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REPORT OF THE WORKING GROUP ON IDENTIFICATION OF COMMUNICATION REQUIREMENTS IN THE POWER SECTOR

PLANNING COMMISSION
GOVERNMENT OF INDIA
OCTOBER, 1984

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DST/PS/ 908 /84

YASH PAL
SECRETARY

Chairman, Working Group on
Identification of the Communication
Requirements in the Power Sector.

5th November, 1984

Dear Hon. Minister,

I am glad to enclose herewith the Report of the Working Group on Identification of the Communication Requirements in the Power Sector. The Terms of Reference to this Group included the examination of the adequacy of the existing communication infra-structure for the Power Sector and to recommend a reliable, flexible and technically viable communication system to meet the present and projected communication requirements of the Power Sector. This Group was set up in June 1983 and, for the first time, brought together the representatives of the Power Sector from the Centre and States, Ministry of Communication and Communication experts from several other agencies.

The data on the existing communication systems in the country was not available at any centralised agency and the Working Group had to obtain the available information from all the Power Sector and Communication organisations. The Group analysed various alternative communication scenerios and established a hierarchy of communications, as needed by the Power Sector. A number of technical solutions were explored to arrive at a flexible and reliable communication system. An important achievement was to arrive at a consensus that the frequency band of 50-150 KHz should be available for the Power Sector PLCC systems, subject to a few acceptable conditions stipulated by Paud T. A number of existing clearance procedures have either been simplified or are being modified in order to hasten the approval of applications for the various Power sector communication systems.

P & T Department proposes to extend communication facilities to all the semi-urban and rural areas upto the sub-divisional/tehsil headquarters level including important small towns in the Seventh Plan. Any of the media such as the Ultra High Frequency, Satellite etc. is likely to be used for establishing these links. The Power sector communication requirements in these areas are proposed to be taken care of in the first phase of P & T Plans.

Contd.....2....

The Group has recommended that the Power sector should establish its own independent system of communication below the State Load Despatch Centre levels which could be a terrestrial network or a satellite-based system, or a combination of them, depending upon the geographical nature of the location. A detailed examination has to be undertaken by every Power organisation to arrive at the optimum mix of satellite and terrestrial component for each area.

The total estimated cost of the recommended communication system at the national level is likely to range between Rs. 200 - 300 crores depending upon the types of systems. There is also a large backlog in the communication system to be covered in order to update the existing system to conform to well-developed, high speed, reliable and efficient standards.

In my opinion, in the past, the communication needs of the Power sector did not receive as much attention as was required. One of the reasons for some of the failures of the Power grids could be lack of adequate communications. The Group has recommended that a separate Head "Communication for Power Systems" in the Power Plans should be created and the funds earmarked for it in the Plan. Alternately, this programme could also be taken up as a Centrally sponsored scheme without any grant element.

The present communication set-up in all the Power organisations is totally inadequate to take up the planning, designing, operation and maintenance of the recommended systems. The training facilities available are inadequate and this aspect needs urgent attention by both Power sector and Communication Departments. There is urgent need to set up a Central organisation which should lay down guidelines for the various systems including preparation of the specifications for the sub-systems, equipments etc. There should be a single agency to coordinate the functions of the various departments dealing with the communication systems. While a particular organisational set up is not suggested by the Working Group, the Government should take an early decision on the type or organisation to be set up.

Contd.....3...

In the Approach Paper to the Seventh Five Year Plan approved by the National Development Council, the provision of a modern and efficient communication system in the Power sector in the Seventh Plan was considered as essential. In my view, the implementation of the recommended communication system in the enclosed Report will meet the short term and long term communication needs of the Power sector.

Before concluding I acknowledge the contribution of all the Members of the Working Group, Technical Experts Group and other sub-Groups and their participation in the finalisation of the work of this Group. I also acknowledge the hard work and the efforts of the Member Secretary, Shri H.R. Rao, in coordinating the deliberations of the various Sub-Groups and in the preparation of the Report.

With kind regards,

Yours sincerely

(YASH PAL)

Shri P.V. Narasimha Rao,
Minister for Planning,
Yojana Bhawan
NEW DELHI.

Encl : As above.

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PREFACE

The Power sector is given a very high priority in the country's development strategy. The importance given to this sector in the country's economy does not require to be explained. Yet the rapid development of this sector needs a mention which can be seen from the following Table:

	1950-51	1960-61	1970-71	1980-81	1989-90
Growth in installed generating Capacity (Megawatts)	2301	5654	16271	33315	71756[1]
Rural Electrification					
(a) Villages electrified (Nos.)	3061	21754	104942	272887	572329[3,1]
(b) Pump sets energised (lakhs)	0.21	1.99	16.20	43.30	86.50[1]
(c) Cumulative investment (Rs crores)[2]	150	751	4200	18444	Not finalised.
(d) Total Plan investment Cumulative (Rs crores)	N.A.	6632	26567	104048	-do-

[1] From the Draft Report of the Working Group on Power for the Seventh Plan.

[2] Source - Economic Survey of India.

[3] 1971 Census

2. Power systems in our country have now reached such a stage that the power supply requires coordinated and integrated operation of a large number of widely spaced and varied generation sources and power supply centres. Extensive transmission systems linking the generating stations with the distribution

systems also have been developed. A new 400 KV system matching with the growth in generation programme is being established for the supply of bulk power to the consuming centres. With the growth in the Power Sector, the organisational structure of the power industry is also changing. The major responsibility for power generation and distribution continues to rest with the State Governments and their Electricity Boards set up under the Electricity (Supply) Act, 1948. This Act was amended in 1976 which gave an option for the creation of generation companies by the State and Central Governments, either jointly or independently. At present, three Central generation companies and two State Power Corporations are functioning. In Mid-1960s, five Regional Electricity Boards were created which are charged with the responsibility of coordinating the operation of power supply industry in their respective regions. Under the Atomic Energy Act, 1962, the responsibility for nuclear power development is vested with the Central Government and a Nuclear Generation Board has been set up recently. With the complexities in the organisational structure of this industry as well as in power development, the urgency for the coordinated and integrated operation of a large and varied sources of power as well as transmission systems have arisen.

3. Regional operation of the power systems has become a reality and the Government is committed to formulate a national grid. For the effective management and operation of the power projects and control of the power systems, setting up of an integrated, efficient, reliable and high speed communication system based on the latest technologies with large capacity to handle data as well as future communication needs is extremely necessary. Though the power systems expanded manifold, neither the communication systems applied to the power sector expanded correspondingly nor the new technologies were adopted. In the early period, the communication requirements were limited and confined to exchange of operational messages. For the present-day complex requirements of the power sector, it is necessary now to have a continuous flow of engineering data as well as information on material management, personnel, financial functioning of projects, etc. Large additions to the generating capacities

and power systems are anticipated in the Seventh Plan. While the dimensions of the Plan are yet to be finalised, the Power sector will be required to play a pivotal role. For effective integrated operation of the Power systems, load despatch centres at State, regional and national levels linked by reliable and efficient communication systems are required. The Regional Load Despatch Centres (RLDCs) are in the process of being set up. Some States have started interim load despatch centres. The National Load Despatch Centre is also likely to be established shortly. High Voltage Direct Current (HVDC) links for transmission of large block of power on point to point basis are being taken up. The need for the identification of a reliable, efficient and technically feasible communication system to this sector has thus become vital.

4. The Planning Commission decided to constitute a Working Group in 1983. The Notification of the setting up of this Working Group and its Terms of Reference are at Annexures I and IA.

ACKNOWLEDGEMENTS

The Working Group would like to place on record its sincere appreciation to all the State Electricity Boards, Central Power Coroporations, Central Ministries of Communications, Energy, Space, Electronics, Civil Aviation and their Departments for their assistance, cooperation and information given on request from the Chairman and the Member-Secretary of the Group. In particular, the Group expresses its thanks to the Central Electricity Authority, Posts & Telegraphs Department, Wireless Planning & Coordination, Civil Aviation, Indian Space Research Organisation, Department of Electronics, Planning Commission, National Thermal Power Corporation and National Hydro Power Corporation and the State Electricity Boards of U.P. Andhra Pradesh, Madhya Pradesh, Maharashtra and West Bengal for their cooperation and assistance in enabling this Group to finalise its recommendations.

2. The Group is also grateful to the Chairman and Members of the Technical Expert Group for their keen interest and valuable contribution in finalising the Group's Report promptly. The Group will also appreciate the assistance of Sarvashri Murli and Venu of ISRO, Ahmedabad who helped the Chairman and the Members of Technical Expert Group in all its deliberations including preparation of the Report.

3. The Technical Expert Group was called upon to make field measurements for determining radio interference levels for PLCC. The Working Group expresses its sincere appreciation for the elaborate arrangements made by the Central Electricity Authority with the help of Northern REgional Electricity Board, Bhakra Beas Management Board, Haryana State Electricity Board, DESU, P & T and WPC in organising field measurements at Delhi and Panipat to carry out this work which has been attempted for the first time in the country. These studies provided valuable data which

would go a long way in streamlining the co-ordination procedures for frequency allocation to Power sector.

4. Mention must be made of Shri J.K.Chawla, who carried out the entire Secretarial work of this Committee, including arrangements for various meetings of the Group, circulation of the Papers and Minutes of the meetings and typing of the Report of the Working Group.

CHAPTER I

METHODOLOGY

This Group was set up for the first time which brought together the representatives of the various power organisations and the Communication Departments of the Central Government. Each Department had expertise and valuable data in its respective subjects. But the Working Group had to collect all such data before it could consider the programme of action. It obtained the available data on the various communication practices being followed as well as the adequacy of the communication infra-structure of the Power sector and the tentative plans for development envisaged by the Power organisations. In the first meeting of this Group papers received on these items from a few Electricity Boards like Madhya Pradesh, Maharashtra, Andhra Pradesh and the Central Organisations of National Thermal Power Corporation, National Hydro Electric Power Corporation and Central Electricity Authority were considered. In these Papers not only the communication systems in vogue were mentioned but also the options available for future developments were indicated. It was decided in the first meeting that the Central Electricity Authority would prepare a Report showing the scale and configuraiton of the power programmes on long-term basis and indicate its communication requirements. Similarly, P & T was requested to prepare a Paper giving the configuration of the communication network for the entire country, for the period upto 1990 and beyond, taking into account the tentative ten-year profile on communications prepared by it.

2. In the second meeting, it was agreed that a "Technical Expert Group" should be set up to arrive at a technically feasible systems configuration to meet the present and projected (1990) communication requirements of Power sector taking into account the various feactors, such as quality, reliability, flexibility and also the planned P & T systems during the same period. (A copy of the Notification setting up this Technical Expert Group is at Annexure II).

3. This Technical Group considered the Papers submitted by the various agencies to the Working Group. The Central Electricity Authority had prepared the detailed communication perspective for the Power Sector by 1990. Other participants of the Group, particularly P & T Department, National Thermal Power Corporation, National Hydro Electric Power Corporation, the State Electricity Boards of Maharashtra, Andhra Pradesh and Madhya Pradesh had prepared very valuable reports. The Indian Space Research Organisation had also submitted its Paper. Taking into account the views/recommendations made in the various Reports, a basic Paper was prepared which contained a proposal for communication system configuration. Model examples were worked out for three States of Uttar Pradesh, Maharashtra and Andhra Pradesh. This Technical Expert Group met two times between 7th to 9th November, 1983 and 28th and 29th December, 1983 and submitted its interim Reprot to the Working Group. The Expert Group sought the guidance of the Working Group on certain issues brought out in the Report, which directed the Expert Group to carry out further studies, particularly on the trunk communication options after examining the proposals of a few more States. The term of the Technical Expert Group was extended upto April 1984. The final Report of the Expert Group was considered by the Working Group in its fourth meeting held in April, 1984.

4. The secretariat of the Working Group also obtained from all the Power organisations the existing organisational set up in the State Electricity Boards and Central Power Corporations. Similarly, the Department of Electronics furnished notes on the capability of indigenous production of the communication equipments. The inadequacy of the Power organisation in the communication sector as well as in training was apparent. But all the Power organisations indicated their willingness to expand/ reorganise their communication cadres to match the future communication programmes in planning, erection, maintenance and operation of systems.

5. In all, the Working Group met five times and finalised its Report.

CHAPTER II

EXISTING COMMUNICATION SYSTEMS IN POWER SECTOR

6. The main medium of communication in the Power sector so far is Power Line Carrier Communication (PLCC). which caters not only for speech but also for tele-protection requirements. In some cases VHF has been used for localised function. Only few States have introduced recently VHF and micro-wave communication systems. These and other systems are discussed in the following paragraphs.

Power Line Carrier Communication (PLCC):

7. This provides facility for transmission of speech, protection-relaying, telemetering and telex signals between the power stations and sub-stations. This facility is generally extended to every new sub-station and power station whenever they are brought into service. PLCC provides for the following:

i) Communication for protection purposes;
ii) Speech and data communication for operation, monitoring and control, etc;
iii) Exchange of Operational data transmission;
iv) Speech and data transmission for monitoring and project implementation.

For (i) above, there should be no time delay in transmission and receipt of signals. Even a small error rate is not tolerable.

8. The communication channels for other requirements are mainly for conveying the operational data or for management information services which are collected at intervals. While the data for (iii) above is collected on cyclic basis at short intervals, the data for management information services is communicated at longer intervals. Generally such data is super-imposed on the speech channel itself.

9. Speech operation is normally limited to 300-2000 HZ out of the standard available speech channel of 4 KHz. The remaining part is reserved for data transmission at low speed teleprinting/

signalling transmission. The data originating at a remote station in a power system is transmitted to the control centre after passing through various sub-stations enroute.

10. Various types of signals, as mentioned above, are superimposed or multi-plexed within the same channel by using appropriate filters. At some locations, a number of lines emanate or terminate. Thus a number of carrier frequencies are used here. On some lines a number of channels with different carrier frequencies are provided. Thus the available frequency band is getting saturated with the expansion of power systems and as such allocation of frequencies has become difficult. Moreover, the PLCC channels are suitable only for low speed data say upto 200 Bauds in sub-channels with VFTs and 1200 Bauds in independent channels.

Radio Links:

11. These can be grouped under four categories, namely High Frequency (HF), Very High Frequency (VHF), Ultra High Frequency (UHF) and micro-wave systems. The introduction of these different communication systems for power sector use can be said to be quite recent. Side by side channels are also located from the P & T Department who have been maintaining their own micro-wave and UHF channels. Application of these different communication system is restricted by planning considerations such as the availability of the frequency bands, communication requirements and the distances proposed to be covered and the inherent reliability.

