PIG MOTION AND DYNAMICS IN COMPLEX GAS NETWORKS

Simulating a complex pigging program

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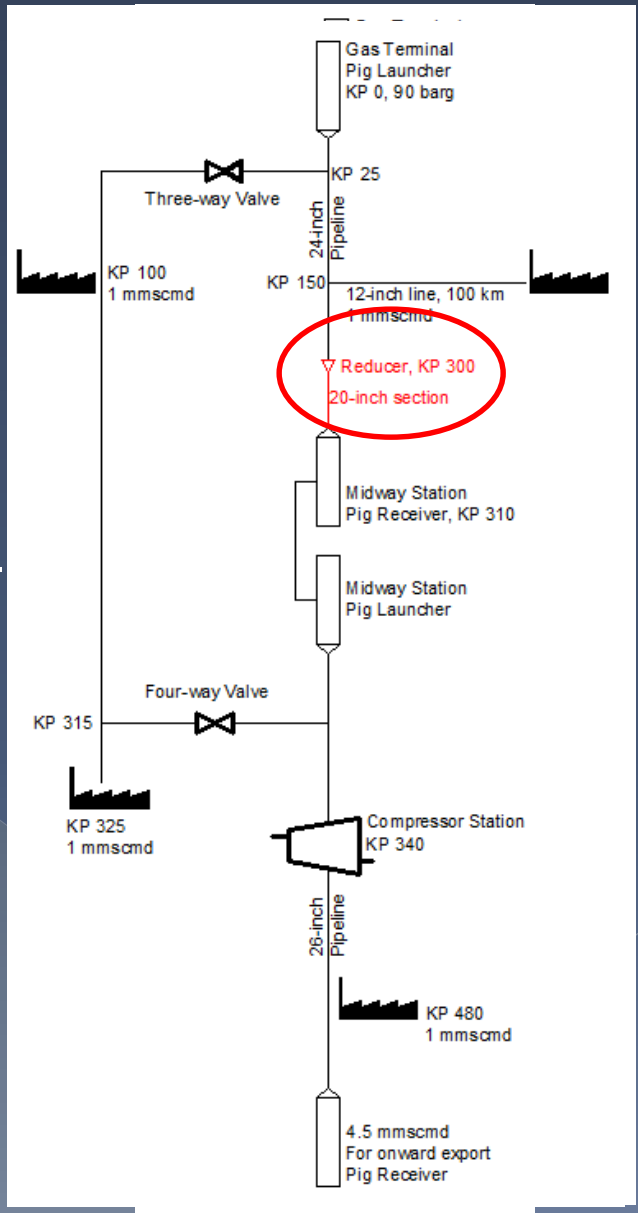
Contents

- Aim of the analysis;
- Piglab Model description;
- Three analyses presented: -
  1. Initial pipeline;
  2. Expanded capacity;
  3. Following pipeline repair.



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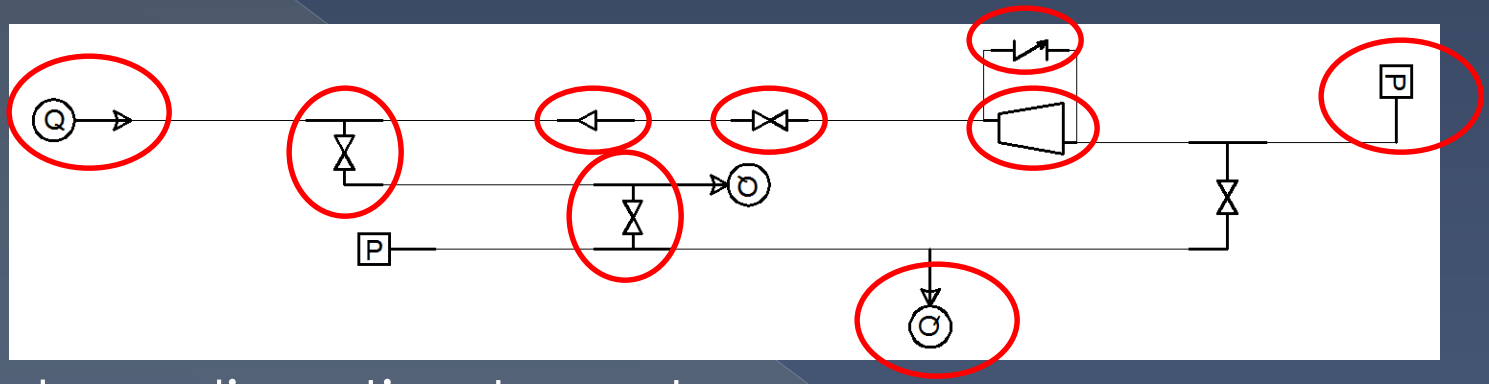
Aim of the model

- Simulate pigging a complex system;



- Reduce disruption to customers;
- Manipulate flows, valves, pressures in real time as the analysis proceeds;
- Avoid possible pig stalling ("Flow diversion");
- Avoid high valve DP before opening;
- Understand schedule / time to pig;
- Cut down on unnecessary downtime or penalty

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Overall aim of the analysis…

- Balance the requirements of the pigs (velocity limitations, pressures, avoid stalling etc) with…
- The requirements of the system and the customers (minimum pressures, required flows etc)

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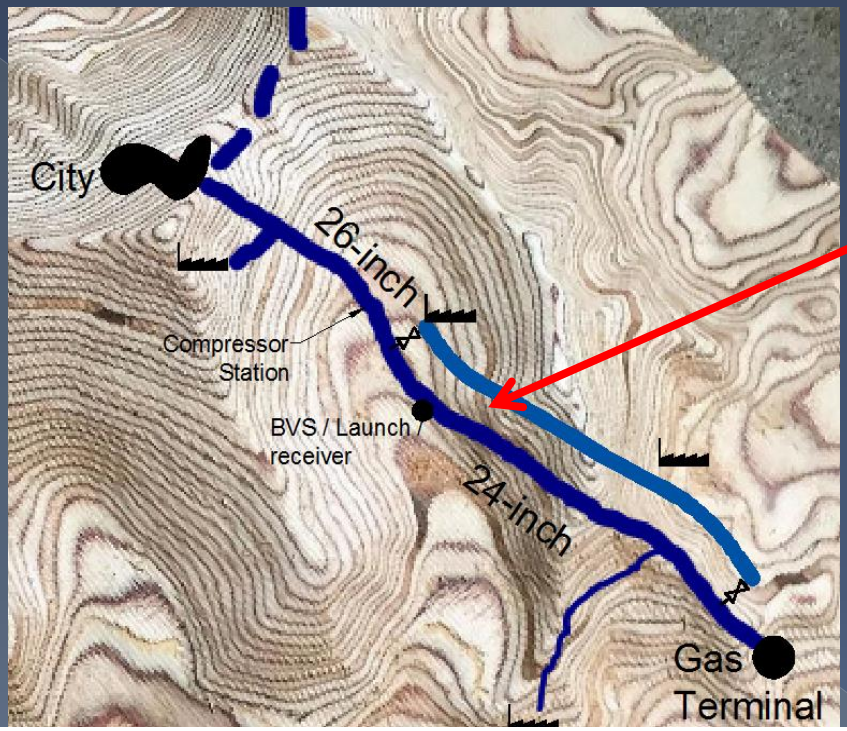
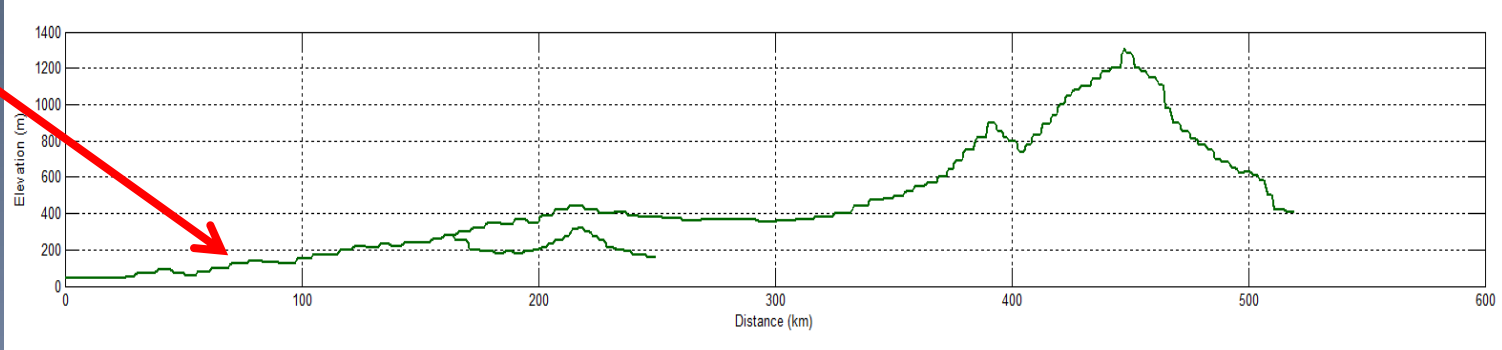
Model description



