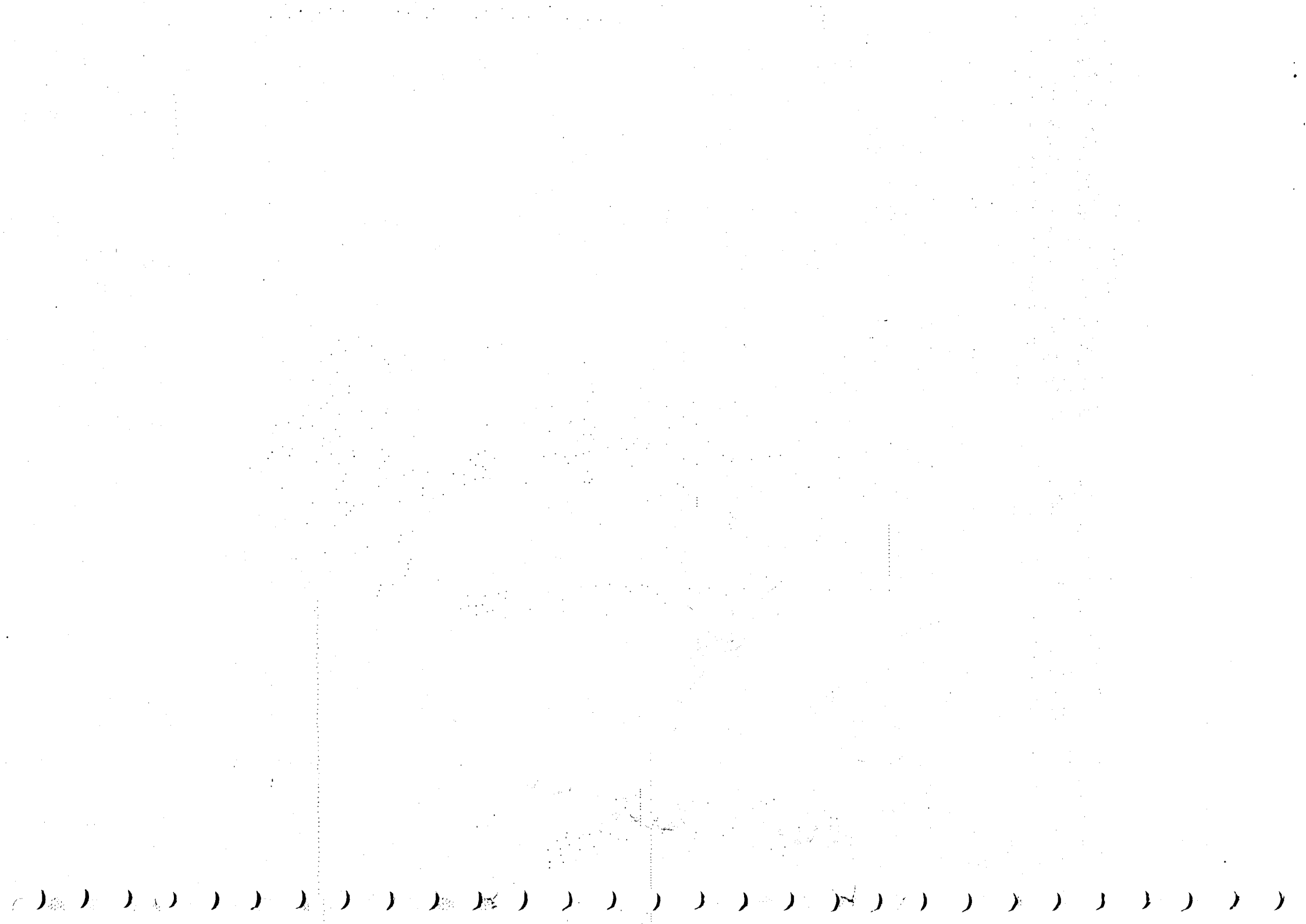
ANNEXURE - 1.0a

ABSTRACT COST ESTIMATE
SYSTEM STRENGTHENING - XIII IN SOUTHERN REGIONAL GRID

(FOR COMPLETED COST)
(Rupees in Crores)

Sr. No.	DESCRIPTION	TOTAL COST
A	Preliminary Survey & Soil Investigation (Annex.- 1.1)	0.46
B	Land Acquisition for Substation and R & R Compensation (Annex. - 1.1)	28.43
C	Cost of Compensation for Transamission Lines (Annex. - 1.1)	
	i) Compensation towatds Crop, Tree & PTCC	5.16
	ii) Compensation towards Forest	0.23
D	**Civil Works (Annex. 1.1)**	
	i) Infrastructure for substations	15.06
	ii) Non Residential Buildings	3.89
	iii) Colony for Trans. Lines & Substations	8.38
E	**Equipment Cost**	
	a) Trans.Lines (Annex.-1.2)	330.71
	b) Sub-Stations (Annex.-1.3)	104.97
F	**Sub Total (A to E)**	**497.28**
G	Incidental Expenditure During Construction **@ 10.75% of [F - C(ii)]**	53.43
H	Contingencies @ 3% of [F - C(ii)]	14.91
I	Centages & Contingencies @ 8% on Compensatory Afforestation (considering Rs.45,000 per Ha for 2.0 Ha)	0.01
J	Customs Duty @ 20.941% (including 2% handling charges)	3.31
	Sub Total (A to J)	**568.94**
K	Interest During Construction(IDC)	23.24
	GRAND TOTAL INCL. IDC	**592.18**

Note:
1. Loan has been assumed to be available from The World Bank and from Domestic sources.
2. Interest rate on Loan has been considered @ 7% for World Bank Loan & 10.5% for Domestic Loan subject to actuals.
3. Debt:Equity ratio has been considered as 70:30.



ANNEXURE - 1.1

All figures in Rs. Lakhs

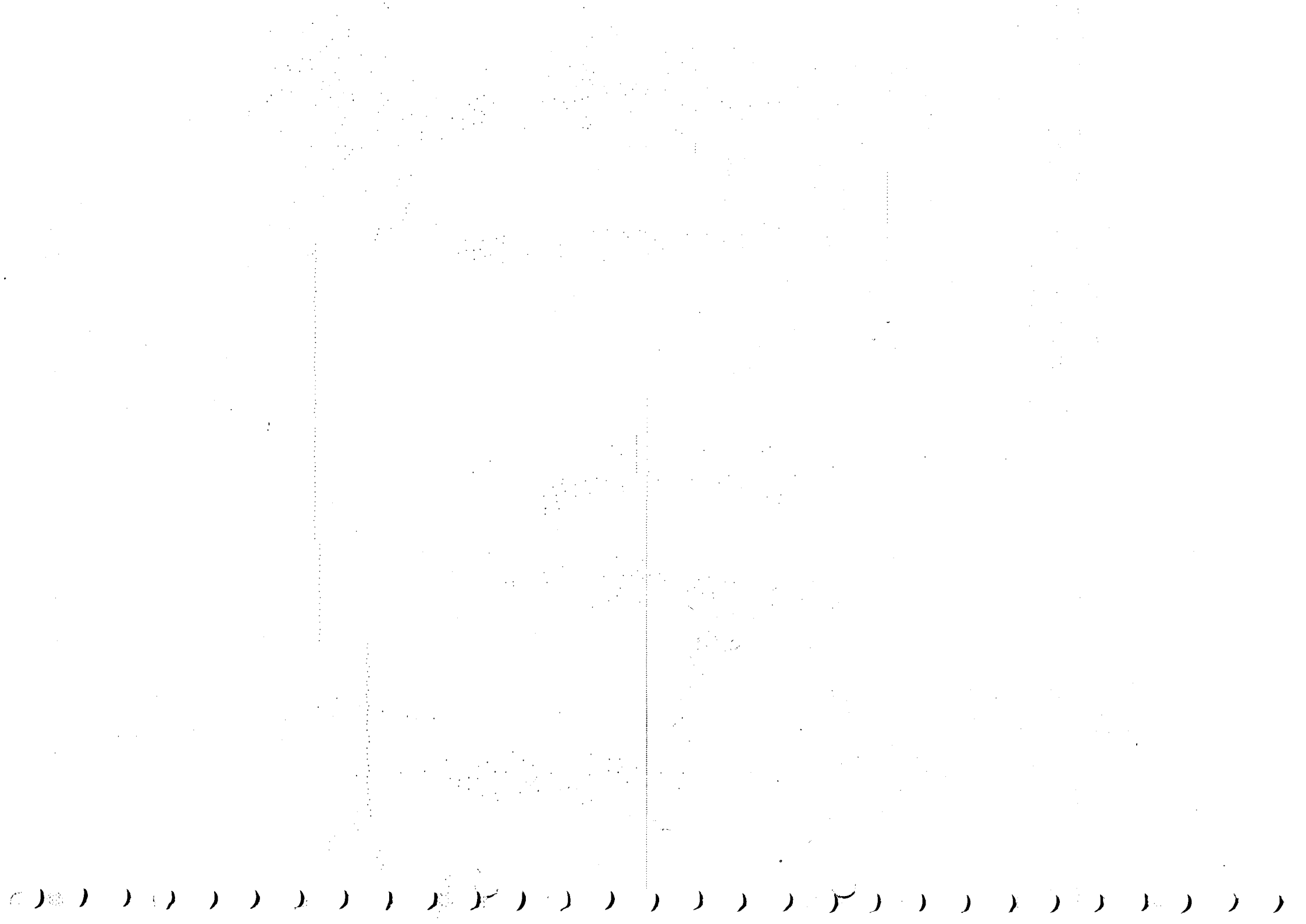
ABSTRACT COST ESTIMATE

PRELIMINARY & GENERAL CIVIL WORKS

PROJ: SYSTEM STRENGTHENING - XIII IN SOUTHERN REGIONAL GRID

Sr. No.	Line/Sub station	Survey & Soil Investigation	Crop & PTCC compensation	Forest compensation incl. NPV		Colony	Total Cost
A.	Transmission Line						
1.0	GOOTY - MADHUGIRI 400KV D/C TRANSMISSION LINE	21.10	316.28	11.33			348.71
2.0	MADHUGIRI - YELAHANKA 400KV D/C (QUAD) TRANSMISSION LINE	7.70	115.28	11.33			134.31
	Sub total	28.80	431.57	22.66		0.00	483.03

Sr. No.	Sub station	Preliminary Survey & Soil Investigation	Land Cost	R & R Cost	Infrastructure	Non-Residential Buildings	Colony	Total Cost
B.	Substations							
1.0	400/220 KV MADHUGIRI NEW SUBSTATION	10.00	2178.00	200.00	1220.00	285.00	701.00	4594.00
2.0	400 KV GOOTY EXTENSION SUBSTATION	0.00	0.00	0.00	20.00	0.00	0.00	20.00
3.0	400/220 KV YELAHANKA SUB STATION (EXTN.)	0.00	0.00	0.00	20.00	40.00	0.00	60.00
	Sub total	10.00	2178.00	200.00	1260.00	325.00	701.00	4674.00



ANNEXURE - 1.1.1

DETAILS OF PRELIMINARY WORKS AND LAND & COMPENSATION FOR TRANSMISSION LINES

PRELIMINARY WORKS

		LINE LENGTH (Km.)	RATE PER KM. (Rupees)	AMOUNT (Rs. Lakhs)
Preliminary survey & soil investigation :				
SYSTEM STRENGTHENING – XIII IN SOUTHERN REGIONAL GRID				
1.0	GOOTY - MADHUGIRI 400KV D/C TRANSMISSION LINE	211	10,000	**21.10**
2.0	MADHUGIRI - YELAHANKA 400KV D/C (QUAD)	77	10,000	**7.70**

ANNEXURE - 1.1.2

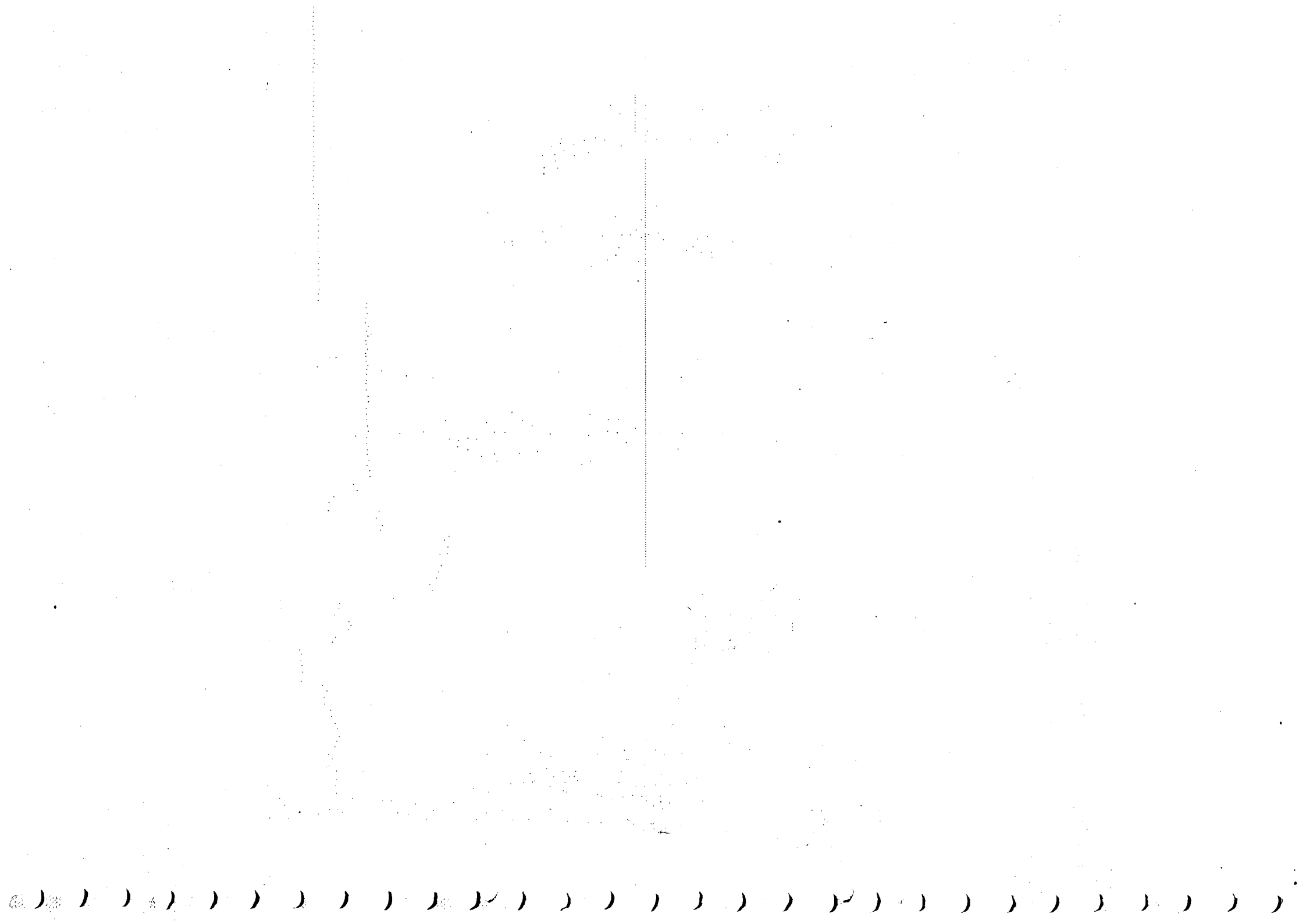
LAND & COMPENSATION

	LINE LENGTH (Km.)		RATE PER KM. (Rupees)		AMOUNT (Rs. Lakhs)
SYSTEM STRENGTHENING – XIII IN SOUTHERN REGIONAL GRID					
GOOTY - MADHUGIRI 400KV D/C TRANSMISSION LINE					
i) Cost of Crop compensation	210.78		100,000		210.78
ii) Cost of PTCC compensation	211.00		50,000		105.50
Total Cost of Crop & PTCC compensation					**316.28**
i) Cost of compensatory afforestation on double degraded forest	2.00	Ha	45,000	per Ha	**0.90**
ii) NPV for forest area diverted	**1.00**	**Ha**	**1,043,000**	per Ha	**10.43**
Total Cost of Compensatory afforestation	**(0.22 KM)**				**11.33**
MADHUGIRI - YELAHANKA 400KV D/C (QUAD) TRANSMISSION LINE					
i) Cost of Crop compensation	76.78		100,000		76.78
ii) Cost of PTCC compensation	77.00		50,000		38.50
Total Cost of Crop & PTCC compensation					**115.28**
i) Cost of compensatory afforestation on double degraded forest	2.00	Ha	45,000	per Ha	**0.90**
ii) NPV for forest area diverted	1.00	Ha	**1,043,000**	per Ha	**10.43**
Total Cost of Compensatory afforestation	**(0.22 KM)**				**11.33**

Total Cost of Compensation towards Crop & PTCC	**431.57**
Total cost of Compensatory Afforestation	**22.66**

***Note:** 1. A total of **2.0 Ha (0.43 kM) forest stretch (including Forest like area irrespective of ownership)** is likely to be encountered in the proposed transmission project. User agency in addition to cost of Compensatory Afforestation (CA) has to pay Net Present Value (NPV) ranging from Rs.4.38 Lakhs to Rs.10.43 Lakhs per Ha. depending upon the type of forest land diverted. Therefore, for estimation purpose maximum cost has been considered as cost of NPV .

NOTE:
Crop compensation is considered for line length excluding forest stretch.



