Doc Custodian: Safety Professional	Marathon Petrole Refi	eum Company LP ning	Doc No: RSW-0169-GV Rev No: 8
Approved By: Safety Supervisor	 Hydrob	lasting	Garyville Refining Safe Practice
Revision Approval Date: 1/6/202	5	Next Review Date: 1/6/2	2030
	TABLE OF CO	ONTENTS	
1.0 PURPOSE			2
2.0 SCOPE			2.
3.0 REFERENCES			2
4.0 ROLES and RESP	ONSIBILITIES		2
5.0 DEFINITIONS			3
6.0 GUIDELINES			5
7.0 TRAINING			13
8.0 APPENDICES			13
9.0 REVISION HISTO	RY		14

Marathon Petroleum Company LP	Garyville Refining Safe Practice	
Hydroblasting	Doc Number: RSW-0169-GV	Rev No: 8

## 1.0 PURPOSE

1.1 The hydroblasting Standard Practice is set forth to provide and describe the policies, procedures and minimum requirements to safely complete hydroblasting operations/activities.

## 2.0 SCOPE

- 2.1 This policy applies to Marathon Garyville Refinery employees and contractors involved with hydro-blasting and/or Hydro-cutting job scope review, set-up, execution / operation, breakdown of equipment and residual material disposal in lay down yards, tank yards, process units, and associated process equipment.
- 2.2 The scope of this Standard Practice applies to all water jetting activities that occur at or above five thousand (5,000) psi.
- 2.3 Note: Water jetting activities outside the scope of this RSW (e.g., less than 5,000 psi) and pressure washing do have hazards and can create a water injection risk. Those risks will be covered by other risk mitigation processes including but not limited to Safe Work Permits, Job Safety/Hazard Analyses and use of Personal Protective Equipment.

### 3.0 **REFERENCES**

- 3.1 The implementation period for the requirements outlined in the Hydroblasting Standard Practice shall be as adhered to as of this procedures effective date
- 3.2 ASTM E1575-98 Standard Practice for Pressure Water Cleaning and Cutting
- 3.3 MPC Refining, Louisiana Refining Division, HESS Standard Practices
- 3.4 Refining Standard Practice RSP-1708-000 Hydro-blasting
- 3.5 National Center for Construction Education & Research (NCCER)

## 4.0 ROLES and RESPONSIBILITIES

- 4.1 The Division's Safety Supervisor is designated as the administrator of this Standard Practice and is responsible for its implementation within LRD.
- 4.2 Hydroblasting operations will be conducted only by trained personnel.

ROLES	RESPONSIBILITIES
Permit Writer	<ul> <li>(a) Issue safe work permits for manual high-pressure waterjetting activities at established waterjetting pads/areas.</li> <li>(b) Issue safe work permits for waterjetting activities in process units, tank farms and other areas requiring safe work permits.</li> <li>(c) Inspect hydroblasting jobs for compliance per Safe Work Permit RSW (e.g., once per shift).</li> <li>(d) If hydroblasting water is to be sent to the wastewater treatment plant and has the potential to contain Benzene the Permit Writer (Operations) must notify the Waste Water Control Room and obtain permission prior to each shift</li> </ul>
Owner of Equipment to be Hydroblasted	Ensure communication of hazardous chemicals last contained in equipment, the hazards of those chemicals and the PPE to be worn to protect against those hazards to the hydroblasting crew.
MPC Maintenance Coordinator	(a) Ensure personnel who fall within his/her area of responsibility have completed the required training.

2 of 16

Printed: 4/28/2025

Marathon Petroleum Company LP	Garyville Refining Safe Practice	
Hydroblasting	Doc Number: RSW-0169-GV	Rev No: 8
	<ul> <li>(b) If personnel will be working on equibeen in HF Acid service, ensure that the on the hazards of HF Acid and an response and first aid actions to take it exposure</li> <li>(c) Inspect hydroblasting jobs for co Permit RSW (e.g., once per shift).</li> <li>a) Follow the practices required by the service of the practices required by the practices</li></ul>	pment that has previously ese personnel are trained overview of the proper n the event of an HF Acid mpliance per Safe Work
Contractors Conducting Hydroblasting.	<ul> <li>(b) Conduct daily inspections of all hydromy complete required documentation.</li> <li>(c) Ensure that all contractor personnel equipment are trained per Section 7 provide documentation of that training (d) Ensure that all contractor personnel are trained per Section 7.1 of this RSW (e) Monitor and operate the hydromanufacturer recommendations.</li> <li>(f) Obtain all required Safe Work Permit (g) Ensure that all equipment meets the this standard.</li> </ul>	Iroblasting equipment and el operating hydroblasting .1 of this RSW and can upon request. on the hydroblasting crew /. oblasting pump per the its. e specifications required by