Model the process and pigging of a complex gas network

With full pipeline description and elevation changes



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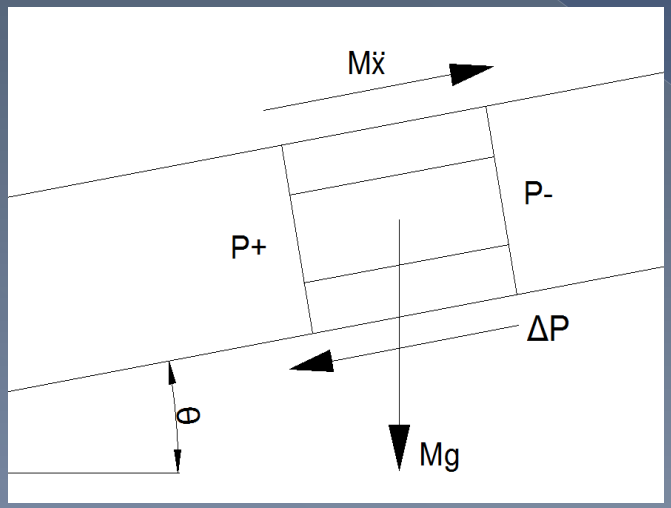
Model description

- Pig types: -
  - Standard cleaning pigs;
  - ...with or without bypass;
  - Inspection tools with / without speed control ;
  - Different mass and pig friction...



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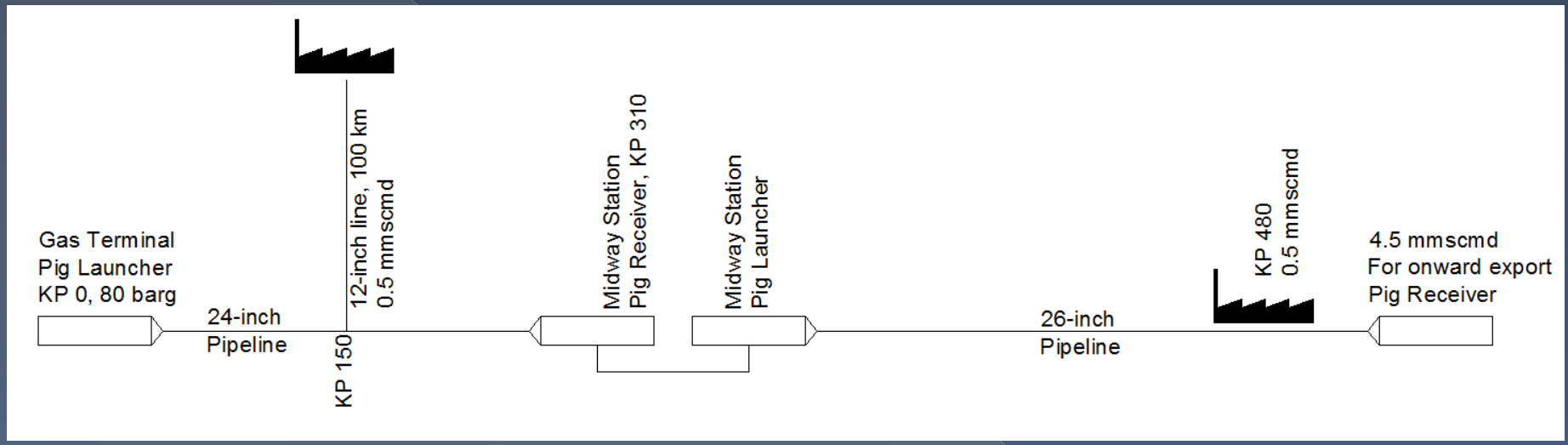
Model 1: Scheme



Total capacity 5.5 mmscmd

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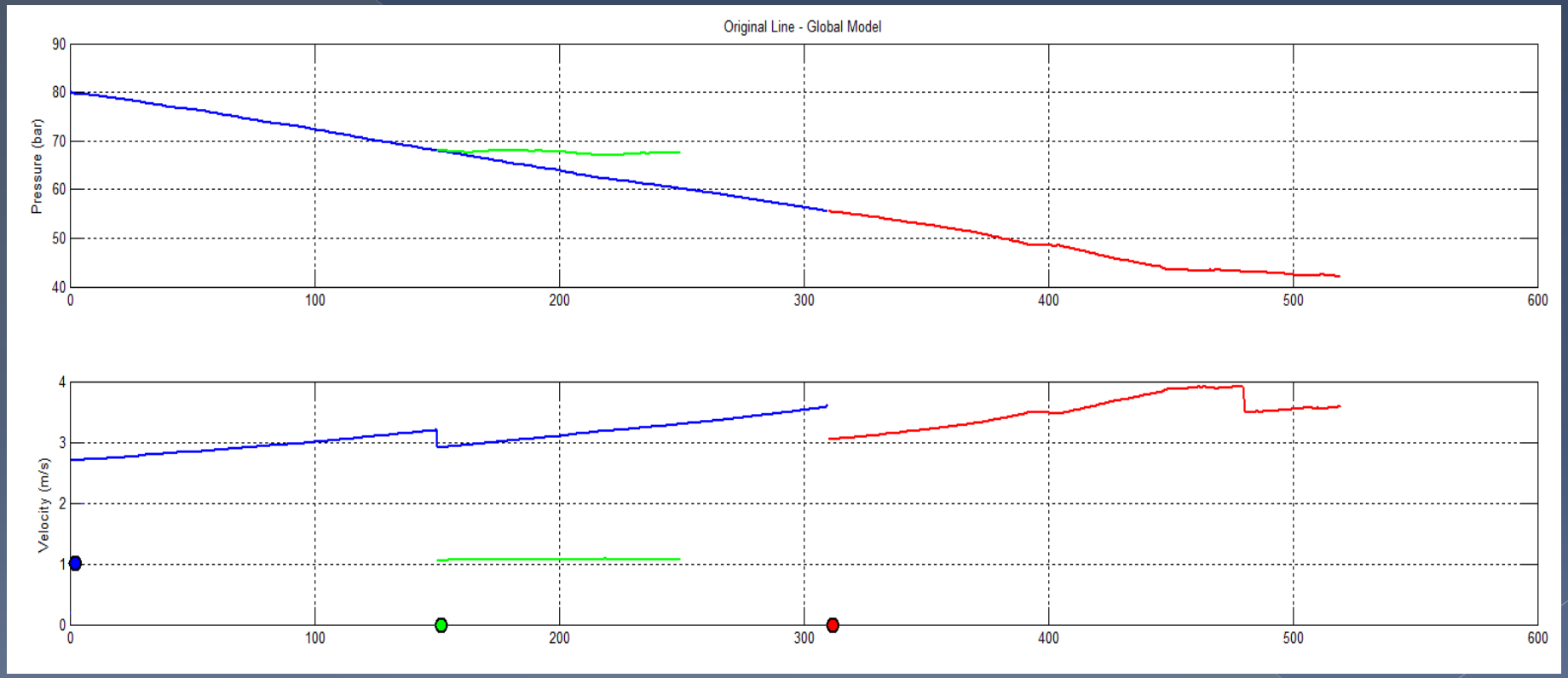
Model 1: Establish Steady State