HF Links:

12. These operate in the frequency range of 3-30 MHz. and are best suited for long distance communication. However, they are susceptible to fading and electro-magnetic interference, natural and man-made. Hence, the application of this system has only restricted use in as much as it can function as a stand-by to the overall communication system and as immediate/emergency link between Project Site/Power House and the Headquarters.

VHF

13. This operates in the range of 30 - 300 MHz. VHF links are useful for fixed and mobile operation with reliable range limited to line-of-sight (40 km or so). They are specially suited

for system maintenance in metropolitan cities. The frequency is shared with Police, Fire-fighting Service and other Departments. Man-made electro-magnetic interference from automobile ignition systems, etc. can be a source of trouble in these operations.

UHF

14. This uses the frequency band of 300-1000 MHz. and is suitable to carry 24-60 super-imposed speech channels per bearer. It is also a line-of-sight communication, but repeater stations can be introduced for long-haul working. Channel-dropping can be effected at intermediate stations for inter-connection to local equipment and other communication systems. However, the inherent noise levels are high restricting its suitability for data transmission over large distances.

15. The VHF/UHF frequency band between 30 MHz and 1000 MHz finds applications in providing fixed point-to-point terrestrial telecom links. The different bands allocated in National Frequency Allocation Plan (NFAP-81) for general and miscellaneous usages of Government/semi-Government organisations in our country is in Annexure III. The operating systems could broadly be categorised as Single Channel, Shared Channels (multi-access system) and Multi-Channels.

Micro-wave:

16. The micro-wave systems operates in the rangeof 2-11 GHz. It is most suitable for point-to-point communication. The system is highly reliable and suitable for large channel requirements upto 1800.

17. The UHF and micro-wave radio link communication systems have a higher degree of reliability over the PLCC. But problems arise in circuits within urban area cable net-work which are looped into and out of several exchanges. The P & T Department does not seem to have resolved such problems fully.

18. In the Annexure-IV the broad details of practices in other countries relating to communication net-works for power systems are given.

CHAPTER III

OPTIONS IN THE COMMUNICATION SYSTEMS

19. The various fields in which communication facility is required are:-

i) Project Management during construction;
ii) Operations monitoring of generating units/stations;
iii) Protection of transmission lines and equipments;
iv) Operational requirements of system elements such as sub-stations, RTU's LDC's etc.;
v) Power systems operations and control; and
vi) Mobile Maintenance System for distribution net-work/ Project site communications.

The various forms these communications may take are(i) speech, (ii) Protection signalling, (iii) Status Signalling, (iv) Telemetry of systems data, (v) Control signals to outlying generating sub-stations, (vi) Teleprinter messages, (vii) Facsimile transmission of charts, graphs, curves, etc., (viii) Project data, (ix) Management information regarding selected systems
(x) Control of mobile maintenance parties.

Location and Hierarchy of Communications:

20. Operational communcation is basically hierarchical in nature, with the basic link being Power-Station-RTU/Sub-station/ Concentrator/Sub-SLDC/SLDC/RLDC. Occasionally there will be direct communication between KTU's and SLDC or/ and RLDC. The generating stations generally have larger communication needs directly to SLDC and RLDC, both for regular operations and emergencies. These concepts are illustrated schematically in Figure 1.

21. The basic controlling and operating responsibility for both generation and transmission system within a State is essentially with SLDC. The RLDC's are being established to coordinate the State grids of the power zones and their interaction may be mostly with SLDC's sub-SLDC's or some major generating

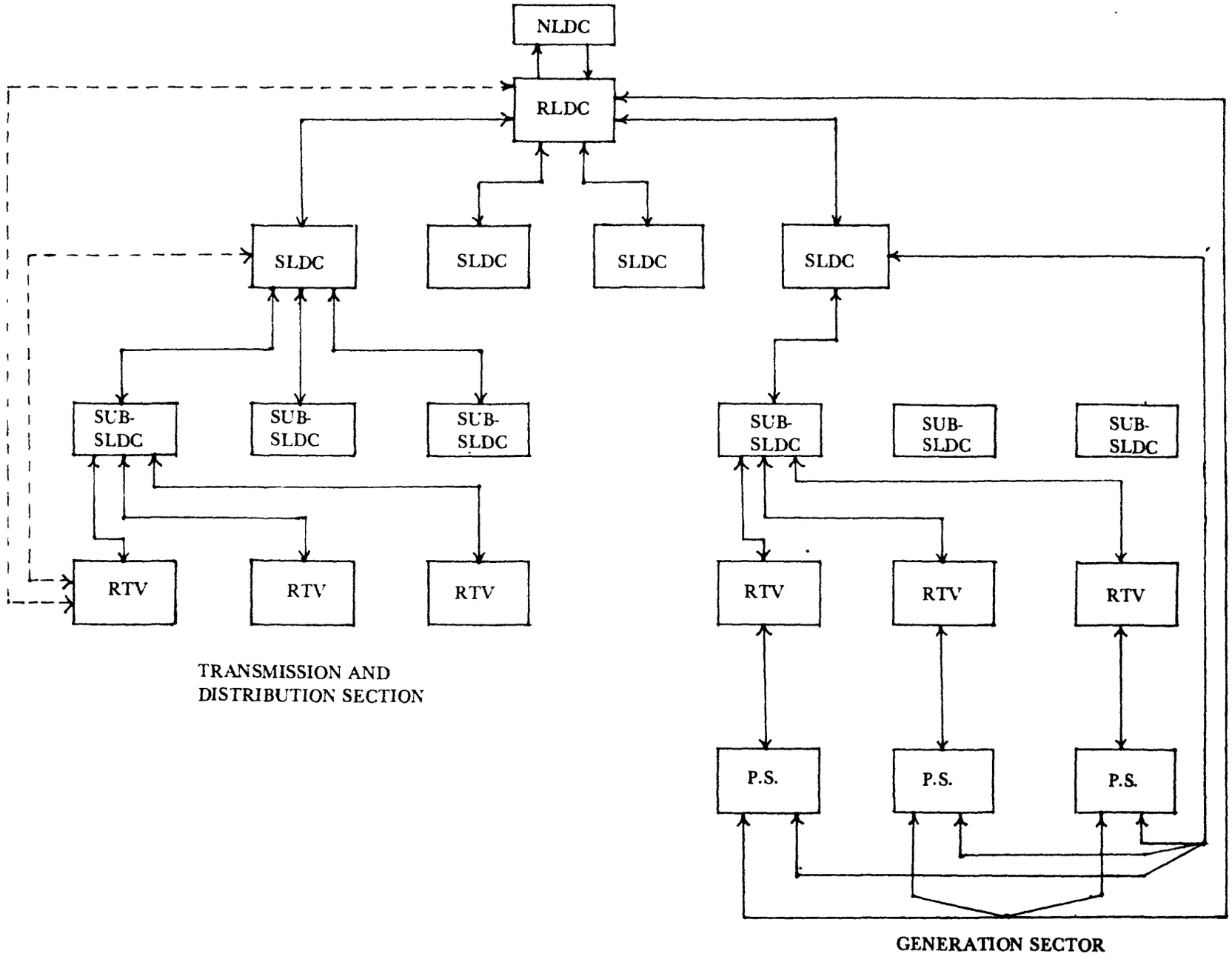

Fig. 1. Hierarchical Communication Structure for Voice and Data Links in the Power Sector

stations. Some examples of the functions carried out using voice channels as well as data channels are listed in Annexure V.

22. In future, Computers are going to be indented on a large scale to handle most of the complex operations in power system management. In such an event, data links assume primary importance over the voice channel. The increased requirement of data communication may also be kept in view while planning and engineering the communication requirement for the Power sector.

23. There are two types of systems to be considered:

i) Communication systems covering small areas, and

ii) Trunk communication systems for long distance routes.

The former makes use of systems like P.L.C.C or V.H.F. The major areas to be considered under this category are:-

a) Local speech/communication,
b) Protection signalling,
c) Communication within a power station complex
d) Field maintenance work,
e) Line erection work,
f) Project construction activities,
g) Intra-city communications,
h) Rural area communications.

The second type, by and large, forms a nationwide network and involves a mixed system having both a satellite component and terrestrial link or P&T leased lines is considered. Satellite-based links can be used to access remote nodes from a central node while the terrestrial-based systems can be used to access the peripheral nodes clustered around each of the remote nodes as also total systems.

Power Line Carrier Communication System (PLCC)

24. The communication between RTUs and down upto 66 KV sub-stations will be primarily on PLCC which will continue to be the only means for protecting the lines and equipment against faults. PLCC is also capable of point-to-point data and voice communication subject to certain practical limitations. The existing PLCC

systems set up a number of years ago also require replacement due to their ageing and unreliability. Modification works have to be taken up either to replace the old equipments where necessary or to refurbish them to bring them up to acceptable performance levels. The P & T Department has agreed that wherever the old PLCC equipment has to be replaced on a one to one basis, i.e. for the same frequency and identical or lower power level, identical manner of operation (phase to earth, or inter-phase) and/or with improved technical characteristics (change from double sideband to single sideband), P & T Department is only to be informed by the customer and in all such cases no new coordination is called for. It is only in cases where power levels are increased in the proposed modifications or interphase coupled operation is modified phase-to-earth coupled operation, a new coordination will be called for as in any fresh cases.

25. At present the customers are required to make applications for PLCC clearances to the respective General Managers of the Territorial Telecom Circles of the P & T Department. But, in the course of discussion, the power organisations pointed out that whenever a PLCC clearance was to be obtained for the power line cutting across more than one State; all the General Managers of the P & T Department in whose area of operation the lines run, are required to be approached at present. This involved delay as well as considerable correspondence, follow-up, etc. Appreciating this point of view, the P & T Department has agreed to modify the present procedures so that only one of the Area General Managers deals with all the references for PLCC clearances of such inter-State transmission lines. The implementation of this new procedure by the P & T Department is expected to eliminate the present delays provided the power organisations approached the General Manager assigned by the P & T Directorate with full data.

26. The frequency band of 50 to 500 KHz is shared with users like Civil Aviation, Defence, P & T, etc. On account of existing coordination, no interference between these users has been experienced. It was also agreed that considering the requirements of 400 KV lines where non-repeater spans may extend upto 500 KMs,

the band between 50 to 150 KHz is best suited for PLCC on these lines.

27. The requirements could be met if this band of 50-150 KHz is exclusively made available for the Power sector. However, there are several other users in this band including the rural communication services of P & T, maritime beacons, maritime mobile communications etc. It was confirmed that the frequency band of 50-150 KHz is not being used by the Civil Aviation Department for non-directional beacons. So far, no measurements of interference with other users in this frequency band had been undertaken in this country. The Technical Expert's Group therefore set up a sub-Group with the representatives of WPC, CEA, P&T etc. to take measurements in order to check up the interference of the PLCC systems with other users of this frequency band. This Group took measurements on the PLCC systems at Badarpur, Mehrauli and Panipat. The measurements taken referred not only to the PLCC interference with the radio links but also with the open wire P&T systems in the adjoining rural areas. No interference to communication lines from PLCC was noticed. The bried report prepared by the Sub-Group is enclosed at Annexure XVII.

28. It is now agreed that the frequency band of 50-150 KHz could be made available to the Power sector without any restrictions subject to the following conditions:

(i) The power level should be restricted to maximum of 40 Watts.

(ii) The PLCC system should employ phase to phase or inter circuit coupling only.

(iii) Phase to ground coupling shall not be used.

(iv) The guidelines in respect of 40 Watt power level could be reviewed after the first two 40 Watt PLCC systems are commissioned in the vicinity of existing P & T communication lines.

(v) PLCC systems in 50 to 150 KHz upto 20 Watt power level may be permitted for long distance 220 KV lines (exceeding 200 Kms) on the basis of the results of measurements already done and if required on the re

sults of the fresh measurements. The question of higher Wattage would also be decided in the light of such measurements.

29 In case where the existing Rural P & T lines have to be diverted or otherwise treated for reduction of interference, it is suggested that the financial burden for such works would have to be borne by the Power organisations.

30. A question arose whether the criterion adopted by the P & T Department for the clearance of P.L.C.C. applications referred to it by the Power organisations in the country could be streamlined. According to the present criteria, the noise level selectively measured at any frequency of the transmission band of an open wireline should be $\leq$ -50DB. The audio signal to noise ratio of the derived circuits shall not be less than 40 dB. The factors which affect the level of interference are:

a) Length of the parallelism;
b) Separation between power and telecom lines/ratio system;
c) The transmission power of PLCC and minimum receive power in the carrier system;
d) Frequency of operation;
e) Type of coupling (phase to phase and phase to group);
f) Type of carrier system.

31. Based on the above studies, the following criteria are being generally adopted by the P & T Department for giving the PLCC clearance;

i) Any frequency above 150 KHz subject to WPC clearance;
ii) If the frequency range is below 150 KHz, then the clearance is subject to:
(a) conditions mentioned in para 28.
(b) minimum separating distance.
(c) Licencing by P & T without any hitch.
(d) Coordination by the Power organisations themselves.

32. In regard to the clearance of the frequency band below 150 KHz, WPC has no objection for giving a blanket clearance for

the use of the band 50-150 KHz by PLCC systems in areas other than (i) those within 20 km. from the coasts and (ii) islands on a provisional basis for a period of 5 years. The situation would be reviewed after this period depending on the other users at that time in the concerned bands.

33. P & T Department has agreed to the free use of transmitted frequency ranges of 84 to 92 KHz and 143 to 150 KHz exclusively by the Power Sector subject to their own coordination.

34. The issue of licence by P & T Department for operation of PLCC system will continue, as at present.

35. In regard to the above, Central Electricity Authority will be the nodal organisation which will maintain the register of frequency allocation to various users of the power sector in an ascending order. CEA will also update the frequency register of all the frequency spectrum used by the power organisations.

36. It is suggested that all the Power organisations furnished to the P & T Department their proposals for issue of licence where frequency below 150 KHz is likely to be used.

37. It is also suggested that the clearance for PLCCs should be taken up along with application for PTCC clearance as this will save time.

38. It has been realised that even in the interim stage, there is a scope for streamlining of the present procedure, to some extent, to eliminate avoidable delays. As suggested by the Wireless Adviser to the Government of India, on receipt of a copy of the request for PLCC authorisation, WPC Wing will undertake the examination of interference to any radio operation without waiting for the comments of the concerned General Manager (Telecom). This would, in a few cases, result in additional work on the part of WPC Wing where the General Manager (Telecom) finds that the proposal in the application is not acceptable or makes a suggestion for operation at other frequencies. However, this additional work can be accepted if it can speed up the clearance procedures.

