

Written Testimony
Before the House Natural Resources Subcommittee
On
Energy and Mineral Resources

Good morning Mr. Chairman and distinguished members of the subcommittee. My name is Cary Ralston and I am the Vice President and General Manager of the Missile Products Division of Alliant Techsystems, better known as ATK. For those not familiar with ATK, it is a publicly traded, Fortune 500 aerospace and defense company that specializes in high performance, applied engineering. Among its achievements, ATK is the largest producer of solid rocket motors used for military and space programs such as the former NASA Space Shuttle; the world's largest producer of commercial and military grade ammunition; a leading supplier of propulsion and warheads for tactical missiles; and the sole provider of rocket propulsion used for our nation's land- and sea-based strategic ballistic missiles. In each of these programs – and hundreds of others that ATK is contracted on – the underlying component is advanced, highly engineered energetic material.

Approximately eight years ago, ATK committed its expertise to the oil and gas sector recognizing that high-performance, aerospace-grade technology could benefit the energy marketplace especially given ATK's track record for producing sophisticated, yet robust components that operate safely and reliably in extremely demanding environments. In practical terms, ATK has succeeded in developing "dual use" technology, a challenge that many defense companies have tried, but failed, to achieve in the past.

Today, ATK is developing a suite of energy-related tools that leverages our advanced air-breathing hypersonic and solid rocket motor technologies. These include several technologies to provide safe, reliable down-hole stimulation and extraction. Our Inertial CO₂ Extraction System (ICES) project is being designed to extract carbon dioxide from coal fired power plant effluent and employs supersonic wind tunnel technology along with inertia separation principles to freeze and separate CO₂ particles. In addition, we are applying our experience in hypersonic research and development to create technologies for down-hole steam generation aimed at producing heavy oil from abundant reserves in Alaska. ATK's Thermal In-situ Maturation and Extraction (TIME) system is a local, on-site retorting tool for the upgrading and extraction of young shale reserves, quantified in the trillions of barrels of oil, found in the western half of the continental United States. Last, ATK's methane hydrate recovery (MHR) system is aimed at producing the vast hydrate reserves located offshore and beneath the tundra. These and other projects are currently undergoing testing and show enormous potential.

This morning, I would like to discuss ATK's down-hole well stimulation technology. We began to support the oil & gas industry more than 40 years ago with a small propellant stick used to deliver pressure to a chemical tool that became the industry standard for cutting damaged and/or stuck pipe. ATK's waterless stimulation tool uses high energy, coated propellant sticks with each stick being approximately two feet in length. The sticks are placed end-to-end across a well pay zone that has been drilled, cased and perforated in a typical manner for hydraulic fracturing. (Slide 1) The propellant tool is deployed using a standard wire-line truck and small crane with no specialized equipment required. Once positioned, the sticks are ignited generating a gas that

is trapped by the fluids and associated pressure normally present in wells. Since the gas can't escape up the well bore it is forced through the well casing perforations. Unlike the current hydraulic fracturing process in which the fracking fluid naturally seeks and permeates existing fissures in the rock, propellant-generated gas is produced at volume and pressures to create its own path, overcoming the opposing rock formation to crack and lift the rock.

The cracked rock twists under the gas pressure creating micro channels which allows the resource to flow into the well for capture. To be clear, while propellant is used, there is no explosion. Rather, the rock is fractured using a highly regulated, controlled gas generation process. The same controlled gas generation that lifts rockets into space creates the pressure necessary to fracture the rock. No chemicals or proppant are needed and the propellant burns to completion leaving only naturally occurring gases in the well.

ATK's tool is highly versatile and can be used to stimulate new, existing or underperforming wells, either as an augmentation to or instead of current hydraulic fracturing procedures. Field demonstrations confirm its utility in oil, gas, and geothermal wells, with application in both vertical and horizontal wells. Unlike past rudimentary nitroglycerin "torpedo" charges or today's hydraulic fracturing procedures, ATK can tailor the duration and profile of the pressure curve needed to fracture rock. Given our knowledge and past experience with energetics, ATK has the ability to design propellants that can generate pressures in excess of 15,000 PSI, pressure sufficient to overcome all types of rock.