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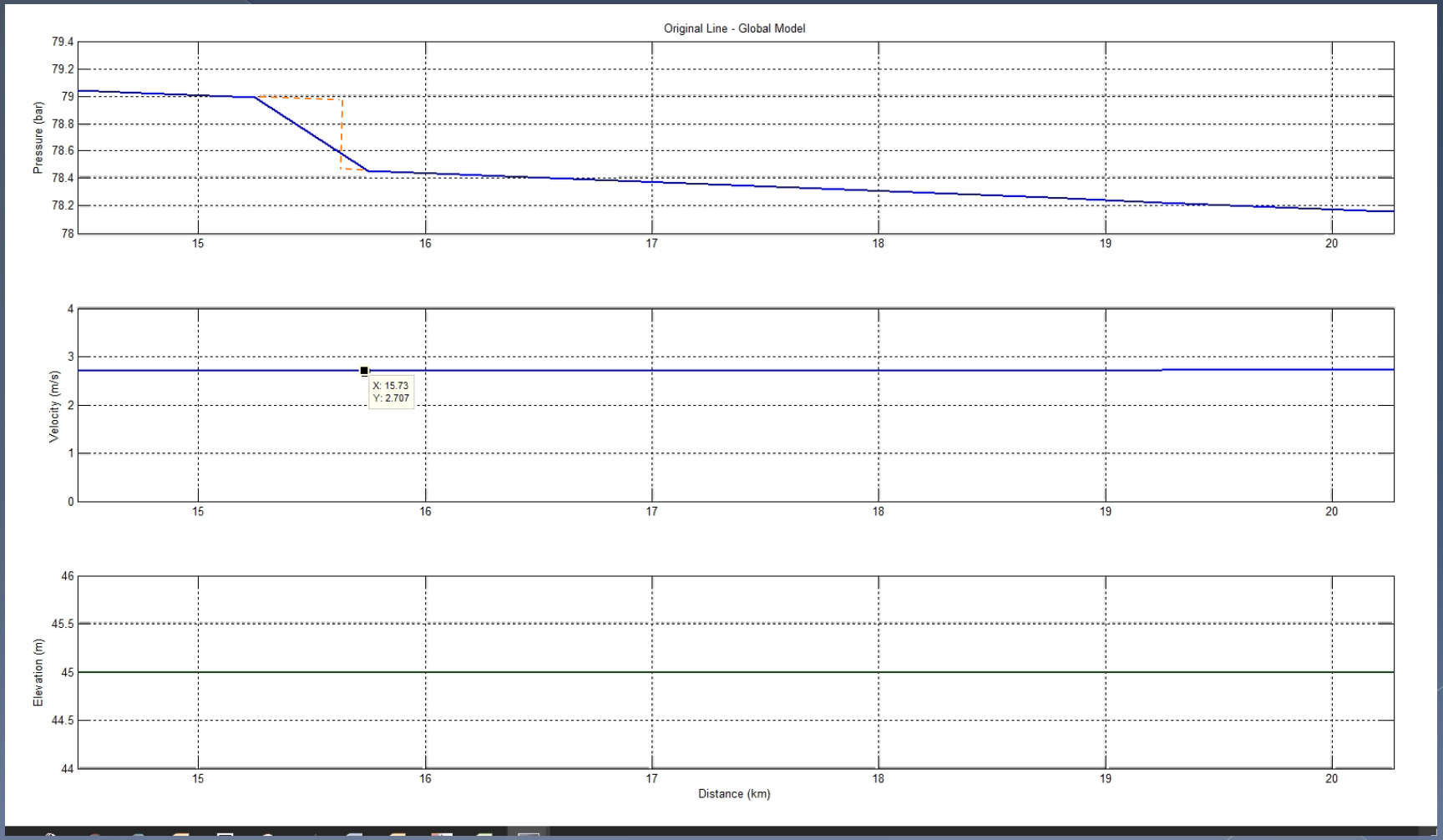
Model 1: Pig at river crossing



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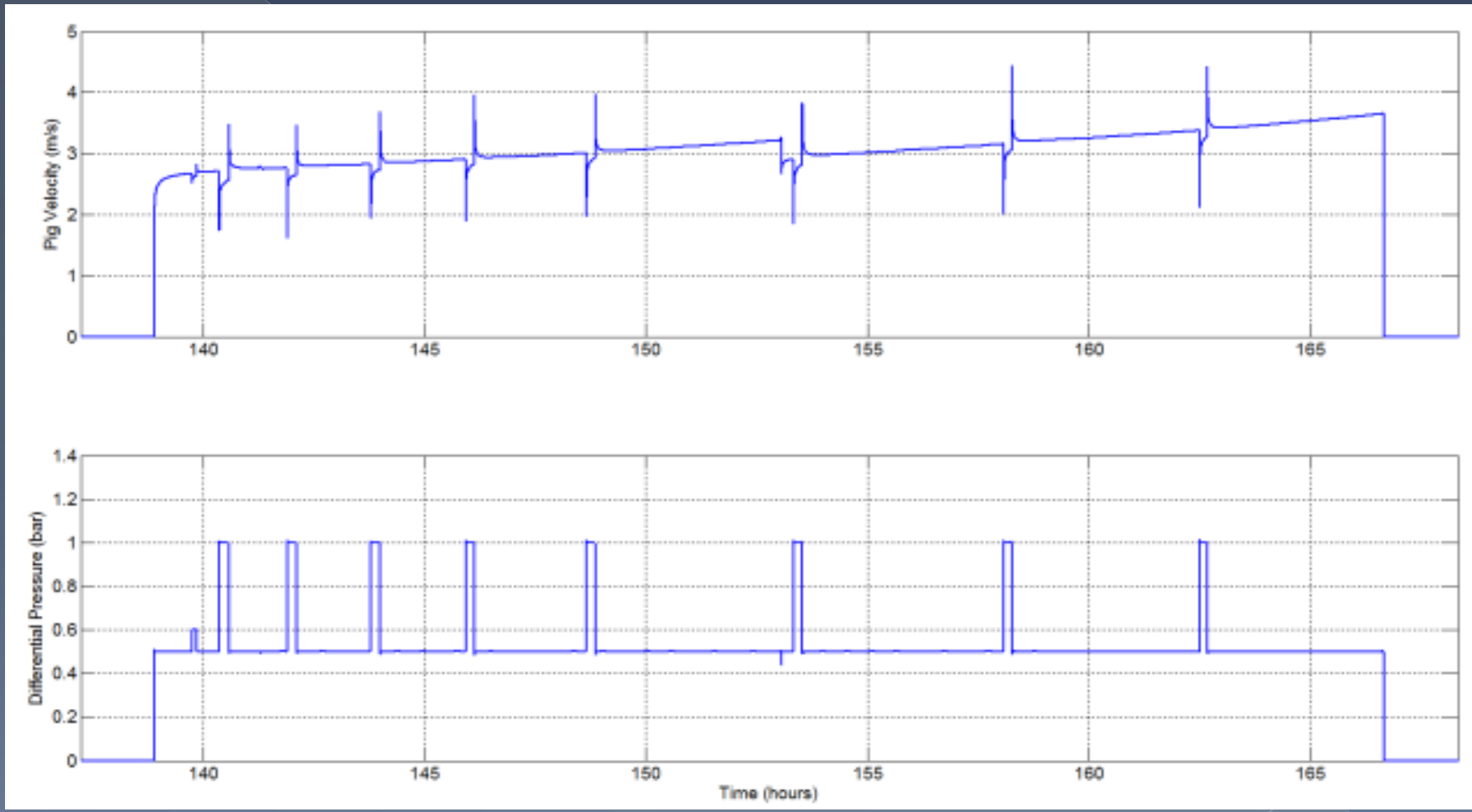
Model 1: Velocity Profile