V.H.F Systems:

39. The use of V.H.F receivers is recommended for communication systems within generating stations complex, field maintenance work, line erection work, intra-city communications and project construction activities. These are, however, meant for voice communication only. A generating station will have various locations according to the type of stations. In thermal stations, a number of peripheral plants such as coal and oil handling plants water treatment plant are to be linked up with the main plant control rooms, Divisional Office/s and main office. In the case of hydro stations, there are locations like storage reservoir, water conductor systems which are to be linked with the main control room and the main administrative office. V.H.F.sets are the most appropriate to help in coordinating the various activities of line erection work, field maintenance work operations and project construction activities. For intra-city communication, V.H.F sets are already being used in the major cities like Ahmedabad and Hyderabad. In large cities like Bombay, zones may have to be created with different frequencies being used in adjacent zones. This will require relay points to convey the instructions to the appropriate zones. This will require utilisation of V.H.F sets requiring proper coordination with the other users of the spectrum.

40. V.H.F. applications are made for either single channel or for a multi-channel system. A doubt arose whether the licence for V.H.F sets is given by the W.P.C. or P & T Department. It was clarified that the Power organisations are required to obtain the clearance of only the W.P.C. for any single channel proposals. As regards the applications for multi-channel V.H.F. systems, the concurrence of the P & T Department would also be required.

Semi-urban and Rural Communications:

41. The PLCC system covers only upto and above 66 KV sub-stations. The number of 33 KV sub-stations are approximately ten times the total number of 400 KV, 220 KV, 132 KV and 110 KV sub-stations. A large majority of these 33 KV sub-stations are without any communication facility at present. These are considered

very important for the efficient functioning of the power system. Besides this, there is the requirement of Zonal Chief Engineers to be connected to each major urban centres and towns falling within his zone of control.

42. The projections by P & T indicate that telecommunication will be established during the Seventh Plan upto sub-division/ tehsil headquarters level, including important small towns. Any of the media such as the UHF, satellite, etc. is likely to be used for establishing these links. In such a situation, it is suggested that the power sector utilise the communication links of the P & T system, wherever possible.

43. It is suggested that the power sector communication requirements in these areas are spelt out in detail and submitted to P & T Department by November 1984 so that their requirements are also taken care of in the formulation of P & T's plans. In fact, power sector's needs in the rural sector should be included in the first phase of P & T's future plans. If circumstances so warrant, the power sector might own and operate its own VHF network for this area.

44. The need for an integrated rural telecommunication system is reinforced by the power sector projections. However, in locations where P & T Department have no plans to establish a viable network, the power sector should be authorised to establish its own communication links like using a multi-access radio system. In the communication systems planning for power sector, this aspect should receive high priority.

45. Project Site Communications: For communications between project sites of NTPC,NHPC, CEA and State Electricity Boards and their respective Headquarters/load despatch centres, the Group felt that satellite medium and/or HF are the most suitable media. Steps which are already underway towards establishing the satellite links for some sites for this purpose are to be pursued.

46. H.F.Systems are best suited to far flung projects and/ or in the hills. Since the H.F. range is large and a number of consumers operate in the H.F. frequency range, it is necessary that the present coordination procedures should be continued to

avoid any interference among the various users. The W.P.C. should consider the request for H.F. Systems on case by case basis. Since the H.F. operations have the limitation of quality and grade of service, this system could be utilised as an intermediate step for fulfilling the immediate needs,as well as a back up to the satellite medium in the long-term.

Trunk Routes and the Arteries:

47. For the trunk routes and the arteries, three distinct options were discussed. These are:-

a) Extensive use of P & T lines: The requirements, as projected by C.E.A for trunk lines, run nearly parallel to the existing P & T trunk routes which use various transmission media, e.g. micro-wave, satellite and coaxial links, etc. Therefore, use of these P & T links for deriving the circuits in a group basis is technically feasible. End links from P & T centres to the Power net-work points would however, be required. A sample exercise of using the P & T trunk routes between Delhi and Loktak was carried out. It was confirmed by the P & T representative that in all the major trunk routes of the P & T network, the channel requirements of Power sector inblocks of 12 channels could be accommodated between P & T centres if firm orders are placed. These could be made available from P & T centre to P & T centre to the users in 6 to 12 month's time. However, forthe end links and wherever augmentation is involved, the lead time requirement would be about 3 to 4 years for commissioning. The availability of the trunk routes is generally good. But the end to end circuit availability is constrained by the local leads.

48. In this case the cost of leasing the channel requirements, as projected for the Power sector, was roughly estimated to be around Rs. 60 crores per annum for all over India. An additional capital investment of roughly Rs 100 crores is anticipated. The cost details are given in Annexure VI.

b) Independent Network using Bunched Channels:

49. A sample exercise to cater to the power sector's trunk and artery communication requirements upto RTU level by an

indepdent micro-wave/VHF/UHF links has been carried out for the U.P. Sate. The exercise has been done taking into account the need for minimising the number of drop points to maintain the quality level. Based on the exercise, the total cost of the system for an All-India network roughly works out to be about Rs 700 crores vide Annexure VII. This does not account for the local distribution, mobile units, etc. Use of 2 GHz, UHF and 8 GHz narrow band micro-wave system for networking over large areas and employing UHF and a limited part of 7 GHz spectrum for short-haul applications on spur routes have been identified as technically feasible options. The phased implementation of the total network may be spread over seven years with the first link being available in about four years. This independent network would need to be manned for operation and maintained at an annual cost. Equipment and facility amortization costs will be additional.

(c) Hybrid System with Satellite Base for Trunk Routes using pooled channels.

50. A hybrid system consisting of satellite terminals and VHF/UHF systems has also been considered by the Group. In this system clusters are formed by VHF/UHF/optical fibre links and the clusters are inter-connected via satellite. This system uses a pool of channels which are allocated on demand whenever any point requires to communicate to any other point and the grade of service would be as good as pre-assigned system. The data channels which have primary importance over voice channels are provided on a pre-assigned basis in a Time Division Multiple Access(TDMA) mode.

51. The number of satellite terminals has been roughly estimated to be 250. The space segment requirement has also been estimated to be approximately half a transponder of INSAT-1. The availability of this capacity in the present and the planned system is to be examined. A sample exercise for the Maharashtra State has also been carried out. Based on this, the total cost for an All-India network has been worked out to be approximately Rs. 170 crores. This assumes that VHF/UHF channels would be leased

from P & T wherever P & T systems exist. A totally captive network consisting of independent VHF/UHF links to join peripheral units to the cluster centre would cost approximately Rs. 220 crores. The cost details are given in Annexure VIII.

52. The implementation time for this option may be about 7 years. However, provision of links required on urgent basis wherever required and phased implementation of the network otherwise is possible.

53. In all the above options, installation and establishment charges, building and infrastructure costs are not included. An attempt was made to work out the operations and maintenance cost based on P & T practice. These figures are given for the various options in Annexure IX.

54. Different combinations of P & T leasing, Satellite based system and terrestrial micro-wave link based system have been considered. The yearly operation and maintenance costs are estimated to vary between Rs. 24 crores and Rs 70 crores for different cases.

55. The system configuration exercise for communication requirements of Andhra Pradesh (AP) was also carried out. While working out the trunk route configuration for the AP projections, it was observed that the power sector locations were fairly widespread. So instead of forming clusters around a satellite earth station, one can also put an independent earth station in most of the locations. This fact emphasises the need for studying each Region's characteristics before arriving at an optimum solution to the network configuration. However, this exercise does not change the basic options.

56. The study of projects from the three SEB's also brings out the fact that the communication networks of individual State Electricity Boards should be properly evolved and then carefully integrated into the national system for proper coordination of the grid.

57. Comparison of Various Options: The three different options discussed above are compared in detail in Annexure X. Ad-

vantages and limitations of each system have been brought out clearly. The following major points need to be considered before selecting any one of the above options for implementation:

i) The main advantage of Option-I (extensive use of P & T lines) is in the availability of the extensive P & T network for use by the power sector. The trouble of establishing a network or running a large operations and maintenance organisation is avoided.

ii) The major limitation in opting for using P & T network is that the present network does not cover power sector locations in most States adequately. The second limitation will be the difficulty for such a network which is designed as a general public network to meet the exigencies of a special user like power sector over any part of the entire network.

iii) Options II and III (independent micro-wave or satellite-based systems) being of dedicated nature can be designed to meet the demands of the power sector regarding reliability, quality and availability in a better way.

iv) The main limitation of Option-II is the under-utilisation of theinstalled capacity of the network and the high cost of implementing such a system, not to mention the operating and maintenanc responsibility and amortization costs.

v) The main advantage of Option-III is the optimal utilisation of the network capacity. Such an optimal utilisation will bring the cost down. However, satellite-based large networking is only now emerging in India and is expected to stabilise with the launch of INSAT-1C in mid-1986.

58. Considering that the three options have distinct merits and demerits, it appears that a mix of these three options could be advantageously derived to meet the power sector requirements.

59. For example, by leasing the P & T links between metropolitan cities and other large cities, the requirements of reliably inter-connecting SLDCs and RLDCs could easily be met. For meeting the power sector's requirements below SLDC level, an independent network would be required. Even below SLDC level some of the P & T's long haul links between few major cities within a State could be utilised with end links being independent.

60. By adopting such an approach, the cost of Option-II reduces to about Rs.400 crores with the P & T lease charges of Rs.4.8 crores per annum being additional as shown in Annexure XI. The cost of Option-III, however, will remain more or less at Rs.200 crores[1] as this is specially tailored for power sector requirements.

61. Therefore, to meet the power sector's communication requirements upto RTU level and important sub-systems, the following strategy appears to be optimum:-

i) Leasing of channels on P & T's long haul links between metropolitan and some of the major cities to meet the requirement of interconnecting SLDC, RLDCs.

ii) An independent network of the power sector below SLDC level. This independent network could be a terrestrial network or a satellite based system or a combination of them depending on the geographical nature of the locations. A detailed examination to arrive at the optimum mix of satellite component and terrestrial component for each area requires to be undertaken.

iii) For establishing links required on urgent basis and where existing communications facility is not adequate, the satellite medium/HF could be utilised.

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1. This option would imply setting up of 250 satellite ground systems. Subsequent estimate of ground station cost suggests that this may be reduced by about Rs.33 crores.

62. The Power representatives expressed their view that the terrestrial endlinks for connecting the peripheral stations and earth stations belonging to the Power sector should be owned, operated and maintained by the Power sector itself. Further, the Central Electricity Authority suggested that the dedicated endlinks being installed by the P & T Department for the RLDC projects should be handed over to the concerned REBs/SEBs. In all cases where the Power sector leases P & T trunk circuits between Metropolitan cities, the concerned endlinks should be owned and operated by the Power sector. The ownership agency for the endlinks was discussed. The Power sector representatives expressed their opinion that these endlinks, being the weakest section in the total systems in achieving the required quality and availability, the power sector should be permitted to own and operate them as part of their dedicated network. However, P & T representative did not agree in accepting this amendment as many technical, operational and administrative difficulties would arise in allowing a particular user to operate from the P&T Centres. There would be difficulty in sharing the infrastructure and in interfacing with the public network. The Working Group suggested that the Chairman would take up the issue of deciding ownership and operation of endlinks with the Secretaries Steering Committee.

RECOMMENDATIONS REGARDING TRUNK/ARTERY ROUTES

63. It may be concluded that though in some sections, particularly long haul trunk routes, P & T may be in a position to give an adequate service to power sector, in large parts of the country, especially below the level of SLDCs and upto RTUs, P & T cannot meet the requirements of power sector with the quality and reliability of service that the power sector is in need of. Thus there is a strong case for allowing power sector (consisting of State Electricity Boards, National Power Corporations and CEA) to establish its own dedicated communications network in these areas.

64. In concrete terms, the power sector could use channels leased from P & T primarily between metropolitan cities and

between metropolitan cities and otherlarge cities (mostly State capitals). The basic criteria for such leasing should be:

a) P & T should have capacity available on these routes to lease in groups.

b) The media should be such that high reliability and availability can be achieved; that is only co-axial, UHF, micro-wave, satellite and Fibre optics links are acceptable.

c) An established and proven performance record should be guaranteed.

d) The availability should be based on certain quality standards of performance (Signal Noise Ratio, Fault Rate, Mean Time to Restore).

65. It was considered whether this criteria could be spelt out more quantitatively. The Group observed that it was not possible to establish a uniform criterion since it varied from route to route. Since the reliability of the trunk routes of the P & T between Metropolitan cities was excellent, the use of P & T channels between Metropolitan cities and some large cities is recommended. It is suggested that the power organisations should work out their requirements and furnish them to the P & T Department. It is seen, based on available data and experience, that this sort of leasing will be possible only from NLDC/RLDC down to the level of SLDC's and probably between SLDCs and one or two important Centres within a State. Below this level, the power sector has to establish its own dedicated communications networks adopting the most techno-economically viable alternative.

66. Since it would not be possible to establish the uniform criteria for leasing as these vary from route to route, a suggestion was made for the constitution of the Standing Committee of the representatives of P & T Department, C.E.A., and Department of Electronics to develop the required criteria and to satisfy that these criteria are met on a specified route for leasing. There was a general agreement that such a check was required.

The P & T representatives felt that such an arrangement would not be feasible. Since there was no consensus on this point, the Chairman was requested to take up this issue in the Secretaries Committee.

67. A suggestion was made that there should be an agreement with the P & T Department in regard to the availability and quality of the system whenever the P & T trunk routes are to be hired. While the Working Group in general felt that such an agreement would be in the interest of maintaining the quality of the system and that such a provision will be beneficial, the P & T representatives did not agree since under the present policy no agreements were signed. The Working Group requested the Chairman to take up this issue also to Secretaries Committee.

68. The Chairman of the Working Group has already written to the Secretaries of the Steering Committee to consider in its next meeting the three issues, namely (i) ownership of the end links, ii) setting up of an independent Committee to evolve the criteria for assessing the performance of leased P & T circuits and (iii) on the right of the Power sector to enter into an agreement with P & T in regard to the availability and quality of the system whenever P & T trunk routes are leased. A copy of the letter addressed to the Secretaries of the Steering Committee in which his own views as Chairman of the Working Group on all these three issues are available is enclosed at Annexure XVIII

69. It is recommended that:

a) The power sector establish communication between points of greatest importance and where existing communications facility is not adequate on an urgent basis using satellite/HFmedium. This approach is advocated mainly because, quick implementation is feasible irrespective of distances involved.

b) Simultaneously a detailed analysis statewise and sectionwise is carried out to arrive at an optimum mix of terrestrial and satellite links. In other

words, a system engineering study to arrive at the optimum cluster configuration to be evolved.