ANNEXURE - 1.1.3
SHEET 1 OF 3

DETAILS OF RESIDENTIAL COLONY

PROPOSED FOR 400/220kV NEW S/S AT MADHUGIRI

SL. NO.	DESCRIPTION	NOS.	AREA (SQ.M.)	AMOUNT (RS.LAKHS) (Rounded off)
1.	Residential Quarters :			
	a) Type B1 @ Rs.18,000 / Sq.m.	11	60.00	119.00
	Type B2 @ Rs.18,000 / Sq.m.	8	70.00	101.00
	Type B3 @ Rs.18,000 / Sq.m.	6	80.00	86.00
	b) Type C @ Rs.20,000 / Sq.m.	1	100.00	20.00
	c) Type D with Servant quarters & garage @ Rs.13500 / Sq.m.	1	176.00	35.00
2	Community centre @ Rs. 18,000/Sq.m	1	300.00	54.00
3.	Transit Camp & Field Hostel @ Rs. 20,000/Sq.m	1	600.00	120.00
4.	Cost of Infrastructure @ 31% (Roads @ 5%, Fencing & Boundary wall @ 4%, Lawns, Gardens, Plantation @2%, Water Supply @ 6%, Internal Sanitation @ 6%, Internal Electrification @ 8%)			166.00
	TOTAL - RESIDENTIAL COLONY			**701.00**
			~	**701.00**

ANNEXURE - 1.1.3
SHEET 2 OF 3

DETAILS OF CIVIL WORKS PROPOSED FOR 400/220kV NEW S/S AT MADHUGIRI

SL. NO.	DESCRIPTION	NOS.	AREA (SQ.M.)	RATE PER SQ.M.(Rs.)	AMOUNT (RS.LAKHS) (Rounded off)
	PRELIMINARY WORKS				
1.	Survey & Soil investigation	L.S.			10.00
	PRELIMINARY WORKS				**10.00**
	INFRASTRUCTURE FOR SUBSTATION				
1.	Levelling / Site Surfacing	L.S.			500.00
2.	Boundary wall / Fencing	L.S.			300.00
3.	Roads & Drainage	L.S.			270.00
4.	Water Supply	L.S.			40.00
5.	Power Supply	L.S.			100.00
6.	Rain Water Harvesting	L.S.			10.00
	TOTAL - INFRASTRUCTURE				**1,220.00**
	NON - RESIDENTIAL BUILDINGS				
1.	Transformer foundation & Rail track		-	-	ıcluded in S/S civil works
2.	Control Room Building	1.00	1000	25000.00	250.00
3	Fire fighting pump house, DG set building, etc.	L.S.			35.00
	TOTAL - NON-RESIDENTIAL BUILDINGS				~ **285.00**

ANNEXURE - 1.1.3
SHEET 3 OF 3

LAND & COMPENSATION COST PROPOSED AT NEW SUBSTATIONS

	APPROX. AREA (ACRES)	RATE PER ACRE (Rs. Lakhs)	COST OF PTCC, AFFORESTATION & OTHER COMPENSATION (Rs. Lakhs)	AMOUNT (RS. LAKHS)
400/220kV NEW S/S AT MADHUGIRI	132.00	16.50		2178.00
Provision for R&R / IGS			200.00	200.00
Total Land & Compensation cost for 400/220kV NEW S/S AT MADHUGIRI				**2378.00**

* Note: As per the information from site.

ANNEXURE - 1.1.4

DETAILS OF CIVIL WORKS PROPOSED AT EXISTING SUBSTATIONS

INFRASTRUCTURE FOR SUBSTATION

Misc. Infrastructure works e.g., Levelling, modification of existing Fencing/Boundary wall, modification of existing Roads, etc. are being proposed for the following Substations where bay extension works are to be carried out :

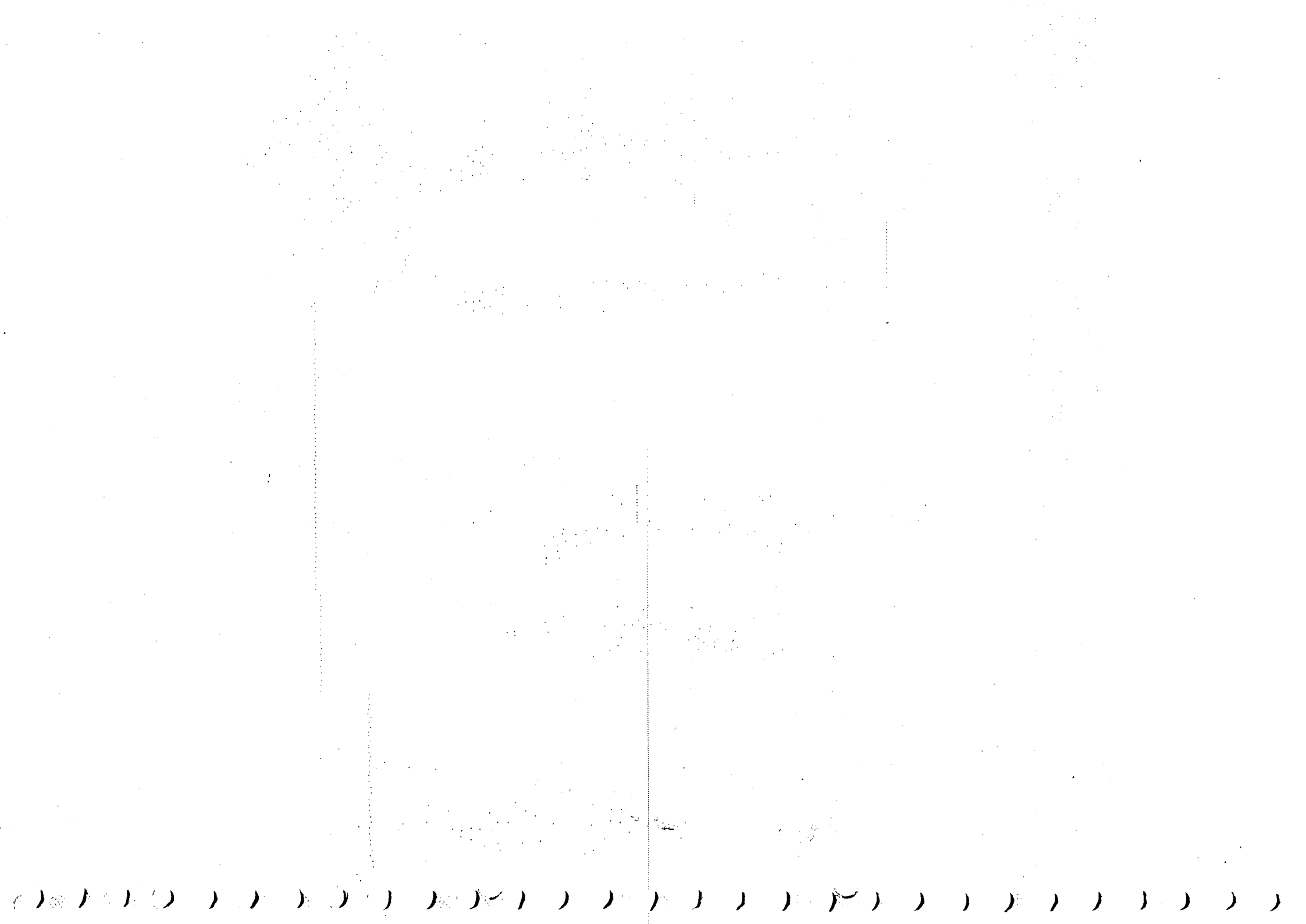
400 KV GOOTY EXTENSION SUBSTATION	Rs.20.00 LAKHS
400/220 KV YELAHANKA SUB STATION (EXTN.)	Rs.20.00 LAKHS

ANNEXURE - 1.2

ABSTRACT COST ESTIMATE
TRANSMISSION LINES

PROJ: SYSTEM STRENGTHENING - XIII IN SOUTHERN REGIONAL GRID

S.NO.	DESCRIPTION	LINE 1 TRANSMISSION LINE : GOOTY-MADHUGIRI 400KV D/C TRANSMISSION LINE 211 KM WORLD BANK FUNDING	LINE 2 TRANSMISSION LINE : MADHUGIRI-YELAHANKA 400KV D/C (QUAD) TRANSMISSION LINE 77 KM WORLD BANK FUNDING	TOTAL
1.0	Tower Steel	4142.08	2632.17	6774.25
2.0	Conductor	7123.85	5200.52	12324.37
3.0	Earthwire	168.84	62.13	230.97
4.0	Insulator	697.16	543.47	1240.63
5.0	Hardware Fittings	419.00	509.62	928.62
6.0	Conductor & E'wire Accessories	422.05	238.40	660.45
7.0	Wind speed measuring equipment	0.00	0.00	0.00
	Sub-Total - Supply Cost	**12972.98**	**9186.31**	22159.29
8.0	Freight, Insurance & Taxes	776.50	553.62	1330.12
9.0	Erection	420.58	265.30	685.88
10.0	Stringing	430.93	191.14	622.07
11.0	Civil Works	1469.77	1031.86	2501.63
	Sub-Total	**16070.76**	**11228.23**	27298.99
	Equipment Cost per Km	76.16	145.82	
12.0	River crossing pile foundation & Aviation	285.11	80.78	365.89
	Total Equipment Cost	**16355.87**	**11309.01**	**27664.88**
	Cost per Km	77.52	146.87	
	Preliminary & Gen. Civil Works	348.71	134.31	483.03
	Total Cost	**16704.58**	**11443.32**	**28147.91**



COST BREAK UP OF TRANSMISSION LINE

ANNEXURE - 1.2.

PROJ: SYSTEM STRENGTHENING - XIII IN SOUTHERN REGIONAL GRID

(Rs. in Lakhs)

TRANSMISSION LINE : GOOTY-MADHUGIRI 400KV D/C TRANSMISSION LINE

Line Length : 211 Km. Wind Zone 2: 39 m/s Plain Terrain

WORLD BANK FUNDING

Sr. No.	Description	Unit	Eqpt Exworks excl. Excise Duty Quantity	Rate (Rs.)	Total	SPARES Quantity	Total	TOTAL Exw & Spares	F & I @ 4% CST @ 2%	Ere/Civil Works	TOTAL
1	2	3	4	5	6=4x5	7	8=7x5	9=6+8	10	11	12=9+10+11
1.0	TOWER STEEL										
1.1	High Tensile Steel	MT	2,376	57,018	1354.75	48	27.37	1382.12	82.93		1465.05
	Mild Steel	MT	4,697	51,633	2425.20	94	48.54	2473.74	148.42		2622.16
	Hexagonal bolts & Nuts	MT	316	76,151	240.64	6	4.57	245.21	14.71		259.92
	Tower Accessories & Earthing	LS			40.21		0.80	41.01	2.46		43.47
2.0	Conductor										
2.1	ACSR "MOOSE"	K.M.	2,570	274,368	7051	26	71.34	7122.60	427.36		7549.96
	Type test charges for conductor	LS			1.25		0.00	1.25			1.25
3.0	Earthwire										
3.1	Earthwire (G.S. 7/3.66 mm)	K.M.	428	38,944	167	4	1.56	168.24	10.09		178.33
	Type test charges for earthwire	LS			0.60		0.00	0.60			0.60
4.0	Insulator										
4.1	Insulator (120 KN Standard Disc)	Nos.	70,619	528	372.87	706	3.73	376.60	22.60		399.20
4.2	Insulator (160 KN Standard Disc)	Nos.	47,380	621	294.23	474	2.94	297.17	17.83		315.00
	Type test charges for insulator	LS			23.39		0.00	23.39			23.39
	Sub Total : 4				690.49		6.67	697.16	40.43	0.00	737.59
5.0	Hardware Fitting										
5.1	Single Suspension 'I' Fittings	Set	2,897	7,844	227.24	29	2.27	229.51	13.77		243.28
5.1	Single Suspension pilot Fittings	Set	164	6,536	10.72	2	0.13	10.85	0.65		11.50
5.2	Single Tension Fittings	Set	9	10,116	0.91	0	0.00	0.91	0.05		0.96
5.4	Double Tension Fittings	Set	1,030	16,995	175.05	10	1.70	176.75	10.61		187.36
	Type test charges for hardware fittings	LS			0.98		0.00	0.98			0.98
	Sub Total : 5				414.90		4.10	419.00	25.08	0.00	444.08
6.1	Conductor & E'wire Accessories										
6.1.1	MSCJ For Conductor	Nos.	1,586	1,196	18.97	16	0.19	19.16	1.15		20.31
6.1.2	MSCJ For Earthwire	Nos.	238	303	0.72	2	0.01	0.73	0.04		0.77
6.1.3	Repair Sleeve for Conductor	Nos.	476	392	1.87	5	0.02	1.89	0.11		2.00

COST BREAK UP OF TRANSMISSION LINE

ANNEXURE - 1.2.1
(Rs. in Lakhs)

PROJ: SYSTEM STRENGTHENING - XIII IN SOUTHERN REGIONAL GRID

TRANSMISSION LINE : GOOTY-MADHUGIRI 400KV D/C TRANSMISSION LINE

Line Length : 211 Km. Wind Zone 2: 39 m/s Plain Terrain

WORLD BANK FUNDING

Sr. No.	Description	Unit	Eqpt Exworks excl. Excise Duty Quantity	Rate (Rs.)	Total	SPARES Quantity	Total	TOTAL Exw & Spares	F & I @ 4% CST @ 2%	Erc/Civil Works	TOTAL
1	2	3	4	5	6=4x5	7	8=7x5	9=6+8	10	11	12=9+10+11
6.1.4	Flexible Copper Bond for earthwire	Nos.	1,311	506	6.63	13	0.07	6.70	0.40		7.10
6.1.5	Vibration Damper For Conductor	Nos.	15,659	899	140.77	157	1.41	142.18	8.53		150.71
6.1.6	Vibration Damper for Earthwire	Nos.	2,623	391	10.26	26	0.10	10.36	0.62		10.98
6.1.7	Bundle Spacer damper for Conductor	Nos.	23882	906	216.37	239	2.17	218.54	13.11		231.65
6.1.8	Rigid Spacer for Conductor	Nos.	1527	454	6.93	15	0.07	7.00	0.42		7.42
6.1.9	Earthwire Tension Clamps	Nos.	345	739	2.55	3	0.02	2.57	0.15		2.72
6.1.10	Earthwire Suspension Clamps	Nos.	966	752	7.26	10	0.08	7.34	0.44		7.78
6.1.11	T - Connector	Nos.	65	1,256	0.82	1	0.01	0.83	0.05		0.88
	Type test charges for C & E accessories	LS			4.75		0.00	4.75			4.75
	Sub Total : 6				**417.90**		**4.15**	**422.05**	**25.02**	**0.00**	**447.07**
7.0	**Tower Erection**										
	I) Normal towers	MT	7,389	5,692						420.58	420.58
	Sub Total : 7				**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**420.58**	**420.58**
8.0	**Foundations**										
8.1	**Excavations**										
	Normal Dry soil	Cu.M.	17,549	190						33.34	33.34
	Normal Wet soil	Cu.M.	34,188	213						72.82	72.82
	Dry Fissured Rock	Cu.M.	12,309	593						72.99	72.99
	Wet Fissured Rock	Cu.M.	7,272	622						45.23	45.23
	Hard Rock	Cu.M.	94	1,311						1.23	1.23
8.2	**Concreting**										
	Concreting 1:1.5:3(M20)	Cu.M.	8,840	6,604						583.79	583.79
	Concreting 1:3:6	Cu.M.	1,155	5,790						66.87	66.87
8.3	Reinforcement	MT	745	56,368						419.94	419.94
	Sub Total : 8				**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**1296.21**	**1296.21**
9.0	**Benching**										
	All kinds of soil except HR & FR	Cu.M.	600	183						1.10	1.10
	Fissured Rock	Cu.M.	200	664						1.33	1.33
	Hard Rock	Cu.M.	200	1,286						2.57	2.57
	Sub Total : 9				**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**5.00**	**5.00**
10.0	**Revetment**										
I)	Random Rubble Stone	Cu.M.	2,000	4,599						91.98	91.98
	Masonary including excavation										

COST BREAK UP OF TRANSMISSION LINE

ANNEXURE - 1.2.1

PROJ: SYSTEM STRENGTHENING - XIII IN SOUTHERN REGIONAL GRID

(Rs. in Lakhs)

TRANSMISSION LINE : GOOTY-MADHUGIRI 400KV D/C TRANSMISSION LINE

Line Length : 211 Km. Wind Zone 2: 39 m/s Plain Terrain

WORLD BANK FUNDING

Sr. No.	Description	Unit	Eqpt Exworks excl. Excise Duty Quantity	Rate (Rs.)	Total	SPARES Quantity	Total	TOTAL Exw & Spares	F & I @ 4% CST @ 2%	Ere/Civil Works	TOTAL
1	2	3	4	5	6=4x5	7	8=7x5	9=6+8	10	11	12=9+10+11
ii)	Stone bound in galvanised wire netting including excavation	Cu.M.	-	4,901						0.00	0.00
iii)	Backfilling and leveling of Volumes enclosed in revetment	Cu.M.	1,000	260						2.60	2.60
iv)	M-15(1:2:4) Concrete for top seal cover of revetment	Cu.M.	20	10,413						2.08	2.08
	Sub Total : 10				0.00	0.00	0.00	0.00	0.00	96.66	96.66
11.0	**Stringing 400KV D/C**	K.M.	211	204,233						430.93	430.93
12.0	**River crossing towers**										
	i) Pile / well foundation	LS								285.11	285.11
13.0	Detailed survey incl profilling and tower	K.M.	211	20,435						43.12	43.12
	Check survey	KM	211	11,782						24.86	24.86
14.0	**Soil investigation in**										
	All kinds of soil except HR &FR	Loc.	5	18,901						0.95	0.95
	Fissured rock	Loc.	4	26,495						1.06	1.06
	Hard rock	Loc.	3	63,745						1.91	1.91
	Transmission Line Total				12,803.88	169.10	12,972.98	776.50	2,606.39	16,355.87	

ANNEXURE - 1.2.1(a)

TRANSMISSION LINE : GOOTY-MADHUGIRI 400KV D/C TRANSMISSION LINE

PALAR RIVER CROSSING LOCATION : DD+25 M TOWERS

BOQ FOR PILE FOUNDATIONS (1 Locations)

SL. NO.	DESCRIPTION	UNIT	UNIT RATES CIVIL	QTY/ TOWER LOC	No. of Tower Location	TOTAL COST CIVIL
				1		
I	PILE FOUNDATION					
1.0	Driving and installation of Cast-in situ vertical bored RCC piles of specified diameter as per the approved drawings, including cost of all necessary labour, materials, tools & tackles, rigs etc. (including boring, concreting, cement, etc. but excluding c					
a)	1200mm dia. bored piles in all types of soil excluding soft rock, shale etc:					
	i) Upto 40 M depth from cut-off level	M	21,843	600	1	13,105,800
	(b) Extra over item 1(a) for boring including socketing in weathered rock, fissured rock , soft rock shale weathered rock limited to maximun depth of 5.0m	M	4,307	24	1	103,368
2.0	Excavation of all types of soil	Cu. M.	204	11	1	2,183
3.0	Backfilling with excavated earth	Cu. M.	140	7	1	1,036
4.0	P.C.C (1:4:8)	Cu. M.	6,159	11	1	67,749
5.0	R.C.C M25 Grade (Concrete for piles not covered but concrete in pile caps and foundation mats, pedestals, tie beams etc. included)	Cu. M.	9,612	253	1	2,431,836
6.0	Form Works	Sq.M	692	487	1	337,004
7.0	i) Reinforcement Steel for pile, pile cap, pedestal etc	MT	74,900	112	1	8,388,800
8.0	Mild Steel Liner supporting the Piles	MT	89,328	43.0	1	3,841,104
9.0	Conducting Standard Penetration Test (SPT) at various elevation in Pile Borehole	Nos.	2,878	48	1	138,144
10.0	Conducting Integrity Test on Pile	Nos.	3,925	24	1	94,200
			TOTAL			28,511,224
				Rs. Lacs		285.11

