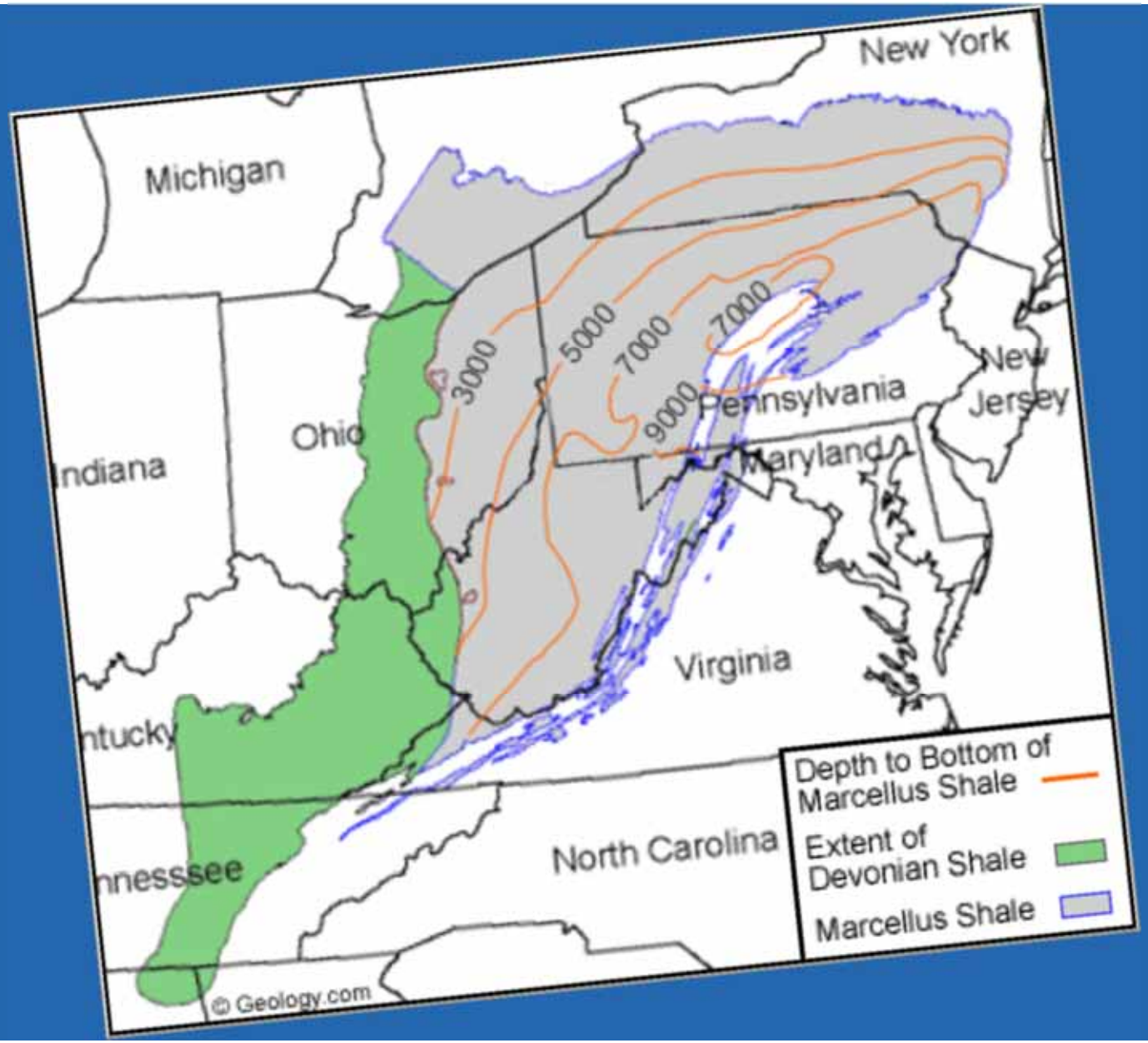
Pad design Key for Marcellus Drilling and general Slot Allocation practice

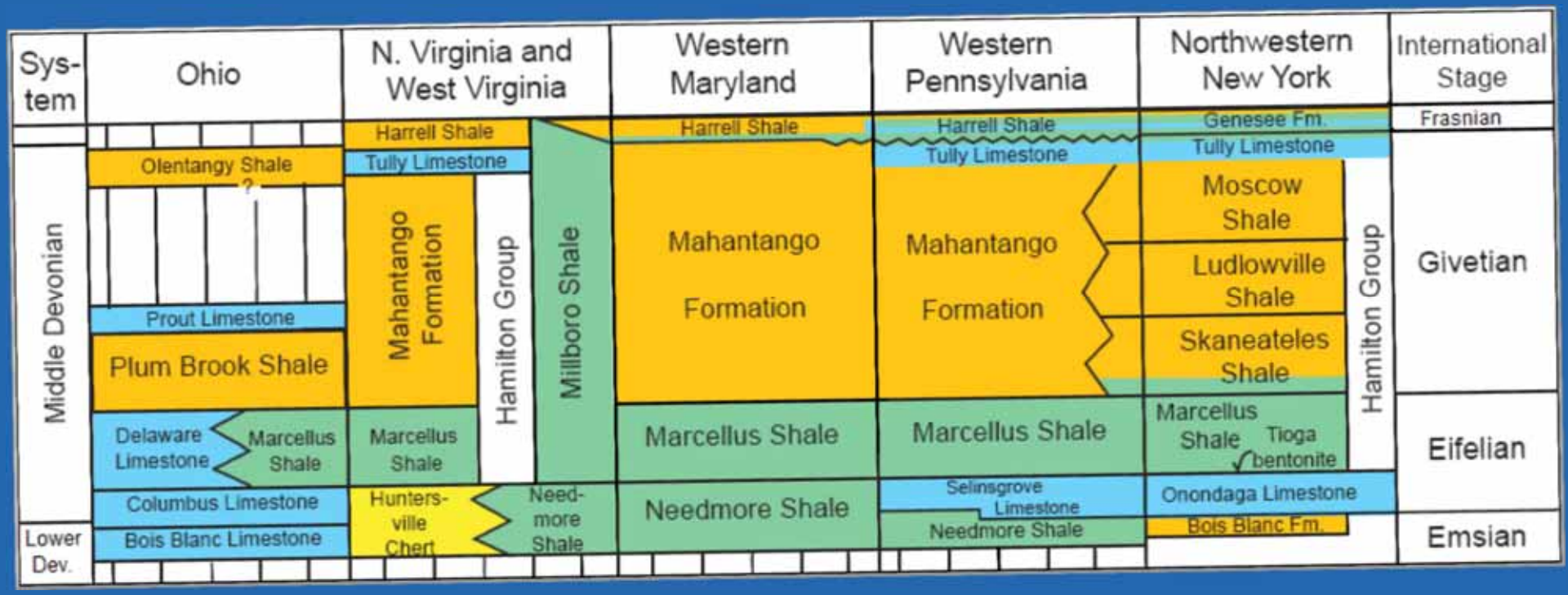
Robert Kuntz and James Ashbaugh, Pennsylvania General Energy; and