An important area of this system definition will be the deciding of the locations to be included in the trunk network in each region or state. A generalised methodology for evolving such a network is briefly described in Annexure XII.

c) As a corrollary, initially the satellite links established will use pre-assigned channels both for voice and data. When the analysis under (b) is completed, a more optimum multiple access and modulation technique could be adopted.

d) In the recommendations given above, the power sector points below RTUs are not covered and an approach outlined in paras 41, 42, 43 and 44. needs to be adopted in these cases.

e) The power sector and P & T should jointly identify the sections on which leasing is possible in the short-term and specific actions be initiated for leasing the lines. In the case of P & T a single focal point with the responsibility to provide the service needs to be identified.

CHAPTER IV

FINANCING THE COMMUNICATION PROGRAMMES

70. As seen from the introductory chapter, there has been stupendous growth of the Power sector since the planning process started in 1950. But the growth of communication systems for this sector did not receive required priority and matching attention. In spite of changing technologies in the communication field, the Power sector continued to manage with the familiar old communication systems as well as the procedures in obtaining the clearance for their installation. The investment made to develop communication facilities for power systems is not separately available. But this would in any way be insignificant in relation to that made for the power development. As could be seen from the Chapter III, the total investments at the national level for the recommended communication system would be in the range of Rs.200 to Rs.300 crores, which is insignificant as compared to the large investment that would be made in the Power sector during the Seventh and subsequent Plans. However, the requirement of each Power organisation will have to be estimated after a System Engineering study is made. There is a large backlog to be covered in order to improve the existing systems to conform to well developed, high speed, reliable and efficient standards. All the Power organisations have assured that the provision of funds for the communication requirements would not be difficult to accommodate in their Plans. One view expressed was that a separate Head "Communication for Power Systems" could be created in the Power Plan and funds earmarked therefor. The other view is that it may be taken up as a Centrally sponsored scheme without any grant element.

CHAPTER V

INDIGENOUS PRODUCTION CAPACITY FOR COMMUNICATION EQUIPMENT

71. The implementation of the communication systems for the Power sector depend to a large extent on the capability of the organisation, good design and supply of equipments according to the specifications and performance standards for which the system is designed. The type of equipments required for the vairous communication systems varies according to the systems involved. Various equipments/components are already being indigenously manufactured. A point arose whether the capacity already established/licensed will be adequate to meet the requirements of the proposed programme.

72. The recommended communication systems by and large are those which are being established by the power organisations the world over. The new area recommended is the application of satellite systems. As discussed in Chapter-III there is urgent need to replace/modify the existing PLCC systems which have become obsolete and unservicable. The application of V.H.F. and micro-wave systems increasingly will place greater demand on the equipment manufacturers. According to the Department of Electronics, there are a number of agencies who manufacture PLCC equipments or have been licensed and will be able to supply the equipment to various power organisations without any difficulty. In Annexure XIII, the capability of the various manufacturers for PLCC equipments is indicated. In Annexure XIV, status of activities under progress at various public sector undertakings for equipment manufacture for satellite communication, V.H.F. systems and narrow band micro-wave systems is available. It is recommended that the Power authorities firm up the quantitative requirements and finalise the technical specifications well in advance so that the supply of the equipment to the various Power agencies is ensured.

CHAPTER VI

ORGANISATION

73. At present, all the power organisations, by an large, have set up specialised groups/cells for planning and designing of the communication systems for the power sector. The main communication medium currently in all the organisations is PLCC except in a few which have recently adopted micro-wave systems also. Hence, the existing organisation is in the main structured for planning and designing of the PLCC systems. These organisations have also got field units for operation and maintenance. The organisational structure is not uniform in all. This applies also to Central Electricity Authority and Central Power Corporations recently set up. For instance, in the State Electricity Board, a separate communications set-up does not exist. In some State Electricity Boards, however, such communication cells have been of recent origin. Generally, the highest posts in the communication/tele-communication field in the State organisations are those of Superintending Engineer or an Executive Engineer who function under the directions of the Chief Engineer or Executive Director who look after the overall transmission system. In the Central Power Corporations of the NTPC and NHPC, communication divisions are set up in their corporate offices and in each project site. In the Central Electricity Authority, a Tele-communication Directorate headed by a Director looks after planning and engineering aspects of the communication for power sector. Technical functions of this Directorate mainly relate to planning, engineering and consultancy in the tele-communication field for power systems and coordination with P&T or for obtaining licence from the Wireless Adviser for clearing wireless sets etc. It also evaluates and processes Tele-communication needs of the various power utilities of the country which include framing specifications, bid evaluations

and laison with various suppliers etc. In the Regional Electricity Boards of the CEA, there is no Division/Unit which exclusively deals with communications. They have to look after other functions as well as communication system work.

74. To meet the power sector's communication requirements, the need for an optimum mix of P & T leased circuites and a separate dedicated network has been established. However, leasing the P&T circuits may have to be limited to communications between Metropolitan and few large cities and it is clear that a fairly extensive dedicated network for power sector has to be established over the years.

75. An effective organisation to implement such a communications network has to be evolved within the power sector and outside. Outside the power sector the organisation is mainly required for coordination, monitoring and steering. This will involve coordination between P & T and power sector for effective utilisation of P & T facilities and to see that P & T provides the services in a timely and guaranteed manner. Also coordination will be required between power sector and various industries for timely supply of equipment for the dedicated networks. Much coordination effort will also be required for timely clearances of industrial licences, import requests, etc.

76. As for the organisation within power sector, a workable arrangement that would involve CEA, State Electricity Boards and Power Corporations has to be evolved to implement the project. There are three major phases:

a) Planning;
b) Execution of Project (installation and commissioning); and
c) Operation and maintenance

Planning includes systems engineering, specifications writing, survey, equipment procurement and acceptance. It is recommended that power sector gets the planning done through some consultancy organisation of repute. Probably power sector is in a

position to carry-out certain part of the execution including civil works, equipment installation, etc. However, the equipment/ system alignment, testing and commissioning will require the expert assistance.

77. Operation and maintenance have to be the responsibility of the power sector. It is necessary to build up an organisation for this within the power sector. It is realised that such an organisation does not exist at this stage. The power sector can form a core group to work with the consultants. Simultaneously a larger organisation which can grow in size and experience along with the network can be built up. Thus over a period of 4 to 5 years, a well-knit and effective organisation that could operate and maintain the installed system as well as plan and execute future expansion could be evolved. It must be noted that for this organisation to be effective, a separate cadre of communications engineers within power sector will be necessary.

78. One could argue that the central administration might confine itself to laying down the general configuration of the system and the specifications of the sub-systems and leave the implementation to individual power sector organisations. On the other hand, one could also take a view that there is need for something like a Power Sector communication Corporation in the Ministry of Power/C.E.A. or any other organisation. Yet another possibility will be to have a special wing for Power Sector Communication in the Ministry and P & T. Till such time as a Central Organisation is established, power sector could make use of external competent agencies like TCIL, RCPO, EIL, EPIL, etc. for executing specific urgent schemes. Capability also exists in the Organisation like P & T, Railways, Department of Space, Ministry of Defence and consultancy services.

79. The Working Group recommends that there is need to set up a power sector communication corporation under the Department of Power or any other organisation which could coordinate with the Communication Ministry, perhaps, through a special wing to be set up for the Power sector in D.G.P & T.

80. With increased scope of tele-communication in power sector and with a view that the power sector should be allowed to own and operate their own communication links below the SLDC level, the responsibilities of the SEBs, C.E.A. etc. will increase manifold. It is recommended that wherever required, the telecom units should be upgraded.

81. Several new works on development side involving planning/ engineering of new media like UHF/HF, Micro-wave, Optical Fibre and Satellite system in addition to the conventional PLCC and VHF would have to be taken up by the C.E.A. Further, coordination work in regard to frequency allocation, and other responsibilities of C.E.A. will increase. Accordingly, C.E.A. is required to be strengthened immediately.

CHAPTER VII

SUMMARY OF RECOMMENDATIONS

OPTIONS IN THE COMMUNICATION SYSTEMS CHAPTER III

(1) Power line carrier communication system will continue to be the only means for protecting the lines and equipments against faults. This will also be predominantly used for communication between RTUs and down upto 66 KV sub-stations. (para 24).

(2) The existing P.L.C.C. systems require replacements due to their ageing and unreliability which require to be either replaced or refurbished to bring them to the acceptable performance levels. The P & T Department has agreed that wherever the old P.L.C.C. equipment has to be replaced on a one to one basis, P & T Department only has to be informed by the customer. It is only in cases where power levels are increased in the proposed modifications or inter-phase coupled operation is modified to phase-to-earth coupled operation, a new coordination will be called for as in any fresh case. When any modification to phase-to-phase has to be made only P & T Department is to be informed. (para 24).

(3) In cases where the P.L.C.C. clearance is required for the Power line cutting across more than one State, P & T Department has agreed that the application would need to be made to only one Area General Manager assigned by the P & T Department with full data instead of the present practice of making applications to all the General Managers of the territorial telecom circles of the Department. (para 25).

(4) Considering the requirements of the 400 KV lines where non-repeated spans may extend upto 500 KM., the frequency band between 50 to 150 KHz is best suited for P.L.C.C. on these lines. (para 26).

(5). It is now agreed that the frequency band of 50-150 KHz could be made available to the Power sector without any restrictions subject to the following conditions:-

(i) The power level should be restricted to maximum of 40 watts.

(ii) The PLCC system should employ phase to phase or inter circuit coupling only.

(iii) Phase to ground coupling shall not be used.

(iv) The guidelines in respect of 40 Watt power level could be reviewed after the first two 40 Watt PLCC systems are commissioned in the vicinity of existing P & T communication lines.

(v) PLCC systems in 50 to 150 KHz upto 20 Watt power level may be permitted for long distance 220 KV lines (exceeding 200 Kms.) on the basis of the results of measurements already done and if required on the results of the fresh measurements. The question of higher Wattage would also be decided in the light of such measurements. (para 28).

(6) In the case of such works where the existing P & T lines have to be diverted or otherwise treated for reduction of interference, the Power organisations would be required to bear the full financial burden. (para 29).

(7) W.P.C. has no objection for giving a blanket clearance for the use of the band 50-150 KHz by PLCC systems in areas other than (i) those within 20 KMs from the coasts and (ii) islands on a provisional basis for a period of 5 years. The situation would be reviewed after this period depending on the other users at that time in the concerned bands. (para 32).

(8) P & T Department has agreed to the free use of transmitted frequency ranges of 84 to 92 KHz and 143 to 150 KHz exclusively by the Power Sector, subject to their own coordination. (para 33).

(9) The issue of license by P & T Department for operation of PLCC system will continue, as at present. (para 34).

(10) In regard to the above, Central Electricity Authority will be the nodal organisation which will maintain the register of frequency allocation to various users of the power sector in an ascending order. C.E.A. will also update the frequency register of all the frequency spectrum used by the power organisation. (para 35).

(11) It is suggested that the clearance for P.L.C.C. should be taken up along with application for P.T.C.C. clearance. All power organisations should furnish to the P & T Department their proposals for issue of license where below 150 KHz is likely to be used. (paras 36 and 37).

(12) The Wireless Planning Coordination Wing will undertake the examination of interference to any radio operation without waiting for the comments of the concerned General Manager (Telecom.) as soon as a copy of the request for P.L.C.C. authorisation was received from the Power Organisations. (para 38).

(13) The use of VHF sets are the most appropriate to help in coordinating the various activities of line erection work, field maintenance work, operation and project construction activities. These are also recommended for communication systems within the generating station complex, intra city communications. (para 39).

(14) Power organisations are required to obtain the clearance of only the W.P.C. for any single channel proposals. Regarding applications for multi-channel V.H.F. systems, the concurrence of the P & T Department would also be required. (para 40).

(15) For semi-urgan and rural co-munications, any of the media such as the UHF, satellite, etc. could be used. The projections by the P & T Department indicate that the tele-communications would be established during the Seventh Plan upto sub-division/Tehsil headquarters level including important small towns. It is recommended that the Power sector utilises the communication links of the P & T system, wherever possible (para 42)

(16) The Power sector communication requirements, for semi-urban and rural communications, should be spelt out in detail and submitted to P & T Department by November, 1984 so that their requirements were taken care of in the formulation of P & T Plans. The needs of the rural sector of the Power sector should be included in the first phase of P & T's future Plans. If circumstances so warrant, the Power sector might own and operate its own VHF network for this area. (para 43).

(17) The Power sector should be authorised to establish its own communication links like using a multi-access radio system in locations where the P & T Department have no plans to establish the communication network. (para 44).

(18) For project site communications, the satellite medium or HF are the most suitable media and steps which are already under way towards establishing the satellite links for some sites are to be pursued. (para 45).

(19) The HF operations have the limitations of quality and grade of services. On this account, this system would be utilised as an intermediate step for fulfilling the immediate needs as well as a back up to the satellite medium in the long-term. (para 46)

(20) Trunk Routes and the Arteries: The Power sector has to establish its own independent system of communication below the SLDC level. This could be a terrestrial network or a satellite based system or a combination of them depending upon the geographical nature of the location. A detailed examination to arrive at the optimum mix of

satellite component and terrestrial component for each area requires to be undertaken by the Power sector. (para 61(ii))

(21) For establishing links required on urgent basis and where existing communications facility is not adequate, the satellite medium/HF could be utilised. (para 61(iii))

(22) The ownership agency for the end links for connecting the peripheral stations belonging to the Power sector and the earth stations and the concerned earth stations themselves as well as such end links of the leased P & T's trunk circuits between metropolitan cities was considered. The Power sector desired that all such end links should be owned, operated and maintained by the Power organisations. The P & T representatives did not accept it since many technical, operational and administrative difficulties would arise. In the absence of the consensus, the Chairman was requested to take up the issue of deciding ownership and the operation of the end links with the Secretaries' Steering Committee. (para 62).

(23) The Power sector could use channels leased from P & T primarily between metropolitan cities and between metropolitan cities and other large cities provided certain basic criteria for such leasing was satisfied. But it would not be possible to establish a uniform criteria since it varied from route to route. It is recommended that the Power organisations work out their requirements and furnish them to the P & T Department. Based on the available data and experience, the leasing of channels between metropolitan cities and some large cities will be possible only from NLDC/RLDC down to the level of SLDCs and probably between SLDCs and one or two important Centres within a State. Below this level, the Power sector has to establish its own dedicated communication network. (para 64 & 65)

(24. Since it would not be possible to establish the uniform criteria for the leasing of the P & T circuits, the

Working Group considered the suggestion of the Power sector representatives for the constitution of a Standing Committee of the representatives of P & T Department, CEA and Department of Electronics to develop the required criteria. The P & T representatives did not agree to such an arrangement as being feasible. Since there was no consensus, the Chairman of the Group was requested to take up this issue also to the Secretaries Steering Committee. (para 66)

(25) The Working Group considered whether there should be an agreement between the user and the P & T Department in regard to the availability and quality of the system whenever P & T trunk routes are to be hired. The P & T representatives did not agree and this issue is also taken to the Secretaries Committee (para 67).

