

EleaKTRA Field Studio

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...a world of solutions

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GLOBAL NETWORK



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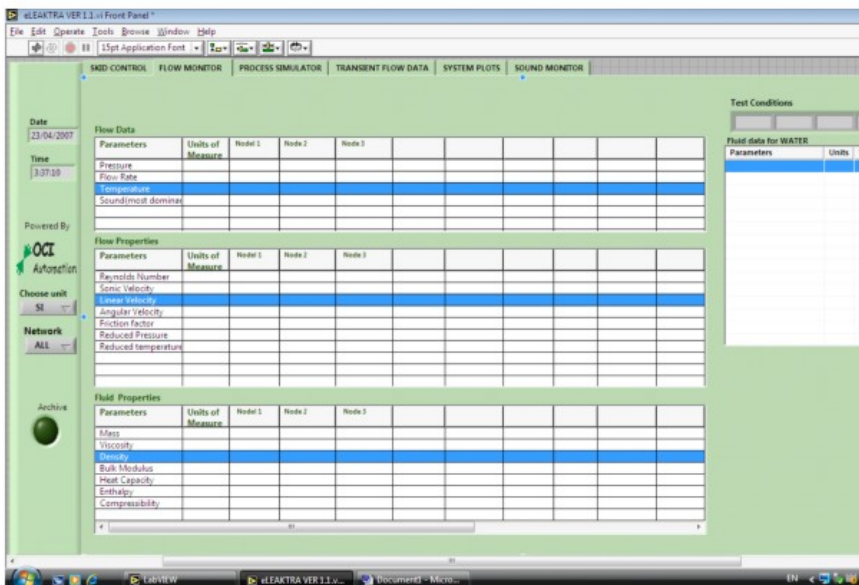
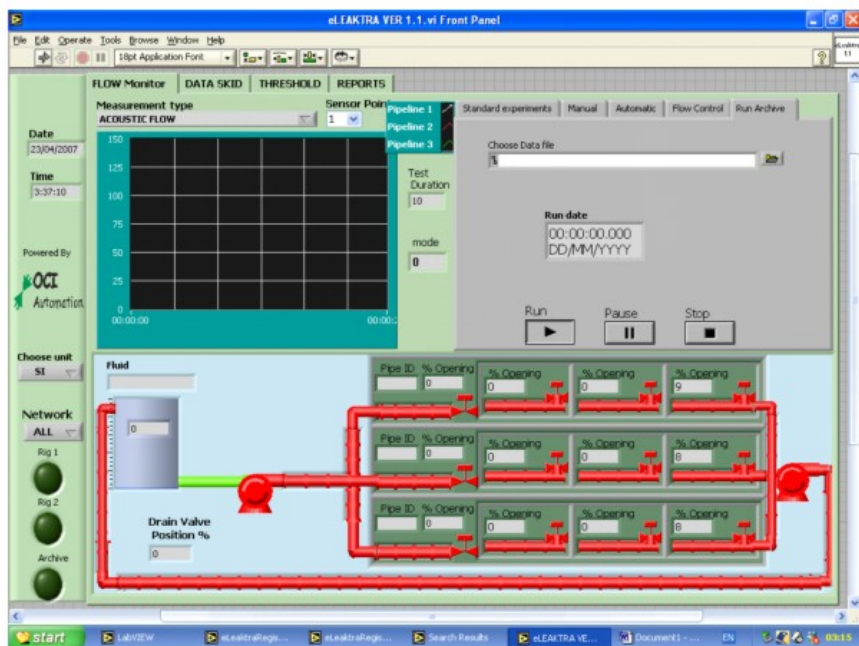