Benny Poedjono, John Zabaldano, Irina Shevchenko , SPE, Schlumberger and Christopher Jamerson, SPE, Apache Corporation

Marcellus Shale Project Location



Marcellus Shale Stratigraphy



Obstacles to Production

- Topographical features limiting:
  - Surface hole locations
  - Water disposal and supply
- Roads restricted to heavy equipment
- Limited pipeline capacity
- Limited drill site options
- Multi-well pad drilling required

Historical Factors

- Selection of tools and technologies
- Single, vertical wells
- Air drilling limitations
- Minimal surveying data

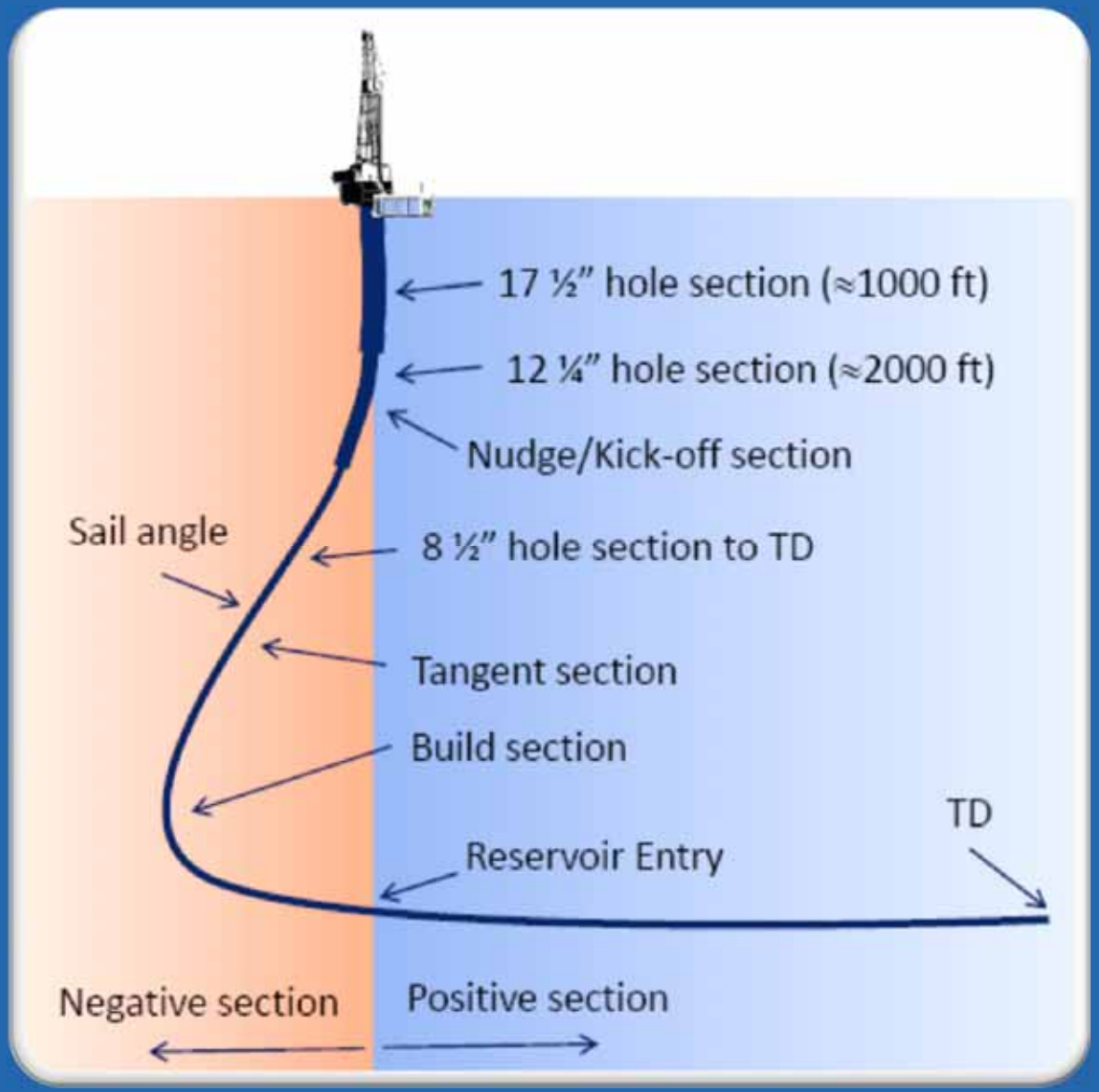
Historical Approach

- 17.5-in surface hole air-drilled blind
- 12.25-in water protection string air-drilled
  - Trips optimized based on drop in ROP
- 8.75-in section air-drilled as deep as possible
  - Minimize tangent sail angle
  - Dropping tendency of 3-5° per 100 ft
  - Roller reamers used to minimize stick-slip

Proactive Multiwell Pad Design

- Seven pairs of wells in Marcellus and Other
- Pad designed to minimize risk of well collisions
- Contractor/Operator agreed on Anticollision Standard
  - Areas of uncertainty defined for 1,000, 2,500 & 5,000-ft TVDs
  - Detailed surveying program
    - North Seeking Gyro used to maximum 20° inclination
    - MWD used once sensors are free of external magnetic interference, through TD

