TN-RAPDRP Project

INDUSTRIAL TRAINING REPORT

Submitted by

S. SHENAHA

in partial fulfillment for the award of the degree of

BACHELOR OF ENGINEERING

in

GEOINFORMATICS ENGINEERING

INSTITUTE OF REMOTE SENSING

DEPARTMENT OF CIVIL ENGINEERING

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BONAFIDE CERTIFICATE

Certified that this report titled **"TN-RAPDRP Project"** is a bonafide record of work done by **Miss. S. SHENAHA (2013107028)** for **GI 8712**-**Industrial Training** during the period from June 1 2016 to June 28 2016 at **Navayuga InfoTech Private Limited**, **Chennai**. Certified further that to the best of my knowledge, the work reported herein does not form part of any other thesis or dissertation on the basis of which a degree or award was conferred on an earlier occasion on this or any other candidate.

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ABSTRACT

The project describes the use of geospatial technology in R-APDRP (Restructured-Accelerated Power Development and Reform Program) project at Kumananchavadi village of Ponamallae Taluk and Thirumudivakkam village of Sriperumbudur Taluk by Tamil Nadu Electricity Board Ltd (TNEB) for improving the power scenario through electrical network mapping and consumer surveying. GIS is spearheading the distribution reforms network mapping, asset creation, work management, ensuring billing and collection efficiency and cordial and effective consumer relationships. In both the villages, all consumers (all tariff categories) were surveyed and mapped using geospatial technology. The objective of GIS mapping and indexing of the consumers was to identify the location of consumer installation on geographical map from the respective distribution transformer (DT). The connectivity was established from a substation (SS), feeder, DT. This aims to ensure attention on fuse of call, voltage fluctuation and default in payment of current consumption (CC) bill, in particular service connection, metre functioning through automatic meter reader (AMR), energy theft, HT/LT lines, overloading of distribution transformers etc. in an efficient manner. Out of total consumers, this was categorised and indexed section wise, distribution zone wise, tariff wise consumer incorporated and electrical asset network mapping was also indexed using geospatial technology. For locating and marking the substation equipment, it was segregated feeder-wise and distribution transformer wise i.e. Consumer Index Number (CIN) was assigned. Apart from this, the T & D (transmission and distribution) loses in electrical network are also likely to reduce gradually by accounting of energy in substations, feeders, distribution transformers and transmission lines at the end-consumer level. Geospatial technology is poised to surely improve the revenue of TNEB and consumer satisfaction.

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1 INTRODUCTION

The Restructured Accelerated Power Development and Reforms Programme (R-APDRP) started in 2008 is a revised version of the Accelerated Power Development Reforms Programme (APDRP). The APDRP scheme was initiated in 2002-03 as Additional Central Assistance to States for reducing the Aggregate Technical and Commercial (AT&C) losses in the power sector [*Aggregate Technical and Commercial Loss captures the total loss in the distribution network. Technical loss may be due to ill maintained equipment, substations and inadequate investment in infrastructure while commercial loss may be due to low metering efficiency, faulty meter reading, theft and pilferages*] and improving the quality and reliability of power supply. This was to be achieved by strengthening and upgrading the sub-transmission and distribution system of high density load centres like towns and industrial centres.

1.1 AN OVERVIEW OF THE PROJECT

The Accelerated Power Development and Reform Programme (APDRP) was first contemplated by the Government of India during the year 2002-2003. The main objectives of the APDRP scheme is to improve the financial viability of the state power utilities/boards, reduce Transmission and Distribution (T&D) losses, improve reliability, quality and availability of power supply, introduce systems approach with MIS. The APDRP also aims at bringing transparency in operations of the power utilities through IT implementation and thereby improve consumer satisfaction.

The scheme was further modified during the XI Plan as "Re-structured Accelerated Power Development and Reform Programme (R-APDRP)" with the aim of restoring the commercial viability of the distribution sector by putting in place appropriate mechanism so as to substantially reduce the Aggregate Technical and Commercial (AT&C) losses. In the first instance, the R-APDRP seeks to address the issue of building the baseline data including meter data acquisition. After ascertaining the AT&C losses, the issue of power system upgradation and modernisation is taken up.

1.2 OBJECTIVE

To restore the commercial viability of the distribution sector by putting in place appropriate mechanism so as to substantially reduce the Aggregate Technical and Commercial (AT&C) losses.

1.3 SCHEMES

For Part A of the scheme, the Central Government will provide 100% loan and for Part B of the scheme 25% of loan (90% for special category States). Power Finance Corporation/ Rural Electrification Corporation will be the agency disbursing the loans under this scheme. The entire amount of loan (100%) of Part A of the project shall be converted into grant, once the base line system is established within 3 years from the date of sanctioning the project. If the Distribution Utilities achieve the target of 15% AT&C loss on a sustained basis for a period of 5 years in the project areas and the project is completed within the time schedule fixed by the Steering Committee, which shall in no case exceed five years from the date of project approval, up-to 50% (90% for special category states) loan against Part-B projects will be convertible into grant in equal tranches. If the utility fails to achieve or sustain the 15% AT&C loss target in a particular year, that year's tranche of conversion of loan to grant will be reduced in proportion to the shortfall in achieving 15% AT&C loss target from the starting AT&C loss figure.

Funds under the R-APDRP scheme are released only when a quadripartite agreement is signed between State Electricity Boards/Utilities, Government of India, Power Finance Corporation and State Government.

1.4 ELIGIBILITY

R-APDRP is for urban areas- towns and cities with population of more than 30,000 (10,000 in case of special category states).The focus of R-APDRP is on actual, demonstrable performance in terms of sustained loss reduction. This is proposed to be achieved in two parts: Part A of the scheme envisages establishment of base line data which includes consumer indexing, GIS mapping and metering of distribution transformers and feeders and SCADA/DMS (Supervisory Control and Data Acquisition System/Data Management System) in project areas having a population of 4 lakh and annual input energy of 350 MU. This part of the scheme also includes IT applications for energy accounting/auditing and IT based consumer service. Part B of the scheme is for renovation, modernization and strengthening of distribution systems.

The eligibility criteria for R-APDRP assistance is:

1. Constitution of State Electricity Regulatory Commission.

2. Reduction of AT&C losses at utility level by 3 % per year for utilities having losses above 30% and by 1.5% per year for utilities having losses below 30%.

3. Setting a time frame for introduction of measures for better accountability at all levels in project area.

4. Submitting the AT& C loss figure of the previous year of the identified project area by 30th of June. This figure is to be verified by an independent agency appointed by Ministry of Power.

5. Evolving an incentive scheme for the staff which is linked to achievement of 15% reduction in AT&C loss in the project area.

1.5 TANGEDCO AND R-APDRP

The Restructured Accelerated Power Development and Reforms Programme (R-APDRP) is being implemented in TANGEDCO. The focus of the programme is the establishment of reliable and automated systems for sustained collection of accurate base line data and the adoption of Information Technology in the areas of energy accounting, besides reduction of Aggregate Technical & Commercial (AT & C) losses. The project area covers towns and cities with population of more than 30,000. The programme consists of two Parts namely Part – A and Part – B scheme works.

1.5.1 Part - A Scheme Works

Part – A includes the projects for establishment of baseline data and IT applications for energy accounting/auditing and IT based consumer service centres. MoP/GOI has already sanctioned projects for implementation of Part-A in 110 towns of Tamil Nadu at a total cost of Rs.417 Crores. MoP/PFC have also notified that the following Seven towns/cities, (having population of more than 4 lacs as per 2001 Census and annual input energy of the order of 350 MUs) of Tamil Nadu are eligible for implementation of SCADA/DMS under Part-A. 1) Chennai, 2) Madurai, 3) Coimbatore, 4) Tiruchy, 5) Salem, 6) Tirunelveli and 7) Tiruppur. The total sanctioned cost of SCADA/DMS projects is 182.17 crores

1.5.2 Part - B Scheme Works

The Part – B scheme work consists of distribution strengthening work which involves implementation of High Voltage Distribution System to reduce the losses to the maximum extent possible. TANGEDCO is planning to reduce the losses to less than 15% by implementing R-APDRP.

Part-B schemes for 87 towns have been sanctioned in five slots for a total of Rs. 3279.56 crores.

2 ABOUT THE COMPANY

2.1 NAVAYUGA GROUP

The Navayuga Group is a multi-dimensional corporate entity with an extremely diversified portfolio that includes mammoth public infrastructure in roads, bridges, metro rail, marine works, IT/ITES companies, ports, power projects and behemoth steel units. It remains the Indian leader by far when it comes to piling, and is now taking its banner across the ocean into the Middle East. Its IT/ITES companies have already established a presence in most geographical sectors.

With what's what of quality accreditations under the belt and a history replete with records and certificates of commendation from private and public sector clients, the company's future trajectory is set with an estimated 10 billion USD in top line over the next 5 years. Plans are also underway to add to the talented and brilliant pool of manpower in a big way every year in order to meet the exponential growth and meteoric rise of the Group on the world horizon.

"To become a pioneering innovator and major player in Indian & International markets, and reach a revenue of more than 10 billion USD over the next 5 years."

2.2 NAVAYUGA INFOTECH

The Group's niche technologies' company, Navayuga Spatial is just 2 years old and already creating benchmarks. It recently bagged the biggest GIS project in the history of the nation, valued at Rs 120 crore. Spatial's global recognition and respect encourages us to believe this is only the beginning.

3 STUDY AREA

Kumananchavadi is a suburb of the city of Chennai in Tamil Nadu, India. It is an upcoming residential suburb located between Iyyapanthangal and Poonamallee on the Mount-Poonamallee Road which is 13.0464° N and 80.1155° E. Thirumudivakkam is a village panchayat located in the Kanchipuram district of Tamil-Nadu state, India. The latitude 12.9671° N and longitude 80.08338° E are the geocoordinate of the Thirumudivakkam.

4 GEO SPATIAL TECHNOLOGY

4.1 UTILISATION OF GIS

Geospatial technology is emerging as a technology to reckon with in diverse applications, with decision making becoming more informed and scientific. It has been identified as one of the three most important emerging fields along with nanotechnology and biotechnology because of its ability to provide unbiased, reliable, repetitive and synoptic nature of data as well as tools for integration of information for analysis, which is very useful in the management and monitoring of natural resources. This project analyses how GIS is being used in R-APDRP (Restructured-Accelerated Power Development and Reform Program) project at Kumananchavadi and Thirumudivakkam villages for improving the power scenario through electrical network mapping and consumer surveying.

4.2 PROBLEMS FACED

AT & C losses are in the range of above 15% during transmission and the present problem statements are:

- Inefficient supply of electricity
- Inordinate time consumption is attending faults
- Electricity theft
- AT & C loss management
- High involvement of manpower

These problems can be largely addressed by the use of GIS.

4.3 OBJECTIVES OF THE STUDY

The present paper aims to highlight the following set of objectives:

- To assess the status of use of geospatial technology in Kumananchavadi and Thirumudivakkam village area.
- To understand the distribution reforms of electrical network mapping and consumer surveying using geospatial technology.
- To study how GIS can help to reduce losses and to improve energy efficiency through its following contributions.

5 METHODOLOGY

5.1 GIS COMPONENT IN R-APDRP PROJECTS

The GIS part in RAPDRP includes four components namely base map preparation, asset mapping, consumer indexing through DGPS survey and integration of GIS-based digital electricity network as depicted below.

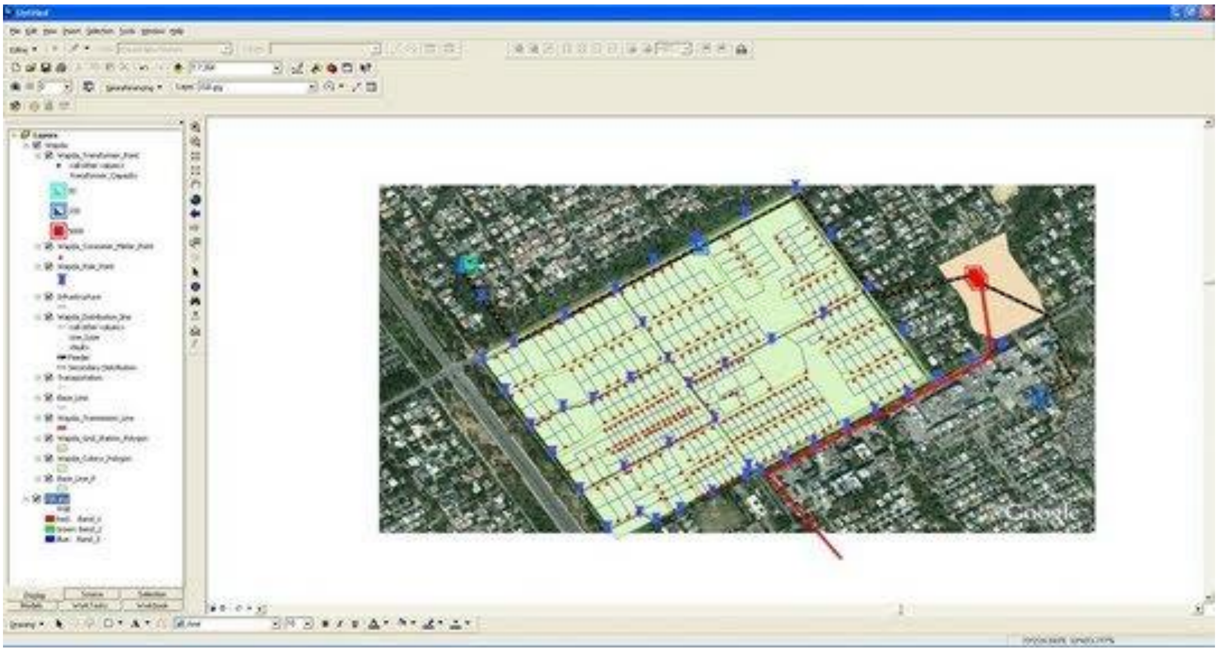


Figure 1: Integration of GIS – based digital electricity network

5.2 DATA USED

5.2.1 Base Map

The base map was created for the project areas using DigitalGlobe satellite imagery. The following steps were involved in the generation of large-scale digital base map using high-resolution satellite data:

- Procurement of satellite imagery
- Control point survey using DGPS – geodetic quality dual frequency GPS
- Geo-rectification/geo-referencing of the satellite imagery
- Capturing the base map features as per the specifications
- Topology creation and attribute linking
- Seamless base map generation

The base map used for this project is depicted in the next page which consists of the google imagery of Chennai and its surroundings with 15m spatial resolution.

