Mark Smith and Elaine Maruca, PLIDCO, USA, reveal an effective solution that succeeds where other pipeline isolation methods can fail.

As pipeline professionals we seek familiar solutions – especially on hazardous projects. As a result, when a pipeline needs to be isolated for a valve insertion or repairs, onsite service teams are looked to as the first responders. If they cannot do the job, the next call usually goes to the familiar outside source who uses the line stopping techniques we are comfortable with, such as freezing, tapping or plugging.

Where do you go when conventional line stopping is not enough or those familiar methods have not been successful? There is one pipeline isolation technology that has been specifically designed for the world’s most challenging line stops in high temperature, high pressure and high flowrate environments, where internal line plugging is not an option. The PLIDCO® Shear+Plug from The Pipe Line Development Company (PLIDCO) of Westlake, Ohio, has been successful on some of the world’s
most volatile pipeline stopping applications since the early 1970s.

**A unique metal-to-metal seal**
The PLIDCO Shear+Plug is a hybrid tool that uses the power of hydraulics to cleanly shear through the pipeline and valving mechanism – providing a positive metal-to-metal seal. “The Shear+Plug machinery, tools and process are heavy duty. They are built and installed like any permanent fixture to the pipeline system,” states Mark Smith, Shear+Plug Manager. “The system features a permanent metal-to-metal line seal that is welded to the pipeline which assures safety and long-term stability of the line isolation.”

**More than just line isolation**
There are multiple solutions for isolating a line without a shutdown. Shear+Plug is unique among them because it can be safely used in high pressure and high temperature conditions. In addition, the line can remain isolated for long periods of time, not being limited to a few hours or days. The solution meets ASME Section 8 Division 1 Piping Code Standards and can withstand temperatures beyond 800 °F and pressures up to 2500 psi. It can remain online for weeks, months, or even years as a permanent plugging fixture or temporary valve on the system. While the solution is installed, leak plugging, valve repairs and other line improvements can be made on normal work schedules instead, eliminating the need of a rushed 24 - 48 hour turnaround. This saves money, promotes safety and allows for flexibility if unforeseen repair needs arise while the line is isolated.

**Assembly & process**
Installing Shear+Plug is like assembling a gate valve into the line piece by piece. The complete Shear+Plug assembly consists of four significant components.

1. Reinforcement rings applied to the pipe, straddling the area to be plugged.
2. The valve body, made up of an upper and lower pipe holding assembly.
3. The retraction housing that contains the blind plate shear blade assembly.
4. The coupon receptacle housing below the valve body that catches the cut coupon.

Because there is no tapping required, no metal shavings can enter the line to cause contamination or damage. Instead, the hydraulic shear drives the flattened coupon into a receptacle below the pipeline – there is no possibility of it falling into the line and having to be retrieved. This is an intrinsic safeguard built into the process that further assures all subsequent plant lines remain free of contaminants long after installation (Figure 1).

All Shear+Plug installations are performed by PLIDCO’s service team. They have a 100% track record for successful installation and safety. Installations can last one week to two months depending on the complexity and onsite requirements of the line stop. The PLIDCO team works closely with plant employees and service companies during the project to assure all aspects of the installation are safe.

**Table 1. Shear+Plug applications and capabilities**

| Applications                                                                 | Materials                                           | Pipeline sizes (diameter) | Pressure range (PSI) | Temperature range (°F) | Flowrate |
|------------------------------------------------------------------------------|**************************************************|----------------------------|---------------------|------------------------|----------|
| Power plants, oil refineries, gas refineries, steel mills, pulp & paper mills, chemical refineries, petro-chemical refineries | Steam, super heated stream, high pressure stream, H₂S, catalyst, petroleum, boiler feed water, high pressure lines | 0.5 - 18 in.         | 0 - 2500             | 300 - 800 800 - 1000 (special material required) | TBD      |
The last line of defense
The Shear+Plug is rarely the first phone call on a challenging line stop simply because many people are unaware of the technology. However, when other methods fail and engineers call on their peers for advice, it often becomes the best chance for success. PLIDCO has had multiple applications where companies have spent hundreds of thousands of dollars on other methods before being invited to the plant to solve the problem. Numerous projects have had an incredibly high degree of difficulty, which makes the success rate even more impressive. On over 90% of these jobs, one, two or three other methods failed before Shear+Plug eventually solved the problem (Figure 2).

Pipeline diameter issues
One of the most common reasons conventional methods fail on challenging line stops is uneven internal pipeline diameter issues. Deposits such as sludge, corrosion and other materials cling to the walls inside the pipeline. Sometimes the buildup can be scraped or removed, but many times these uneven diameters created by material buildup make an internal pipeline plugging solution impossible.

Dimensional irregularities become problematic for internal pipeline methods to effectively block the flow of material inside the lines using an internal plug. It is not uncommon for repair teams to encounter diameter flaws or irregularities right in the middle of a project. When that happens, the project manager from the plant has a tough decision to make. Can he live with the 5 - 10%, or 15%, gap and residual material flow inside the line, or does he need to find another solution? This decision is made more difficult because frequently significant amounts of money and time have already been invested on the project.

