# SECTION IV: Source Control

## 1. Agency Jurisdiction:

The FOSC and the SOSC exercise the respective authorities of the U.S. Environmental Protection Agency and the Alaska Department of Environmental Conservation (ADEC) and provide immediate direction to the oil spill response, including source control.

ADEC regulations at 18 AAC 75.055(b) require that the operator be able to stop the incoming flow of oil (shut down the pipeline) within one hour of detecting a discharge. ADEC also requires source control be addressed in the contingency plan [18 AAC 75.425(e)(1)(F)(i)]. These source control procedures, "to stop the discharge at its source and prevent further spread," must also meet ADEC's best available technology review requirements [18 AAC 75.425(e)(4)(A)(i)].

BLM administers the Federal Agreement and Grant of Right of Way for TAPS. Stipulation 2.14 requires an oil spill contingency plan that includes "immediate corrective action including Oil Spill Control . . .." Source control is therefore a requisite to provide immediate corrective action.

DOT-OPS approves the oil spill contingency plan under its authority in 40 CFR Part 195, including source control strategies.

## 2. Background:

**Scope of action:** Source control for a leaking barrel may be to simply drive in a wooden peg. It is not so simple for a large diameter oil pipeline. After the area has been characterized for hazards and the appropriate safety plan has been established, the leak source must be, at least cursorily, examined. The insulation remaining around the pipeline must be removed. The nature of the damage must be generally known to determine both what sort of methods can be used to stop the leak, and what may be needed for the permanent repair.

TAPS has over 177 pipeline valves that can stop the flow of oil. Each pair of valves can enclose a segment of pipeline. The Oil Spill Contingency Plan (Cplan) accepts that shutting down the pipeline and stopping the flow of oil to the segment with the leak is initial source control. The ultimate size of the spill is, at that point, limited to the TAPS design volume in the segment. The spill volume will be less if the leak is not at the lowest point in the segment. Because of the hydraulic profile of the pipeline, rising over high points and dropping through valleys, it may be possible to completely empty a segment of oil by closing the valve on one end of a segment only and allowing the oil to drain to an adjacent lower segment. It is completely dependent on where and what type of leak occurs.

**Concerns for working near a high-pressure leak (See also the section on Safety):** A high-pressure crude oil spray atomizes volatile elements very quickly, potentially producing significantly higher vapor concentrations without large amounts of liquid oil pooled nearby. The high-pressure jet also spreads the oil over a larger area, with the wind having a greater affect on the spread of oil aerially.

**Health and safety:** There are significant health and safety threats while working around an oil spill. Personal Protective Equipment (PPE), including air filters, self-contained breathing apparatus, and protective clothing, can protect workers from respiratory exposure or skin contact, but other dangers exist including slips, trips and falls and reduced visibility and sight lines. A decontamination station needs to be set up, especially in case any worker needs to be evacuated from the area.

**Fire/explosion:** With the presence of flammable vapors in the outdoors, any ignition source, including a spark of static electricity, could start a fire. If the vapor concentrations were high enough, an explosion could occur. The mechanized construction equipment needed to lift or apply heavy clamps against pressure is almost always a potential source of ignition.

**Limit further spread of spilled oil by responders:** Prior to entering the site, appropriate site control must be established to restrict access and limit the spread of contamination.

## 3. Observations and Recommendations:

### A. Pipeline Shutdown

**Observations:** On October 4, 2001, the Operations Control Center (OCC) received notification of a leak on the pipeline between Pump Station 6 and Pump Station 7 near Milepost 400. The leak was detected at approximately 2:53 PM during a fly over by an APSC Security surveillance helicopter. On receipt of this report at 2:54 PM, OCC controllers initiated a pipeline shutdown. The shutdown sequence was designed to minimize oil pressure at the leak location.

Based on the leak location, the OCC initiated an orderly shutdown of Pump Stations 1, 3 and 4 (Pump Station 2 is ramped down). This series of actions was taken to stop the injection of any additional volume of oil into the pipeline system. The final Pump Station in the series, Pump Station 4, was idled at 2:58 PM. The mainline pumping units at Pump Station 7 and Pump Station 9 (south of the leak site) were left on line in an effort to continue to reduce the pressure in the segment where the leak was located.

