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Innovative Application of Esri's - TGIS

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SUMMARY

AEP is a Fortune 500 Company comprised of both a large and complex organizational structure. AEP employs a multi-disciplinary workforce in order to plan and service our electric Generation, Transmission, and Distribution assets. AEP is rapidly growing, with several billion dollars in projects planned that include replacing aging infrastructure, improving reliability, relieving grid congestion, and facilitating the use of renewable resources.

Challenges faced when dealing with multiple infrastructures and assets distributed across the United States include safety, reliability, operation, and maintenance, with a high focus on reduction in costs. Critical aspects of asset integrity include keeping a record of age, properly planning replacement, and load compensations. These are tracked in multiple systems monitored and maintained by several business units. Historically, the data is complete. However, there has been little visibility between the systems and business units. Transmission Station sought to broaden the utilization of Esri's (Environmental Systems Research Institute) software, which Line had already implemented to provide a real-time visual and collaborative space for aggregating multiple programs and systems. Adoption of Esri's software has enhanced the coordination, communication, and collaboration which are key to maintaining the accuracy of the information.

The benefits realized to date have been achieved with minimal modifications to the Esri software. The majority of the effort has been linking information from all the various systems of record and aggregating the information in the Esri ArcPro software. These minor process changes allow for a quick and easy visual representation of planned location intelligence and analysis.

KEYWORDS

Mapping, Asset Management, Reporting, Planning, Work Management, GIS, Esri, Dashboard, Predictive Analysis, IPS

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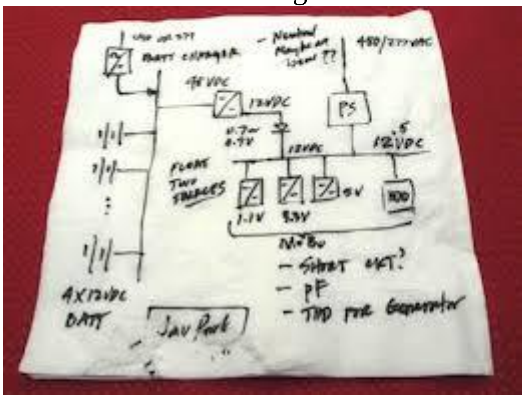
INTRODUCTION

Planning and designing today's grid is a complex balance of meeting the challenges of changing grid characteristics, the increasing reliability and restoration expectations of customers, and challenges related to aging infrastructure – while simultaneously ensuring that investments are made in a timely and prudent manner. Generation, Transmission, and Distribution have traditionally modeled the growth of planned area industrial loads. Planning difficulties include aging infrastructure and cost recovery, environmental regulations, grid optimization, security resiliency through threat assessments, mitigation based on location, asset condition, ratings, and weather, to note a few.

Transmission stations connect through multiple assets and electrical equipment (similar to Fig. 1) that are distributed outside a Station to Transmission lines, and then transfer power from point A to B. As shown in Figures 2 and 3, the Transmission lines and supporting structures are recorded by the GIS department in an Esri mapping application internally branded as TGIS (Transmission Geographic Information System). In TGIS, the stations that connect to the lines have been represented as a single point shown on the map. Station x,y coordinates were captured with a GPS unit, or were determined from the stations' mailing addresses.



In the past, AEP relied on the intensive review of widely varied types of records regarding asset repairs, field-identified issues and emergency replacement situations ranging from emails, spreadsheets, databases, paper logs (from notes on napkins to field log books), word of mouth, etc. As can be imagined, a complete review of all such data sources is resource intensive. Even after a careful analysis, it is often difficult to see system trends or understand all the work required at a particular station or local area.

Ideally, the utility would have information available to ensure that equipment is replaced proactively within a reasonable window prior to failure, and that grid expansion is done immediately before additional capacity is needed. In reality, this is difficult to achieve due to a lack of information, or not easily processing the data into a meaningful format to make decisions. An Esri dashboard provides the interface from multiple systems of record to help visualize spatial relationships of assets from the grid to the individual level. This creates transparency and helps track warranties, age, maintenance schedules, projects, outages and cost of equipment over the years.

