Seneca Resources can now measure pre-frac prep time in hours instead of days, and has cut casing test costs by 40 percent.

**OVERVIEW**
In the Marcellus Shale, Seneca Resources operates more than 150 deep shale wells. To help ensure leaks will not pollute aquifers or air, Seneca pressure tests all casing before fracturing. However, traditional methods for testing casing required intervention and were very costly. When Halliburton approached Seneca about field testing new RapidStart™ Initiator CT sleeves, Seneca quickly agreed. In their first well, the sleeves cut casing test costs 40% by eliminating time and expenses associated with coiled tubing and tubing-conveyed perforating. RapidStart Initiator CT sleeves also reduced the risk of unobserved casing damage due to sleeve activation pressures that exceed test pressures. The unique method of opening these sleeves helps ensure that the simulated fracturing pressure used in testing will not be exceeded. On a six well pad, Seneca could cut casing test costs even more and gain revenue by bringing wells on production sooner.

<table>
<thead>
<tr>
<th>CHALLENGE</th>
<th>SOLUTION</th>
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<tr>
<td>Valid casing integrity tests without running a plug</td>
<td>New sleeve actuates without exceeding test pressure</td>
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<td>After running integrity tests with traditional toe sleeves, companies increased pressure to open them, invalidating the test. The only way to avoid this was to install plugs above the sleeves and then test casing against the plugs. This resulted in additional cost, time, and risk.</td>
<td>RapidStart Initiator CT sleeves do not require pressures in excess of test values to open. The sleeve opens only after certain test pressures have been achieved for 20-60 minutes or more. This can eliminate time, cost, and risk with running, testing against, and retrieving a plug.</td>
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<td>Improve efficiency and well economics</td>
<td>New toe sleeve run as part of normal casing string</td>
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<td>Cost associated with prepping the well can be as low as $60,000. However, they can also easily exceed $100,000 depending on location and problems that may arise. This can delay production, negatively impact well and field economics and reduce return on investment.</td>
<td>The RapidStart Initiator CT sleeve is run as part of a normal completion, so a crew is already on site. CT, in this case, stands for Casing Test. There are no additional costs or risks associated with wireline or coiled tubing units, and rigging the units up or down to set bridge plugs.</td>
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<td>Small activation window can trigger costly intervention</td>
<td>Unique actuation method cuts risk, creates flexibility</td>
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<td>To comply with regulations, some operators set activation pressure of conventional toe sleeves very close to the max casing pressure test value. This caused sleeves to open earlier than anticipated (or sometimes not at all). This could trigger the need for an expensive intervention.</td>
<td>The new sleeves open only when test pressure has been maintained for a period of time. If crews reduce pressure, they stop the meter. This lets them fix any issues they find and retest the well – before the sleeve opens. It gives them a “second chance” that helps avoid costly interventions.</td>
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RapidStart™ Initiator CT sleeves are a normal part of completions. They also enable positive verification of casing integrity prior to fracturing operations. They are rated to 15,000 psi total pressure, 10,000 psi differential pressure and 350°F. The sleeve also eliminates the need for perforating via wireline or coiled tubing.

**A CASE STUDY: Verifying casing integrity before fracturing**

For pressure testing, RapidStart™ Initiator CT sleeves gave Seneca Resources the flexibility, speed and savings of traditional sleeves with the reliability and safety margins of plugs.

By using Halliburton’s new sleeves, Seneca saved approximately 40 percent on prefrac well preparation compared to traditional well prep with coiled tubing and tubing-conveyed perforating.

Halliburton already had a completion crew on site. To help manage the pressure test, only one additional person was needed for part of one day.
Casing pressure tests essential for environmental protection
To help ensure the safety of freshwater aquifers and reduce air pollution, the oil and gas industry has long recognized the need to ensure that wells are securely cased before fracturing begins. However, the need to improve the economics associated with completing multiple stage horizontal wells has always been a key business driver.

The testing gap between traditional sleeves and bridge plugs
Until now, to reliably open the sleeves after the pressure test, companies had to apply higher pressure than they used in the test itself. Where casing integrity tests are required, this invalidates the test because the extra pressure could cause casing damage that might go undetected.

When casing integrity tests are required, the test is achieved by setting bridge plugs and pressuring up the well to the level that would be used for fracturing. In horizontal wells, this often requires a wireline unit and crew. This operation takes time and adds cost to the completion. After scheduling the equipment and crew, the crew needs to drive to the site, rig up, run downhole, set the bridge plug, and wait for the test to be completed.

Seneca agrees to field test new approach
Both approaches to testing, i.e., with plugs or traditional sliding sleeves, had pros and cons. Halliburton developed the RapidStart™ Initiator CT sleeve to deliver the best of both without the drawbacks of either. When Halliburton approached Seneca about field testing the new sleeve on one of their horizontal shale gas wells, Seneca quickly agreed.

Unique tool eliminates need for high-pressures that invalidate tests
Unlike other sleeves, pressure alone does not open the RapidStart Initiator CT sleeve. When well pressure at the tool exceeds the activation pressure, pins are sheared and unique metering process begins. This metering process provides a window of opportunity to obtain a pressure test. The metering time depends on the absolute pressure at the tool. If a problem is discovered during the test, crews relieve pressure on the well and the countdown meter stops.

When the allotted test window expires (usually 20 to 60 minutes or more), the sleeve shifts open with upwards of 25,000 pounds of opening force without ever exceeding the casing test pressure value. Thus, Seneca validated casing integrity, achieved injection at the completion toe, and avoided intervention.

New Halliburton RapidStart™ Initiator CT sleeves enable Seneca Resources to reduce casing integrity test costs by 40 percent.

A CASE STUDY: Verifying casing integrity before fracturing
New Halliburton RapidStart™ Initiator CT sleeves enable Seneca Resources to reduce casing integrity test costs by 40 percent.

**New sleeve eliminates need for plugs and coiled tubing crew**
Excessive pressure that could damage casing is not needed to open the sleeve. Therefore, RapidStart™ Initiator CT sleeves eliminate the primary argument for going to the expense of setting and pulling plugs. RapidStart Initiator CT sleeves require only one person – generally for less than a day (during the crucial phases of pressure testing) – to provide guidance to the completion team already on site. There is no need for round-the-clock crews, heavy equipment, or additional footprint on location.

**RapidStart Initiator CT sleeve helps wells produce sooner**
Because plugs are no longer needed, operators can save at least a day, plus the cost of a coiled tubing or wireline unit, their crew, and associated logistical/scheduling costs.

In Seneca’s case, the well was pressurized to 9,600 psi for 24 minutes. No problems were noted and after 33 minutes, the sleeve shifted open and fracturing commenced.

**Seneca estimates new sleeve saved 40 percent on pre-frac well prep**
Seneca estimates that RapidStart Initiator CT sleeves cut its casing integrity testing costs by 40 percent compared to coiled tubing intervention.

**Will use RapidStart Initiator CT sleeves again**
As a result of savings, Seneca Resources plans to use Halliburton’s RapidStart Initiator CT sleeves in other upcoming wells.

“The industry has needed something like the RapidStart Initiator CT sleeves for a long time. Halliburton saved us money and enabled us to validate our casing’s integrity while keeping the advantage provided by traditional toe sleeves.”

Tunde Ajayi
Senior Completions Engineer
Seneca Resources