## 5.0 DEFINITIONS

- 5.1 **Anti-Withdrawal Device** –A mechanical means of restraint used during flex lancing or line mole operation. It must withstand the force it will be subjected to, to prevent the flex-lancing/line moling from backing out of the tube/pipe due to gravity, a plugged nozzle orifice, obstruction in the pipe, or unanticipated pull out.
- 5.2 **Blow By** When a dump valve fails, allowing water to pass out of tip or nozzle when the dump valve is in the dumping or fail-safe position.
- 5.3 **Dump Control Valve** A manually controlled device operated by the hydro-blasting operator, designed to divert high-pressure water out a large diameter outlet, overall reducing system pressure to a non-hazardous level. These are actuated by foot control or by hand when mounted to a jetting gun.
- 5.4 **Dump System -** System should be equipped with a device that will either shut down the unit, idle it to low RPM, bypass the flow, or reduce the discharge pressure to a low level. It shall be manually controlled only by the hydro-blasting operator. This device shall immediately shut off the pressurized water stream if the operator loses control. This valve or switch must have a guard to prevent inadvertent actuation and controlled by the worker closest to the nozzle.
- 5.5 **Fail-Safe Valve** A manually operated fail-safe valve, which is attached to a lance and, unless actuated by the operator, diverts the water stream from the nozzle, reducing the pressure. Squeeze action by the operator is necessary to actuate the high-pressure stream.
- 5.6 **Flex Lance** A flexible tube or hose section carrying water to a nozzle, used to clean pipes, where the inside diameter of the pipe is not small enough to prevent the lance from turning back on itself, shall have a piece of rigid straight tube, 1.5 times the diameter of the pipe fitted immediately behind the nozzle to prevent turn back.
- 5.7 **Focus Tube –** (Snorkel, Lance Protector) A section of tubing that is mounted to an AWD

3 of 16

## Printed: 4/28/2025

Marathon Petroleum Company LP	Garyville Refining Safe Practice	
Hydroblasting	Doc Number: RSW-0169-GV	Rev No: 8

and restricts the amount of free space between the tube/pipe and face of the AWD.

- 5.8 **Foot Control Valve** The operator's control valve. The foot control valve is designed for actuation by the operator's foot, either in place of, or in addition to, a hand control.
- 5.9 **Hose Safety Shroud** A protective covering over a high-pressure hose that is designed to protect the worker from hose failure or prevent leakage from a threaded connection or weep hole impacting a worker. Shrouds should be designed in a manner as to cover nearby threaded connected and weep holes and be removable to allow high pressure hose inspections. Typical shroud length minimum is six (6) feet.
- 5.10 **Hydro-blasting** The use of water spray driven by pressure more than 5000 psi up to 20,000 psi to clean unwanted accumulations of residue that adhere to equipment surfaces.
- 5.11 **Hydro-cutting** The method of cutting materials (metal, concrete, etc.) by inducting an abrasive material (such as #30-60 grit garnet) into an UHP water stream. The water velocity accelerates the abrasive to sonic velocities which enable it to make precision cuts. The cutting head must always be fastened securely and controlled by means of a tracking device.
- 5.12 **KEVLAR** Specially designed material used in protective clothing to be worn during the processes using UHP systems.
- 5.13 **Lance** A rigid metal tube or flexible braided metal covered tube which is used between the end of the hose and nozzle to facilitate some cleaning operations
- 5.14 **Lancing (Flex and Rigid)** the operation of cleaning process equipment through inserting a combination of lance and nozzles with pressurized water.
- 5.15 **Line Moling** –. A Hydro-blasting operation in which a hose and nozzle combination feeds itself through a pipe by means of water spray jets from the sides or back of nozzle. Typically used on lines greater than 2 inches ID and larger that cannot be cleaned with automated or semi-automated tooling.
- 5.16 **Metatarsal Boots** Boots required to be worn while conducting any manual hydro blasting operation. These boots have a rigid section covering the metatarsal section of the foot.
- 5.17 **Nozzle** a device at the end point of the lance, shotgun or other water directing-device completing the hydroblasting operation.
- 5.18 **Pressure Washing** The use of pressurized water at or below 3,000 psi with or without the addition of other liquids or solid particles, to remove unwanted matter from various surfaces.
- 5.19 **Qualified Person** A person who, by reason of training and experience, is familiar with the operation to be performed and the hazards involved, is physically capable, and has the knowledge to perform the assigned task. Also has knowledge of properly shutting down equipment in case of an emergency.
- 5.20 **Pressure Relief Valve** A pressure actuated device used to prevent excessive pressure in the system typically set 500-1000 PSI below rupture disc pressure.

Marathon Petroleum Company LP	Garyville Refining Safe Practice	
Hydroblasting	Doc Number: RSW-0169-GV	Rev No: 8