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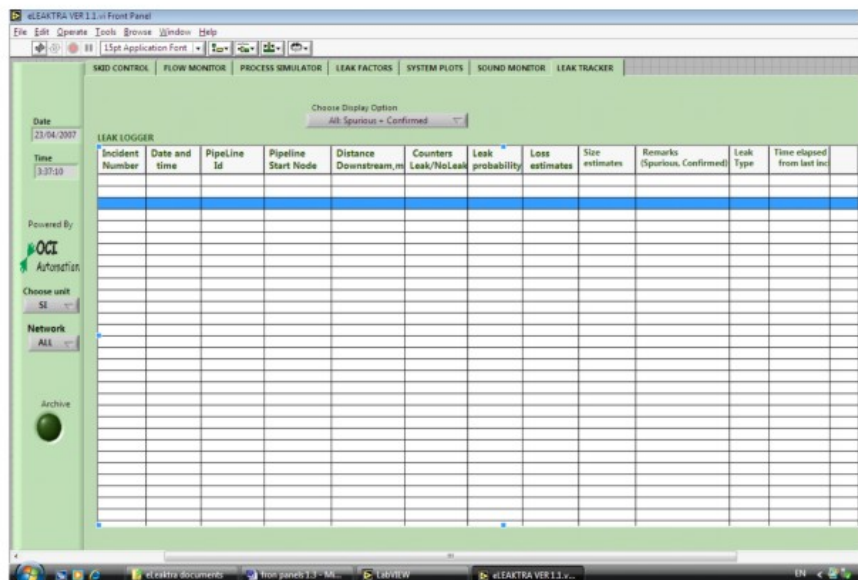
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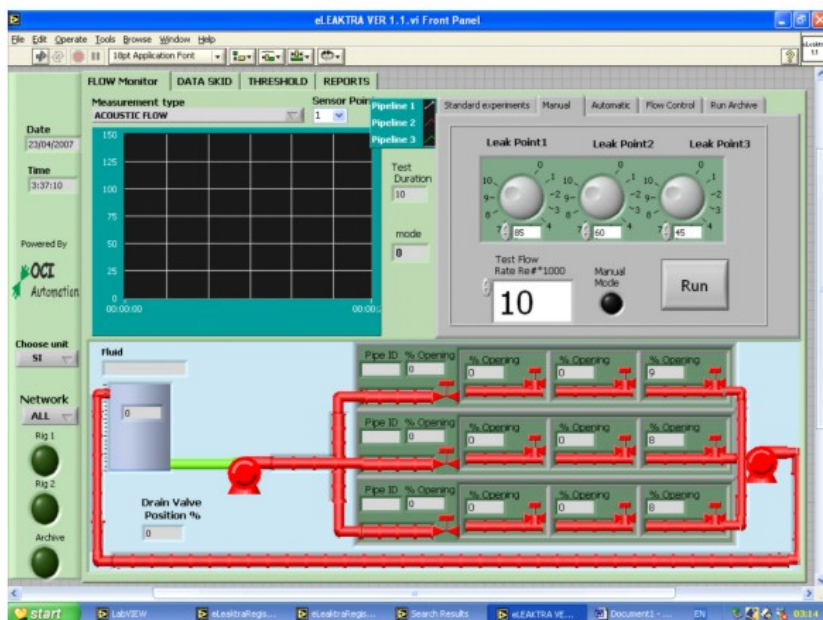
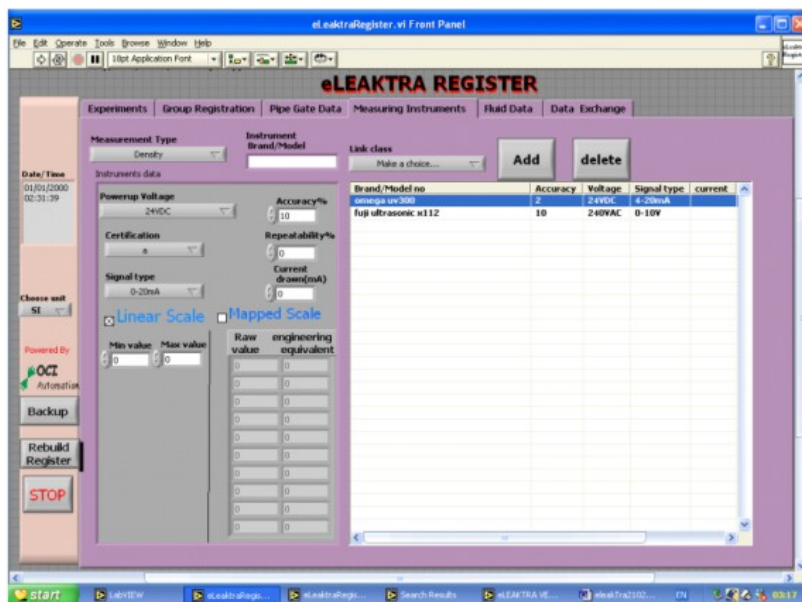
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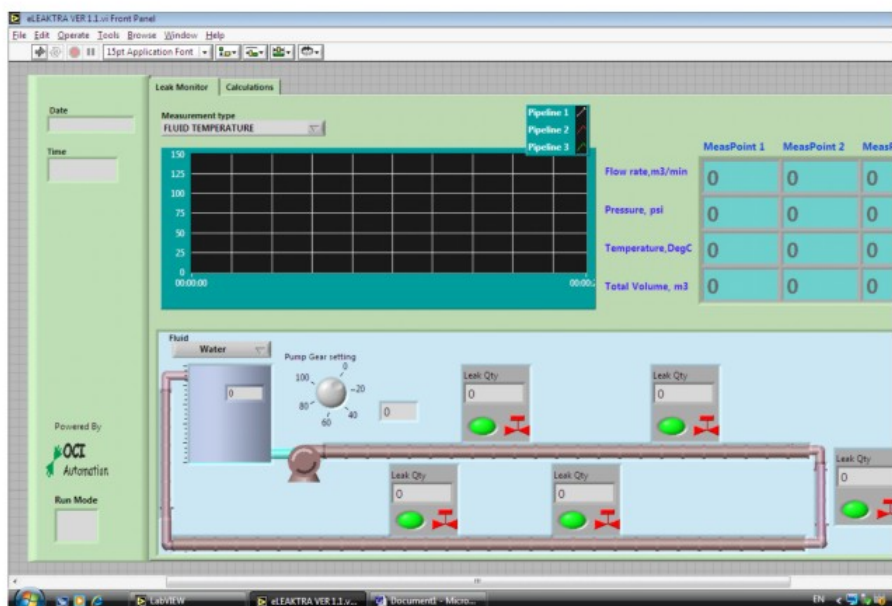


