

**FRANK DUM AND NEIL SHEEHAN, T.D. WILLIAMSON,
INC., USA, DESCRIBE HOW DOUBLE BLOCK AND BLEED
TECHNOLOGY KEPT BITUMEN FLOWING DURING A LINE TIE IN.**

Handling the heat

In the frozen muskeg of northern Alberta, Canada, a series of steam injection wells push black, oily, highly viscous bitumen from deep below the acidic and boggy terrain. Bitumen is essentially extremely heavy crude oil too deep to be conventionally mined and a natural byproduct of decaying organic matter. It is captured through a process known as steam assisted gravity drainage (SAGD). Steam is injected into the ground through one well, heating the bitumen and lowering its viscosity to a point that will allow it to flow by gravity into a second (slightly lower) well for transport back up to the surface. A 70% water and 30% oil emulsion exits the wellhead at approximately 182 °C, before being collected from the well pads and pumped through a 24 in. pipeline operating at 110 – 160 °C. This pipeline, which is insulated and elevated approximately 3 ft above the ground to avoid thawing the muskeg, carries up to 335 000 bpd of bitumen to a local

processing plant for separation and treatment.

Earlier this year, a new well pad needed to be tied in to the 24 in. main line. This new well pad operates at a higher temperature than the main line; as a result, the processing plant cannot handle the higher temperature emulsion. To solve this problem, a blending skid was inserted into the 24 in. line at the point where the new well pad enters. This blending allows the temperature of the well pad product to decrease to acceptable levels prior to entering the plant.

The main line could be shut down for one hour in order to facilitate the isolation and installation of a temporary bypass necessary to complete the tie in, but shutting it down too much longer would result in the bitumen hardening in the line. If the main line must be shut down for an extended period of time, all well pads would need to be shut down, the entire contents of the pipelines would have to

be flushed and the processing plant would have to cease production. Needless to say, shutting down the entire system would be very expensive. As an added challenge, the muskeg thaws too much for access after late April, so completing the tie in quickly was critical in order to avoid the likelihood of stuck equipment.

Double block and bleed

As an alternative to long term shutdown, T.D. Williamson, Inc. suggested use of its STOPPLE® Train plugging system, which provides double block and bleed capability in combination with a reduced need for line intrusions. Refining and processing facilities are increasingly seeking out double block and bleed as a means of



Figure 1. Double block capacity is provided by linking two plugging heads together into a 'train' formation.

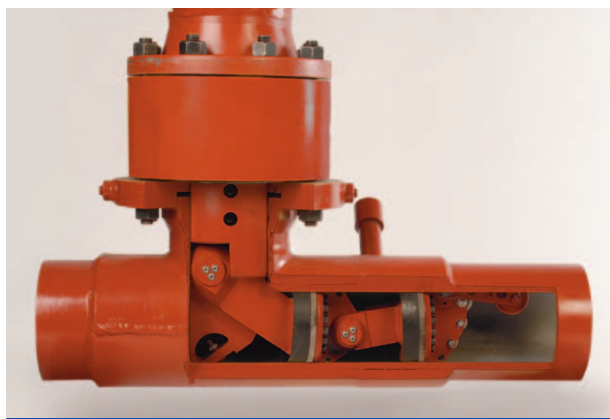


Figure 2. A linked plugging head of the STOPPLE Train system.

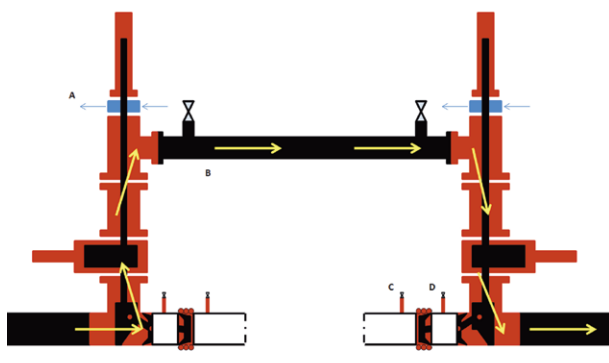


Figure 3. A) Cooling spools to prevent overheating within the hydraulic cylinders used to set the plugging heads; B) a 16 in. outlet to which bypass piping was installed; C) with the plugging heads set, equalisation valves between the plugging heads opened; D) bleed valves between the primary and secondary plugging heads opened.

maximising safety during both routine maintenance and emergency repairs on active systems in potentially volatile environments.

The concept of double block and bleed involves the using two barriers plus a bleed port between a line's pressurised contents and the downstream line intervention being performed. The idea is not a new one, and operators have achieved this in the past through various combinations of valves and/or plugging heads, or even inflatable bladders.

However, the STOPPLE Train system uses a different method in order to achieve double block and bleed. The system is based on technology developed by T.D. Williamson over five decades ago, which utilises plugging heads in unison, as shown in Figure 1. The two plugging heads (rated to 1480 psi at 82 °C, or reduced pressures at temperatures up to 176 °C) are linked together into a 'train' formation, thus creating the double block. The first plugging head serves as the upstream plugging head. Once seated in line, this forms the primary seal. The second plugging head is the downstream plugging head and forms the secondary seal. Should the primary seal allow any leakage, the secondary seal acts as a backup capable of holding full line pressure.

