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# A Plan of Islanding Scheme for Pune City

**Jayesh Joglekar,** *MIT Pune*
**Yogesh P. Nerkar,** *PVG's COET, Pune*

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# A Plan of Islanding Scheme for Pune City

Jayesh Joglekar and Yogesh P. Nerkar


## Abstract

The availability of electrical energy ensures development and progress while its non-availability means stagnation or 'back tracking'. The condition of 'No Power' [1] is the costliest state and leads to social, economical and production loss. Power system blackout means inconvenience and hardship to society. Uninterrupted power supply is essential for the national productivity and social structure and hence system must be made flawless at any cost. Reliable and disturbance free electric power supply is recognized as a key to 'Societal progress throughout the world'. Grid failure occurs due to continued overstressing, low frequency operation, increased load demand, peaking characteristics of the demand, ineffective load control, reduced level of security due to opening of interstate lines and violation of grid discipline. After occurrence of severe system disturbances, the system may split into parts, which may or may not survive depending on the load generation balance. The part system containing the generation sources and certain loads, which are planned to be separated from the main grid during system disturbance at, preconceived points either through under frequency and / or directional power relays are called 'Islands'[2]. During restoration due to wide fluctuations in the frequency it becomes very difficult to maintain the load-generation balance. Inability to control the frequency may lead to unsuccessful restoration. Repeated collapse of the system island due to tripping of generators either due to over frequency or under frequency causes delay in getting normalcy. In this situation the computer-computer links between the State Load Despatch Centre (SLDC) and Area Load Despatch Centre (ALDC) play a key role [3]. The priority during the restoration period such as railway traction, essential consumers such as water supply scheme, hospitals etc and lastly to the civil societies should be given. It is also necessary to have provision of disturbance recorder and event logger at power generation stations and various interconnected substations. These and other major aspects are considered in proposing the islanding scheme of the Pune city.


**KEYWORDS:** islanding, ALDC, ring main system

## I. INTRODUCTION

Pune city (Maharashtra State, India) is having large industrial belt and MSEB gets large revenue from electric consumers of the city. It is necessary to provide disturbance free and reliable electric supply to consumers. In this work complete power scenario of Pune power system is studied. Lonikand EHV substation and Chinchwad substation are two receiving substations for Pune city. It is proposed to install Area Load Dispatch Centre (ALDC) at Chinchwad, Pune. Four different alternatives are proposed to provide electric supply to Pune city in case of supply disturbance.

## II. IMPORTANCE OF POWER RELIABILITY FOR PUNE CITY

Pune city is situated in Western region of Maharashtra in India. It is the second most developing city after Mumbai and having importance due to rapid growth of industrialization in and around it. Major industrial groups like Bajaj, TELCO, Kirloskar, Cummins, Kalyani & Garware are having industrial units in suburban zone of Pune as Pimpri, Chinchwad, Hadapsar & Mundhwa. Defense organisations such as National Defence Academy (NDA) and Institute of Armament Technology (IAT) at Khadakwasala, Armament Research & Development Equipments (ARDE) at Pashan, Ordinance factory at Khadki, Indian Air-Force Station at Lohgaon are also enhancing the importance of the city in the country. The annual growth rate of the city is higher than 5% since 1991. Monthly revenue collection from state electricity board (MSEB) consumers in this city is around Rs.120 cores. In this investigation requirement of active as well as reactive power for Pune city is studied. Relevant data is obtained from Lonikand and Chinchwad substations. Other details are obtained by personal visits at different substations in and around Pune.

## III. MSEB SYSTEM AT PUNE

Pune city has 220 kV ring main system which connects eight substations [1,2,3,4]. Pune has peak demand of around 650 MW and 350 MVAR. This demand is fulfilled by:

One 400 kV substation along with: Eight 220 kV substations,
Six 132 kV substations,
One 100 kV substation,
Twenty 22 kV substations and around
Four thousand 11 kV substations.

This network connects to seven 400 kV lines of western grid at Lonikand and four 220 kV lines at Chinchwad and Lonikand substation.

