



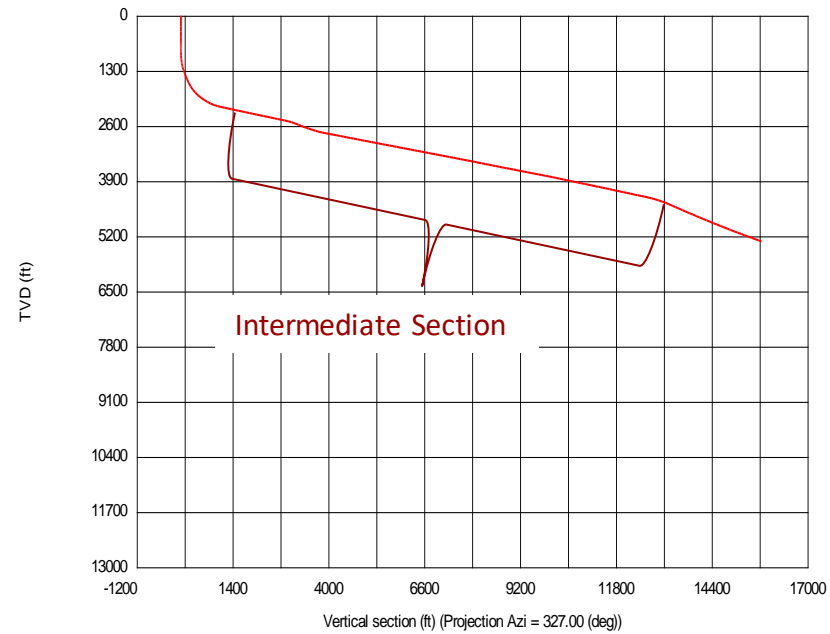
HXR DRILLING SERVICES

ERD Well Design

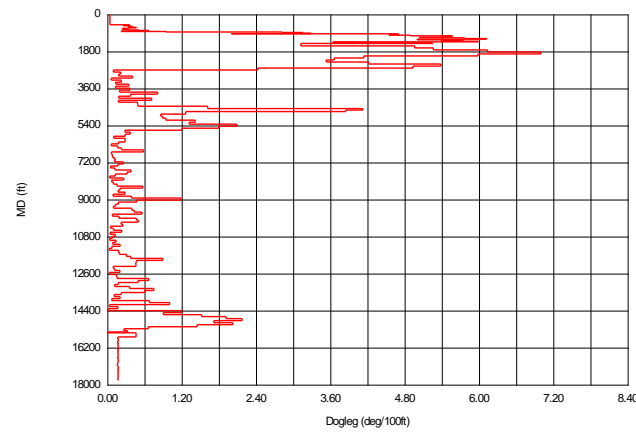
Platform Development Floated “Mud-Over-Air” Casing



Section view



Dogleg



Intermediate Section

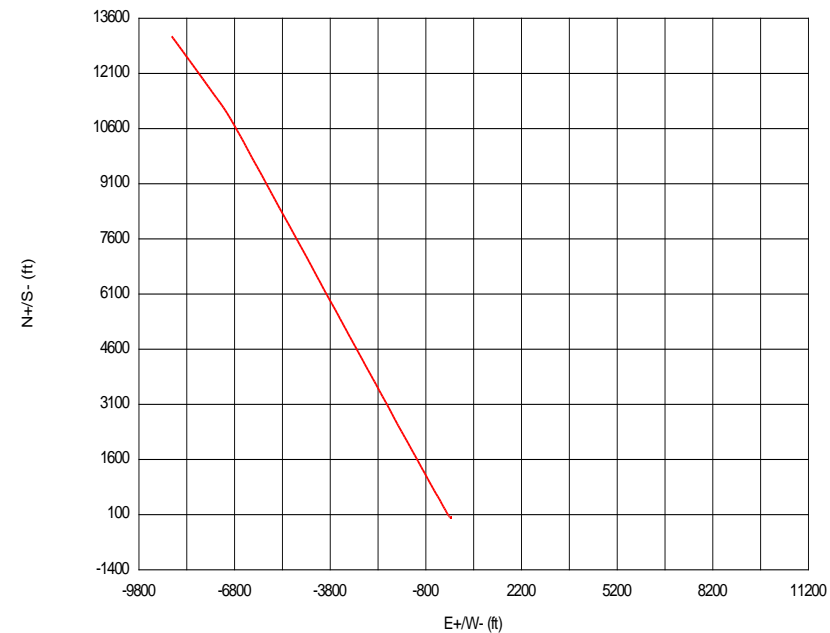
4523' – 15465' MD / 2483.2' – 4579.6' TVD