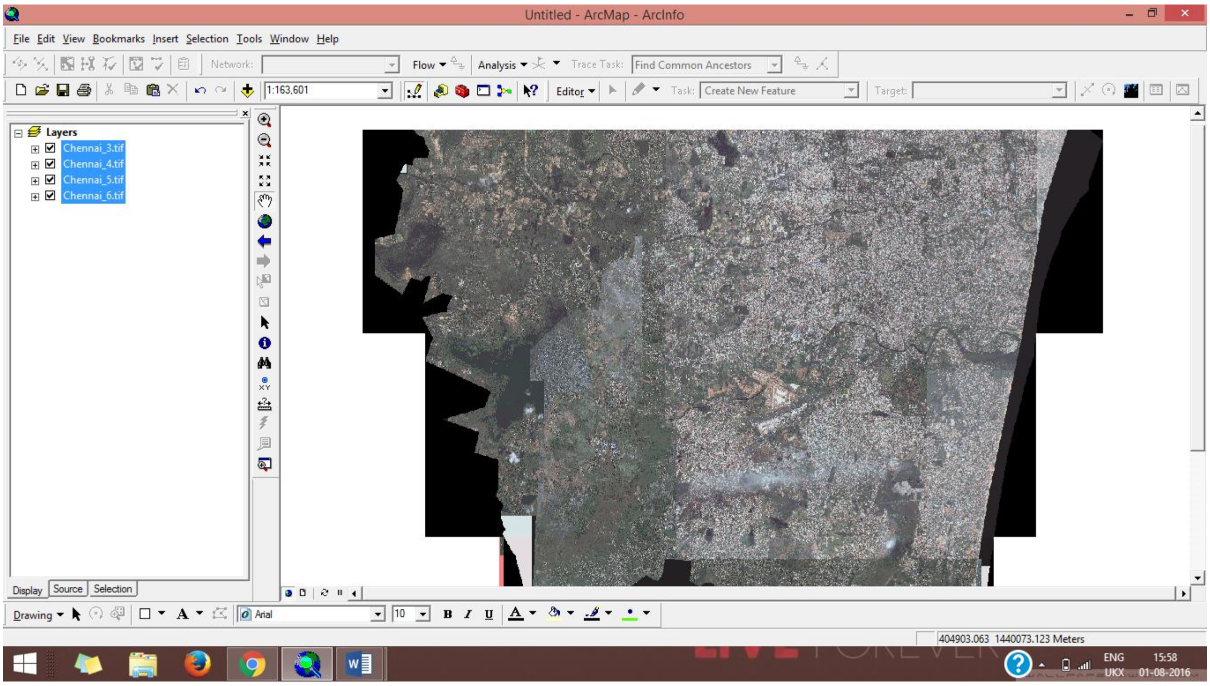


Figure 2: Base map of the study area

5.2.2 Field Mapping

The purpose of this was to create, edit and use GIS maps in the field. One important aspect of field mapping is to plot out the ground reality on the map. The GIS expertise works as follows:

- The town boundary identification and mapping within the project area i.e. ring fencing is provided.
- Digitisation of base layers including roads, railways, rivers, canals, water bodies, buildings.
- Collection of important landmarks like government offices, religious places, road crossings etc to update the map
- DGPS survey of sub meter accuracy of substations ex. 110/11KV at Thirumudivakkam substation with attributes in the prescribed format. There are three 11kv feeders at Thirumudivakkam substation. In these three feeders, all the technical attributes such as pole, conductor, type, length etc. were mapped onto the geo-referenced satellite data on a scale of 1:2000 in electrical network. GPS survey was done to capture the location and attribute information about poles, distribution transformers (DTs) and lines etc acquired from the field.
- Identification and mapping of HT (high tension) feeders and collection of attributes such as type of poles, size of conductor etc. through DGPS survey.

- Identification and mapping of LT (low tension) feeders through DGPS survey and collection of all attributes associated with LT poles.
- Attribute details of network: 11KV HT/LT line diagram with ACSR conductor size and length, cable size, DTs capacity, parameters of the equipments, HT/LT poles / pillars.
- Distribution transformer details: The details about transformers such as voltage ratio, capacity, and feeder details etc.
- This network database has a linkage with consumer data base.
- Identification and mapping of all consumers with meters through door-to-door survey.
- Codification of all assets and consumers as per codification scheme in the distribution network analysis.
- Assets codes of all assets such as DTs, poles, were legibly painted on the asset as per specified colour code preparation etc to be done before painting.
- The soft and hard copy as per requirements of the utility were generated.
- Consumer details: This involves identification of all service numbers, address of the consumers, the LT pole number/pillar box number to which consumer is connected.

5.3 GIS – BASED CONSUMER DATABASE INDEXING

The consumer services are categorised as tariff war, feeder war, DT war. These are indexed with consumer profile. This activity includes:

- Plotting the base map with important landmarks as labels for data collection purposes
- Collecting information from DTs, poles, consumers etc.
- Data entry made in the field forms
- Attributing of all information in GIS
- Creating the data model

5.4 SRS Objectives

The requirement for Asset Mapping and Consumer Indexing is defined in the R-APDRP SRS under the Section G 4 DGPS Survey, Consumer Indexing and Asset Mapping. This design document "Asset Mapping and Consumer Indexing Design" is developed for review and approval from the TANGEDCO defining the asset's attributes and consumer indexing attributes. The survey data will be submitted in the following design format.

Following SRS objectives have been taken into consideration while developing the asset codification and consumer indexing mechanism describe in subsequent sections:

5.4.1 Generic

- ✓ Providing a GIS based Unique Customer Indexing, mapping and asset coding for the electrical distribution system network entities (66KV/33KV and below) of the Utility.
- ✓ The indexing has to be carried out in a way by which it would be possible to relate the following:
    1. The administrative control hierarchy.
    2. The geographical location.
    3. The Customer code to indicate the type of Customer, serial number of Customer, source of power supply (poles/feeder pillar box (over/under ground)), phase and the 'DT' from which the customer is served.
- ✓ This code is primarily for quick mapping and sorting of the asset element.
- ✓ The indexing scheme shall be tightly coupled with the GIS system to give data with reference to geographical location.
- ✓ It shall be possible to view upstream and downstream data from a selected element
- ✓ Asset code number is meant for internal linkage of Customer with nearest entity and asset entity with others.

5.4.2 Asset

- ✓ Each of the elements likes 66kV lines/33 KV lines, power transformers, 11 KV feeders, feeder branches up to Distribution transformers to poles, LT feeder circuits, LT poles/feeder pillar boxes (over/under ground) shall be uniquely indexed with defined relationships based on the normal mode of feeding LT Line
- ✓ The electrical network must be uniquely coded with location to facilitate easy and quick retrieval from GIS.
- ✓ The entire information of all the assets and object elements should be stored in a database by unique computer generated numeric code and should be correlated with existing code of the UTILITY.
- ✓ The coding should be on a structured pattern and have provision for insertion of new component into the system.

- ✓ Provide connectivity to the uniquely coded electrical network.
- ✓ The Geographical location of electrical division & sub-division and a candidate power substation, electrical connectivity and technical parameters wherever applicable etc. shall be made available on query for tracking any asset or Customer.

5.4.3 Consumer

- ✓ The codification logic shall be developed to limit the code number digits to six to eight for Customers.
- ✓ Uniquely indexing each Customer based on the electrical system network information.
- ✓ The indexing work shall cover Sub-transmission network i.e. all assets and Customers covered by 66kV/33KV/11KV and LT network entities of the UTILITY.
- ✓ The consumer indexing process must be unique to include all types of consumer.
- ✓ Physically link of each customer on the map with the asset network.
- ✓ The asset code and Customer number so arrived at should be linked with the then existing asset code and Customer number of the UTILITY.
- ✓ Database should be able to furnish all the information of the particular element.
- ✓ The vendor shall submit the codification methodology during study phase for approval by the UTILITY.
- ✓ Listing of Customers by elements like Distribution Transformer wise, and LT feeder wise.
- ✓ Each of the Customers shall have an exclusive six to eight digit numeric code. This code shall be accepted by the system. The Customer code shall provide complete identity of the Customer as well as his connectivity to the electrical system profile.
- ✓ Customer code number shall be used for Metering, billing and all other service functions. Hence this code number will be available on the front end.

5.4.4 Assets Outside The Substation

All the assets that are not part of a substation and to be mapped will be detailed with the description including the attributes; the same will be defined and designed in the schema in the below sections.

5.4.4.1 High Tension (HT) Lines

Table 1: High Tension (HT) Lines

Dataset ID	AF_1	**Dataset Type**	Asset Feature
Feature/ Table Title	ASSET_HT_LINE	**Table Alias**	High Tension Line
Source	Asset Survey	**Feature Type**	Line Feature
Feature Definition	Electric supply line placed above ground in open air, hoisted overhead using support structures either a pole or a tower, for transmission or distribution of electricity. Generally found overhead can also be underground. A continuous connected supply line from a distribution station forms a feeder line or feeder network.		

5.4.4.2 Low Tension (LT) Lines

Table 2: Low Tension (LT) Lines

Dataset ID	AF_2	**Dataset Type**	Asset Feature
Feature/Table Title	Asset_LT_Line	**Table Alias**	LT Line
Source	Asset Survey	**Feature Type**	Line Feature
Feature Definition	Electric supply line placed above ground in open air hoisted overhead using support structures by poles, for distribution of electricity from the Distribution Transformer. Generally found overhead can also be underground.		

5.4.4.3 Service Lines

Table 3: Service Lines

Dataset ID	AF_3	**Dataset Type**	Asset Feature
Feature/Table Title	Asset_Service_Line	**Table Alias**	Service Line
Source	Asset Survey	**Feature Type**	Line Feature
Feature Definition	Line connecting the consumers from the HT / LT pole		

5.4.4.4 Implant Line

Table 4: Implant Line

Dataset ID	AF_4	**Dataset Type**	Asset Feature
Feature/Table Title	Asset_Implant_Line	**Table Alias**	Implant Line
Source	Asset Survey	**Feature Type**	Line Feature
Feature Definition	Line connecting the assets of network – to show the logical connectivity of assets located within the same location/ structure.		

5.4.4.5 High Tension Pole

Table 5: High Tension Pole

Dataset ID	AF_6	**Dataset Type**	Asset Feature
Feature/Table Title	Asset_LT_Pole	**Table Alias**	LT Pole
Source	Asset Survey	**Feature Type**	Point Feature
Feature Definition	A pole used to support overhead LT lines, and related equipment such as street lights.		

5.4.4.6 Low Tension Pole

Table 6: Low Tension Pole

Dataset ID	AF_6	**Dataset Type**	Asset Feature
Feature/Table Title	Asset_LT_Pole	**Table Alias**	LT Pole
Source	Asset Survey	**Feature Type**	Point Feature
Feature Definition	A pole used to support overhead LT lines, and related equipment such as street lights.		

5.4.4.7 Distribution Structure

Table 7: Distribution Structure

Dataset ID	AF_7	**Dataset Type**	Table
Feature/Table Title	Asset_Distribution_Structure	**Table Alias**	Distribution Structure
Source	Asset Survey	**Feature Type**	
Feature Definition	These are structures that contain any components of distribution network like transformer, switches, capacitors; isolators etc and operate at single voltage level.		

5.4.4.8 Distribution Structure for DT

Table 8: Distribution Structure for DT

Dataset ID	AF_7a	**Dataset Type**	Asset feature
Feature/Table Title	Asset_Distribution_Structure_DT	**Table Alias**	Distribution Structure
Source	Asset Survey	**Feature Type**	Polygon feature
Feature Definition	These are structures that contain distribution transformers.		

5.4.4.9 Distribution Structure for Ring Fencing Meter

Table 9: Distribution Structure for Ring Fencing Meter

Dataset ID	AF_7b	**Dataset Type**	Asset feature
Feature/Table Title	Asset_Distribution_Structure_RFM	**Table Alias**	Distribution Structure
Source	Asset Survey	**Feature Type**	Polygon feature
Feature Definition	These are structures that contain Ring fencing meter.		