- 5.21 **Rigid Lance** A rigid tube used to extend the nozzle from the end of a hose or jetting gun.
- 5.22 **Rupture Disk** safety device that protects personnel from equipment that has exceeded the maximum allowable working pressure (MAWP). Must be rated no greater than 1.2 times higher than the MAWP of the pump.
- 5.23 **Shot-gunning** an operation involving hand-held equipment to complete the cleaning. (e.g. outside of tube bundles, storage tanks, etc.) A hydro-blasting operation where a handheld lance/shotgun and nozzle combination can be directed in virtually all planes of operation.
- 5.24 **Shoulder Stock** A mandatory part for the jetting gun that rests on the front of the operators shoulder to provide control and maintains a distance between the gun and the operators' body.
- 5.25 **Stinger** a device used to provide an extra margin of safety by eliminating the possibility of the lance doubling within the process equipment (e.g. tubing, etc.)
- 5.26 **Tracking Device** A device used to maintain control and secure the cutting head of hydrocutting equipment. The tracking device may be magnetic or chain track which moves the cutter with manual, hydraulic, or electric units (in approved areas).
- 5.27 **Ultra-High Pressure (UHP) Hydro-blasting** The process of water cleaning a surface at high pressure 20,000 psig and greater. The water spray travels at high velocities through small precision orifices in a nozzle (sometimes rotating) to perform the job of cleaning internal or external surfaces of equipment.
- 5.28 **Weep Hole** A small hole in a high-pressure coupling fitting, typically rated above 15,000 psi designed to leak water if the fitting is not properly fitted or tightened.
- 5.29 **Whip Checks** A shore length of nylon or wire cable with a minimum of 2,500 lbs. tensile strength secured to each end of two hoses that relate to coupling that is designed to limit the movement of hoses in the event of failure.

## 6.0 GUIDELINES

- 6.1 PRE-JOB PLANNING
  - 6.1.1 Permitting shall be followed according to LRD HESS Standard Practices.
  - 6.1.2 Check the surrounding areas to determine what effect the hydroblasting may have on personnel or what effect the surrounding environment may have on the hydroblasting.
  - 6.1.3 Hydroblasting operations shall utilize red tape and usage of "Danger" tags describing potential hazards. Barricades shall be erected at a distance that would prevent anyone outside the barricade from being injured (including overhead operations) by a failure of the equipment or from the high-pressure water stream. This barricaded area shall include the backside of exchangers or exit points of lines and equipment where the high-pressure water stream could exit.
  - 6.1.4 The backside of exchangers must be guarded with material that will withstand the pressure of the nozzle blast force.

Marathon Petroleum Company LP	Garyville Refining Safe Practice	
Hydroblasting	Doc Number: RSW-0169-GV	Rev No: 8

- 6.1.5 Proper usage of hazard recognition techniques must be utilized prior to beginning operations and shall be located in an easily accessible location near the operation. This includes techniques such as Stop, Look, Analyze, Mitigate (SLAM) and Job Safety Hazards Analysis (JSA/JSHA).
- 6.1.6 Ensure that everyone on the hydro blasting crew understands that hydroblasting operations will be shut down if unauthorized personnel enter the barricaded area.
- 6.1.7 Provisions must be established for the collection and/or disposal of hazardous waste and runoff.
- 6.1.8 Determine if special personal protective equipment is required due hazards of the chemicals involved in the hydroblasting operation or on the equipment or parts being hydro cleaned.
- 6.1.9 Consider the accessibility of utilities, such as water or electric.
- 6.1.10 Avoid running hoses, electric cords, etc., across roads and high traffic areas. Avoid placing hoses in high pedestrian traffic areas. Adequate protection is required should placement jeopardize the integrity of the hose.
- 6.1.11 Make sure permission to set up, attaching to utilities, Safe Work Permits, etc., are obtainable in the area.
- 6.1.12 During long jobs, worker fatigue should be considered and appropriate steps taken. (see section 9.3 for back thrust calculations) Workers should not be exposed to a reaction force greater than one-third (1/3) of their body weight.
- 6.1.13 Work Rotation should be given, changing the operator of the jetting gun at intervals not to exceed 2 hours.
- 6.1.14 If hydroblasting is being performed in close proximity to other work crews, ensure there is adequate spacing or barrier to prevent one job task from creating a hazard to personnel working nearby.
- 6.1.15 Ensure that all required approvals are in place if fire hydrants are used as a water utility. Make sure that fire hydrants are operated properly
- 6.1.16 The LRD Safety Checklist for Hydro-blasting FORM (RSW-0169-FORM 01-GV)) shall be completed prior to beginning operation. Completed checklists shall be maintained on site by the contractor.
- 6.1.17 Good housekeeping is required throughout the operation. Improper housekeeping could lead to trips/falls potentially resulting in serious injury. This includes, but not limited to, the following items: hose placement, discarded trash, contaminated personal protective equipment, and/or any wastes.
- 6.1.18 Only essential personnel shall be located within six feet (6') of pressurized connections.
- 6.1.19 Individuals performing hydroblasting work shall maintain contact with pump attendant through line-of-sight, radio communication or through additional personnel.

Marathon Petroleum Company LP	Garyville Refining Safe Practice	
Hydroblasting	Doc Number: RSW-0169-GV	Rev No: 8

6.1.20 All personnel and process equipment shall be protected against debris/chemicals that could result in serious injury or damage.

## 6.2 **PERSONAL PROTECTIVE EQUIPMENT**

The following personal protective equipment (PPE) shall be required when conducting Hydroblasting operations:

- 6.2.1 Head Protection: All personnel shall wear an approved hard hat.
- 6.2.2 **Eye/Face Protection**: All personnel operating hydroblasting equipment shall wear safety glasses and face shields. When performing blasting on equipment or parts that previously contained acidic or caustic materials, personnel shall wear goggles and face shields or a full-face respirator.