(26) The Power organisations should carry out a detailed analysis Statewise and section-wise, to arrive at an optimum mix of terrestrial and satellite links (para 69).

(27) The generalised methodology on the locations to be included on the trunk network in each region or State is briefly described in Annexure XII which may be generally followed. Initially, the satellite links may be established which will use pre-assigned channels both for voice and data (para 69).

(28) The Power sector and P & T Department should jointly identify the sections on which leasing is possible in the short-term and specific actions be initiated for leasing the lines. In thecase of P & T, a single focal point with responsibility to provide this service needs to be identified. (para 69).

FINANCING THE PROGRAMME CHAPTER IV

(29) The total investment at the national level for the recommended communication system is estimated to be in the range of

Rs.200 to Rs.300 crores which depends upon the systems adopted by each Power organisation (para 70)

(30) There is a large backlog in the communication systems to be covered in order to improve the existing systems to conform to well developed, high speed, reliable and efficient standards. All the Power organisations have assured that provision of funds for the communication requirements would be accommodated in their Plans (para 70).

(31) It is recommended that a separate Head "Communication for Power Systems" may be created in the Power Plans and the funds earmarked therefor. Alternatively this programme may be taken up as a Centrally sponsored scheme without any grant element (para 70).

INDIGENOUS PRODUCTION CAPACITY CHAPTER V

(32) The indigenous capacity already established/licensed for production of various communication equipments, will be adequate to meet the requirements of the proposed programme. (para 72).

(33) The Power authorities should firm up the quantitative requirements of various equipments required for their proposed systems and finalise the technical specifications well in advance so that the supply of equipments to the various power agencies is ensured (para 72).

ORGANISATION CHAPTER VI

(34) The existing organisations in the Power sector are mainly structured for planning and designing of P.L.C.C. systems. Apart from that, the organisational structure is not uniform in all the Power organisations. Separate communication set up does not exist. This applies also to Central Electricity Authority and Central Power Corporations recently constituted (para 73).

(35) There are three major phases in preparing the communication systems, namely planning, execution of the project and operation and maintenance. It is recommended that the Power sector got the planning done through some consultancy organisations of repute. While the Power sector has the capability to carry out certain part of the execution of the communication projects, it will require the expert assistance in equipments/system alignment, testing and commissioning (para 76).

(36) For communication links established by Power authorities operation and maintenance will be the responsibility of the Power sector which should build up an organisation for this purpose as the existing set ups are inadequate. Well-knit and effective organisations by all the power organisations, in the next 4 to 5 years, should be evolved (para 77).

(37) The Power organisations might create a separate cadre of communication engineers within power sector to undertake the planning, execution and operation and maintenance of the communication systems (para 77).

(38) Till such time a Central organisation is established, Power sector could use competent agencies to execute specific immediate schemes (para 78).

(39) While specific organisational structure at the Centre is not suggested, there is need to set up a Central organisation according to the scope of responsibility. While it may be argued that the individual systems could be implemented by the individual power organisations, there is need for Centre to lay down the general configuration of the system and the specification of the sub-systems. There is need to set up a Power Sector Communication Corporation under Department of Power or any other organisation which could also coordinate with the Communication Ministry, perhaps through a special wing to be set up for Power sector in D.G.P. & T. (para 79)

(40) Central Electricity Authority of Department of Power will be saddled with increased responsibilities of coordination, Accordingly, Central Electricity Authority will have to be strengthened immediately to takeup increased work (para 81).

ANNEXURES

ANNEXURE I

No. I-1(2)/83-P&E
GOVERNMENT OF INDIA
PLANNING COMMISSION
(Power and Energy Division)

Yojana Bhavan
Parliament Street,
New Delhi 110001, the 10th June, 1983.

NOTIFICATION

Since development of Power and efficient management has a high priority in our Plan, provision of an efficient and dependable communication system is of vital importance both from the point of view of project management and operation. In order to identify the communication requirements in the power sector and the various options available, both in the short-term and the long-term, it has been decided to constitute a Working Group as follows:

Composition

1.	Prof. Yash Pal, Chief Consultant, Planning Commission	Chairman
2.	Secretary or his nominee, Department of Power	Member
3.	Secretary or his nominee, Ministry of Communication	Member
4.	Secretary or his nominee, Department of Electronics	Member
5.	Secretary or his nominee, Department of Space	Member
6.	Adviser (Communications) Planning Commission	Member
7.	Advisor (Energy) Planning Commission	Member
8.	Chairman, Central Electricity Authority	Member
9.	Chairman, National Thermal Power Corpn	Member
10.	Chariman, National Hydro-Electric Power Corporation	Member
11.	Chairman, State Electricity Board Maharashtra	Member
12.	Chairman, State Electricity Board, Andhra Pradesh	Member
13.	Chairman, State Electricity Board, Madhya Pradesh	Member
14.	Consultant(Power), Planning Commission	Member-Secretary

Terms of Reference

(i) To examine the adequacy of the communication infrastructure of the power sector; and plans for its development;

(ii) To suggest meausures in this regard:

(a) in the short-term, and
(b) on a long-term basis.

(iii) To identify areas of technical development, systems-engineering and production of communication equipment to ensure that the requirements of the power sector in the area of communications can be met to the maximum extent possible through indigenous sources.

The Chairman of the Working Group may associate/coopt such other officials or non-officials as members as are considered necessary.

The Working Group will submit its report within a period of six months.

If non-officials are associated/coopted, such non-officials shall be entitled to TA/DA as permissible to Grade-I officers of the Government of India and the consequent expenditure will be borne by the Planning Commission.

Sd/-

(K.C.Agarwal)
Director(Administration)

to

(i) Chairman, Working Group (Prof. Yash Pal)

(2) Member-Secretary, Working Group (Shri H.P.Rao,Consultant(Power))

Copy to·

(1) Secretary, Department of Power, New Delhi

(2) Secretary, Ministry of Communications, New Delhi.

(3) Secretary, Department of Electronics, New Delhi.

(4) Secretary, Department of Space, New Delhi

(5) Adviser (Communications), Planning Commission

(6) Adviser (Fnergy), Planning Commission

(7) Chairman, C.E.A., R.K.Puram, New Delhi

(8) Chariman, N T.P.C., Nehru Plance, New Delhi

(9) Chairman, N.H.P.C., Nehru Place, New Delhi

(10) Chairman, Maharashtra State Electricity Board, Borbay

(11) Chairman, Andhra Pradesh State Electricity Board, Hyderabad

(12) Chairman, Madhya Pradesh State Electricity Board, Jabalpur.

It is requested that the name of the representative of the Ministry/Department may mindly be intimated to the Member-Secretary of the Wlrking Group.

Sd/-
(K.C.Agarwal)
Director(Administration)

Copy for information to:

(1) P.S. to Minister for Planning

(2) P.S. to Member(F)

(3) P.S. to Secretary

(4) P.S. to Adviser

(5) All Heads of Divisions

(6) Administration-I Branch

(7) Accounts-I Branch

(8) Officers of the P & E Division

Sd/-
(K.C. Agarwal)
Director(Administration)

ANNEXURE IA

No. I-1(2)/83-P&E
GOVERNMENT OF INDIA
PLANNING COMMISSION

Yojana Bhavan
Parliament Street
New Delhi-110001, the 11/13 January, 1984.

NOTIFICATION

Subject: Working Group on the Identification of the Communication Requirements in the Power Sector.

Vide Notification No.I-1(2)/83-P&E dated 10th June, 1983, a Working Group was constituted. The Working Group was required to submit its report within a period of six months from the date of issue of the notification, as above.

2. In view of the multifarious problems involved in these new technical areas and consequent need of detailed and indepth studies, it has now been decided to extend its term till be end of April 1984.

3. It is also notified that the Wireless Adviser, Ministry of Communication; Chairman, West Bengal State Electricity Board and Chairman, Uttar Pradesh State Electricity Board would be coopted as Members on the Working Group.

4. The other terms of reference would remain the same as already notified.

Sd/-
(K.C.Agarwal)
Director (Administration)

To

(1) Chairman, Working Group (Prof. Yash Pal)
(2) Member-Secretary, Working Group (Shri H.P.Rao, Consultant (Power)

copy to·

(1) Shri P.M. Ahluwalia, Joint Secretary, Deptt. of Power, New Delhi

(2) Shri R.K.Srivastava, Addl. Secy. Department of Electronics, Lok Nayak Bhavan, Khan Market, New Delhi.

(3) Shri A.K.Sanyal, Deputy-Director General (ML) P & T Board, Dak Tar Bhavan, New Delhi.

(4) Shri V.V.Choudhary, Director (L), P & T Board, Poom No.404, Dak Tar Bhavan, New Delhi.

(5) Prof. Jai P. Singh, Programme Director, INSAT, Satellite Communications Programmes Office, Department of Space, Bangalore.

(6) Shri K. Narayanan, Head, Communication System Division,Space Application Centre, Ahmedabad.

(7) Shri A.N.Singh, Chairman, Central Electricity Authority,Sewa Bhavan, R.K.Puram, New Delhi.

(8) Shri A.K.Sah, Chairman, National Thermal Power Corporation,Nehru Place, New Delhi.

(9) Shri Pirzada Ghulam Nabi, Chairman, National Hydro Power Corporation, Nehru Place, New Delhi.

(10) Shri V.S.Shevde, Chairman, Maharashtra State Electricity Board, Hong Kong Bank Building, M.G.Road, Fort,Bombay.

(11) Dr. N. Tata Rao, Chairman, Andhra Pradesh State Electricity Board, Hyderabad.

(12) Shri T.K.Srinivasan, Chairman, Madhya Pradesh Electricity Board, Jabalpur.

(13) Shri Krishan Sondhi, Adviser (Communications), Planning Commission.

(14) Shri S.L.Khosla, Adviser (Energy), Planning Commission.

(15) Shri R.K.Sanyal, Chairman, Uttar Pradesh State Electricity Board, Lucknow.

(16) Shri T.V.Srirangan, Wireless Adviser, Ministry of Communications, New Delhi.

(17) Shri A. Ghatak, Chairman, West Bengal State Electricity Board, 48/1, Diamond Harbour Road, Calcutta.

Copy for information to·

(1) P.S. to Minister for Planning
(2) P.S. to Member (F)
(3) P.S. to Secretary
(4) P.S. to Adviser (NKS)
(5) All Heads of Divisions
(6) Administration-I Branch
(7) Accounts-I Branch
(8) Officers of the P & E Division.

Sd/-
(K.C. Agarwal)
Director (Administration)

ANNEXURE II

MOST IMMEDIATE

No. I-1(2)/83-P&E
GOVERNMENT OF INDIA
PLANNING/COMMISSION
(Power & Energy Division)

Yojana Bhavan
Parliament Street
New Delhi-110001, the 19th Sept. 1983

NOTIFICATION

Subject: Working Group on the Identification of Communication Requirements in the Power Sector.

In the second meeting of the Working Group held on 15-9-1983 under the Chairmanship of Chief Consultant, Planning Commission, it was decided to set up a Technical Expert Group with the following composition and terms of reference.

2. Composition

(1)	Shri K.Naryanan, Head, C.S.D./S.A.C. Department of Space, Ahmedabad.	Chairman
(2)	Representative of the Department of Electronics	Member
(3)	Representative of P & T Department	"
(4)	Representative of Wireless Planning and Coordination Wing, Ministry of Communications	"
(5)	Representative of Central Electricity Authority	"
(6)	representative of National Hydro-electric Power Corporation	"
(7)	Representative of National Thermal Power Corporation	"
(8)	Representative of U.P. State Electricity Board	"
(9)	Representative of Maharashtra Electricity Board	"
(10)	Consultant (Power, Planning Commission	Member-Convenor

3. Terms of Reference: To arrive at a technical systems configuration to meet the present and projected (1990) communication requirements of Power Sector taking into account the various factors such as quality, reliability, flexibility and also the planned P & T system during the same period.

(4) The Chairman of the Technical Expert Group may associate/coopt such other officials or non-officials as Members, as are considered necessary.

5. The Group will submit its report within a period of eight weeks.

6. If non-officials are associated/coopted, such non-officials shall be entitled to T.A.,D.A. as permissible to Grade-I officers of the Government of India and the consequent expenditure will be borne by the Planning Commission.

Sd/-
(K.C.Agarwal)
Director (Administration)

To

(1) Shri K.Narayanan, Head, C.S.D./S.A.C.,Deptt of Space,Ahmedabad.
(2) Member-Convenor, Shri H.P.Rao, Consultant (Power),Planning Commission.

Copy to·

(1) Secretary, Department of Flectronics, New Delhi.

(2) Secretary. P & T Department, Ministry of Communications,New Delhi.

(3) Wireless Adivser, Ministry of Communications,Sanchar Bhavan,New Delhi.

(4) Chairman, Central Electricity Authority, Sewa Bhavan,R.K.Puram, New Delhi.

(5) Chairman, National Hydro-electric Power Corpn,Nehru Place,New Delhi

(6) Chairman, National Thermal Power Corporation,Nehru Place,New Delhi.

(7) Chairman, U.P. State Electricity Board,Lucknow.

(8) Chairman, Maharashtra State Electricity Board,Bombay.

It is requested that the name of the representative of the Ministry/Department may kindly be intimated to the Member-Convenor of the Group, immediately.

Sd/-
(K.C.Agarwal)
Director (Administration)

Copy for information to:

(1) P.S. to Minister for Planning
(2) P.S. to Member (F)
(3) P.S. to Secretary
(4) P.S. to Adviser(MNC)
(5) All Heads of Divisions
(6) Administration-I Branch
(7) Accounts-I Branch
(8) Officers of the P&E Division.

Sd/-
(K.C.Agarwal)
Director (Administration)

ANNEXURE III

Extracts from NFAP-81

Information relating to freqeuncy bands from which authorisations could be made for general and miscellaneous usages of Govt./Semi-Govt. organisations and private parties is given below:-

1. Below 30 MHz:

Frequency allocations below 30 MHz will generally be made as per Radio Regulations of the I.T.U. and after examination of each case on its merit.

2. Authorisation in the following sub-bands could be considered. This be treated only for broad guidance:

2.1 30 - 108 MHz band:

30-32 MHz, 36 - 38.25 MHz, 70 - 72 MHz, 73.5 - 74 MHz, 77 - 77.5 MHz, 79 - 80 MHz, 83 - 85.5 MHz and 91.5-95 MHz.