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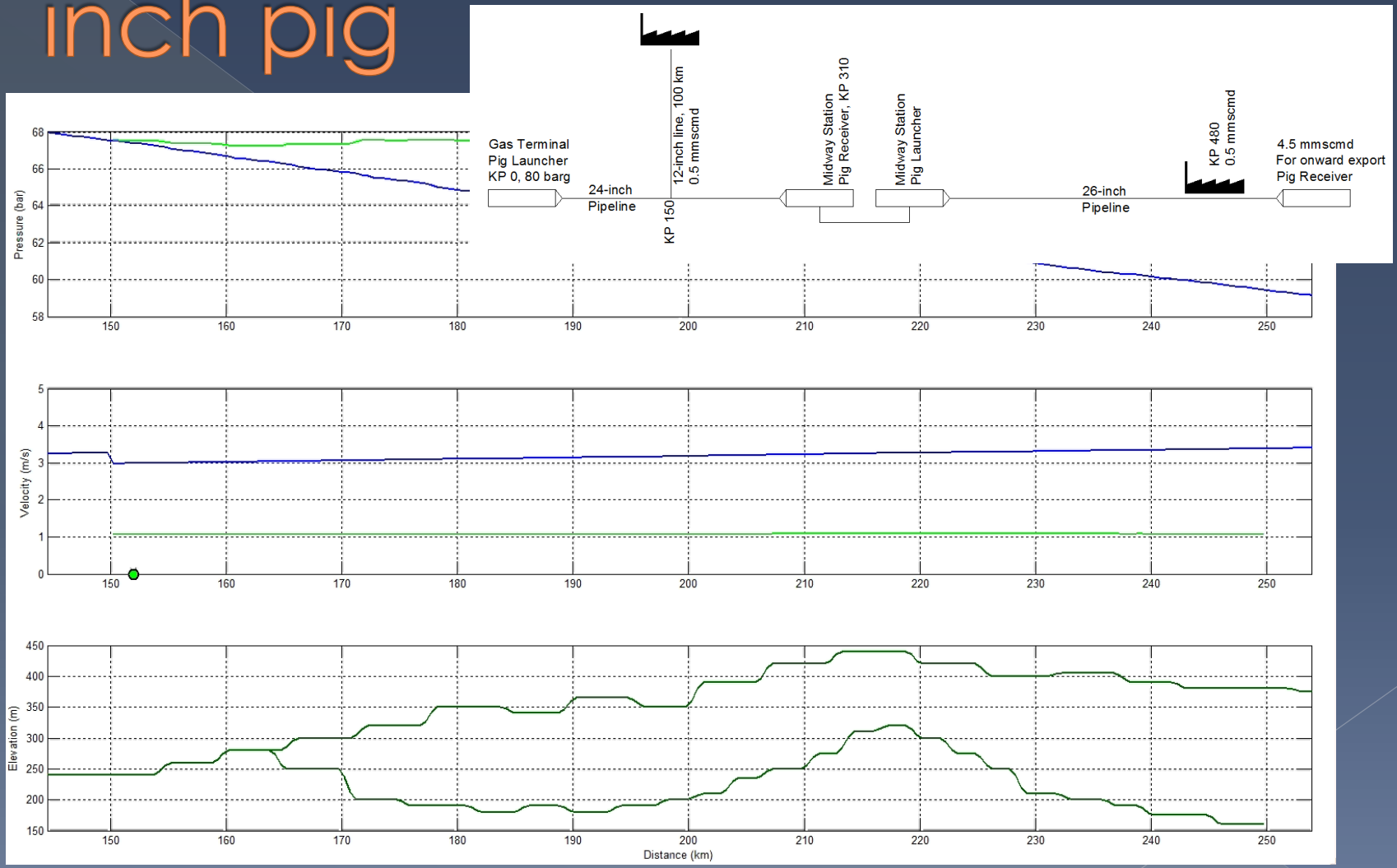
Model 1: Launching the 12-inch pig



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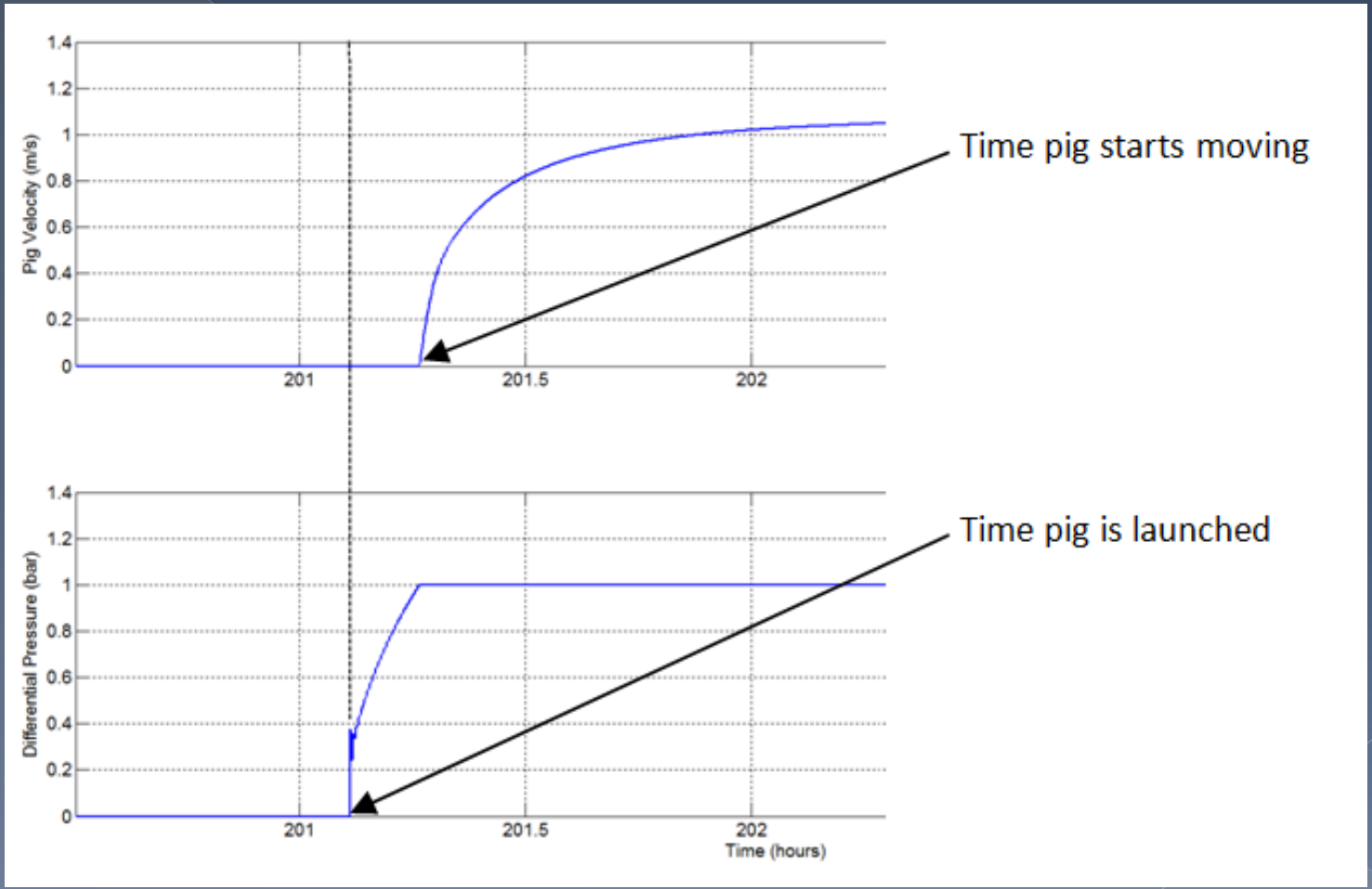
Model 1: Launching the 12-inch pig



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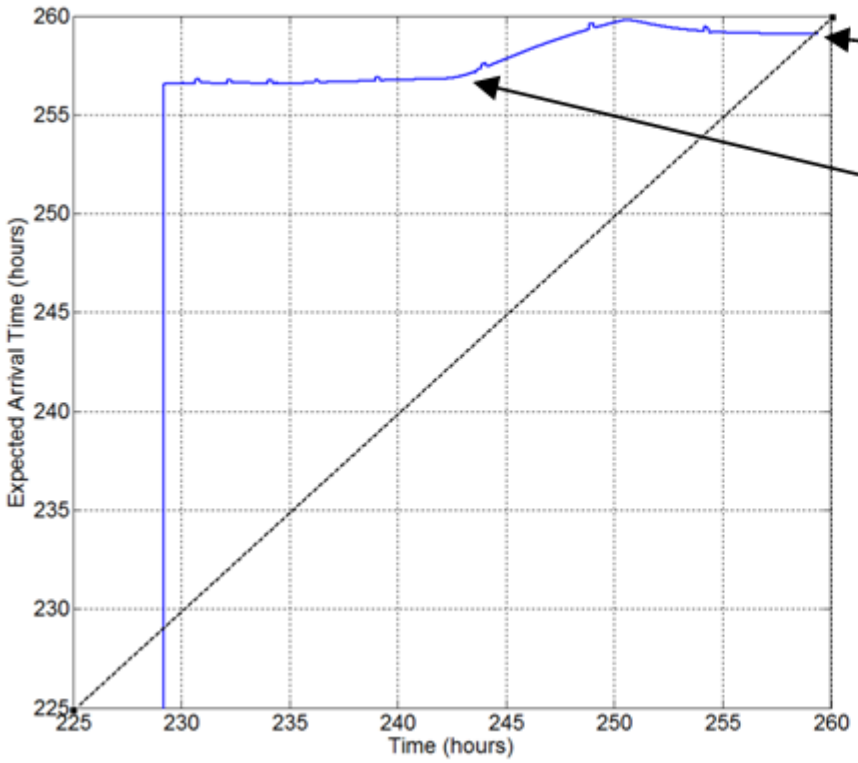
Model 1: Estimated Time of Arrival (ETA) with changing conditions



