How extensive planning helped OMV Petrom increase production with StimTube™ wellbore stimulation tool

Six months of collaborative planning and modeling result in safe job execution and a large production increase for Halliburton client.

**OVERVIEW**
OMV Petrom in Romania had a number of aging wells with declining production. Perforations had become clogged. In many such cases, the Marathon StimTube™ tool would be ideal to open them up. When activated, it produces gas that forces surrounding liquid into perforations, expanding the perfs into reservoir rock.

However, when working with the tool, accurate and thorough prejob modeling is important to help ensure safety and results. Halliburton worked with OMV Petrom for months to model various sizes of charges against conditions in the well, rock properties, fluid volume and more. This modeling determined how to get the best results with the least risk. It paid off. The crew completed the job without any safety incidents and with improved production. OMV Petrom reported a sustained production increase of 66 percent from the well.

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<th>CHALLENGE</th>
<th>SOLUTION</th>
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<td>Low production due to clogged perfs</td>
<td>The Marathon StimTube tool</td>
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<td>OMV Petrom had a decades-old reservoir with declining production. However, enough reserves remained to justify the expense of trying to get them out. The issue: perfs had become clogged from sand during the many years of production. But what was the best way to open them?</td>
<td>Halliburton has extensive experience with the Marathon StimTube tool. With proper pre-job modeling, it opens clogged perfs safely. A detonator cord triggers an explosion that produces CO\textsubscript{2}, that then forces liquid into perfs, widening them past wellbore damage into reservoir rock, restoring reservoir flow.</td>
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<td>Low reservoir pressure</td>
<td>Pumping additional fluids in well</td>
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<td>To work effectively, the StimTube tool needs back pressure that forces the explosion into perfs. Unfortunately, OMV Petrom’s reservoir produced little back pressure because of depletion over many years. Without sufficient back pressure, reservoir rock and casing, not perfs, would absorb the explosion.</td>
<td>Halliburton pumped an additional 2,240 feet of water into the well. Modeling with Halliburton’s ShockPro™ and PulsFrac™ software showed that the weight of this much fluid would create enough back pressure to enable the tool to work properly and protect the wellbore from damage.</td>
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<td>Proximity of perfs to bottom of well</td>
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<td>The OMV Petrom well had perforations near total depth (TD). Under such conditions, the explosion can reflect off the bottom of the well and force the tool rapidly upward. A split second later, the tool can rocket back down, snapping the cable, and resulting in an expensive fishing expedition.</td>
<td>Halliburton software also modeled the amount of movement in the tool using various sizes of propellant. Results ranged from one to three meters. From years of experience in other parts of the world, Halliburton knew that the e-line being used could handle that much movement and it did.</td>
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OMV Petrom’s well was in Romania, but Halliburton’s closest StimTube™ crew was in the Netherlands. Six months of planning ensured OMV Petrom and Halliburton worked well together, and helped the StimTube job come off as planned and without any safety incidents.

Modeling also showed that because of the proximity of the perfs to the bottom of the well, the explosion would force the StimTube tool up and down one to three meters. Halliburton’s experience in other parts of the world indicated that the e-line used to trigger the explosion was sufficiently strong to handle this much movement.

Two months after the StimTube job, OMV Petrom indicated that oil production at the treated well had stabilized at a rate 66% higher than before the job.
Declining pressure, clogged perfs reduce production in mature field
OMV Petrom in Romania had a mature field with declining pressure and clogged perfs that reduced production. They hoped that the Marathon StimTube tool could help open the perfs and boost production.

Normally, to be considered as a candidate for the StimTube tool, a reservoir should have a bottomhole pressure of approximately 3,000 psi. This back pressure partially shields the formation and casing from the propellant while funneling the force into perforations. Because the pressure in OMV Petrom’s mature field was low, predicting tool behavior became a challenge. Very little data was available on reservoirs with low bottomhole pressures.

Understanding how StimTube tool works is key to good results
The StimTube tool can overcome near-wellbore damage, and restore the connection between the reservoir and the wellbore in many circumstances. Heat, pressure and carbon dioxide generated during activation produce high pressure that forces surrounding fluids into perfs, opening them up.

To work effectively, the pressure must be carefully calculated to stay within a window; it must exceed the frac gradient of reservoir rock, but not exceed the strength of the casing. A number of different ways exist to help ensure this.

Collaborative planning and ShockPro™ simulation address risks
Halliburton has performed StimTube jobs throughout the world for decades and makes extensive use of proprietary ShockPro™ and PulsFrac™ modeling software. These software tools can predict wellbore events in the milliseconds during and immediately after the explosion with remarkable precision.

Specialists from both companies worked together to understand how to help prevent safety issues and help ensure good results. They modeled the effect of several different sizes of propellant after accounting for numerous wellbore properties, such as diameter; formation pressure, porosity and rock strength; casing strength, gauge, composition and age; the location of perforations; well depth; and perforation locations.

Models showed that StimTube stimulation could succeed with acceptable risk if the right-sized charge was placed perfectly. Being placed even slightly above or below the perforations would greatly diminish the effect of the stimulation. crews must place the tool adjacent to perfs for maximum effectiveness.

Locating peak of the formation and perforations
With all this in mind, Halliburton used its gamma ray tool to precisely locate the formation of interest. Then Halliburton used its casing collar locator tool to precisely correlate the depth of the StimTube tool with the depth of perforations.

Six months of collaborative planning and modeling result in safe job execution and sustained 66 percent production increase for OMV Petrom well.
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**Proximity of perforations to bottom of well raises another concern**
After locating the perfs, some turned out to be close to the bottom of the well. Near the bottom, the force of an explosion could ricochet, forcing the StimTube tool rapidly upward and then downward again as the force of the explosion subsides. Such motion has been known to tear tools from the cable that supports them, resulting in expensive fishing operations.

However, simulation showed between one to three feet of tool movement would be generated. Experience in other parts of the world led Halliburton to believe that this amount of movement was within the safety limit of the cable being used.

**Amount of propellant adjusted for wellbore geometry**
At the depth of the operation, the wellbore was four inches in diameter. Modeling showed that a 2.5-in. StimTube tool could burst the casing. So Halliburton reran the simulations, using a 2-in. tool. Simulations showed that two 3-ft StimTube tools attached together would create enough force to overcome near-wellbore damage and initiate fracs that grew into reservoir rock.

**Capitalizing on the one chance to get it right**
The simulations also showed that the team needed to create additional back pressure to focus the force of the explosion on the perfs and help protect the casing. Models recommended adding the weight of 2,240 feet of water to the wellbore to create this back pressure.

After six months of planning and collaboration, a Halliburton crew set out from the Netherlands and drove across Europe to Romania. Upon arrival at the job site, the Halliburton crew discovered yet another issue: a language barrier. However, with the help of translators, both crews worked well together. Everything went as planned. The job finished without a safety incident.

**66 percent sustained production increase after two months**
After withdrawing the tools and water from the well, the OMV Petrom crew restarted the pumps and found an immediate increase in production. Two months later, when production had stabilized, OMV Petrom found that sustained production had increased by 66 percent.

They attribute the success of the job to exceptional planning that kept people and assets safe. OMV Petrom and Halliburton are currently looking at performing similar operations on additional wells and are in the process of qualifying wells.

“Halliburton’s experience, software and planning kept our people and assets safe while producing excellent results.”

Cristian Ion Todea
Senior Head of Operations, OMV Petrom