80° Landing Dropping to 72° Over Structure Top

43.5 ppf Casing / 3812 psi Collapse

10 ppg MW in Pipe

Plan view

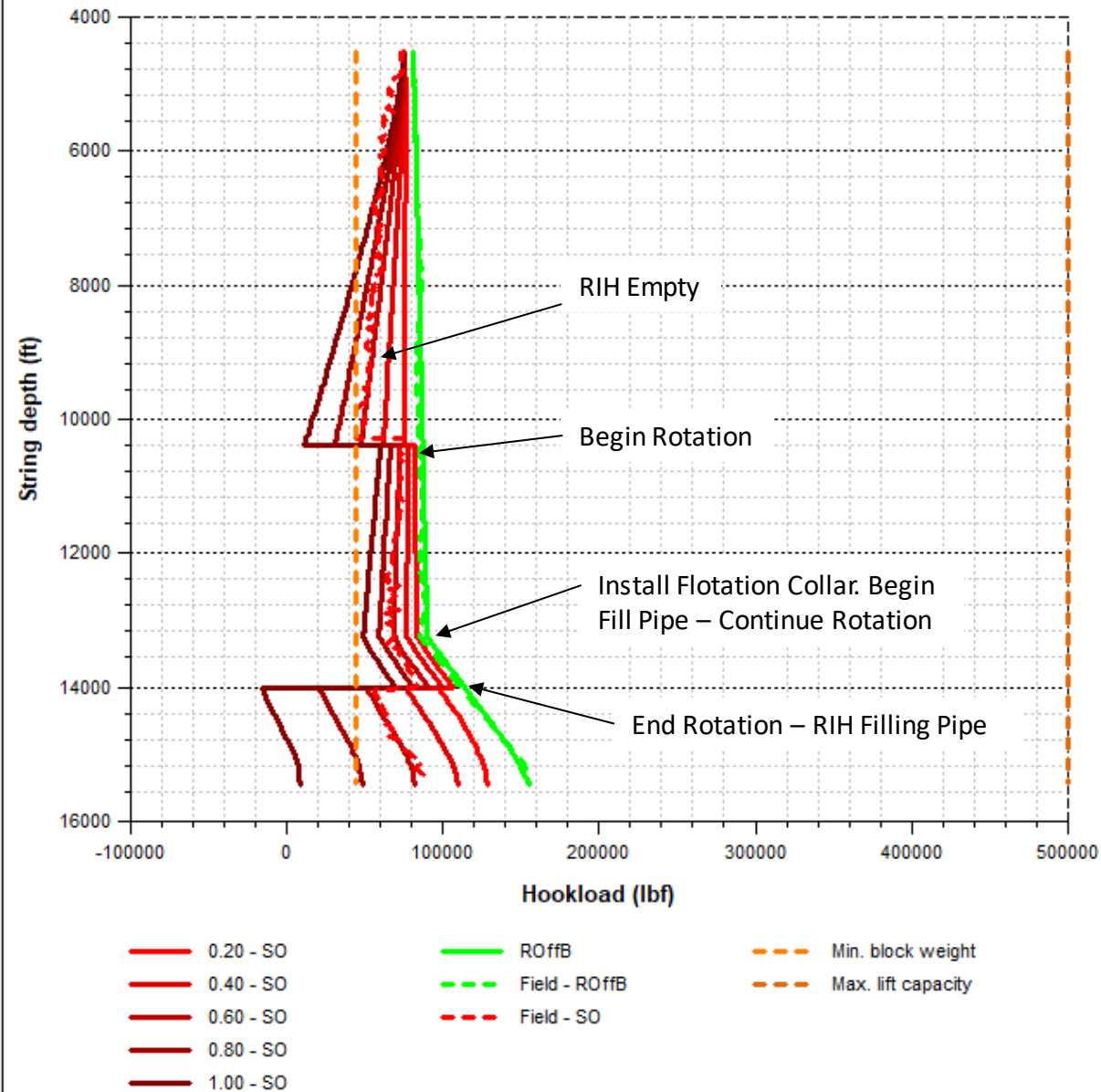


Design Comparisons:

- **Conventional vs Floated “Mud-Over-Air” Rotated**

Hookload - calculated and field data (FF in 4523 - 15465 (ft))