In contrast to internal line plugging methods, the Shear+Plug method uniquely solves this problem by being able to safely shear through the pipe and create a solid, 100% metal-to-metal seal stopping flow and making diameter problems a non-issue. “When we get called into a project in the middle of diameter-based line stopping problem, the first question the project manager asks is, can you guarantee a 100% seal? Our answer is always the same, yes, we guarantee it,” says PLIDCO’s Mark Smith. “When you have a metal blind plate that seals against the pipe holding assembly, you have 100% flow stoppage. It’s intrinsic to the Shear+Plug process.”

High pressure issues (1480 - 2500 psi)
High pressure is another common challenge on a line stop. In high pressure environments, safety of personnel is paramount. The ability of the seal to actually stop the flow of material for an extended period of time is the engineering issue. Presently, the double line stop on either side of the isolated area with an internal plug is the most familiar solution to plant engineers and maintenance managers. Unfortunately, in high pressure environments, even minor diameter irregularities can be magnified. A 5% flow leak on a 2000 psi line is releasing 100 psi of material into the line and that is problematic. If the line is containing hazardous content H$_2$S or various petrochemical materials, any level of porosity is unacceptable. Some applications can tolerate a small amount of leakage. However, in other applications 100% stoppage is absolutely critical. This is why line or plant shutdown is sometimes the only option when traditional methods fail. Shear+Plug’s metal-to-metal seal intrinsically delivers the 100% stoppage and offers plant managers a critical repair solution – even after other methods have failed.

High temperature issues (600 - 1000 °F)
High temperatures above 600 °F can limit the amount of time certain line stopping methods can safely hold back material flow. When the elevated temperatures get to 800 °F or above 1000 °F, these conditions are typically beyond the specifications of many line plugging techniques. Materials and sealants can literally begin to melt at these temperatures causing failure. The prevailing thought in the industry is that on very high temperature lines, you have to schedule more turnarounds to do maintenance or shutdown for emergency repairs.

Shear+Plug’s high temperature capability provides an immediate and cost-effective solution by enabling critical repairs immediately without having to shutdown the line or
having to wait for a scheduled turnaround. Its metal-to-metal, blind plate barrier effectively seals high temperature lines just like a permanent gate valve. On extremely high temperatures above 800 °F, special materials are used to further assure a safe stoppage. Once installed, Shear+Plug is a safe, secure stop that can remain on the pipeline permanently. This is significant because with this capability, interim maintenance is now possible, and critical repairs can be easily performed without plant/line shutdown.

**Header systems that cannot isolate an area without shutdown**

Some large header systems simply do not have the ability to isolate. When nuisance leaks, misbehaving bypass loops, valve problems or other system issues occur the only option is ‘patch work’ and wait until the next shutdown or turnaround. “We were called into one refinery, and upon arrival there was a cloud of steam vapour hovering over the plant,” states Manager Mark Smith, “The plant manager told us that because of infrequent shutdowns, many of the repairs were clamps and temporary fixes. After surveying the plant, we identified several places where we could perform very high temperature line stops that would allow for all maintenance to be accomplished without shutting down any processes. They were able to do new tie-ins, repair multiple valves, eliminate multiple leaks and perform all accumulated maintenance activity. Immediately after the repairs were complete there was no vapour cloud over the facility. It was operating at peak efficiency.” By reducing the leaks, this facility was able to save hundreds of thousands of dollars in energy – in addition to the savings delivered by avoiding any line shutdowns.

**Assuring safety in highly volatile environments**

When you are dealing with high pressure, high temperature steam and chemical lines – and hazardous gases like H₂S, safety for everyone throughout the process is essential. The intrinsic qualities of the Shear+Plug’s 100% line stoppage eliminates many of the risks associated with work on some of the world’s most volatile pipelines, but the best safety practices of the installation team are also particularly noteworthy.

Members who are considered subject matter experts by the industry man the installation team. Every project begins with a safety plan called a job safety analysis (JSA) where the team members and plant team members come together to understand the installation process and how the technology will eventually engage with the pipeline. Inspections of the safest installation sites are determined, hazards and risks are discussed, including the process of bringing equipment into the plant. This is documented and a step-by-step plan and process is developed from arrival through completion and final departure from the facility.

Each day of the project a job hazard analysis/critical task analysis is reviewed between plant team members and the installation team to identify that day’s possible issues. Weather conditions, electrical lines, obstructions and variables involved with specific tasks are reviewed. The meticulous and constant safety awareness of specific perils, obstacles, or risks by all stakeholders on a daily basis is why there has never been a safety incident on a Shear+Plug project.

**Conclusion**

Being aware of Shear+Plug technology and its unique capabilities offers plant managers and anyone involved in pipeline system repairs an effective solution when conventional methods will not work or have failed. This technology makes the hazardous and sometimes daunting task of dealing with high temperature/high pressure lines much more manageable.