Wellbore Profile



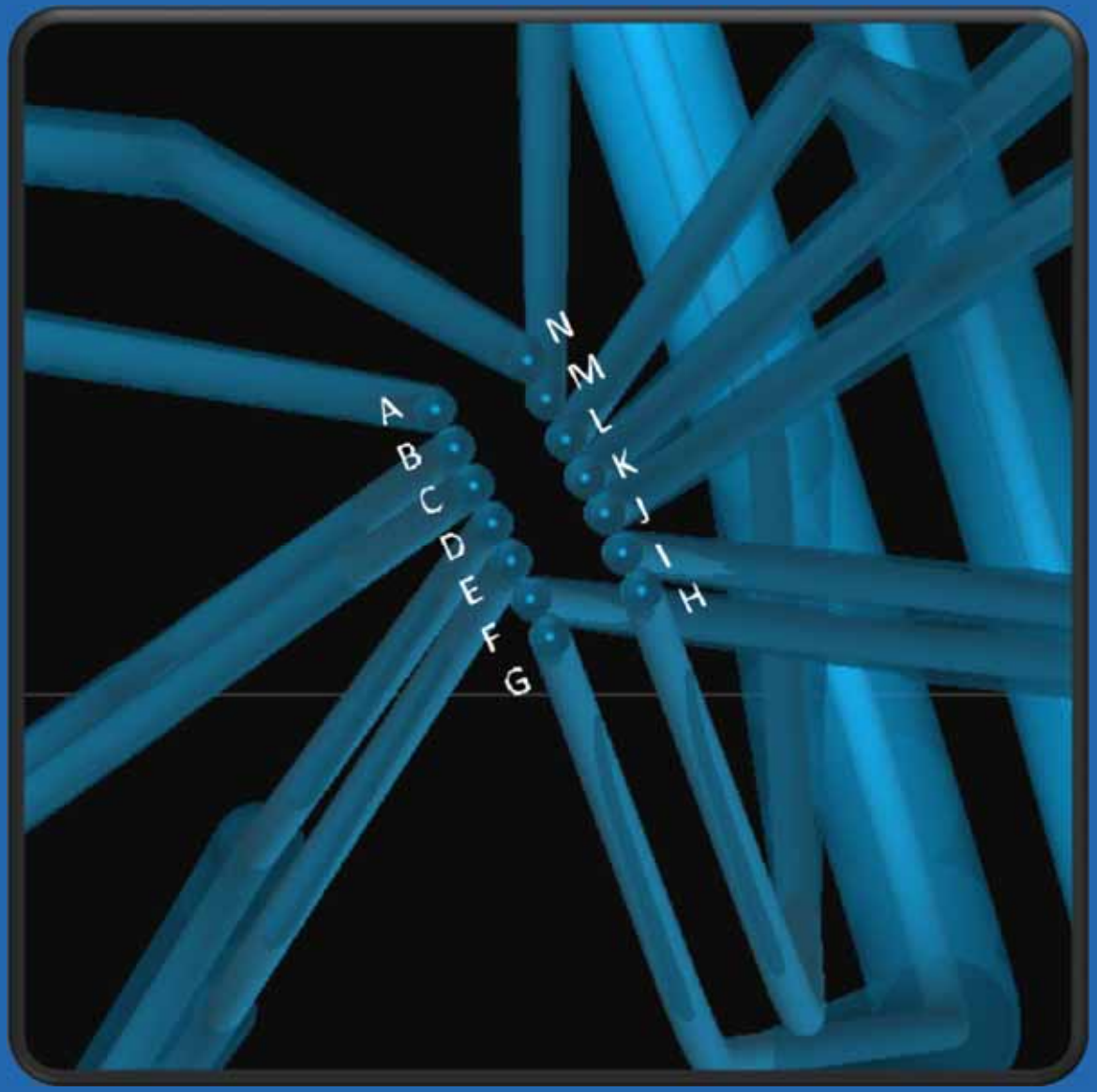
Wellbore Profile

- 17.5-in section
  - TVD ~ 1,000 ft
  - Air drilled
  - No directional control
- 12.25-in section
  - TVD ~ 2,500 ft
  - Air drilled
  - Minimum directional control
  - Maximum DLS 1.25°/100 ft
  - Sail angle 13-20°
- 8.5-in section
  - TVD = target reservoir
  - Maximum DLS 10°/100 ft

