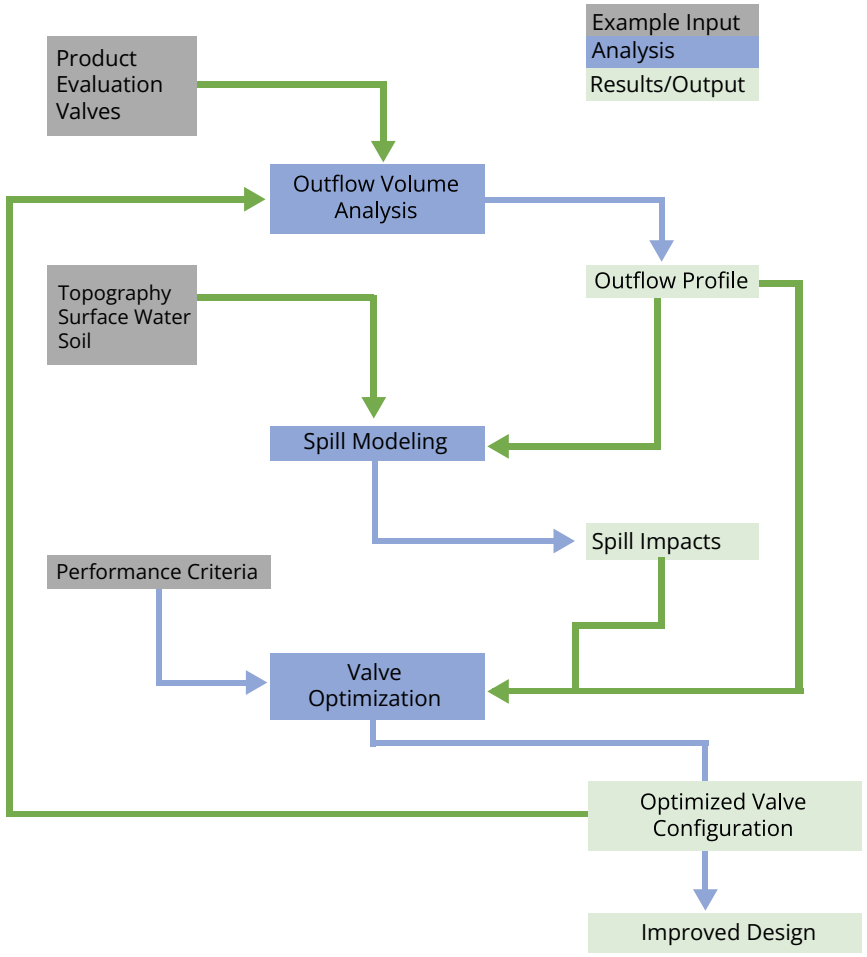
Dynamic Risk

ENGINEERING SERVICES

Industry Leading Engineering Expertise for Outflow Analysis, Overland Spill Modelling and Valve Optimization Analysis

Dynamic Risk brings a unique blend of superior engineering know how and experience together with world class software, data management, and engineering response projects. By building high performance teams in each of these areas, we deliver high-value services and technical solutions to our clients consistent with industry and discipline best practices for pipeline integrity management programs.



OUTFLOW ANALYSIS

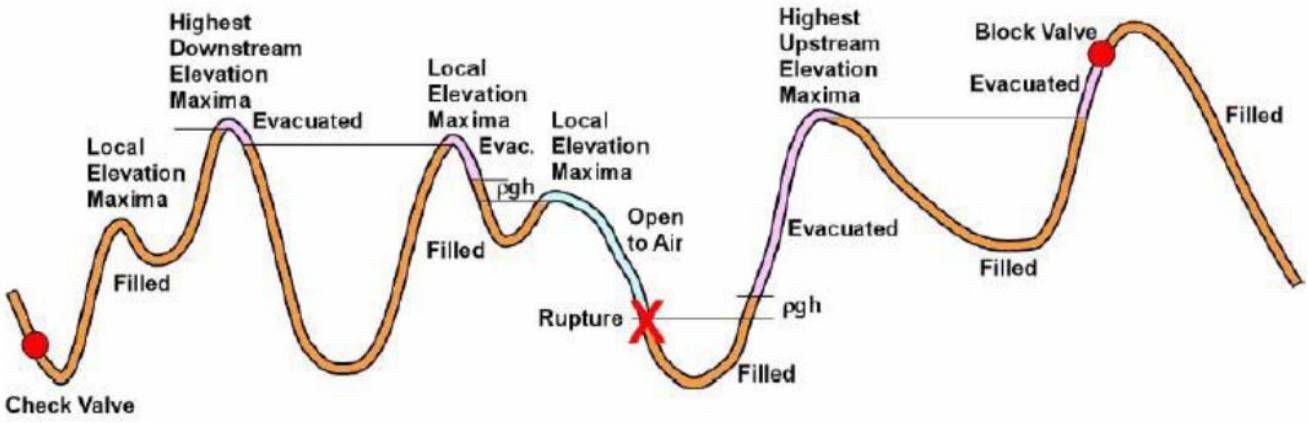
The potential impact of a loss of containment is a major driving factor for the overall risk associated with the operation of liquids pipelines. The process of assessing such an impact requires a conservative and useful prediction of the amount of product that may be lost in the event of a failure.