5.4.4.10 Distribution Structure for HT Service

Table 10: Distribution Structure for HT Service

Dataset ID	AF_7c	**Dataset Type**	Asset feature
Feature/Table Title	Asset_Distribution_Structure_HT	**Table Alias**	Distribution Structure
Source	Asset Survey	**Feature Type**	Polygon feature
Feature Definition	These are structures that contain HT SERVICE (services other than RMG)		

5.4.4.11 Switching Structure

Table 11: Switching Structure

Dataset ID	AF_7d	**Dataset Type**	Asset Feature
Feature/Table Title	Asset_Switching_Structure	**Table Alias**	Switching Structure
Source	Asset Survey	**Feature Type**	Polygon Feature
Feature Definition	Structure that does not contain any transformer and operate at single voltage level.		

5.4.4.12 Ring Fencing Meter

Table 12: Ring Fencing Meter

Dataset ID	AF_8	**Dataset Type**	Asset Feature
Feature/Table Title	Asset_Ring_Fencing_Meter	**Table Alias**	Ring Fencing Meter
Source	Asset Survey	**Feature Type**	Point Feature

Feature Definition	Ring fencing is required for measuring the net input energy (difference of energy entering into and leaving) of the TANGEDCO Town boundaries / operational area is electrically ring fenced through: • Installation of import/export meters at the boundary of those lines that are feeding outside as well as inside area of operation so that import and export of energy can be measured for the town. These lines may emanate from the sub-stations located within or outside towns. • Import/export meters on the dedicated feeder emanating from sub-stations located within town area but feeding outside town area. • Import/export meters on 33/11 kV sub-stations LILO/tie lines. In other words, these are the points from where the energy is either received or sent out of the TANGEDCO's Town boundary identified as the project area under the R-APDRP.

5.4.4.13 Distribution Transformer

Table 13: Distribution Transformer

Dataset ID	AF_9	**Dataset Type**	Asset Feature
Feature/Table Title	Asset_DT	**Table Alias**	Distribution Transformer
Source	Asset Survey	**Feature Type**	Point Feature
Feature Definition	Reduce the electrical energy (volts) from HV (11-33kV-22kV) to LV (440V) required for distribution to consumers. Distribution transformer is usually last in the chain of electric supply network. Often mounted on a pole or a plinth.		

5.4.4.14 DT Energy Meter

Table 14: DT Energy Meter

Dataset ID	AF_10	**Dataset Type**	Asset Feature

Feature/ Table Title	Asset_DT_Energy_Meter	**Table Alias**	Energy Meter
Source	Asset Survey	**Feature Type**	Point Feature
Feature Definition	These are energy meters installed at the Distribution Transformers to measure the energy out from the DT's		

5.4.4.15 Distribution Isolator (Only for HT)

Table 15: Distribution Isolator (Only for HT)

Dataset ID	AF_11	**Dataset Type**	Asset Feature
Feature/Table Title	Asset_DI	**Table Alias**	Distribution Isolator
Source	Asset Survey	**Feature Type**	Point Feature
Feature Definition	Equivalent to switches controlled by a single mechanism (SPST) means simple on-off switch. Isolator switch isolates (disconnects) BOTH the Live (brown) and neutral (Blue) wires at the same time. This is defined for switch operations at HT side.		

5.4.4.16 Fuse

Table 16: Fuse

Dataset ID	AF_12	**Dataset Type**	Asset Feature
Feature/Table Title	Asset_Fuse	**Table Alias**	Fuse
Source	Asset Survey	**Feature Type**	Point Feature
Feature Definition	Electric fuse is a safety device used to protect an electric circuit against an excessive current. The fuse metal melts to provide rapid arc extinction, and which drops to an open-circuit position readily distinguishable from the ground.		

5.4.4.17 UTS (Unitised Transformer)

Table 17: UTS (Unitised Transformer)

Dataset ID	AF_13	**Dataset Type**	Asset Feature
Feature/Table Title	Asset_UTS	**Table Alias**	Unitized Transformer
Source	Asset Survey	**Feature Type**	Point Feature
Feature Definition	Type of Distribution Structure		

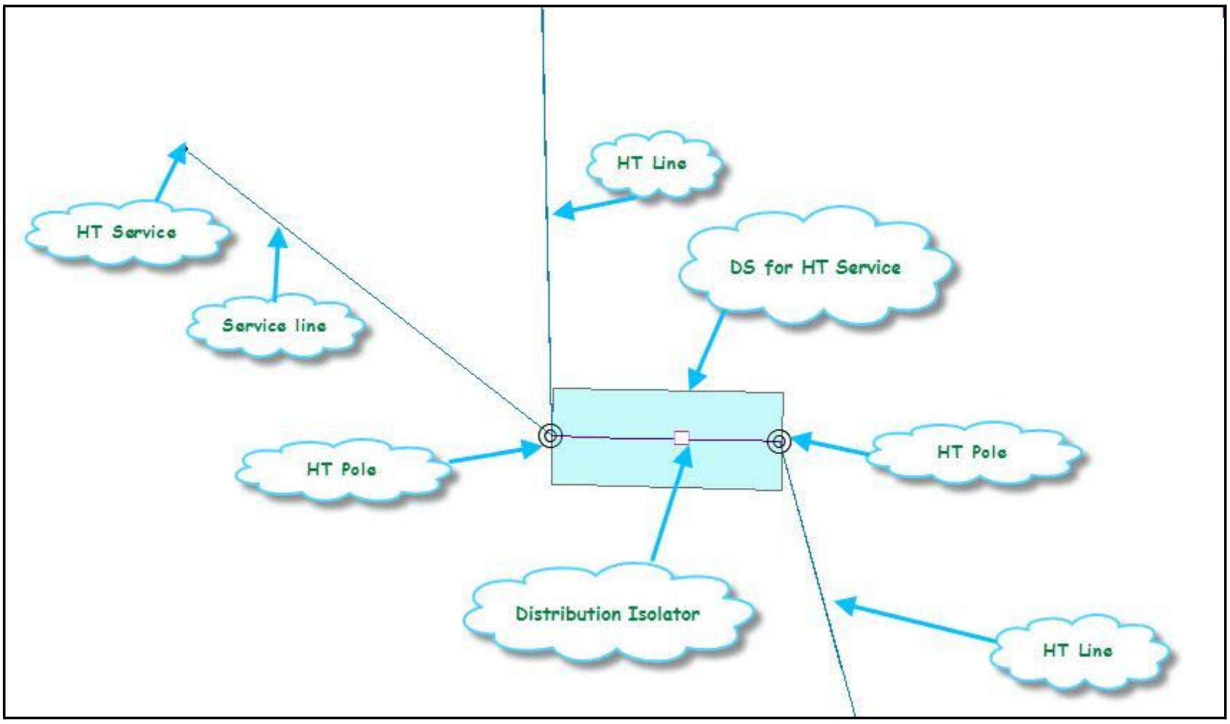


Figure 3: GIS representation of internal arrangements for overhead

5.4.5 Assets Outside Substation – Underground Network

The following elements are found in the underground network of assets outside substation

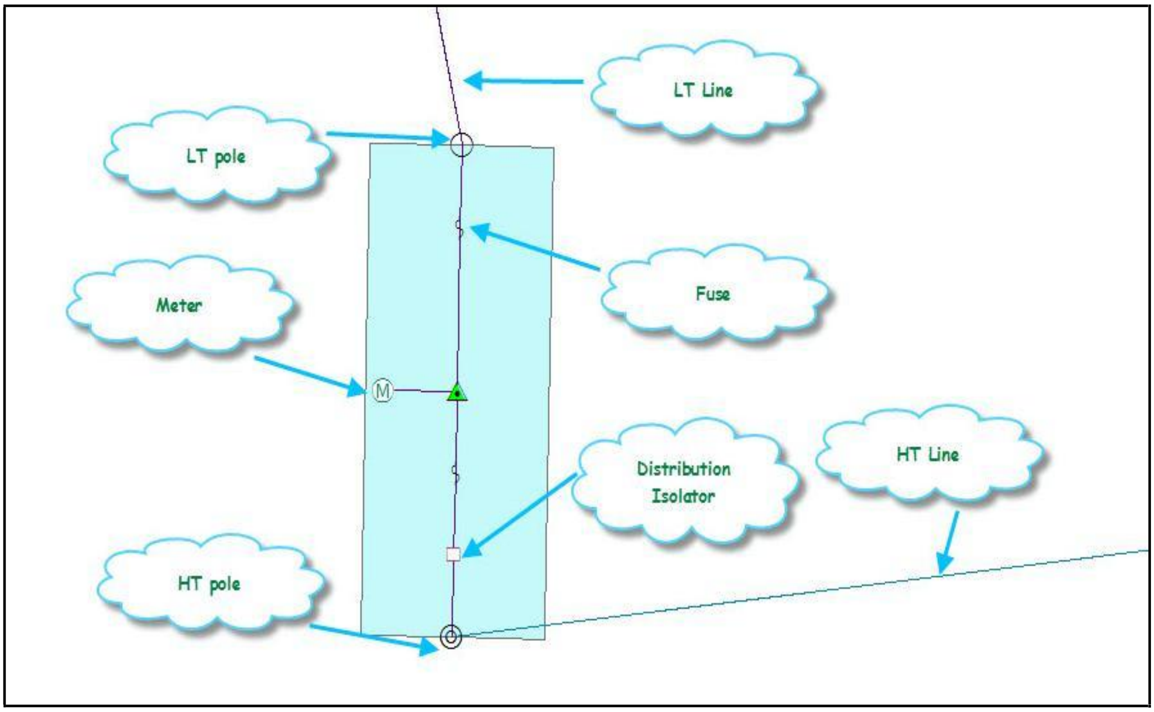


Figure 4: Distribution Structure Arrangement for DT with one HT Feeder

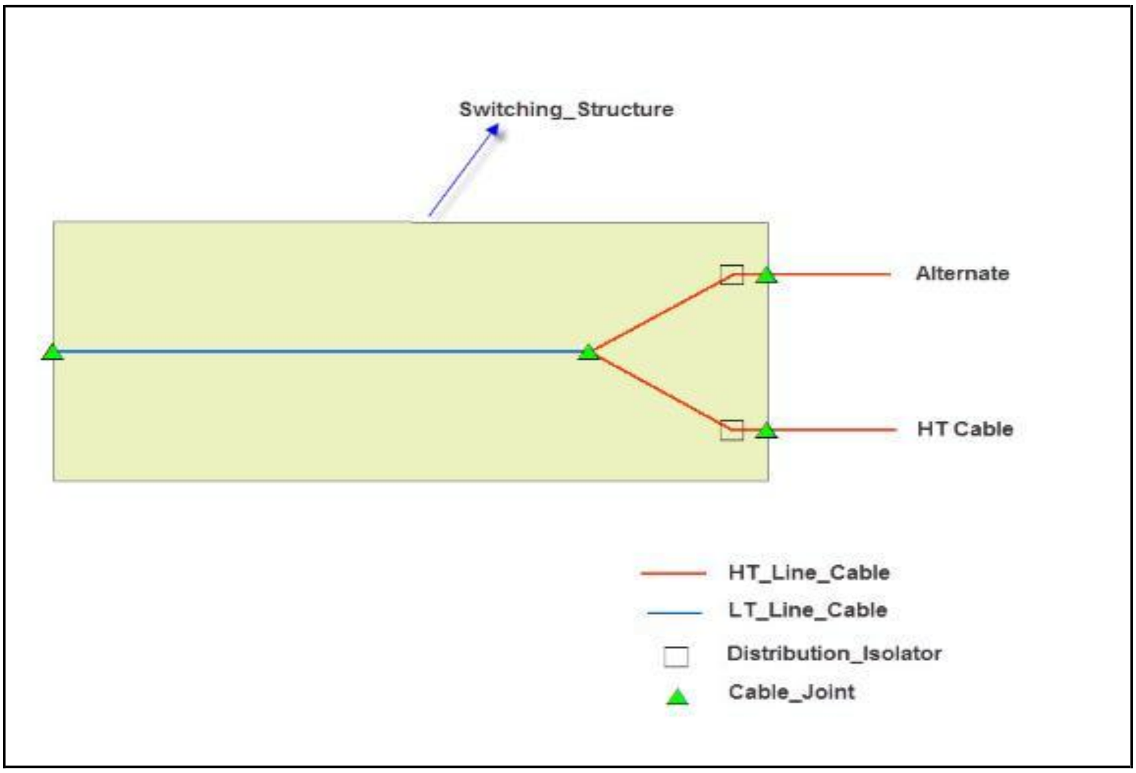


Figure 5: Arrangement for switching Structure

5.4.5.1 Pillar

Table 18: Pillar

Dataset ID	AF_14	**Dataset Type**	Asset Feature
Feature/Table Title	Asset_Pillar	**Table Alias**	Pillar
Source	Asset Survey	**Feature Type**	Polygon feature
Feature Definition	Metallic Large box where the .415 kv line to line voltages are connected to streets from which the consumers tap their single phase line for usage. Inside the feeder pillar are bus bars which are connected to each other through a tiny thick metallic wire called fuse. Bus bar arranged such that three phase 4 wire systems is splintered into several units. Normally used to bifurcate underground power cables. These are the first box next to DT's in the UG network. The second and subsequent pillar are referred as service pillar		

5.4.5.2 Cable Joints

Table 19: Cable Joints

Dataset ID	AF_15	**Dataset Type**	Asset Feature
Feature/Table Title	Asset_Cable_Joints	**Table Alias**	Cable Joints
Source	Asset Survey	**Feature Type**	Point Feature
Feature Definition	Cable joint is a joint where two or more cables are joined together to provide the degree of electrical conductivity required by the electrical system without any voltage drop or energy loss		

5.4.5.3 HT Line Cable

Table 20: HT Line Cable

Dataset ID	AF_17	**Dataset Type**	Asset Feature
Feature/Table Title	Asset_HT_Line_Cable	**Table Alias**	High Tension Line Cable

Source	Asset Survey	**Feature Type**	Line Feature
Feature Definition	Electric supply Cables placed under ground and connected using pillars or Cable joints, for transmission or distribution of electricity. A continuous connected supply line from a distribution station forms an electricity network.		

