

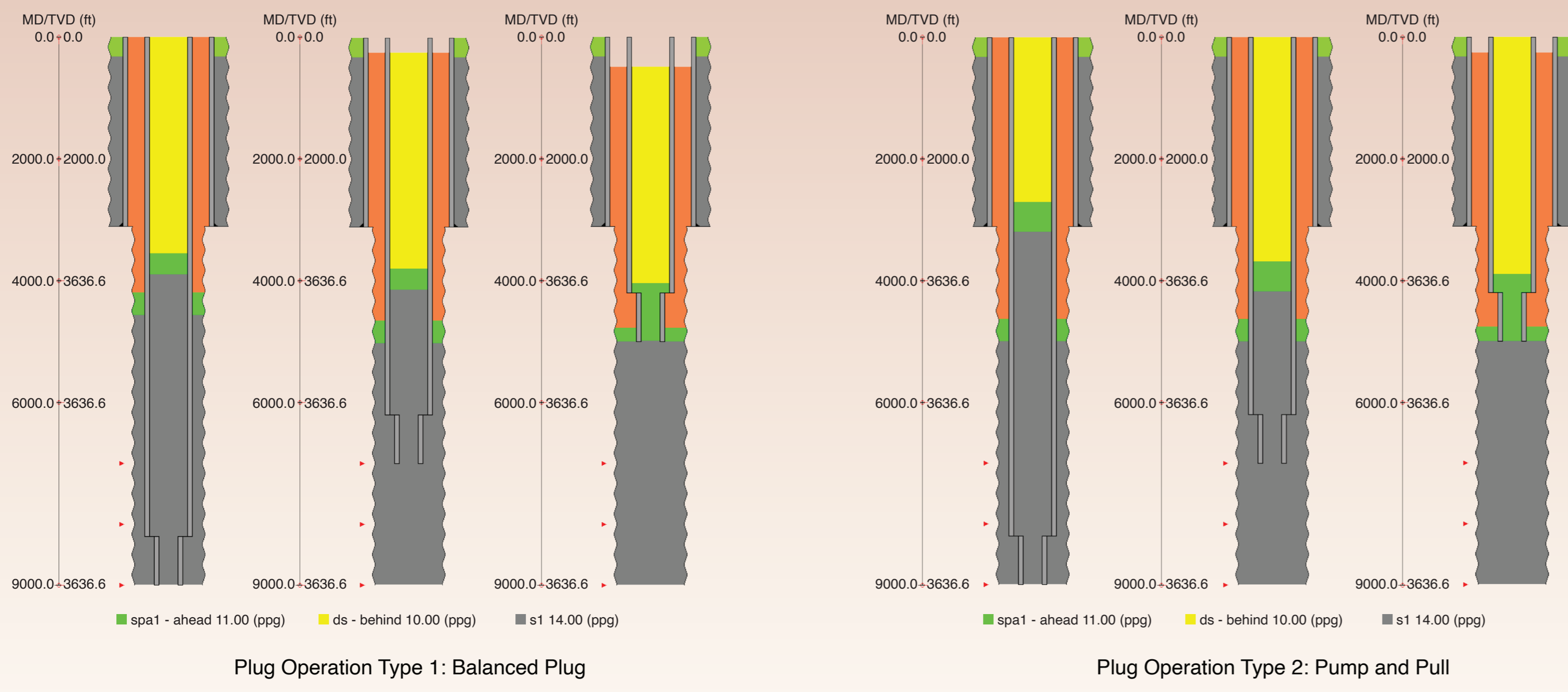
Simulating Cement Plug Temperature During Pull-Out-Of-Hole

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Introduction:

Accurate prediction of wellbore and slurry temperatures during plug cementing necessitates highly sophisticated calculations, even for the most straight forward scenarios. A new transient heat transfer model is presented here that takes into account the effects of pulling pipe and pumping, enhancing the capability of plug slurry temperature simulations.