Final ETA, 259 hours

Initial ETA, 256.5 hours

(The time is since the beginning of the simulation)

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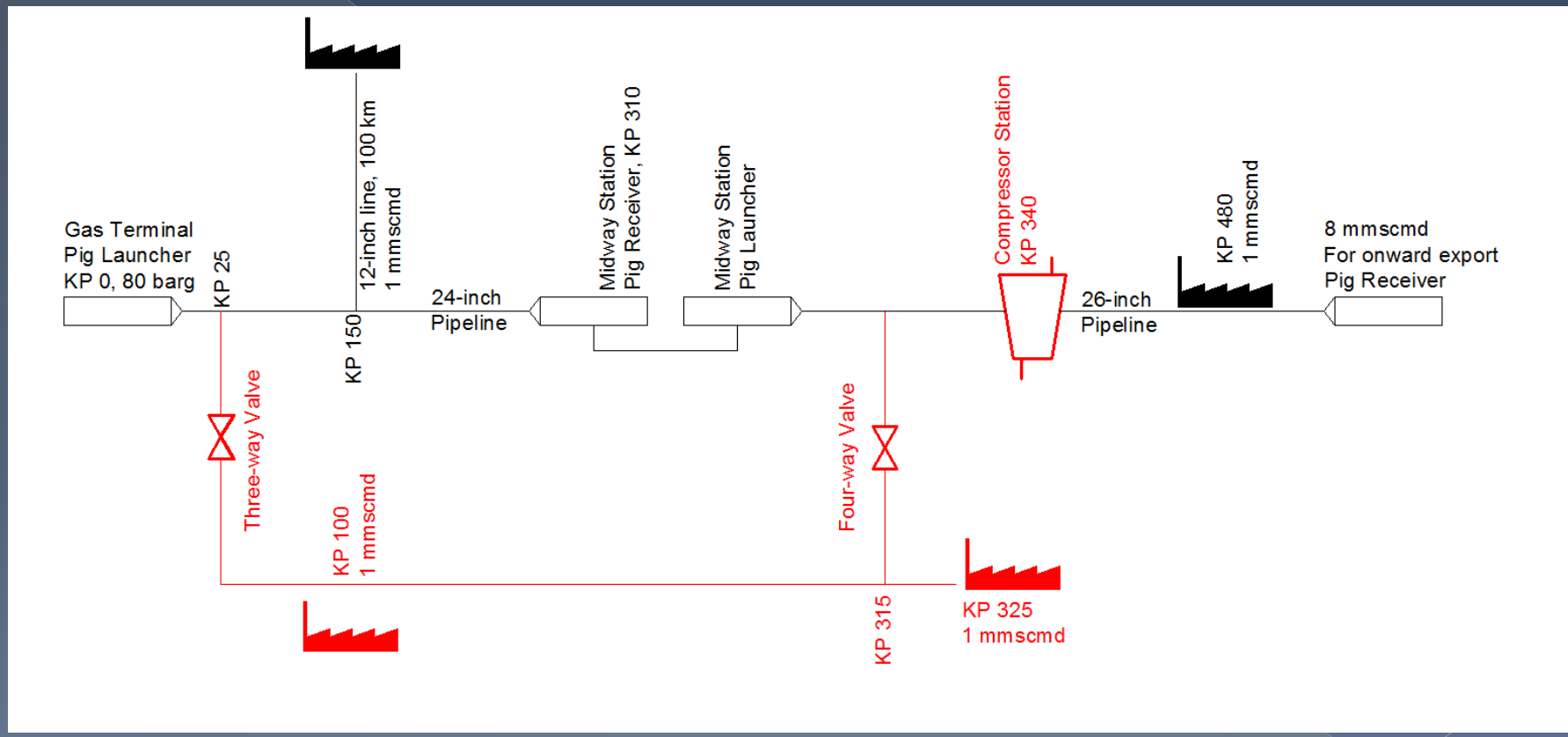
Model 2: Extension



Total capacity 12 mmscmd

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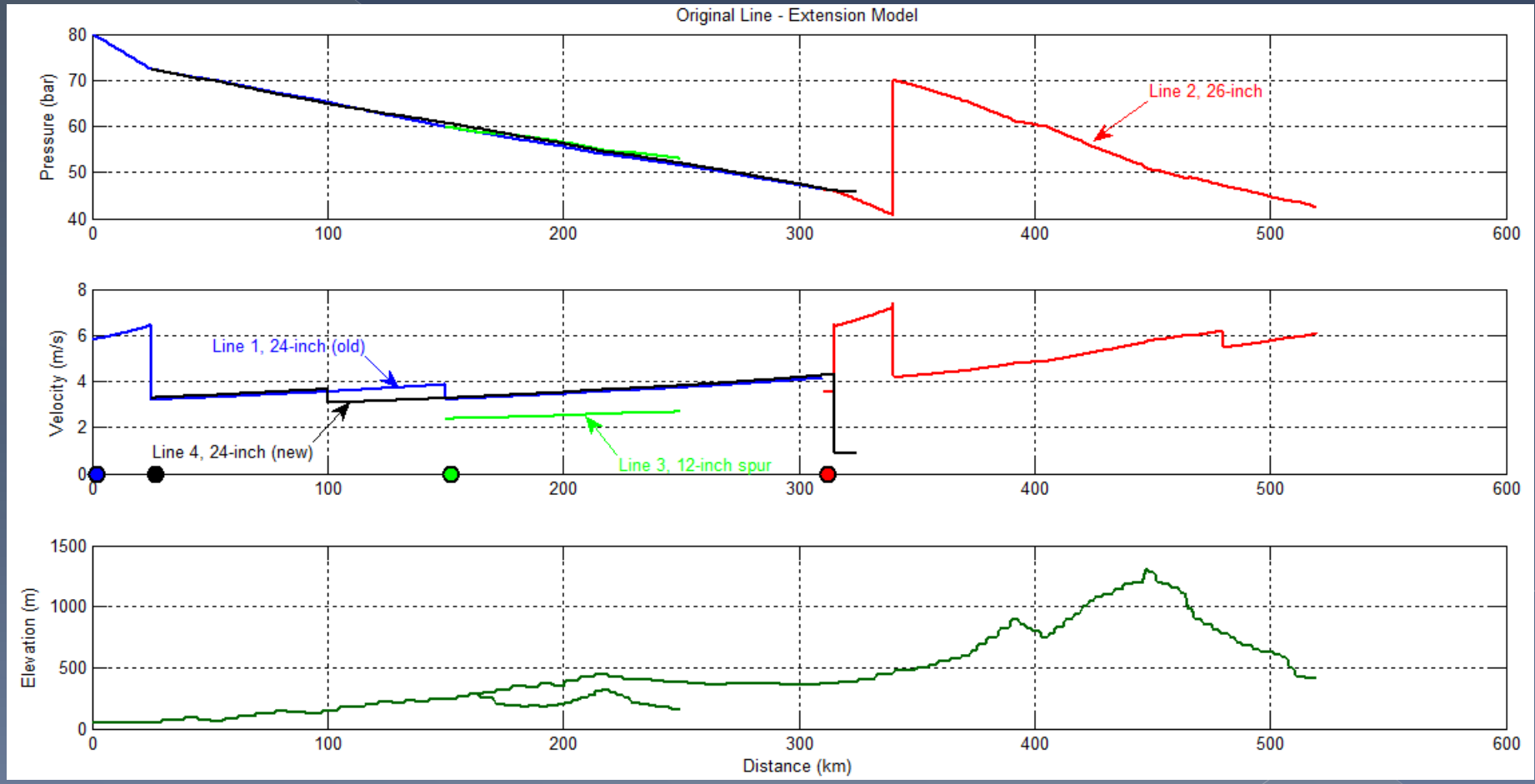
Model 2: Establish steady state conditions



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Model 2: Timetable for pigging

- Pipeline at steady state;
- Run cleaning pig through Line 1;
- Run an ABC (speed control) MFL pig through Line 1 or reduce flow and deploy MFL tool. Increase flow after the tool passes KP 25 (three way valve to the new line) – note predicted ETA;
- Reduce flow and switch off compressor (a pig cannot be deployed through the compressor);
- Launch pig into Line 2 and examine risk of flow diversion;
- Launch pig into line 3 (no change from previous);
- Launch pig in new line 4. Risk of low pressure at outlet to customer.