5.4.5.4 LT Line Cable

Table 21: LT Line Cable

Dataset ID	AF_18	**Dataset Type**	Asset Feature
Feature/Table Title	Asset_LT_Line_Cable	**Table Alias**	LT Line Cable
Source	Asset Survey	**Feature Type**	Line Feature
Feature Definition	Electric supply Cables placed under ground and connected using pillars or Cable joints, for distribution of electricity. A continuous connected supply line from a distribution station forms an electricity network.		

5.4.5.5 Distribution Box

Table 22: Distribution Box

Dataset ID	AF_19	**Dataset Type**	Asset Feature
Feature/Table Title	Asset_Distribution_Box	**Table Alias**	Distribution Box
Source	Asset Survey	**Feature Type**	Point Feature
Feature Definition	Distribution box is a component of an electricity supply system which divides an electrical power feed into subsidiary circuits, while providing a protective fuse or circuit breaker for each circuit, in a common enclosure. Normally, a main switch, and in recent boards, one or more Residual-current devices (RCD) or Residual Current Breakers with Over current protection (RCBO), will also be incorporated.		

5.5.6 Assets Inside Substation

All the assets that are part of a substation and to be mapped will be detailed with the description including the attributes; the same will be defined and designed in the schema in the below sections.

5.5.6.1 Substation

Table 23: Substation

Dataset ID	AF_23	**Dataset Type**	Asset feature
Feature/ Table Title	Asset_Substation	**Table Alias**	Substation_boundary
Source	Asset Survey	**Feature Type**	Polygon Feature
Feature Definition	A substation is a part of an electrical generation, transmission, and distribution system. Substations transform voltage from high to low, or the reverse, or perform any of several other important functions		

5.5.6.2 Feeder Line

Table 24: Feeder Line

Dataset ID	AF_24	**Dataset Type**	Asset Feature
Feature/Table Title	Asset_FLC	**Table Alias**	Feeder_Line
Source	Asset Survey	**Feature Type**	Line Feature
Feature Definition	A feeder line is part of an electric distribution network, usually a radial circuit of intermediate voltage.		

5.5.6.3 Feeder Meter

Table 25: Feeder Meter

Dataset ID	AF_25	**Dataset Type**	Asset Feature
Feature/Table Title	Asset_Feeder_Meter	**Table Alias**	Feeder Meter

Source	Asset Survey	**Feature Type**	Point Feature
Feature Definition	These are feeder Meters which are installed on each of the feeders going out from the Substation.		

5.5.6.4 Current Transformer

Table 26: Current Transformer

Dataset ID	AF_26	**Dataset Type**	Asset Feature
Feature/ Table Title	Asset_CT	**Table Alias**	Current Transformer
Source	Asset Survey	**Feature Type**	Point Feature
Feature Definition	Produces an alternating current (AC) in its secondary which is proportional to the AC current in its primary.		

5.5.7 Consumer

The section below details the list of the consumers and its attributes for the design of schema for Consumer Indexing. Below mentioned details have been taken from the R-APDRP's RFP and in detailed discussions with the TANGEDCO team and Navayuga Team.

5.5.7.1 HT Consumers

Table 27: HT Consumers

Dataset ID	CS_1	**Dataset Type**	Consumer Feature
Feature/Table Title	Consumer_HT	**Table Alias**	HT Customer
Source	Consumer Survey	**Feature Type**	Point Feature
Feature Definition	High tension or HT supply is applicable for bulk power purchasers who need 11 kilo-Volts or above.		

5.5.7.2 LT Consumers

Table 28: LT Consumers

Dataset ID	CS_2	**Dataset Type**	Consumer Feature
Feature/Table Title	Consumer_LT	**Table Alias**	LT Customer
Source	Consumer Survey	**Feature Type**	Point Feature
Feature Definition	Most small consumers of electricity like individual houses, shops, small offices and smaller manufacturing units get their electricity on LTconnection.		

5.5.7.3 LTCT Consumers

Table 29: LTCT Consumers

Dataset ID	CS_3	**Dataset Type**	Consumer Feature
Feature/ Table Title	Consumer_LTCT	**Table Alias**	LTCT Customer
Source	Consumer Survey	**Feature Type**	Point Feature
Feature Definition	NA		

The consumer contains three types .HT, LT , LTCT. All the consumers number will have 12 digits.

For consumer_LT and consumer_LTCT: (section code is responsible)

- The first 2 digits indicate REGIONAL CODE. For example :08
- Next 3 digits indicate SECTION CODE.
- Next 3 digits indicate DISTRIBUTION CODE (003 for 3 , 004 for 4).
- Next 4 digits indicate SERVICE NUMBER. This is called as running number like 0001, 0002 etc.

For CONSUMER_HT: (circle code is responsible)

- First 2 digits indicate REGIONAL CODE.
- Next 3 digits is 909.
- Next 3 digits indicate CIRCLE CODE.
- Next 4 digits indicate running number.

6 DISCUSSION AND INFERENCE

TNEB observed the following benefits:

- ✓ It was able to clearly ascertain the location of all consumers and their distribution spatially.
- ✓ The connectivity and spread of consumers of one distribution zone to other zones were clearly identified and rectified.
- ✓ The organisation was able to extract the number and details of consumers connected to a specific transformer and poles.
- ✓ It was able to have a centralised HT and LT network album and was able to plan the location of new transformer erection based on the spatial distribution of network and consumers.
- ✓ TNEB was able to extract the different categories of consumers based on the tariff category, consumption (HT / LT / LTCT / agri / hut / industrial / commercial etc).
- ✓ TNEB was able to assess the sanctioned load of various consumers for a DT against the DT capacity, identifying the DT load and planning for revised network connectivity.
- ✓ The organisation could identify and locate the missing consumers based on LT billing database and was able to locate / identify the defaulters and their spatial distribution. As few towns are rolled out for go-live with complete enterprise operations, TNEB was able to identify the peak load of given transformer and able to analyse the power requirements and reasons based on the spatial distribution and connected consumers
- ✓ TNEB was able to identify the location of consumers and reasons during fuse of call service.
- ✓ When the HT consumers and DT's are connected with AMR and modem with SIM's, the energy recordings took place in near real time and the organisation was able to spatially plot the energy consumption of different meters.

On successful implementation and further rollout, TNEB expects the GIS implementation to help it in

- ✓ Efficiently managing power supply
- ✓ Locating the fault on line, service mains
- ✓ Attending faults in minimum time
- ✓ Identifying and reducing the theft / waste.
- ✓ Providing consumer satisfaction
- ✓ Improving image of the organisation

7 CONCLUSION

It is evident from the preceding discussion that geospatial technology has emerged as a powerful and imperative system in R-APDRP. GIS is used for asset mapping and consumer indexing and thus the whole power distribution system has greatly enhanced the efficiency in energy sector and to improve the reliability of the whole power system. GIS can play a strong role in managing the “smart grid” and it is the complete installation of smart meters which implies an intelligent electric delivery system that responds to the needs and directly communicates with consumers. The tariff-wise consumer profile load details, in each feeder can be calculated through GIS for accounting of total energy sold out and it can evaluate the AT&C loss. Consumer details can be updated and revenue billing and collection and future load demand can be calculated.

The ATC losses are computed to be around 16% in the initial results (2012-2013) from the pilot town and the refinements being made after the study of results along with the GIS network and consumer mapping and the installation of HVDS (high voltage distribution system), by strengthening of conductors, the losses are expected to be reduced from 16% to 10 % in the coming months. GIS can effectively be used to manage and monitor information on the distribution of electricity to end-users.

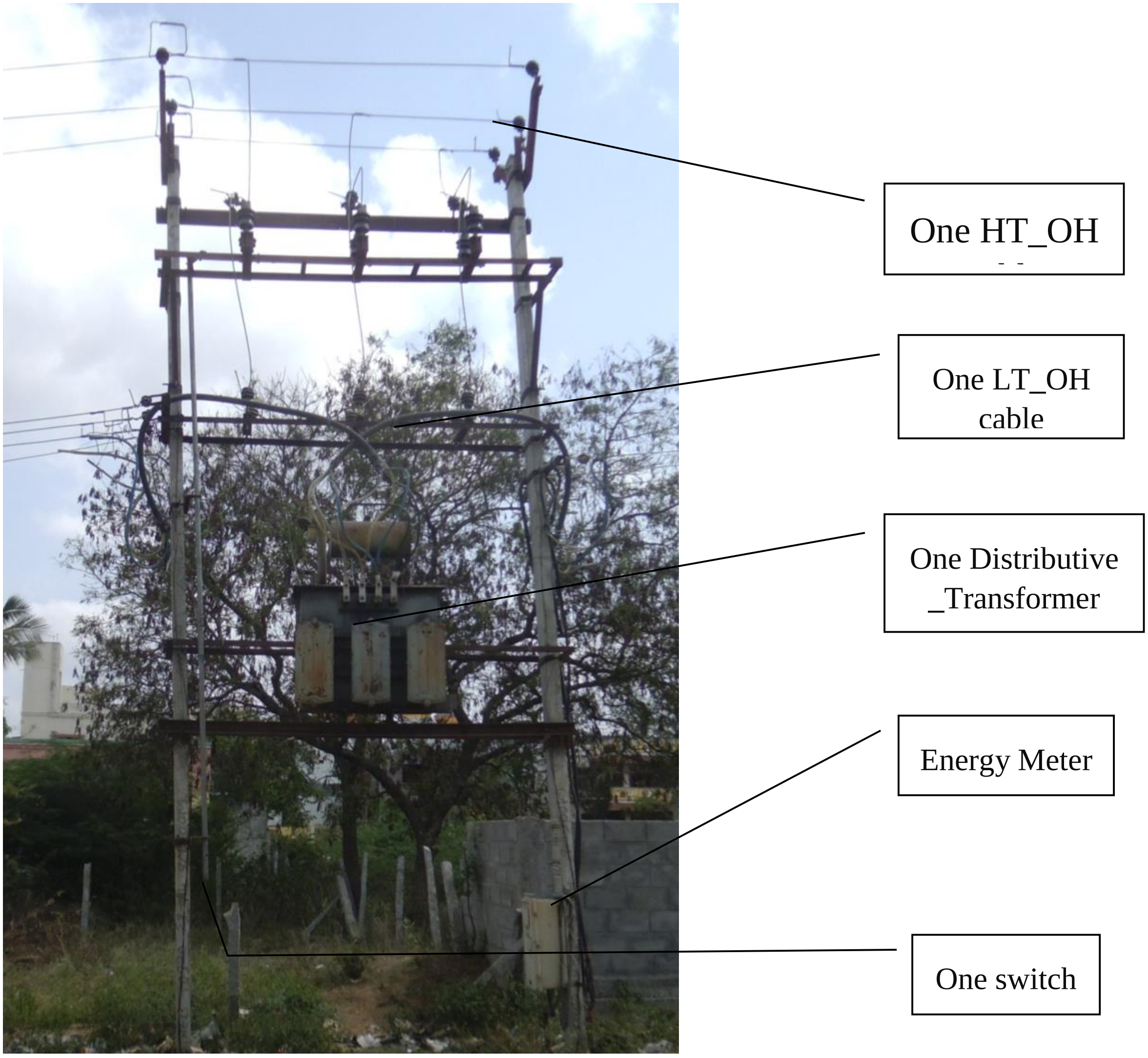
The use of GIS in power distribution network has greatly improved the efficiency in energy sector; improving the reliability of distribution network. This study is to improve the understanding and networking of electricity power distribution in an efficient manner. The electricity distribution facilities, such as power lines, transformers, service mains are involved in the distribution of energy to the end-users with the aid of variety of information can be better organised on the computer system linking the master data base to an output map. This information helps in spatial decision making and is easily updateable for the needs of large power distribution network. This geographical data can be used for the purpose of studying and analysing the present power scenario. Hence it plays a strong role in smart grids.

8 **APPENDIX – EXCERSISE**

8.0 WEEK 0

CONSTRUCTION OF DT_STRUCTURE

- Primarily, Basic introduction and instructions were given based on DT_structures and Few Transformer images were given as examples.
- We created the DT_strucured based on the “**bkp_mudi division**” photos.
- We arranged the DT structure by studying the give photos of the transformer.