## 6.2.3 Body Protection:

- 6.2.3.1 At a minimum, all personnel operating hydroblasting equipment that will be exposed to hydroblasting water or mist shall wear a rain suit. Neck protection shall be worn when applicable.
- 6.2.3.2 Suitable chemical protective clothing shall be worn when a rain suit will not provide adequate protection for the operators against the chemicals' hazards that he/she may be exposed to during the job.
- 6.2.3.3 Personnel that are operating remote hydroblasting equipment and are not exposed to hydroblasting water or mist can wear flame-resistant chemical clothing over their FR clothing.
- 6.2.3.4 Body protection (rain or chemical suits) must be donned at the jobsite prior to work activities and doffed before going to shared common areas such as breakrooms, office buildings, lunchrooms, control rooms, etc. in order to prevent cross contamination
- 6.2.4 **Hand Protection:** All personnel shall wear PVC chemical protective gloves as a minimum when operating hydroblasting equipment. Gloves must be of the type to protect the operators against the chemical that he/she may come into contact with during the job.
- 6.2.5 PPE for HF Acid Containing Equipment:
  - 6.2.5.1 Modified level B HF PPE shall be worn when jetting equipment that previously contained HF acid, including equipment that is located on the bundle jetting pad.
  - 6.2.5.2 Modified level B for this purpose is defined as: A full hood with grade D breathing air supplied through the hood for ventilation and positive pressure. No supplied-air respirator required. The hood is required to provide splash protection. A Bottle Watch must be in place at the breathing air source and maintain positive airflow into hood at all times. No backup personnel in HF PPE are required.

## 6.2.6 Foot Protection

- 6.2.6.1 All operators shall wear waterproof boots with safety toes.
- 6.2.6.2 **Metatarsal** Guards and shin protection shall be required. Kevlar/Turtle Skin/Cut suit (rated for the pressure being used/documented) can be used in lieu of shin guards with metatarsal boots if it adequately covers the metatarsal and shin region of the lower extremities. This PPE shall

7 of 16	Printed: 4/28/2025
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Marathon Petroleum Company LP	Garyville Refining Safe Practice	
Hydroblasting	Doc Number: RSW-0169-GV	Rev No: 8

be used by personnel conducting manual waterjetting/shotgunning operations.

- 6.2.7 **Hearing Protection:** Hearing protection shall be worn by all operators of hydroblasting equipment. In some instances, double hearing protection may be required.
- 6.2.8 **Respiratory Protection:** Respiratory protection must be worn where chemicals may be present above the permissible exposure limit. Consult the Safety Department Representative or Refinery Industrial Hygienist if there are any questions

## 6.3 EQUIPMENT INSPECTION

Because of the extreme pressure and the hazards of high-pressure water injection injuries, all hydroblasting equipment must be inspected as described below and as required by the MPC Hydroblasting Checklist (RSW-0169-Form01-GV).

- 6.3.1 Hose Inspection and Testing:
  - 6.3.1.1 All High-pressure hose must be marked with manufacturer's name or symbol, serial number, and Maximum Allowable Working Pressure (MAWP).
  - 6.3.1.2 High pressure hoses and hose ends must be inspected prior to use. Those with visible metal braiding obvious kinks, or with damaged ends/fittings must be tagged and taken out of service.
  - 6.3.1.3 High pressure hoses and lances must have a thorough visual inspection (e.g., entire length of hose and hose fittings) every three months. Color coded tags or similar method should be used for easy identification of the visual inspection date. Quarterly visual inspection of rental equipment will be the responsibility of the rental company and/or the contractor using the equipment.
  - 6.3.1.4 High pressure hoses must be visually inspected and hydrostatically tested at least annually. Note: Hoses must be marked individually with the hydrostatic test date OR the Contractor must be able to positively identify each hose and provide MPC documentation that the hose has been hydrostatically tested within the last 365 days. Inspection Frequency Inspection Type Daily Visual Quarterly Visual and Tagged Annually Hydrotest
- 6.3.2 Nozzle and Tip Inspection:
  - 6.3.2.1 Check nozzles to be sure it is free from any debris prior to installing nozzle
  - 6.3.2.2 Periodic checks should be made to ensure tip is secure during the job.

## 6.3.3 Relief System Inspection:

- 6.3.3.1 Hydroblasting pumps must be equipped with rupture disc assembly rated no greater than 1.2 times the MAWP of the pump. An inspection of the assembly prior to use must show visual evidence (color code banding/tagging) of having been inspected at least quarterly for integrity of the rupture disc.
- 6.3.3.2 Personnel must never bypass or otherwise disable the pump rupture disc assembly.
- 6.3.3.3 Only rupture disks of the same type and rating as supplied and recommended by the manufacturer may be used.