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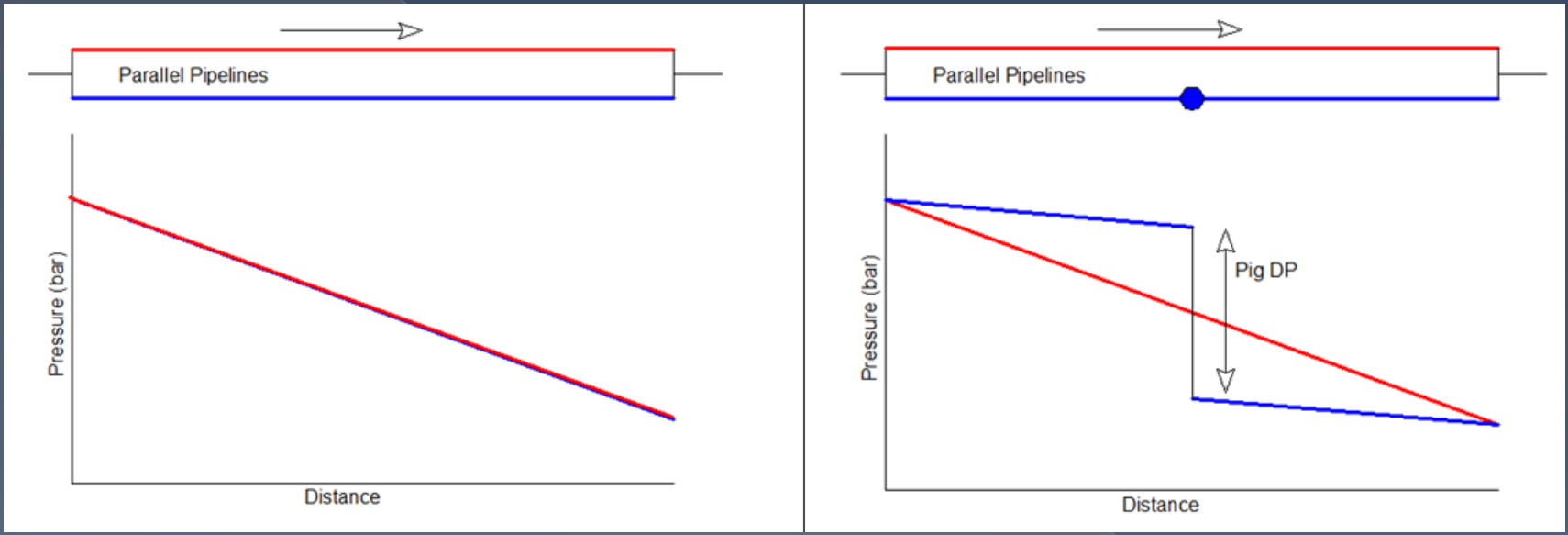
Model 2: Flow diversion



Two lines with common inlet and outlet.
Flow is proportional to pressure gradient.
Pressure gradient less in line with pig so risk of stalling as flow diverts

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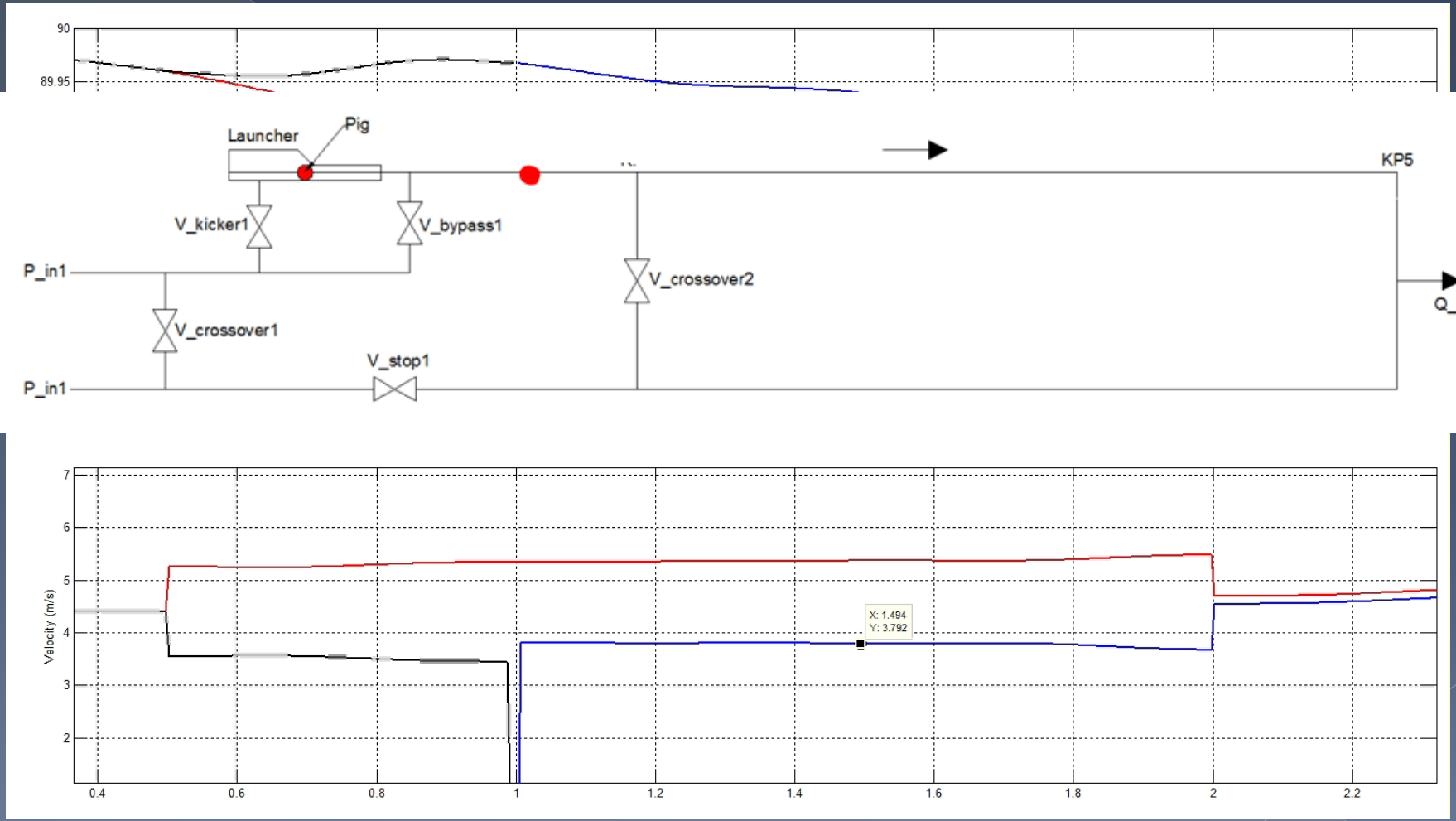
Model 2: Flow Diversion



