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Research Paper

Gis Based Power Distribution System: Load on Tansformers of Vasant Vihar-Phase-II Located at Dehradun District by Using Geospatial Technology

Technology

KEYWORDS : Power distribution system, Remote sensing, Geographic Information System (GIS), GPS & DGPS and Geospatial Information System etc

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ABSTRACT

In Uttarakhand state, different hydrological projects are there which are generating about 4613.23 Million Unit electricity which is more enough to distribute among the existing population, so state is exporting electricity to other states which is a main source of income to the government of the state. The population of the Uttarakhand state is about 84.89 lakhs at present state has sufficient electricity to distribute among the existing population but in future scenario by seeing that population is increasing is an alarming rate and urban scrawl , this condition may not be possible. Use of modern technology is essential for the development in this sector. Remote sensing, Geographic Information System (GIS), Geographical Information System, or Geospatial Information System is an emerging tool in this new most important area. With the help of this technology different studies can be done like Load Flow Studies, Load Forecasting, Management Information System (MIS), Total energy accounting, Installation of capacitor banks & network reconfiguration and High Voltage Distribution System (HVDS) etc.

In this direction, one case study has been conducted at USAC, Vasant Vihar phase 1 region of Dehradun district of Uttarakhand state. The main objective of the study is to create Power distribution system. High resolution satellite data has been taken and georeferenced it in appropriate scale. Building the database primarily involves conducting GPS survey of consumer households, connected electrical feeders and distribution transformers. Different thematic layers has been developed such as settlement layer, road map, LU/LC (Land use and Land cover) map, DEM (Digital Elevation Model), Aspect map, Slope map, location map of poles connected to Transformer and position of Transformers etc. With the help of connected houses to the poles, Load on transformer has been calculated and result shows that in which transformer load is more It plays a key role in determining technical loss, planning and optimization of distribution system. With periodic updating and monitoring, GIS mapping of the Electrical Network and Consumer database helps in improved load management, loss reduction, better revenue realization, asset and work management and possibly better consumer relationship.

INTRODUCTION

The distribution system is a part of power systems which is dedicated to delivering electrical energy to the end user. Present reform focus of India is distribution sector as this sector immediately affects the consumers. Economic importance of distribution system is very high and the amount of investment involved dictates careful planning, design, construction and operation which assure growing demand for electricity in terms of growing rates and high load densities. Present distribution system in India is the weakest link when compared to generation or transmission. High technical losses in the system are primarily due to inadequate investments over the years for system improvement works, which has resulted in unplanned extensions of the distribution lines, overloading of the system elements like transformers and conductors, and lack of adequate reactive power support. The commercial losses are mainly due to low metering efficiency, power theft and pilferages.

Distribution is the most critical segment of the electricity business chain. The real challenge of reforms in the power sector lies in efficient management of the distribution sector.

Scarcity of available land in urban areas and ecological considerations can put the problem of optimal distribution planning beyond the resolving power of unaided human mind. Load magnitude and geographic location of distribution system should be determined such that distribution substation must be placed and sized in such a way as to serve the load at maximum cost effectiveness by minimizing feeder loss and construction costs. Distribution system contains much wider varieties of voltage levels, components, loads and interconnections than the generation and transmission systems.

In Uttarakhand state, different hydrological projects are there which are generating about 4613.23 Million Unit electricity which is more enough to distribute among the existing population, so state is exporting electricity to other states which is a main source of income to the government of the state. The population of the Uttarakhand state is about 84.89 lakhs at present state has sufficient electricity to distribute among the existing population but in future scenario by seeing that population is increasing is an alarming rate and urban scrawl , this condition may not be possible. Use of modern technology is essential for the development in this sector. **Remote sensing, Geographic Information System (GIS)**, **Geographical Information System**, or **Geospatial Information System** is an emerging tool in this new most important area. With the help of this technology Load magnitude and geographic location of distribution system can be determined such that distribution substation must be placed and sized in such a way as to serve the load at maximum cost effectiveness by minimizing feeder loss and construction costs.

OBJECTIVE OF THE STUDY

The main objectives of the study are as follows:

1. To generate thematic layers of Vasant Vihar phase-2 region:
   - Settlement layer generation
   - Road map generation
   - Located Transformer layer in study area
   - Located pole layer in study area attached to that particular transformer
2. To find relationship between poles and settlement layer.
3. To calculate Load on different transformers located in study area.