8 of 16

#### Printed: 4/28/2025

Marathon Petroleum Company LP	Garyville Refining Safe Practice	
Hydroblasting	Doc Number: RSW-0169-GV	Rev No: 8

- 6.3.3.4 The pressure relief system must discharge vertically, never horizontally so the high-pressure water would not injure a worker standing or working near the unit.
- 6.3.3.5 Personnel must never work on or change any elements of the pressure relief system while pumps are operating

### 6.4 **SAFETY PROCEDURES WHILE OPERATING HYDROBLASTING EQUIPMENT**

Personnel operating hydroblasting equipment must be trained on the proper operation of the equipment and familiar with how to safely set up and operate the equipment. The following minimum safety procedures must be followed to ensure a safe hydroblasting operation:

- 6.4.1 Necessary Safe Work Permits (e.g., hot work, confined space, etc.) shall be obtained before the start of any hydroblasting job. The hydroblasting crew must always check for current permits at the beginning of each shift.
- 6.4.2 Hose end restraining devices (whip checks) shall be used on all connections to prevent hose whipping.
- 6.4.3 All fittings used to connect nozzles and hoses must be rated at least to the MAWP of the pump.
- 6.4.4 At least one tire on a hydroblasting pump unit must be double chocked against accidental movement when parked on location.
- 6.4.5 A trained pump attendant is required to be in attendance of pump(s) at all times. The attendant must be close enough to shut down the pump(s) in an emergency. The attendant must not leave his/her responsibility for any length of time while the pump(s) is operating without another trained attendant relieving that person or shutting the pump(s) down. A pump attendant is not allowed to attend more than two pumps in operation within the same barricaded area. Note: This requirement applies in the event of an emergency as well.
- 6.4.6 Hydroblast pumps must be grounded to a valid earth ground.
- 6.4.7 Personnel must never place hoses under arms, near neck or face, or between the legs.
- 6.4.8 Hoses must be protected from traffic damage. Hose bridges or other mean must be in place so a vehicle never runs over high-pressure hydroblasting hose. Hoses must be laid out in a manner to avoid localized abrasive wear on the hose (against sharp edges, corners, etc.).
- 6.4.9 Barricading of the pump(s) and job site hazards is required on every hydroblasting jobs and should be a minimum of 10 feet. All barricades should have four sides and have signage or tags that indicate "Danger Hydroblasting" or similar language to identify that hydroblasting work is being done.
- 6.4.10 Personnel should never step on high-pressure hoses.
- 6.4.11 If the pump hose or lance appears frozen, the pump must not be engaged or the engine started until the equipment has been thawed out, and low-pressure water flowed through the system to the nozzle end of the lance. Note: If the line cannot be cleared of ice using low pressure water flow, then alternative safe mean of clearing the hose and lance or shotgun can be used. The alternative safe procedures must be approved by MPC Safety and Maintenance Coordinator.
- 6.4.12 No attempt shall be made to adjust any nut, hose connections, fittings, etc., while the system is under pressure. The pump shall be stopped and any pressure in the line discharged prior to making any adjustments.
- 6.4.13 All water flow to the low/high pressure hose shall be actuated by a dump valve and equipped with a guard to prevent accidental actuation. The dump valve may be foot or hand operated. The fail-safe system must only be controlled by the worker closest to the nozzle. The dump valve must never be gagged or disabled.
  6.4.14 Personnel must never tie down, lock, or bypass a fail-safe system. Note: Anyone

#### 9 of 16

#### Printed: 4/28/2025

Marathon Petroleum Company LP	Garyville Refining Safe Practice	
Hydroblasting	Doc Number: RSW-0169-GV	Rev No: 8

caught tampering with, locking or otherwise bypassing a hydroblasting fail safe system will be disciplined up to and including removal from an MPC refinery.

- 6.4.15 Personnel must never stand on top of or directly behind the pump while it is operating.
- 6.4.16 When approaching the operator, have your presence acknowledged. Approach only after the high-pressure cleaning tool has been stopped.
- 6.4.17 If possible, all jobs shall include a direct line-of-sight between the pump operator/attendant and the hose end equipment operator. If direct line-of-sight cannot be achieved, radio communication or use of an additional person for line-of-sight must be utilized to assist in quickly de-energizing the pump.
- 6.4.18 High-pressure hoses must never be kinked or intentionally damaged or mishandled.
- 6.4.19 After the pump, hose, and gun (or lance) are assembled, water must be pumped through the system at low pressure to flush any debris out of the line before the nozzle is attached.
- 6.4.20 Prior to the start of the job, test the nozzle/switch/foot valve to make sure the water flow ceases. If water bleeds through any of these positive shut off devices, they must be repaired or replaced before the work can proceed.
- 6.4.21 Elevated runways, platforms, etc., must have standard guardrails and toe boards which meet OSHA standards. These walkways and platforms must be kept clear of oil, grease, waste materials, and all tripping hazards. Non-skid surfaces shall be added where the walking surface is such that a person might slip.
- 6.4.22 No operation shall be left unattended while under pressure. The operation shall be shut down and the pump taken out of gear. Never depend entirely on the fail-safe system when lances, hoses, etc., are left unattended.
- 6.4.23 One control valve or switch shall control only one high-pressure nozzle.
- 6.4.24 When the hose drop or rise exceeds ten feet, it shall be securely tied off to a rigid support to limit the strain due to hose weight. Additional tie off locations may be required for longer vertical runs of hydroblasting hose. Good judgment and experience shall be used to determine how many tie off locations are needed to minimize strain on the hydroblasting hose.
- 6.4.25 On long duration jobs, lubricating oil, hydraulic fluid, water, gearbox oil, fuel, and other required lubrication should be checked every shift (not to exceed 12 hours) or more often if recommended by the manufacturer
- 6.4.26 All equipment shall be tested prior to use as follows:
  - 6.4.26.1 All components (i.e. shotgun, flex-lancing, etc.) to be used in the hydroblasting operation shall be the same equipment being tested.
  - 6.4.26.2 All required personal protective equipment (PPE) shall be used while performing testing procedures. Personal protective equipment shall include: hand, hearing, face/eye, foot, body. Specialized protective equipment may be required based upon tasks.
  - 6.4.26.3 Slowly engage pump (1000 psi increments), while operator utilizes hydroblasting equipment. Operator shall slowly flush devices to allow water flow through equipment. Flex-lances may require testing in equipment such as in exchanger tubes and/or process equipment.
  - 6.4.26.4 A visual inspection of hoses, connections, and equipment shall be performed while slowly achieving Maximum Allowable Working Pressure (MAWP). Hoses showing leaks or damage shall be removed from service and tagged for notification of leak/damage.