SO, ROFFB: casing flotation

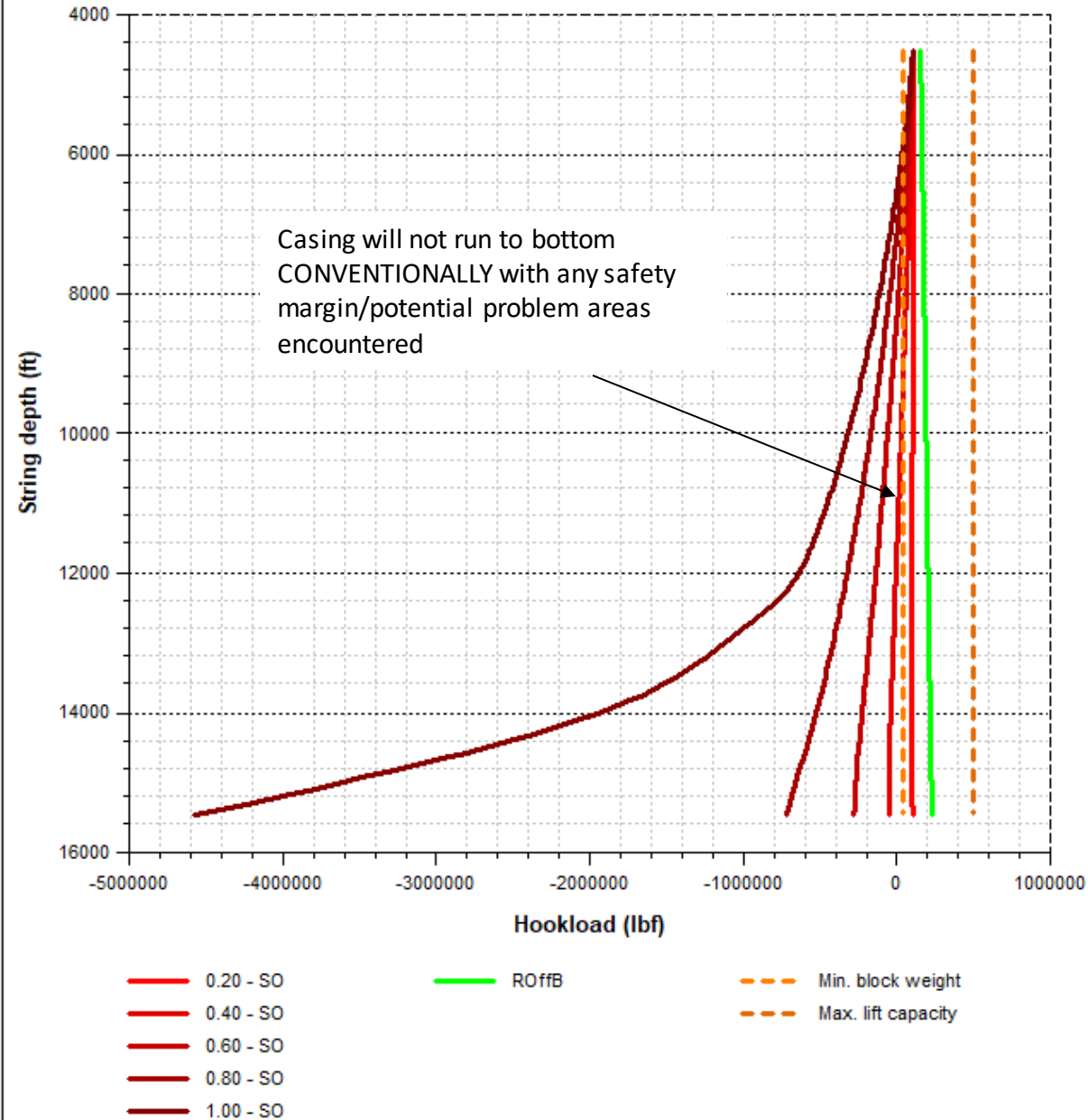


Floated “Mud-Over-Air” Casing Run

The ability to rotate partially empty casing provides significant flexibility in well design: Going further, easier.

Additionally, it gives the drilling team another tool to run pipe through problematic zones by allowing the pipe to be reamed/rotated through tight spots and over ledges versus the conventional approach of simply trying to work the pipe. That practice runs the risk of swabbing/surging the formation, which can cause self-inflicted instability.