## IV. PRESENT SCENARIO

Lonikand EHV substation is connected to Karad, Koyna, Padgha, Kalwa and Parali by 400 kV lines. Out of these lines supplying power from Koyna and Parali are double circuit. Two 220 kV single circuit lines are also supplying power from Babhaleshwar.
Chinchwad is another receiving station for Pune city. It receives power from Kandalgaon and Apta substations with 220 kV single circuit line. Kandalgaon substation receives power from Koyna and Bhira hydroelectric power plants and Apta substation receives power from Uran gas power plant and also from Koyna hydroelectric power plants.
To cover complete area and for reliable power supply, a 220 kV ring is formed in and around Pune city. Total eight substations namely Lonikand, Theur, Parvati, Chinchwad, Telco, Bhosari, Century Enka and 512 ABW (Army Based Workshop) are connected through the ring. Another 132 kV network is formed by connecting substations at Theur, Phursungi, Mundhawa, Kothrud, NCL (National Chemical Laboratory) and Chinchwad. Figure – 1 represents the interconnectivity of Pune city with MSEB network.

## V. PAST EVENTS

The Western Region Grid comprises of the state of Maharashtra, Gujrath, Madhya Pradesh, Chattisgad, and Goa has experienced severe power system disturbances in last twenty years. Details [5] are presented in Table: 1

## VI. PROPOSAL OF ISLANDING SCHEME FOR PUNE CITY

From the above discussions it is seen that for the implementation of islanding scheme, a separate generation unit is very much necessary. During the last system disturbance on 30$^{th}$ July 2002, TATA / BSES could island from Maharashtra system and continued electric power supply to Mumbai only because of the availability of adequate generation capacity. On the same lines, for the preparation of this proposal of islanding for Pune city four different alternatives are considered.

### *1. ADEQUATE CAPACITY GENERATION UNIT FOR PUNE CITY*

The peak demand of Pune city is around 650 MW and 350 MVAR. In case of separate generation unit made available for Pune city, the generating unit and existing capacitor banks available at various substations in Pune city can fulfill reactive power requirement. By considering various financial aspects for

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installation and commissioning of the new generation units, the possibility of establishment of separate power plant for Pune city is rare in near future

## *2. SEPARATE LEASE LINE FROM DPC*

Dabhol Power Company (DPC) is connected to Lonikand substation via New Koyna substation. Hence no separate erection cost for transmission is involved. Since 29th May 2001 the power generation from DPC power plant is not available. After sorting out legal matters power generation of 728 MW can be made available for Pune city. The total length from DPC to Lonikand is 228.3 circuit km. As a thumb rule, the 400 kV transmission line can generate 0.55 MVAR per km, therefore reactive power available at Lonikand using 400 kV double circuit line in this scheme will be 250 MVAR. Further requirement of reactive power can be fulfilled using capacitor banks provided (around 100 MVAR at different substations). It will provide an ideal solution for implementation of the Islanding scheme.

## *3. USE OF HYDROELECTRIC PLANTS*

The time period required for restarting of hydroelectric power plants is relatively small as compared to thermal power stations. The Koyna hydroelectric power plant along with small hydroelectric generating units at Varasgaon, Panshet, Bhatghar, Bhira and Pavana is also considered for fulfilling power demand of Pune city. Major difficulty with hydroelectric power generation is the restriction on water availability for the power generation. In the hydroelectric power plants connected to Pune city, Koyna is the largest having power generation capacity 1960 MW. However water availability for generation at Koyna hydroelectric plant is restricted to 67.3 TMC. Small hydroelectric generation units at Varasgaon, Panshet, Bhatghar, Bhira and Pavana can run as overexcited synchronous motor which may fulfill the requirements of reactive power of Pune city, whenever required.

