



# LEARNING FROM INCIDENTS AWARENESS ALERT

2012AW13

Shell Global Solutions

For Information Purposes Only

September 2012

## High Pressure Water Washing Injuries

### Target audience for this alert

- Maintenance and Turnaround Departments
- Production Departments
- HSSE personnel

This LFI describes three incidents at Shell Manufacturing sites involving contract workers performing high pressure water washing (hydroblasting or hydrojetting) activities.

### March 2012

**What happened** - A High Pressure Water Wash (HPWW) contract worker was using the contractor's equipment to clean the tubes of a fin fan exchanger for inspection in a process unit. The contractor's flexible lance hose was connected to a semi rigid tubing (called a strain relief hose or 'whip') which was connected to the foot pedal dump valve assembly. (See Figure 1) The coupling between the flexible hose and whip failed. High pressure water coming from the strain relief hose struck the worker's foot resulting in a lost-time injury.

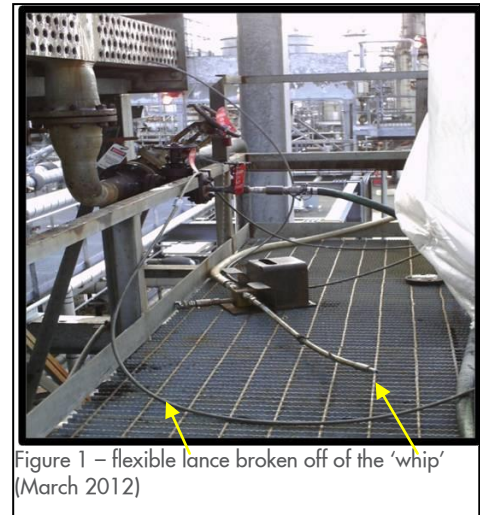


Figure 1 – flexible lance broken off of the 'whip' (March 2012)

**Why it happened** - The ¼" (0.6 cm) threaded end on the coupling between the semi rigid strain relief hose and the flexible tubing sheared, most likely due to external force overload. The HPWW contract worker had bent the strain relief hose across the front of the dump valve foot pedal to eliminate a potential tripping hazard behind him. When the connection broke, the worker released the foot pedal to stop the water flow, but not before the 20,000 psi (1,360 bar) water forced the strain relief hose to swing around and the flexible hose to shoot over the platform railings to the ground level below. The whip was just long enough to reach the contract worker's foot in the dump valve and the water cut through his rubber boots.

### February 2012

**What happened** - A contractor work crew was cleaning a 24' (7.3m) diameter column using a 4" (100mm) rotating nozzle on an 18" (450mm) extension rod. One HPWW contractor worker handled the hose and rod at the top opening of the column. A second contractor worker operated the dump valve from about 15' (5m) away from the column opening. The worker at the column opening felt a loss in tension in the flexible hose and shouted to the person operating the dump valve to let go of the dump valve. Before the dump valve was released, the nozzle came out of the manway. The water jet cut the worker standing at the manway across the lower abdomen and thigh (lost time injury).

**Why it happened** - The contractor was lowering a rotating nozzle into the column by the flexible hose. It was reported after the incident that the movement of the nozzle through the column was difficult to control. Because the

This LFI Alert is made available to you ('Recipient') pursuant to the relevant agreement between Shell Global Solutions International and/or affiliates of Shell ('Shell Global Solutions'), and your company, and is written for intended Shell use and not tailored for non-Shell use, including Recipient's company. Although the LFI represent Shell Global Solutions' good faith judgment of the matters dealt with, they are merely provided for information only and for Recipient's use by its qualified professionals, and should not be relied upon as authoritative guidance in any particular situation. When relevant, Recipient shall seek advice from its own technical advisors and the vendors of their specific equipment. Shell Global Solutions makes no representations or warranties, express or implied, concerning the accuracy, sufficiency or completeness of the information contained in any LFI Alert. Shell Global Solutions accepts no liability whatsoever for any loss or damage arising out of or in connection with the contents of this LFI Alert.