COST BREAK UP OF TRANSMISSION LINE

ANNEXURE - 1.2.2

PRO. SYSTEM STRENGTHENING - XIII IN SOUTHERN REGIONAL GRID

(Rs. in Lakhs)

TRANSMISSION LINE : MADHUGIRI-YELAHANKA 400KV D/C (QUAD) TRANSMISSION LINE

Line Length : 77 Km. Wind Zone 2: 39 m/s TERRAIN Plain Terrain

WORLD BANK FUNDING

Sr. No.	Description	Unit	Eqpt Exworks excl. Excise Duty Quantity	Rate (Rs.)	Total	SPARES Quantity	Total	TOTAL Exw & Spares	F & I @ 4% CST @ 2%	Ere/Civil Works	TOTA
1	2	3	4	5	6=4x5	7	8=7x5	9=6+8	10	11	12=9+10+1
1.0	TOWER STEEL										
1.1	High Tensile Steel	MT	1,828	57,018	1042.29	37	21.10	1063.39	63.80		1127.19
	Mild Steel	MT	2,631	51,633	1358.46	53	27.37	1385.83	83.15		1468.98
	Hexagonal bolts & Nuts	MT	202	76,151	153.83	4	3.05	156.88	9.41		166.29
	Tower Accessories & Earthing	LS			25.55		0.52	26.07	1.56		27.63
2.0	Conductor										
2.1	ACSR "MOOSE"	K.M.	1,876	274,368	5147.14	19	52.13	5199.27	311.96		5511.23
	Type test charges for conductor	LS			1.25			1.25			1.25
3.0	Earthwire										
3.1	Earthwire (G.S. 7/3.66 mm)	K.M.	156	38,944	60.75	2	0.78	61.53	3.69		65.22
	Type test charges for earthwire	LS			0.60			0.60			0.60
4.0	Insulator										
4.1	Insulator (120 KN Standard)	Nos.	50,347	528	265.83	503	2.66	268.49	16.11		284.60
4.2	Insulator (160 KN Standard)	Nos.	40,112	621	249.10	401	2.49	251.59	15.10		266.69
	Type test charges for insulator	LS			[redacted]			23.39			23.39
	Sub Total : 4				538.32		5.15	543.47	31.21	0.00	574.68
5.0	Hardware Fitting										
5.1	Single Suspension 'I' Fittings	Set	-		0.00	0	0.00	0.00	0.00		0.00
5.2	Single Suspension pilot Fittings	Set	139	31,615	43.94	1	0.32	44.26	2.66		46.92
5.5	Double 'I' Suspension Fittings	Set	1,025	24,461	250.73	10	2.45	253.18	15.19		268.37
5.8	Quad Tension Fittings	Set	436	47,999	209.28	4	1.92	211.20	12.67		223.87
	Type test charges for hardware fittings	LS			0.98			0.98			0.98
	Sub Total : 5				504.93		4.69	509.62	30.52	0.00	540.14

COST BREAK UP OF TRANSMISSION LINE

ANNEXURE - 1.2.2

(Rs. in Lakhs)

PRO. SYSTEM STRENGTHENING - XIII IN SOUTHERN REGIONAL GRID

TRANSMISSION LINE : MADHUGIRI-YELAHANKA 400KV D/C (QUAD) TRANSMISSION LINE

Line Length : 77 Km. | Wind Zone 2: 39 m/s | TERRAIN Plain Terrain

WORLD BANK FUNDING

Sr. No.	Description	Unit	Eqpt Exworks excl. Excise Duty Quantity	Rate (Rs.)	Total	SPARES Quantity	Total	TOTAL Exw & Spares	F & I @ 4% CST @ 2%	Ere/Civil Works	TOTAL
1	2	3	4	5	6=4x5	7	8=7x5	9=6+8	10	11	12=9+10+11
6.1	**Conductor & E'wire Accessories**										14.83
6.1.1	MSCJ For Conductor	Nos.	1,158	1,196	13.85	12	0.14	13.99	0.84		0.28
6.1.2	MSCJ For Earthwire	Nos.	87	303	0.26	1	0.00	0.26	0.02		1.45
6.1.3	Repair Sleeve for Conductor	Nos.	347	392	1.36	3	0.01	1.37	0.08		2.65
6.1.4	Flexible Copper Bond for earthwire	Nos.	489	506	2.47	5	0.03	2.50	0.15		0.00
6.1.5	Vibration Damper For Conductor	Nos.	-	899	0.00	0	0.00	0.00	0.00		4.10
6.1.6	Vibration Damper for Earthwire	Nos.	979	391	3.83	10	0.04	3.87	0.23		212.83
6.1.7	Quad Spacer damper for Conductor	Nos.	8696	2,286	198.79	87	1.99	200.78	12.05		7.31
6.1.8	Quad rigid Spacer for Conductor	Nos.	636	1,075	6.84	6	0.06	6.90	0.41		1.17
6.1.9	Earthwire Tension Clamps	Nos.	147	739	1.09	1	0.01	1.10	0.07		2.73
6.1.10	Earthwire Suspension Clamps	Nos.	341	752	2.56	3	0.02	2.58	0.15		5.05
	Type test charges for C & E accessories	LS			5.05			5.05			252.40
	Sub Total : 6				**236.10**		**2.30**	**238.40**	**14.00**	**0.00**	
7.0	**Tower Erection**									265.30	265.30
	I) Normal towers	MT	4,661	5,692						**265.30**	**265.30**
	Sub Total : 7				**0.00**		**0.00**	**0.00**	**0.00**		
8.0	**Foundations**									13.40	13.40
8.1	**Excavations**									31.56	31.56
	Normal Dry soil	Cu.M.	7,055	190						66.96	66.96
	Normal Wet soil	Cu.M.	14,818	213						48.24	48.24
	Dry Fissured Rock	Cu.M.	11,292	593						2.48	2.48
	Wet Fissured Rock	Cu.M.	7,755	622							
	Hard Rock	Cu.M.	189	1,311						406.34	406.34
8.2	**Concreting**									40.65	40.65
	Concreting 1:1.5:3(M20)	Cu.M.	6,153	6,604						315.10	315.10
	Concreting 1:3:6	Cu.M.	702	5,790						**924.73**	**924.73**
8.3	Reinforcement	MT	559	56,368							
	Sub Total : 8				**0.00**		**0.00**	**0.00**	**0.00**		

COST BREAK UP OF TRANSMISSION LINE

ANNEXURE - 1.2.2

PRO. SYSTEM STRENGTHENING - XIII IN SOUTHERN REGIONAL GRID (Rs. in Lakhs)

TRANSMISSION LINE : MADHUGIRI-YELAHANKA 400KV D/C (QUAD) TRANSMISSION LINE

Line Length : 77 Km. | Wind Zone 2: 39 m/s | TERRAIN : Plain Terrain

WORLD BANK FUNDING

Sr. No.	Description	Unit	Eqpt Exworks excl. Excise Duty Quantity	Rate (Rs.)	Total	SPARES Quantity	Total	TOTAL Exw & Spares	F & I @ 4% CST @ 2%	Ere/Civil Works	TOTA
1	2	3	4	5	6=4x5	7	8=7x5	9=6+8	10	11	12=9+10+1
9.0	**Benching**										
	All kinds of soil except HR & FR	Cu.M.	1,200	183						2.20	2 20
	Fissured Rock	Cu.M.	2,000	664						13.28	13 28
	Sub Total : 9				0.00	0.00	0.00	0.00	0.00	15.48	15 48
10.0	**Revetment**										
I)	Random Rubble Stone	Cu.M.	1,000	4,599						45.99	45 99
	Masonary including excavation										
ii)	Stone bound in galvanised wire netting	Cu.M.	-	4,901						0.00	0 00
	including excavation										
iii)	Backfilling and leveling of	Cu.M.	1,500	260						3.90	3 90
	Volumes enclosed in revetment										
iv)	M-15(1:2:4) Concrete for top seal	Cu.M.	120	10,413						12.50	12 50
	cover of revetment										
	Sub Total : 10				0.00	0.00	0.00	0.00	0.00	62.39	62 39
11.0	**Stringing 400KV D/C (Quad)**	K.M.	77	248,232						191.14	191 14
12.0	**Aviation Signal**										
	Painting of Normal towers	MT	48	14,647						7.03	7 03
	Obstruction lights(1 M + 2 L)	Nos.	20	359,710	71.94	0.00	0.00	71.94	4.32	1.81	78 07
13.0	**Detailed survey incl profilling and tower spotting**	K.M.	77	20,435						15.73	15 73
	Check survey	KM	77	11,782						9.07	9 07
14.0	**Soil investigation in**										
	All kinds of soil except HR &FR	Loc.	18	18,901						3.40	3 40
	Fissured rock	Loc.	4	26,495						1.06	1 06
	Transmission Line Total				9,139.31		118.94	9,258.25	553.62	1,497.14	11,309 01
	PROJECT TOTAL				**21943.19**		**288.04**	**22231.23**	**1330.12**	**4103.53**	**27664.88**

ABSTRACT COST ESTIMATE
SUBSTATIONS

ANNEXURE - 1.3
Rs. Lakhs

PROJ: SYSTEM STRENGTHENING - XIII IN SOUTHERN REGIONAL GRID

S.No	DESCRIPTION	SUBSTATION: 400/220 KV MADHUGIRI NEW SUBSTATION	SUBSTATION: 400 KV GOOTY EXTENSION SUBSTATION	SUBSTATION: 400/220 KV YELAHANKA SUB STATION (EXTN.)	TOTAL
		WORLD BANK FUNDING	WORLD BANK FUNDING	DOMESTIC FUNDING	
1.0	500 MVA, 400/220/33KV, 3PH Auto Transformer	1970.84	0.00	0.00	1970.84
1.1	63MVAR, 420KV , 3 PH Bus Reactor	366.33	0.00	0.00	366.33
	Sub-Total 1.0	2337.17	0.00	0.00	2337.17
2.0	400 KV GIS Equipment	0.00	0.00	1459.63	1459.63
2	400 KV EQUIPMENT				
	Circuit Breaker	322.16	72.50	0.00	394.66
	Isolator	255.96	50.41	0.00	306.37
	Current Transformer	270.57	54.94	0.00	325.51
	Capacitive Voltage Transformer	80.02	27.99	35.12	143.13
	Lightning Arrestor	31.04	9.43	11.79	52.26
	Sub-Total 2.0	959.75	215.27	46.91	1221.94
3	220 KV EQUIPMENT				
	Circuit Breaker	131.18	0.00	0.00	131.18
	Isolator	109.22	0.00	0.00	109.22
	Current Transformer	86.87	0.00	0.00	86.87
	Capacitive Voltage Transformer	64.80	0.00	0.00	64.80
	Lightning Arrestor	11.83	0.00	0.00	11.83
				0.00	
	Sub-Total 3.0	403.90	0.00	0.00	403.90
4	72.5 KV EQUIPMENT	24.37	0.00	0.00	24.37
5	33 KV EQUIPMENT	1.54	0.00	0.00	1.54
6	Control & Relay Panels	534.76	58.14	56.91	649.81
7a	PLCC Equipment	132.07	39.95	63.81	235.83
7b	Voice & Data Connectivity	12.87			12.87
8	SWITCHYARD ERECTION				
	Equipment Structure	504.00	94.00	10.00	608.00
	Other Equipment (Busbar matls.)	438.60	51.50	0.00	490.10
	Equipment Civil Works	514.00	70.00	0.00	584.00
	Erection	87.03	5.22	0.00	92.28
	Sub-Total 8	1,543.63	220.72	10.00	1,774.36
9	SUBSTATION AUXILIARIES	548.66	38.00	73.00	659.66
	Total Equipment Cost	6498.74	572.09	1710.26	8781.08
10	CUSTOMS DUTY INCL. HANDLLING CHARGES	0.00	0.00	276.72	276.72
	Total Cost	6,498.74	572.09	1,986.98	9057.81
	Preliminary & Gen. Civil Works	4,594.00	20.00	20.00	4634.00
	Grand Total	11,092.74	592.09	2,006.98	13691.81

ANNEXURE.- 1.3.1

COST BREAK UP OF SUB STATION -EQUIPMENT

(Rs. in Lakhs)

PROJ: SYSTEM STRENGTHENING - XIII IN SOUTHERN REGIONAL GRID

SUBSTATION: 400/220 KV MADHUGIRI NEW SUBSTATION

					WORLD BANK FUNDING					
Sr. No.	Description	Unit	Qty.	Rate excl. E.D.	Total	Spares	Total Exw. & Spares	F&I @ 4% & CST@2%	Ere/Civil Works	Tota
1	2	3	4	5	6=4x5	7	8=6+7	9	11	12=8+9+10+11
1.0	500 MVA, 400/220/33KV, 3PH Auto Transformer	Nos.	2	872.79 (incl. E.D.)	1745.58	87.28	1832.86	103.13	27.35	1963.34
	Type test charges for Transformer	L.S.	1	7.50	7.50		7.50			7.50
1.1	63MVAR, 420KV 3ph Bus Reactor	Nos.	1	315.20 (incl. E.D.)	315.20	15.76	330.96	18.62	10.76	360.34
	Type test charges for Reactor	L.S.	1	5.99	5.99		5.99			5.99
2.1	**420 KV Equipment**									
2.1.1	420 KV, 2000A, 50 KA Circuit Breaker without PIR	Nos.	9	20.31	182.81	6.70	189.51	11.37	2.40	203.28
2.1.2	420 KV, 3150A, 50 KA Circuit Breaker without 3Ph	Nos.	4	25.78	103.11	8.51	111.62	6.70	0.56	118.88
2.1.3	420 KV, 2000A, 50KA Isolator 3-ph	Nos.	0	5.95	0.00	0.00	0.00	0.00	0.00	0.00
2.1.3	420 KV, 3150A, 50KA Isolator 3-ph with 1 E/S	Nos.	38	6.03	229.24	1.99	231.23	13.87	10.86	255.96
2.1.5	420 KV , 3000A Current Transformer 1Ph	Nos.	42	5.90	247.92	5.90	253.82	15.23	1.52	270.57
2.1.6	420 KV CVT 1Ph	Nos.	18	3.75	67.47	7.50	74.97	4.50	0.55	80.02
2.1.7	336 KV Lightning Arrestor 1Ph	Nos.	21	1.24	26.10	2.49	28.59	1.72	0.73	31.04
	Sub Total 2.1				856.65	33.09	889.74	53.39	16.63	959.75
2.2	**220KV Equipment (40 KA)**									
2.2.1	220KV Circuit Breaker 3ph	Nos.	10	11.79	117.91	3.89	121.80	7.31	2.07	131.18
2.2.2	220KV Isolator 3-ph	Nos.	37	2.57	95.03	1.72	96.75	5.81	6.66	109.22
2.2.3	220KV Current Transformer 1PH	Nos.	30	2.52	75.62	5.04	80.66	4.84	1.37	86.87
2.2.4	220KV CVT 1Ph	Nos.	24	2.31	55.47	4.62	60.09	3.61	1.10	64.80
2.2.5	216KV Lightning Arrestor 1PH	Nos.	24	0.41	9.78	0.82	10.60	0.64	0.60	11.83
	Sub -Total 2.2				353.81	16.09	369.90	22.21	11.79	403.90
2.3	**72.5KV Equipment**									
2.3.1	72.5 KV Circuit Breaker ,3-ph	Nos.	1	10.21	10.21	3.37	13.58	0.81	0.46	14.85
2.3.2	72.5 KV Isolator, 3-ph	Nos.	1	1.81	1.81	0.60	2.41	0.14	0.23	2.78
2.3.3	72.5 KV Current Transformer 1-ph	Nos.	3	0.72	2.17	0.72	2.89	0.17	0.08	3.14
2.3.4	72.5 KV Potential Transformer 1-ph	Nos.	3	0.83	2.48	0.83	3.31	0.20	0.10	3.60
	Sub -Total 2.3				16.67	5.52	22.19	1.32	0.86	24.37
2.4	**11 KV Equipment**									

ANNEXURE.- 1.3.1

COST BREAK UP OF SUB STATION -EQUIPMENT

(Rs. in Lakhs)