At approximately 3:00 PM, the OCC contacted APSC System Engineering to verify the exact leak location and to jointly determine the most effective plan to reduce pipeline volume and pressure in the segment containing the leak at Milepost 400.975, approximately 14 miles upstream of Pump Station 7. To further isolate the leak segment from the upstream segment, the closure of the Remote Gate Valves (RGVs) in the segment between Pump Station 4 and Pump Station 5 was initiated at 3:23 PM. To provide maximum evacuation of pressure and volume from the leak area it was determined necessary to drain down the volume and pressures from the local high points at Milepost 394 and Milepost 403. To achieve this goal, Pump Station 7 was left on line until its suction pressure was below 200 psi. As the pressure and volume decreased in the segment, one of the two pumps at Pump Station 9 was idled at 3:49 PM. The suction pressure at Pump Station 7 was 180 psi at 4:02 PM and was idled. Additional oil was pulled through the segment by continuing the pumping operation at Pump Station 9 until 4:21 PM when it was idled. At this point the RGVs between Pump Stations 6 and 7 were commanded closed. At shutdown, the calculated leak site pressure was 415 psi.

**Recommendations:** The pipeline controller appears to have taken the appropriate actions for the information provided. The operating requirement at 18 AAC 75.055(b), which addresses stopping the incoming flow of oil, was met. There is no indication that changes are called for in training or procedure.

## B. Pressure Reduction

**Background:**
Once a segment of pipeline is isolated, pressure will be reduced as oil drains down. Depending on the hydraulic profile of the segment, pressure may be further reduced by using external pumps at one of the pipeline valves bordering the segment to pump oil into the adjacent segment. Special fittings are required to attach the pumps to the valves.

**Observations:** The pressure was too high for the safe application of the Plidco Smith+ Clamp (also known as the Bullet Clamp). While this clamp could, once installed, withstand the pressure of the oil, it requires that workers physically manipulate it into position over the jet stream of oil. The larger the jet stream is, the more difficult it is to install. In addition to the physical dangers involved, the placement of workers in the area of the oil spray was deemed unacceptable. The Team Clamp (also known as the Hydraulic Clamp) could be applied without placing workers in the immediate area of the spray. The clamp is designed for installation for TAPS operating pressures and potential leak jet streams. However, the pressure at the leak was higher than the pressure that had been used during testing and training for the application of the clamp.

The oil level at Check Valve (CKV) 66 was below that of the valve, so pumping downstream was not feasible. To pump upstream of RGV65 required overcoming the pressure of the oil at the valve. An APSC Pump Around Skid (formerly known as the Gel Block Skid) had been developed and assembled to do just that. This skid was already being mobilized and was capable of pumping approximately 200 gpm against the pressure at the valve. The pump operation would push the oil back toward Pump Station 5. The pump was set by 6:00 AM on October 5, 2001. However, pumping did not begin until approximately 7:45 AM because of work that had to be completed to allow oil to be pumped back into tankage at Pump Station 5. It required approximately 29 hours to reduce the pressure at the site of the leak for the planned permanent repairs.

A second pump was later brought to the site as a backup should the first pump fail. The second pump was not used.

**Recommendations:** There were no issues identified that require immediate actions. However, several ideas to increase the ability to reduce pressure and/or stop the leak at a site merit investigation for effectiveness and practicality. They include:

- Modifications to the pump skid or the valves to allow faster connection of pumps,
- Having more pump capacity available, both in terms of number of skids distributed along TAPS and the capacity of each pump,
- Develop a decision tree or other planning tool to determine allowable pump around parameters for locations along the pipeline.

Other more speculative actions may include:

- Investigating tools to tap into the pipeline and withdraw oil directly.

**Caveat**
At any given site, pressure reduction via pump around may or may not be effective. In limited circumstances, pressure may only be reduced through drain-down at, or in the vicinity of, the leak.

**Check Valve 50 Incident**

**Background:**
During routine ground surveillance on January 4, 2002, APSC discovered that CKV 50 had moved 13 inches upstream (northerly) and that nine pipeline anchors had tripped. Further investigation revealed that the Ledeen actuator shear key, which attaches the check valve clapper to the actuator, had failed. This evidence clearly pointed to a significant backflow of oil at CKV 50 causing the valve to slam shut.

It should be noted that check valves under normal operating conditions are designed to prevent the backflow of oil. A review of pressure and flow data for Pump Station 5 and Pump Station 6 from October 1, 2001 to January 4, 2002 by APSC hydraulic engineers found that there was one significant backflow event which occurred on Oct 5, 2002. Three other potential relief events were examined but none of these events caused reverse flow into Pump Station 5. The significant reverse flow event occurred on October 5, 2001 at 7:24 AM during shutdown procedures implemented as part of the Milepost 400 Bullet Hole response.

The broader issue of pipeline movement and tripped anchors is being addressed in an ongoing analysis of the aboveground pipeline using Reliability Centered Maintenance (RCM) methodology. This analysis will produce recommendations for maintenance and monitoring procedures to ensure pipeline integrity.