10 of 16

#### Printed: 4/28/2025

Marathon Petroleum Company LP	Garyville Refining Safe Practice			
Hydroblasting	Doc Number: RSW-0169-GV	Rev No: 8		

## 6.5 WATERJETTING WITH AUTOMATED EQUIPMENT

Automated waterjetting solutions are strongly preferred over manual waterjetting activities whenever practical. Automated solutions can reduce hazards and the overall risk to waterjetting equipment operators. Manual Lancing or water jetting activities without anti withdrawal device is <u>strictly prohibited</u>. Potential exceptions to this may be approved through the GVL variance process.

## 6.6 LANCING (STIFF AND FLEX LANCING)

High pressure lancing can be a high hazard task if the correct equipment and procedures are not implemented. The following minimum procedure must be implemented to ensure safe lancing operations:

- 6.6.1 Automated waterjetting solutions are strongly preferred over manual waterjetting activities whenever practical. Automated solutions can reduce hazards and the overall risk to waterjetting equipment operators
- 6.6.2 Anti-withdrawal devices used on tube sheets when flex lancing or rigid lancing must include use of a snorkel/focus tube that does not exceed 1 inch clearance from the tube sheet. In vertical tube sheet applications, the maximum gap clearance of the snorkel and the tube sheet must be additionally protected from the potential of the lance coming out under hydraulic pressure. To prevent the potential of a water-cut to the foot, the gap (between the snorkel/focus tube and the tube sheet) must be protected from the lance operator by utilizing some type of physical barrier (wood or steel). 3.7.3 Apply pressure
- 6.6.3 Apply pressure only after the lance or mole is inserted into the tube
- 6.6.4 An adequate shield should be placed on the exit point of the tube bundle being cleaned to prevent debris from striking personnel or equipment. Note: Special care must be taken when jetting U-tubed bundles (e.g., lance stops).
- 6.6.5 During jetting/lancing the worker operating the lance shall be in control of the pressure (e.g., foot dump valve.
- 6.6.6 During manual operations, use adequate shielding when using nozzles containing back jets to clean the entrance of a line. Note: The first two feet of a line or tube shall be cleaned by shotgunning before lance is inserted.

## 6.7 LINE MOLING

High pressure pipe and line moling can be a high hazard task if the correct equipment and procedures are not implemented. The following minimum procedure must be implemented to ensure safe line moling operations

- 6.7.1 An anti-withdrawal device, securely attached to equipment, shall be used while line moling to prevent accidental removal of the line mole while still under pressure at the insertion point. The line mole line must be secured (e.g., lance stopper or equivalent) for the maximum length of travel.
- 6.7.2 In addition to the use of anti-withdrawal devices when line moling, a stinger rod shall be attached to the end of the nozzle 1.5 times the inner diameter (ID) of the largest diameter of the pipe being cleaned must be used. This keeps the line from reversing. Note: If the pipe contains a "T" then the stinger rod shall be 2 times the ID of the largest diameter pipe being cleaned.
- 6.7.3 Line moles shall be equipped with back thrust nozzles that pull the hose/line forward.
- 6.7.4 Apply pressure only after the lance or mole is inserted into the tube.
- 6.7.5 The barricaded area shall include the exit end of the piping to prevent access at

11 of 16

#### Printed: 4/28/2025

Marathon Petroleum Company LP	Garyville Refining Safe Practice			
Hydroblasting	Doc Number: RSW-0169-GV	Rev No: 8		

### that location.

6.7.6 The first two feet of the line/exchanger shell shall be cleaned by shotgunning.

## 6.8 SHOTGUNNING

The use of a handheld hydroblasting gun (aka: shotgunning) can be a high hazard task if the correct equipment and procedures are not implemented. The following minimum procedure must be implemented to ensure safe shotgunning operations:

- 6.8.1 Ther person operating the nozzle shall have direct control of the dump system.
- 6.8.2 Never manually hold objects to be cleaned.
- 6.8.3 The six feet of hose closest to the shotgun shall be enclosed by a shroud rated for at least 1 ½ times the working pressure to protect the operator in the event of a hose failure or a leak
- 6.8.4 The shroud shall be marked or otherwise have indication of its pressure rating.
- 6.8.5 A hydro jetting gun or shotgun shall have a minimum length of 66 inches from butt to nozzle with a barrel length of no less than 48 inches. If a shorter length is required see Section 3.10.6 for approval process. The approval for a shorter shotgun must include any additional PPE requirements (e.g., shin guards).
- 6.8.6 Short sticking the shot gun apparatus is not allowed at any time, stock must remain firmly against shoulder at all times.
- 6.8.7 At no time shall the reaction force (force exerted backward on the jetting apparatus) exceed 1/3 of the shotgunning operator's body weight (see section 9.3). Shotgun operators shall not operate equipment that generates a thrust more powerful than they are comfortable operating.

## 6.9 2D & 3D VESSEL CLEANING

The following additional requirements must be followed when utilizing 2-Dimensional (2D) and 3-Dimensional (3D) hydroblasting equipment for vessel cleaning:

- 6.9.1 Where equipment is manually positioned, a foot pedal or other form of dump valve controlled by the worker closest to the equipment shall be used.
- 6.9.2 In all cases the water jetting pump operator will remain in close proximity to the water jetting pump and have a means to immediately shut off the pressure. The water jetting pump pressure may only be turned on by the designated water jetting pump operator
- 6.9.3 A single crew member must be assigned the duties of monitoring the entire vessel being cleaned this person shall also have means of immediate communication with the waterjetting pump operator.
- 6.9.4 The single crew member assigned to monitor the entire vessel shall ensure the following:

(a) The vessel and vessel openings and barricaded areas are clear of all personnel each time the pressure is engaged and while the nozzle is running.
(b) Vessel openings that are not required to be open must either be bolted shut or securely covered with a warning tag attached. The material used to cover vessel openings must be adequate to withstand the water pressure it will see from the hydroblasting equipment.

(c) Vessel openings that are required to remain open during the cleaning process shall be barricaded with red tape for a distance of at least 10 feet.

(d) In all cases, proper barriers or restrictions must be applied in order to prevent the jet stream or tool from exiting the vessel, including the possible event of a cable or fastener failure.

6.9.5 Confined space entry shall not be permitted concurrently when orbital jetting in

12 of 16

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#### Printed: 4/28/2025

Marathon Petroleum Company LP	Garyville Refining Safe Practice			
Hydroblasting	Doc Number: RSW-0169-GV	Rev No: 8		

the space is in operation. The orbital jetting machine shall be lock/tagged out and verified deenergized prior to personnel entering the space if entry is required and the machine is in the space.

## 6.10 SPECIAL CONSIDERATIONS

- 6.10.1 All electrical equipment that may be impacted by the hydroblasting (including overspray) must be covered or de-energized or otherwise protected. All 110-volt electrical equipment required to support the hydroblasting operation must be properly grounded and protected with a ground fault circuit interrupter (GFCI) to prevent the possibility of electrocution.
- 6.10.2 Abrasive jetting can be an ignition source. Never use abrasive jetting in atmospheres or areas where flammable or combustible materials are above 10% LEL. Ensure that this hazard is recognized on the Safe Work Permit (see Note below).
- 6.10.3 Precautions shall be taken when jetting lines, tubes, or equipment with pyrophoric iron sulfides to ensure the pyrophoric iron sulfides are controlled (wetted) at the exit point to the atmosphere.
- 6.10.4 When hydroblasting lines, tubes, and equipment that contain corrosive solids and liquids, consideration shall be given to reactivity and appropriate precautions taken (e.g., PPE, runoff, barricading, perform during low activity periods, etc.).
- 6.10.5 When using hydroblast methods to remove lead-based paint, requirements stipulated in the OSHA Lead Standard shall be adhered to.
- 6.10.6 Variances from the requirements of this RSW are only acceptable after all other measures have been exhausted and require approval per an approved RSW waiver. Examples of these may include but are not limited to the use of shotguns less than 66 inches in length, and not being able to make use of an attached anti-withdrawal device for either flex lancing, rigid lancing, or line moling.

## 7.0 TRAINING

13 of 16

Personnel conducting hydroblasting operations must be trained both on the hydroblasting equipment and the operation that they will be performing. The following are the minimum training requirement for personnel conducting hydroblasting.