PROJ: SYSTEM STRENGTHENING.- XIII IN SOUTHERN REGIONAL GRID

SUBSTATION: 400/220 KV MADHUGIRI NEW SUBSTATION

					WORLD BANK FUNDING					
Sr. No.	Description	Unit	Qty.	Rate excl. E.D.	Total	Spares	Total Exw. & Spares	F&I @ 4% & CST@2%	Ere/Civil Works	Total
1	2	3	4	5	6=4x5	7	8=6+7	9	11	12=8+9+10+11
2.4.1	11 KV Isolator 3-ph	Nos.	1	0.74	0.74	0.24	0.98	0.06	0.03	1.08
2.4.2	11 KV Horn gap fuse (1 ph)	Nos.	3	0.04	0.11	0.04	0.15	0.01	0.04	0.20
2.4.3	11 KV Lightning Arrestor(1 ph)	Nos.	3	0.06	0.17	0.06	0.23	0.01	0.03	0.27
	Sub - Total 2.4				1.02	0.34	1.36	0.08	0.11	1.54
3.0	**Control & Relay Panels**									
3.1	**Control & Relay Panels (400 KV)**									
3.1.1	CB Relay panel without A/R	Nos.	3	4.56	13.67	1.37	15.04	0.90	0.08	16.02
3.1.2	CB Relay panel with A/R	Nos.	10	4.58	45.77	4.58	50.35	3.02	0.27	53.64
3.1.3	Line protection panel	Sets	4	8.28	33.14	3.31	36.45	2.19	0.12	38.76
3.1.4	Transformer protection panel (HV & MV sides)	Sets	2	10.49	20.98	2.10	23.08	1.38	0.06	24.52
3.1.5	Reactor protection panel	Sets	1	7.68	7.68	0.77	8.45	0.51	0.03	8.99
3.1.6	Bus bar protection panel (double)	Sets	1	57.30	57.30	5.73	63.03	3.78	0.03	66.84
3.1.7	Time synchronisation equipment	Sets	1	1.44	1.44	0.14	1.58	0.09	0.03	1.70
3.1.8	Relay test kit	Nos.	1	3.87	3.87	0.39	4.26	0.26	0.00	4.52
	Sub - Total 3.1				183.85	18.39	202.24	12.13	0.62	214.99
3.2	**SUBSTATION AUTOMATION SYSTEM for 18 bays (400KV) & 10 bays(220kV)**	Set	1	152.16	152.16	15.22	167.38	10.04	2.33	179.75
3.3	**Control & Relay Panels (220kV)**									
3.3.1	CB relay panels with A/R	Nos.	7	4.58	32.04	3.20	35.24	2.11	0.19	37.54
3.3.2	CB Relay panel without A/R	Nos.	3	4.56	13.67	1.37	15.04	0.90	0.08	16.02
3.3.3	Line Protection Panel	Sets	6	8.28	49.70	4.97	54.67	3.28	0.18	58.13
3.3.4	Bus bar protection panel	Sets	1	24.28	24.28	2.43	26.71	1.60	0.01	28.32
	Sub - Total 3.2				119.69	11.97	131.66	7.89	0.47	140.02
	Sub - Total 3				455.70	45.58	501.28	30.06	3.42	534.76
4.0	**PLCC Equipment**									
4.1	**PLCC Equipment (400 KV)**									
4.1.1	2000A, 0.5 /1.0 mH Line Traps	Nos.	4	2.91	11.64	1.16	12.80	0.77	0.47	14.04
4.1.2	3150A, 0.5 /1.0 mH Line Traps	Nos.	4	6.83	27.30	2.73	30.03	1.80	0.39	32.22
4.1.3	Ph. To Ph. Coupling Device	Nos.	4	0.80	3.20	0.32	3.52	0.21	0.14	3.87
4.1.4	H.F. Cable	Km.	2	1.22	2.44	0.24	2.68	0.16	0.61	3.45

ANNEXURE.- 1.3.1

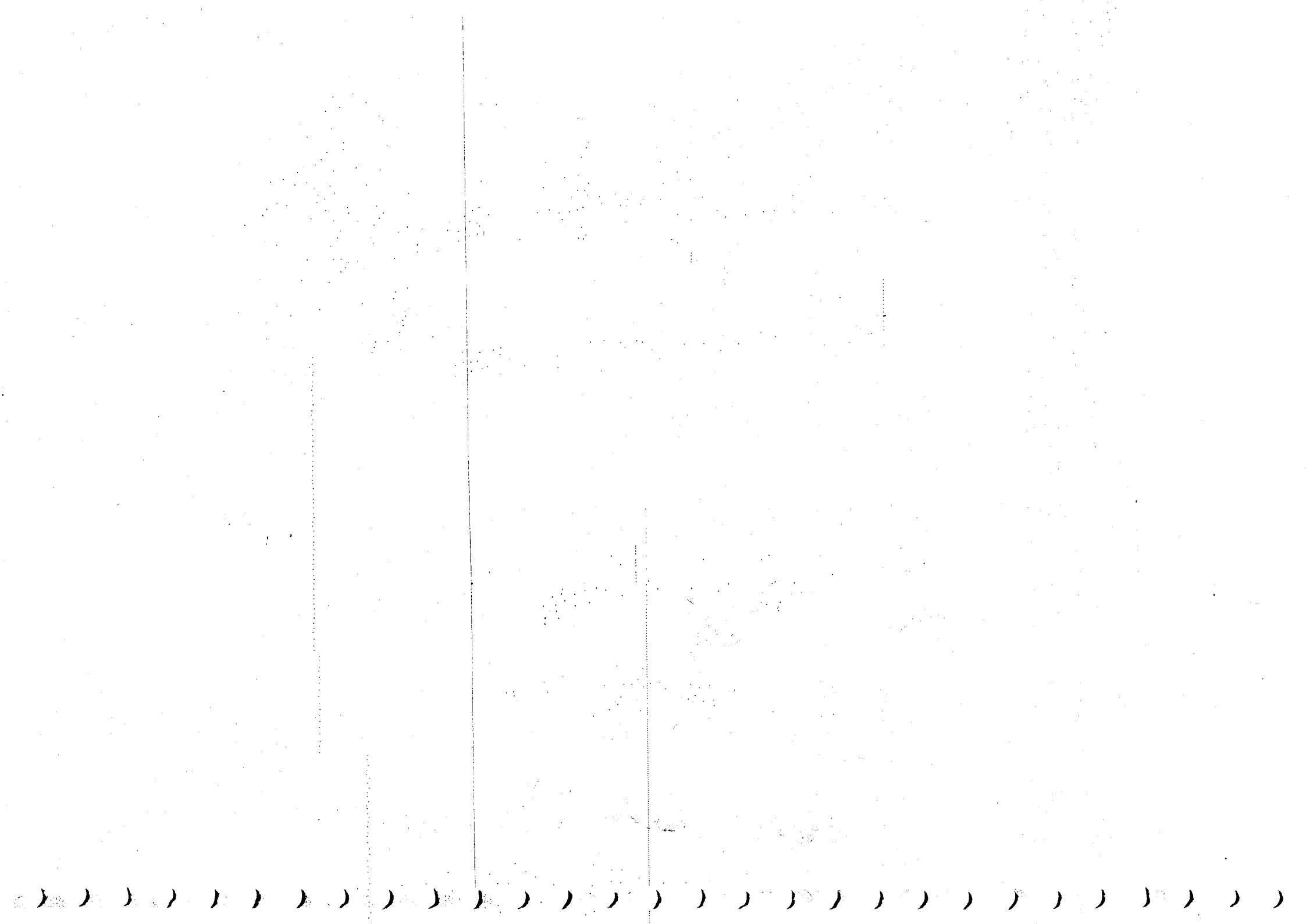
COST BREAK UP OF SUB STATION -EQUIPMENT

(Rs. in Lakhs)

PROJ: SYSTEM STRENGTHENING - XIII IN SOUTHERN REGIONAL GRID

SUBSTATION: 400/220 KV MADHUGIRI NEW SUBSTATION

					WORLD BANK FUNDING					
Sr. No.	Description	Unit	Qty.	Rate excl. E.D.	Total	Spares	Total Exw. & Spares	F&I @ 4% & CST@2%	Ere/Civil Works	Total
1	2	3	4	5	6=4x5	7	8=6+7	9	11	12=8+9+10+11
4.1.5	Carrier Equipment	Nos.	10	2.74	27.35	2.74	30.09	1.81	0.30	32.20
4.1.6	Protn. Coupler	Nos.	8	1.30	10.37	1.04	11.41	0.68	0.21	12.30
4.1.7	EPAX(24/8)	Nos.	1	2.82	2.82	0.28	3.10	0.19	0.01	3.30
4.1.8	Testing and maintenance Equipment	Nos.	1	1.03	1.03	0.10	1.13	0.07	0.00	1.20
	Sub - Total - 4.1				86.15	8.61	94.76	5.69	2.14	102.59
4.2	PLCC Equipment (220 KV)									
4.2.1	1600A, 0.5 mH Line Traps	Nos.	12	2.04	24.48	2.45	26.93	1.62	0.93	29.48
	Sub - Total - 4.2				24.48	2.45	26.93	1.62	0.93	29.48
4.3	Data & Voice Connectivity	Details:- Annexure 1.4					12.87			12.87
	SWITCHYARD ERECTION									
5.0	Equipment Structure	L.S.	1		504.00		504.00			504.00
6.0	Other Equipment (Bus Bar materials)	L.S.	1		438.60		438.60			438.60
7.0	Equipment Civil works	L.S.	1						514.00	514.00
8.0	Erection	L.S.	1						87.03	87.03
	Sub - Total				942.60	0.00	942.60	0.00	601.03	1543.63
	SUBSTATION AUXILIARIES									
9.0	Fire Fighting System	L.S.	1		82.00		82.00			82.00
10.0	Air Conditioning & Ventilation	L.S.	1		26.00		26.00			26.00
11.0	Lighting system	L.S.	1		61.00		61.00			61.00
12.0	D.G. Set (500 KVA)	Nos	1	33.29	33.29		33.29	2.00	0.29	35.58
13.0	Battery and Battery charger (220V & 48V)	L.S.	1		30.00		30.00			30.00
14.0	Power & Control Cables	L.S.	1		231.00		231.00			231.00
16.0	LT Transformer 11KV/0.433KV, 800 KVA	Nos	1	14.85	14.85		14.85	0.89	0.23	15.96
17.0	LT Transformer 33KV/0.433KV, 800 KVA	Nos	1	16.50	16.50		16.50	0.99	0.25	17.74
18.0	LT Switch gear	L.S.	1		49.00		49.00			49.00
19.0	Maintenace Equipment for CB & Transformer	L.S.	1	0.38	0.38		0.38			0.38
	Sub Total				544.02	0.00	544.02	3.88	0.76	548.66
	Sub station Total				**5,355.37**	**214.71**	**5,582.95**	**240.00**	**675.79**	**6,498.74**



ANNEXURE.- 1.3.2

COST BREAK UP OF SUB STATION -EQUIPMENT

(Rs. in Lakhs)

PROJ: SYSTEM STRENGTHENING - XIII IN SOUTHERN REGIONAL GRID

SUBSTATION: 400 KV GOOTY EXTENSION SUBSTATION

WORLD BANK FUNDING

Sr. No.	Description	Unit	Qty.	Rate excl. E.D.	Total	Spares	Total Exw. & Spares	F&I @ 4% & CST@2%	Ere/Civil Works	Total
1	2	3	4	5	6=4x5	7	8=6+7	9	10	11=8+9+10
1.0	**420 KV Equipment**									
1.1	420 KV, 2000A, 40 KA Circuit Breaker without PIR	Nos.	3	20.31	60.94	6.70	67.64	4.06	0.80	**72.50**
1.2	420 KV, 2000A, 40KA Isolator 3-ph	Nos.	8	5.49	43.96	1.81	45.77	2.75	1.88	**50.41**
1.3	420 KV , 2000A Current Transformer 1Ph	Nos.	9	5.12	46.06	5.12	51.18	3.07	0.69	**54.94**
1.4	420 KV CVT 1Ph	Nos.	6	3.75	22.49	3.75	26.24	1.57	0.18	**27.99**
1.5	390 KV Lightning Arrestor 1Ph	Nos.	6	1.24	7.46	1.24	8.70	0.52	0.21	**9.43**
	Sub Total 2.1				180.91	18.63	199.54	11.97	3.77	**215.27**
2.0	**Control & Relay Panels**									
2.1	**Control & Relay Panels (400 KV)**									
2.1.1	CB Relay panel with A/R	Nos.	3	4.58	13.73	1.37	15.10	0.91	0.08	**16.09**
2.1.2	Line protection panel	Sets	2	8.28	16.57	1.66	18.23	1.09	0.06	**19.38**
2.1.3	Bus bar protection augmentation	Sets	1	0.86	0.86	0.09	0.95	0.06	0.05	**1.06**
2.1.4	Event logger panel	Nos.	1	18.42	18.42	1.84	20.26	1.22	0.13	**21.61**
	Sub - Total 2.1				49.58	4.96	54.54	3.28	0.32	**58.14**
3.0	**PLCC Equipment**									
3.1	**PLCC Equipment (400 KV)**									
3.1.1	2000A, 0.5 /1.0 mH Line Traps	Nos.	4	2.91	11.64	1.16	12.80	0.77	0.47	**14.04**
3.1.2	Ph. To Ph. Coupling Device	Nos.	2	0.80	1.60	0.16	1.76	0.11	0.07	**1.94**
3.1.3	H.F. Cable	Km.	1	1.22	1.22	0.12	1.34	0.08	0.31	**1.73**
3.1.4	Carrier Equipment	Nos.	5	2.74	13.68	1.37	15.05	0.90	0.15	**16.10**
3.1.5	Protn. Coupler	Nos.	4	1.30	5.18	0.52	5.70	0.34	0.11	**6.15**
	Sub - Total 4.0				33.32	3.33	36.65	2.20	1.10	**39.95**

ANNEXURE.- 1.3.2

COST BREAK UP OF SUB STATION -EQUIPMENT

(Rs. in Lakhs)

PROJ: SYSTEM STRENGTHENING - XIII IN SOUTHERN REGIONAL GRID

SUBSTATION: 400 KV GOOTY EXTENSION SUBSTATION

Sr. No.	Description	Unit	Qty.	Rate excl. E.D.	WORLD BANK FUNDING Total	Spares	Total Exw. & Spares	F&I @ 4% & CST@2%	Ere/Civil Works	Total
1	2	3	4	5	6=4x5	7	8=6+7	9	10	11=8+9+10
	SWITCHYARD ERECTION									
4.0	Equipment Structure	L.S.	1		94.00		94.00			94.00
5.0	Other Equipment (Bus Bar materials)	L.S.	1		51.50		51.50			51.50
6.0	Equipment Civil works	L.S.	1						70.00	70.00
7.0	Erection	L.S.	1						5.22	5.22
	Sub - Total				145.50	0.00	145.50	0.00	75.22	220.72
	SUBSTATION AUXILIARIES									
8.0	Lighting system	L.S.	1		8.00		8.00			8.00
9.0	Power & Control Cables	L.S.	1		30.00		30.00			30.00
	Sub Total				38.00	0.00	38.00	0.00	0.00	38.00
	Sub station Total				447.31	26.92	474.23	17.45	80.42	572.09

COST BREAK UP OF SUB STATION -EQUIPMENT

PROJ: SYSTEM STRENGTHENING - XIII IN SOUTHERN REGIONAL GRID

ANNEXURE - 1.3.3

(Rs. in Lakhs)

SUBSTATION: 400/220 KV YELAHANKA SUB STATION (EXTN.)

			DOMESTIC FUNDING							
Sr. No.	Description	Unit	Qty.	Rate incl. E.D.	Total	Spares	Total Exw. & Spares	F&I @ 4% & CST @ 2%	Ere/Civil Works	Total
1	2	3	4	5	6=4x5	7	8=6+7	9	11	12=8+9+10+11
1.0	**420 KV GIS Equipment**									
1.1	420kV, 3150A, 40kA SF6 gas insulated Line feeder bay module each comprising of SF6 gas insulated circuit breaker, current transformer, bus-bar disconnectors with common grounding switch, safety grounding switches,high speed fault making grounding switches, local control cubicle, SF6 gas monitoring system for complete bay , gas insulated terminal connection for connecting overhead line (Air/SF6) with GIS through gas insulated interconnection bus (3150A rating etc.) to complete feeder bay module	Set	2	541.60	1083.20	54.16	1137.36	45.49	55.90	**1238.75**
1.2	420kV , 3 single phase (isolated), SF6 gas insulated , metal enclosed 4000A, 40kA bus bars each enclosed in three individual bus enclosures running along the length of the switchgear to interconnect each of circuit breaker bay module. Each bus bar set shall be complete with Voltage transformer, disconnectors with grounding switch, local control cubicle, SF 6 gas monitoring system for the complete bus etc	Set	2	75.32	150.63	7.53	158.16	6.33	56.38	**220.87**
	Sub Total 2.1				**1233.83**	**61.69**	**1295.52**	**51.82**	**112.28**	**1459.63**
2.0	**420 KV Equipment**									
2.1	420 KV CVT 1Ph	Nos.	6	4.13	24.81	8.27	33.08	1.86	0.18	35.12
2.2	336 KV Surge Arrestor 1Ph	Nos.	6	1.37	8.22	2.74	10.96	0.62	0.21	11.79
	Sub Total 2.2				**33.03**	**11.01**	**44.04**	**2.48**	**0.39**	**46.91**
3.0	**Control & Relay Panels**									
3.1	**Control & Relay Panels (400 KV)**									
3.1.1	CB Relay panel with A/R	Nos.	2	5.05	10.10	1.01	11.11	0.63	0.05	11.79
3.1.2	Line protection panel	Sets	2	9.14	18.27	1.83	20.10	1.13	0.06	21.29
3.1.3	Bus bar protection panel (Augmentation for 2 bays	Sets	2	0.95	1.89	0.19	2.08	0.12	0.10	2.30
	Sub - Total 3.1				**30.26**	**3.03**	**33.29**	**1.88**	**0.22**	**35.39**
3.2	**SUBSTATION AUTOMATION SYSTEM FOR 400 KV (2 bays)**	Set	1	18.08	18.08	1.81	19.89	1.12	0.51	21.52
	Sub - Total 3				**48.34**	**4.84**	**53.18**	**3.00**	**0.73**	**56.91**
4.0	**PLCC Equipment**									

COST BREAK UP OF SUB STATION -EQUIPMENT

PROJ: SYSTEM STRENGTHENING - XIII IN SOUTHERN REGIONAL GRID

ANNEXURE - 1.3.3

(Rs. in Lakhs)

SUBSTATION: 400/220 KV YELAHANKA SUB STATION (EXTN.)