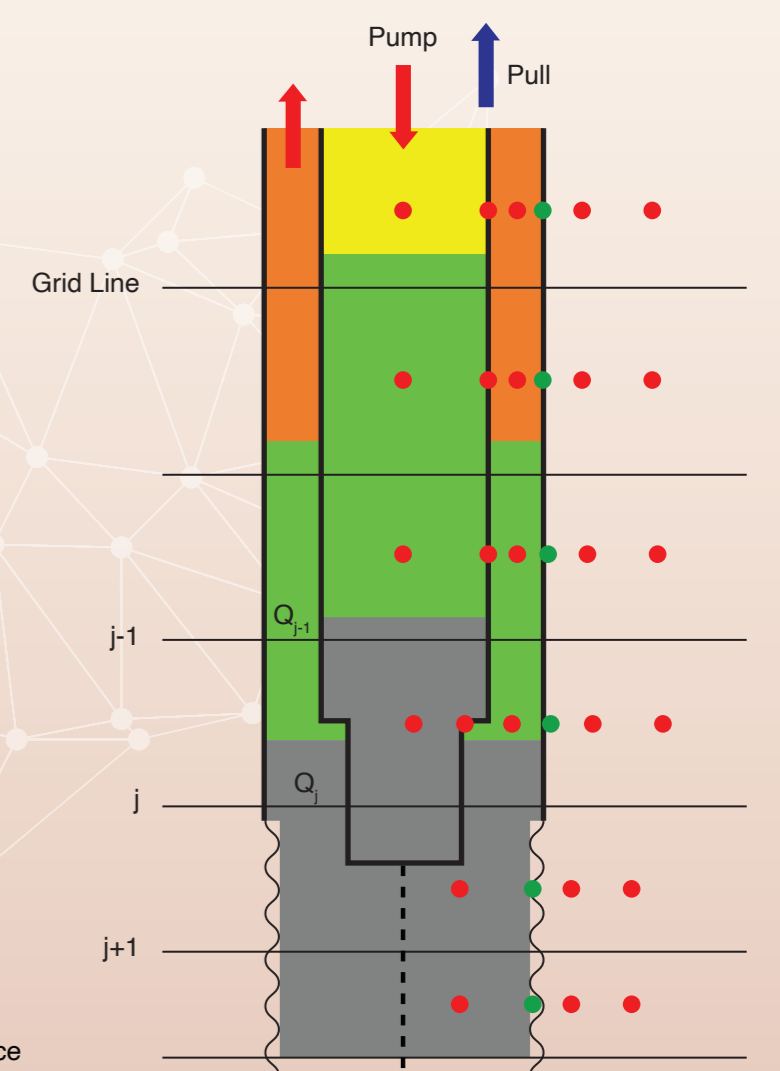
Plug Cementing: Balanced Plug & Pump and Pull (PAP):



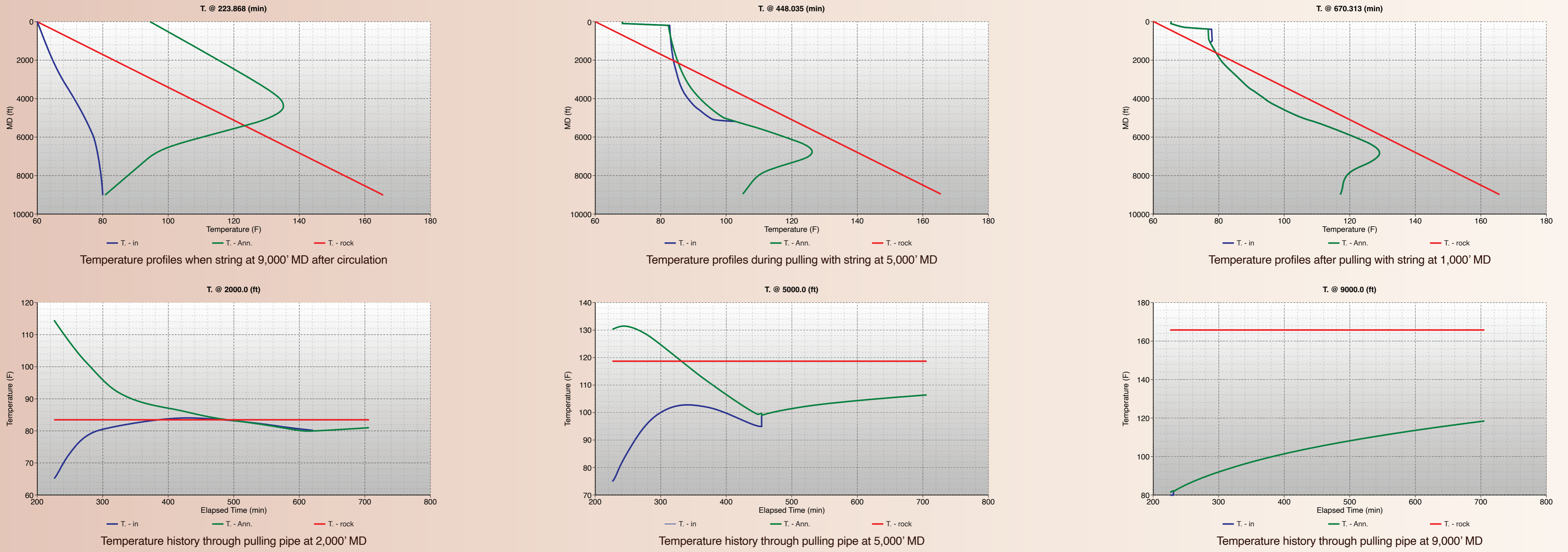
Prior Model:

The original model considers fluid flow and heat transfer with stationary pipe. It has been utilized in multiple programs in the oil and gas industry for over two decades.