Copyright 2012 All Rights Reserved, Shell Oil Company

Copyright 2012 All Rights Reserved, Shell Internationale Research Maatschappij B.V

## AWARENESS ALERT

length of the rigid section of the equipment (the rod and nozzle) was less than the column diameter, the flexible hose bent and allowed the nozzle to reverse direction.

A restrainer bar had been specified in the permit, based on the site's procedures for hydroblasting. After the incident, the contractor indicated that it was believed that the restrainer bar was only a requirement for cleaning horizontal pipe. The contractor did not install a restrainer bar because they were working on a vertical column.

The contract worker handling the hose was wearing standard PPE and a raincoat. The contractor's practice was to use puncture resistant PPE only when the water pressure exceeded 10,000 psi (680 bar). This job used 6,000 psi (400 bar) water.

### May 2011

**What happened** - A HPWW contractor worker was using a rigid lance to clean the tubes of an exchanger in the wash yard. Half way through the second row of exchanger tubes, he encountered what he believed to be a plugged tube. While attempting to clear the plugged tube, the lance shot backwards out of the tube and towards the contractor. The lance whipped around behind him and the high pressure water punctured his leg (recordable injury).

**Why it happened** - When the 24" (600mm) lance shot backwards from the tube, the contractor held onto the flexible tubing. The lance whipped around behind him before he was able to remove his large rubber work boot (size 16US, UK15, continental 51) from the enclosed dump valve pedal to de-pressure the system. The high pressure water penetrated the contractor worker's puncture resistant apron and his rain suit. The apron prevented the injury from being more serious.

A safety device, called an Anti-Withdrawal Device (AWD) can be used to prevent a rigid lance from backing out of an exchanger tube during cleaning. It was not used because the contractor:

- wanted to clean the exchanger as fast as possible and knew that using an AWD is more time consuming;
- felt that using a rigid lance without an AWD was safe enough based on past experience; and
- believed that operating a rigid lance without an AWD complied with both the site and contractor's procedures.

The contractor's procedures allowed use of the rigid lance without an AWD as long as a lance at least 24" long and a dump valve were used. Shell procedures did not specify any requirement for use of an AWD. Shell personnel considered the contractor to be competent to make decisions related to industrial cleaning services and supported the decision to use the rigid lance without an AWD.



Figure 2 – Anti withdrawal device (AWD)

### Lessons learned

We rely on specialty contractors to plan and execute high pressure water washing activities in a safe manner. Safe work practices related to the high pressure water washing incidents in this LFI include the following, as applicable:

- Use automated or semi-automated high pressure water washing equipment/ techniques and consider potential alternatives such as chemical cleaning.
- Perform inspections of hoses and their couplings to identify equipment conditions that require repair prior to use.
- Use properly sized whip check connections on couplings to help reduce the movement of hoses if a coupling breaks.
- Require the worker who is handling the lance/hose to operate the dump valve to help reduce the time it takes to de-pressure the hose.
- Use foot pedals designed to not interfere with the worker's ability to remove his / her foot in unusual circumstances (instead of an enclosed dump valve pedal that can potentially interfere with the removal of the worker's foot.)

## AWARENESS ALERT

- Use restrainer bars and/or anti-withdrawal devices (AWD) to help prevent the nozzle from unexpectedly exiting the equipment.
- Use a rigid lance that is 1.5 times the diameter of the equipment being cleaned to help prevent the potential reversal of the tool.
- Use PPE that is appropriate for the hazard to help reduce the severity of potential injuries related to the effects of high pressure water impact.

### Further information

- Learning Materials



Industry guidelines for High Pressure Water Washing – Some guidelines are available on-line, free of charge. Others may be ordered.

- [WorkSafeBC – High Pressure Washing Saver Work Practices \(Canada\)](#)
- [Water Jet Technology Association - Recommended Practices for the Use of HP Waterjetting Equipment \(US\)](#)
- [Stichting Industriële Reiniging – Manual High Pressure Water Jetting \(Netherlands\)](#)
- [2009 US Mine Safety & Health Administration – fatal hydroblasting incident documentation](#)
- Manufacturing LFI Coordinator