Sr. No.	Description	Unit	Qty.	DOMESTIC FUNDING Rate incl. E.D.	Total	Spares	Total Exw. & Spares	F&I @ 4% & CST @ 2%	Ere/Civil Works	Total
1	2	3	4	5	6=4x5	7	8=6+7	9	11	12=8+9+10+11
4.1	PLCC Equipment (400 KV)									
4.1.1	3150A, 0.5 /1.0 mH Line Traps	Nos.	4	7.53	30.12	3.01	33.13	1.86	0.39	35.38
4.1.2	Ph. To Ph. Coupling Device	Nos.	2	0.88	1.77	0.18	1.95	0.11	0.07	2.13
4.1.3	H.F. Cable	Km.	1.0	1.35	1.35	0.14	1.49	0.08	0.31	1.88
4.1.4	Carrier Equipment	Nos.	5	3.02	15.09	1.51	16.60	0.93	0.15	17.68
4.1.5	Protn. Coupler	Nos.	4	1.43	5.72	0.57	6.29	0.35	0.11	6.75
	Sub - Total - 4.1				54.05	5.41	59.46	3.33	1.02	63.81
	SWITCHYARD ERECTION									
5.0	Equipment Structure	L.S.	1		10.00		10.00			10.00
	Sub - Total				10.00	0.00	10.00	0.00	0.00	10.00
	SUBSTATION AUXILIARIES									
6.0	Lighting system	L.S.	1		8.00		8.00			8.00
7.0	Power & Control Cables	L.S.	1		20.00		20.00			20.00
8.0	LT Switch gear	L.S.	1		5.00		5.00			5.00
9.0	Extension of GIS hall (included in civil works)	Sq. m.	160	0.25	40.00		40.00			40.00
	Sub Total				73.00	0.00	73.00	0.00	0.00	73.00
	Sub station Total				1,452.25	82.95	1,535.20	60.63	114.42	1,710.26
	~ CUSTOMS DUTY INCL HANDLING CHARGES									276.72
	PROJECT TOTAL - SUBSTATIONS				7,254.93	824.58	7,592.38	318.08	870.63	8,781.08

ANNEXURE.- 1.4

ABSTRACT COST ESTIMATE

(Summary of Cost for Data & Voice Connectivity)

PROJ: SYSTEM STRENGTHENING - XIII IN SOUTHERN REGIONAL GRID

S.No.	Description	Cost (Rs. In Lakhs)
1	PLCC/PABX Equipments	12.87
	TOTAL COST	12.87

ANNEXURE.- 1.4.1

COST BREAK UP OF TELECOM &PLCC EQUIPMENT

PROJ SYSTEM STRENGTHENING - XIII IN SOUTHERN REGIONAL GRID

(Rs. in Lakhs)

Sr. No.	Description	Unit	Qty.	Rate incl. E.D.	Total	Spares	Total Exw. & Spares	F&I @4% & CST 2%	Ere/Civil Works	Total
1	2	3	4	5	6=4x5	7	8=6+7	9	10	11=8+9+10
1.0	PLCC Equipment									
A1	Analog PLCC Indoor Equipment									
(a)	PLC Terminal Equipment, Single Channel, 40 W	Set	4	2.74	10.94	1.09	12.03	0.72	0.12	12.87
	Sub - Total -1.0				10.94	1.09	12.03	0.72	0.12	12.87
	Total				10.94	1.09	12.03	0.72	0.12	12.87

ANNEXURE - 2.0

PHASED FUND REQUIREMENT
(BASE COST)

SYSTEM STRENGTHENING - XIII IN SOUTHERN REGIONAL GRID

FIGS. IN RS. CRORES

YEAR	EXP. EXCL. IDC	IDC	TOTAL
2010-2011	20.77	0.00	20.77
2011 - 2012	9.52	0.20	9.72
2012 - 2013	95.20	3.89	99.09
2013 - 2014	217.22	12.90	230.12
2014 - 2015	133.28	3.67	136.94
TOTAL	**475.98**	**20.66**	**496.64**

ANNEXURE - 2.0a

PHASED FUND REQUIREMENT
(COMPLETED COST)

SYSTEM STRENGTHENING - XIII IN SOUTHERN REGIONAL GRID

FIGS. IN RS. CRORES

YEAR	EXP. EXCL. IDC	IDC	TOTAL
2010-2011	20.77	0.00	20.77
2011 - 2012	9.74	0.21	9.95
2012 - 2013	104.59	4.16	108.75
2013 - 2014	261.65	14.60	276.24
2014 - 2015	172.19	4.27	176.46
TOTAL	**568.94**	**23.24**	**592.18**

WHEELING CHARGES
(AS PER NEW CERC NORMS)
(BASE COST)

ANNEXURE - 3.0

(Considering Return on Equity @ 15.5%)

PROJ : **SYSTEM STRENGTHENING - XIII IN SOUTHERN REGIONAL GRID**

1.0. Project Cost (Equity 30%, Debt 70%)	Rs.	496.64	Crs.
2.0. Fixed Charges			
2.1. O & M Charges for Transmission Lines & Substations	Rs.	14.19	Crs.
2.2. Depreciation (@5.28% for TL, @0% for land, @3.34% for building,@5.28% for Sub station, @6.33% for PLCC)	Rs.	24.56	Crs.
(TL = Rs 334.07 Crs.; S/S= Rs 116.34 Crs.; Land= Rs 28.22 Crs.			
Building= Rs 12.18 Crs.; PLCC= Rs 5.84 Crs.)			
2.3. Return on Equity @15.5%	Rs.	23.09	Crs.
2.4. Interest on World Bank Loan @ 7.0% and on Domestic Loan @ 10.5 %	Rs.	27.39	Crs.
2.5. Interest on Working Capital @ 13.0% a) on 2 months receivables b) O & M (1 month) c) Maintenance spares @ 15% of O&M expenses	Rs.	2.36	Crs.
Total Annual Fixed Charges	Rs.	91.59	Crs.
3.0. **Monthly Fixed Charges (for Base Cost)**	Rs.	763.25	Lakhs.

Note : The wheeling charges have been calculated as per new CERC NORMS (Notification dated 19.01.2009). Taxes & Incentives shall be taken as per Actuals.

WHEELING CHARGES

ANNEXURE - 3.0a

(AS PER CERC NORMS)

(COMPLETED COST)

(Considering Return on Equity @ 15.5%)

PROJ : SYSTEM STRENGTHENING - XIII IN SOUTHERN REGIONAL GRID

1.0. Project Cost (Equity 30%, Debt 70%)	Rs.	592.18	Crs.
2.0. Fixed Charges			
2.1. O & M Charges for Transmission Lines & Substations	Rs.	14.19	Crs.
2.2. Depreciation (@5.28% for TL, @0% for land, @3.34% for building,@5.28% for Sub station, @6.33% for PLCC)	Rs.	29.28	Crs.
2.3. Return on Equity @15.5%	Rs.	27.54	Crs.
2.4. Interest on World Bank Loan @ 7.0% and on Domestic Loan @ 10.5%	Rs.	32.60	Crs.
2.5. Interest on Working Capital @ 13.0% a) on 2 months receivables b) O & M (1 month) c) Maintenance spares @ 15% of O&M expenses	Rs.	2.68	Crs.
Total Annual Fixed Charges	**Rs.**	**106.29**	**Crs.**
3.0. **Monthly Fixed Charges (for Completed Cost)**	**Rs.**	**885.79**	**Lakhs.**

Note : The wheeling charges have been calculated as per new CERC NORMS (Notification dated 19.01.2009).
Taxes & Incentives shall be taken as per Actuals.

ANNEXURE -4.0

CALCULATION OF INTEREST DURING CONSTRUCTION FOR

SYSTEM STRENGTHENING - XIII IN SOUTHERN REGIONAL GRID

(FOR BASE COST)

(Rupees in Crores)

	Rate of	2010 - 2011				Oct 2011 - Mar 2012 (6 months)					2012 - 2013					2013 - 2014					Apr 2014 - May 2014 (2 months)					in 2014 - Mar 2015 (10 month		GRAND
	Interes	Original Phasing	IDC	TOTAL for the year	TOTAL Closing Bal.	Original Phasing	IDC	Adjusted IDC	TOTAL for the year	TOTAL Closing Bal.	Original Phasing	IDC	Adjusted IDC	TOTAL for the year	TOTAL Closing Bal.	Original Phasing	IDC	Adjusted IDC	TOTAL for the year	TOTAL Closing Bal.	Original Phasing	IDC	Adjusted IDC	TOTAL for the year	TOTAL Closing Bal.	Original Phasing	TOTAL Closing Bal.	TOTAL
World Bank Loan	7.0%	0.00	0.00	0.00	0.00	5.61	0.00	0.00	5.61	5.61	56.09	0.00	0.00	56.09	61.70	127.99	0.00	0.00	127.99	189.69	50.48	0.00	0.00	50.48	240.18	20.21	260.39	260.39
Domestic Loan	10.5%	0.00	0.00	0.00	0.00	3.91	0.10	0.10	4.11	4.11	21.00	1.53	2.36	24.89	29.00	20.19	4.11	8.80	33.09	62.09	8.39	1.16	2.51	12.06	74.15	13.10	87.26	87.26
Equity (IR) (30%)		20.77		20.77	20.77	0.00			0.00	20.77	18.10			18.10	38.87	69.04			69.04	107.91	26.80			26.80	134.71	14.28	148.99	148.99
TOTAL		20.77	0.00	20.77	20.77	9.52	0.10	0.10	9.72	30.49	95.20	1.53	2.36	99.09	129.58	217.22	4.11	8.80	230.12	359.70	85.68	1.16	2.51	89.34	449.04	47.60	496.64	496.64
Equity as % of Total cost					100.00%					68.120%					30.000%					30.000%					30.000%		30.000%	30.000%

NOTE :

1. Scheduled commissioning date of the project has been considered after 32 months from Investment Approval i.e., 01.10.2011.
2. Rate of Interest on World Bank Loan @ 7.0% & on Domestic Loan as 10.5% payable at the end of the year.
3. The Transmission System has been considered to be executed by the POWERGRID with a Debt : Equity ratio of 70:30.
4. **Fund provision for the year 2010 -2011 has been kept in accordance with the actual advance expenditure.**

GRAND TOTAL (2010 - 2015)

(FOR BASE COST)

Financing Details	Rate of Interes	Original Phasing	IDC	Total incl. IDC
World Bank Loan	7.0%	260.39	0.00	260.39
Domestic Loan	10.5%	66.59	20.66	87.26
Equity (IR) (30%)		148.99		148.99
TOTAL		**475.98**	**20.66**	**496.64**

ANNEXURE -4.0a

CALCULATION OF INTEREST DURING CONSTRUCTION FOR

SYSTEM STRENGTHENING - XIII IN SOUTHERN REGIONAL GRID

(FOR COMPLETED COST)

(Rupees In Crores)

	Rate of	2010 - 2011				Oct 2011 - Mar 2012 (6 months)					2012 - 2013					2013 - 2014					Apr 2014 - May 2014 (2 months)					Jun 2014 - Mar 2015 (10 month		GRAND
	Interest	Original Phasing	IDC	TOTAL for the year	TOTAL Closing Bal.	Original Phasing	IDC	Adjusted IDC	TOTAL for the year	TOTAL Closing Bal.	Original Phasing	IDC	Adjusted IDC	TOTAL for the year	TOTAL Closing Bal.	Original Phasing	IDC	Adjusted IDC	TOTAL for the year	TOTAL Closing Bal.	Original Phasing	IDC	Adjusted IDC	TOTAL for the year	TOTAL Closing Bal.	TOTAL for the year	TOTAL Closing Bal.	TOTAL
World Bank Loan	7.0%	0.00	0.00	0.00	0.00	5.74	0.00	0.00	5.74	5.74	61.04	0.00	0.00	61.04	66.78	154.31	0.00	0.00	154.31	221.09	64.17	0.00	0.00	64.17	285.26	26.92	312.18	312.18
Domestic Loan	10.5%	0.00	0.00	0.00	0.00	4.00	0.11	0.10	4.21	4.21	22.48	1.62	2.54	26.64	30.85	24.46	4.52	10.08	39.06	69.91	10.72	1.32	2.95	14.99	84.89	17.45	102.34	102.34
Equity (IR) (30%)		20.77		20.77	20.77	0.00			0.00	20.77	21.07			21.07	41.84	82.87			82.87	124.72	33.92			33.92	158.64	19.02	177.65	177.65
TOTAL		20.77	0.00	20.77	20.77	9.74	0.11	0.10	9.95	30.72	104.59	1.62	2.54	108.75	139.47	261.65	4.52	10.08	276.24	415.71	108.81	1.32	2.95	113.08	528.79	63.38	592.18	592.18
Equity as % of Total cost					100.00%					67.613%					30.000%					30.000%					30.000%		30.000%	30.000%

NOTE :

1. Scheduled commissioning date of the project has been considered after 32 months from Investment Approval i.e., 01.10.2011.
2. Rate of Interest on World Bank Loan @ 7.0% & on Domestic Loan as 10.5% payable at the end of the year.
3. The Transmission System has been considered to be executed by the POWERGRID with a Debt : Equity ratio of 70:30
4. Fund provision for the year 2010 -2011 has been kept in accordance with the actual advance expenditure.

GRAND TOTAL (2010 - 2015)

(FOR COMPLETED COST)

Financing Details	Rate of Interest	Original Phasing	IDC	Total incl. IDC
World Bank Loan	7.0%	312.18	0.00	312.18
Domestic Loan	10.5%	79.11	23.24	102.34
Equity (IR) (30%)		177.65		177.65
TOTAL		**568.94**	**23.24**	**592.18**

ANNEXURE -5.0

CALCULATION OF COMPLETED COST OF PROJECT

(Figures in Rs. Crores)

YEAR	Base Cost excl. IDC		Indian Escln. Rate		Compln. Cost excl. IDC		Completed Cost excl. IDC
	Cost excl. Afforestn. Cost	Afforestn. Cost	Based on WPI (80%)	Based on CPI (20%)	Cost excl. Afforestn. Cost	Afforestn. Cost	
2010 - 2011	20.77				20.77		20.77
Oct 2011 - Mar 2012 (6 months)	9.29	0.23	4.71%	5.27%	9.52	0.23	9.74
2012 - 2013	95.20		9.41%	10.53%	104.59		104.59
2013 - 2014	217.22		9.41%	10.53%	261.65		261.65
Apr 2014 - May 2014 (2 months)	85.68		1.57%	1.76%	108.81		108.81
Jun 2014 - Mar 2015 (10 months)	47.60		7.84%	8.78%	63.38		63.38
	475.75	0.23			568.71	0.23	568.94

Assumptions :

1. For Indigenous escalation, GOI guidelines dated 6.8.97 have been referred. Labour component has been assumed as 20% of the total Indigenous component and balance 80% updated based on average WPI (for all commodities).
2. Details of CPI and WPI indices for last 12 months are enclosed at **Annexure -6.0.**

ANNEXURE - 6.0

INDEXATION ADOPTED FOR CALCULATION OF COMPLETED COST

MONTH/ YEAR	CPI (2001= 100)	Increase	WPI (2004-05 = 100)	Increase
04/2010	170	1.1333	138.3	1.1100
05/2010	172	1.1391	138.8	1.1060
06/2010	174	1.1373	139.4	1.1028
07/2010	178	1.1125	140.6	1.1002
08/2010	178	1.0988	140.7	1.0882
09/2010	179	1.0982	141.5	1.0893
10/2010	181	1.0970	142.4	1.0912
11/2010	182	1.0833	143.1	1.0808
12/2010	185	1.0947	145.4	1.0941
01/2011	188	1.0930	147.4	1.0935
02/2011	185	1.0882	146.0	1.0831
03/2011	185	1.0882	148.0	1.0898
04/2011	Average	**1.1053**	Average	**1.0941**

NOTE :

1. For calculating completed cost, 20% of Average rate of increase of CPI and 80% of average rate of increase of WPI has been considered in Annexure - 5.0.
2. Source of the above data : CPI - IEEMA Circulars
   WPI - Min. of Commerce & Industry

28th meeting of the Standing Committee of Southern Region

Central Electricity Authority
System Planning & Project Appraisal Division
Sewa Bhawan, R.K. Puram, New Delhi – 110066.

Date: July 15, 2009

No. 51/4/SP&PA-2009/ 629-638

To

1.The Member Secretary, Southern Regional Power Committee, 29, Race Course Cross Road, **Bangalore 560 009.** **FAX : 080-22259343**	2.The Director (Projects), Power Grid Corp. of India Ltd. "Saudamini", Plot No.2, Sector-29, **Gurgaon 122 001, Haryana.** **FAX : 95124-2571932**
3.The Director (Transmission), Transmission Corp. of Andhra Pradesh Ltd., Vidyut Soudha, **Hyderabad – 500 082.** **FAX : 040-66665137**	4.The Director (Transmission), Karnataka State Power Transmission Corp.Ltd., Cauvery Bhawan, **Bangalore 560 009.** **FAX : 080 -22228367**
5.The Member (Transmission), Kerala State Electricity Board, Vidyuthi Bhawanam, Pattom, P.B. No. 1028, **Thiruvananthapuram - 695 004.** **FAX : 0471-2444738**	6. Member (Distribution), Tamil Nadu electricity Board (TNEB), 6th Floor, Eastern Wing, 800 Anna Salai, **Chennai - 600002.** **FAX : 044-28516362**
7.The Director (Power), Corporate Office, Block – I, Neyveli Lignite Corp. Ltd., **Neyveli , Tamil Nadu – 607 801.** **FAX : 04142-252650**	8.The Superintending Engineer –I, First Floor, Electricity Department, Gingy Salai, **Puducherry – 605 001.** **FAX : 0413-2334277/2331556**
9. Director (Projects), National Thermal Power Corp. Ltd. (NTPC), NTPC Bhawan, Core-7, Scope Complex, Lodhi Road, **New Delhi-110003.** **FAX-011-24360912**	10. Director (Operations), NPCIL, 12th Floor,Vikram Sarabhai Bhawan, Anushakti Nagar, **Mumbai – 400 094.** **FAX : 022- 25991258**

Sub: **28th meeting** of the Standing Committee on Power System Planning of Southern Region - Minutes of the meeting.

Sir,

The **28th meeting** of the Standing Committee on Power System Planning of Southern Region was held on **15th June 2009 (Monday)** at 10:00 AM at Orange County, Karadigodu Post, Siddapur, Coorg, Karnataka. Minutes of the meeting are enclosed.

The minutes are also available at CEA's website, **www.cea.nic.in**.

Yours faithfully,

15/07/2009

(Pardeep Jindal)
Director (SP&PA)
(Telephone: 26732325
FAX No.: 011 26102045)

* - Incase there is no additional bay space at the Narendra S/S, the possibility of connecting Basavana Bagewadi – Narendra with LILO of one circuit of the Narendra-Guttur 400kV D/C line would be explored.

The above system would be implemented by KPTCL as transmission scheme for evacuation of power from Yeramaras(2x800MW) & Edlapur (1x500 MW) generation projects in the time-frame matching with the commissioning schedule of these projects.

4.6.2 Establishing new 765/400kV S/S at Madhugiri, Connectivity to Yelahanka 2X500 MVA 400/220 kV S/S and Additional ISTS In-feed for Bangalore:

(i) Madhugiri 400/220kV S/S with provision of establishing a 765/400kV S/S in the same switchyard - **to be implemented by PGCIL**

(ii) Gooty – Madhugiri(proposed new 765/400kV S/S by PGCIL), 400kV D/C line – **to be implemented by PGCIL**.