**Observations:**
During the Milepost 400 incident, the check valve clappers from Pump Station 5 to Gobblers Knob (4.8 miles of pipeline) were opened in anticipation of flowing oil backward to reduce the pressure at MP 400. At this time the Pump Station 5 relief valves were out of service. To provide a flow path to the tanks at Pump Station 5, the relief valves needed to be brought into service. It was anticipated that the relief set points would be set slightly higher than the static head pressure from Gobblers Knob to allow a slow flow of oil through the relief valves into the tanks. In the process of bringing the relief valves back into service, all four relief valves were opened fully. This led to a reverse flow of greater than 1.3 million barrels/day through the four relief valves into Pump Station 5. The high backflow rate through the check valve probably caused the shear key connecting the Ledeen actuator to the valve clapper shaft to shear, allowing the clapper to drop suddenly and stop the flow of oil. The force of the moving oil against the closed clapper caused the valve and pipe movement.

**Recommendations:**
The recommendations from the ongoing RCM analysis of the aboveground pipe are not yet available. The following are preliminary recommendations, which should be reviewed when the RCM recommendations become available.

(1) Consider modifying the mainline relief valve maintenance procedures to include closing the inlet or outlet block valve prior to stroking the valve to eliminate the possibility of the reverse pipeline flow condition.

(2) Consider modifying existing OCC procedures to reduce the likelihood of crude oil backflow when the check valve clappers are locked up for smart pig passage or other special situations.

## C. Stopping the Leak (Temporary Patch or Plug)

**Background:**
The purpose of the temporary patch or plug is only to stop the flow of oil from the leak. If, for any reason, it is necessary to continue pipeline operations before a final, permanent repair can be completed, the considerations included in the section "return to operations" must be considered.

Many of the complications of working near or at high-pressure flammable liquids are covered above and in the section on safety.

Before the leak can be stopped, it must be exposed, that is, the pipe insulation must be removed. The insulation will be saturated with oil and difficult to handle. The jet stream of oil and flammable vapors may also interfere with the safe removal of the insulation.

**Selection of Patch:**
There are two fundamental limits on use of any patch. First, the patch must be engineered to hold onto the pipe and seal against the leak. Second, it must be designed so that workers are able to install the patch safely while the leak is ongoing. One of the most secure types of patch for a small hole in a pipe is a clamp that bands the circumference of the pipe and connects to itself. More extensive damage may require a sleeve, which encloses a greater length of pipe.

**Engineering limits on clamps:**
There are three criteria that relate to a clamp's ability to patch a leak. The quality of being able to seal and contain a fluid under pressure is known as pressure boundary containment. The clamp must also meet temperature rating requirements as stresses and forces can vary significantly with changes in temperatures. Third, if remotely actuated, the clamp must be able to close against the jet stream force of the leaking oil.

**Installation limits on clamps:**
If a clamp is not remotely activated, it must be manually closed against the jet stream force of the leaking oil. For the pipeline Hydraulic Clamp, installation issues related to the lifting device to place the clamp and the operations of the clamping mechanism need to be addressed.

**Observations:** The Plidco Smith+ Clamp, despite it's common name of "bullet hole clamp," was deemed inappropriate to seal this bullet hole because installation against the jet stream pressure in the hazardous vapor environment was considered unsafe for the workers who would have to manually install the clamp. The pipeline Hydraulic Clamp was chosen because it could be applied remotely under the site line pressure and jet stream force.

Additional fire and safety expertise was called on by contracting with Williams Fire and Hazard Control (Williams) and bringing them on site. During this time (October 5), crews started removing insulation from near the leak and oil recovery rates from several containment ponds (installed that day and the night before) were matching the leak rate. Before the evening of October 5, all of the additional requested tools and equipment were on site. Application of the clamp, however, was deferred until the Williams crew was on site and had fully reviewed the situation and procedures. The clamp was applied by 3:00 AM on October 6.

**Additional considerations:**
See page VII-1 in the "Return to Service" section for a discussion of the criteria for pipeline repair prior to restart.

**Recommendations:** Review of decision processes and the sequence of events reveals that worker safety was the highest priority during decision-making. Those decisions are unassailable. Nevertheless, there are a number of actions that can save time in a response to a similar event in the future.

- Further develop scenarios, procedures and training to use the Pipeline Hydraulic Clamp, Smith+ Clamp and other existing tools and methodology under appropriately extreme conditions. Define those conditions and the limits to the tools and methodology. Ensure the integration of safety concerns and issues during scenario and procedure development and training.

- Investigate development of additional methods, tools, and safety plans that may be used to stop or mitigate the leakage of oil.

- Review existing procedures and processes related to source control (e.g., Pump Around Skid use and insulation removal) for potential modification and safety concerns.

In general, ensure an integration between source control methodologies and safety concerns described in Section V.