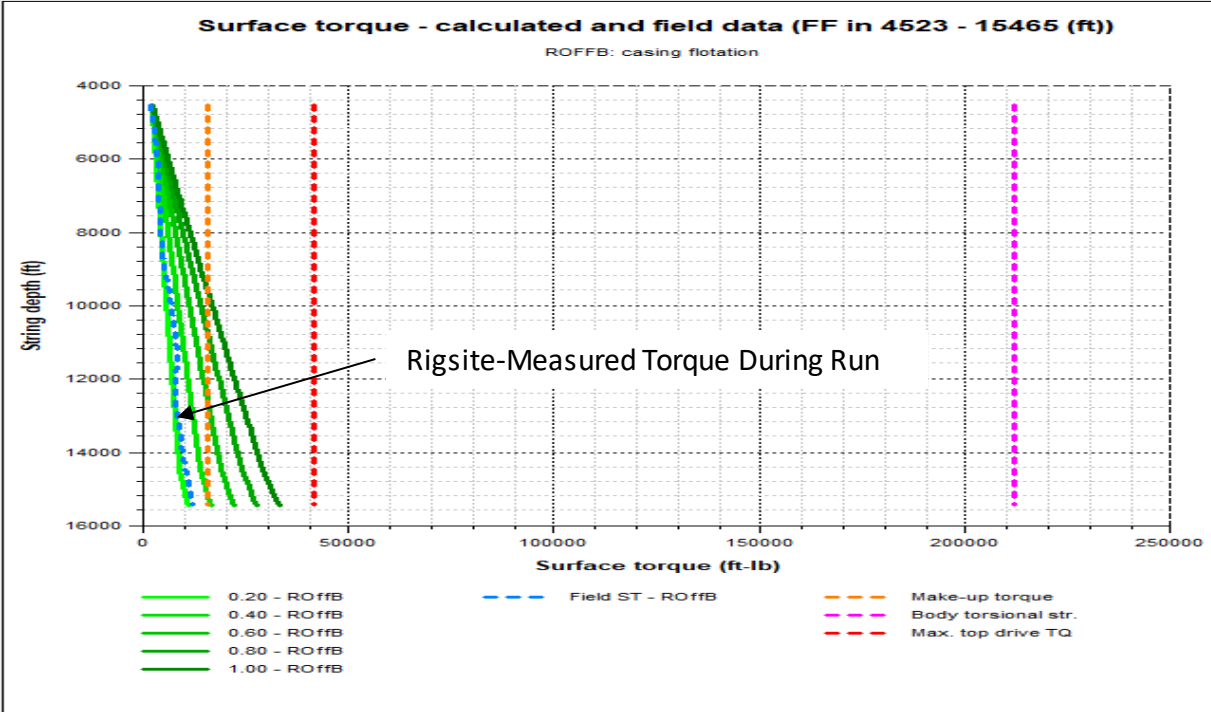
Hookload - calculated and field data (FF in 4523 - 15465 (ft))



Conventional Casing Run

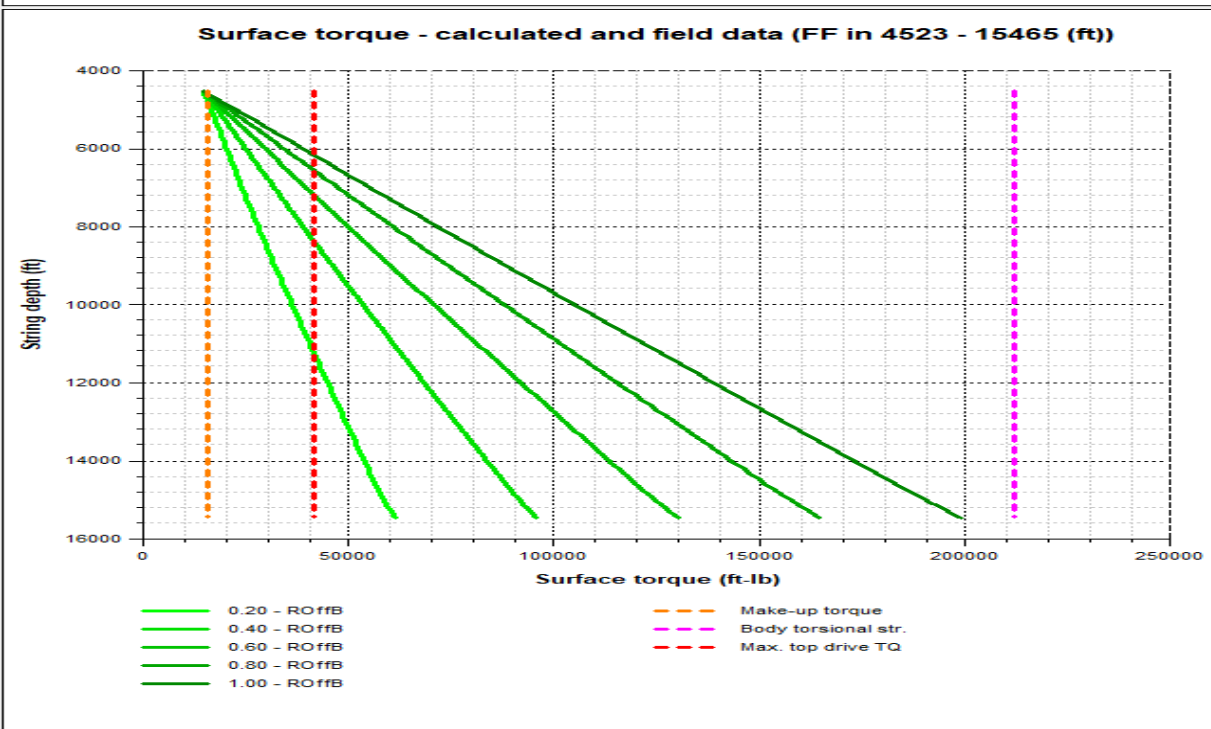
Typically, ERD Developments don't start off very "ERD" – the first wells usually have a shorter stepout, and allow the drilling team to shake things out, see how the models match up, recalculate rock properties, etc.