(iii) Madhugiri - Yelahanka 400kV D/C Quad line – **to be implemented by PGCIL**

(iv) Hosur – Electronic City 400kV D/C line – **to be implemented by PGCIL**
(The Hosur – Electronic City 400kV D/C line could be built using Right of Way of the existing Peenya-Singarapet 220kV line(presently Yerandahally-Hosur line). This RoW could be used by building multi-circuit towers and/or dismantling part of the line depending upon practicability. SRTS,PGCIL, would examine feasibility of using RoW of existing 220kV circuit for implementation of this line with help provided by TNEB and KPTCL)

(v) Instead of Hiriyur – Yelahanka 400kV D/C line to be built by KPTCL for Bellary TPS, KPTCL would extend the Bellary TPS- Hiriyur 400kV D/C line up to Madhugiri S/S – **to be implemented by KPTCL**

(vi) PGCIL would provide a total of ten (10) numbers of 220kV bays at Yelahanka S/S. These bays would at the cost of KPTCL.

4.6.3 Strengthening/Restructuring of Bangalore 400 kV Ring Arrangement:
The existing 400kV connections around Bangalore would be rearranged to achieve Nelamangala – Yelahanka DC line, Yelahanka – Hoody - Kolar D/C line, Kolar - Electronic City - Somanahalli S/C line and Somanahalli – Bidadi - Nelamangala D/C line. Any revisions required in the protection schemes would also be carried out by PGCIL as System Strengthening Scheme for SR – **to be implemented by PGCIL**.

5.0 Transmission System Associated with Simhadri-II TPS:

5.1 ED, PGCIL informed that for evacuation of power from the Simhadri-II TPS of NTPC, Simhadri-II – Gazuwaka 400 kV D/C line was inter-alia agreed in the 25th meeting of Standing Committee. Due to growth of residential area in the vicinity, right of way problem and various existing 220 kV and 400 kV existing lines in position, termination of proposed Simhadri-II – Gazuwaka 400 kV D/C line at Gazuwaka was extremely difficult. Also, two numbers of adjacent bays for termination of both circuits were not available at Gazuwaka substation hence these have to be terminated at two opposite ends of the switchyard requiring single circuit line approach from two different sides.

5.2 The issue was discussed and following was agreed:

(i) Instead of the Simhadri-II TPS to Gazuwaka 400kV D/C line, the Gazuwaka – Vemagiri 400kV D/C line would be LILOed at the Simhadri-II TPS through 2x400kV D/C lines – **to be implemented by PGCIL as ATS for Simhadri-II TPS.**

(ii) NTPC would provide four number of 400kV line bays at their generation switchyard.

6.0 Transmission System Associated with Cheyyur UMPP in Tamil Nadu 4000 MW

6.1 Member(PS), CEA stated that the transmission system for this project was presently proposed to be implemented by private developer selected through tariff based competitive bidding process. Considering the time required in processing award of the project to successful bidder through this process, there was an urgency to finalize the transmission system for TNUMPP so that necessary approvals and back-to-back contractual agreements between State utilities buying power from TNUMPP, the Generation developer and the Transmission developer could be obtained in time.

6.2 Director, CEA explained that the Cheyyur UMPP (TNUMPP) at Cheyyur Taluk, Kanchipuram District, Tamil Nadu was being taken up by Coastal Tamil Nadu Power Ltd, an SPV company of PFC, who had applied to POWERGRID seeking Long Term Open Access for evacuation and transmission of power from the project to its beneficiaries. As per the allocation of power from this UMPP, 3100 MW has been allocated for Southern Region and rest 900 MW for Western and Northern Regions:

Southern Region (3100 MW):		
Tamil Nadu	-	1600 MW
Karnataka	-	800 MW
Andhra Pradesh	-	400 MW
Kerala	-	300 MW
Western Region (400 MW):		
Maharashtra	-	400 MW
Northern Region (500 MW):		
Uttar Pradesh	-	300 MW
Punjab	-	200 MW

The project was presently expected to be commissioned in the time frame of 2015-17. A comprehensive transmission requirement has been assessed for evacuation of power from the new IPP projects, including TNUMPP, coming in Andhra Pradesh and Tamil Nadu who have applied for LTOA.

6.3 The system was discussed and following transmission system was agreed:

1. TNUMPP – Tiruvalam 765kV 2xS/C or D/C line **$**
2. Tiruvalam – Kurnool 765kV S/C line
3. Kurnool – Raichur 765kV 2xS/C or D/C line **$**
4. TNUMPP – Salem 765kV S/C line
5. Salem – Madhugiri 765kV S/C line (line no.# 2)*

Minutes of the 10th meeting of SRPC held on 02.07.01

CONTENTS

(Contents Contd.)

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SOUTHERN REGIONAL POWER COMMITTEE
BANGALORE

MINUTES OF THE 10TH MEETING OF SRPC HELD AT TIRUPATI ON 02.07.2009

1. INTRODUCTION

1.1 The 10th meeting of the Southern Regional Power Committee was held at Tirupati on 2nd July 2009. The list of participants is at Annexure-I.

1.2 Shri P.Sri Rama Rao, Director (GO), APTRANSCO welcomed the Members and delegates to the meeting at Tirupati, the holy town, whose presiding deity was Lord Venkateshwara. He added that being a pilgrimage centre of international repute there was an upsurge of crowds in Tirupati on account of which, the arrangements were constrained. He expressed hope that the blessings of the presiding deity would shower on the power sector of SR. He welcomed the following Special Invitees to the SRPC meeting:

i) Shri Gopal Reddy, CMD, APSPDCL
ii) Shri V.Ramakrishna, Member (PS), CEA
iii) Shri Lokesh Chandra, Director (Transmission), MoP
iv) Shri A.K.Tiwari, Director (Operation), MCL
v) Shri A.K.Aggarwal, Member Secretary, NRPC
vi) Shri Subodh Garg, CEO, REC Transmission Projects Ltd.

1.3 Shri M.L.Batra, Member Secretary, SRPC welcomed the dignitaries to the 10th SRPC at the sacred land of Tirupati. He thanked the Power Utilities of Andhra Pradesh for making excellent arrangements for the conduct of the meeting and stay. He said that though south west monsoon was delayed till now, it was hoped that the rainfall would improve in the coming weeks. He welcomed Chairperson, SRPC & CMD, APTRANSCO and requested him to preside over the meeting. He also thanked Shri C.P.Singh, Chairman, TNEB for having given valuable guidance and directions to SRPC forum during his tenure as Chairperson, SRPC

1.4 Shri Sutirtha Bhattacharya, Chairperson, SRPC & CMD, APTRANSCO welcomed the Members, other dignitaries & the Special Invitees to the meeting. He thanked CMD, APSPDCL & Director (GO), APTRANSCO and their team for their concerted efforts to make this meeting successful. He also thanked the TTD for their cooperation in arranging the visits. He added that a number of issues were involved and hoped that with the proactive contribution of the Members and Special Invitees,

the issues would get resolved. There were indications that the south west monsoon was spreading its wings. He welcomed the following new Members:

i) Shri Narasimha Reddy, CMD, APNPDCL, Warangal
ii) Shri R.N.Nayak, Director (Operation), Power Grid

1.5 SRPC placed on record the excellent services rendered by the following outgoing members:

i) Shri Natarajan Gulzar, CMD, APEPDCL, Vizag
ii) Shri S,Majumdar, Director (Operation), Power Grid

1.6 The agenda items were taken up for discussion.

2. CONFIRMATION OF THE MINUTES OF THE 9TH MEETING OF SRPC

2.1 Minutes of the 9th meeting of the Southern Regional Power Committee held at Kumarakom on 6th March 2009 were forwarded vide letter No.SRPC/SE-II/9 SRPC/2009/2206-51 dated 1st April 2009.

2.2 The Minutes were confirmed without any amendment.

3. MEMBERSHIP OF SRPC

3.1 Government of India vide Resolution F.No.23/1/2004-R&R dated 25th May, 2005 had notified establishment of Southern Regional Power Committee (SRPC) followed by amendment Resolution dated 29th November, 2005. These resolutions laid down the constitution, functions etc. relating to the functioning of RPC for facilitating the integrated operation of the power system in Southern Region. MOP, vide Resolution dated 9th May 2008 had notified certain amendments in respect of the Membership of SRPC.

3.2 As per the decisions taken in the 9th SRPC Meeting, the matter regarding Membership of Traders and other generators was taken up with Secretary (Power), Government of India by Chairperson, SRPC & CMD, APTRANSCO vide letter dated 9th April, 2009 (Annexure-II).

3.3 In the meeting, MS, SRPC informed that as per the provisions of GoI Resolutions, ED (SO), NLDC would be a new Member of SRPC.,

i) Edlapur (1x800 MW), being located adjacent to the RTPS project, will be connected to RTPS switchyard through extended bus arrangement.

ii) Yeramaras (2x800 MW) – Raichur (New) 765/400 kV (PGCIL) substation, 400 kV Quad D/C line.

iii) Basavana Bagewadi 400/220 kV 2x315 MVA S/S

iv) Yeramaras – Basavana Bagewadi 400 kV Quad S/C line

v) Basavana Bagewadi – Narendra (PGCIL) 400 kV Twin D/C line *

* In case there is no additional bay space at the Narendra S/S, the possibility of connecting Basavana Bagewadi-Narendra with LILO of one circuit of the Narendra-Guttur 400 kV D/C line would be explored.

The above system would be implemented by KPTCL as transmission scheme for evacuation of power from Yeramaras (2x800 MW) & Edlapur (1x500 MW) generation projects in the time-frame matching with the commissioning schedule of these projects.

30.1.2 On a query, Member (PS), CEA clarified that Raichur New 765/400 kV S/S would be in the Regional Scheme as other evacuation systems were also being planned to be connected at this substation.

30.2 Establishing new 765/400 kV S/S at Madhugiri, Connectivity to Yelahanka 2x500 MVA 400/220 kV S/S and Additional ISTS In-feed for Bangalore

30.2.1 The following transmission system had been finalized in SCPSPSR:

i) Madhugiri 400/220 kV S/S with provision of establishing a 765/400 kV S/S in the same switchyard – to be implemented by PGCIL

ii) Gooty-Madhugiri (proposed new 765/400 kV S/S by PGCIL), 400 kV D/C line – to be implemented by PGCIL

iii) Madhugiri-Yelahanka 400 kV D/C Quad line – to be implemented by PGCIL

iv) Hosur-Electronic City 400 kV D/C line – to be implemented by PGCIL (The Hosur-Electronic City 400 kV D/C line could be built using Right of Way of the existing Peenya-Singarapet 220 kV line (presently Yerandahally-Hosur line). This RoW could be used by building multi-circuit towers and/or dismantling part of the line depending upon practicability. SRTS, PGCIL would examine feasibility of using RoW of existing 220 kV circuit for implementation of this line with help provided by TNEB and KPTCL)

v) Instead of Hiriyur-Yelahanka 400 kV D/C line to be built by KPTCL for Bellary TPS, KPTCL would extend the Bellary TPS-Hiriyur 400 kV D/C line up to Madhugiri S/S – to be implemented by KPTCL

vi) PGCIL would provide a total of ten (10) numbers of 220 kV bays at Yelahanka S/S. These bays would be at the cost of KPTCL

30.2.2 Director (GO), APTRANSCO enquired about the requirement for Madhurigiri-Yelahanka 400 kV D/C line as contemplated and requested for a review. KSEB also endorsed the view of Director (GO), APTRANSCO.

30.2.3 Member (PS), CEA said that there would be a paradigm shift in future in regard to sharing of the transmission charges, as was being proposed by CERC. He requested the constituents to agree for the above proposal as the implementation had to start.

30.2.4 ED (SR-II), PGCIL informed that Hosur-Electronic City 400 kV D/C Quad line using the Right of Way of the existing Peenya-Singarapet 220 kV line (presently Yerandahally-Hosur line) was not possible, as per the survey done by PGCIL in coordination with KPTCL.

30.2.5. After discussions, it was decided that except for the 400kV Madhugiri-Yelahanka D/C (quad) line, the other proposals were agreed to by the members. In respect of Madhugiri – Yelahanka D/C line, the scheme would be considered in the next SRPC meeting.

30.3 Transmission System associated with Cheyyur UMPP in Tamil Nadu (4000 MW)

30.3.1 The Cheyyur UMPP (TNUMPP) at Cheyyur Taluk, Kanchipuram District, Tamil Nadu was being taken up by Coastal Tamil Nadu Power Ltd., an SPV Company of PFC, who had applied to Power Grid seeking Long Term Open Access (LTOA) for evacuation and transmission of power from the project to its beneficiaries. As per the allocation of power from this UMPP, 3100 MW of power had been allocated for Southern Region and rest 900 MW for Western and Northern Regions as given below:

Southern Region (3100 MW)		
Tamil Nadu	-	1600 MW
Karnataka	-	800 MW
Andhra Pradesh	-	400 MW
Kerala	-	300 MW
Western Region (400 MW)		
Maharashtra	-	400 MW
Northern Region (500 MW)		
Uttar Pradesh	-	300 MW
Punjab	-	200 MW

CONTENTS

(Contents contd.)

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SOUTHERN REGIONAL POWER COMMITTEE
BANGALORE

MINUTES OF THE 11TH MEETING OF SRPC HELD AT BANGALORE ON 17.09.2009

1. INTRODUCTION

1.1 The 11th Meeting of the Southern Regional Power Committee was held at Bangalore on 17th September 2009. List of participants is at Annexure-I.

1.2 Shri S. Pratap Kumar, Director (Transmission), KPTCL on behalf of KPTCL & KPCL welcomed the Members and the delegates to the meeting. He said that KPTCL & KPCL were inseparable and had jointly hosted the meeting. Power Utilities of Karnataka had been given the opportunity to host the SRPC meeting after a gap of two years. He expressed hope that the stay of the delegates was comfortable.

1.3 Shri M.L.Batra, Member Secretary, SRPC expressed great pleasure in welcoming the Members to the 11th SRPC meeting. He hoped that the deliberations would be fruitful. He requested Shri Sutirtha Bhattacharya, Chairperson, SRPC & CMD, APTRANSCO to preside over the meeting.

1.4 Shri Sutirtha Bhattacharya, Chairperson, SRPC & CMD, APTRANSCO thanked the power utilities of Karnataka for making excellent arrangements for the stay and conduct of the meeting. He on behalf of the Committee also wished a speedy recovery to Shri C.P.Singh, Chairman, TNEB. He welcomed the following new Members:

i) Shri K.Vijayanand, Managing Director, APGENCO
ii) Shri M.Naveen Kumar, Managing Director, PCKL
iii) Shri I.J.Kapoor, Director (Commercial), NTPC
iv) Shri S.K.Soonee, Executive Director, Power Grid

1.5 SRPC also placed on record the excellent services rendered by the following outgoing members:

i) Shri Ajay Jain, Managing Director, APGENCO
ii) Shri Vijayanarasimha, Managing Director, PCKL

2. CONFIRMATION OF THE MINUTES OF THE 10TH MEETING OF SRPC

2.1 Minutes of the 10th meeting of the Southern Regional Power Committee held at Tirupati on 2nd July 2009 were forwarded vide letter No.SRPC/SE-II/10 SRPC/2009/5404-47 dated 28th July, 2009.

2.2 MS, SRPC informed that PGCIL vide letter No.SR-II:Comml:2009-10/983 dated 3rd August 2009 had sought amendment to para 30.2.5 (copy enclosed as Annexure-II). After obtaining approval of Chairperson, SRPC, necessary corrigendum was issued vide letter dated 18.08.2009 (copy enclosed as Annexure-III).

2.3 The Minutes were confirmed.

3. REIMBURSEMENT OF SRPC EXPENDITURE

3.1 The net amount payable by each organization for the year 2009-10, after adjustment of the surplus/deficit for the previous period is shown in Annexure-IV.

3.2 MS, SRPC requested the Utilities to expedite the payments, wherever due.

4. TRANSMISSION SYSTEM FOR EVACUATION OF POWER FROM SIMHADRI-II TPS (2x500 MW) OF NTPC

4.1 The following issues had been deliberated in the SRPC meeting:

- The 1st Unit of the project was expected by December 2010.
- NTPC had received power requirement from SR constituents in excess of the installed capacity of 1000 MW and draft PPA had been circulated.
- It was noted that formal allocation from the project was to be issued by MOP.
- APTRANSCO had concurred to accord Open Access for its transmission system for Simhadri STPS Stage-II.
- NTPC had informed that a common Open Access application on behalf of the beneficiaries had been submitted to APTRANSCO.

4.2 In the 28th meeting of SCPSPSR it was noted that due to RoW problem, PGCIL was facing problem in implementing Simhadri-II - Gazuwaka 400 kV D/C line envisaged earlier. Therefore, following transmission system had been agreed:

i) Instead of Gazuwaka to Simhadri-II TPS 400 kV D/C line, Gazuwaka-Vemagiri 400 kV D/C line would be LILOed at Simhadri-II TPS through 2x400 kV D/C lines - to be implemented by PGCIL as ATS for Simhadri-II TPS.

25.5 **Issue regarding LTOA & signing of BPTA for the Nagarjuna TPS by M/s. UPCL in Nandikur (Karnataka)**

25.5.1 During the Standing Committee meeting discussions, Director (Transmission), KPTCL informed that M/s. UPCL (i.e. Nagarjuna TPS) was establishing a Thermal Power Station with 1015 MW capacity at Nandikur in Udupi District. Out of this, 915 MW of power will be utilized in Karnataka and remaining 94 MW will be sent to Punjab State Electricity Board and KPTCL was constructing 400 kV quad moose DC line from UPCL switchyard to Shanthigrama, Hassan (PGCIL) substation and 220 kV DC line to 220 kV Khemar substation. In this regard, he stated that UPCL has been asked to sign Bulk Transmission Agreement with Power Grid Corporation of India for the whole capacity of the project. He also informed that UPCL was also considering selling power to Kerala. During discussions, it was suggested that Punjab might sign BPTA in proportion to its share from the project for sharing transmission charges for SR, WR and NR. Kerala, if it signs PPA with UPCL might share SR charges in proportion to its share from UPCL and Karnataka might share SR transmission charges in proportion to the power they intend to draw at Mysore. The issue was further discussed and it was decided that the issue needed to be resolved by Commercial Committee of SRPC.

25.5.2 The Committee noted the above. It was decided that the issue of sharing the transmission charges be deliberated in the Commercial Sub-Committee of SRPC.

25.6 **Madhugiri-Yelahanka 400 kV Quad line**

Member (PS), CEA appraised the Committee about the meeting he had with Chairman, APTRANSCO in Hyderabad and in the meeting APTRANSCO had agreed to include the proposal under Regional Scheme. It was agreed that Madhugiri-Yelahanka 400 kV Quad line to be implemented by Power Grid would form part of Regional Scheme.