STUDY AREA

The study area comprises with Vasant Vihar-phase-II, Dehradun district of Uttarakhand state with latitude and longitude is 30.3157^0 and 78.3586^0.

DATA USED

Satellite data: High resolution satellite data

Collateral data: GPS, DGPS

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METHODOLOGY

The major steps involved in the methodology that has been formulated for remote sensing based study **"load on Transformers located in Vasant Vihar phase-2 region"** are as follows:

i. **Acquisition of satellite data**
ii. **Data processing**
o **Geo-referencing of Data**
iii. **Collection of Ground truth information**

For Transformer:

Ground based information will be collected in the given format:

S. No.	Geog. Latitude	Geog. Longitude	Art no.	Type	In	Un
Fn (Frequency)	Qn.	Vi (Input voltage)	Temp cat.	IS	Lot No.	

For poles attached to transformer:

S. No.	Geog. Latitude	Geog. Longitude	Pole number	No. of houses attached to pole

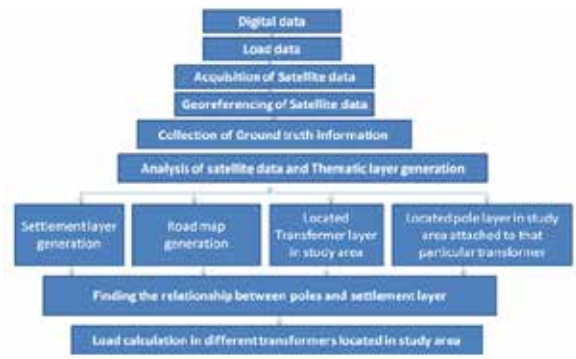
iv. Analysis of satellite data and Thematic layer generation:

- Settlement layer generation
- Road map generation
- Located Transformer layer in study area
- Located pole layer in study area attached to that particular transformer

v. **Finding the relationship between poles and settlement layer:** To find the relationship between poles and connected houses to those poles which are connected at any particular transformer.

vi. **Load calculation in different transformers located in study area:** Load at any transformer will be calculated on the basis that how many houses attached to one transformer and what is the capacity of that particular transformer or how much load on particular transformer.

Figure1-Flow chart of Methodology for Load calculation on Transformers



RESULT

➢ **Transformer's information collected from ground:**

Sr. No	Transformer Information	GPS Points	Neighboring Information
1	(Tr-1) Art no. 20020,80557 Type –CLMD 13 IN – 19.68Amps Un : 440v Fn : 50˜ Qn : 15 KVA Vi : 3/15 KV Temp Cat – 25/D°C IS : 13340:1993 Lot No – 050404 Internal Fuse Connection Self healing , MPP Dry type Capacitor , Date : 04/04/2005	N-(Lat)-30°09'21.7" E-(Long)-77°59'51.3" RL- 631m (Elevation) UPCL – VV – A 2-045 A8-SG-1	Near Kali mandir/Tea-State
2	(Tr-2) Art no. 20030,80011 Type-CLMD 43 IN : 39.3 Amps Un : 440v Fn : 50˜ Qn : 30 KVA Vi : 3/15 KV Temp Cat – 25/D°C IS : 13340 : 1993 Lot No- 050407 Date : 07/04/2005	N-(Lat)-30°19'29.2" E-(Long)-77°59'57.6" RL- 636m (Elevation)	Near House B.S Gill 180/ II VV
3	(Tr-3) Art no. 20030,80011 Type-CLMD 43 IN : 39.3 Amps Un : 440v Fn : 50˜ Qn : 30 KVA Vi : 3/15 KV Temp Cat – 25/D°C IS : 13340 : 1993 Lot No- 050407	N-(Lat)-30°19'25.5" E-(Long)-77°59'46.4" RL- 625m (Elevation) UPCL VV-A SG-1 2-054	Near SGRR Public School/Study Center EQUATOR
4	(Tr-4) Art no. 20030,80011 Type-CLMD 43 IN : 39.3 Amps Un : 440v Fn : 50˜ Qn : 30 KVA Vi : 3/15 KV Temp Cat – 25/D°C IS : 13340 : 1993 Lot No- 050407	N-(Lat)-30°19'33.0" E-(Long)-77°00'08.7" RL- 634m (Elevation) UPCL VV-D A-3 Ph-II	Near House N.D Ghildi-yal 118/II