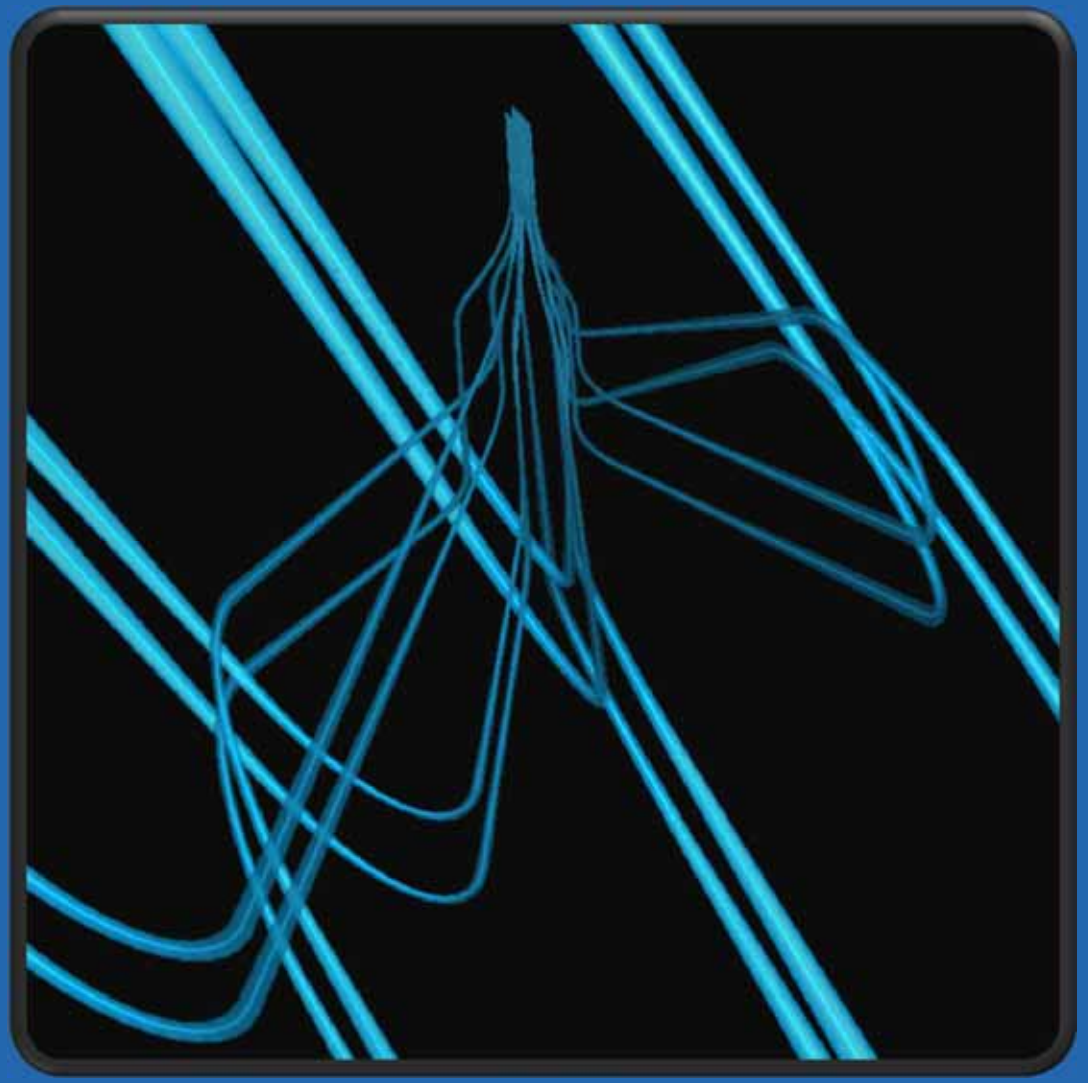
Pad Design Collaboration

- Contractor receives draft set of surface/target coordinates
- Preliminary pad visualization created
- Iterations for target/surface-hole assignments
  - Avoid trajectories crossing at any depth
  - Optimize total footage drilled
  - Minimize flat time

