PIPELINE MODELING SOFTWARE

The proposed Pipeline modeling software shall encompass the following modules.

1. Pipeline Hydraulics

- Oil pipe hydraulics
  - ✓ Miller equation
  - ✓ MIT equation
- Gas pipe hydraulics
  - ✓ Flowrate models
  - ✓ Weymouth
  - ✓ Modified Weymouth
  - ✓ Panhandle
- Head loss
- Hydraulic pressure required to transport fluid
- Equivalent length and diameter ratio
- Vapour pressure
- Bulk modulus
- Gravity effects
- Pipeline pressure drop
- Geothermal effect
- Joule Thompsons effect
- Pipe sizing
- Pipeline system head curves
- Laminar and turbulent flow
- Properties of flowing liquids
- Friction factors and Reynolds numbers.
- Kinetic energy of fluid flow
- Pumps and compressors and their sizing etc.
- Heater and coolers
- Heat exchangers
- Mixers
- Pipe couplings
- Temperature profiles of pipeline
- Pipeline insulation
- Fluid compressibility
- Fluid density and viscosity models
- Properties of pipeline fluids

- ✓ Enthalpy
- ✓ Gibbs free energy
- ✓ Entropy
- ✓ Fugacity
- ✓ Partial pressure
- ✓ K-value

- Fluid models
  - ✓ Bernoulli model
  - ✓ Conservation of mass
  - ✓ Conservation of momentum
  - ✓ Equations of state
    - ❖ Peng Robinson's equation
    - ❖ Soave Redlich Kwong (SRK) equation

2. Leak detection in pipeline

- Detection of leak
- Localization of leak
- Time of leak detection
- Pressure at the point of leak
- Leak volume estimation etc
- Gas leak
- Liquid leak
- Full and partial leak opening
- Orifice flow leak models
- Leak containment

3. Pipeline flow assurance

- CO_2 corrosion
  - ✓ Effect of temperature
  - ✓ Effect of pressure
  - ✓ Effect of CO_2 mole composition
  - ✓ Effect of fugacity
  - ✓ Effect of pH
  - ✓ Effect of glycol addition etc
- H_2S corrosion

    - ✓ Effect of temperature
    - ✓ Effect of pressure
    - ✓ Effect of H2S mole composition
    - ✓ Effect of fugacity
    - ✓ Effect of pH
    - ✓ Effect of glycol addition etc
    - ✓
- Pipeline Erosion
- Pipeline Hydrates
- Pipeline Slug Analysis
- Pipeline Wax formation and Deposition Analyses
- Pipe Wall shear stress etc

4. Multiphase flows in pipeline

- Liquid hold up
- Phase fraction
- Slip velocity
- Flow patterns
    - ✓ Slug flow
    - ✓ Bubble flow
    - ✓ Stratified flow
    - ✓ Churn flow
    - ✓ Annular flow
    - ✓ Dispersed flow
- Flow regime etc.
- States of flow
    - ✓ Steady state
    - ✓ Transient state
    - ✓ Pseudo-steady state

5. Pipeline Risk and Integrity management.

- Pipeline risk models
- Pipeline risk analyses and management
- Pipeline integrity management etc

6. Pipeline Economics

- NPV.
- Pay-out-time
- IRR
- Levelized cost
- Transport cost
- Monte Carlo simulation

Note: the software will be applicable for onshore and offshore pipelines which comprise of gas gathering, transmission, and local distribution systems. The software will be adaptable to model the following fluids

1. Natural gas.
2. Oil
3. Water.
4. Hydrocarbon gases
5. Condensates
6. NGLs
7. Hydrogen and others