



**PIPELINE STUDIO™
SYSTEM INTEGRATION
WHITE PAPER**

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1. INTRODUCTION

The purpose of this paper is illustrate how Pipeline Studio™ can be easily integrated into a bespoke application that requires a true pipeline simulator at its heart by using the open data formats available with the product. The paper includes specific examples of how such a solution can be built and is intended as a source of inspiration.

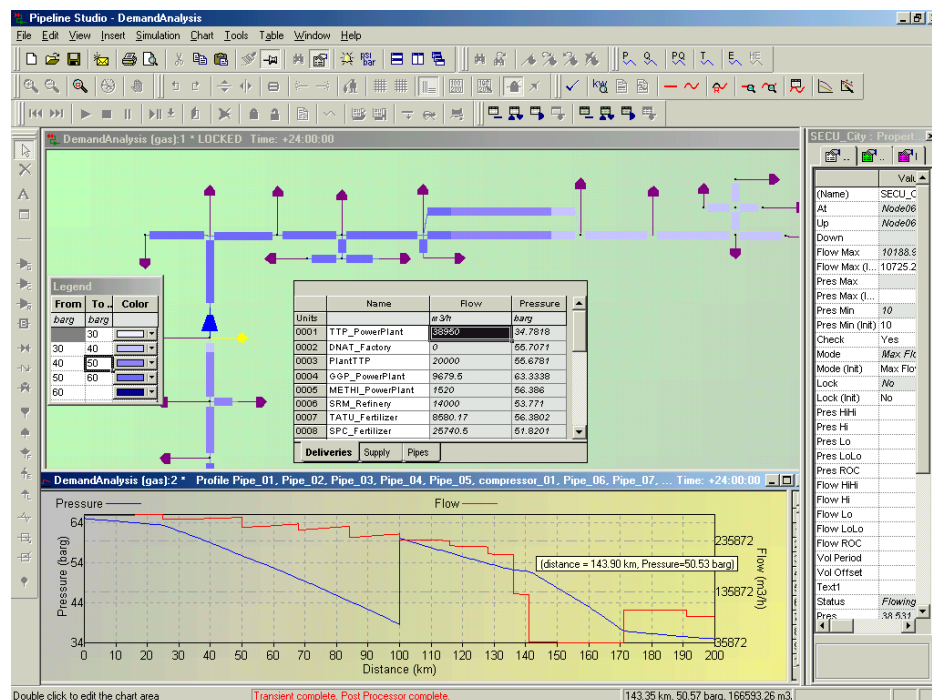
2. WHY PIPELINE STUDIO?

Pipeline Studio™ is a state-of-the-art hydraulic simulation tool that quickly and accurately performs both steady-state and transient analyses of single phase fluid flow in simple or complex pipeline networks.

Pipeline Studio™ is an easy-to-use off-the-shelf standard product. Incorporation of Pipeline Studio™ as a component within other systems alleviates the time consuming set-up and running of simulations that rely on data from other sources such as SCADA, load forecasters or nominations.

The Pipeline Studio™ user benefits from:

- Tight integration with MS Office™ style applications
- Familiar “Windows” look and feel
- Steady-state and transient simulation within one environment
- Simulation of Gas or Liquid networks.
- High quality technical support from Energy Solutions



3. INTEGRATED APPLICATIONS

Pipeline Studio™ has been developed with ease of integration in mind. Formatted text files, which define the initial boundary conditions and transient scenario for simulations, may be imported into Pipeline Studio™ as parameters to command line arguments. Similarly, Pipeline Studio™ produces formatted output text files that are compatible with MS Office™ products such as MS Excel™ and MS Word™. By utilising these features, Pipeline Studio™ can be easily integrated into a bespoke application that requires a true pipeline simulator at its heart.

The real power of embedding Pipeline Studio™ as a component in a bespoke application comes when you consider that such applications will typically involve a custom User Interfaces (written in e.g. Delphi™ or MS Excel™). Custom User Interfaces can be designed to focus entirely on the problem being solved and therefore the application user does not need to know anything about “irrelevant” details of the simulation or searching for data - they just push the buttons and the results appear!

Energy Solutions has many years of experience delivering bespoke applications built around Pipeline Studio™. Typical applications that have been delivered are:

- **Nomination Checker:** Nominations are physically verified, ensuring that the supply and demand is checked and balanced.
Pipeline Studio™ embedded in a Delphi™ Application.
- **Inventory and Pressure Prognosis:** Using the next gas day forecast, the pipeline inventory is calculated to ensure operational requirements are satisfied. The pipeline pressure is calculated to ensure critical pressure constraints are not violated.
Pipeline Studio™ embedded in a SCADA System.
Pipeline Studio™ embedded in an MS Excel™ Application.
- **Survival Time Calculator:** Prediction of the time to reach a minimum or a maximum inventory violation following the loss of a supply or a delivery.
Pipeline Studio™ embedded in a Delphi™ Application.
- **Off-Spec Gas Predictor:** Composition tracking using Pipeline Studio™ permits prediction of gas quality downstream of a mixing point. A planning application is used to enable selection of supply points and supply flow rates to guarantee delivery of gas within specified quality bounds.
Pipeline Studio™ embedded in an MS Excel™ Application.