2.2 108 - 230 MHz band:

136 - 138 MHz, 143.6 - 144 MHz, 146.0 - 146.45 MHz, 147.95 - 149.9 MHz, 150.05 - 151.5 MHz, 156.00 - 157.5 MHz, 159.5 - 162.5 MHz, 166.5 - 168 MHz, 173 - 174 MHz.

2.3 230 - 622 MHz band:

314.00 - 328.6 MHz, 335.4 - 367 MHz, *436.5 - 437 MHz, *461.5 - 462 MHz, and 585 - 622 MHz.
* Limited to single channel.

2.4 622 - 960 MHz band:

845 - 935 MHz.

2.5 1400 - 1550 MHz.

1427 - 1525 MHz.

2.6 For small capacity (300 Chs.) microwave/multi-channel links 2.3 - 2.5 Gz would be preferred.

2.7 Authorisation above 2.5 GHz are not indicated but could be ascertained, if necessary.

2.8 All single channel operations be preferably restricted to band below 23- MHz. For single channel use in UHF band, frequencies below 336 MHz could be considered.

3. Supplementary Information

3.1 For 'radio paging' allocations on 26.35 MHz, 26 55 MHz and 150.30 MHz, 151.07 MHz are preferred. Authorisation could be considered for indigenous production in bands around 300 MHz, 900 MHz also.

3.2 Radio Control of Models: Frequency channels between 26 - 27.5 MHz are presently authorised. For indigenous production, exploitation of bands around 300 and 900 MHz could also be considered.

3.3 Wireless Microphones: Frequency allocations around 35 MHz and/or 300 MHz could be feasible.

3.4 Simultaneous interpretation/translation systems:

For use of 'inductive' coupling equipment, a few spots in band 30 -150 MHz would be preferred.

3.5 Cordless telephones: Subject to approval of P&T for attachment of these accessories to P&T instruments", radio transmitters fitted in such devices could be considered for allocation of suitable channels.

3.6 'Non-commercial' personal communication:

Low-power walkie-talkies employing RF power of 100 mW are generally permitted for 'non-commercial' personal communication and usages connected with hobby,recreation, sports, mountainerring, hiking, etc. Presently, allocations for 'imported' equipment in "C.B." band are made on the following preferred channels, viz., 26968, 26976, 27125, 21125 and 27065 KHz. For indigenous production, allocations in 300 MHz , 900 MHz band could also be considered.

PRACTICES IN OTHER COUNTRIES

A study of the practices in various countries relating to the cummunication channels for power systems reveals that radio ststems have begun to be used widely in U.S.A., Japan, Canada, etc. in networks by the power utilities. In these countries, PLCC is also employed but adequate freuency spectrum is not available to satisfy all the needs of telecommunication in view of the saturation that has already occurred. Published information in regard to the practices followed in various countries of the world in respect of their own UHF/microwave link is given below:

CANADA:

The utilities own Microwave communication system has been used for protection of 300, 230 and 120 kV lines by Hydro-Quebec who have also utilised it for protection and control of the 735 kV system. The distance between stations varies from 14 to 78 km.

BELGIUM:

The electric supply companies have their on microwave links for control of high-voltage systems. They operate in the range of 410 to 465 MHz. 24 and 60 channels groups are both used with the latter forming the majority. The utilisation of channels is about 30% for telephony, 44% for data transmission, 19% for distance protection and 7% for inter-switch board telephony.

HOLLAND:

With the installation of 380 kV system, a private microwave network has been established using frequencies in the range of 7.125 to 7.425 GHz. There are 22 links with lengths varying from 6 to 57 km and a total length of 555 km.

ITALY

There are radio links working in parallel with PLCC, thus ensuring good availability. A tropospheric radio link for special remote control has been operating between Sardinia and Tuscany since 1969. This link is an important part of the control loop of the 200 kV D.C. system between Sardinia and the continent covering a distance of 330 km (including 300 km over the sea) and operates at 450 MHz with good availability.

GERMANY:

In the German Bayernwerk system, there are 10 to 12 microwave links whose availability without reserve is 99% and with installed reserve apparatus is 99.67.

FINLAND:

Finland has gone in for microwave systems when the channel requirement is six and above.

BRAZIL:

Brazil has microwave systems operating in the 7 GHz band and has about 60 links on a total route length of 2530 km. UHF system is also used for places with smaller channel demand and there are 34 links connected to the microwave routes covering a total length of 1214 km.

ENGLAND

Radio channels are used by the South of Scotland Electricity Board and the North of Scotland Hydro Electric Board. The latter has an extensive 1.5 GHz microwave network which is used as the principal communication medium. The CEGB of U.K. uses mainly rented circuits since distances are short. The P.O. network is extensive, wholly underground and highly relaible Some private pilot cables are used around big cities while PLCC is reserved exclusively for protection, signalling being costly over short distances and because of frequency allocation problems.

USSR:

There is wide application of multi-chennel PLCC over the phase conductors of 110-330 kV lines and over the earth wires of long distance 500 and 750 lines. In additon, intra-bundle operation is also used for PLCC.

Some examples of functions carried out in the Power Sector using Voice and Data Channels.

The following lists are collected from the Papers presented by State Electricity Boards, basically to illustrate the Communication Channel requirements. This list is by no means an exhaustive list.

Voice Channel utilisation (from APSEB PAPER)

(i) To control line operations such as opening and closing of isolators and earth switches.

(ii) To co-ordinate issue and cancellation of line work permits.

(iii) To co-ordinate the change-over of loads and line feeds from one sub-station to another.

(iv) Issue of instructions for changes in generation, line switching etc.

On-line data channel utilization:
(FROM MSEB & APSEB Papers)

To transmit data regarding:

(i) Essential values of Generation

(ii) Load flows

(iii) Bus voltages

(iv) Circuit breaker and isolator positions

(v) Transformer tap positions etc.

Off-line data channel utilisations (from MSEB Paper)

To transmit data regarding:

(i) Coal and oil stocks

(ii) Unit outages

(iii) Statistical information

(iv) Spares inventory etc.

Functions for computer processing of data (from MPEB Paper).

The data collected from various points in the power network is processed in a computer to yield the following:

(i) Economics of power generation
(ii) Schedule of inter-change of power
(iii) Load forecast studies
(iv) Switching operation details
(v) System security checks
(vi) Limit valuation monitoring
(vii) Compilation of daily data
(viii) Preparation of load curves
(ix) Statistics required for future planning
(x) Load frequency control signals
(xi) Load management signals.

LEASE CHARGES FOR PROVIDING CIRCUITS TO POWER SECTOR ON P&T NETWORK

(A) Central Electricity Authority have indicated their requirement of of circuits, interlinking various places like generating stations, sub-stations etc. to SLDC, RLDC and NLDC. The actual circuit requirement from point to point destination is not indicated. P & T is leasing the circuits for point to point working and charging the users according to the distance between the destinations. In the Exhibit XIII submitted by Central Electricity Authority, trunk communication routes and a total number of channels have been indicated. Taking this as a guideline, the total chargeable speech kilometer were worked out and it is approximately 16 lakhs. P&T is charging Rs.250/- per chargeable channel km. Total leasing charges works out to be 16 lakhs x 250 = Rs.40 crores per annum.

(B) Apart from the charges for leasing all the circuits, there will be endlinks connecting the various location of utilisation of Electricity Boards. There are total 417 such locations, out of which at 18 places the UHF links are being provided (WREB, NREB and EREB schemes), 19 locations are indicated as concentrators which are not having any position in the hierarchy and are only the convenient places for clustering the circuits. This will not normally be linked up while providing the leased circuits on the P&T network. Therefore, the new places to be connected will be 417 - 18 - 19 = 380.

The actual locations of utilisation are yet to be identified and the requirement of tower heights will depend on the actual locations and detail engineering. In many places, it may require only the roof mounted antennae and existing P&T towers may also be utilised. Considering the average tower height of 60 m, the cost of UHF link will approximately be Rs. 25 lakhs.

(i)	The cost of 380 UHF links is at Rs. 25 lakhs/link	= 380 x 25 = Rs. 95 crores
(ii)	Approx. cost of Augmentation of 18 UHF links being executed and other P&T links.	Rs. 5 crores
		Rs.100 crores

The additional investiment to the tune of Rs.100 crores will be required for providing the endlinks and augmentation as indicated above. The rentals of the facility for provision of UHF links will be about Rs. 20 crores per year.

(C) Total annual rentals which will be charged by P&T for leasing out the circuits indicated in Exhibit XIII of CEA on the existing P&T medium and providing UHF endlinks, will be Rs.60 crores per annum approximately (Rs.40 crores as indicated in "A" and Rs.20 crores in "B")

ANNEXURE VII

COST DETAILS FOR AN INDEPENDENT TERRESTRIAL MICROWAVE BASED SYSTEM

These calculations are made based on CEA projections for bunched channel microwave system for each State. The total distance of these links is about 40,000 Kms.

However, large areas are not covered by any microwave links, and in some hilly terrains the hops will have to be over very short distances thus increasing the cost. Taking into account these two factors, the effective length of the links can be increased by 10,000 Kms i.e. to 50,000 Kms.

One has also to consider that these links will carry long haul traffic across regions and hence the number of drop points will have to be minimised to maintain quality. This will mean that to cover many of the power sector points en route a long haul link, fairly long end links will have to be set up. This is expected to raise the actual distance by about 40%, the total distance working out to 70,000 Kms.

Considering the standard rate of Rs.1 lakh per route-Km for establishing microwave links, the cost of this system works out to be about Rs.700 crores.

ANNEXURE VIII

COST DETAILS FOR A SATELLITE BASED HYBRID SYSTEM

Network configuration for this option is not available for the entire country at this stage. Hence the study example worked out for Maharahstra State has been taken as a base and extrapolated for the entire country, roughly as proportional to the ratio of power sector points in Maharashtra compared to the total India.

Two types of projections were considered. The first projection consists of setting up earth stations and forming clusters partly by establishing independent UHF one hop links and partly by leasing from P&T in short trunk sectors. The cost for this system is as follows :

Table 1

Sl. No.	Item	Per unit cost (Rs.in lakhs)	Total cost (Rs. in Crores)
1.	14 Nos. of remote earth stations.	60.00	8.4
2.	1 No. of earth station at SLDC	100.00	1.0
3.	25 Nos. of one-hop UHF links.	30.00	7.5

Total for Maharashtra : Rs. 16.9 crores

National system cost = Rs.170 crores.

Considering 35 sectors of P&T leasing (both local and trunk) with an average distance of 50 Km and 4 chls per sector.

Yearly lease charges = 35 x 50 x 4 x 250 = 17.5 lakhs

National lease charges = Rs. 2 crores

In the second projection, 17 trunk sector where P&T channels were proposed to be leased, were also replaced by one hop UHF links. Considering the same figures as earlier with 42 one hop UHF links.

Total cost for Maharashtra = Rs. 22 Cr.

National system cost = Rs.220 Cr. *

Besides these, the lease charge for the half transponder capacity in INSAT-1 will be about Rs. 1.0 crore per annum.

* Subsequent estimate of ground station cost suggests that this may be reduced by about Rs.33 crores.

ANNEXURE IX

DETAILS OF OPERATION AND MAINTENANCE COST

The general philosophy followed in the P&T system has been considered in making the following projections.

The costs considered are :

1. Depreciation value : 4.0%
2. Maintenance charges : 10.0%

In the case of microwave link based system, the tower cost approximately 40% of the system cost. Hence, spares provision is taken only as 6%. Using the above data, the operation and maintenance cost for Options-II and III are worked out as follows, on an yearly basis.

Independent microwave link based national system (10% of Rs.700 Cr.)	Rs. 70.0 Cr.
Combination of Option I and II (10% of Rs. 400 Cr.)	Rs. 40.0 Cr.
Satellite based hybrid system fully owned by power sector (14% of Rs.220 Cr.)	Rs. 30.8 Cr.
Satellite based hybrid system with leasing from P&T on short trunk sectors wherever applicable. (14% of Rs. 170 Cr.)	Rs. 23.8 Cr.

The above projections do not include interest on the capital expenses.

ANNEXURE X

COMPARISON OF OPTIONS FOR TRUNK AND ARTERY ROUTES FOR THE COMMUNICATION SYSTEM FOR INDIAN POWER SECTOR

1.0 INTRODUCTION:

In the Interim Report of the Technical Expert Group of the Working Group on Identification of Communication Requirements in the Power Sector three distinct options for the trunk and artery routes have been identified.

These options are:

(a) Extensive use of P&T Lines
(b) Independent Terrestrial Network
(c) Independent Hybrid system with satellite base using pooled channels.

In this paper the salient features of these three options are discussed. The main advantages and limitations of each of the options have been brought out and compared.

2.0 Extensive use of P&T Lines:

The requirements as projected in the documents presented by the power sector for trunk lines run nearly parallel to the existing P&T trunk routes. Therefore, use of P&T links for deriving the circuits on a group basis is technically feasible. Artery links (end links) from P&T centres to the power sector points would however be required. A sample exercise of using the P&T trunk routes between Delhi and Loktak has been carried out. It would be possible on all major trunk routes of the P&T network to provide the power sector channel requirements in blocks of 12 channels between P&T centres if firm orders are placed in 6 to 12 months time. However, for the artery (end) links and wherever augmentation is involved the lead time requirement would be about 3 to 4 years for commissioning. In this option the cost of leasing the channels was roughly estimated to be around Rs.60 crores per annum for all over India. An additional capital investment of roughly Rs.100 crores is anticipated.

2.1 Advantages :

i) The inter-metropolitan trunk routes and other important trunk routes of P&T are well established. Therefore by using these links duplication of P&T's long distance links is avoided.

ii) It would be possible to provide links on some selected routes in a very short time.

iii) On major trunk routes and some of the important routes of P&T media diversity is available. This will also be available to power sector circuits over these routes. However, this media diversity may not be covering all the enroute drop-in & out points corresponding to artery links. Route Diversity cannot be a major consideration, since the availability of channels in a

diversity medium will depend on a number of factors, such as P&T priorities in allocations, etc.

iv) The operation and maintenance of links upto the power sector points would be by P&T and these costs are included in the lease charges. The operations and maintenance staff of P&T need only augmentation and a separate set-up would not be required. However, the operational procedures and coordination points between power sector and P&T have to be well defined for effective working of the system.