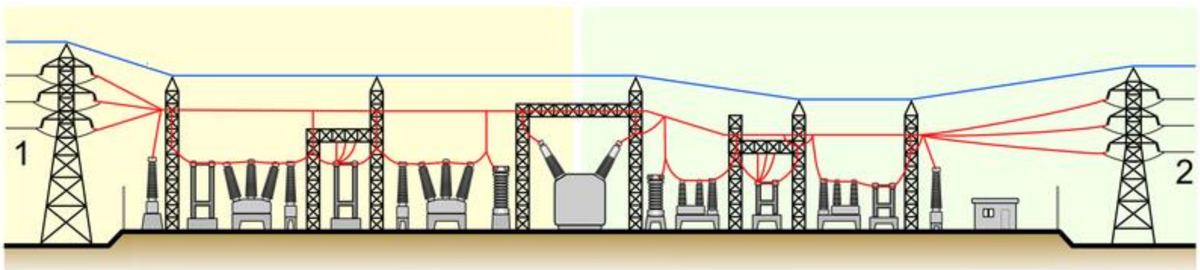


Fig.1. Transmission Station Equipment/Assets (examples)

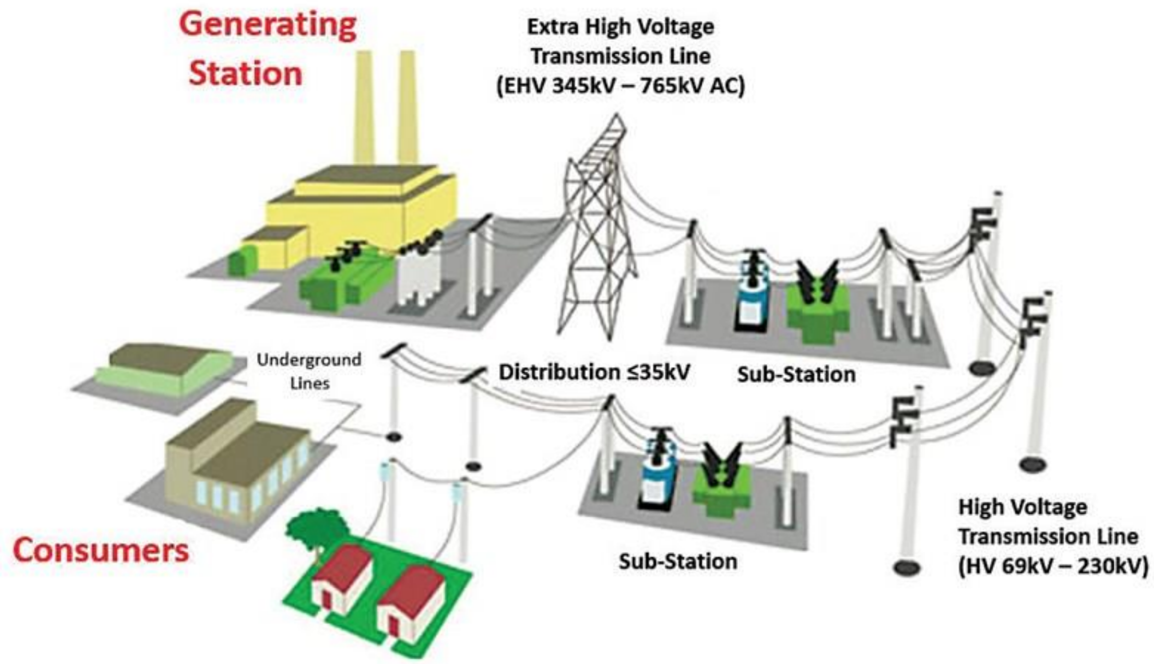


Fig.2. Transmission Line and Station Interface (examples)