- Open ArcMAP →Add data→**Thirumudivakkam_DB**→Assert→Zoom to layer for further work.
- Open ArcMAP → Tools → Customize →Commands Toolbar → **“DTR ARRANGEMENT for UG**” tool was used in order to construct the dt_strcuture.
- In the given arrangement layer drop down box select **“Assert_Distribution_Structures_DT”**, Click→ Selection location points , we had to select the starting and the ending point after which the Dt_Structure gets constructed.
- The construction of the Dt_structure should always be parallel or perpendicular to the HT_Line.
- The Dt_arrangements has many types of arrangement, we employed few of which includes

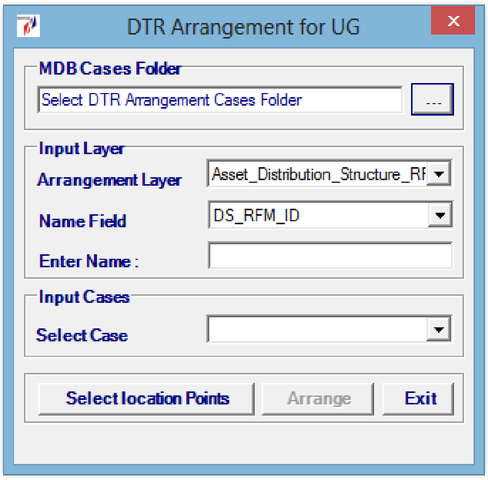
1. HT_pole with one Isolator and one Transformer structure.

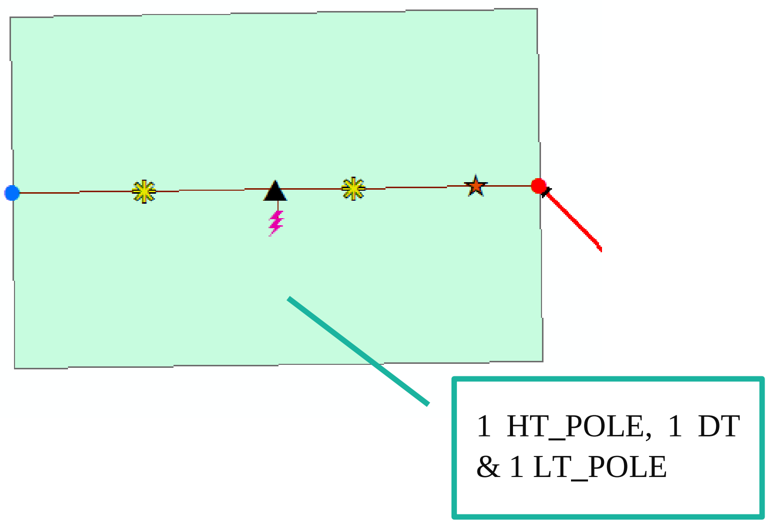
2. Two HT_Pole with three Isolators in which one is only TRUE through which the
current passes other two are FALSE.

3. Two Transformer structures with two Energy meter used for power transmission in large area supply. This type of structure is very rare and complicated.

4. One HT_Pole, LT_Pole, DT_Transformer and a LT_UG_cable .

Normally most of the structures includes one transformers.





CONNECTION :

- ❖ The LT_line should be connected to the LT_Pole or LT_Line_cable and the HT_Line or HT_Line_cable should to the HT_Pole respectively.
- ❖ HT_pole can have only one line connection , when more than one is connected it shows ERROR.

DATA ENTRY FOR THE TRANSFORMER :

- ❖ Right Click on DT_Transformers→Open Attribute table →The Transformers Type, Date, Make, Volts in Ampere etc are entered along with its State code and Division Name.
- ❖ Similarly, The obtained survey data are enter in various components like LT_Pole, HT_Pole, HT_line, LT_line, Distributive Isolator, Energy meter, Fuse etc. of the DT_Structure carefully.
- ❖ Fields are added , Open attribute table→Option→New field→select name and type→ click OK.

ERRORS FACED DURING THE PROCESS:

- ❖ Snapping error (happens when two attribute is not snapped properly, leads to connection error in later stage.)
- ❖ Wrong arrangement of Dt_Structure.
- ❖ Direction of flow when ambiguous and not in specific direction
- ❖ Implant line breakage error.
- ❖ Void of neither HT nor LT pole in the structure.
- ❖ Man-Made errors (deleting of some attribute without knowledge, misplacing attributes, all lead to error.)

8.1 WEEK 1

- ❖ **Arc GIS 9.3** was successfully installed in the System.
- ❖ The Required **Arcgis Tools** for The Project were installed. The following tools were installed:

- ✓ **Circuit Number Updation installer:** This TNEB Tool is used for updating the circuit numbers in the layers asset_LT_line,asset_LT_pole and Distribution_structure_DT.
- ✓ **Convert shape To PGDB tool:** It Converts Shape File to Personal Geodatabase Format.
- ✓ **Data Validation Tool:** Validates the PGDB and gives an error log saved in txt format with their respective object ID.
- ✓ **Domain values Checking Installer:** Domain values are checked and Text log files are created in the feature class wise.
- ✓ **Unique ID Generation Installer:** Unique ID is generated with The given Template in the features.

Data is given in the form of shapefile. Shapefile is converted to Personal geodatabase format (PGDB).PGDB consists of several layers of data in a single dataset file. Standardisation of data is possible in PGDB format.

Conversion of outside substation (SS) dataset to PGDB format in Kumananchavadi and Thirumudivakkam village:

i. Select shape to PGDB migration tool.

ii. Input the shapefile initially.

iii. Select the target location and name the output file.

iv. Maintain the source feature class and target feature class.

v. Can also select “automatch”[but manual checking is necessary]

vi. Click SAVE

vii. Next select field and match the source feature class and target feature class similarly

viii. Feed the feature class output file as output file as input in the load and click append.

ix. Data migration STARTS.

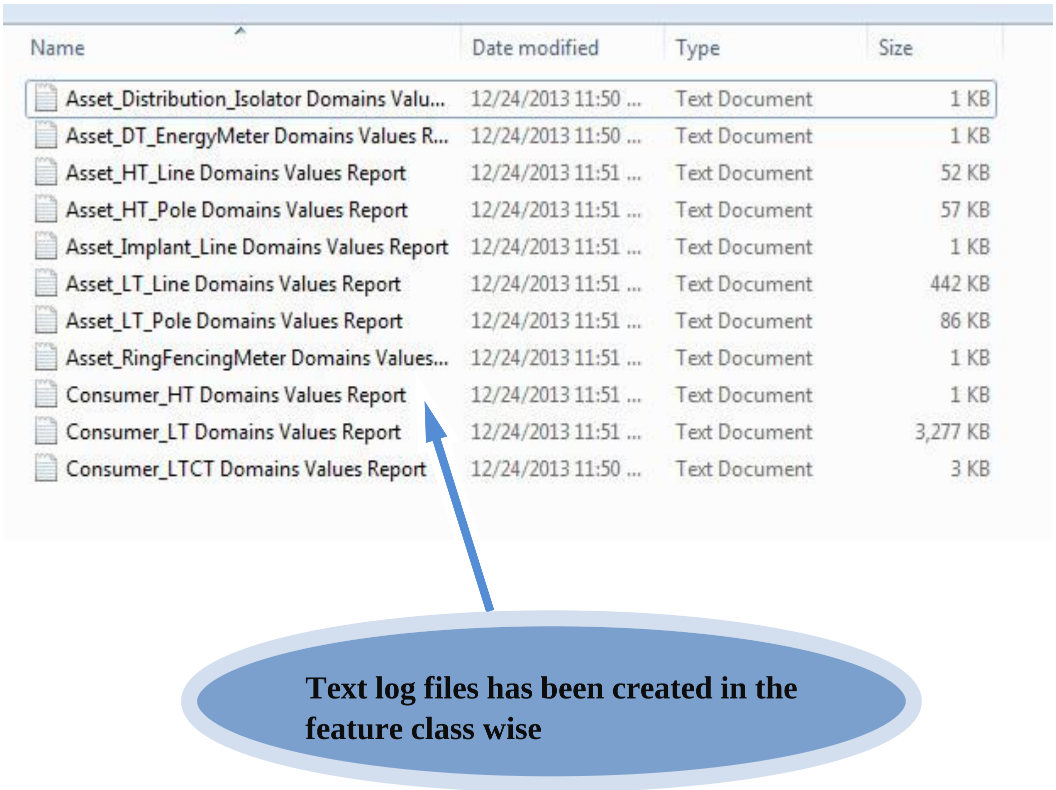
Thirumudivakkam was given for DATA validation. The Data given is displayed bellow:

Domain value Checking: Domain values are given standardized value for a given field.Thus the domain values are checked for all the features in the Katpadi substation and log error files are created in text file format.

Open ArcMAP → Tools → Customize →Commands Toolbar → TNEB → Domain values checking. Select the Domain values Checking Command drag it to the tools menu. Add PGDB

When you click this command the following UI Form will be opened

Text files will be shown like this:



Name	Date modified	Type	Size
Asset_Distribution_Isolator Domains Valu...	12/24/2013 11:50 ...	Text Document	1 KB
Asset_DT_EnergyMeter Domains Values R...	12/24/2013 11:50 ...	Text Document	1 KB
Asset_HT_Line Domains Values Report	12/24/2013 11:51 ...	Text Document	52 KB
Asset_HT_Pole Domains Values Report	12/24/2013 11:51 ...	Text Document	57 KB
Asset_Implant_Line Domains Values Report	12/24/2013 11:51 ...	Text Document	1 KB
Asset_LT_Line Domains Values Report	12/24/2013 11:51 ...	Text Document	442 KB
Asset_LT_Pole Domains Values Report	12/24/2013 11:51 ...	Text Document	86 KB
Asset_RingFencingMeter Domains Values...	12/24/2013 11:51 ...	Text Document	1 KB
Consumer_HT Domains Values Report	12/24/2013 11:51 ...	Text Document	1 KB
Consumer_LT Domains Values Report	12/24/2013 11:51 ...	Text Document	3,277 KB
Consumer_LTCT Domains Values Report	12/24/2013 11:50 ...	Text Document	3 KB

1. Please verify the error logs and find the errors based on the Object Id as shown the error notepads as shown below.

Asset_LT_Pole Domains Values Report - Notepad

File Edit Format View Help

```
Domain Values errors Report
==========================================================================================
FeatureClass                              FIELD                          ObjectID
==========================================================================================
Asset_LT_Pole                           LTP_SL_TYPE                        6211
Asset_LT_Pole                           LTP_SL_TYPE                        6216
Asset_LT_Pole                           LTP_SL_TYPE                        6218
Asset_LT_Pole                           LTP_SL_TYPE                        6221
Asset_LT_Pole                           LTP_SL_TYPE                        6231
Asset_LT_Pole                           LTP_SL_TYPE                        6232
Asset_LT_Pole                           LTP_SL_TYPE                        6236
Asset_LT_Pole                           LTP_SL_TYPE                        6237
Asset_LT_Pole                           LTP_SL_TYPE                        6238
Asset_LT_Pole                           LTP_SL_TYPE                        6239
Asset_LT_Pole                           LTP_SL_TYPE                        6240
```

The major Domain or constraint for the error logs are as follows:

Field Name	Data Type	Field Description	Null/Not Null	Constraint
HTL_ID	Varchar(30)	Internal Line Identification No.	Not Null	PK
HTL_AIN	Varchar(15)	Asset Identification Number (AIN)	Not Null	
HTL_EHT_HT	Varchar(10)	HT Line Type	Not Null	CK • EHT • HT
				•
HTL_VOLT_KV	Decimal(6,2)	Power line Voltage in KV	Not Null	CK • 400 • 230 • 110 • 66 • 33 • 22 • 11 • 6.6

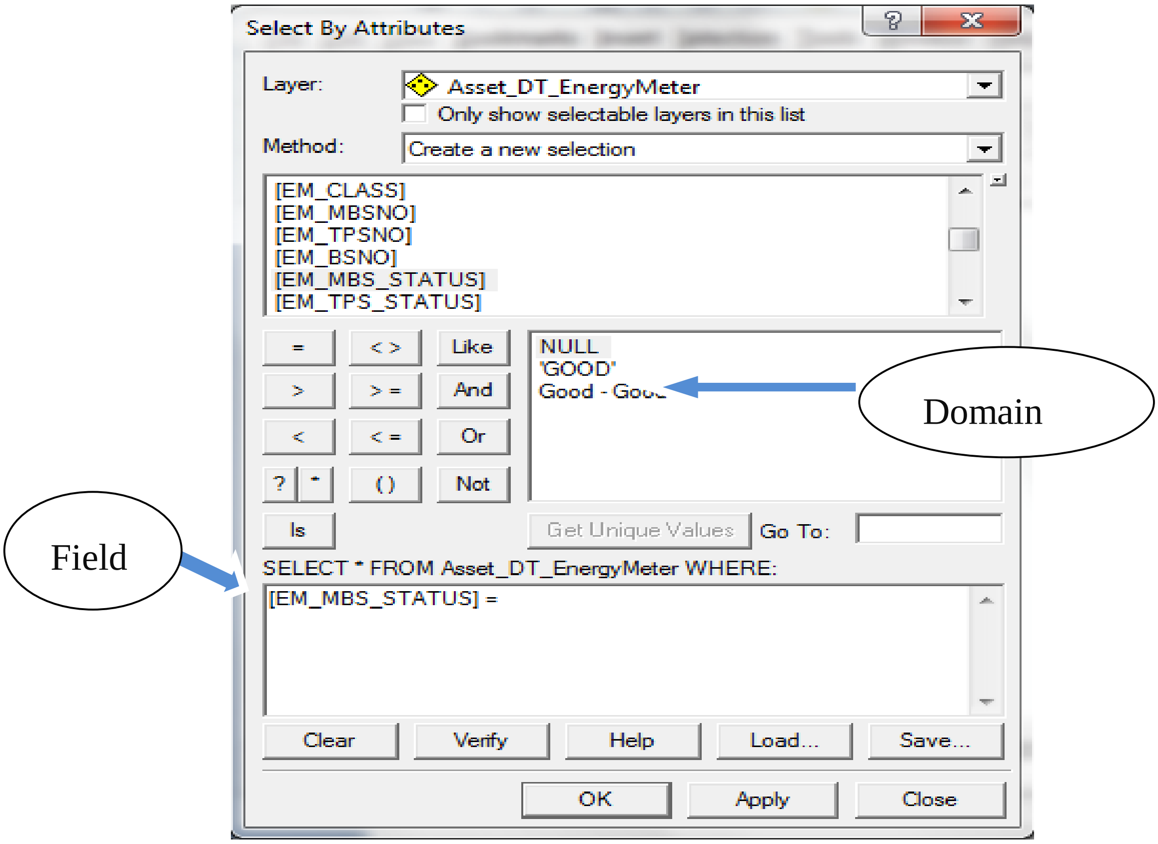
Field Name	Data Type	Field Description	Null/Not Null	Constraint
HTL_PHASE	Varchar(5)	Phase of HT line	Not Null	CK • RYB
HTL_PWS	Varchar(50)	Phase wire system	Not Null	CK • 3PhThree wire system • 3Ph Four wire system
HTL_CTYPE	Varchar(50)	Power line conductor type	Not Null	CK • Aluminum Conductor Steel Reinforced (ACSR) • All Aluminum Alloy Conductor (AAAC) • All Aluminum Conductor (AAC) • Aerial Bunched Conductor (ABC) • Cross Linked Polyethylene (XLPE) • COPPER • OIL FILLED COPPER (OFC) • Paper Insulated Lead Covered (PILC)