CASE STUDIES

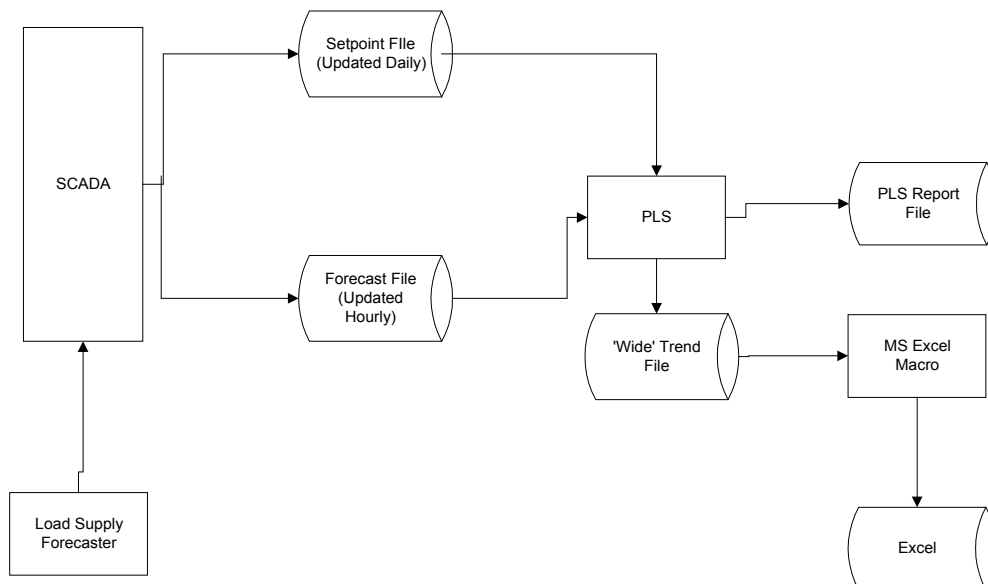
4.1 MEDIUM PRESSURE REGIONAL DISTRIBUTION NETWORK

Medium pressure regional distribution networks suffer from a low pipeline capacity and lack of storage. Employing a Predictive Model would enhance Day to day planning.

A cost effective solution is to develop a Prognosis Application using Pipeline Studio™ as the simulation component. Integration is uncomplicated and can be completed by the end user or by Energy Solutions.

This case describes how a regional medium pressure distribution system operator has integrated Pipeline Studio™ into their SCADA system, permitting analysis of pipeline conditions at the start of the gas day, and to look ahead for the next 24 hours, 48 hours or the next 7 days if forecast data is available.

As is typical of most planning or operational applications, the pipeline geometry for this tool does not vary and therefore a single fixed Pipeline Studio™ configuration is used. Initial boundary data, provided by SCADA, is imported into Pipeline Studio™ via text files and is used to compute a steady-state solution. Transient simulation data is provided in the appropriate file format from a demand forecasting tool.

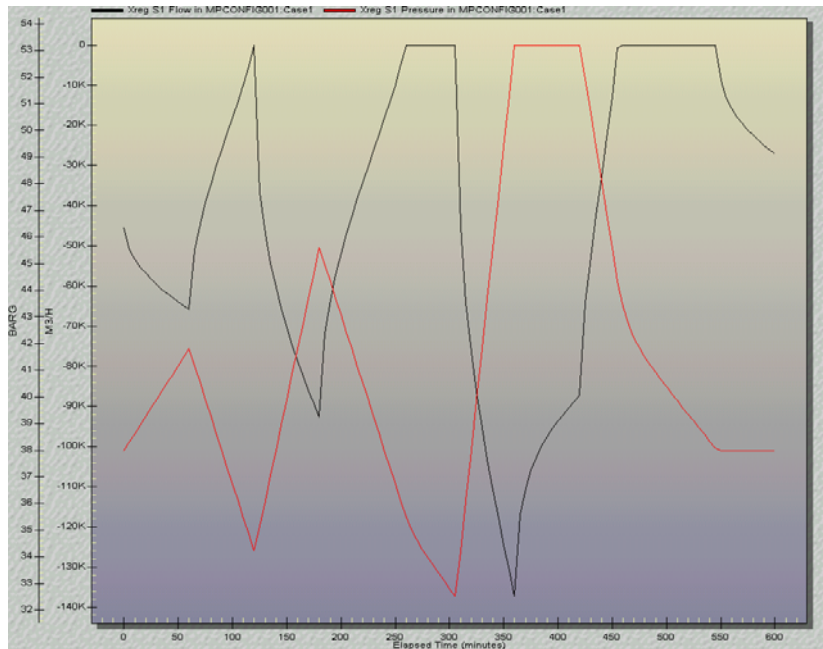


The initial boundary conditions and transient scenario are imported automatically into Pipeline Studio™ using command line arguments. For ease of use the whole application is controlled from a batch file. Therefore importing the