Data Entry Form

DATA ELEMENT				
S/N	System Element	Process Element	Fluid	Model Function
1	1	0	Water	0
2	4	1	Alcohol	2
3	7	2	Cruid Oil	4

Remove
Clear
Export

Figure 18: Data Entry Form



Performance Indicator	Specific Performance Criteria	Operating Condition
Sensitivity	Response time not to exceed <input type="text"/> for <input type="text"/> leak rate	Steady State
	Response time not to exceed <input type="text"/> for <input type="text"/> leak rate	Transient
	Minimum detectable leak rate <input type="text"/>	
Reliability	False alarm rate <input type="text"/> times/year	Overall
	False alarm rate <input type="text"/> times/year	Steady State
	False alarm rate <input type="text"/> times/year	Transient
Robustness	Number of loss of functions due to instrumental errors <input type="text"/> times/year	Overall
	Number of loss of functions due to operational changes <input type="text"/> times/year	
	Startup stabilization period not to exceed <input type="text"/> minutes	
Accuracy	Leak location error not to exceed <input type="text"/> for <input type="text"/> leak rate	Steady
	Leak rate error not to exceed <input type="text"/>	
	Leak mass/volume not to exceed <input type="text"/>	

Figure 16: Leak Detection Performance

X-GATE

The final tab is the X-Gate tab. It comprises of several tabs each receiving data about the system, process, model and fluid. Figure 17 below depicts the tab.

Subsea Production Platforms | Tank Farms/Terminals | Subsea Well Completion/Drilling Assets | Process Systems | Subsea Pipeline Risers/Flowlines | Gas Plants/LNG | Off Gas Platforms | Facilities Assets | Compressor/Pump Utilities | Valves/Lines | Subsea Pipelines

System Element

Process Element

Model Function

Fluid

Add View All

Figure 17: Leak Detection Performance

To add values, the form is filled and the 'Add' button is then clicked. To view all values added, click on the View All button. The dialog box below is displayed.

