Study Committee D2
Information Systems and Telecommunication
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ASSET MAPPING & VULNERABILITY ASSESSMENT USING GIS TOOLS - POWERGRID EXPERIENCES

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Motivation

- Owing huge volume and widespread transmission assets, it is a challenging task for its management to regularly monitor vast asset base.
- Maintaining vast transmission infrastructure healthiness requires intense monitoring, which is currently done manually.
- GIS mapping of each Transmission assets such as Tower, Substation etc., vulnerability assessment and maintenance task planning can be optimized and improved.
- This shall greatly enhance the quality & reliability of operation and maintenance management of vast geographically spread transmission assets.
- The paper covers the POWERGRID (India) practices in utilizing the GIS tools for studying the vulnerability of its existing transmission assets and also while planning of new assets in respect of Disaster warnings, Flooding and submergence, River Meandering, Land Slides, Avalanches, Assets in Cyclonic course, Areas exposed to adverse weather, Polluting zones, Forest, Wild life, Power line, Railway, River & Highway crossings.

Method/Approach

- To map asset and study its vulnerability, various map services such as Bhuvan Map, Open street map, Google Map, Bing Map etc. have been used in combinations to get maximum advantages of each the GIS services.
- Novel Decision support System(DSS) shown in figure-1, has been designed to support asset managers to deal with unstructured (non-recurring) challenges.
- These challenges can be sudden such as cyclone, landslide, earthquake etc. as well as long lasting in nature like pollution issues near the asset.
- DSS can be an important tool for solving these problems related to disaster management and provide asset manager assistance to manage and maintain their asset in most difficult conditions.
- DSS can also helps management of the organization in taking remedial action based on the various techno-commercial analysis as well asset data and remote sensing data.

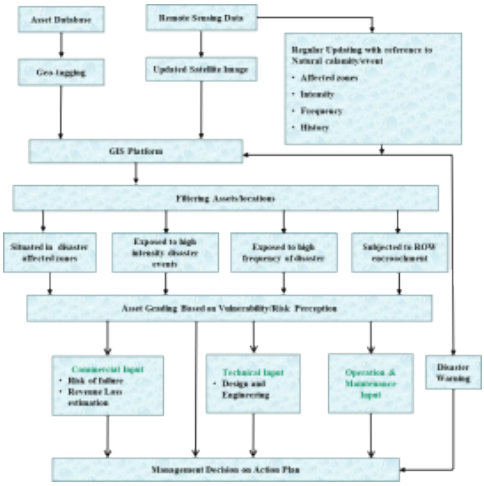

Figure-1: Flowchart of Decision Support System

Discussion

Case Study –I: Finding River Crossings of Biswanath Chariali (BNC)-Agra high capacity HVDC Line

To find river crossing of the transmission line, intersections tool feature of QGIS is used. This tool creates a new layer of shape file consisting of intersection point of river layer and transmission line layer.

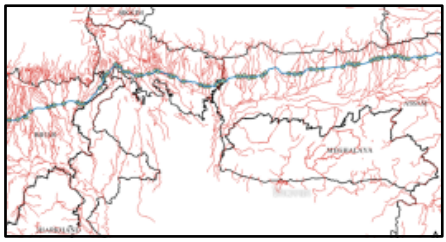

Figure-2: Analysis on finding river crossing

Findings

The river data are extracted and found that total number of river crossing in BNC-Agra HVDC line is 124 including major and minor rivers as encircled in figure-2.

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Case Study –II: Flood Hazard Analysis of BNC-Agra HVDC Line

Analysis of existing transmission line and planning for new transmission w.r.t. flood can be done by plotting line and historical flood data in QGIS. Case study of one the transmission line shown in figure-3, wherein impact of the Assam flood on transmission line has been demonstrated.

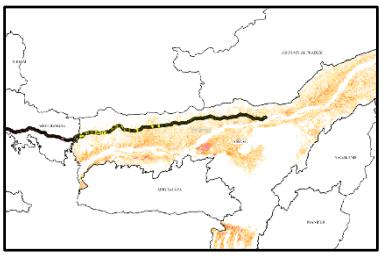

Figure-3: Analysis of flood hazard using Bhuvan

Findings

From the flood layer analysis, it is found that Tower No 1-1017 are in Assam flood area where Tower No 39-109 & 591-661 are more vulnerable.

Case Study –III: Study of ±500kV HVDC Line on Cyclone

This case-study shows the impact of the disaster (cyclone Hudhud in this case) on the transmission line. This can be done by plotting line data and cyclone data on GIS platform and analyzing it w.r.t. to cyclone's impact zone, intensity based on different speed buffer of the cyclone.

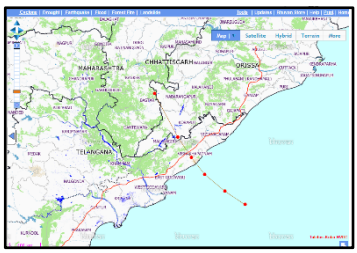

Figure-4: Cyclone intersection ±500kV HVDC line

Findings

The intersection point (figure-4) of the cyclone to the transmission line (longitude-83.0297E, Latitude-17.972N) was determined and intimated to the respective site person for necessary measures.

Case Study –IV: River Meandering Analysis

Figure-5: River meandering

Findings

- This case study explains about the river meandering analysis at river crossings on Brahmaputra river near Jogighopa in Assam.
- The upper part of the above figure-5 shows river path as on Feb, 2009 and the lower part shows the river path as on March, 2013 where silt formation and river course change during this period is clearly visible.
- This phenomenon creates problem during tower construction near river bank due to river meandering. A historical study is needed to forecast the river course and plan the tower location and its construction accordingly.

Conclusion

- The paper explains the utilization of mapping and vulnerability assessment of the transmission system in disaster prone areas using GIS platforms with various case studies carried out on 1775km long, BNC-Agra ±800kV 6000MW HVDC line, travelling in different geographical areas through various terrains and crossing many river and water bodies .
- Various GIS services i.e. Disaster service, Web Map Service and other online GIS tools also have been described with practical case studies.
- The use cases of desktop GIS tool, QGIS and its functionality has been summarized.
- It is observed can be seen that GIS services enabled POWERGRID to view its assets on a single platform. it optimizes the transmission line routing process and reduce its construction and maintenance cost as well as avoid vulnerable zones.