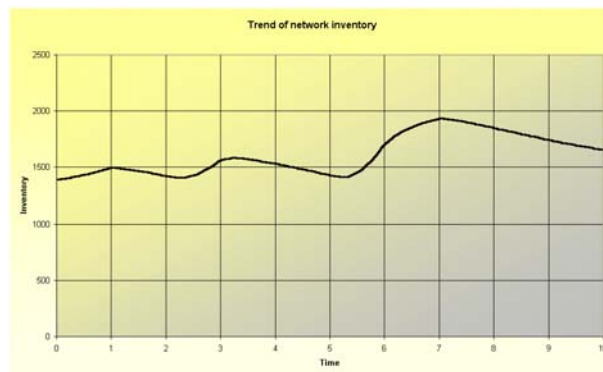
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initial boundary conditions, importing the transient scenario, running the Pipeline Studio™ steady-state and transient simulations, and viewing the output data in Pipeline Studio™ GUI and MS Excel™ is all executed by the user "double-clicking" on a batch file.

Trends of pressure and flow at all inlet, outlet and critical points are provided (additional trends may be added by the user if required). The user interrogates the output trend plots to identify if any contract pressure points will be violated during the gas day. If contract pressures are violated, interruptible contracts are cut.



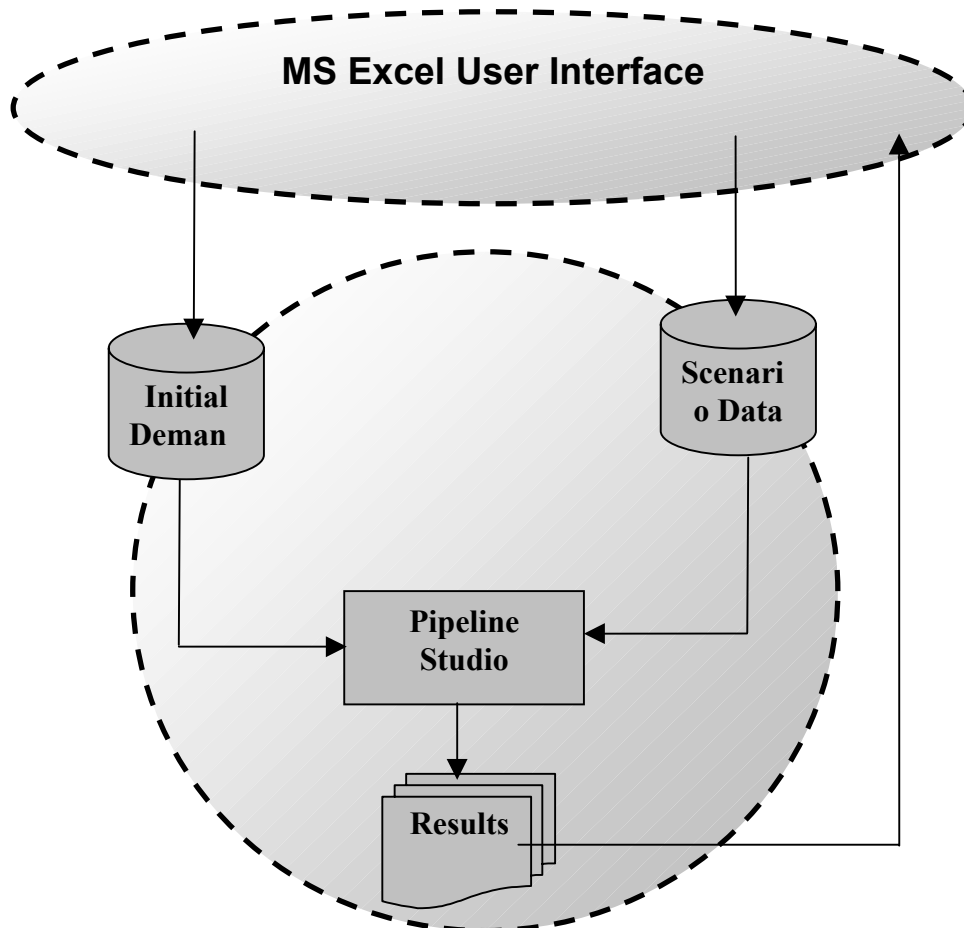
The "wide trend graph" file, imported to MS Excel™ using a macro, is used to analyse network inventory and minimise interruptions, ensuring that sufficient levels of gas supply are maintained to meet the current and next gas day operations.