LEAK CONSEQUENCE

In the Leak Consequence tab, information is collected about the consequences of the recorded leak. Other values could be calculated using this information. The figure below depicts the Leak Consequence tab.

The screenshot shows the 'Leak Consequence' tab in the ELEAKTRA FIELDSTUDIO software. The interface includes a menu bar (File, Edit, View, Options, Help) and a toolbar. The main area is divided into several sections:

- PIPELINE/FLUID/OPERATING INPUT DATA:**
 - LIQUIDS ONLY:** Average ambient temperature [degC], Density [kg/m3] [TSC, 1 bar], Onshore/Offshore [ON = on, OFF = off], Pipeline diameter (inches), Pipeline Length (km), Fluid Type (L or G), Fluid flow rate [1000 m3 (m3)/h], Fluid hazard factor.
 - GASES ONLY:** Enter zero for Tg, k, z and Mwu. Average gas temperature [degC], Ratio of specific heats [kPa/Cv], Compressibility Factor, Gas molecular weight.
- VARIABLE INPUT DATA PER SECTION:** A table with 10 columns for sections 1-10.
 - SECTION DEFINITION:** Section Length [km], Ls.
 - SAFETY CONSEQUENCE:** Population density factor, S2.
 - ENVIRONMENTAL CONSEQUENCE:** Liquid Clean-up/other costs [\$/m3], E3.
 - OTHER DATA:** Time to detect leak and shut down [hrs], Leak expectancy (HH:MM:SS or LL), Assumed hole size [mm], Water depth [m], Pressure [bar] - input only/end values.
- CALCULATED VALUES:** A table with 10 columns for sections 1-10.
 - FLUID RELEASE DATA:** Area of hole [mm2], Ignition factor, Liquids Only, Persistence Factor, Climate factor, Potential leak rate [kg/h], Potential leak mass [tonnes], Gases only, Critical flow pressure [bar], Actual gas density [kg/m3], Potential leak rate [kg/h].
 - CONSEQUENCE FACTORS:** Safety (SCF per km), Environment (ECF per km).

A 'Calculate' button is located at the bottom right of the calculated values section.

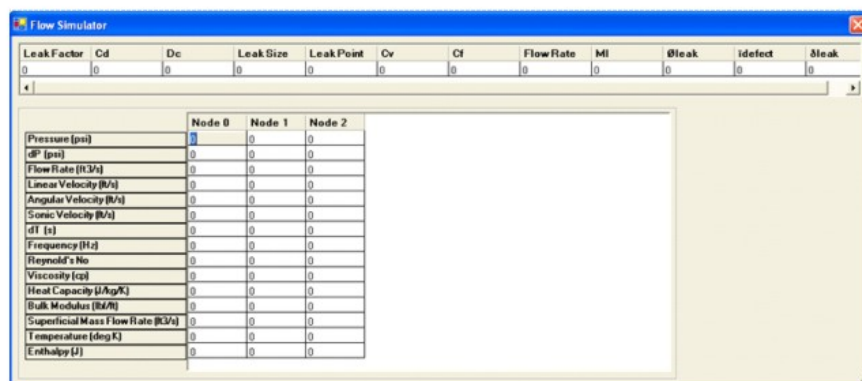
Figure 15: Leak Consequence

LEAK DETECTION PERFORMANCE

The Leak Detection Performance tab collects information about the performance of current leak detection methods. The figure below shows the Leak Detection Performance tab.

Flow Simulator

The Flow Simulator window displays information about the flow properties associated with each node in the pipe. These properties include the Pressure, Pressure Point Analysis, Flow Rate, Linear Velocity, Angular Velocity, Sonic Velocity, Change in Time, Frequency, Reynold's Number, Viscosity, Heat Capacity, Bulk Modulus, Superficial Mass Flow Rate, Temperature and Enthalpy. Figure 12 below shows the Flow Simulator