Field Name	Data Type	Field Description	Null/Not Null	Constraint
LTL_PWS	Varchar(50)	Phase wire system	Not Null	CK • 3Ph Three wire system • 3Ph Four wire system • 3Ph Five wire system • 3Ph Six wire system • 2 Ph Three wire system • 1Ph Two wire system • 1 Ph Three wire system
LTL_CTYPE	Varchar(50)	Power line conductor type	Not Null	CK • Aluminum Conductor Steel Reinforced (ACSR) • All Aluminum Alloy Conductor (AAAC) • All Aluminum Conductor (AAC) • Aerial Bunched Conductor (ABC) • Cross Linked Polyethylene (XLPE) • COPPER • OIL FILLED COPPER (OFC)
LTL_DONE_BY	Varchar(50)	Done By	Null	CK • ABB Sweden • Port Gloster • Universal • GajendraElc • Gopal • Contractor • Dept • Others

Steps to correct the error logs:

- ✓ **Step 1:** Check the field name in the log.
- ✓ **Step 2:** Go to selection→select by attributes→select the required field→click get unique value dialog box.
- ✓ **Step 3:** In the unique values, the values with ‘-‘are the domain values. Thus the values without ‘-‘ are selected.

- ✓ **Step 4:** Selected Attributes are opened and changed with the respective domain value.



8.2 WEEK 2

Manual Domain Check and combination of layers.

After finishing the domain values error correction we have to manually check the values in the LT_POLE feature that is not shown in the domain values error report.

- ✓ The values may be indicated in numbers for some fields and that is an error. So we should look at the number and check for the order in the available domain values.
- ✓ <u>**For example:**</u> In the INSULATOR_TYPE field, if the number is 2, we have to choose the second value in the domain value list. Likewise the errors are checked and corrected manually.
- ✓ In some cases the error will be “NA” or simply like this “ “ .in that cases we have to give <NULL> as the value.

- ✓ The fields like SUPPORT_TYPE, STREETLIGHT_TYPE, INSULATOR_TYPE, OPENPOINT Y/S are checked manually.
- ✓ Pin, shackle, intermediate, end point (suspension), angle are some of the domain values in the INSULATOR_TYPE field in the LT_POLE feature.

This same manual domain check is done for SERVICE_LINE and CONSUMER_LT features also. So the domain check for the features is completed. Then the combination of service line and the consumer is done with Arc catalog.

- ✓ The service line feature from the asset data is copied and then pasted in the consumer asset data.
- ✓ So the consumer and the service line features can be accessed. Each service line should have its own consumer.
- ✓ The consumer id should not have duplicates and also the service line id.
- ✓ The duplicates can be checked by using the summarize option shown when we right clicked the field. Summarize option creates a field in the attribute table and if any value in the field is more than 1 that is considered as a duplicate.

Then after finishing this work, we have to use the tool called “SUBSTATION ID & SUBSTATION NAME” tool that we have already installed (TNEB CHECKLIST TOOL).

TNEB check tool and generation of Unique ID.

- ✓ Click the tool. Then choose the fields SS_ID and SS_NAME. Click check.
- ✓ It will run for some time and the reports are shown in the folder.
- ✓ Open the .txt file and it contains the error list.
- ✓ The error list will show the field name, object id and name of the error (description).
- ✓ **For example**: the feature class name :- Asset_LT_Pole
    - Object id :- 61
    - Description :- SSID & SSNAMEs are mismatch
- ✓ So using this error list open the attribute table of the features and use the domain values and correct the errors.
- ✓ For selecting the common errors in the features we can use SELECT BY ATTRIBUTES option in the selection menu.
- ✓ It will open a dialog box. In that, select the feature you want and the fields available in the feature will be shown. Click the field having error and click GET UNIQUE VALUES option.

- ✓ So the values in that field are shown.
- ✓ We can use expressions to select the attributes.
    - o For example: [LTP_SS_ID] = 'KPD'
- ✓ So click apply or ok. The rows with the value KPD are selected in the attribute table of LT_POLE.
- ✓ If it is an error that can be corrected using available domain values.
- ✓ The domain values are shown only if we work with START EDITING mode.
- ✓ After correcting the errors, cross check can be done using the GET UNIQUE VALUES option that shows the available values.

Then the REGION CODE and CIRCLE CODE for all the asset features are checked.

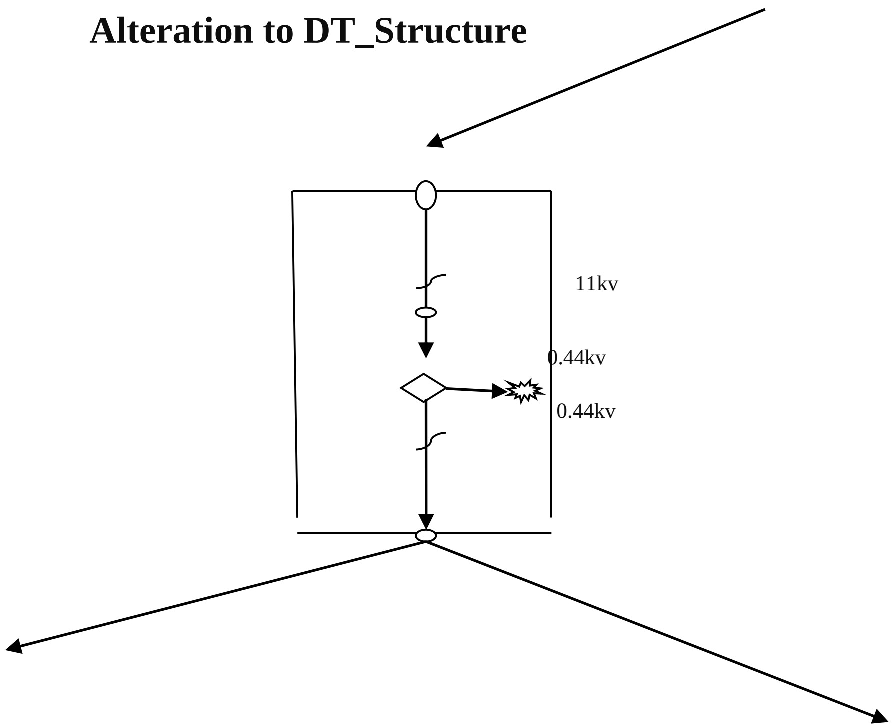
- ✓ The region code for Vellore region is ‘08’ and the circle code is ‘0412’
- ✓ All the asset features should be checked. so we can use the FIELD CALCULATOR option as an easier way.
- ✓ But this way works easily in STOP EDITING mode only. So save the edits and click stop editing in the EDITOR menu.
- ✓ So open the attribute tables of a feature, then right click on the region code field. Click FIELD CLACULATOR. A dialog box will be opened.
- ✓ Just type ‘08’ in the space for expression. The single quotes are necessary. Click ok.
- ✓ So the values of the field will be changed into 08. The same operation should be done for circle code but with the values ‘0412’.

Then the UNIQUE ID GENERATION tool is used for generating the unique ids in the SERVICE_LINE feature.

- ✓ The unique id generation tool is already installed (TNEB UG TOOLS).
- ✓ Click the tool in the toolbar.
- ✓ Select the feature as ASSET_SERVICE_LINE. And the layer field as SL_ID.
- ✓ In the unique id box type VL_VL_SL_001. click run
- ✓ It will take some time to generate the unique id.
- ✓ Check the field in the attribute table whether all the rows are generated with values.

After finishing these works, the structure of the Distribution_Transformer is checked. The structure of a DT is shown in the figure:

Alteration to DT_Structure



- ✓ The outline box structure is called as DISTRIBUTION_STRUCTURE_DT. Inside this the transformer will be there which is in diamond shape in the above figure.
- ✓ The distribution structure will contain two ASSET_FUSE, an ENEGRY_METER and CAPACITOR in some cases an ISOLATOR, IMPLANT_LINE, HT_POLE, LT_POLE.
- ✓ HT_LINE will join in the HT_POLE and the LT_LINE will join in the LT_POLE.
- ✓ The input voltage from the HT_LINE will be 11kv and it passes through the transformer and it is converted into 0.44kv to the LT_LINE and the ENERGY_METER.
- ✓ ENERGY METER is necessary in all DTs. only one HT_LINE will come to the HT_POLE but from a LT_POLE many LT_LINE will go (4 to 5 lines).
- ✓ DISTRIBUTION_ISOLATOR should also be present in the DS_DT.

So this is the structure of DT. Now we have check the DT structure i.e., we have to check for the presence of an energy meter and check for the continuous flow direction of the implant lines and also the voltage should be checked.

- ✓ The implant line from the HT_POLE should pass to the DT and it should have the voltage of 11kv.
- ✓ There should be no splitting in the implant line between the HT_POLE and the DT. So there should be only one implant line from HT_POLE to DT.
- ✓ If there is two or more implant lines select all those implant lines by pressing shift key and use START EDITING mode ,click EDITOR and select MERGE. Now there will be only one implant line. We have to do the same operation for the implant line between the DT and the LT_POLE.
- ✓ If there is an error in the voltage line means select the implant lines that should be changed using SHIFT KEY. Then click on the ATTRIBUTES icon in the toolbar.
- ✓ In that dialog box the attributes of the selected features are displayed. So we can change the attributes as we required.
- ✓ For example: the voltage of 0.23kv is an error and it should be changed into 0.44kv.
- ✓ The flow directions can be changed by selecting the implant line ,then
    - Select modify feature in the task box of the editor toolbar
    - Select target as IMPLANT _LINE
- ✓ Then right click on the selected line, select flip. So the direction of the line will be changed.
- ✓ Then we have to check for the existence of ENERGY_METER. If it is not there,
    - Select create new feature in the task box and target as implant line. Then draw the implant line form the DT in perpendicular direction using the SKETCH TOOL.
    - Then choose the target as IMPLANT_LINE and use the sketch tool to place the energy meter at the end of the new implant line.
    - Snapping should be turned on before all these processes. Go to editor menu and select snapping option then click on all the check boxes under the vertex field.
    - The new implant line and the energy meter should have the voltage of 0.44kv.
    - We can use LABEL FEATURES option by right clicking on the feature.

- Also we can choose the attribute that should be labeled on the features by right click on the feature and click the properties and choose the labels tab and choose the respective field form the drop down list box available in that tab. Then click ok.

✓ The newly placed energy meter and the implant line should be add with some attributes.
  - Select the DT and the IMPLANT_LINE, Copy the DT_ID of the transformer where the implant line is newly placed and then paste it to the INTERNAL ID of the implant line in the attributes dialog box.
  - Change the voltage to 0.44kv for both implant line and energy meter.
  - Change the attribute from ‘N’ to ‘Y’ in the ENERGY METER STATUS field for the DT feature.
  - For the INETERNAL ID of the energy meter, copy the DT_ID and paste it in the INTERNAL ID of the energy meter and with that add _EM01.
  - For example: If the normal DT_ID is ‘KPD_DPV_DT001, copy it and paste in the energy meter id and add _EM01.
  - So the INTERNAL ID will become ‘KPD_DPV_DT001_EM01’.

✓ After checking the structure for all the available DTs, we have to run the CIRCUIT NUMBER UPDATION tool.

✓ This tool we have already installed and it helps to generate the circuit number for LT_LINES.

✓ Click on the tool. A small dialog box will be opened.

✓ Select the input layers ASSET_LT_LINE in LTLINE layer, ASSET_LT_POLE in LTPOLE layer, ASSET_DISTRIBUTION_ STRUCTURE_DT in DSDT layer. Click update.

✓ This tool will run for at least six hours.

So after running the tool the circuit numbers has been generated for LT_LINE and LT_POLE. We can see the circuit number fields in the attribute table of those layers.