## *4. SEPARATE LEASING OF GENERATING UNITS*

Next alternative thought is about leasing generating units and a separate line (Express Feeder) from Chandrapur STPS to Lonikand via Parali substation. At Chandrapur STPS there are four units of 210 MW capacity and three units of 500 MW capacity. In case of system disturbance, separate generation units of 500 MW and 210 MW capacity from Chandrapur STPC along with transmission network from Chandrapur to Lonikand via Parali can be leased for supplying power demand of Pune city. The total length of 400 kV double circuit network is

539.3 X 2 = 1078.6 i.e. @ 1080 circuit km. It can generate reactive power of around 594 MVAR. In this specific case reactors have to be used for maintaining voltage profile of the system.

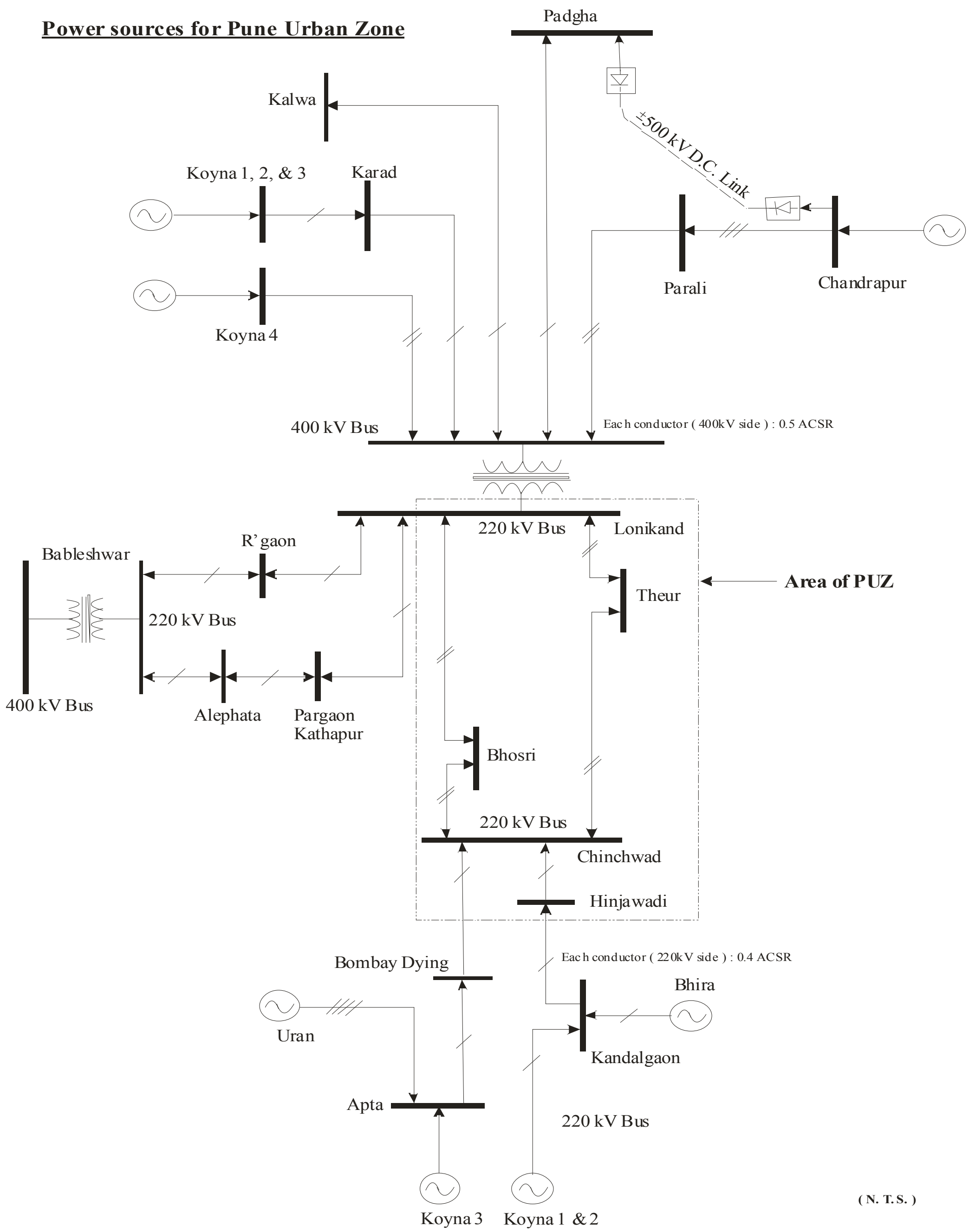


FIGURE 1: INTERCONNECTIVITY OF PUNE CITY WITH MSEB NETWORK

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| **Sr. No.** | **Date** | **Cause** | **Time** |
|---|---|---|---|
| 01 | 13-Jul-1983 | Low Frequency | 16:24 |
| 02 | 26-May-1987 | Failure of equipment | 20:46 |
| 03 | 17-Aug-1989 | Relay Operation | 16:35 |
| 04 | 23-Nov-1990 | ICT Tripping | 21:07 |
| 05 | 24-Nov-1990 | ICT Tripping | 08:37 |
| 06 | 25-Oct-1991 | Tie-line tripped | 10:51 |
| 07 | 12-Feb-1992 | ICT Tripping | 16:15 |
| 08 | 31-Mar-1992 | Tie-line tripped | 15:03 |
| 09 | 15-Jun-1992 | Storm, Tower Collapse | 19:26 |
| 10 | 28-May-1993 | Line overloading | 21:45 |
| 11 | 19-Apr-1995 | Line fault(Itarsi - Indore) | 17:58 |
| 12 | 01-May-1995 | Bus fault-Indore substation | 15:45 |
| 13 | 31-Jul-1995 | OCC at Kalwa substation | 15:15 |
| 14 | 10-Nov-1995 | OCC at Bhilai substation | 11:30 |
| 15 | 14-Nov-1995 | OCC at Bhusawal substation | 08:40 |
| 16 | 30-Nov-1995 | Line fault (Parali-Lonikand) | 09:12 |