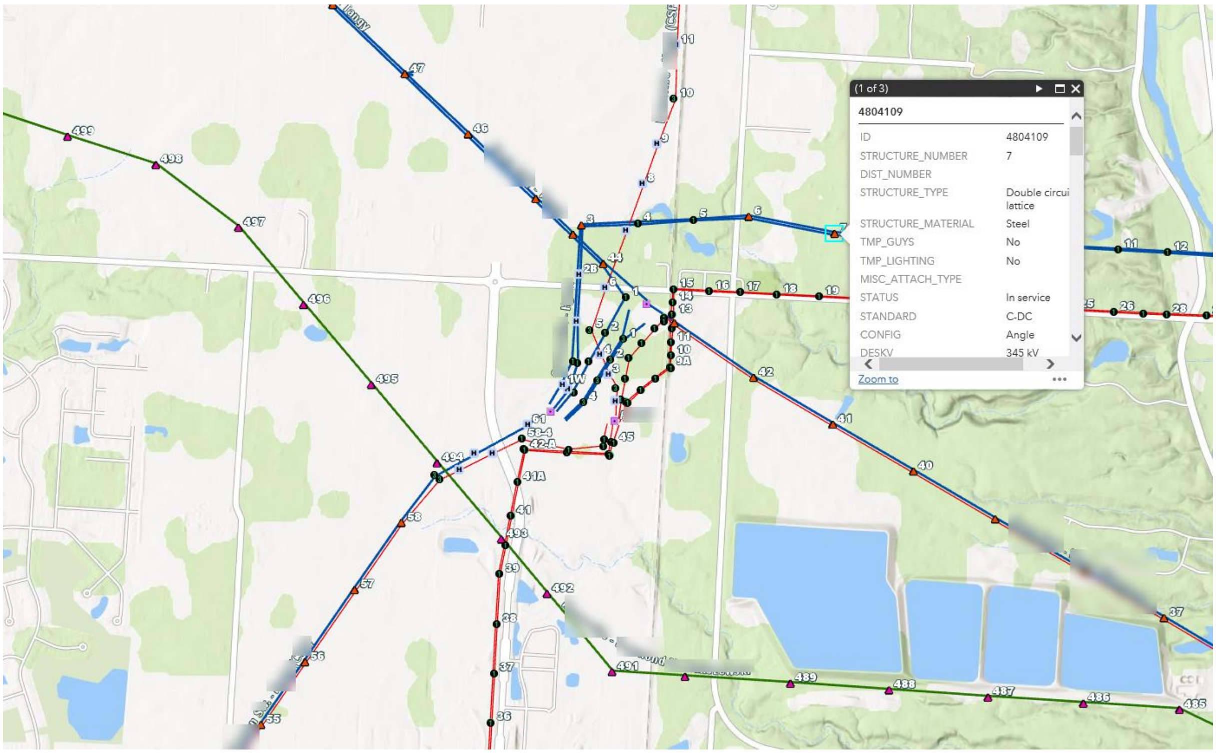


Fig.3. Transmission Line Esri GIS Database (example)

SYSTEMS OF RECORD

In the following paragraphs, two key systems of record for Transmission assets will be described. IPS is the system of record for Station, while the Line group utilizes Esri's GIS analytical and mapping software as their system of record for lines.

IPS is an enterprise asset management and reporting application that stores information about the equipment, such as location e.g. station, region, and state, manufacturer, serial number, age, and various other details. However, it lacks spatial awareness of assets and does not allow one to confirm what assets are in inventory – without the help of heavy script writing.

Equipment assets are designed using CAD software, ordered through an internal system, and then commissioned items are logged and maintained in the IPS system. While the data in IPS is needed for many departments to perform their work, access to IPS is limited to only a few departments. These select departments can extract reports that will help them perform their job, but those reports are outdated at the moment of extraction. Once generated, teams have to sift through the data — in order to come up with the proper charting and analysis of results for things like planned work, last maintenance cycle, load ratings, or other critical items associated with equipment or service. To initiate the first time extraction, a special request from a governance group has to be approved. Once approved, the database admin group writes an intensive script, or requires the involvement of multiple group members to get information (as described above).

The Transmission Line group adopted Esri's software platform approximately 15 years ago as their as-built asset management system of record – to map and report on transmission line data across the system. Esri was chosen for its spatial capabilities, as well as the ability to manage assets. The TGIS application is heavily adopted, allowing almost every department to view Transmission Line's system of record. TGIS also allows visibility of Distribution's assets, which are managed in GE Small World.