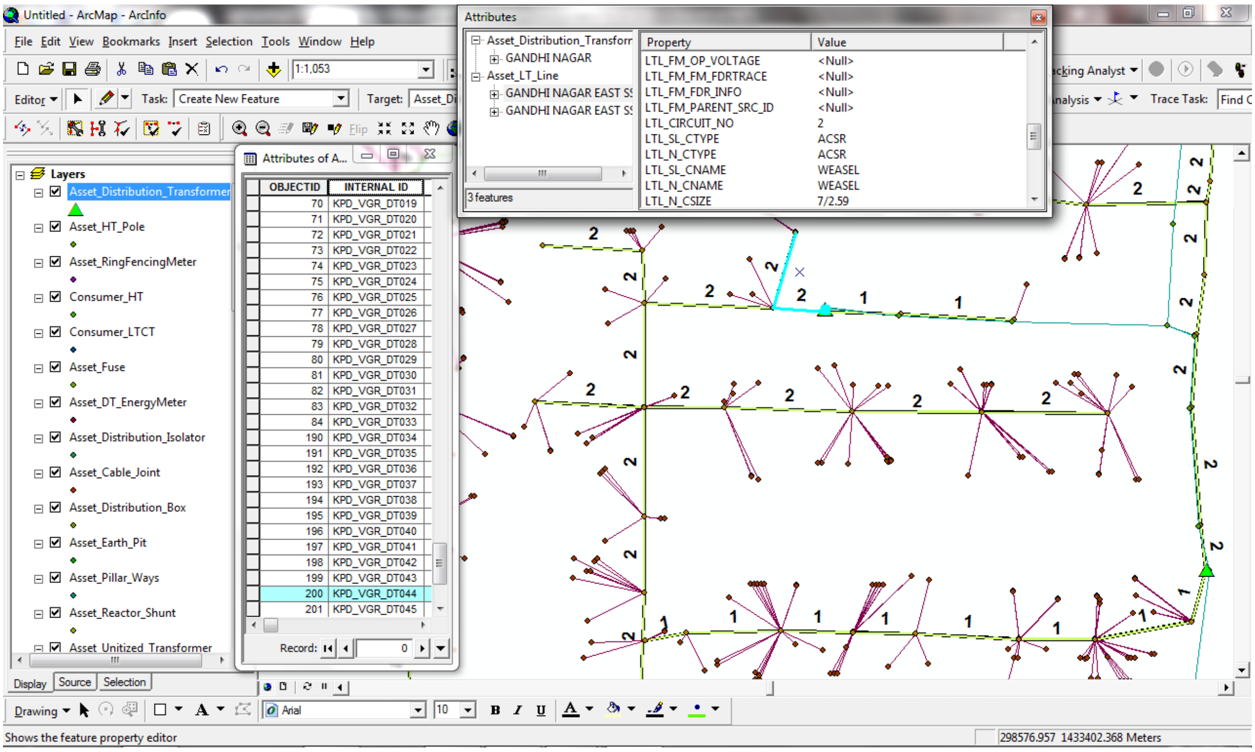
Circuit number generation and error correction.

So the next work is noting the circuit number errors. The circuit number errors can be noted by following steps.

✓ There will be more number of lines that passes from the LT_POLE. 4 to 5 number of lines will pass. They are called as LT_LINEs.

✓ Each LT_LINE should have its own unique circuit number starting from 1 and goes on.

- ✓ If two or more lines contains the same circuit number that is noted as error. The DT_ID of the DT which contains the LT_POLE is noted in the notepad as error.
- ✓ If there is only one line means the circuit number should be 1.



Circuit number correction

8.3 WEEK 3

Spatial Joint and Attribute Updation of DT_ID for various layers.

3rd week of internship started with data validation and tutorial of Geometric Network –NET JUNCTIONS.

A separate excel datadase was given and was asked to analyse. The database had the following data layers and it's fixed domain values

- ✓ DT_Energy Meter
- ✓ RFM
- ✓ Consumer_HT
- ✓ Feeder_Meter

DT KVA	EM_PTRATIO	EM_LCTRATIO	EM_MF	EM_CTRATIO	EM_LPTRATIO	TYPE
16	1	150/5 A	30	150/5 A	1	Ring Type
25	1	150/5 A	30	150/5 A	1	Ring Type
40	1	150/5 A	30	150/5 A	1	Ring Type
50	1	150/5 A	30	150/5 A	1	Ring Type
63	1	150/5 A	30	150/5 A	1	Ring Type
75	1	150/5 A	30	150/5 A	1	Ring Type
100	1	150/5 A	30	150/5 A	1	Ring Type
200	1	400/5 A	80	400/5 A	1	Ring Type
250	1	400/5 A	80	400/5 A	1	Ring Type
500	1	800/5 A	160	800/5 A	1	Ring Type

Transformer Details		
Frequency	50 Hz	
Transformation ratios	Capacity of DT	CT Ratio
	Up to 100 KVA	150 / 5 A
	200 & 250 KVA	400 / 5 A
	300 , 400 & 500KVA	800 / 5 A
Type	Ring type	
Burden	5 VA	
Class of accuracy	0.5S	
Short time thermal current	Minimum 5 K Amp. for one second	

CIRCU	0472
TOWN ID	092
REGION	07

Further also kindly note that Multiplication Factor (MF) can be calculated from the furnished CT /PT ratio , if that MF is missing (MF = CT ratio * PT ratio).

The above methodology can be adopted for all towns data if incase missing.

DT Energy Meter / RFM / Consumer HT / Feeder Meter / Sheet1

The sheets were analysed completely and the values in the corresponding data layers were checked and mismatching datas were changed accordingly with the help of ‘Field Calculator’.

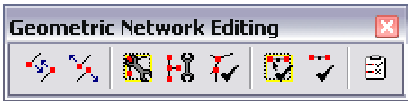
GEOMETRIC NETWORK

A geometric network is a connectivity relationship between a collections of feature classes in a feature dataset. Each feature has a role in the geometric network of either an edge or a junction. Multiple feature classes may have the same role in a single geometric network.

The basic methodology for creating a geometric network is to determine which feature classes will participate in the network and what role each will play.

Two methods are available for creating a network: creating a new, empty geometric network and building a geometric network from existing simple features.

The image below shows the Geometric Network Editing toolbar



Geometric Network Editing toolbar buttons and their functions

Button	Name	Function
	Connect	Connects the selected JunctionFeatures
	Disconnect	Disconnects the selected network feature
	Rebuild Connectivity	Incrementally rebuilds network connectivity for the selected area
	Repair Connectivity	Repairs connectivity
	Verify Connectivity Command	Verifies the connectivity of the selected feature or all features
	Verify Network Feature Geometry Tool	Allows you to define an area and verify network geometry of features inside the area
	Verify Network Feature Geometry Command	Verifies network geometry of the selected features or all features
	Network Build Errors	Selects all features that cause errors in the network build

How to build a geometric network from existing simple feature classes

1. Right-click the feature dataset (Asset) that will contain the network.
2. Point to New.
3. Click Geometric Network.
4. Read the information on the first panel and click Next.
5. Click the first option to build a geometric network from existing features.
6. Click Next.
7. Click the feature classes that you want to include in this geometric network.
8. Type a name for the new geometric network.
9. Click Next.
10. If any of the feature classes selected to participate in the network contain an enabled field, you can choose to keep the enabled values or reset them to true. Click No to enable all network features. Otherwise, Persist enabled values is selected by default.
11. Click Next.
12. The following layers were enabled for net junctions:
    - Service line
    - HT line
    - LT line

- HT Cable line
- LT Cable line

13. Review the options you specified for your new network. If you want to change something, you can go back through the wizard by clicking the Back button.
14. When satisfied with your options, click Finish to create the new geometric network.

Editing Geometric Network Features

Geometric network features store various mechanisms and behaviors that maintain the topological connectivity between them. ArcMap is tightly integrated with the geodatabase when it comes to editing network features.

You can use ArcMap editing capabilities to create new network edges and junctions. By using the ArcMap snapping environment, you can create these features while maintaining network connectivity on the fly.

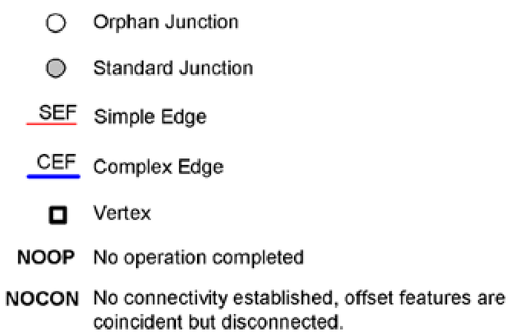
Geometric networks that are projected on the fly cannot be edited within ArcMap.

Network feature classes can participate in composite relationships with feature classes within the same geometric network, provided that the features are not connected.

Connectivity models

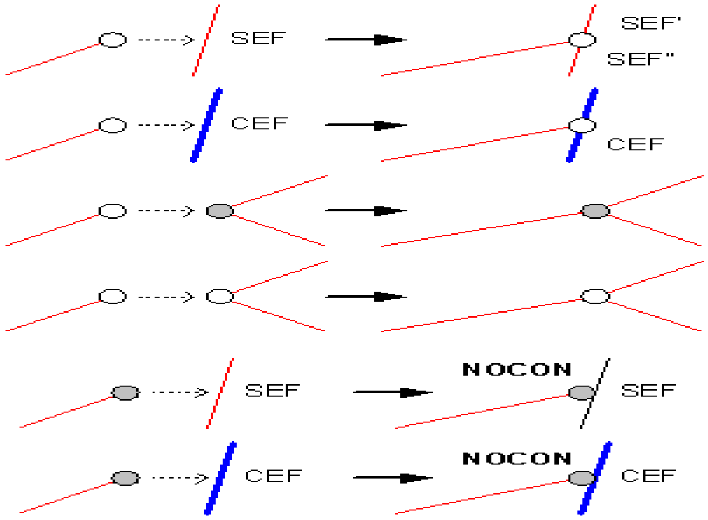
Edit operations that involve adding, deleting, moving, and subsuming network features can all affect the connectivity of a geometric network. Each type of operation may or may not create connectivity, depending on the type of network features involved. If connectivity is not created, it can be established by using the Connect command.

The following set of diagrams illustrates various editing scenarios and their resulting connectivity or lack thereof. In these diagrams, use the key below to identify what types of features are illustrated in each scenario:



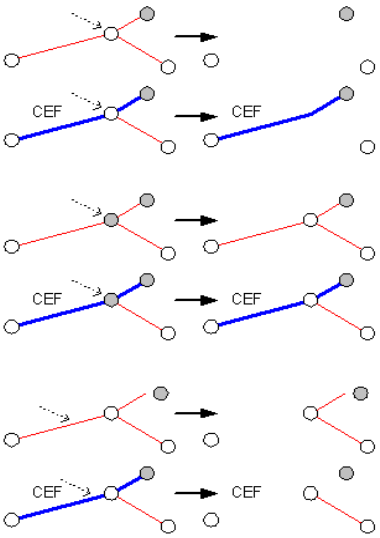
Stretching and moving

When stretching or moving junctions, any edges connected to them rubber-band to remain connected. When you snap these junctions to other network features, the following illustration summarizes the network connectivity that results:



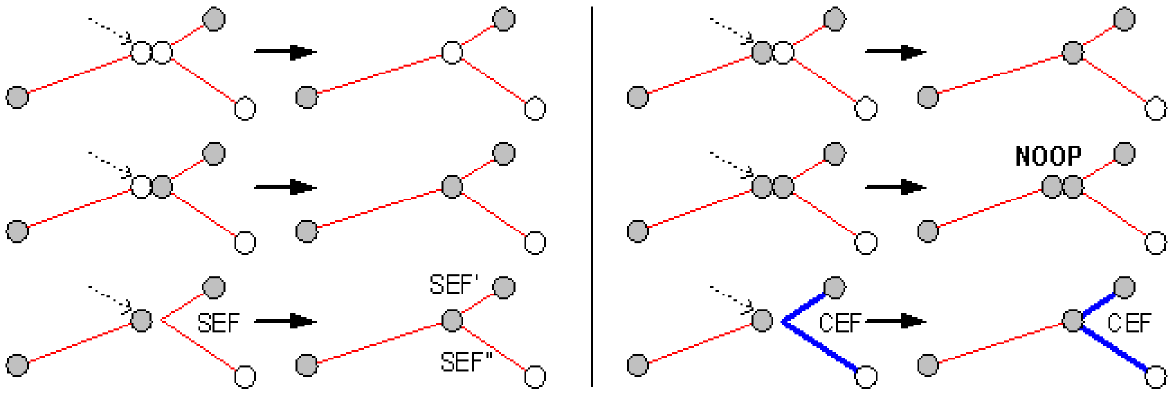
Deleting

Deleting network features can affect those features connected to them. When you delete an edge feature, the edge is physically deleted from the geometric network and logically deleted from the logical network; however, its connected junction features will not be deleted.