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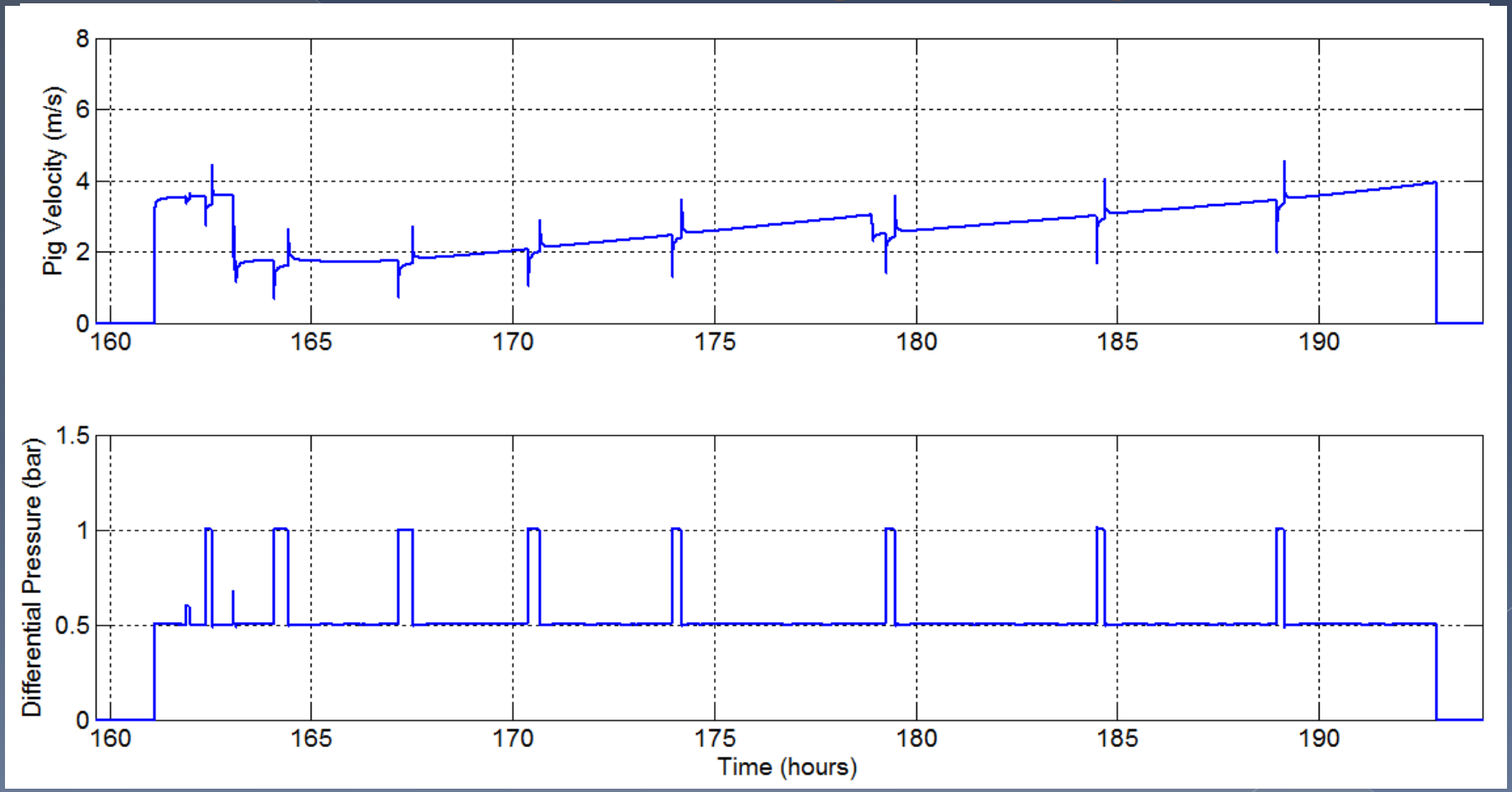
Model 2: Speed control Vs Flow reduction (Line 1)



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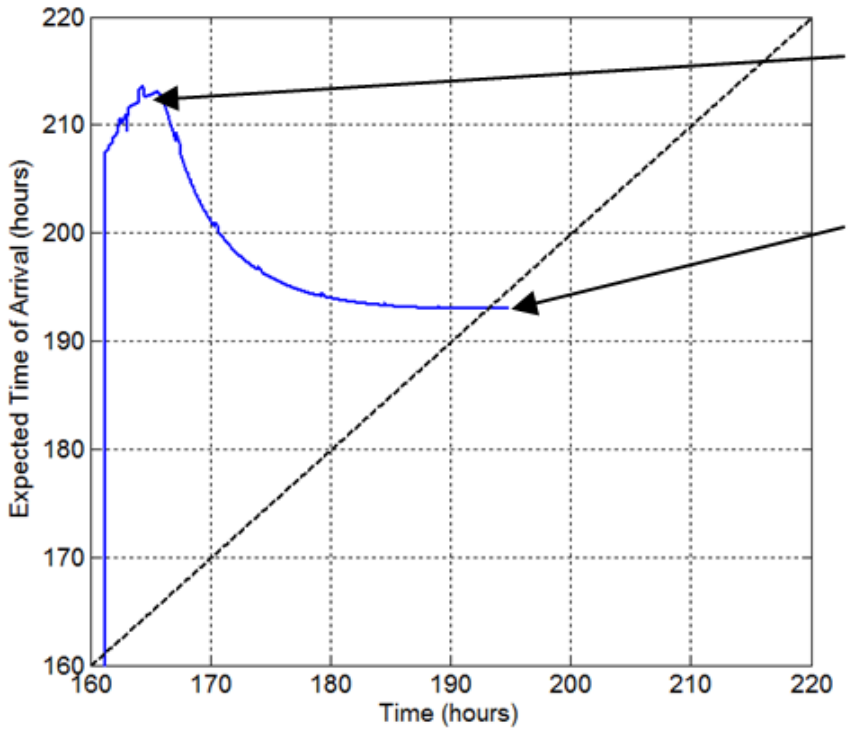
Model 2: ETA for reduced flow case



Initial ETA with low flow

Final ETA after recovery of the flow

(The time is since the beginning of the simulation)

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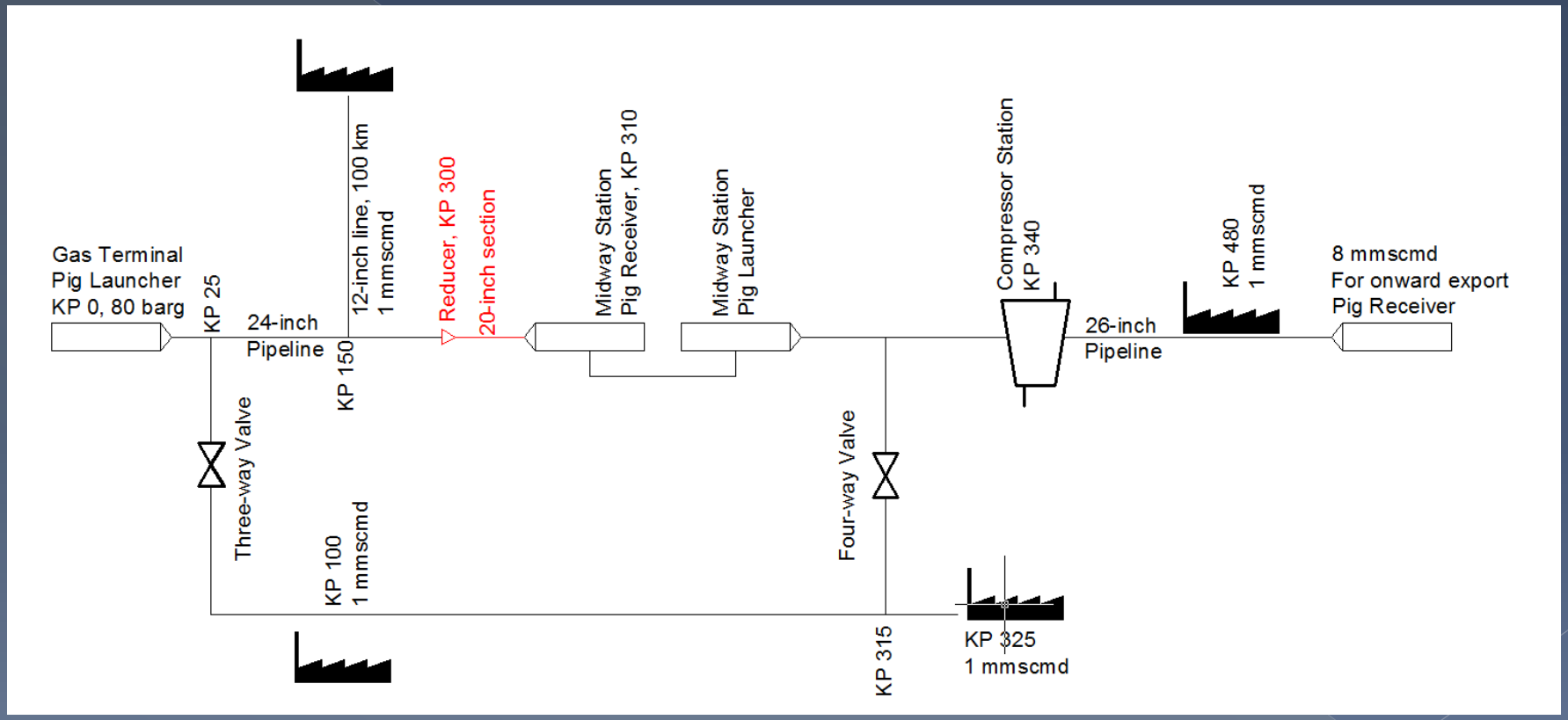
Model 3: Following repair to pipeline