Partly because of the use for two independent asset management databases, changes are not always well communicated between the Line and Station groups during project scoping, engineering and construction. On a larger scale, this communication challenge occurs throughout Transmission. When groups do not communicate effectively, there can be notable added costs for construction change orders due to rework and schedule delays. When the Station groups utilized the Esri program to view Line information, it became clear that other systems of record could be linked to a visual mapping application. These systems include ordering applications, estimating, and planning systems – as well as design software to be shared across multiple business units as shown in Fig. 4. The map can then be used to perform analysis of the equipment from the grid level to the local or individual level.

Fig.4. Stakeholders Model (example)

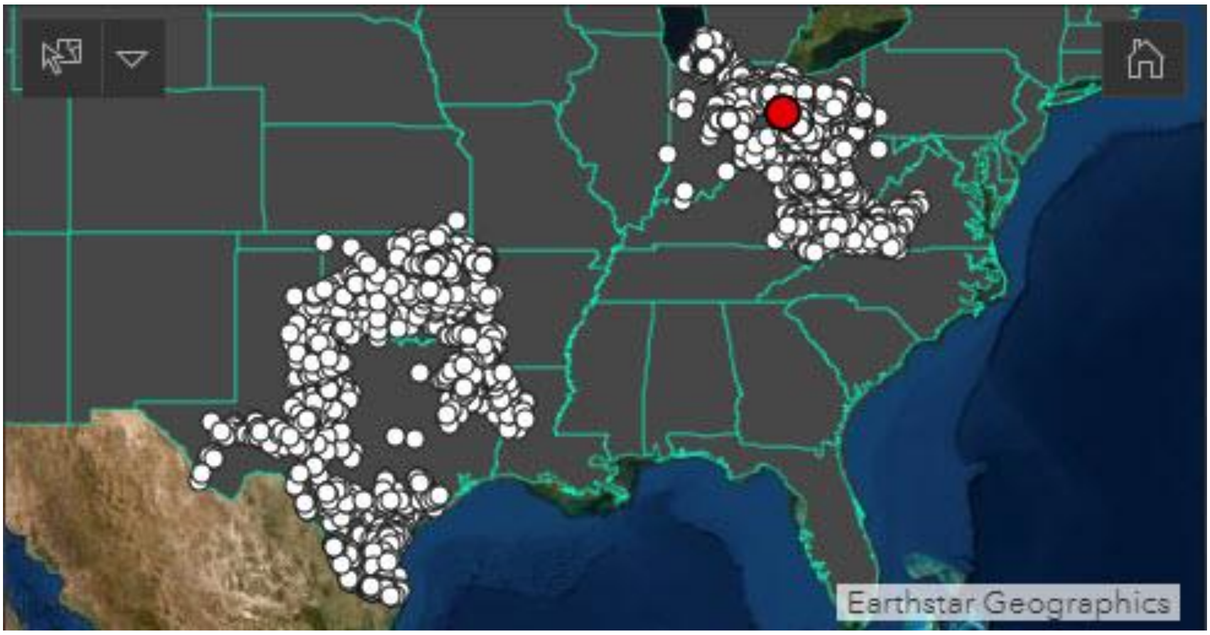
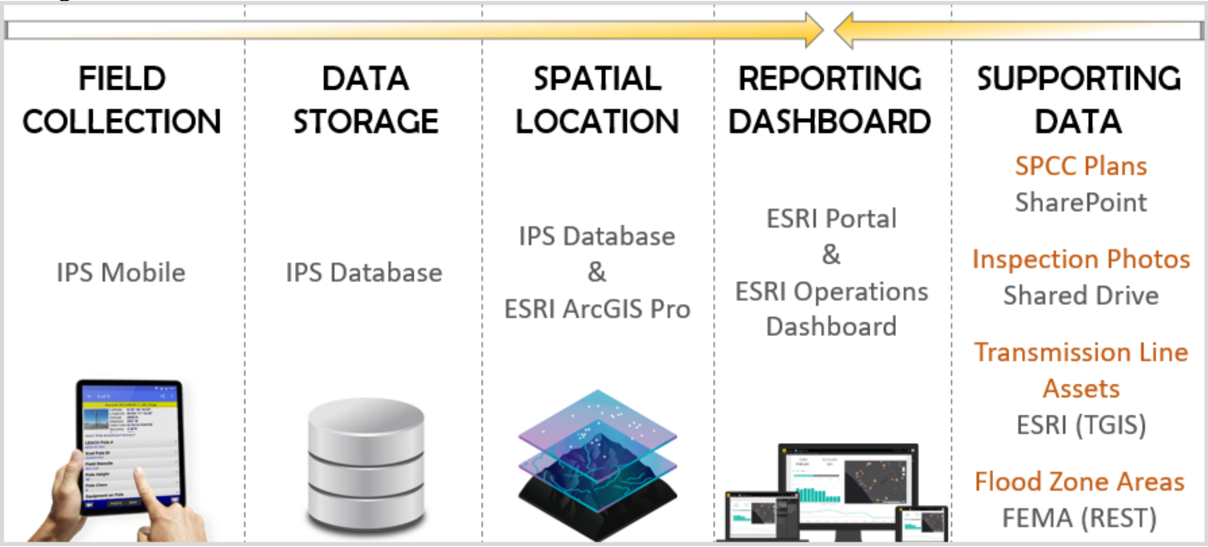