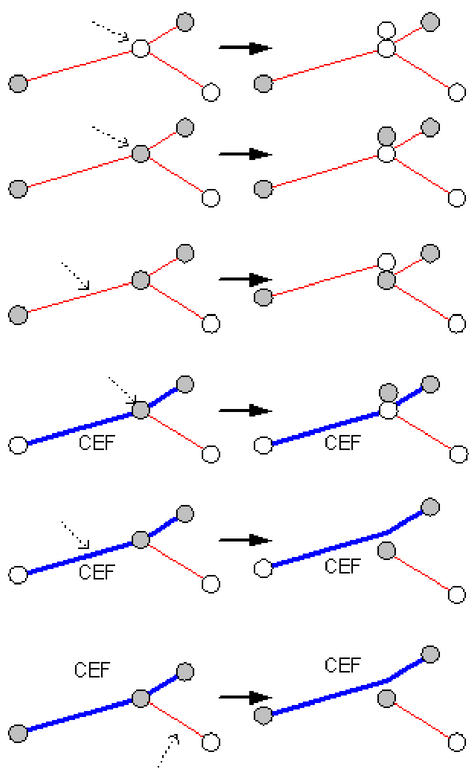
Connecting features

The following illustration summarizes how connectivity is affected when connecting network features using the Connect command in ArcMap:



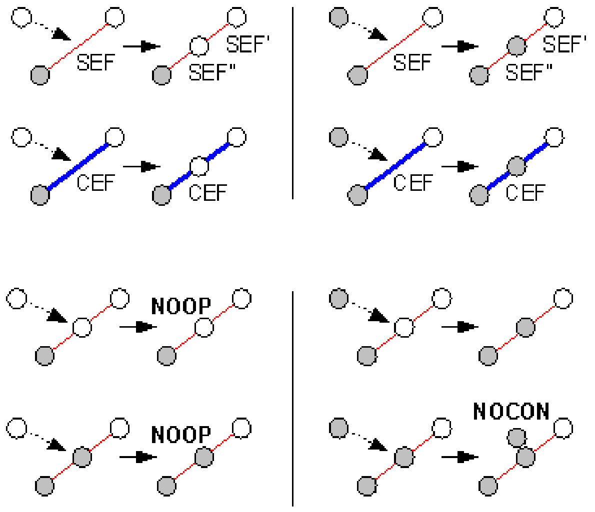
Disconnecting features

The following illustration summarizes how connectivity is affected when disconnecting network edge features and junction features using the Disconnect command in ArcMap:



Creating new network features

When creating new network features and snapping them to other network junction and edge features, the resulting connectivity and the effects on the features you connect them to are summarized below:

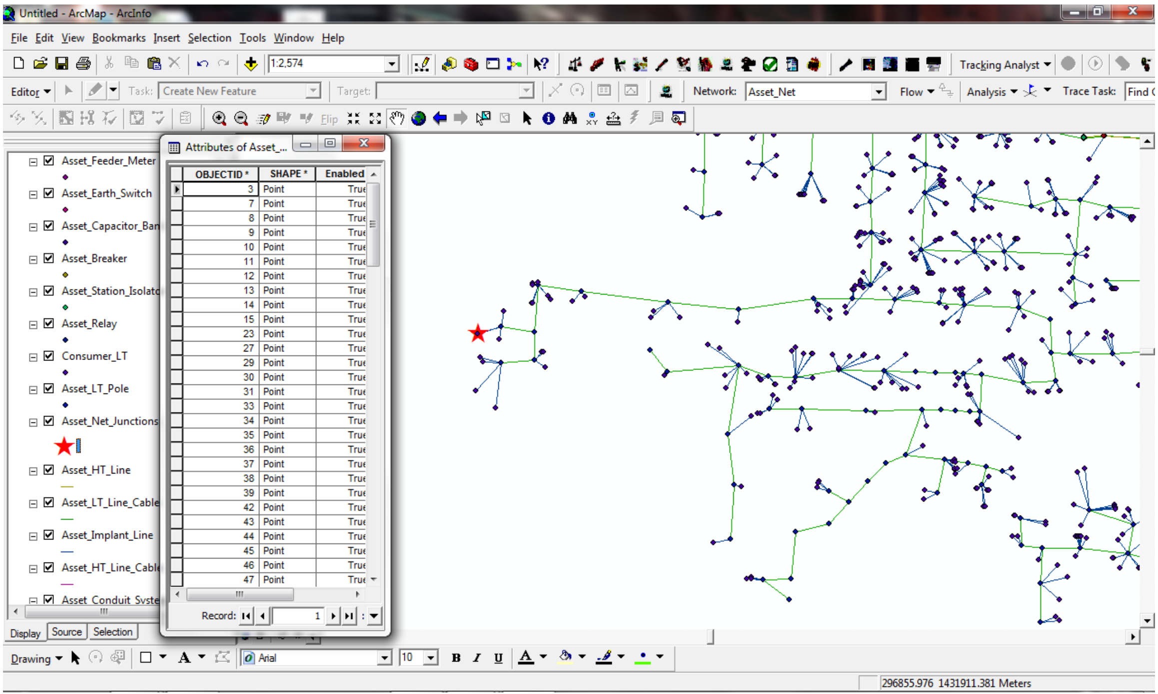


Network Build Error Table

Once geometric network is built features with invalid geometries are identified during the network building process and recorded in the network build errors table. The network build errors table is a user-managed table. As such, it does not get updated when the features listed within are edited. It is up to the end user to update the table's contents as soon as possible after creation so that the table will correctly reflect the state of the features. The table is used by the Network Build Errors command within ArcMap to identify the features with invalid geometries.

The methodology for repairing a network build error is dependent on the type of invalid geometry.

- ✓ The Assetnet junctions formed is selected and its attribute table is opened.
- ✓ It is denoted by ‘  ’.
- ✓ Assetnet junctions with consumer nearby are joined by disconnect and join.
- ✓ Assetnet junctions without consumers are merged by combining the substation.



Assetnet junctions are denoted by ★

8.4 WEEK 4

DT Wise check of consumer_LT, consumer_LTCT, service line, LT pole and LT line.

The next work is to check the consumer for all the DTs in the data. For this process we can use the query builder technique.

- ✓ Select features LT_POLE, LT_LINE, CONSUMER_LT, CONSUMER_LTCT, SERVICE_LINE and DT only. Unselect all other features.
- ✓ Right click on a feature, go to definition query tab and click the QUERY BUILDER enter the query, Click ok.
- ✓ The query will look like:
    - [SL_DT_ID] = 'KPD_DPV_DT001' (ServiceLine)
    - [LTCTC_DTR_ID] = 'KPD_DPV_DT001' (LTCT consumer)
    - [LTL_DT_ID] = 'KPD_DPV_DT001' (LT line)
    - [LTP_DT_ID] = 'KPD_DPV_DT001' (LT pole)
    - [LTC_DT_ID] = 'KPD_DPV_DT001' (LT consumer)

- ✓ This query will show only feature of the given DT. So we can work easily with that.
- ✓ So we have to look for the consumers without service lines. Select those consumers and create a layer from the selected consumer (it is not necessary to create a layer).
- ✓ Remove the query from the SERVICE_LINE now. So all the service) line features will be shown.
- ✓ Then go to selection menu click SELECT BY LOCATION.
- ✓ There we can use a query:
    - Select SERVICE_LINE
    - INTERSECTS
    - CONSUMER_LT
- ✓ This will select the SERVICE_LINEs that intersect with the consumers. But those service_lines are with different DT_ID.
- ✓ So open the attribute dialog box copy the DT_ID from the selected CONSUMER_LT and then paste in the internal id of the selected SERVICE_LINEs.
- ✓ Repeat the same procedure for CONSUMER_LTCT.
- ✓ If there is no service line exists for a consumer we have to manually place a new service_line for the consumer. But we have change the internal_Id of that newly added service line.
- ✓ Delete the service line if it has no consumers.

This is the procedure for the consumer check.

The next work is to check for snapping manually. All features should be snapped correctly to the vertex. If it is not snapped we have to snap it correctly. Double click on a feature, so we can see the box like structure appears on the feature, click and drag it to another feature by pressing V we can see the vertex and place the feature in that vertex.

By this way we can snap the features in to another feature.

Then we have to check the ASSET_SWITCHING_STRUCTURE like we did for the DISTRIBUTION_TRANSFORMER. The implant lines inside the switching structure are checked.

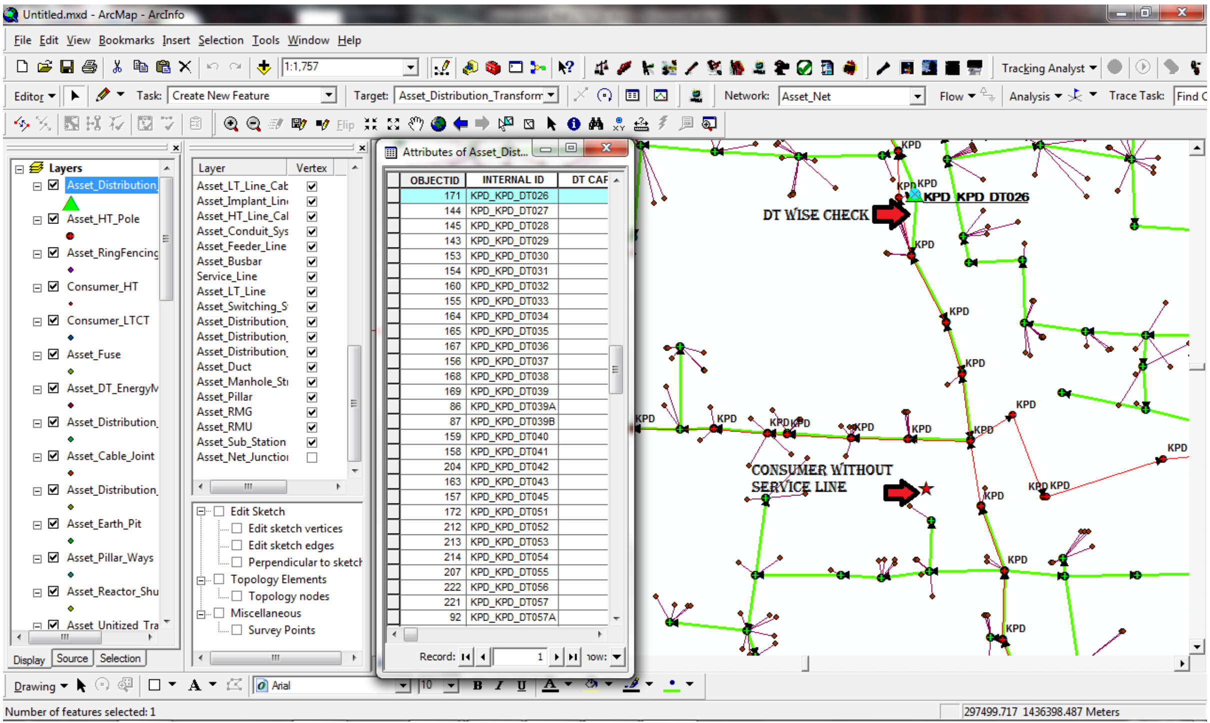
Totally there are 36 features in the ASSET_SWITCHING_STRUCTURE.

Snapping:

All features should be snapped correctly to the vertex. If it is not snapped we have to snap it correctly. Double click on a feature, so we can see the box like structure appears on the feature, click and drag it to another feature by pressing V we can see the vertex and place the feature in that vertex.

We have done snapping for ASSET_LT_POLE, LT_LINE, ASSET_RFM, HT_LINE, and HT_POLE.

By this way we can snap the features in to another feature.



Snapping and DTwise check

ARC FM:

Challenge

Many utilities have invested heavily in geographic information systems (GIS). Until now these systems were used by a fraction of company employees, but utilities today need to leverage their existing systems and make geospatial information available to other departments.

ArcFM is an Enterprise GIS with reliable network intelligence that provides information such as pipe water direction flows, the number of customers attached to a gas meter, and what devices are downstream of a particular fuse. While this information has been vital to Mapping Services or Asset Management groups, it can also be useful in other areas of the company. The challenge is to leverage that network intelligence across your organization without the cost and complexity of heavy desktop deployments.

Solutions

Schneider Electric's Geospatial Services is that vital link between your desktop GIS and flexible, lightweight applications for any aspect of your business.

With the new Orbit solution, crews can quickly gather information in the field, at specific locations, and collaborate on field-oriented projects. Orbit leverages Geospatial Services from both ArcFM and Orbit Data Services to provide work information and mapping functionality, as well as manage the data captured during work.

Using Fiber Manager to maintain your fiber optic network? You don't have to take Fiber Manager in the field. Wavepoint uses Geospatial Services from ArcFM Server to give you the power of tracing and network connectivity in a lightweight web application.

Value Proposition

The integration of the single geodatabase behind your ArcFM Solution Enterprise GIS means there is one version of the truth reliably informing critical functions. Geospatial Services gives you the power to expand this single version of the truth throughout your organization.

Mobile – Both Orbit Mobile and Wavepoint give you the power of mobility. Take Orbit Mobile into the field for data collection, regardless of whether you have network connectivity. Access Wavepoint on a portable device such as a tablet or phone and take it with you to the telecom room where it's most needed.

Scalable – Access the Geospatial Services provided by ArcFM Server and Orbit Data Services to build a custom application that suits your specific business needs.

Differentiation Factors deployed at some of the largest and smallest utilities in the world, the ArcFM Solution is the industry leader in GIS solutions for utilities. It provides the foundation for an intelligent network infrastructure that improves efficiencies, increases safety, and enables smarter business decisions for all types of utility Geospatial Services like ArcFM Server and Orbit Data Services leverage this strong foundation to facilitate two-way data transfer and deliver detailed, geospatial information across your organization without the cost and weight of expanding a full GIS solution company-wide.

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