The calibrations and FF's measured in those shorter wells can be used for the planning of longer wells. In this scenario, using WBM offshore, we knew we'd not only cross unstable faults that would have to be reamed, but the S/O HKLD FF would be in the .30 range.



Floated Casing Torque

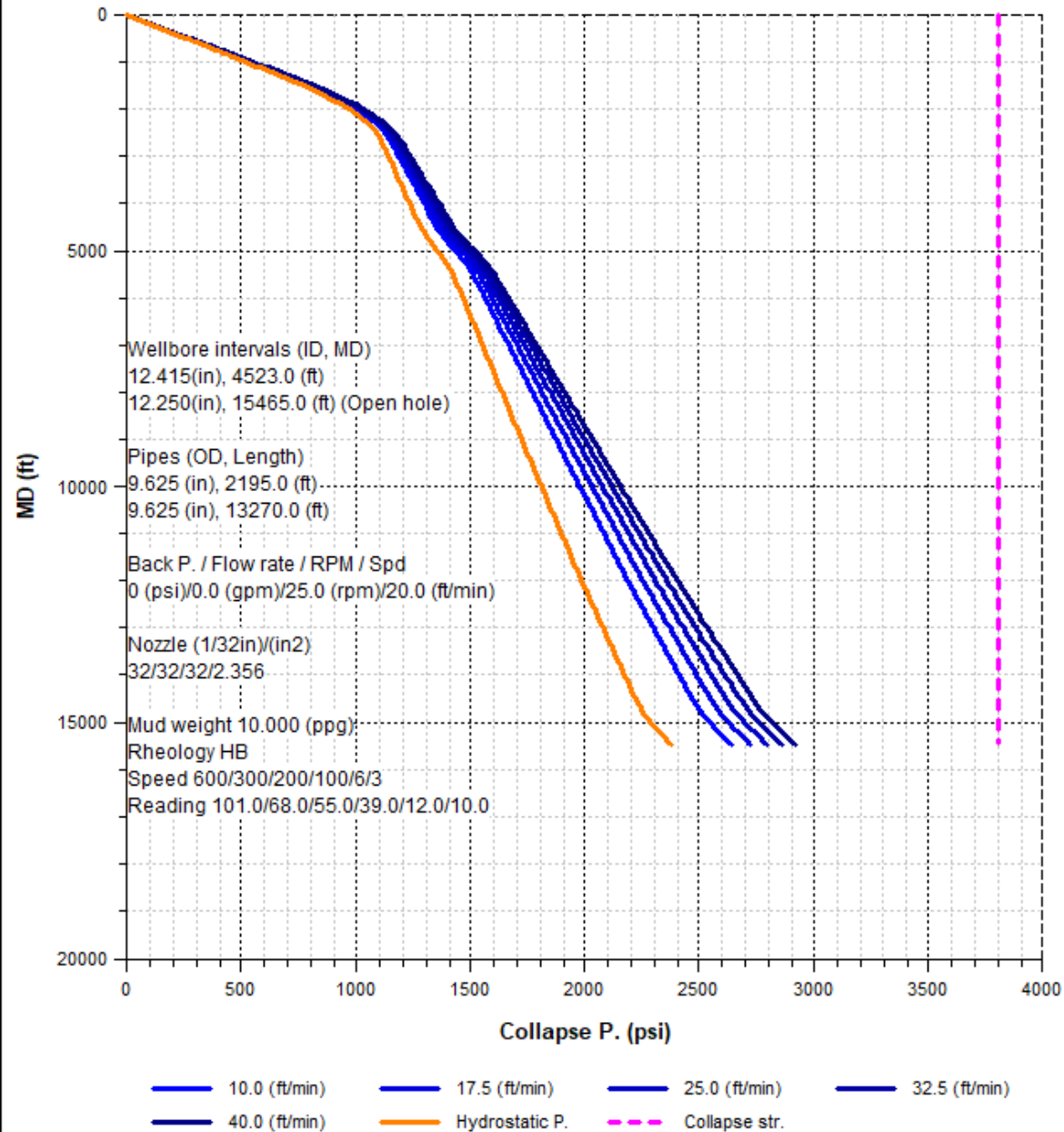
- ~.22 Torque FF During Run



Conventional Casing Torque

- Torque is above TDS Max Torque

