

# Integrating GIS with Pipeline Simulation Software

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## Targa Resources

- One of the largest independent providers of integrated natural gas and NGL midstream services in the United States
- 11,300 miles of gas gathering and NGL pipelines
- 22 gas processing plants
- 10 billion cubic feet per day of capacity

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## Gregg Engineering

- A leading developer of Pipeline Simulation Software for all types of pipeline systems
- First company to develop a PC-based Pipeline Simulator
- A leading provider of pipeline engineering services, including design and optimization

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## The Situation in 1996

- Purchased Gregg Engineering WinFlow to simulate gathering systems
- Consultant hired to create WinFlow models
- Consultant found errors in paper maps
- Pipeline simulation model completed
- No way to update maps from models

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## The Plan in 1997

- Test making maps from GIS
- Test making models from GIS
- If successful, integrate GIS and Pipeline Simulation
- Make corrections once
- Make a return on investment from GIS and simulations

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## Pipeline Simulations

- Simulate the flow of natural gas and liquids in a pipeline system.
- Analyze current operations
- Predict flows and pressures under new conditions
- Design new pipeline systems
- Optimize existing pipeline systems

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# Pipeline Simulation

- Mathematical model
- Based on network of nodes and legs
- Solved for a set of flows and pressures
- Calculated flows and pressures compared to actual values
- Good model will predict operations at other conditions



# Important Modeling Considerations

- Flows - Material balance
  - Know ALL flows into and out of system
  - Don't mix flow data from different time periods
- Network connectivity
- Leg parameters
- Flow properties
- Elevations



## GIS Study 1998

- Proof of Concept
  - Create maps from GIS
  - Create models from GIS
- Develop enterprise GIS strategy
- Identify and decide issues
- Test processes to clean up GIS data
- Analyze cost and benefits of corporate GIS

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## AutoCAD or GIS

- GIS selected
  - ESRI ArcView 3.1 for desktop GIS
  - ESRI SDE on Oracle database for data storage
  - ESRI ArcIMS for corporate display
- Put **ALL** non-flow simulation data in GIS
- Eliminate dual AutoCAD map and GIS
- Convert maps to GIS

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# Cartographic Displacement

- Options
  - Maintain fixed scale cartographic displacement in GIS
  - Maintain geographically accurate locations in GIS
  - Keep two sets of data
  - Cartographic displacement on fly not available
- Decision – Only maintain geographic locations
- Initially unhappy paper map users
- Ultimately right decision

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# Dynamic Segmentation

- To use or not to use dynamic segmentation (stationing or measures)
- New technology in 1998
- Very little gathering pipe ever stationed
- Difficult to use with gathering systems
- Chose simple snapped points and polylines
- Unique GIS polyline for each leg in model

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## Pipeline Data Models

- PODS and ISAT based on stationing
- Tried stationing and PODS but too difficult
- No stationing meant no PODS or ISAT
- Developed proprietary data model
- APDM not available at time
- APDM also based on stationing

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## Topology (Connectivity)

- Pipeline simulation model based on network
- ESRI Network Analyst not developed at time
- Used simple network model with few rules
  - Network consist of nodes (points or simple junctions) and legs or segments (simple edge polylines)
  - Nodes and legs visually snapped together

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## GIS, Measurement & Simulation Data

- Still considerable discussion in gathering industry: What data belongs in GIS
- We decided to put ALL non-flow modeling data in GIS
- New polyline whenever attribute data changes
- We linked the flow data to GIS using unique measurement ID's



## Topology Cleanup

- Network topology is essential
- Need all pipe in GIS
- Need all pipe correctly connected
- Built visual topology cleanup tools based on snapping
- Tried error fixing and tracing – both tedious
- Avoid global snapping





## ArcView Extension Tools

- Cut, copy and paste
- Point and polyline snapping
- Polyline connectivity check
- Multipart and duplicate check
- Point and polyline snap check
- Now mostly part of ArcGIS 9.2

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## GIS to WinFlow (Old method)

- Export ASCII CSV node, leg and flow files from ArcView
- Use WinFlow DataManager script to create model from CSV files
- Worked great

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## GIS to WinFlow (New Method)

- WinFlow has ShapeFile import / export tool built-in
- Uses ShapeFiles instead of CSV files
- Easier to run back and forth or simultaneously
- Gregg has built a set of tools to check and fix connectivity

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## Conclusion

- Integrating GIS and Pipeline Simulation is practical and cost effective
- GIS and Pipeline Simulation helps us operate, optimize and expand our gathering system
- No magic bullet to cleanup GIS data
- We made right decisions and would not change a thing

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## Future Plans

- Continuing to enhance and expand our GIS
- Continuing to improve GIS update process
- Working on tighter GIS and WinFlow integration
- Gregg Engineering developing GIS cleanup process
- Develop practical multiphase gathering system Pipeline Simulation using elevations and improved liquid hold prediction



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