| 17 | 09-Dec-1995 | Line fault (Jabalpur-Amtk) | 07:36 |
| 18 | 11-Dec-1996 | Line fault (Indore-Asoj) | 16:02 |
| 19 | 28-Feb-1997 | Bus fault at Bhusawal substation | 20:51 |
| 20 | 04-Mar-1997 | Bus fault at Bhusawal substation | 10:05 |
| 21 | 07-Jun-1997 | Bus fault at Chandrapur substation | 17:58 |
| 22 | 26-Oct-1997 | OCC at Chandrapur substation | 23:35 |
| 23 | 16-Dec-1998 | Line B/D (K-S, K-B) | 10:56 |
| 24 | 23-May-2002 | Storm, Tower Collapse | 08:54 |

| | | | |
|---|---|---|---|
| 25 | 29-May-2002 | Storm, Tower Collapse | 02:09 |
| 26 | 30-Jul-2002 | Low Frequency, Over drawn | 20:11 |
| 27 | 06-Oct-2003 | Bus fault at Kalwa substation | 10:37/11:24 |
| 28 | 05-Nov-2003 | Low Voltage | 10:24/10:33 |
| 29 | 07-Nov-2003 | Low Voltage | 13:03 |
| 30 | 06-Dec-2003 | Tie line tripped | 12:20 |
| 31 | 05-Feb-2004 | Circuit Breaker fault | 14:21 |

TABLE – 1 POWER SYSTEM DISTURBANCES IN LAST TWENTY YEARS

After availability of appropriate capacity power supply for Pune city, the next stage is to monitor the power flow using ALDC, Pune (proposed) in this scheme. Through computer-computer link [6] the system data available at SLDC Kalwa can be made available at Pune ALDC. During system disturbance the well-trained staff will take care of successful implementation of Islanding scheme for the Pune city. Depending on generation-load balance, the expert team will take decision about the priorities of the loads such as hospitals, water supply etc.
Figure – 2 shows tie line connection with Pune city. These tie lines are connected to Talegaon, Narayangaon, Supa, Jejuri, Yawat and various 22 kV rural feeders from various substations in Pune ring main system. By appropriate setting of the under frequency relay tie lines will get separated at 48 Hz frequency.