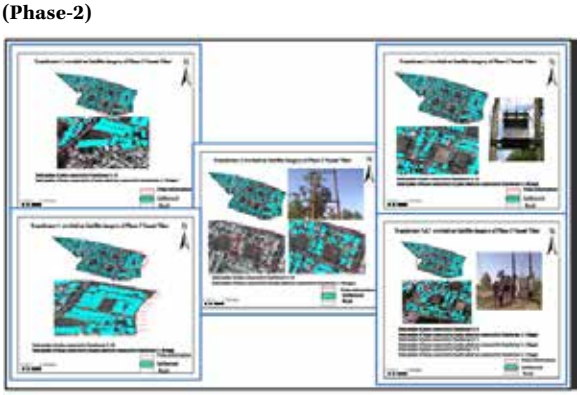
5	(Tr-5,7) Art no. 20020,80557 Type-CLMD 13 IN : 19.68 Amps Un : 440v Fn : 50˜ Qn : 15 KVA Vi : 3/15 KV Temp Cat – 25/D°C IS : 13340 : 1993 Lot No- 050404 Internal Fuse Connection Self healing , MPP Dry type Capacitor , Date : 04/04/2005	N-(Lat)-30°19'24.8" E-(Long)-77°59'28.8" RL- 626m (Elevation)	Near Pradhan Office Uttranchal Himalayee Aajivika Sudhar Ayojana.
6	(Tr-6) Ref ISS – 2026 KVA – 250 Type of cooling-ON HV – 11000 Fn - 50˜ LV – 433 Impedance V – 4.75% Amp – H-V 13.12 LV – 333.35 Core & Windings Kg-495 Phase HV – 3 Oil Lt : 270 LV – 3 Total weight Kg : 1050 Year of manufacture : 1995 Customer Ref. ESPG – 1/178/90 Max Load Losses – 3600W Max no load losses – 550W	N-(Lat)-30°19'28.9" E-(Long)-77°59'31.0" RL- 628m (Elevation) PH/1,2	Near House VV – 2 D.S Bhawan DPS Negi

➢ Poles information connected to Transformers 1st , 2nd, 3rd ,4th ,5th ,6th and 7th collected from ground of Vasant Vihar (phase-2)

Table 1st : Comparison between Power quantity and Supply of Electricity to each home of different transformers in Vasant Vihar (phase-2):

Transformer no.	Quantity	Supply of Electricity to each home	If 1 house require 1 KVA	If 1 house require 2 KVA (For double story building)
Transformer 1	15 KVA	15/20=0.75KVA	0.25 KVA (Less)	1.25 KVA (Less)
Transformer 2	30KVA	30/50=0.60 KVA	0.40 KVA (Less)	1.40 KVA (Less)
Transformer 3	30 KVA	30/40=0.75KVA	0.25 KVA (Less)	1.25 KVA (Less)
Transformer 4	30 KVA	30/40=0.75KVA	0.25 KVA (Less)	1.25 KVA (Less)
Transformer 5	30 KVA	30/10=3 KVA	2 KVA (More)	1 KVA (More)
Transformer 6	250 KVA	NA	-	-
Transformer 7	15 KVA	15/15=1KVA	Equal	1 KVA (Less)

Figure 2: GPS location map of Poles connected to Transformer 1 to 7 overlaid on Satellite imagery of Vasant Vihar (Phase-2)



Transformer no.	Power (watt)=V*I	Load on Transformer
Transformer 1	15 KVA=15000 VA	Low load
Transformer 2	30KVA=30000 VA	Maximum load
Transformer 3	30 KVA=30000 VA	Low load
Transformer 4	30 KVA=30000 VA	Low load
Transformer 5	30 KVA=30000 VA	Minimum load
Transformer 6	250 KVA=250000 VA	----------
Transformer 7	15 KVA=15000 VA	Average load

Table 2nd : Graphical representation of Comparision between Power quantity and Load on transformers located in Vasant Vihar (phase-2):

CONCLUSION

From this study undertaken, it can be concluded that the power Distribution Company and the department can be used in many ways to improve the planning, maintenance and management standards of the department. With periodic updating and monitoring, GIS mapping of the Electrical Network and Consumer database helps in improved load management, loss reduction, better revenue realization, asset and work management and possibly better consumer relationship.

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