Initial Slot Map with Naming Conventions

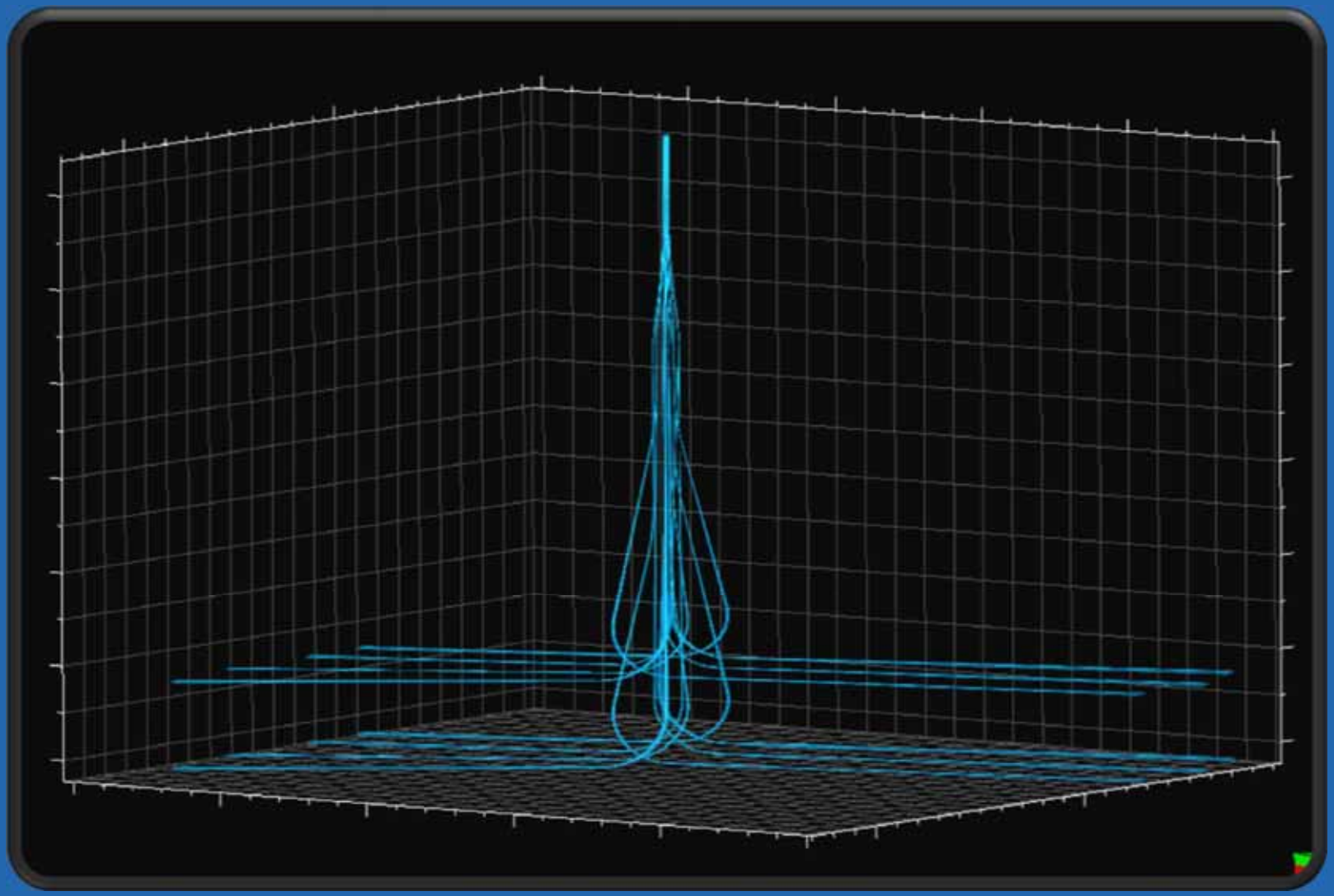


Initial Pad Design



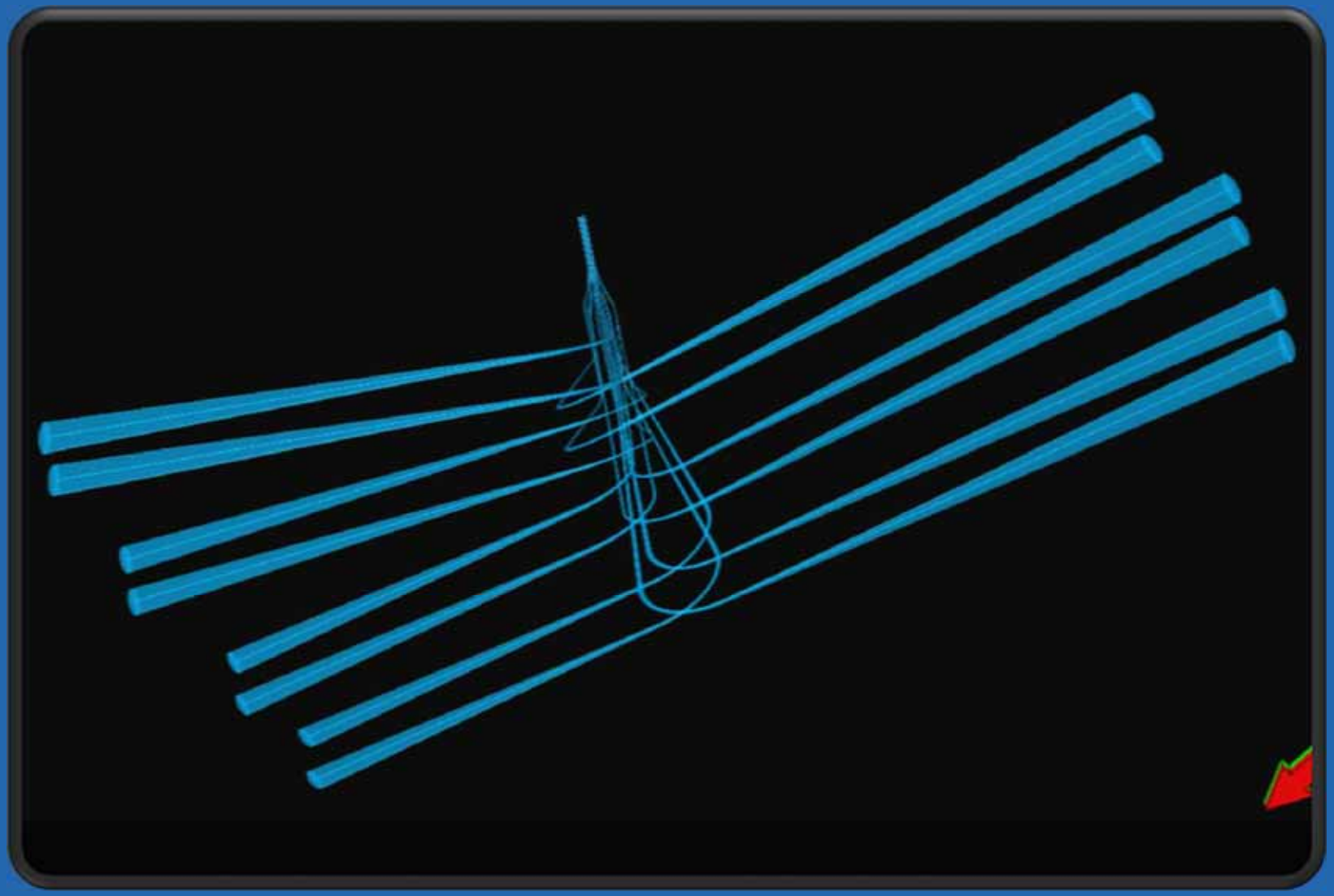
Wellbores separated to landing points

Initial Pad Design



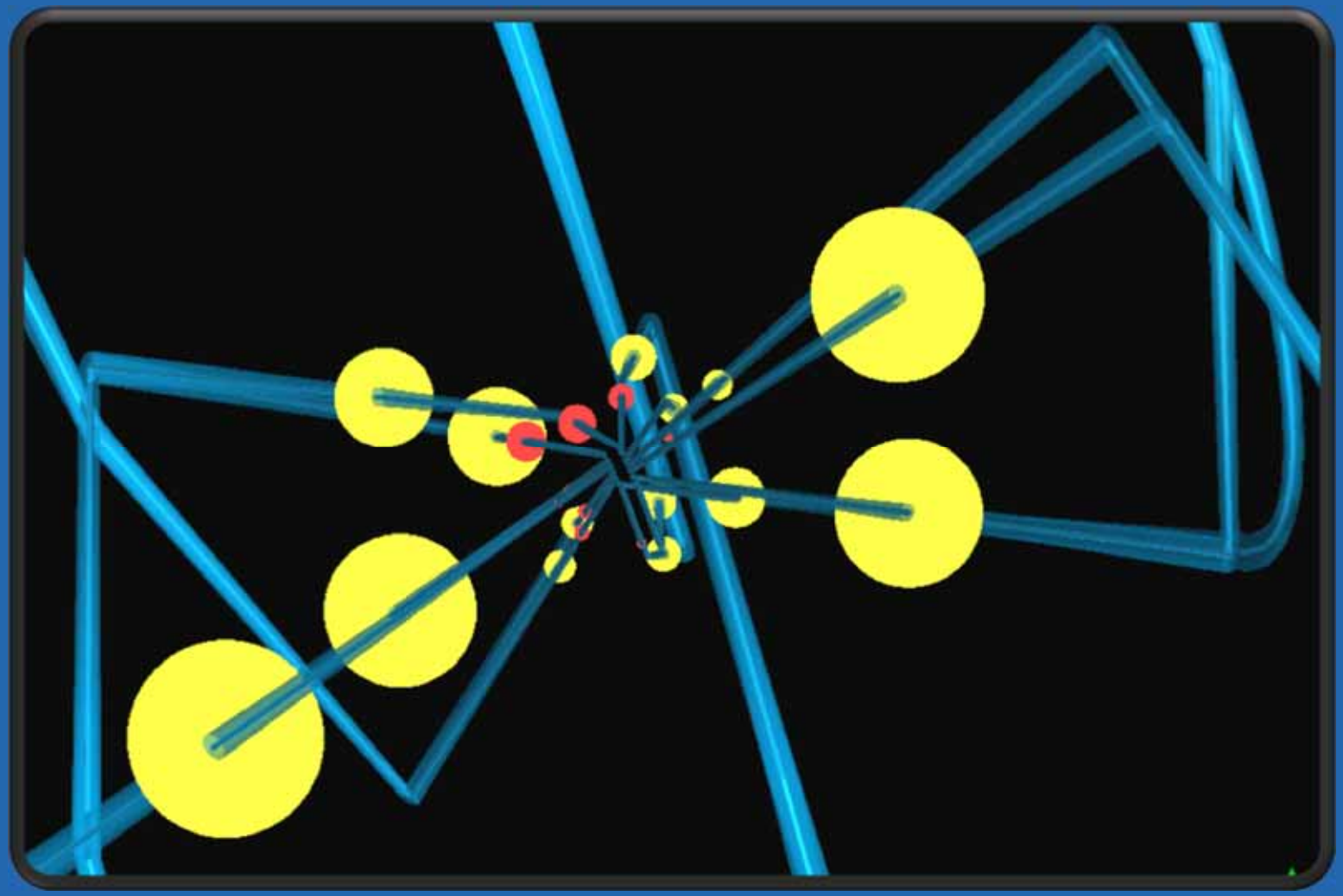
Optimized Surface hole and target reservoirs