The STOPPLE Train system requires one standard STOPPLE fitting and hot tap, in contrast to traditional methods of achieving double block and bleed, which require multiple fittings and taps. Due to the design of the plugging heads, both heads can be inserted into the line through a single opening, as shown in Figure 2. Furthermore, positioning a pressure bleed port between the two plugging heads allows the void between them to be bled down, creating a 'zero energy' zone. This port also allows for seal verification before downstream operations.

High temperature solution

In order to facilitate tie in of the new well pad, T.D. Williamson proposed a scenario in which its double block and bleed system would be used in conjunction with a temporary bypass around the pipeline section requiring intervention. The line operator agreed and gave the go ahead for work to commence in early April 2011, at which time daytime high temperatures were hovering at approximately 5 °C, with daily low temperatures at -10 °C. Once again, there were time constraints so as to avoid the frozen muskeg thawing and becoming too muddy to navigate.

As work began, the pipeline insulation was removed, the exterior was cleaned and two 24 in. STOPPLE fittings were welded on the pipeline in the 12 o'clock position and approximately 60 ft apart, in a process which took approximately six days to complete. In addition, four 2 in. THREAD-O-RING™ fittings were welded to the pipeline: two of these served to aid equalisation and two were for bleeding the space between the STOPPLE Train plugging heads. Tapping valves were installed on all fittings and hot taps were made.

Due to the high temperature of the bitumen to be bypassed, special cooling spools were used. This application prevented overheating of hydraulic fluid and seal failures in the hydraulic cylinders that would be used to set the plugging heads. Water from a transport truck was pumped through the cooling spools and back into the truck.

Detour in place

Next, 24 in. spools were installed on the tapping valves; these spools served as an extension to the standard plugging head housing due to the extra length of the STOPPLE Train plugging heads. Two 24 in. housings containing the plugging heads were then installed atop these spools. It had been previously determined that a 16 in. bypass could handle all of the main line volume without any interruption, so each housing featured a 16 in. outlet to which bypass piping was installed. A pair of 2 in. branch connections were installed and

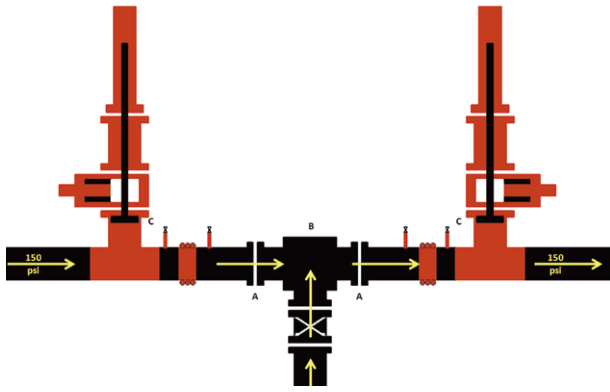


Figure 4. A) approximately 10 - 12 ft of the isolated line section cut out; 24 in. flanges welded to each side of the cut section; B) a blending skid installed, tying the new well pad to the main line; C) completion plugs set in the line fittings and blind flanges installed.

tapped on the top of the bypass piping near each end. The full setup is shown in Figure 3.

With the bypass in place, the 24 in. main line was shut down for one hour while the plugging heads were inserted through the valves and into the line. When the main line was reactivated, all flow was being diverted through the bypass piping. The plugging heads blocked all flow and pressure from the section of line where the tie in was to be made. The equalisation valves between the plugging heads were opened and all product was flushed and removed. Both secondary plugging heads held at 100%, and the tie in area was then

isolated and evacuated. The bleed valves between the primary and secondary plugging heads were opened and all product flushed and removed. Both primary plugging heads held at 100%, so the tie in location was not only isolated and evacuated but also protected with a double block and bleed isolation at both ends.

As shown in Figure 4, approximately 10 - 12 ft of the isolated line section was cut out, while 24 in. flanges were welded to each side of the cut section. A blending skid was installed to these flanges, which tied the new well pad into the main line. The main line was shut down again for an hour while the plugging heads were retracted, then the main line was brought back up to restore the system to full functionality. The housings and bypass line were flushed, drained and dismantled, then completion plugs were set in the line fittings and blind flanges were installed. From installation of valves to setting of completion plugs, the work took seven days, during which time the line remained operational thanks to the bypass.

Benefits

The successful bypass and tie in of the new well pad provided the line operator with a number of tangible benefits. First and foremost, use of the STOPPLE Train plugging system provided a means to achieve the added safety of double block and bleed isolation. In the past, this operation could potentially have required at least twice as many line interventions, but in this case it required just two, one for each set of STOPPLE Train plugging heads. Reducing the number of interventions saved time and expense and also left the line with far fewer fittings (potential future leak paths). In addition to bringing more product online, this project also successfully avoided the need for a potentially costly long term shutdown of the processing plant, once again saving time and money. [i](#)