Using GIS to Build the History of a Pipeline

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Problem Definition

- PHMSA’s tabular data is organized by Operator ID number
- Operators constantly buy and sell pipelines
- Tabular data can’t follow a pipeline as it changes operators
- Solution: tie the data to a GIS pipeline segment and track the “history” of a pipeline as it changes operators
- Complications: operators are not required to identify which lines they have bought and sold, requiring tools which spatially match incoming pipeline data to existing pipeline data
NPMS Background

• US DOT PHMSA regulates gas and hazardous liquid pipelines
• The NPMS (National Pipeline Mapping System) contains GIS data from 1,100 operators of gas transmission and hazardous liquid pipelines, as well as LNG plant and breakout tank data
• Operators are required to submit their GIS data annually
• NPMS data is used for emergency response, inspection planning, risk management, planning smart growth, and allowing the public to view pipelines in their area
Public Viewer on www.npms.phmsa.dot.gov
Change Detection Process

- Change detection compares incoming data to existing data and enables pipeline history to be built.
- Custom tools were built by PHMSA (with contractors Michael Baker Intl. and New Century Software) to analyze and find matches for incoming data.
Not as easy as it sounds...

All of the following situations lead to the failure to make a clean, automated match for an incoming pipeline segment

- Operator has resurveyed lines
- Operator has constructed new lines or laterals
- Operator has sold lines in a congested pipe corridor and doesn’t know who has bought them
- Operator has bought lines in a congested pipe corridor and doesn’t know who sold them
- Pressure on a gas line has been upgraded, bringing it into the requirements to submit to NPMS but not identified as a new line in the operator’s records
Example

• Lines resurveyed? Was the lateral on the left sold?

**Pink** = New (incoming) Submission
**Green** = Previous submission
Example

- Congested pipeline corridor
- Symbology = Operator ID number
- Multiple pipelines in the same buffer zone used to identify matches, and many lines running together have the same OPID
- How can you program a tool to find matches in this situation?
Custom tools compare newly submitted segments to the universe of OPIDs in the national layer.
Analyst is presented with use cases and has the ability to create a new history record or identify the incoming pipe segment as identical to an existing segment.
Results

Each incoming pipe segment is classified by:

- **Match confidence:**
  - High Confidence match (Green)
  - Medium Confidence match (Yellow)
  - Low Confidence match (Red)
  - No Match (Red)

- **Use Case (UC):**
  - Match between same Operator – UC1
  - Match between different Operators – UC10
  - No match for Submission feature – UC4
  - No match for Submission feature but feature attribute states addition – UC3
Pipe segmentation

- Changes in segmentation create issues with inheriting history
- Operators create a new pipe segment when an attribute changes
- Operators can also create segments arbitrarily
- Which history should a new segment inherit?

- Multiple segments cannot inherit one history record
History Creation

Once matches are verified or created, incoming data is sent through a load process:

- Unique ID from the existing feature is transferred to the incoming feature
- Existing feature is removed from the existing layer
- Incoming feature is added to the existing layer
- Incoming feature is added to the History layer
PIMMA Plus

A new web application built to allow the user to query pipeline history as well as integrated tabular data.
Using history to meet mission goals

• Display liquid lines whose commodity has recently been converted to ethanol
• Display pipe segments with accidents over the past five years
• Display pipe segments that have been inspected in the past 24 months
Questions?

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