Initial Pad Design



Trajectories do not cross at any depth

Initial Pad Design



Uncertainty areas added at 2,500 ft and 5,000 ft TVD provide accountability of deviation from plan.

Pad Design Revisions

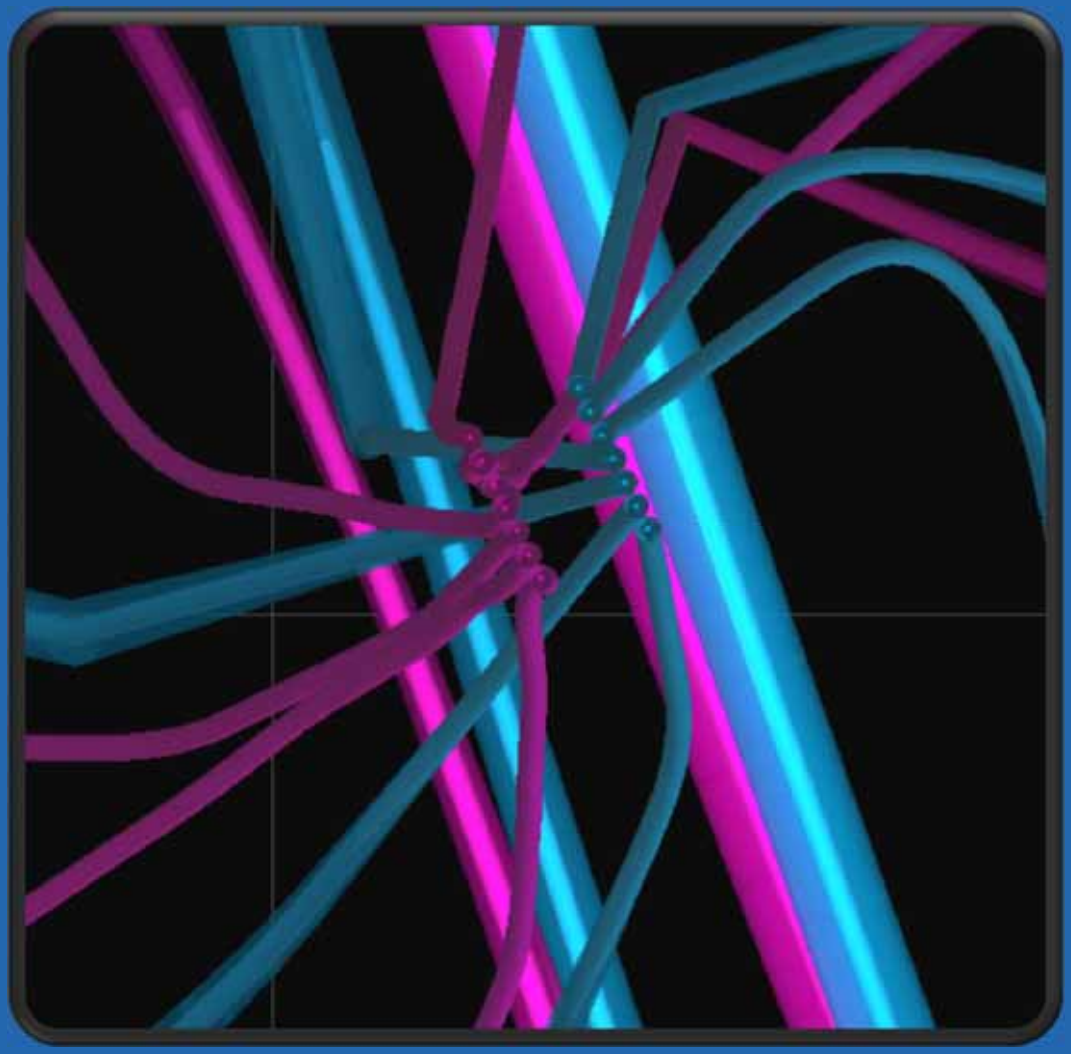
- Surveyed surface-hole coordinates received
- Geological targets revised
- Target/Slot pairing revised per permitting requirements

Well Name	Reservoir	Slot Options
AA55-T	Marcellus	A,B,C,D
AA56-T	Marcellus	A,B,C,D,E,F
AA57-B	Marcellus	A,B,C,D,E,F,G
AB77-B	Other	A,B,C,D,E,F,G
AB78-T	Marcellus	B,C,D,E,F,G
AB79-B	Other	C,D,E,F,or G
AB70-T	Marcellus	E,F,G