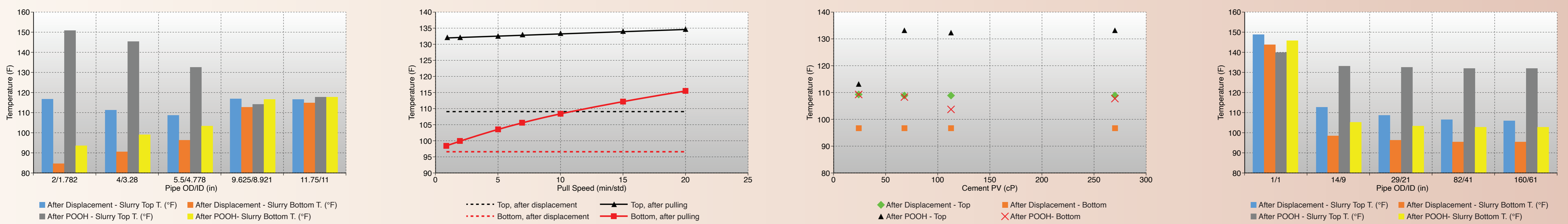
New Model:



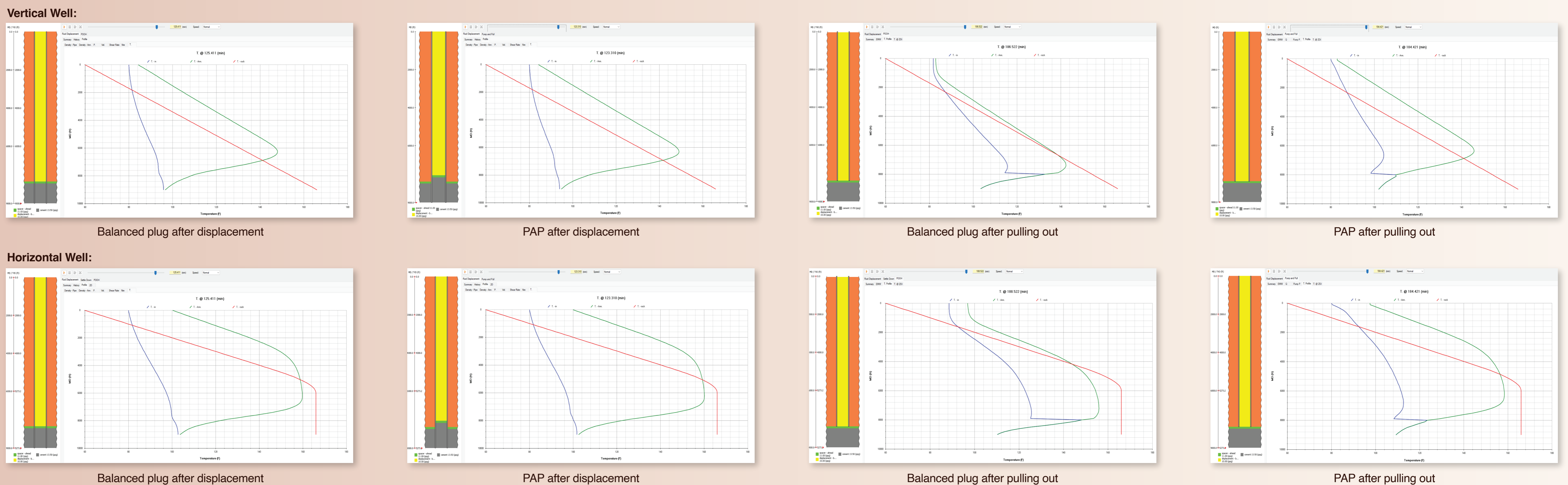
Basic Model:



Balanced Plug Results:



Balanced Plug vs. PAP Results:



	Balanced plug (18 ft/min)	Balanced plug (45 ft/min)	PAP(18 ft/min) Pumping: 0.53 bpm	PAP(45 ft/min) Pumping: 1.32 bpm
After displacement - Slurry Top T. (°F)	109.1	109.1	107.3	107.3
After displacement - Slurry Bottom T. (°F)	96.6	96.6	94.7	94.7
After POOH - Slurry Top T. (°F)	132.6	132.3	109.7	107.2
After POOH - Slurry Bottom T. (°F)	103.6	99.9	101.9	98.0

A comparison of slurry temperature between balanced plug and PAP in a vertical well

	Balanced plug (18 ft/min)	Balanced plug (45 ft/min)	PAP(18 ft/min) Pumping: 0.53 bpm	PAP(45 ft/min) Pumping: 1.32 bpm
After displacement - Slurry Top T. (°F)	123.3	123.3	122.3	122.3
After displacement - Slurry Bottom T. (°F)	103.6	103.6	102.5	102.5
After POOH - Slurry Top T. (°F)	148.1	147.8	123.4	121.0
After POOH - Slurry Bottom T. (°F)	110.2	106.7	109.2	105.6

A comparison of slurry temperature between balanced plug and PAP in a horizontal well

Conclusion:

The simulation study based on the proposed model leads to the following conclusions:

1. The ΔT top vs bottom of the plug reduces as the pipe size increases.
2. Viscosity impact is small, except at very low viscosities
3. Pulling speed can impact the temperature of the slurry bottom significantly
4. T downhole is slightly lower in PAP vs. balanced plug job in all scenarios at similar speeds