Surge: Collapse P. with floated casing

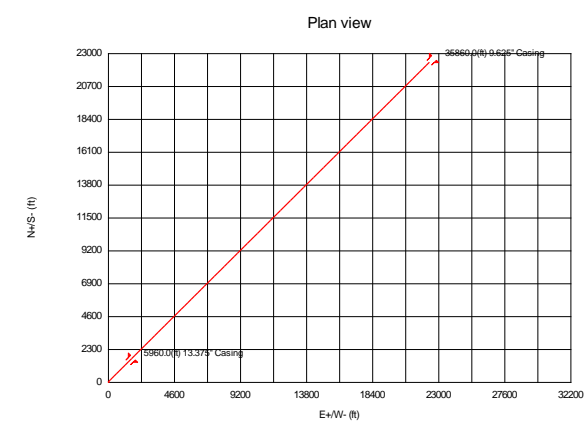
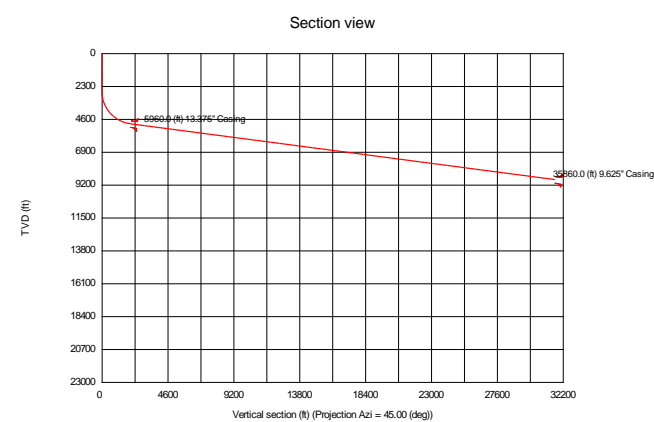
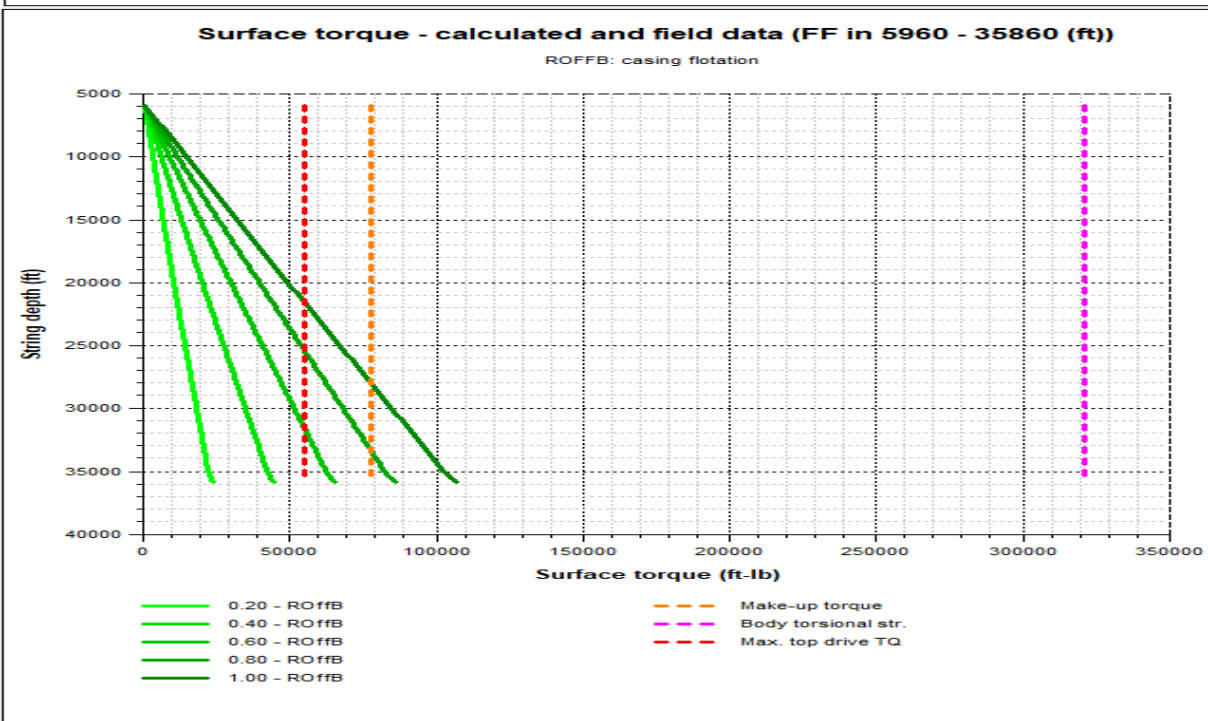
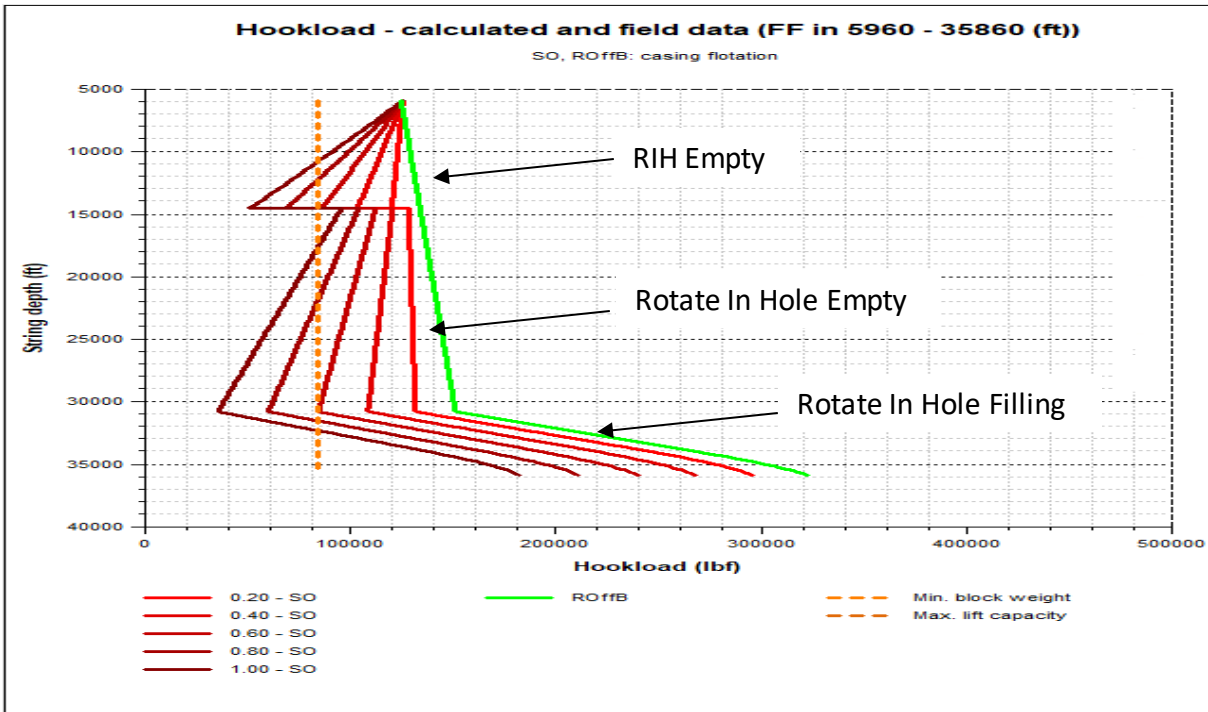