Final Pad Design

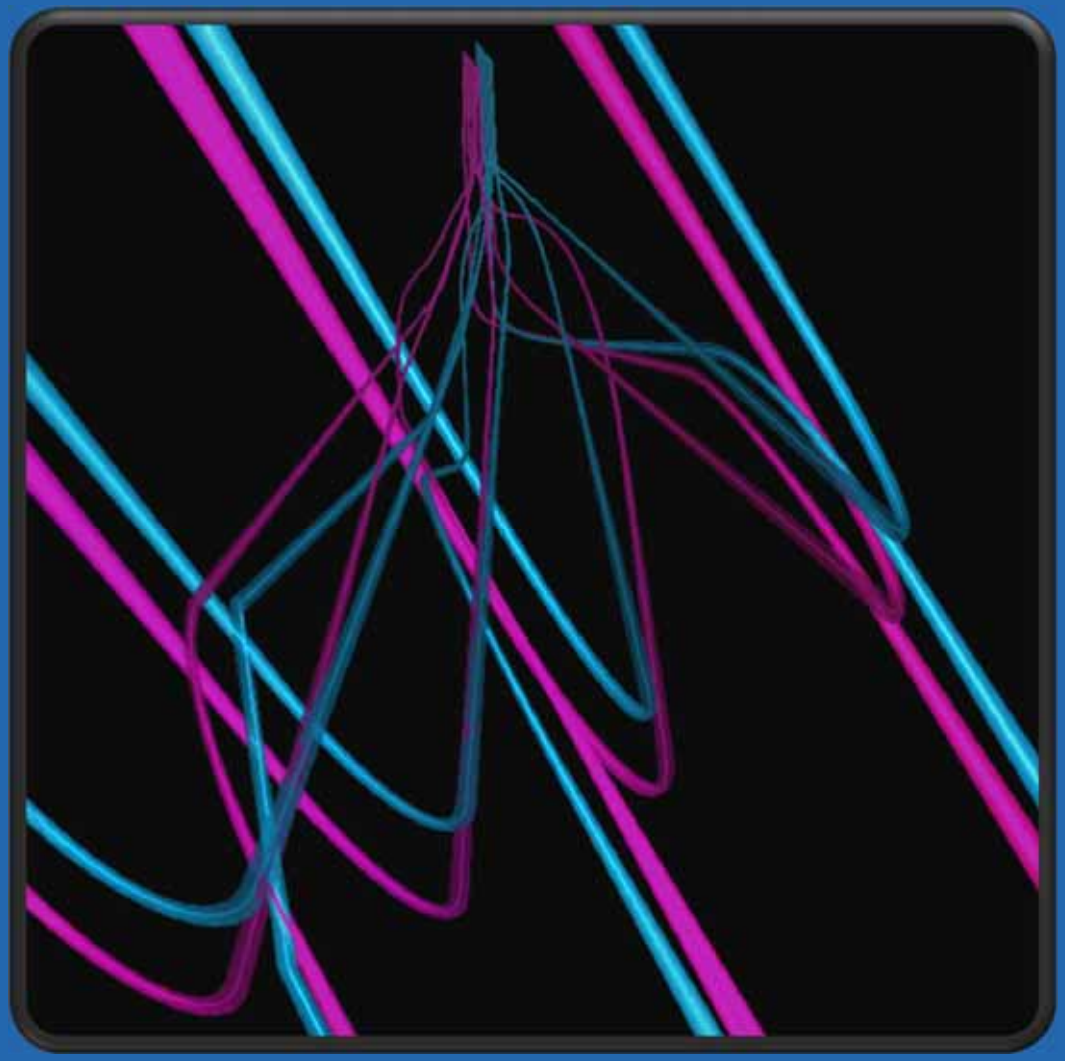
- Created after Phase 1 surface holes drilled/surveyed.
- Re-planned wellbores based on actual surface hole trajectories
- Reassessed anticollision requirements
- Recalculated areas of uncertainty

Final Slot Assignments



Red = Phase 1, Blue = Phase 2

Final Pad Design



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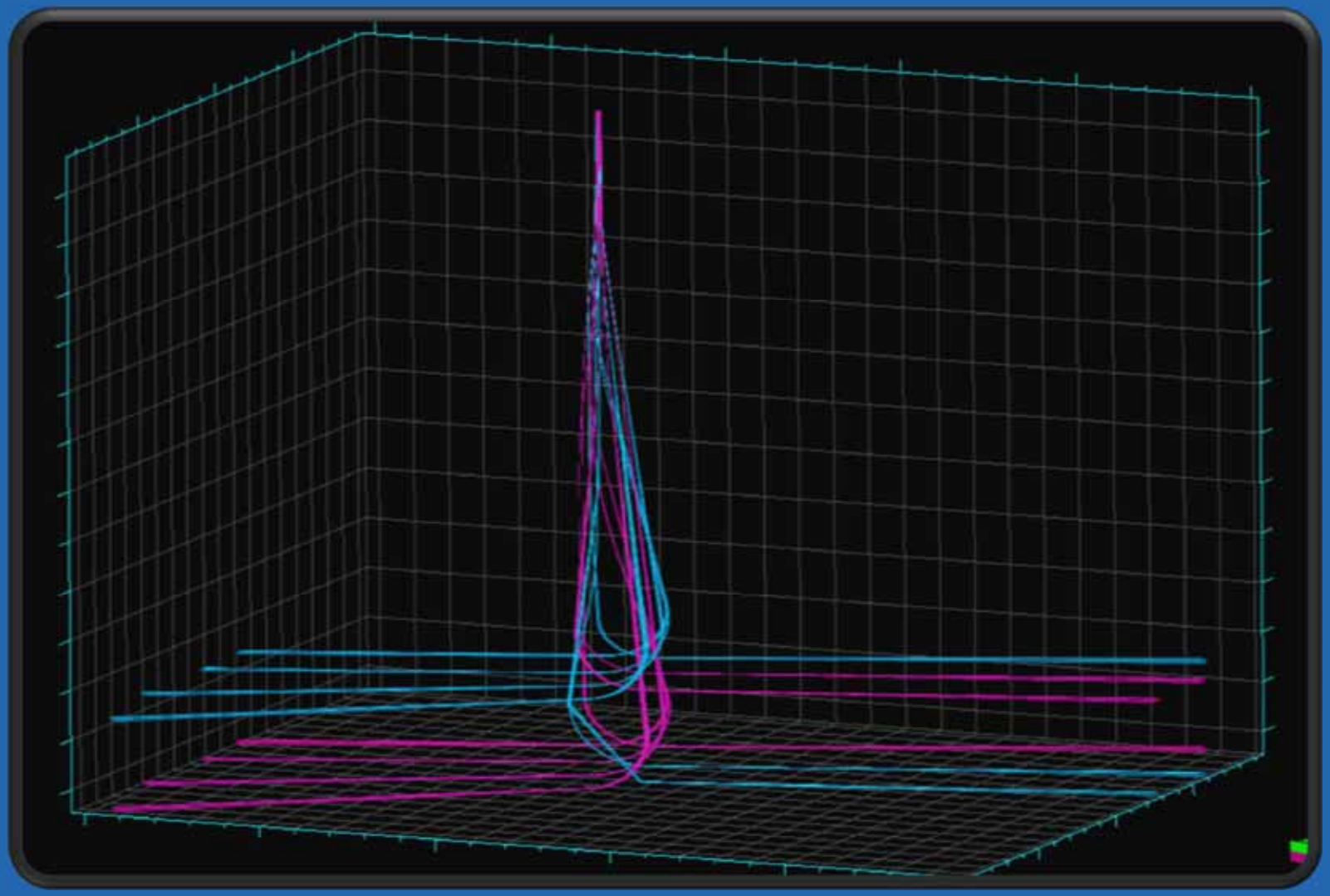
Final Pad Design