Fig.5. Station Equipment Mapped Data (example)

PROOF OF DATABASE UNIFICATION

Use of an Esri dashboard can enable greater collaboration, and allow enhanced understanding of system needs or statuses. An example of this is a dashboard created to view and track oil containment inspection results and Spill Prevention Control and Countermeasure (SPCC) Plans. Through this dashboard, the Station Engineering group has been able to demonstrate the benefits of Esri dashboards for helping meet regulatory compliance obligations.

Station Engineering worked with the Field Servicers on a program to record oil containment inspections at each station across the footprint. Inspection results were then uploaded to IPS for data storage.



Condition assessments were performed and observations were logged, including the presence of leaks, deterioration of systems, or damaged items needing to be repaired. Photographs documenting the inspection observations were taken and stored in a separate server location. The data was extracted from IPS as a spreadsheet totalling at 4,030 inspection locations that each had approximately 80 columns for filtering different characteristics. Then it was linked in Esri's software to give the data a spatial location, as shown in Fig. 5.

The spatially located data was then added to an Esri reporting dashboard with real-time filtering capabilities, as shown below in Fig. 6. Meeting environmental regulatory requirements means managing SPCC plans, inspection records, and reporting to the proper authorities if, and when, spills and leaks occur. Having the SPCC documents linked to the stations in the dashboard helps identify missing or out-of-date SPCC plans, which enables compliance. Those historical records and pictures that were stored in other server locations were easily linked to each station inspection on the map – to aid in site-specific analysis and requirements. Different filtering characteristics from location, damage assessments, inspections date range, and voltage ratings are outlined in the dashboards below. Applying filters (like what is shown in Fig. 7) specifically to a single station location shows how many inspection reports are at the station. Pictures were taken on-site with a mobile device, and stored on a share drive. GIS then geotagged the pictures to represent their actual locations on the map. Within the dashboard, the users are able to click on the camera icon to see the pictures like what is shown in Fig. 8. The GIS dashboard allows users to look at equipment installed in certain areas for trends indicating problems due to the environment, weather, or specific manufacturer issues, etc.