## VII. COMMUNICATION SYSTEM

For the successful implementation of Islanding scheme high performance communication network is necessary [7]. Basic requirement for the network is broadband communication medium with high frequency data transfer. This requirement is fulfilled by optical fiber communication scheme for the city area [8]. Figure – 3 shows a block diagram of the optical fiber communication link.

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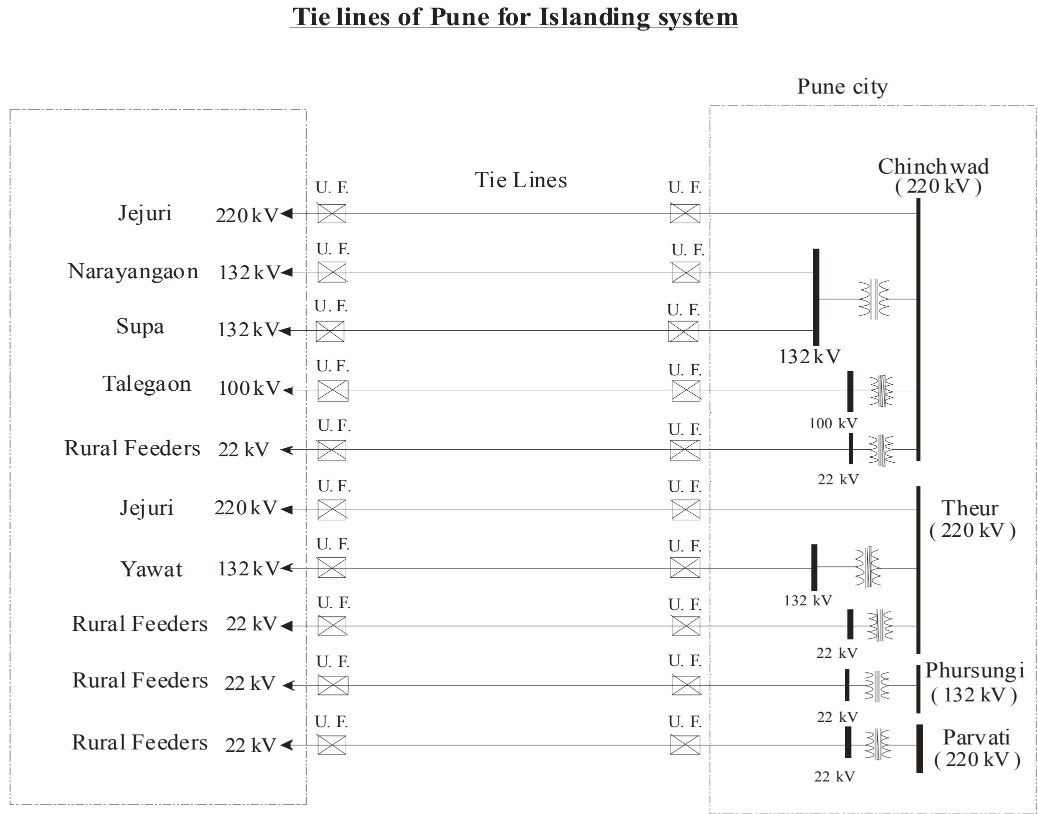
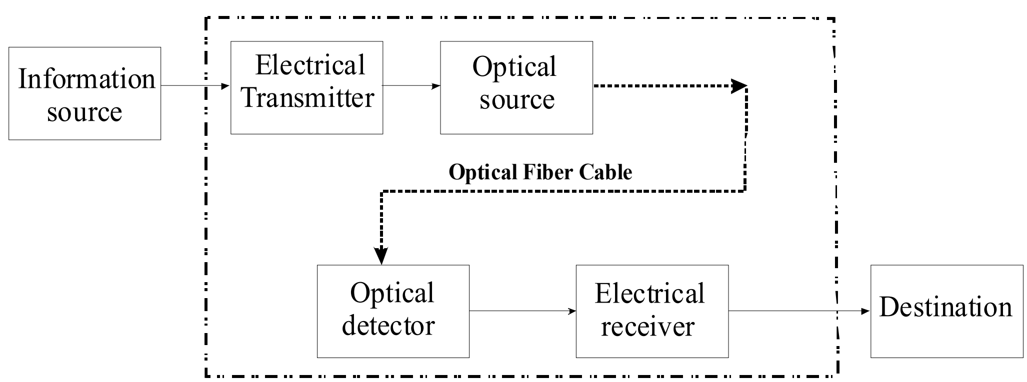