	Node 0	Node 1	Node 2
Pressure (psi)	0	0	0
dP (psi)	0	0	0
Flow Rate (ft ³ /s)	0	0	0
Linear Velocity (ft/s)	0	0	0
Angular Velocity (ft/s)	0	0	0
Sonic Velocity (ft/s)	0	0	0
dT (s)	0	0	0
Frequency (Hz)	0	0	0
Reynold's No	0	0	0
Viscosity (cp)	0	0	0
Heat Capacity (J/kgK)	0	0	0
Bulk Modulus (B/R)	0	0	0
Superficial Mass Flow Rate (ft ³ /s)	0	0	0
Temperature (deg K)	0	0	0
Enthalpy (J)	0	0	0

Figure 12: Flow Simulator

Flow and Fluid Properties

The Fluid and Flow Properties window displays information about the general flow properties upstream and downstream of the point on the pipe where there is a leak as well as the properties of the fluid flowing in the pipe. The flow properties shown are the distance where the leak occurs, the pressure, pressure point analysis, flow rate, linear velocity, angular velocity, sonic velocity, time, change in time, frequency and Reynold's number.

The fluid properties shown are the viscosity, density, bulk modulus, heat capacity, superficial mass flow rate, enthalpy and temperature.

Figure 13 below depicts the Fluid and Flow Properties View.

ELEAKTRA FieldStudio

File Edit View Options Help

Settings Leak Register Leak Consequence Leak Detection Performance XGate

Form A Form B Form C **Computation**

Input

Details

UPSTREAM **DOWNSTREAM**

Steady Flow

Pressure

Flow Rate

Distance

Transient Flow

Pressure

Flow Rate

Distance

Compute Cancel

Leak Factor

Leak Factor Cv Dc Leak ☐

Leak Size Ql Cd defect ☐

Leak Point Flow Rate MI Leak ☐

Figure 10: Computation

Further details about the calculated leak factor can be seen under the View Menu. These are:

- Flow Simulator
- Fluid and Flow Properties
- Multiphase Flow

ELEAKTRA FieldStudio

File Edit **View** Options Help

Settings Leak Register **Multiphase Flow** Leak Consequence Leak Detection Performance XGate

Form A Form B Form C Computation

Input

Details

UPSTREAM **DOWNSTREAM**

Steady Flow

Pressure

Flow Rate

Distance

Transient Flow

Pressure

Flow Rate

Distance

Figure 11: Computation

LeakTra FieldStudio

File Edit View Options Help

Settings Leak Register Leak Consequence Leak Detection Performance XGate

Form A Form B Form C Computation

Location

OPL/OML No./Unit Description

Nearest Town

State

Operational Area

☒ Land
☐ Offshore
☐ Coastland
☐ Swamp
☐ Inland Waters

Type of Spill/Leak

☒ Crude Oil
☐ Product (Specify)
☐ Drilline mud/chemicals
☐ Others (specify)

Type of Operation at Spill Site

Cause of Leakage/Spillage

☒ Unknown
☐ Blowout
☐ Equipment Failure (specify)
☐ Operator/Maintenance Error
☐ Corrosion

☐ Sabotage
☐ Sand/Erosion/Wave
☐ Accident
☐ Others (Specify)

Weather Conditions

☒ Bright and Sunny
☐ Cloudy
☐ Rainy
☐ Others (specify)

Wind Direction

Wind Speed

Sea Conditions

☒ Calm
☐ Rough
☐ Not Applicable

Direction of Current:

Strength of Current:

Swell Height:

Tidal Condition

☐ High
☐ Low

Quantity Leaked

Estimated Quantity of oil/contaminant leaked:

Detailed Calculations:

Quantity of Crude Oil/Contaminant Recovered as at time of reporting:

Details of immediate pollution to inland waters, beaches, farmland, etc:

Steps being taken to prevent further pollution:

Casualties: ☒ Yes ☐ No

Details:

Other remarks:

OK Cancel

Figure 8: Form B

LeakTra FieldStudio

File Edit View Options Help

Settings Leak Register Leak Consequence Leak Detection Performance XGate

Form A Form B Form C Computation

OIL SPILLAGE/LEAKAGE RESPONSE/CLEAN-UP REPORT

Steps being taken to prevent further pollution:

Clean-up Party:

Progress of clean-up:

☒ 20% ☐ 40% ☐ 60% ☐ 80% ☐ Completed

Clean-Up Duration:

Man-Hours used:

Amount of crude oil/contaminant recovered:

Damage

To the environment:

☐ Land/Spill media
☐ Water Bodies
☐ Air Media

Method of settlement of damage claimed

☒ Arbitration
☐ Court settlement
☐ Direct negotiation between landfords and company
☐ Others (Specify)
☐ Not applicable

Equipment/Containment Method

☒ Bundwalls
☐ Booms
☐ Sorbents
☐ Others (Specify)

Chemical Dispersants

Type:

Quantity:

Not applicable:

Rehabilitation for the impacted area

Compensation Paid (\$ if any):

Cost of Spill

Naira Loss due to oil spilled:

Clean-up cost:

Down-time man hours lost:

Repair work:

TOTAL:

Follow Up Studies:

OK Cancel

Figure 9: Form C

LEAK REGISTER TAB

After the operating parameters have been set, the system is ready to begin computations. The Leak Register Tab consists of four sections viz; Form A, Form B, Form C and the Computation tab. The forms collect detailed information about the leak, while the computation tab calculates the leak factor corresponding to such recorded leaks.

The figures below represent screen shots of these sections.

The screenshot displays the 'LeakTra FieldStudio' application window. The 'Leak Register' tab is selected, and 'Form A' is active. The form is titled 'OIL SPILLAGE/LEAKAGE NOTIFICATION REPORT'. It contains several input fields and a large text area for comments. The 'Incident Date' is set to 9/14/2010, and the 'Time' is 1:27:31 PM. The 'Incident Ref No' and 'Facility/Location' fields are empty. The 'Location Downstream, m' and 'Type' fields are also empty. The 'Estimated Quantity Spilled' field is empty. The 'Known extent of pollution' field is empty. The 'Precautionary measures taken since the spillage/leakage occurred to prevent hazards that may arise' field is empty. The 'Comments' field is a large text area. The 'OK' and 'Cancel' buttons are at the bottom right.

OIL SPILLAGE/LEAKAGE NOTIFICATION REPORT	
Incident Ref No	Facility/Location
Incident Date: 9/14/2010	Known extent of pollution
Time: 1:27:31 PM	Precautionary measures taken since the spillage/leakage occurred to prevent hazards that may arise
Location Downstream, m	
Type	
Estimated Quantity Spilled	
Comments	

Figure 7: Form A

Process Instrumentation

The Fluid Skid

On the fluid skid, settings are made for properties specific to the fluid under observation. These properties include the the liquid fluid properties for liquids, the gas fluid for gases and the liquid fraction. The liquid fluid properties include the fluid type, the viscosity, heat capacity, bulk modulus, density, critical pressure, critical temperature, watercut and molar mass.

The gas fluid properties include the fluid type, the viscosity at reference temperature, the reference temperature, the Sutherland's constant, the critical pressure, the critical temperature, the number of moles, the gas compressibility constants, the heat capacity constants and the gas oil ratio.

The screenshot shows the 'ELEAKTRA FieldStudio' application window. The 'Pipe Gate' dropdown is set to 'Fluid Skid'. The 'Liquid' section has the following fields: Type (dropdown), Viscosity, Heat Capacity, Bulk Modulus, Density, Critical Pressure, Critical Temperature, Watercut, and Molar Mass. The 'Gas' section has the following fields: Type (dropdown), Viscosity at Reference Temperature, Reference Temperature, Sutherland's Constant, Number of Moles, Gas Compressibility Constants (a, b), Heat Capacity Constants (a, b, c, d), and Gas Oil Ratio. The 'Liquid Fraction' field is also visible.

Figure 6: Fluid Skid

To view all fittings currently on the pipe, click on the View All button. A dialog box similar to the one in Figure 6 below is displayed



Figure 4: Pipe Fittings Dialog

To remove a fitting, select the fitting and click on the Remove Button. To remove all fittings, click on the Clear Button. Click on the OK Button to close the dialog box.

Process Control

Process controllers are any features or settings that may influence the flow rate of the fluid through the pipe. These include the Pump Discharge Pressure, the Pump Suction Pressure, and Valves.