Outflow modelling is the process by which these predictions are made. By interpreting the operational parameters into appropriate hydraulic considerations, a leak and resulting spill can be modeled at points along the pipeline centerline. The results of these simulations are combined to form a profile for the entire pipeline showing areas of higher and lower potential outflow[1].

The amount of product released during a leak is ultimately dependent on the local hydraulic pressure at the leak site over the duration of the shutdown procedure along with the geometry of the pipeline as it contributes to the drainage of the pipeline. The conditions affecting the outflow of product during a leak occur in four distinct phases:

- Phase 1: Full Operation
- Phase 2: Pump Shutdown
- Phase 3: Valve Closure
- Phase 4: Gravity Drainage

Figure 1: Evacuation of a pipeline where the product can drain by gravity through the rupture orifice



OUTFLOW ANALYSIS BENEFITS

- Accurate Environmental Consequence Results
- Improved Risk Results
- Emergency response planning

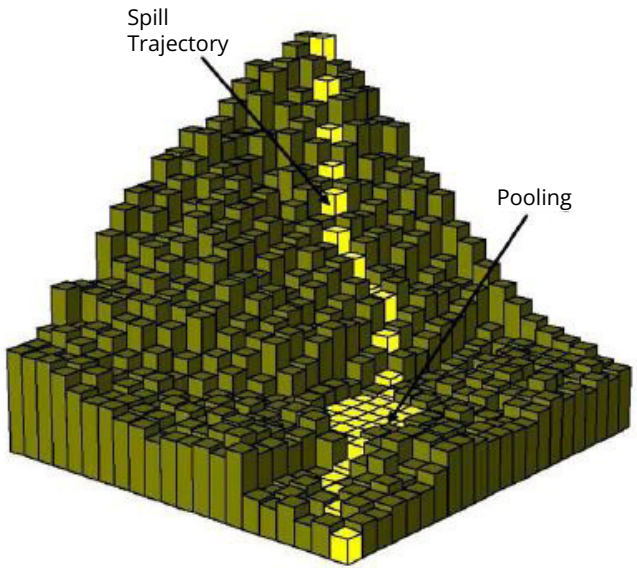
OVERLAND SPILL MODELLING

Our transient three-dimensional overland spill model leverages the outflow volume results and detailed digital elevation data, that is used to determine the migration paths of a liquid product spill based on agreed upon scenarios. The estimated product spill plume will then be determined at the point of intersect using HCA's or Environmentally Sensitive Areas to determine new direct and indirect Environmentally Sensitive locations along the pipeline system. Specifically, the model can be used to determine whether the spill plume would intersect waterbodies, waterways, HCAs or any defined sensitive areas.

Further analysis can be done for Hydrological Transport Modeling by considering flow direction and connectivity between streams and waterbodies as required.

[1] Deng, C., Zuczek, P., Mihell, J., and Adams, K., 2008, "An Integrated Outflow-Spill Modeling Approach for Risk- Based Valve Placement of Liquid Transmission Pipelines," IPC2008-64092.