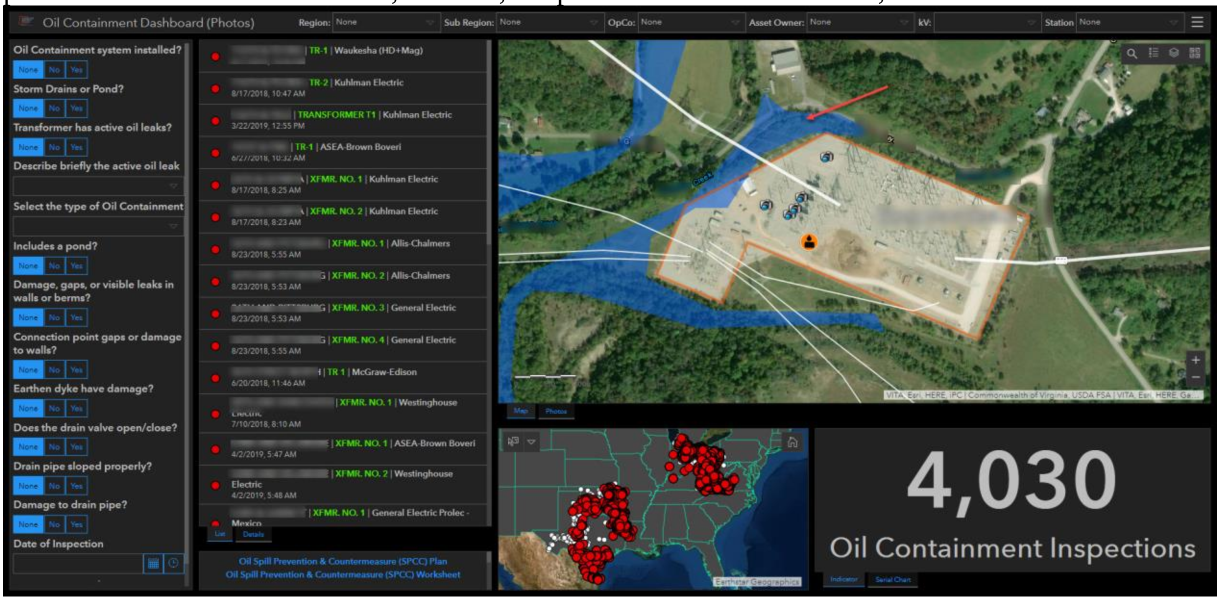


Fig.6, Station's Oil Containment Dashboard (example)

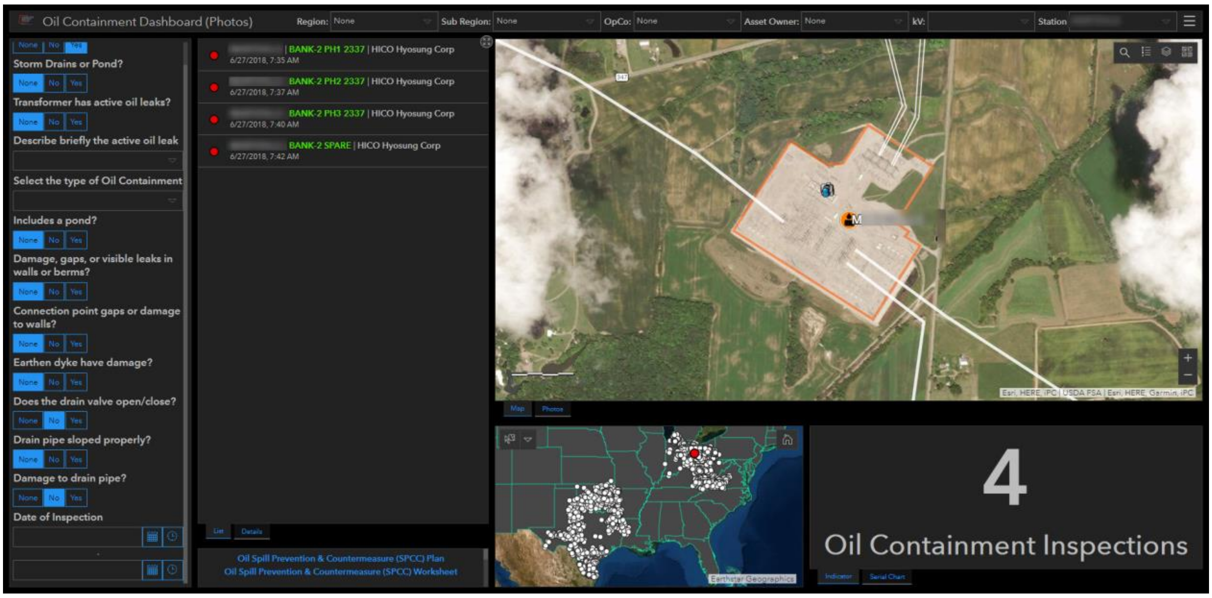


Fig.7, Station's Oil Containment Dashboard filter (example)