26. **ISSUE RELATING TO CLAUSE 7.1 OF UI REGULATIONS**

26.1 Chief Engineer, SLDC, KPTCL vide letter dated 07.09.09 (Annexure-XVII) had brought to attention difficulties faced due to reduced schedule in case of States which have Open Access Generators who have opted out of the State Grid.

26.2 In the meeting, MS, SRPC informed that in the TCC meeting held on the previous day, KPTCL had suggested that Hon'ble CERC may be approached for amendment

in the Clause 7.1 of UI Regulations as the IPPs in the State were exporting huge quantum of power.

26.3 In the meeting, KPTCL informed that the matter required further examination.

27. **HANDING OVER OF 220 KV IDUKKI-TRICHUR LINE**

27.1 Power Grid vide their letter dated 08.09.09 had informed that KSEB had agreed to hand over the above line in July 2009. However, KSEB was having difficulty in handing over the line. It was also informed that any delay in completion of 400 KV Cochin-Trichur DC line may result in time and cost overrun.

27.2 In the meeting, MS, SRPC informed that the in the TCC meeting held on previous day, KSEB had informed that they were not in a position to hand over the 220 kV Idukki-Trichur line until some alternative arrangement was made to cater to power requirements of North Kerala. KPTCL was requested to allow maximum transfer of power on Kadakola-Kaniyampetta line. KPTCL had informed that they would examine the issue and revert back.

27.3 Chairman, KSEB highlighted the power security concerns of North Kerala areas which had suffered two black outs in the recent past.

27.4 ED (SR-II), PGCIL informed that except this corridor portion, all the other sections would be completed by December 2009.

27.5 Director (Transmission), KPTCL assured KSEB of all possible assistance.

28. **REPLACEMENT OF TRANSFORMER OIL IN VIZAG HVDC CONVERTER TRANSFORMERS POLE-I**

28.1 PGCIL vide their letter dated 08.09.09 had informed that six Nos. of Converter Transformers manufactured by M/s. AREVA, had been supplied and installed at Vizag HVDC pole-1 and the same were commissioned during September 1999. Three transformers are continuously in service since then and are being regularly maintained to deliver the expected performance. As part of the maintenance activity, the DGA & Furans of the Converter Transformer oil, are being monitored and the results interpreted from time to time and the health of the units assessed. Recently the Furan gases in these transformers had shown a rising trend and also the presence of Copper Sulphide. The same was taken up with the manufacturer for appropriate remedial measures. Accordingly, the manufacturer had suggested to replace the transformer oil at Bhadravati and Vizag. The oil replacement was essential to ensure the satisfactory and reliable operation of the Pole-I HVDC Back

ANNEXURE-8.0

No.11/4/2007-PG

भारत सरकार
Government of India
विद्युत मंत्रालय
Ministry of Power
Shram Shakti Bhawan, Rafi Marg, New Delhi – 110001
Telefax No. 23730264

New Delhi, 3rd December, 2009

To

CMD
PGCIL
Gurgaon.

Sub: Prior Approval of the Government under Section 68 of the Electricity Act, 2003 for System Strengthening in Southern Region-XIII.

Sir,

I am directed to refer to PGCIL's letter no. C/CP/SR-III dated 12.10.2009 on the above subject and to convey the prior approval of the Central Government under sub-section (1) of Section 68 of the Electricity Act, 2003 with the following scope of works for System Strengthening in Southern Region-XIII as agreed by the constituents of Southern Region in 28th and 29th meetings of the Standing Committee on Power System Planning in Southern Region and subsequently in the 10th and 11th meetings of Southern Region Power Committee:

a) Establishment of new 400/220 kV substation at Madhugiri with 2x500 MVA transformers with provision of establishing a 765 kV substation in future in the same switchyard.
b) Gooty-Madhugiri 400 kV D/C line
c) Madhugiri-Yelahanka 400 kV D/C Quad line.

The approval is subject to compliance of (a) the requirement of the relevant provisions of the Electricity Act, 2003, as amended from time to time and the rules and regulations framed there under and (b) the rules governing the overhead lines as specified in the Indian Electricity Rules, 1956 till they are substituted by corresponding rules framed under the Electricity Act, 2003.

This approval is also subject to the following conditions:

1. The implementing agency will commence construction of the project within 3 years, unless this term is extended by the Ministry of Power.
2. Ministry of Power may withdraw the approval before the expiry of the period of 3 years after giving a one-month notice.

Yours faithfully,

(K.V. Gopala Rao)
Under Secretary to the Govt. of India

(Sec-68)

ANNEXURE-9.0

IRRs CALCULATION ON COMPLETED COST

TRANSMISSION PROJECTS

1ST QUARTER 2011

CASH FLOW STATEMENT FOR CALCULATION OF PROJECT IRR

COMPLETED COST

SYSTEM STRENGTHENING – XIII IN SOUTHERN REGIONAL GRID

(Rupees in Crores)

Sl No	Year	Costs Associated With the Scheme					Net Benefit
		INFLOW			OUTFLOW		
		PAT +Depreciation +Int Term Loan	Salvage Value	Total Inflow	Capital Cost	Total Outflow	
1	2010	0.00		0.00	-20.77	20.77	-20.77
2	2011	0.00		0.00	-9.95	9.95	-9.95
3	2012	0.00		0.00	-108.75	108.75	-108.75
4	2013	0.00		0.00	-276.24	276.24	-276.24
5	2014			69.25	-176.46	176.46	-107.21
6	2015			86.30		0.00	86.30
7	2016			84.28		0.00	84.28
8	2017			82.05		0.00	82.05
9	2018			79.77		0.00	79.77
10	2019			77.45		0.00	77.45
11	2020			75.14		0.00	75.14
12	2021			72.83		0.00	72.83
13	2022			70.51		0.00	70.51
14	2023			68.20		0.00	68.20
15	2024			65.88		0.00	65.88
16	2025			63.57		0.00	63.57
17	2026			40.87		0.00	40.87
18	2027			39.88		0.00	39.88
19	2028			38.93		0.00	38.93
20	2029			37.77		0.00	37.77
21	2030			36.95		0.00	36.95
22	2031			36.30		0.00	36.30
23	2032			35.86		0.00	35.86
24	2033			35.59		0.00	35.59
25	2034			35.52		0.00	35.52
26	2035			35.52		0.00	35.52
27	2036			35.52		0.00	35.52
28	2037			35.52		0.00	35.52
29	2038			35.52		0.00	35.52
30	2039			32.58		0.00	32.58
31	2040			32.58		0.00	32.58
32	2041			32.58		0.00	32.58
33	2042			32.58		0.00	32.58
34	2043			32.58		0.00	32.58
35	2044			32.58		0.00	32.58
36	2045			32.58		0.00	32.58
37	2046			32.58		0.00	32.58
38	2047			32.58		0.00	32.58
39	2048			32.58		0.00	32.58
40	2049		89.50	94.93		0.00	94.93
						IRR	10.69%

Note: i) Year 2010 means Financial year 2010-11 and so on.

TRANSMISSION PROJECTS

1ST QUARTER 2011

CASH FLOW STATEMENT FOR CALCULATION OF EQUITY IRR

COMPLETED COST

SYSTEM STRENGTHENING – XIII IN SOUTHERN REGIONAL GRID

(Rupees in Crores)

Sl No	Year	Costs Associated With the Scheme: INFLOW PAT +Depreciation -Loan Repayment	Salvage Value	Total Inflow	OUTFLOW Equity Cost	Total Outflow	Net Benefit
1	2010			0.00	-20.77	20.77	-20.77
2	2011			0.00	0.00	0.00	0.00
3	2012			0.00	-21.07	21.07	-21.07
4	2013			0.00	-82.87	82.87	-82.87
5	2014	46.16		46.16	-52.94	52.94	-6.78
6	2015	53.37		53.37		0.00	53.37
7	2016	29.20		29.20		0.00	29.20
8	2017	25.62		25.62		0.00	25.62
9	2018	22.84		22.84		0.00	22.84
10	2019	22.88		22.88		0.00	22.88
11	2020	22.91		22.91		0.00	22.91
12	2021	22.95		22.95		0.00	22.95
13	2022	22.99		22.99		0.00	22.99
14	2023	23.03		23.03		0.00	23.03
15	2024	23.07		23.07		0.00	23.07
16	2025	23.11		23.11		0.00	23.11
17	2026	2.76		2.76		0.00	2.76
18	2027	4.46		4.46		0.00	4.46
19	2028	7.92		7.92		0.00	7.92
20	2029	11.92		11.92		0.00	11.92
21	2030	15.40		15.40		0.00	15.40
22	2031	36.30		36.30		0.00	36.30
23	2032	35.86		35.86		0.00	35.86
24	2033	35.59		35.59		0.00	35.59
25	2034	35.52		35.52		0.00	35.52
26	2035	35.52		35.52		0.00	35.52
27	2036	35.52		35.52		0.00	35.52
28	2037	35.52		35.52		0.00	35.52
29	2038	35.52		35.52		0.00	35.52
30	2039	32.58		32.58		0.00	32.58
31	2040	32.58		32.58		0.00	32.58
32	2041	32.58		32.58		0.00	32.58
33	2042	32.58		32.58		0.00	32.58
34	2043	32.58		32.58		0.00	32.58
35	2044	32.58		32.58		0.00	32.58
36	2045	32.58		32.58		0.00	32.58
37	2046	32.58		32.58		0.00	32.58
38	2047	32.58		32.58		0.00	32.58
39	2048	32.58		32.58		0.00	32.58
39	2049	5.43	89.50	94.93		0.00	94.93
				-			
						IRR	16.29%

Note: i) Year 2010 means Financial year 2010-11 and so on.

Transmission Projects

1ST QUARTER 2011

CASHFLOW STATEMENT FOR CALCULATION OF ECONOMIC IRR

COMPLETED COST

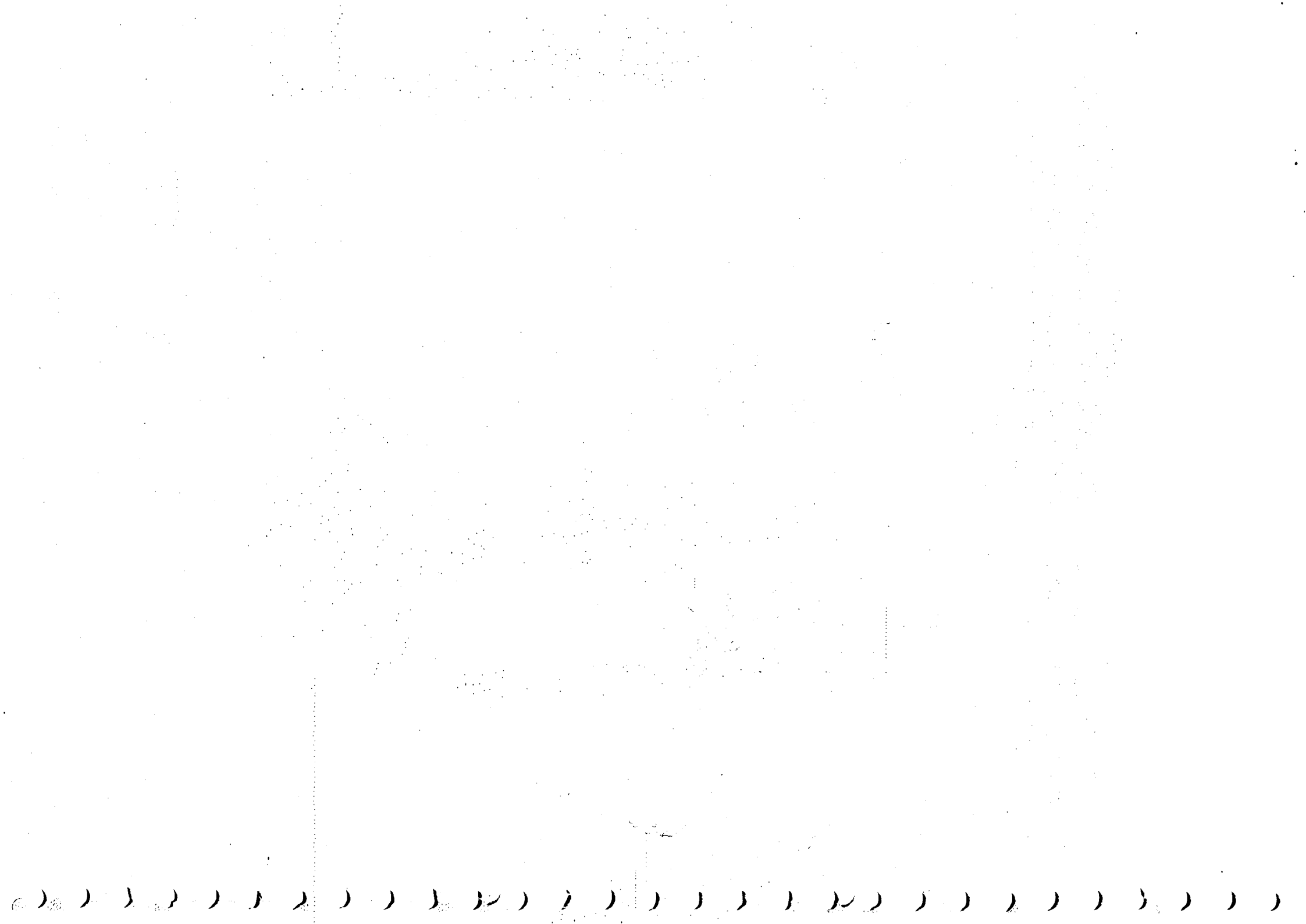
SYSTEM STRENGTHENING – XIII IN SOUTHERN REGIONAL GRID

(Rupees in Crores)

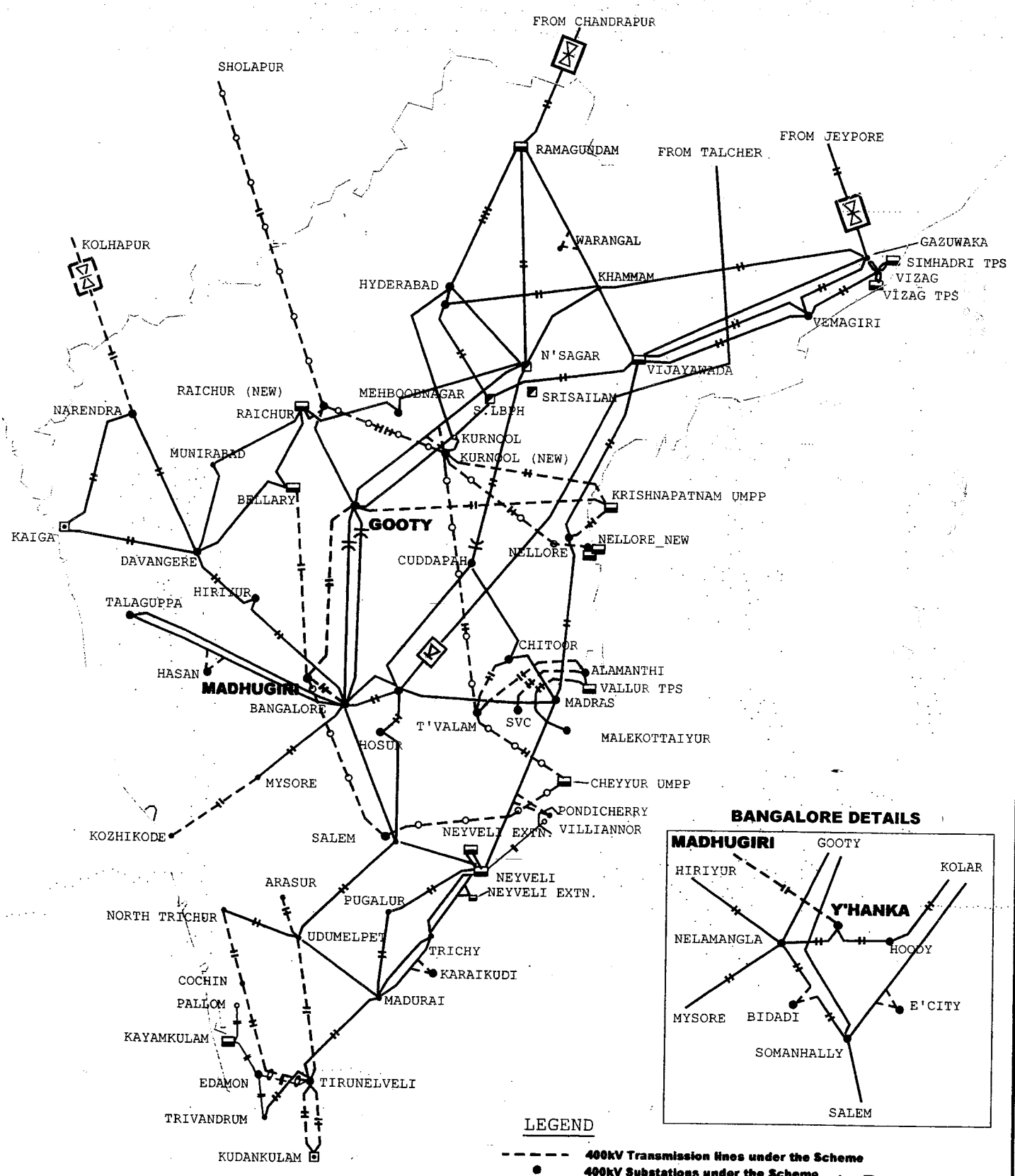
Sl No	Year	Costs Associated With the Scheme: INFLOW PAT +Depreciation +Int Term Loan	Salvage Value	Total Inflow	OUTFLOW Capital Cost	Total Outflow	Net Benefit
1	2010			0.00	-19.30	19.30	-19.30
2	2011			0.00	-9.25	9.25	-9.25
3	2012	0.00		0.00	-101.08	101.08	-101.08
4	2013	0.00		0.00	-256.76	256.76	-256.76
5	2014	69.25		69.25	-164.02	164.02	-94.76
6	2015	86.30		86.30		0.00	86.30
7	2016	84.28		84.28		0.00	84.28
8	2017	82.05		82.05		0.00	82.05
9	2018	79.77		79.77		0.00	79.77
10	2019	77.45		77.45		0.00	77.45
11	2020	75.14		75.14		0.00	75.14
12	2021	72.83		72.83		0.00	72.83
13	2022	70.51		70.51		0.00	70.51
14	2023	68.20		68.20		0.00	68.20
15	2024	65.88		65.88		0.00	65.88
16	2025	63.57		63.57		0.00	63.57
17	2026	40.87		40.87		0.00	40.87
18	2027	39.88		39.88		0.00	39.88
19	2028	38.93		38.93		0.00	38.93
20	2029	37.77		37.77		0.00	37.77
21	2030	36.95		36.95		0.00	36.95
22	2031	36.30		36.30		0.00	36.30
23	2032	35.86		35.86		0.00	35.86
24	2033	35.59		35.59		0.00	35.59
25	2034	35.52		35.52		0.00	35.52
26	2035	35.52		35.52		0.00	35.52
27	2036	35.52		35.52		0.00	35.52
28	2037	35.52		35.52		0.00	35.52
29	2038	35.52		35.52		0.00	35.52
30	2039	32.58		32.58		0.00	32.58
31	2040	32.58		32.58		0.00	32.58
32	2041	32.58		32.58		0.00	32.58
33	2042	32.58		32.58		0.00	32.58
34	2043	32.58		32.58		0.00	32.58
35	2044	32.58		32.58		0.00	32.58
36	2045	32.58		32.58		0.00	32.58
37	2046	32.58		32.58		0.00	32.58
38	2047	32.58		32.58		0.00	32.58
39	2048	32.58		32.58		0.00	32.58
40	2049	5.43	55.04	60.47		0.00	60.47
						IRR	11.77%

Note: i) Year 2010 means Financial year 2010-11 and so on.