**U. F.** = Under Frequency Relay : 47.60 Hz, 0.2 sec. For all Tie lines. ( Proposed )

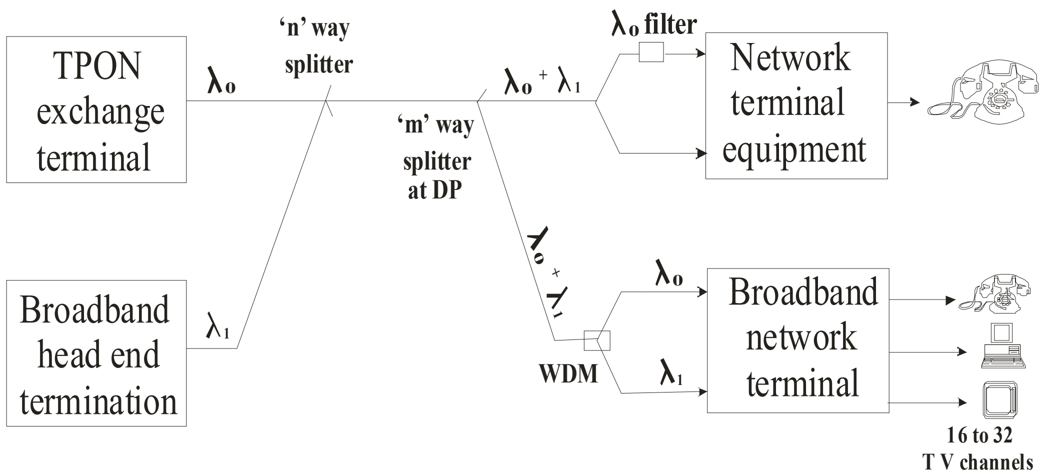
FIGURE 2: TIE LINE CONNECTIONS WITH PUNE CITY




Optical Fiber Communication System

FIGURE 3: BLOCK DIAGRAM OF THE OPTICAL FIBER COMMUNICATION LINK

Distance between source and destination can vary from 20 km to 300 km. Due to high radiance LED source along with multimode graded index fiber system 34 Mbps to 140Mbps data speed can be obtained. Figure – 4 show Broadband Passive Optical Network (BPON) useful for the substation automation.
Proposed scheme developed for the successful implementation of the Islanding of Pune City is presented in the paper.




**TPON = Telephony on a Passive Optical Network**
**WDM = Wavelength Division Multiplexing**

FIGURE 4: BROADBAND PASSIVE OPTICAL NETWORK (BPON)

## VIII. CONCLUSIONS

For the islanding of the Pune city various aspects of the power system are considered. Detailed study of the load variations of Pune city has been done. Following are the main conclusions:
1) Implementation of islanding scheme is difficult for Pune city due to the non-availability of generation.
2) In this proposal four alternatives are suggested for fulfilling the requirement of power demand for the Pune city. By leasing the generator units of adequate capacity and associated transmission network, the implementation of islanding scheme may become feasible.
3) By providing a special facility of islanding of the desired generator units from the interconnected system network it is possible to continue the reliable power supply for the important load centers like Pune.

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4) Apart from the active power considerations for the implementation of the islanding scheme, it is also necessary to take care of reactive power balance, voltage profile, stability and security aspects.

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