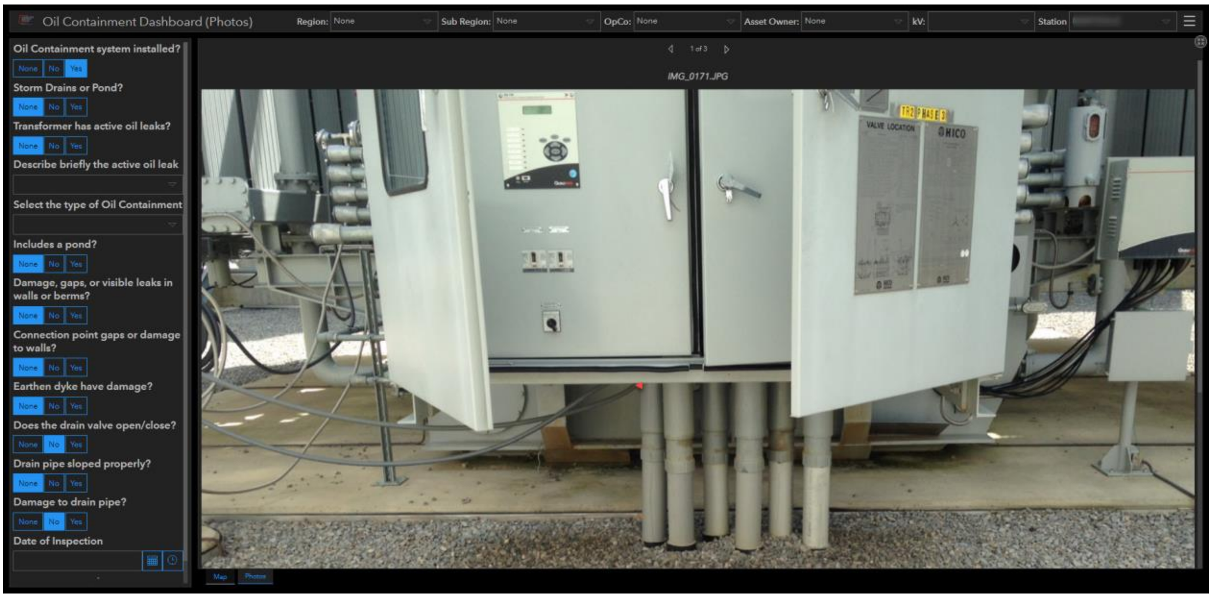


Fig.8, Station's Oil Containment Dashboard Site Picture (example)

FUTURE PLANS

The successful use of Esri dashboards for the oil containment project has demonstrated the potential benefits of connecting other Station information into the GIS system. We are piloting the aggregation of 3D CAD designs of station infrastructure and the information of line assets – which we believe will provide an array of benefits, such as the ability to map planned outages to the pieces of equipment affected. Including the high level of detail for equipment information will allow for a strategic plan for maintenance and repairs. When a failure occurs, the workforce planning department can visually see the location of nearby crews, and more quickly dispatch them to start performing restoration activities. This scenario is similar to requesting Rideshare, which allows users requesting a ride to see a map with the estimated time of arrival of a pickup, and where the car is in relation to the person being picked up. It also aids personnel in identifying the location of specific equipment across our footprint that may need to be pulled from the system, due to defective material. A visual mapping report can be analysed by anyone in the office or the field. Users can collect pictures and notes on-site with a mobile device that is also linked directly to the main map, and the information collected in the field is available to the office in real-time.

CONCLUSION

While both IPS and TGIS are used as their respective system of record, there are multiple other programs in place for tracking additional asset information such as maintenance issues, recalls, warranty information, and asset-specific geolocations. Storing information across multiple non-interconnected systems complicates system renewal and planning activities. It was found that using the GIS software enables real-time processes of spatial tracking and analysis tools. TGIS has proven to streamline the process in asset tracking, condition, and increase savings (in both time and money), while abiding by strict regulations. Increasing cross-collaboration by sharing digitized planning efforts reduces risk. Using Esri's software to view, analyse and filter the data has greatly reduced the time needed for data analysis, and has simplified management's review time. An overall geospatial mapping model allows for accommodation for enhanced collaboration among field and office staff throughout the company, and for greater innovation of operations. The result is the ability of respond to grid demands more quickly, and to deploy larger projects more efficiently.

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