Among other factors, the weight of pipe used will need to be below modeled Collapse Pressure (not simple hydrostatic). This model should take into account:

- Running Speed
- RPM

Other Options to MAXIMIZE Reach?

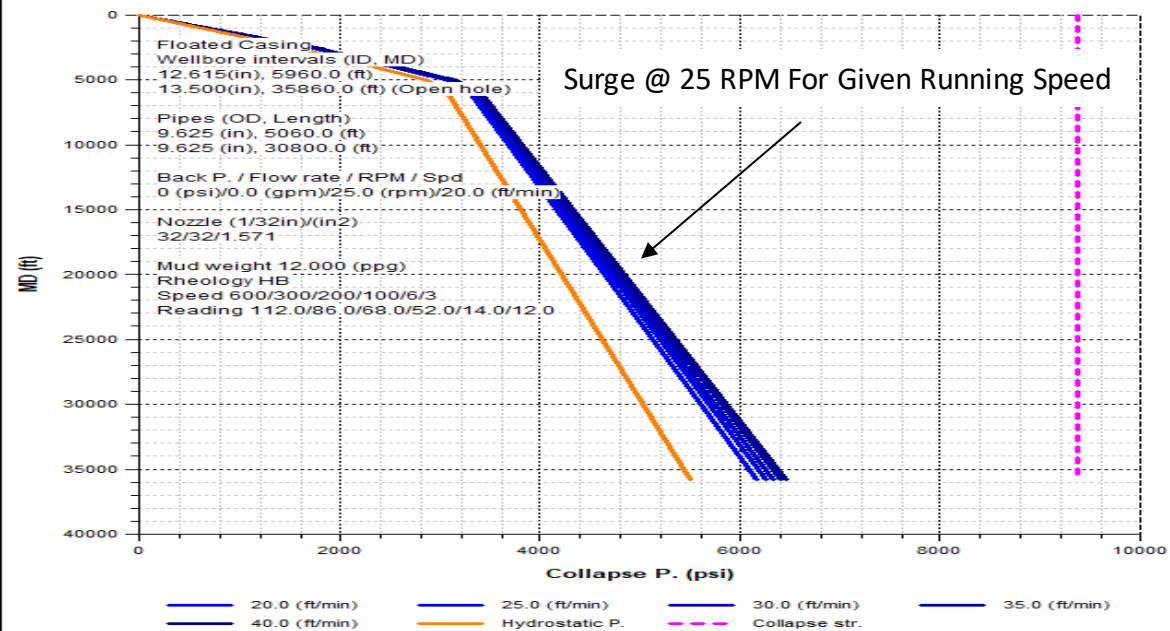
1. **Tapered Casing (10.75" x 9.625", etc.)**
2. **Heavy Fill-Weight Mud above the Flotation Collar**
3. **Higher RPM/Slower Running Speed will increase available running weight**
4. **Floated Liner?**
5. **Rollers/Non-Rotating T&D Reduction Sleeves?**



HOW FAR CAN YOU GO?

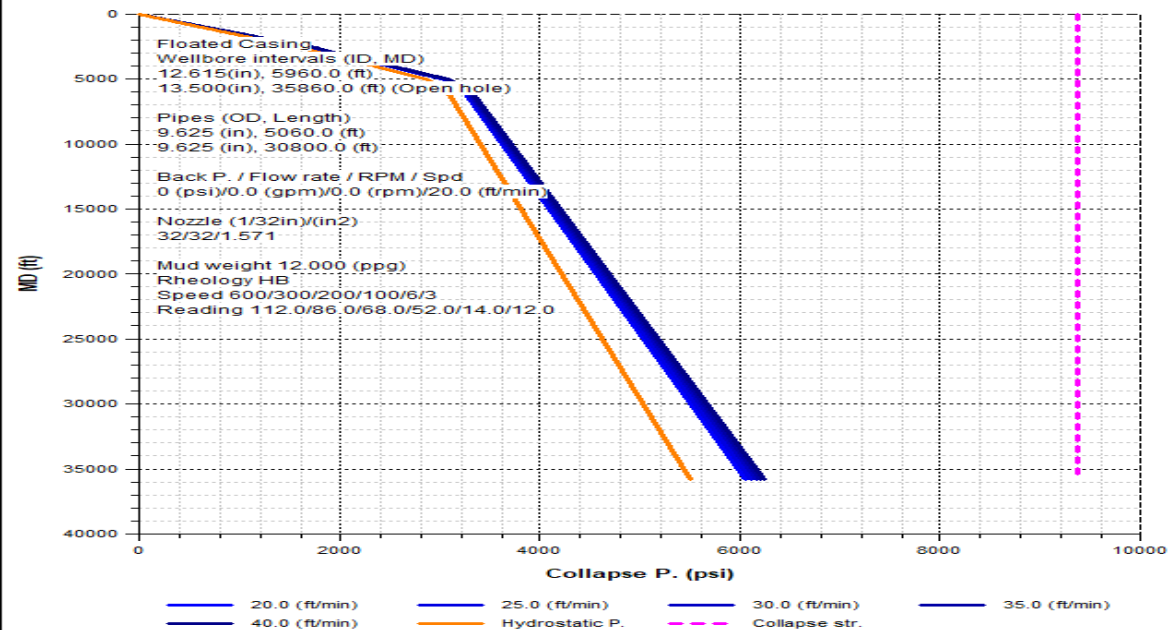
5960' – 35860' MD / 4932.2' – 8835.0' TVD
 82.5° Tangent
 3.5:1 Stepout
 53.5 ppf Casing / 9390 psi Collapse
 12 ppg MW in Pipe
 25 RPM Rotary Speed

Surge: Collapse P. with floated casing



Surge @ 25 RPM

Surge: Collapse P. with floated casing



Surge @ 0 RPM