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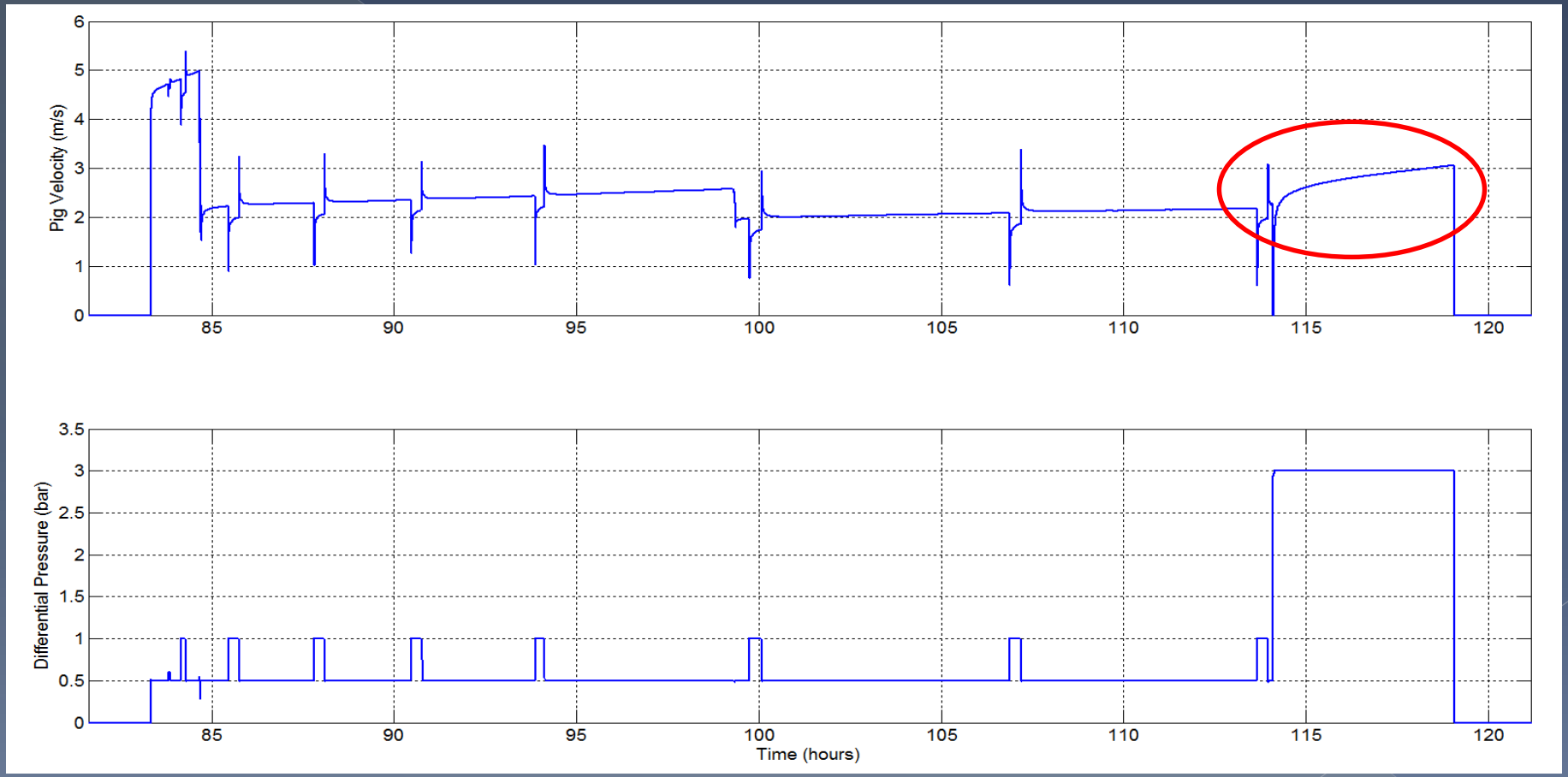
Model 3: Pigging the 24-inch x 20-inch line



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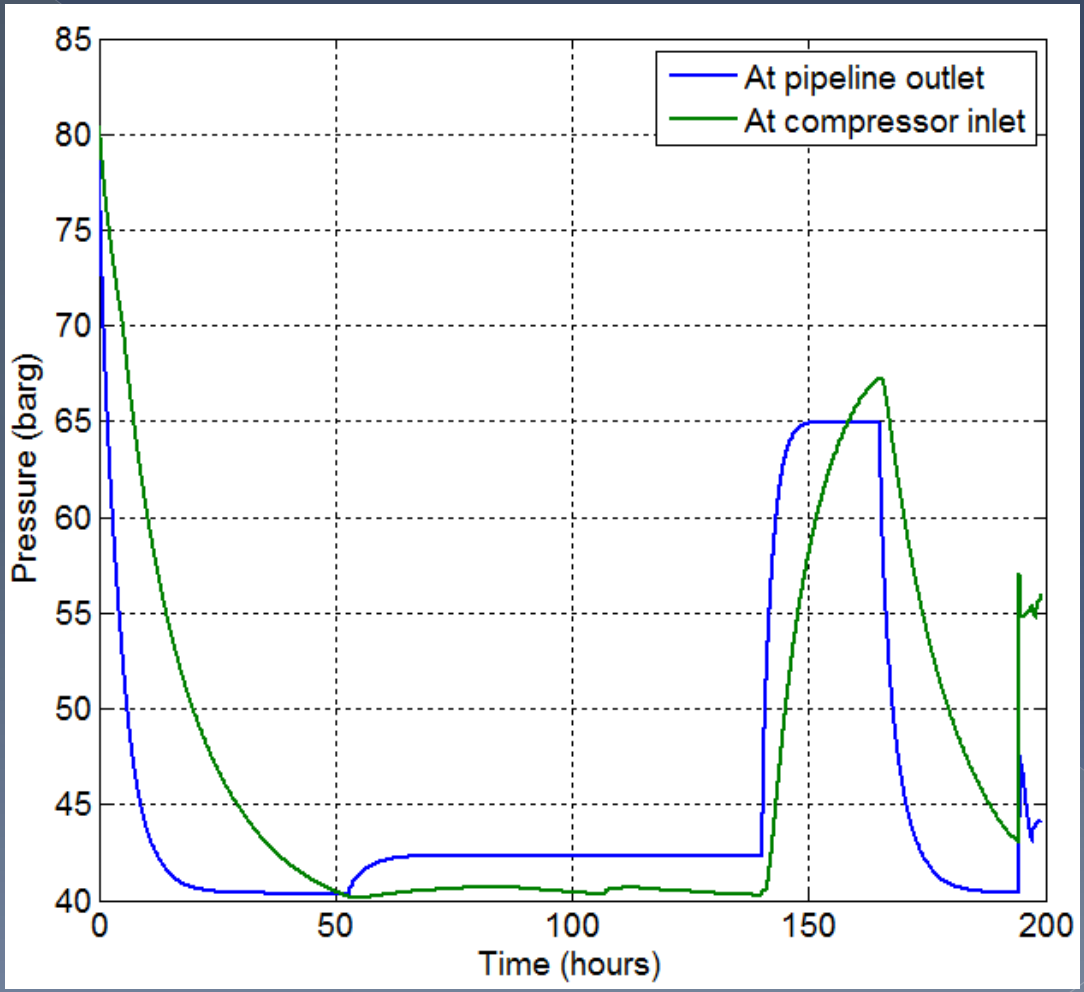
Model 3: Checks on minimum pressure



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Summary

- Model set up to allow investigation and sensitivity analysis into pigging in complex gas networks;
- Interlinked network of pipelines, valves, compressors, gas sources and sinks, pressure controls;
- Steady state and transient analysis along with pig motion;
- Reduction of disruption to customers and ensuring the system runs as it was designed to and pigging is performed as required.

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Thank You!

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