Helix Technologies Pty Ltd

Project	Helix QA	Client	Helix QA
Project No.	4567	Design Date	11/03/2017
Category	Demo Liquid QA	Atmos. Press	100.19 kPa
Network Type	Liquid	Calc. Method	Darcy
Description	Three Reservoir Problem		

Three Resevoir Problem ref. 'Hydraulics of Pipeline Systems', Bruce E. Larock et al.
Three reservoirs at elevations of 100 m, 85 m and 60 m. There is an external demand of 0.06 m³/s at the junction. Pipe 1 is 2000 m long diameter 300 mm. Pipe 2 is 1500 m long diameter 250 mm.
Pipe 3 is 3000 m long diameter 250 mm. All pipes have an internal roughness of 0.5 mm. No fitting losses.

Calculation	Publication Results	Helix deltaQ Calculation	
Pipe 1 Flow rate	0.1023 m3/s	0.1022 m3/s	
Pipe 2 Flow rate	0.0200 m3/s	0.0200 m3/s	
Pipe 3 Flow rate	0.0622 m3/s	0.0622 m3/s	good correlation

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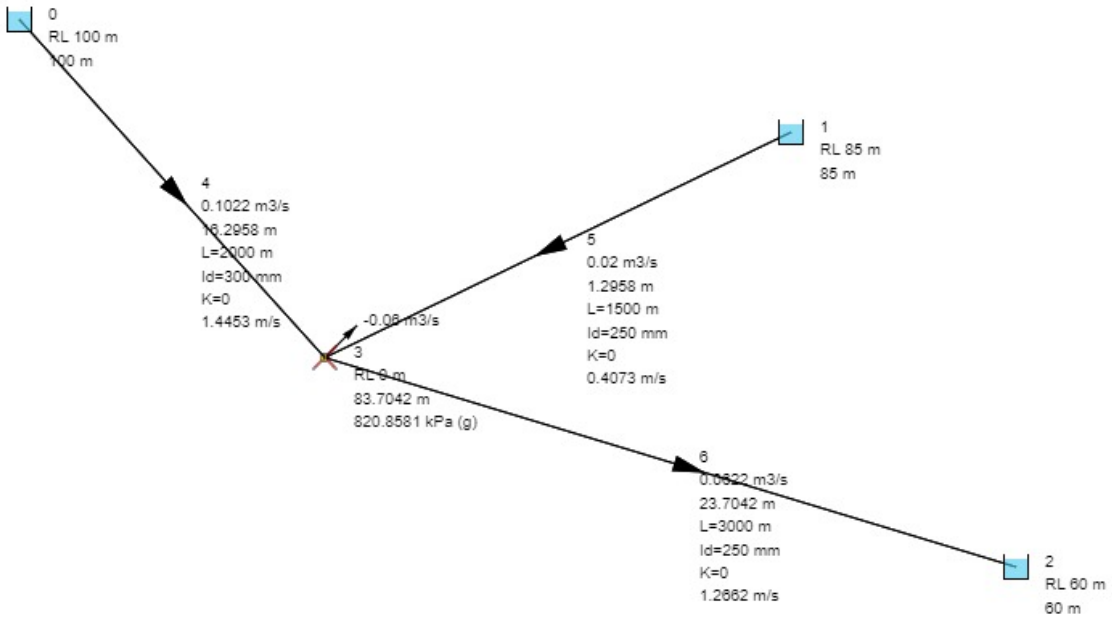

Three Reservoir Problem

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Pipe No	4	From node to node	0 - 3
Description		Equipment No	
Liquid	Water	Viscosity	1.31 cp
Temperature	10 C	Density	1000 kg/m3
Vapour Pressure	0.8 kPa		
Pipe Description	Steel Pipes 12"	Pipe Class	Sch 20
Nominal Diameter	300 mm	Inside Diameter	300 mm
Outside Diameter	323.9 mm	Pipe Length	2000 m
Pipe Roughness	0.5 mm	Allowable Press.	3730 kPa
Orifice Plate Dia	-	Non Return Valve	No
Total Fittings k	0	Total Fittings kf	0
Flow Rate	0.1022 m3/s	Velocity	1.4453 m/s
Friction Loss	16.2958 m	Fitting Losses	0 m
Slurry Losses	0 m	Orifice Losses	0 m
Fixed Head Loss	0 m	Booster Pump Head	0 m
Total Head Loss	16.2958 m	Total Pressure Drop	159.8069 kPa
Entry Total Head	100 m	Exit Total Head	83.7042 m
Entry Gauge Head	0 m	Exit Gauge Head	83.7042 m
Reynolds No.	330981.8668	Friction Factor	0.0229487 (Darcy f)