Compared to current hydro-fracking procedures, ATK's tool is relatively easy and quick to deploy, requiring very little infrastructure or support equipment to operate. (Slide 2) The tool can be quickly employed in remote, unimproved regions and/or in areas where water supply is of great concern either due to drought or competing demands.

To date, ATK and its partners have employed this propellant stimulation tool in over 600 wells across 11 states and 4 countries. Preliminary results have been impressive, yet inconsistent. Among the documented results, ATK's technology has increased production by greater than two times compared to other technologies currently used in the field; for injection wells, a substantial increase (up to double) in volume at significantly lower pressures; an increase by a factor of 1-2 in output in existing, re-stimulated wells; and a 30 - 50% reduction in the pressure required to breakdown increasingly deeper and longer horizontal wells. In addition, the tool has demonstrated utility for repair operations such as removing stuck components.

Field demonstrations clearly show that the tool works – often with significantly higher output – but not every well responds positively. What is needed, and what ATK is actively pursuing, is more data so that we can tailor our propellant to better match local geological formations. Ultimately, ATK expects to have an inventory of propellant and deployment techniques which will be customized for individual plays. This should allow us to predictably and repeatedly deliver improved production.

Notionally, ATK regards its current well-stimulation tool as a baseline or Generation 1.0 model. It is functional and shows great potential but has certain limitations. In particular the current propellant has a single *Pressure vs. Time* profile which may not be optimal in all geological

formations. (Slide 3) As with any new technology, a continuous product improvement regimen is necessary and this approach is fundamental to how ATK develops and matures its technology. Specifically, ATK is intent on lengthening the duration of the propellant burn at pre-set pressure points. Doing so will extend the fractures beyond the current distance of approximately 30-90 feet from the well bore and thus create even greater contact with the oil and natural gas reservoir. Modifying the operating parameters of a propellant is a process that ATK does regularly in its rocket motor business and is core to ATK as a company.

To optimize the propellant's performance, ATK is seeking industry partners who can add their operational experience to ATK's energetics expertise. Recently, ATK representatives were in North Dakota, Oklahoma, Texas, and Colorado meeting with exploration and production companies, as well as university faculty, well owners, and oil producing Native American tribes to explore the feasibility of teaming and sharing data. Such partnerships are instrumental to exposing more (potential) users to the tool as well as capturing more and better data that can be fed back into our models and prototypes for improved performance.

The benefits of ATK's well stimulation tool directly address many of the most pressing problems facing the current hydro-fracking process. First, the tool uses little or no water in the performance of the stimulation. Currently, a minimal amount of water (approximately 1000 feet) is needed at the well head to prevent the gas from exiting the well bore. This water is naturally present in most well bores but in some select cases a nominal amount of fluid may need to be added.

Second, ATK's propellant stimulation procedure needs no chemicals or proppant to enhance the flow of oil and natural gas. The propellant-generated gas creates thousands of micro fractures in the rock. These micro fractures create a highly porous pathway in which the fractured rock acts as its own proppant and which helps suspend and maintain the overburden. Because neither water nor chemicals are added, the requirement to capture, process and dispose of fracking fluid is greatly reduced thus making the overall operation more manageable and less expensive. From a community perspective, a reduction in the amount of externally injected water equates to a smaller operational footprint which in turn can lessen the impact on community roads and infrastructure.

Finally, ATK's well stimulation tool is less expensive to operate relative to other hydraulic-related stimulation technology. This is due in large part to the reduced operational footprint and the time needed to set up and perform the stimulation. In addition, propellants are an abundant commodity that can readily and economically be shared among an ever growing group of competing users. Taken in total, these advantages translate to greater access and availability to more operators, whether they are big national E&P companies or small, local well owners.