As with pipe fittings, to specify the placement of the valve on the pipe, the actual valve type is selected from the valve drop down list, and then the distance downstream to where it is positioned is entered in the Distance Downstream text box. The Add button is clicked on to register the settings, while the View All button is clicked on to display all valves currently attached to the pipe.



Figure 5: Process Control Skid

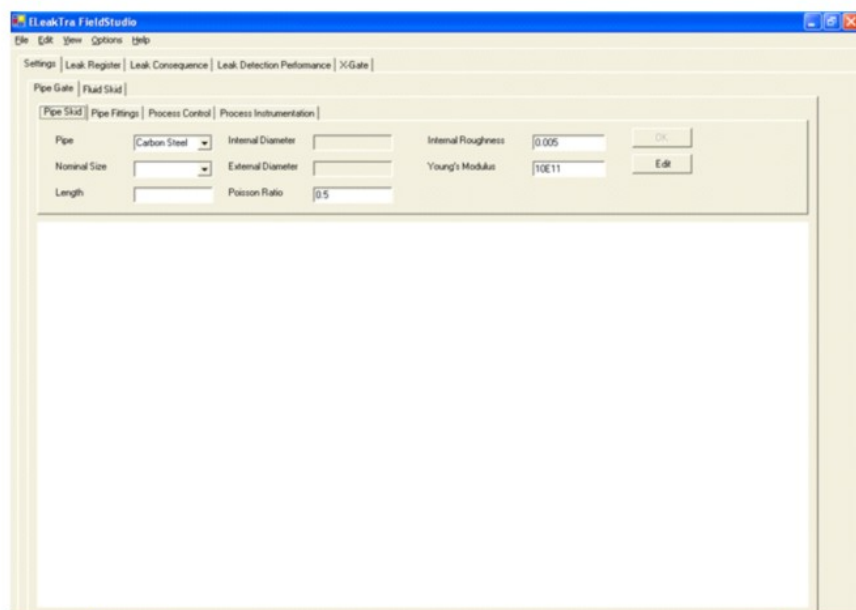


Figure 2: The Pipe Skid

Pipe Fittings

Pipe Fittings refer to any component attached to the pipe at a certain distance downstream that may affect the steady flow of the fluid. The skid is as shown below.

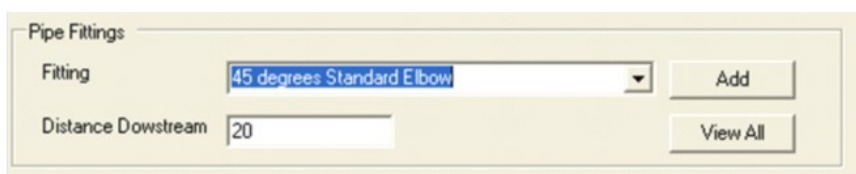


Figure 3: Pipe Fittings Skid

To specify the placement of pipe fittings on the pipe, select the actual fitting from the Fitting drop down list, and then enter the distance downstream to where it is positioned in the Distance Downstream text box. Click on the Add button to register the settings.

Figure 1: Splash Screen

Once the user enters the correct password and clicks on the 'Sign In' button, the system user interface is displayed.

The user interface consists of five general tabs: the Settings tab, the Leak Register tab, the Leak Consequence tab, the Leak Detection Performance tab and the X-Gate tab.

These tabs shall be discussed below in detail.

SETTINGS TAB

In the Settings Tab, general conditions of the simulated operating environment are set. This environment includes: the Pipe Gate, and the Fluid Skid.

Pipe Gate

The Pipe Gate holds general operating conditions related to the pipe through which the fluid would flow. These conditions are set in 4 different tabs: the Pipe Skid, the Pipe Fittings tab, the Process Control tab and the Process Instrumentation tab.

Also, a large canvas area is displayed on the Pipe Gate. Based on the pipe settings, a graphical representation of the pipe is displayed on the canvas.

Pipe Skid

On the Pipe Skid, settings are made for the pipe specifics, including the type of the pipe (the default is Carbon Steel), the nominal size, the pipe length, the pipe internal diameter, the pipe external diameter, the pipe poisson ratio, the pipe internal roughness and the young's modulus.

Figure 2 below displays the Pipe Gate, with the Pipe Skid being the active tab.