Design, build, and field test a high power laser tool and system

- Enables 10x+ control to orient and engineer wellbore-formation connectivity in near wellbore region where wellbore stress, regional in-situ stress, perforations / other geometries, choice of fluid properties, fluid rates, the pumping schedule and other design properties, strongly influence heat extraction potential

Technical Barriers & Targets

- Target to perform oriented slot operation in 7” casing with Initial proof of concept stage operating parameters:
  - 6,000 ft
  - 3,000 psi
  - 150C

- Achieving target requires "world first" developments:
  - > 500 ft downhole environment
  - Circumferential cut with penetration
  - Right angle operation at <10” tool diameter
  - Optics package designed for high pressure
  - Deeper depths / umbilicals
  - High pressure downhole environments
  - Mobile splicing
  - Downhole high power laser downhole connector
  - Onshore workover-style supporting surface spread

Challenge: High Power Fiber Cable

- Packaging of fiber optic in cable, installation of cable in conveyance structure, and mechanical stresses caused by hanging weight and tool operation

Technical Accomplishments

- World first design of a high power laser cutting tool for well completion applications
- World first tests of high power laser downhole
- World first 12,000 ft packaged high power fiber cable: fiber optic, break detection, 3-wall stainless
- World first installation of packaged high power fiber cable & conductor into 2,000 ft coiled tubing
- World first high power laser hardware (optics package & fiber connector) tested to >5,000 psi

Challenge: Preliminary Field Tests

- Executing on significant lessons learned in improving conveyance reliability, debris management, operational procedures & ruggedizing surface system
- Dedicated test well created through re-entry of plugged and abandoned well near Galveston, TX to allow rapid iteration & downhole / conveyance tests

Conclusions & Lookahead

- Prelim success on interim technical milestones but true value will not be apparent until field testing data
- Foro Energy has moved aggressively to conduct earlier and more frequent field testing to maximize the probability of a successful unique geothermal completion operation in a dedicated test well