Figure 2: Overland Spill Modelling Approach



BENEFITS:

- Robust and comprehensive approach
  - » Scientific
  - » Defendable
- Optimized valve design
  - » Identify optimal valve design through iterative modeling
- Total clarity on release volumes
  - » Clean up costs, equipment, and location
  - » Total consequence associated with a worst-case scenario release
- Risk-based design
  - » Enhanced P&M measures where appropriate
  - » Leak detection, ILI, repairs, inspections
  - » Secondary containment
- Detailed analysis for spill plume

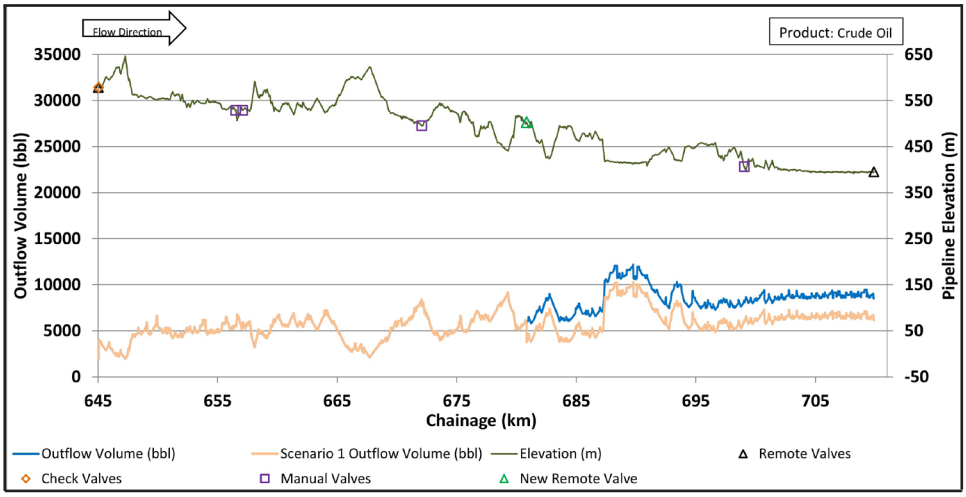
VALVE OPTIMIZATION ANALYSIS

The outflow analysis identifies sections of pipe where outflow volumes can be used in further analysis to evaluate valve configuration and optimization as well as valve maintenance activity planning and prioritization. Valve optimization can be used in a few different approaches, such as consequence based valve modeling and reduction in outflow volumes with the actuation of valves to be remotely operated. The analysis consists of iterative modeling of outflow volumes based on the theoretical placements of various types of valves along the pipeline. This assists operators with determining the optimal valve placements to achieve the most reduction in outflow volumes, keeping cost benefit analysis in mind.

BENEFITS:

- Achieve optimal valve placement design
  - » Identify optimal valve location and type by iterative modelling
- Facilitate reduction in outflow volumes
- Prioritized cost-benefit analysis
- Co-location of valves at existing valve stations
- Identify potential to automate existing valves
- Emergency response planning

Figure 3: Valve optimization reduced outflow volumes



As depicted in Figure 3, baseline outflow volumes can be used to perform valve optimization scenarios to aid in the reduction of outflow volumes along the pipeline route. The plot displays the comparison between the baseline scenario and the scenario with a newly placed remote valve along the pipeline route. An optimal location for an additional valve (remote, check or manual valves with various closure times) can be determined by analyzing the baseline outflow profile for each theoretical valve placement and the criterion for the location of an optimal valve placement in the lowest average spill volume for the pipeline segment.

ABOUT DYNAMIC RISK

Dynamic Risk's technology and consulting services optimize risk-informed decision making to manage risk through an asset's entire life cycle. Our IRAS platform software models pipeline systems to proactively determine where they are most likely to fail and the corresponding consequences of unintended releases. From gathering systems, midstream pipelines, transmission pipelines, and distribution networks, we have software applications and in-house engineering expertise to provide complete pipeline risk assessment, data management and compliance reporting.

Dynamic Risk is part of Eddyfi/NDT, an innovative industrial technology group focused on advanced diagnostic technologies to monitor the world's infrastructure health. The company employs over 1,200 people throughout 25 offices worldwide and serves clients in more than 110 countries.

www.eddyfi-ndt.com

Canadian Headquarters

Suite 1110
333 – 11 Avenue SW
Calgary, Alberta, T2R 1L9

(403) 547-8638

USA Headquarters

10001 Woodloch Forest Dr
Suite 250
The Woodlands, TX 77380

(832) 482-0606

EDDYFI NDT