4.2 EXCEL DRIVEN DEMAND ANALYSIS APPLICATION

Inventory analysis within a pipeline network is essential for maintaining and scheduling the supply-demand balance. Detailed study of the inventory ensures that pipeline operations satisfy the nominated or forecasted volumes, whilst maintaining the pipeline pressure within operational or contractual limits.

MS Excel™ is configured to supply initial boundary set-point and transient scenario data to Pipeline Studio™. MS Excel™ is also employed as the man-machine interface (MMI) to Pipeline Studio™, eliminating the requirement for users to be trained in the operation of Pipeline Studio™.



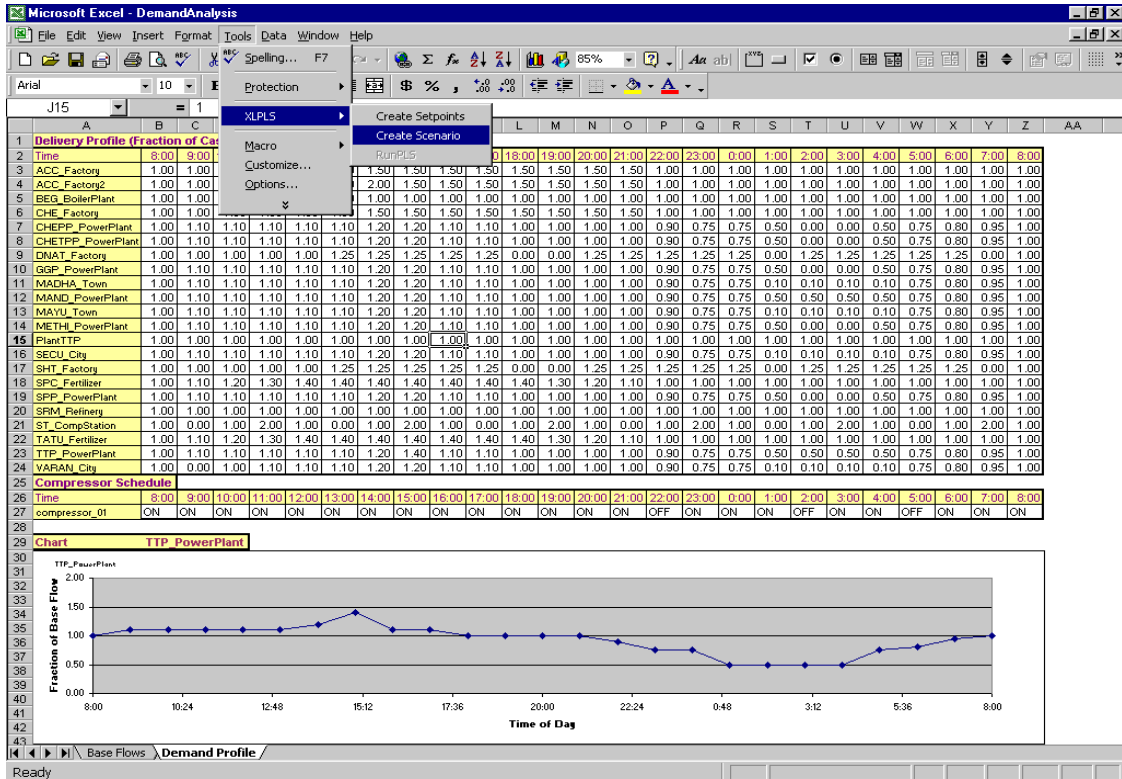
This case describes how Pipeline Studio™ and MS Excel™ are integrated to produce an application for demand and inventory analysis.

The MS Excel™ spreadsheet is configured to submit initial flow set points at each delivery and the status of each compressor. The transient scenario, calculated as a fraction of the demand, is then produced using the drop down menus or by direct manipulation of the load graph. Once the boundary conditions are defined, and the transient scenario computed, the user creates

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the initial data file and transient scenario file; which is then input to the Pipeline Studio™ simulation.

A Pipeline Studio™ simulation is initiated by selecting the application control from the MS Excel™ Tools menu. Pipeline Studio™ performs steady-state and transient simulations, on completion of which results are transferred back to MS Excel™ and displayed as user customised graphs and tables.



The results permit visualisation of inventory forecasts and pressures in the pipeline network. Using this data the pipeline scheduler can determine if the nominated flow rates maintain pipeline constraints for the daily operational plan.

This application is available for download from the Energy Solutions website: <http://www.energy-solutions.com>.