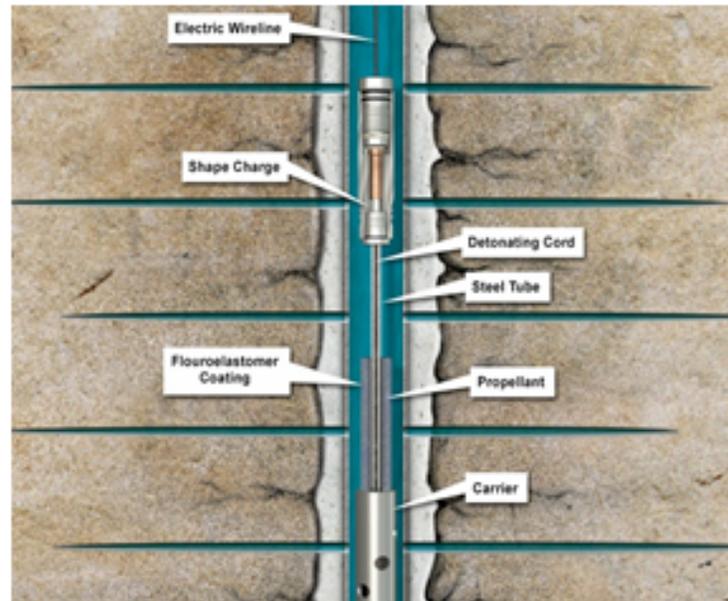
In summary, ATK is extremely proud of its efforts to leverage its aerospace expertise to provide useful tools to a new market. Our desire and willingness to pursue this market reflects the potential to provide value-added expertise and technology to a large, extremely important sector of the US economy.

Thank you and I look forward to answering your questions.

Solid Propellant Stimulation Tool Description



- Environmentally sealed ignition designed tool with pre-machined fracturing segments that ideally provide equal flame spreading and, therefore, completely burn the propellant grain
- Configuration design is critical to the success of the tool
- Assembled at well site to assure maximum tool benefit and ease of transfer
- Results can be measured in the same day
- Successfully tested in several application and down-hole conditions



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Alliant Techsystems Proprietary

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Propellant Well Stimulation



Current HF Process

VS.



ATK Alternative

Benefits of Energetics Fracturing Process

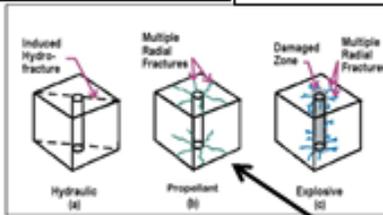
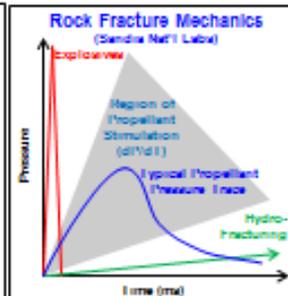
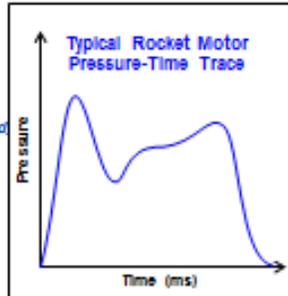


PRIMARY BENEFITS

- Release of the gas disbursement
 - Explosives 1,000,000 psi in 1 microsecond
 - Hydraulic 5,000 psi in 1 hour
 - Propellants 20,000 psi in 10-1000 milliseconds (Tailored)
- Reduces or eliminates the amount of water required
- Drastically reduces or eliminates the disposal of used fracturing water
- Much lower cost
 - 50% cost reduction versus current procedure
 - Minimal on-site equipment
 - Shorter service time needed to get well on line

ADDITIONAL BENEFITS

- Eliminates the need for chemicals to alter the success of the fracturing technique
- Creates multiple fractures with controls instantly around boreholes to eliminate aquifer contamination
- Increases injection and withdraw rates in gas storage wells
 - Removes "skin" and cleans the wellbore damage the perforating process creates, which reduces breakdown pressure in some formations
 - Improves effectiveness of acidizing by using propellant before acidizing
 - Stimulates selected zones without the need to set packers
 - Minimal formation damage from incompatible fluids and minimal vertical growth out of the pay zone



Bottom line: Demonstrated performance, lower cost