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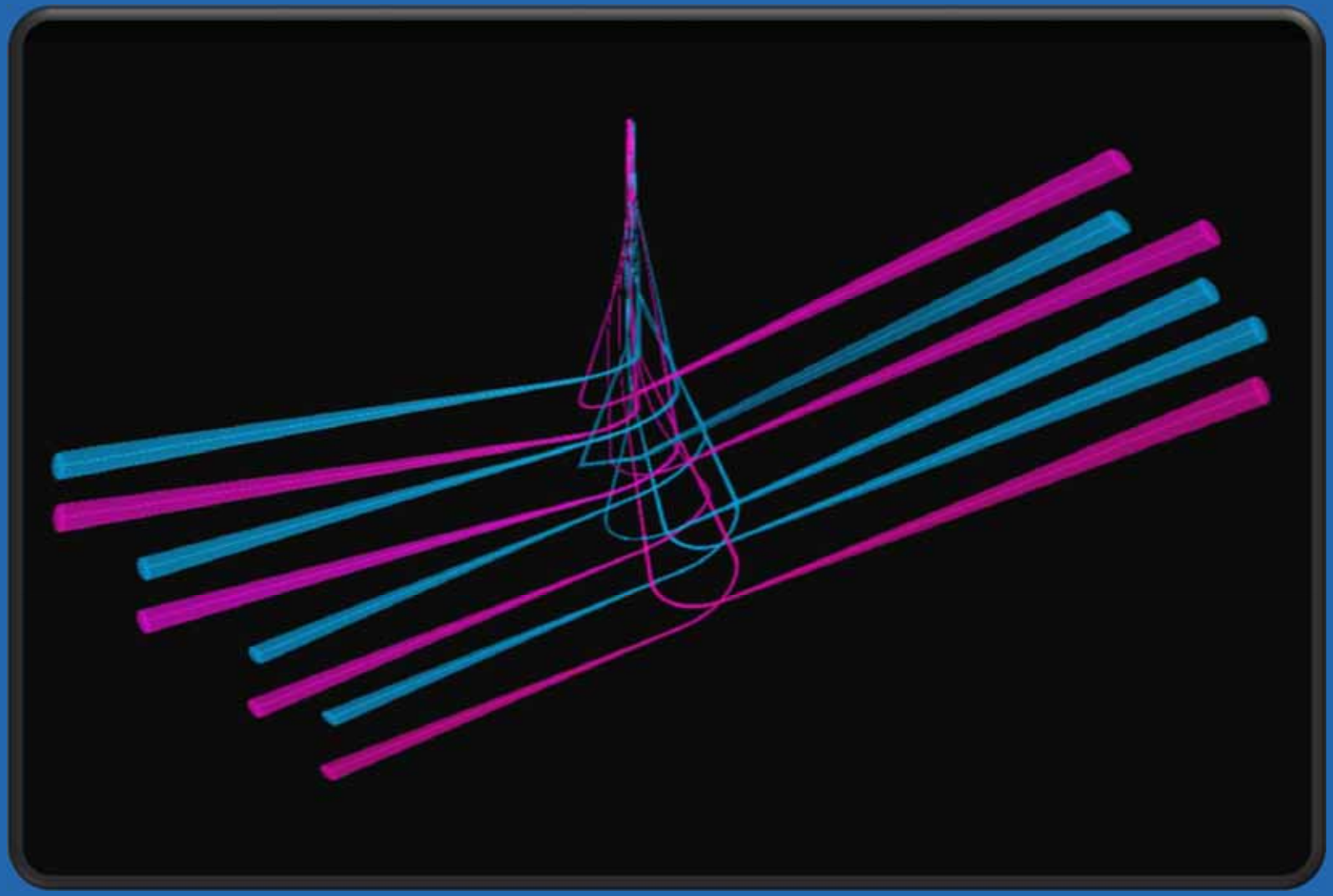
Final Pad Design



Red = Phase 1, Blue = Phase 2

Conclusion

- Drilling program continues to evolve
  - New techniques
  - Fit-for-purpose technologies
- Pad design represents step-change in regional reservoir development
  - Incorporates lessons learned in offshore environments
  - Collision risks and associated costs reduced
  - Multiple wells from single-well footprint yields better project economics

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