Figure IV-1: Response crew installing the hydraulic clamp

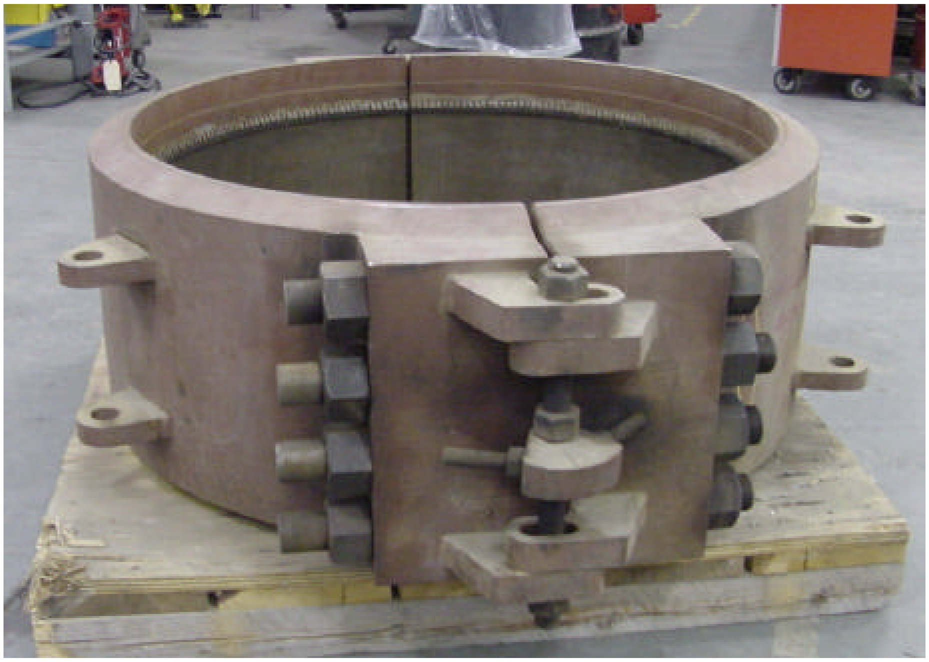
Figure IV-2: Plidco Pipeline Sleeve Clamp

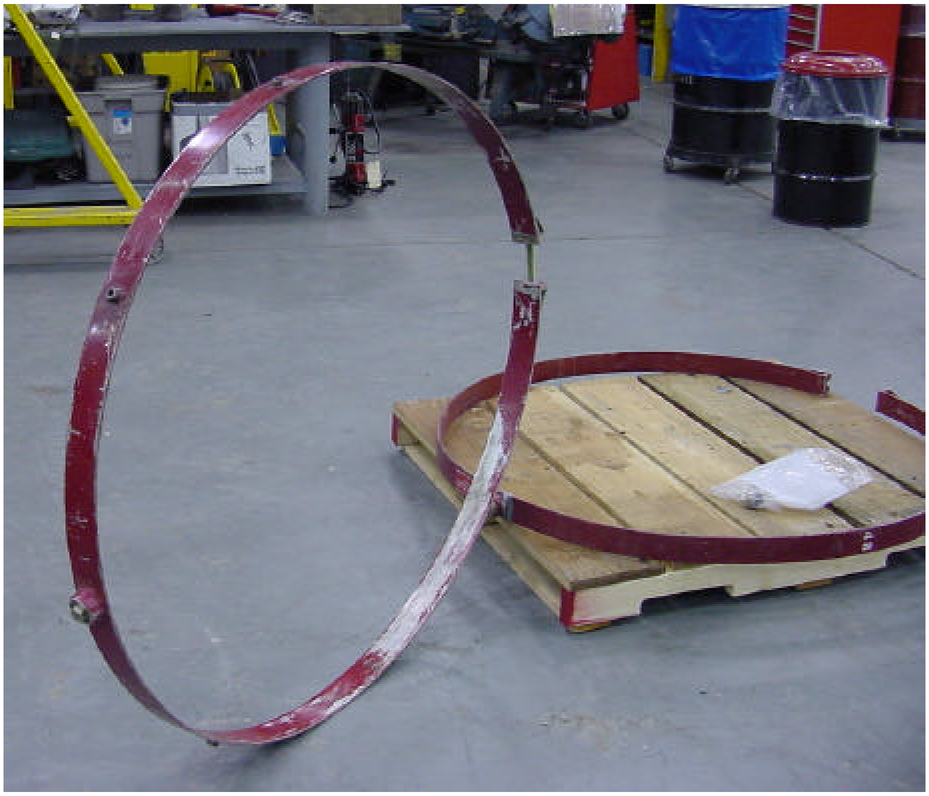

Figure IV-3: Plidco Bullet Hole Clamp