2.2 Limitations

i) Artery (end) links would be required at many locations from P&T centres to the power sector points. These artery links could be single, double or three hop links depending on the distances.

ii) The coverage by the P&T network of the power sector points within a State is generally inadequate.

iii) The channels upto power sector points would require to be provided on a group or superbasis to ensure better reliability even if the requirement is for fewer channels.

iv) Availability of channels on existing P&T links at all places is not assured as the power sector requirements were not included in P&T's plans. This is so as there were no firm projections of this extent from the power sector. Therefore, in some places it may not be possible to provide the channels by augmenting the existing links. Separate links may have to be established in such places.

v) P&T network uses different media like microwave co-axial, satellite over different routes. The network for power sector therefore will have different media working in tandem. This may affect the overall reliability of the network. Also in some places the P&T links operating on co-axial do not have stand-by provision.

vi) P&T network is extensive and very large and designed as a general public network. In such a network it could be difficult to meet the exigencies of a special user over a wide area and extended period.

vii) Presently the P&T network is of analogue type and designed and engineered only for voice and telegraphy and not for data communication. However, the data links are being introduced.

3.0 Independent Terrestrial Network

A sample exercise to cater to the power sector's trunk and artery communication requirements upto RTU level by an independent microwave/UHF/VHF links has been carried out for the U.P. State.

It is desirable to have this network to be passing through all power Sector points in tandem on a long route. However it is not technically feasible to do so as the drop-in and out points would be too many, deteriorating the circuit quality. Therefore, the exercise has been carried out keeping the drop-in and out points to the minimum.

Based on the exercise, the total cost of the system for an All-India network roughly works out to be about Rs.700 crores. Use of 2 GHz and 8 GHz narrow band microwave systems for networking over large areas and UHF and limited part 7 GHz and 10 GHz spectrum for short-haul applications on spur routes have been identified as technically possible options. The phased implementation of the total network may be spread over seven years with the first link being available in about four years.

3.1 Advantages

i) The number of artery routes required would be smaller than those required in option-I. But the number, however, may not be significantly lower than those of option-I.

ii) Being an independent network well defined operational and maintenance procedures may be easier to evolve with well marked accountability.

iii) With dedicated manpower to operate and maintain the network the reliability and availability of the network would be higher than that of option-I.

iv) The specific and distinct requirements of a special user would be easier to incorporate in an independent network.

3.2 Limitations

i) The network would be extensive and large. In many places it would run nearly parallel to the P&T's network resulting in duplication of the same.

ii) Due to the low capacity requirements of the power sector, this large and extensive independent network would be working well below its potential capacity resulting in heavy under utilisation.

iii) Media diversity would not be available unless planned and incorporated separately. System design should ensure that media diversity is not an essential requirement in such a network.

iv) Effective operational and maintenance organisation for this large network requires to be set up. This is a time consuming and fairly difficult task.

v) The cost of operations and maintenance is not included in the estimated cost figures.

4.0 Independent Hybrid System with Satellite Base Using Pooled Channels

In this system clusters are formed by peripheral links and the clusters are interconnected via satellite. This system uses a pool of channels which are allocated on demand whenever any point requires to communicate to any other point and the grade of service would be as good as pre-assigned system. The data channels which have primary importance for real time data acquisition are provided on a pre-assigned basis in a Time Division Multiple Access (TDMA) mode.

The number of satellite terminals has been roughly estimated to be 250. The space segment requirement has also been estimated to

be approximately half a transponder of INSAT-1. The availability of this capacity in present and planned system is to be examined. A sample exercise for the Maharashtra State has also been carried out. Based on this, the total cost for an All India Network has been worked out to be Rs.220 crores. The implementation time for this option is about 7 years. However, provision of links required on urgent basis wherever required and phased implementation of the network is possible.

4.1 Advantages :

i) The wide coverage of a satellite permits easier establishment of links that are required on urgent basis and are in remote areas. On the same basis it is easier to extend the network in future to some additional points also.

ii) As the network operates on sharing a pool of channels it offers the flexibility of allocating on temporary basis more number of channels wherever required in an emergency.

iii) Being an independent network the specific and distinct requirements of a special user would be easier to incorporate. Well defined operational and maintenance procedures may be easier to evolve with marked accountability. With dedicated manpower to operate and maintain the reliability and availability of the network would be higher than that of option-1.

iv) The network is large and extensive. However, the low capacity requirements of the power sector can be met by this network with optimal utilisation of the network capacity.

4.2 Limitations :

i) The type of traffic is required to be thin for effective functioning of the network. However, the requirements projected are for such type of traffic only.

ii) In forming the clusters, terrestrial peripheral links are required which introduces another medium working in tandem.

iii) Media diversity is not available unless planned and incorporated separately. The costing does not include this.

iv) The network would be large and extensive. In many places the satellite terminals may be located in areas covered by P&T earth stations or by P&T's terrestrial networks.

v) Effective operational and maintenance organisation for this large network requires to be set up. This is a time consuming and fairly difficult task.

vi) The cost of operations and maintenance is not included in the estimated cost figures.

vii) The availability of capacity on INSAT-1 is to be ensured.

COST DETAILS OF A COMBINATION OF OPTION-I AND OPTION-II

It is considered here that below SLDC level independent microwave link based system will be set up, and between SLDC and RLDC's as well as between major cities within a state wherever possible, P&T lines will be leased.

Following the arguments in Annexure-VII it is seen that the minimization of drop points within a state is not essential, because regional traffic will be carried by P&T lines. Hence, the total distance of microwave links will be about 40,000 Kms, costing Rs.400 Crores.

For calculating the P&T lease charges, one can consider a capacity requirement of approximately 2 groups (24 channels) over a trunk distance of about 8,000 Kms. This works out to an annual lease charge of Rs.4.8 Crores.

ANNEXURE XII

GENERALIZED METHODOLOGY FOR EVOLVING A COMMUNICATION SYSTEM

Based on the studies carried out for the three states, (Viz. UP, Maharashtra and Andhra Pradesh) and the points brought up during discussions of the Technical Expert Group, the following set of criteria evolves for selecting the locations of satellite terminals or terrestrial LOS link nodes.

i) All the significant thermal and hydroelectric power stations,

ii) All major distribution centres having three or more branches of 132 KV and 220 KV transmission lines,

iii) All substations of 400 KV transmission lines,

iv) Large concentrations of points such as around SLDC's ALDC's or source of power (such as around Damodar Valley or Govind Vallabh Pant Sagar etc.) can be linked through a single earth station node backed up with an effective local area network using one of the mediums such as microwaves, coaxial cables, fibre optics or PLCC.

ANNEXURE XIII

LIST OF INDIGENOUS MANUFACTURERS FOR PLCC EQUIPMENT

	HBB	WSI	BPL	BHEL	ITI
Line Trap	Yes upto 800A/1mH	Yes all ranges	Yes all ranges	-	-
Coupling Capacitor/CVT	Yes all ranges	Yes all ranges	-	Yes	-
Protective Device	Yes	Part	Part	-	-
Line Matching Units	Yes	Obtained from sub-suppliers or HBB	Part	-	-
Coaxial Cable	DELTON Cable & Indian Cable Co.				
Carrier Sets	Yes	Not yet manufacturing	upto 40 W	-	upto 15 W
Four Wire Group Selector	Yes	-	Yes	-	Yes
Private Automatic Telephone Exchange	-	-	Yes	-	Yes
Telephone sets	-	-	-	-	Yes
Teleprotection Equipment	Yes	-	Yes	-	-
Transducers & Telemetering Equipment	Yes	-	-	-	Ye
Frequency Shift Channel for teleprinting	Yes	Yes	-	-	Ye

HBB's Licenced Capacity.

	Qty Nos	Note
Carrier Sets	286	The latest licenced capacities of the above manufacturers are not available
Protection Couplers	156	
Frequency Shift Channels	137	
LMUs	489	
Wave Traps	240	
Telemetering Equipment	70	
Transducers	2600	

ANNEXURE XIV

BRIEF STATUS OF ACTIVITIES UNDER PROGRESS AT VARIOUS PRODUCTION AGENCIES FOR EQUIPMENT MANUFACTURE FOR SATELLITE COMMUNICATION, UHF SYSTEMS AND NARROW BAND MICROWAVE LOS SYSTEMS TO MEET THE EXPECTED REQUIREMENT OF THE POWER SECTOR

Production Agency	Satellite Comm. Systems	UHF/Microwave Systems (Digital)			
		600-700 MHz	800-900 MHz	2.3-2.5 GHz	Upper GHz band
1	2	3	4	5	6
1. I T I	a) Supplied FDM/FM Eqpt. to INSAT program of P&T. b) TDMA equipment not made yet. c) Prime Supplier to P&T.	a) Equipment is under development for P&T. b) Field trial model is expected to be ready by Mid 84.		a) Have got Proven 2.1-2.3 GHz digital radio equipment. b) Can be extended to 2.3 to 2.5 GHz as well	No work in progress
2. B E L	Have plans to take up manufacture of digital sat-com. terminals based on proposed tie up with SAC.	a) Have developed digital UHF equipment for P&T. b) The field trial would be ready by mid 84.	M/s. BEI. Indicated that they will be able to extend the frequency range of their P&T digital system to suit 800-900 MHz band operation.	a) Have got 2.3 to 2.5 GHz digital radio. b) Field trial equipment can be shown in mid 84	-do-
3. E C I L	a) Have supplied 3 KW HPAs to the P&T. b) Have taken up engg. of small earthstations based on SAC, know-how. c) Have proposed to take up manufacture and supply of complete systems to the power sector.		Have proposed manufacture of digital radio relay equipment based on foreign collaboration.		No work in progress
4. G C E L	Have letter of intent for manufacture of satellite terminals.	a) Have proposed to take up development work for P&T. b) Field trial eqpt. would be ready by end, 84.	a) Have 800-900 MHz analogue radio system ready. Supplies are being made to IOC, ONGC etc b) Equipment can be converted into digital radio without any difficulty.		No work in progress
5. MELTRON	Have proposed to take up manufacture of satellite terminals		Developing eqpt. for AIR based on joint AIR-MELTRON efforts.		- do -

ANNEXURE XV

LIST OF DOCUMENTS SUBMITTED TO THE WORKING GROUP AND THE TECHNICAL EXPERT GROUP

1. Communication Perspective for Power Sector by 1990' paper presented to the Working Group by Telecommunications Directorate of Central Electricity Authority, September 1983.

2. 'Existing Communication Infrastructure of Power Sector and Plans for its Development', paper presented to the Working Group by Madhya Pradesh Electricity Board.

3. 'Report on Communication Requirements of MSEB by 1985 and 1990', paper presented to the Working Group by Maharashtra State Electricity Board.

4. 'Communication Requirements of the Power Sector', paper presented to the Working Group by Andhra Pradesh State Electricity Board.

5. 'Communication Requirements of the Power Sector', paper presented to the Working Group by National Thermal Power Corporation.

6. 'Communication Requirements for Hydro-electric Projects and the Associated Transmission Works', paper presented to the Working Group by the National Hydro-electric power Corporation.

7. 'Note on the Tentative Plan for the Tele-communication Network', paper presented to the Working Group by the P&T Department.

8. 'A Satellite Telecommunication Network for the Real-Time control and Information System of the Federal Power Commission of Mexico', a paper presented at the Satellite Communication Conference 1983, Ottawa, Canada, by R. Neri, et al.

9. 'Informatory Note for the Manufacturers of Two-way Radio Communication and Allied Equipments', a paper presented to the Technical Expert Group by WPC Wing of Ministry of Communications.

10. 'A Proposed Communication System configuration for the Indian Power Sector', by Space Application Centre, Ahmedabad, Dec.1983.

11. 'VHF/UHF Communications' by Space Applications Centre, Ahmedabad, Dec. 1983.

12. 'Implications of Independent Microwave System for Indian Power Sector', by Space Application Centre Ahmedabad. Dec. 1983.

13. 'Comparison of options for trunk and Artery Routes for the Communication System for the Indian Power Sector', by Space Applications Centre, Ahmedabad. FEB. 84.

14. 'Consideration in Selecting a Communication Systen for the Indian Power Sector' by Space Applications Centre, Ahmedabad, Feb 1984

15. 'Proposals for Communication Requirements of APSE Board, by APSEB, Hyderabad, Dated Jan. 1984.

16. 'Informatory note on Wireless Licence' issued by WPC Wing of Ministry of Communications', by WPC representative.

17. 'Memo regarding Radiation and Induction effects of PLCC', by Central Electricity Authority, Feb. 1984.

18. 'Status Report on the Field Strength Measurements of PLCC', by WPC, Feb. 1984.

19. 'Utilization of existing P & T network for meeting the requirements of communication by Power Sector in New Delhi - Calcutta Section' by P & T representative, Dec. 1983.

20. 'Brief status of activities under progress at various production agencies for equipment manufacture for satellite communications, UHF system and narrow-band microwave LOS systems to meet the expected requirement of the power sector', Note presented by DOE representative during the Fourth meeting of the Technical Expert Group.

21. Optical Fibres for power line Communication - Sumitomo Electric Industries LTD.

ANNEXURE XVI

LIST OF TECHNICAL ABBREVIATIONS.

R.L.D.C.	:	Regional Load Despatch Centre
H.V.D.C.	:	High Voltage Direct Current
P.L.C.C.	:	Power Line Carrier Communication
V.H.F.	:	Very High Frequency
K.Hz.	:	Kilo Hertz
U.H.F.	:	Ultra High Frequency
H.F.	:	High Frequency
M.Hz.	:	Mega Hertz
P & T	:	Post and Telegraph
R.T.U.	:	Remote Terminal Unit
L.D.C.	:	Load Despatch Centre
S.L.D.C.	:	State Load Despatch Centre
N.L.D.C.	:	National Load Despatch Centre
W.P.C.	:	Wireless Planning and Coordination
C.E.A.	:	Centre Electricity Authority
P.T.C.C.	:	Power & Telecommunication Co-ordination Committee
K.V.	:	Kilo Volts
N.T.P.C.	:	National Thermal Power Corporation
DB	:	Decibels
N.H.P.C.	:	National Hydro Power Corporation
G.Hz	:	Gegahertz
E.I.L.	:	Engineers India Ltd.
E.P.I.L.	:	Engineers Projects India Ltd.
V.F.Ts	:	Voice Frequency Telegraphy
T.C.I.L.	:	Telecom Consultants India Ltd.
R.C.P.O.	:	Radio Communication Project Organisation
D.O.E.	:	Department of Electronics
C.I.G.R.F.	:	Conference International Grand Refoux Electric (French Term)

ANNEXURE XVII

REPORT OF THE SUB-GROUP OF THE TECHNICAL EXPERT GROUP TO TAKE MEASUREMENTS ON THE INTERFERENCE OF PLCC SYSTEMS WITH OTHER USERS

In the 3rd meeting of the Main Working Group on Identification of Communication requirements in the Power sector, held on 30th December, 1983, the Chairman desired (vide Para 3-C and 6 of the minutes) to undertake a study to assess the actual interference potential between PLCC and other radio systems to develop criteria for colocation. WPC was requested to associate with the above studies.