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Pipe No	5	From node to node	1 - 3
Description		Equipment No	
Liquid	Water	Viscosity	1.31 cp
Temperature	10 C	Density	1000 kg/m3
Vapour Pressure	0.8 kPa		
Pipe Description	Steel Pipes 10"	Pipe Class	Sch 20
Nominal Diameter	250 mm	Inside Diameter	250 mm
Outside Diameter	273 mm	Pipe Length	1500 m
Pipe Roughness	0.5 mm	Allowable Press.	4440 kPa
Orifice Plate Dia	-	Non Return Valve	No
Total Fittings k	0	Total Fittings kf	0
Flow Rate	0.02 m3/s	Velocity	0.4073 m/s
Friction Loss	1.2958 m	Fitting Losses	0 m
Slurry Losses	0 m	Orifice Losses	0 m
Fixed Head Loss	0 m	Booster Pump Head	0 m
Total Head Loss	1.2958 m	Total Pressure Drop	12.7071 kPa
Entry Total Head	85 m	Exit Total Head	83.7042 m
Entry Gauge Head	0 m	Exit Gauge Head	83.7042 m
Reynolds No.	77721.3318	Friction Factor	0.0255311 (Darcy f)

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Description	Three Reservoir Problem		

Pipe No	6	From node to node	3 - 2
Description		Equipment No	
Liquid	Water	Viscosity	1.31 cp
Temperature	10 C	Density	1000 kg/m3
Vapour Pressure	0.8 kPa		
Pipe Description	Steel Pipes 10"	Pipe Class	Sch 20
Nominal Diameter	250 mm	Inside Diameter	250 mm
Outside Diameter	273 mm	Pipe Length	3000 m
Pipe Roughness	0.5 mm	Allowable Press.	4440 kPa
Orifice Plate Dia	-	Non Return Valve	No
Total Fittings k	0	Total Fittings kf	0
Flow Rate	0.0622 m3/s	Velocity	1.2662 m/s
Friction Loss	23.7042 m	Fitting Losses	0 m
Slurry Losses	0 m	Orifice Losses	0 m
Fixed Head Loss	0 m	Booster Pump Head	0 m
Total Head Loss	23.7042 m	Total Pressure Drop	232.4591 kPa
Entry Total Head	83.7042 m	Exit Total Head	60 m
Entry Gauge Head	83.7042 m	Exit Gauge Head	0 m
Reynolds No.	241634.3119	Friction Factor	0.0241635 (Darcy f)

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Node No	0	Node Type	Tank
Description		Equipment No	
Rel. Level (RL)	100 m	Pressure Input	0 kPa
Nozzle K value	-	Ext Flow (+In/-Out)	-
Int.(Gauge) Head	-	Int.(Gauge) Pressure	-
Total Node Head	100 m		

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Node No	1	Node Type	Tank
Description		Equipment No	
Rel. Level (RL)	85 m	Pressure Input	0 kPa
Nozzle K value	-	Ext Flow (+In/-Out)	-
Int.(Gauge) Head	-	Int.(Gauge) Pressure	-
Total Node Head	85 m		

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Node No	2	Node Type	Tank
Description		Equipment No	
Rel. Level (RL)	60 m	Pressure Input	0 kPa
Nozzle K value	-	Ext Flow (+In/-Out)	-
Int.(Gauge) Head	-	Int.(Gauge) Pressure	-
Total Node Head	60 m		

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Node No	3	Node Type	Junction
Description		Equipment No	
Rel. Level (RL)	0 m	Pressure Input	0 kPa
Nozzle K value	-	Ext Flow (+In/-Out)	-0.06 m3/s
Int.(Gauge) Head	83.7042 m	Int.(Gauge) Pressure	820.8581 kPa
Total Node Head	83.7042 m		