EXHIBITS



SYSTEM STRENGTHENING IN SR - XIII



BANGALORE DETAILS

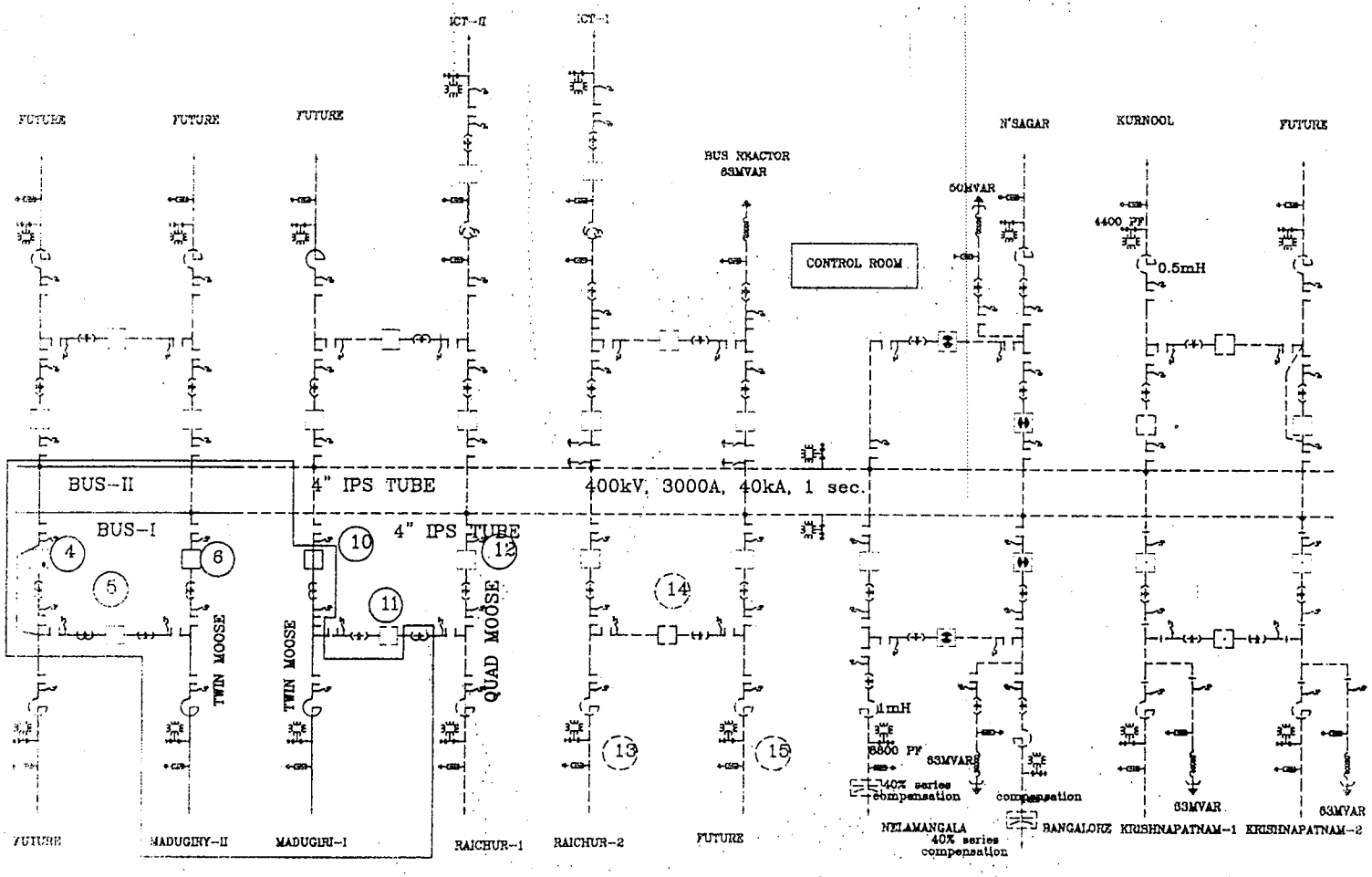
LEGEND

400kV Transmission lines under the Scheme

400kV Substations under the Scheme

EXHIBIT - 2.0

SINGLE LINE DIAGRAM -SUBSTATIONS



PRESENT SCOPE

BILL OF QUANTITY – 400 kV

SL.	ITEM DESCRIPTION	QTY.	SYMBOL
1	CIRCUIT BREAKER WITHOUT CR 3150 A, 40 KA, 1SEC	3	
2	ISOLATOR WITH ONE EARTH SWITCH 3150 A, 40 KA-1 SEC	3	
3	CURRENT TRANSFORMER 3000/1 A, 120% EXTENDED RATING	12	
4	CAPACITOR VOLTAGE TRANSFORMER 4400 PF	6	
5	WAVE TRAP 3150 A, 1.0/0.5 mH	04	
7	SURGE ARRESTER 336 kV	06	

LEGEND:

PRESENT SCOPE

EXISTING/FUTURE

FOR TENDER PURPOSE

RECOMMENDED	
DGM(Engg)	
DGM(Engg)	
GM(Engg-S/S)	
GM(SEF)	
APPROVED	

GM(Engg S/S)

POWER GRID CORPORATION OF INDIA LIMITED

(A GOVERNMENT OF INDIA ENTERPRISE)

CLEARED BY

PROJECT: SYSTEM STRENGTHENING-XIII IN S/

SUBSTATION: 400/220 kV GOOTY S/S(EXTN)

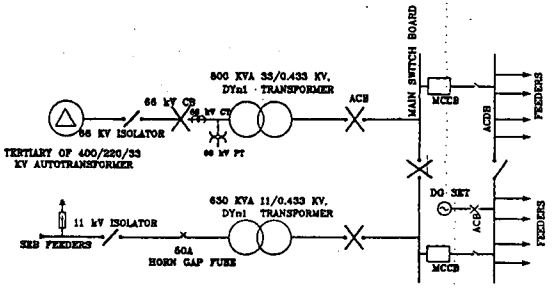
TITLE: 400 kV SINGLE LINE DIAGRAM

DRAWN CHKD SCALE (IRON)

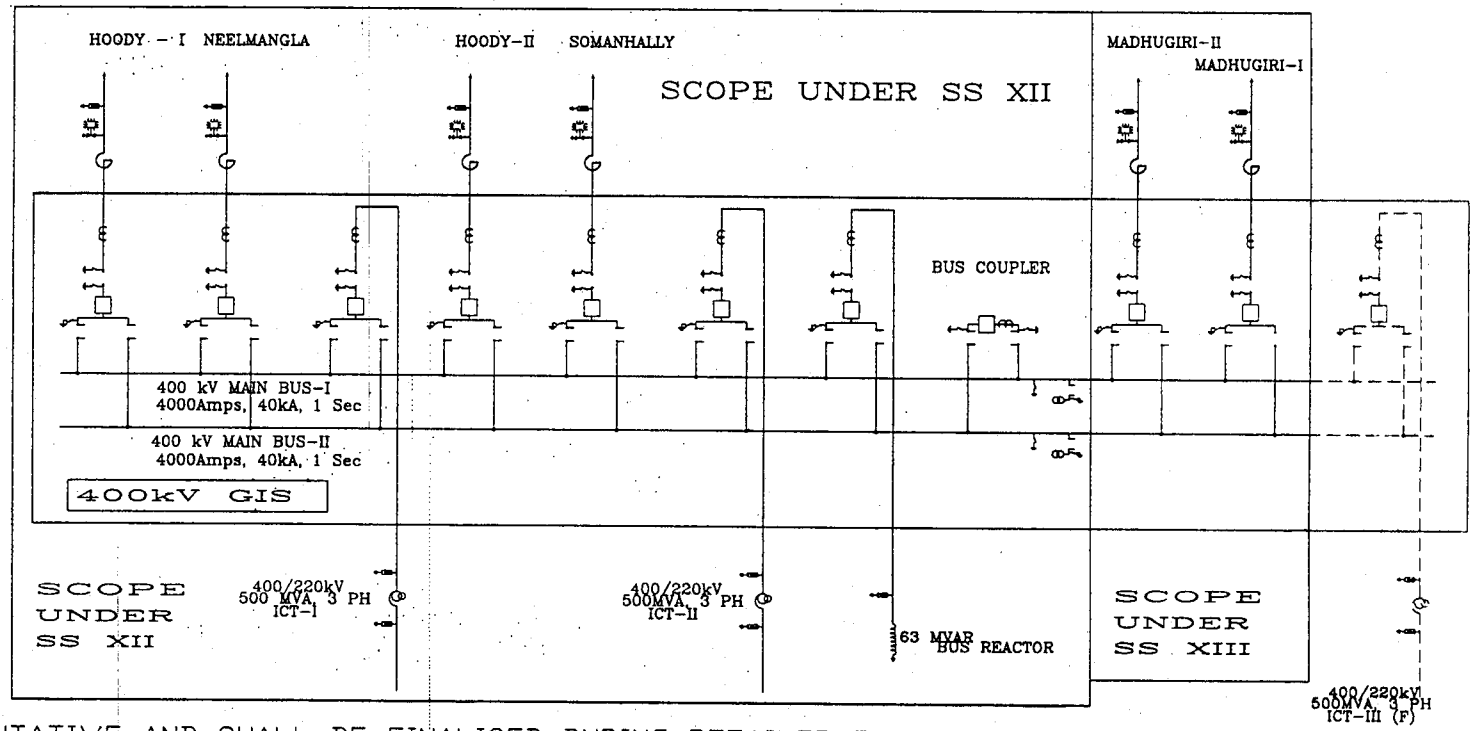
PRESENT SCOPE

FUTURE SCOPE

BILL OF QUANTITY – 400 kV				
SL.	ITEM DESCRIPTION	SS XII QTY.	SS XIII QTY.	SYMBOL
1	500 MVA AUTO TRANSFORMER 3-PH., 400/220/33 KV	2	0	
2	63 MVAR BUS REACTOR	1	0	
3	CAPACITOR VOLTAGE TRANSFORMER 4400/8800 PF	12	6	
4	SURGE ARRESTER 390 kV	21	6	
5	WAVE TRAP 0.5/1.0 mH	8	4	



SCHEME FOR CONNECTION OF LT TRANSFORMERS



NOTE:

1. THE LOCATION OF MODULES ARE TENTATIVE AND SHALL BE FINALISED DURING DETAILED ENGINEERING
2. THE CONNECTION FROM GIS TO OVERHEAD LINE, SHUNT REACTOR & AUTOTRANSFORMER SHALL BE THROUGH SF6 TO AIR BUSHING. THE REACTOR & TRANSFORMER SHALL HAVE AIR BUSHING
3. THE 400kV WAVE TRAP, SURGE ARRESTOR, CVT SHALL BE OUTDOOR TYPE
4. LOCATION OF CTs SHOWN IS TENTATIVE AND SHALL BE FINALISED DURING DETAILED ENGINEERING.

FOR TENDER PURPOSE

DGM ENGG S/S	AGM ENGG S/S	GM ENGG SEF	GM ENGGS/S&TL	ED ENGG II
RECOMMENDED			APPROVED	

POWER GRID CORPORATION OF INDIA LIMITED
(A GOVERNMENT OF INDIA ENTERPRISE)

PROJECT: SYSTEM STRENGTHENING–XII IN SOUTHERN REGION

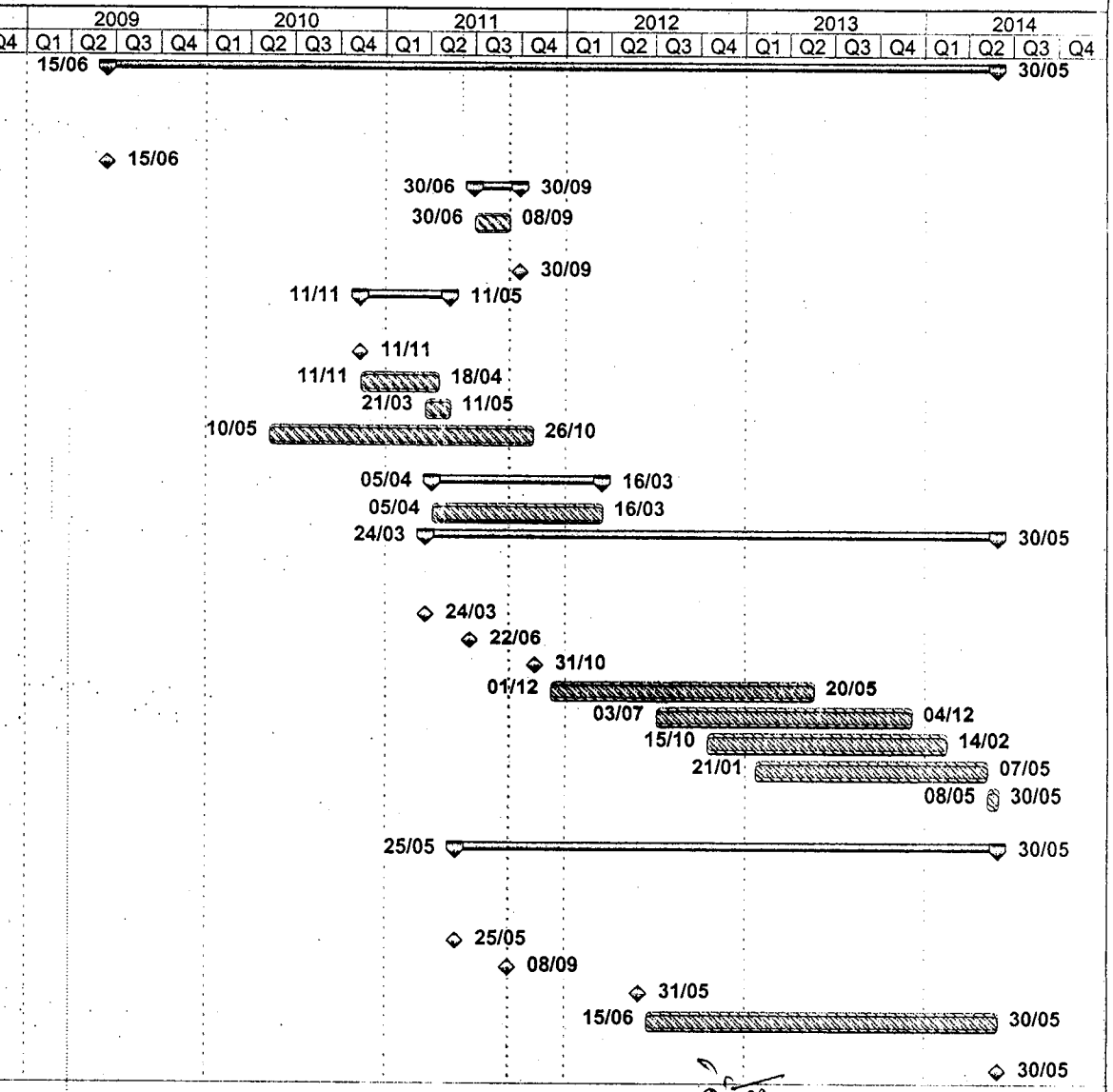
SUBSTATION: 400/220 kV YELAHANKA SUBSTATION

TITLE: 400kV SINGLE LINE DIAGRAM

DATE	DRAWN	DRG. NO.	REV.
14.08.2009		C/ENGG/SR/SS-XII/YELAHANKA/SLD/01 SHEET 1 OF 2	0

TRANSMISSION SYSTEM ASSOCIATED SYSTEM STRENGTHENING SOUTHERN REGION XIII
IMPLEMENTATION SCHEDULE

ID	Task Name	Duration
1	**TRANSMISSION SYSTEM ASSOCIATED WITH STRENGHTHENING IN SOUTHERN REGION - XIII**	230.19 wks
2	PROJECT START	0 wks
3	**INVESTMENT CLEARANCE**	11.73 wks
4	PREPARATION OF FR AND APPROVAL BY MANAGEMENT	9 wks
5	INVESTMENT APPROVAL	0 wks
6	**DETAILED SURVEY USING MODERN SURVEY TECHNIQUES**	23 wks
7	Placement of Award	0 wks
8	COMPLETION OF SURVEY	20 wks
9	SUBMISSION OF REPORT	6.6 wks
10	**LAND ACQUISITION AND RAP**	68 wks
11	**ENVIRONMENT CLEARANCE**	44 wks
12	FOREST CASE SUBMISSION & APPROVAL	44 wks
13	**Constrction of i) 400 KV D/C Gooty - Madhugiri Line and ii) 400 KV D/C Quad Madhugiri - Yelahanka Line**	147.88 wks
14	NIT	0 wks
15	OBD	0 days
16	LOA	0 wks
17	ENGINEERING & SUPPLY	68 wks
18	Foundation	66 wks
19	Tower Erection	62 wks
20	Stringing	60 wks
21	Final Checking, Testing & Ready for Commissioning	3 wks
22	**Establishment of 400/220 KV New Sub-Station AT Madhugiri & Extn. of Gooty Sub - Station**	139.99 wks
23	NIT	0 wks
24	OBD	0 wks
25	LOA	0 wks
26	ENGINEERING, SUPPLY, ERECTION, TESTING & COMMISSIONING	90.7 wks
27	**Project Completion**	0 wks



Project: SR XIII Impementation sch 7
Date: 07/09/11

Task ▨ Milestone ◆ Summary ▬