2. After a preliminary examination of the problem, WPC convened a meeting on 30th January, 1984, to work out the modality of taking actual observation in the field. The representatives from CAD, Air Headquarters, P&T and CEA were present. In the meantime on 4.1.84, a decision was taken in WPC to streamline the procedure of examination of the PLCC clearances without even waiting for the recommendation ofthe relevant GMs (Telecom.) and the same was conveyed to the Member-Secretary, Main Working Group. On 7th and 9th February, 1984, measurements on radiated PLCC were carried out in and around Delhi with all the above user agencies, CEA and DESU. On 24th February, 1984, certain measurements were carried out at Ballabgarh. The results of these measurements were conveyed to the Technical Expert Group which held its 3rd meeting on 28th and 29th February, 1984. The results were discussed in this meeting by the members. However, CEA representative presented a paper in this meeting which contained certain observations by Podzech and the report of the Working Group No.4 of CIGRE Study Committee No.35. The Chairman of the Technical Expert Group desired that this fresh input should further be discussed by WPC and the other national users agencies urgently and fresh measurements, if required had to be carried out on an urgent basis.

3. In a meeting convened on 8.3.84, the above input from CEA was discussed by CAD, Air Headquarters, P&T and CEA and it was decided that further measurements (i) from induced field of the PLCC to P&T open wire carrier systems and (ii) radiated field effects of the PLCC to the radio communication services were to be carried out at convenient location where this could be possible. CEA was requested to furnish the details of the locations with clearly marked distances radially from the various PLCC lines operating at different frequencies.

4. In the meantime based on a decision taken in the meeting convened by Power Secretary, Secretary(C), etc., A Task Force was set up to come up with the solutions to the short term problems in regard to PLCC. The Task Force consisted of representatives from CEA, P&T, DOE, and WPC, under the Chairmanship of P&T Department. This Task Force met on 12.4.1984, wherein the problems were discussed and it was decided to take field measurements, as indicated in the above paragraphs.

5. During the Period 2nd to 4th August, 1984, these field measurements, namely, induced and radiated from the various PLCC lines originating from Panipat to various distances were taken by WPC, P&T and C.E.A.

6. The results of the radiated measurements vide Annexures A to D were forwarded to Member-Secretary, Main Working Group and CEA. From the limited observations/measurements in the band above 150 KHz, it can be observed that the norms followed for clearance of PLCC spot frequencies in WPC is more liberal than that would have to be applied on the basis of the re-

sults of the measurements. As only a limited number of measurements could be carried out, the results were inconclusive. However, it has been decided to give a blanket clearance in Band 50 to 150 KHz by WPC on a provisional basis for 5 years in all locations except 20 Kms. from the coasts and in islands. The decision would be reviewed after 5 years depending upon the usages at that time in the concerned band.

7. The measurements from induced field to open wire system of P & T were also to be taken. The Group considered what additional safety measurements could be taken to avoid interference of PLCC to telecom lines. Sometimes the PLCC clearance was given with protective measures like G.D. tube and telecom line run close to the power line. Considering different aspects, the Group decided to measure the interference voltage on telecom line in Panipat-Ambala section of the Panipat-Dehar 400 KV and Panipat-Pipli 200 KV line. The average separation between Dehar-Panipat 400 KV line and Panipat-Karnal C-8 alignment along GT road is about 2.5 Kms; and that in Karnal Indri Section with the non C-8 alignment is about 0.7 Kms. The PLCC system is working on "phase to phase" coupling as indicated by Bhakra-Beas Management Board and there was no possibility to change over to 'phase to ground' coupling. The transmitted level of PLCC system at Panipat and Dehar was +18 dB_o. (1 mill.watt is taken as the base).

8. Interference measurements were carried out on the following 4 places:

(1) Panipat Carrier

(2) Charannda Telephone Exchange

(3) Karnal Carrier

(4) Indri Telephone Exchange

9. The measurements did not reveal any interference and were less than noise level. The noise level was -80 dB_o and below.

10. So it was concluded that the PLCC working has no interference from Dehar-Panipat 400 KV Power line to the P & T open wire carrier line in Panipat-Karnal and Karnal Indri Section.

11. But the Group could not take measurements on power level beyond +18 dB_o since the power transmitted across this 400 KV line could not be increased beyond this level. Though the complete analysis could not be done, the Group concluded that 50-150 KHz frequency could be used for PLCC subject to WPC clearance. In case any interference was noticed the guidelines could be established afresh and matter coordinated. The P & T would continue to issue licenses as at present

Mehrauli Najafgarh 220 KV
TX output 15 W(pep),
Type of Coupling: Phase to phase
Coupling loss: 3 db(each end),
Frequency: 372 Khz
Receiver Pass Band: 1 Khs.

FIELD STRENGTH MEASUREMENT OF PLCC RADIATIONS

S.No.	Radial distance from PLCC line	Height of the antenna of FSM	Field strength db(UV/m) with the antenna position		Remarks
			Vertical	Horizontal	
1.	-	-	56	44	In the equipment room.
2.	-	-	96	88	Near the wave trap and coupling condenser.
3.	100 meters	-	85	75	
4.	-	-	95	89	Below the mid-point of 2 towers carrying PLCC.
5.	1000 meters	15 feet	29	22	On the roof top of a house.
6.	2000 meters	-	21	14	
7.	2000 meters	7 feet	31	27	
8.	5000 meters	-	13	10	
9.	-do-	7 feet	27	24	
10.	3000 meters	15 feet	20	13	On the roof top at IMS Ghatorni.

NOTE: The level increases by 3 db with 100% modulation.

Mehrauli-Badarpur 220 KV
TX Output 15W (PEP),
Frequency 282 KHz.
Coupling loss 3 db(either end)
Type of coupling: Phase to Phase
Receiver Pass Band: 1 Khz.

FIELD STRENGTH MEASUREMENT OF PLCC RADIATION

S.No.	Radial distance from PLCC line.	Height of the antenna of FSM	Field strength db (UV/m) with the antenna position		Remarks
			Vertical	Horizontal	
1.	-	-	56	50	Near the equipment (in the room).
2.	-	-	100	91	Below the wave trap coupling condenser.
3.	100 meters	-	74	58	
4.	700 meters	15 feet	54	42	
5.	500 meters	-	49	43	On the roof top of the House.
6.	3000 meters	7 feet	37	31	
7.	-do-	-	26	16	
8.	2000 meters	15 feet	30	25	On the roof top at IMS Ghatorni.
9.	-do-	20 feet	36	31	-do-

ANNEXURE-B

Mehrauli-Badarpur 220 KV
TX. output-15W (Pep),
Coupling loss: 3 db(each end),
Type of Coupling: Phase to Phase
Frequency 152 KHz; Receiver P.B. 1KHz.

FIELD STRENGTH MEASUREMENTS OF PLCC RADIATIONS

S.No.	Radial distance from PLCC line	Height of FSM antenna	Field strength db(UV/m) with the antenna position		Remarks
			Vertical	Horizontal	
1.	-	-	75	67	Near the PLC terminal in the equipment room.
2.	-	-	96	88	Below the wave trap/ coupling condenser.
3.	100 meters	-	75	65	
4.	700 meters	-	73	69	-
5.	500 meters	2 meters	47	42	On the roof top of the house.
6.	3000 meters	-	27	20	-
7.	3000 meters	2 meters (7 feet)	38	32	-
8.	2000 meters	15 feet	32	-	On the roof top at IMS Ghitorni.

ANNEXURE-C

FIELD STRENGTH MEASUREMENTS OF PLCC AT PANIPAT.

Frequency KHz.	S.No.	Radial Distance. Km.	Field strength dB(UV/m) with antenna position		Remarks.
			Vertical	Horizontal	
200	1	2.75	55.5	45.5	Panipat-Dehar 400 KV TX 20W(Pep) Phase to Phase coupling Pilot level-20dB, coupling less 3 dB. RX PB 1KHz Height of the antenna, 5 ft.AGL Frequencies 200, 170, 101.25 and 55 KHz.
	2	4.0	39.5	32.5	
	3	6.5	39.5	49.5 (?)	(Noisy beyond this distance).
170	1	2.75	79.5	73.5	
	2	4.0	42.5	36.5	
	3	6.5	60.5(?)	49.5(?)	
	4	8.0	30.5	25.5	
101.25	1	2.75	72.5	N/H	(N/H: Not Heard)
	2	6.5	44.0	32.0	(Noisy beyond this distance).
450	1	1.25	26.5	20.5	Panipat-Thermal 220 Kv, TX-LOW(p.e.p) Pilot-20db. Frequencies 450 and 220 KHz coupling less 3 dB RXPB 1 KHz. (Noisy beyond this distance).
220	1	2.75	30.5	26.5	Noisy beyond this distance.
152.5	1	2.5	58.5	53.0	Panipat Dadri 220 KV TX LOW(pep) Pilot -20 dB Frequencies 152.5 RX PB 1.0 KHz. Noisy beyond this distance.

Annexure XVIII

D.O. NO: I-1(2)/83-P&E

PROF. YASH PAL
CHIEF CONSULTANT

PLANNING COMMISSION
INDIA
NEW DELHI-110001

12th September 1984

You are aware that the Planning Commission had constituted a Working Group under my chairmanship to recommend the communication needs of the Power sector. This Group has now completed its work and its Report should be available shortly. The last meeting of the Group was held on September 1, 1984.

The Group has been successful in resolving a number of issues. In my view, the problems related to PLCC clearance are more or less behind us. This was possible through a great deal of technical experimentation, discussion and understanding on the part of all concerned. We have also been able to analyse the communication needs in fair depth. We have studied various alternatives for meeting these needs and have come out with specific recommendations in this regard. It is clear from our work that besides other needs, a great deal of additional communication expertise would have to be inducted in the Power sector. However, a few of the important issues could not be decided on the basis of a consensus because they were connected with administrative and policy aspects on which the representatives of P&T could not be expected to take a decision.

In the enclosed note, I have indicated 3 of these issues for discussion in the Secretaries Steering Committee in accordance with the promise which I gave to the Group. I suggest that we might meet at an early date convenient to all of us so that some decisions in this regard might also be appended to the Report, which I propose to submit shortly.

With regards,

Yours sincerely,
Sd/-
(YASH PAL)
O/C

COPY TO:

1. Shri S. Venkitaramanan
   Secretary, Department of Power
2. Shri K. Thomas Kora
   Secretary, Ministry of Communication
3. Shri S.R. Vijayakar
   Secretary, Department of Electronics
4. Prof. S. Dhawan
   Secretary, Department of Space

(ALONG WITH ENCLOSURE AS ABOVE)

SOME POINTS RELATED TO THE WORK OF WORKING GROUP ON IDENTIFICATION OF THE COMMUNICATION REQUIREMENTS IN THE POWER SECTOR

1. It has been recommended that the Power sector would use channels leased from P&T primarily between metropolitan cities and between metropolitan cities and other large cities provided certain basic criteria for such leasing was satisfied. This could be leased between P&T Centre to P&T Centre on a group basis. However, independent end links taking these channels to the user premises will be required. The question as to who should own and operate this link came up for discussions in the Working Group meeting. The power sector expressed the opinion that these end links should be owned and operated by power sector as part of their dedicated network. This is because it is considered that the end links are the weakest section in the total system in achieving the required availability and quality. Also the end links do not receive adequate attention in maintenance and operation in P&T. However, P&T expressed reservations in accepting this as many technical, operational and administrative difficulties would arise in allowing a particular user to operate from their P&T Centre. The main difficulty would be in sharing the infra structure and in interfacing with the public network and inviting similar demands from other bulk users. The Working Group could not come to a consensus on this issue and the Chairman was requested to take the issue of deciding the possibility of allowing the Power sector to own and operate the end links to the Secretaries Steering Committee.

2. Another issue relating to leasing of the channel from P&T was the need for an independent Committee to evolve the criteria for assessing the suitability of a circuit in terms of established and proven performance record which should be guaranteed, availability based on certain quality standards of performance (signal noise ratio, fault rate, meantime to restore) to be leased and also to satisfy the performance of that circuit when it is made available to suit the Power sector requirements. There was a general agreement that such a check is required. However, P&T representatives felt that such an arrangement will not be feasible. The Chairman was requested to take up this issue of independent evaluation of leased, circuit performance before it is being leased in the Secretaries Committee

3. The third related issue is on the right of Power sector to enter into an agreement with P&T in regard to the availability and quality of the system whenever P&T trunk routes are leased. The Working Group in general felt that such an agreement would be in the interest of maintaning the quality of the system and that such a provision is required. The P&T representative clarified that signing of such agreement is not acceptable under the present policy. The Working Group requested the Chairman to take up this issue also in the Secretaries Committee.

4. It would, perhaps, be useful, if I as Chairman of the Working Group also give my views on the above three issues.

(i) In my view the problem regarding the ownership of end links is purely of an administrative nature and it should be possible to work out an appropriate arrangement in this regard. One can understand the hesitation of P&T to allow several users in their premises, where a large number of lines are being terminated. On the other hand, it should also be possible that a few authorised supervisors from the Power sector be present and to make the Power sector pay for the use of facilities on

the P&T end links. The other end of the link could be managed by the Power sector as also the laying of the link itself. At a technical level, any problems which arise, could be easily resolved. We have to remember that another solution can also work as in the case of international traffic where each end is looked after by the respective administration with clear understanding about specification etc.

(ii) If the Power sector has to lease a P&T channel, it appears natural that they should have means of satisfying that the channel has the required quality, standards and an assessment of this by an independent group would be useful both to P&T and the Power sector.

It appears to me that it would be useful to start a culture where specific agreements would be drawn up between the bulk purchasers of service and the suppliers. While doing this, one can of course put in appropriate clauses, which protect the supplier in the event of service deterioration due to reasons beyond its control. An attempt should certainly be made to draw such an agreement.

One of the preferred (and also less expensive) alternatives of meeting the communication needs of the Power sector involves using space communication. In fact the Report estimates that something like 250 ground stations may be required. It is clear to all technical people that should this approach be taken, then even the trunk route requirement would be met through space segment, though it is always advisable wherever possible to have a back up route through leasing of trunk microwave channels and installation of the ancillary end links. In regard to the space segment, one might have to proceed by seeking an allocation of the space channels for the Power sector and then allowing the Power sector to design and develop the ground segment. Various State Electricity Boards would need to develop their stations in accordance with the specifications laid down and the net-work can be managed by the Power sector itself. This network would be an independent network and, therefore, there should not be much of a problem in allowing the ground stations to be owned and operated by the Power sector. This would be similar to what has already been agreed for some other organisations. This aspect was not discussed in detail in the Working Group, but appears implicit in its recommendations and, therefore, I thought I would bring it to your notice.