- 7.1 Hydroblasting personnel must have documented training in the use of hydroblasting equipment and use including, but not limited to:
  - (a) Energy isolation of the hydroblasting equipment,
  - (b) Confined Space Entry,
  - (c) Correct body positioning for hydroblasting operations,
  - (d) Inspection and proper use of hydroblasting shotguns,
  - (e) Inspection and proper use of flex lancing equipment,
  - (f) Inspection and proper use of rigid lancing equipment,
  - (g) Inspection and proper use of line moling equipment, and
  - (h) Installation and use of anti-withdrawal safety devices.
- 7.2 Every employee on the hydroblasting crew must know how to properly shutdown a pump and disconnect its energy source (e.g., electric or diesel) in the event an adjustment or maintenance to the cleaning system needs to be performed.
- 7.3 Contractors shall maintain, and provide upon request, documentation of hydroblasting training as described above.
- 7.4 LRD Safety Checklist for Hydroblasting (RSW-0169-Form01-GV)
- 7.5 Water Injection Injury

## 7.5.1 This patient may be suffering from a waterjet injury. Evaluation and management

## Printed: 4/28/2025

Marathon Petroleum Company LP	Garyville Refining Safe Practice			
Hydroblasting	Doc Number: RSW-0169-GV	Rev No: 8		

should parallel that of a gunshot injury. The external manifestations of the injury cannot be used to predict the extent of internal damage. Initial management should include stabilization and a thorough neurovascular examination. X-rays can be used to assess subcutaneous air and foreign bodies distant from the site of the injury. Injuries to the extremities can involve extensive nerve, muscle, vessel damage, as well as cause a distal compartment syndrome. Injuries to the torso can involve internal organ damage. Surgical consultation should be obtained. Aggressive irrigation and debridement is recommended. Surgical decompression and exploration may also be necessary. Angiographic studies are recommended and preoperatively if arterial injury is suspected. Bandages with a hygroscopic solution (MgSO4) and hyperbaric oxygen treatment have been used as adjunctive therapy to decrease pain, edema and subcutaneous infections emphysema. Unusual with uncommon organisms in immunocompetent patients have been seen; the source of the water is important in deciding on initial, empiric antibiotic treatment, and broadspectrum intravenous antibiotics should be administered. Cultures should be obtained

7.5.2 In the event of an injury, immediate medical attention is required. Supervision and Medical staff must be notified of the cause of the injury. To ensure that this is not overlooked, all operators engaged in hydro-blasting or hydro-cutting shall carry an immediately accessible waterproof card. This card should outline the possible nature of the injury indicating person may have been involved in a hydro-blasting or hydro-cutting incident.

#### 7.5.3 Example below.

WARNING!!!	IMPORTANT MEDICAL	MEDICAL ALERT NOTE TO PHYSICIAN This patient may be suffering from a wateriet injury. Evaluation
An injury caused by high pressure waterjets can be serious. In the	INFORMATION!	and management should parallel that of a gunshot injury. T external manifestations of the injury cannot be used to pre-
<ul> <li>event of any waterjet injury:</li> <li>Seek medical attention immediately. Do not delay!</li> </ul>	READ THIS PLASTIC CARD AND KEEP IT IN YOUR WALLET IN THE	the extent of internal damage. Initial management should include stabilization and a thorough neurovascular examina X-rays can be used to assess subcutaneous air and foreign bodies distant from the site of injury. Injuries to the extrem ere involve enterning agence incode damage are to
Inform the doctor of the cause of the injury.	EVENT OF A WATERJET INJURY, SHOW THE CARD TO YOUR	can involve extensive nerve, muscle, vessel damage, as w cause a distal compartment syndrome. Injuries to the tors: involve internal organ damage. Surgical consultation shou obtained. Aggressive irrigation and debridement is recom- mended. Surgical decompression and evolvation may also
Show the doctor this card.	DOCTOR.	necessary. Angiographic studies are recommended pre- operatively if arterial injury is suspected. Bandages with a
<ul> <li>Tell the physician what type of waterjet project was being performed at the time of the accident and the source of the water.</li> </ul>	Distributed by: Water-let Technology Assn Industrial & Municipal Cleaning Assn., 906 Olive Street, Suite 1200, St. Louis, Mo G3101-1448, phone: (313)241-1445, fax: (314)241-1449, e-mail: wita-inca@wita.org. website: www.wita.org	hygroscopic solution (MgSO <sub>4</sub> ) and hyperbaric oxygen treat have been used as adjunctive therapy to decrease pain, ec and subcutaneous emphysema. Unusual infections with uncommon organisms in immunocompetent patients have seen; the source of the water is important in deciding on ini empiric antibiotic treatment, and broad-spectrum intervenou antibiotics should be administered. Cultures should be obta

Marathon Petroleum Company LP	Garyville Refining Safe Practice			
Hydroblasting	Doc Number: RSW-0169-GV	Rev No: 8		

# 8.0 Appendices

## 8.1 Pressure/Flow Calculations

Pressure / Flow Thrust Calculations 0.052 <b>x</b> GPM <b>x</b> √PSI = lbThrust											
Flow	Pressure (psi)										
(GPM)	5000	7500	10000	12500	15000	17500	20000	25000	30000	36000	40000
3	11	14	16	17	19	21	22	25	27	30	31
4	15	18	21	23	25	28	29	33	36	39	42
5	18	23	26	29	32	34	37	41	45	49	52
6	22	27	31	35	38	41	44	49	54	59	62
7	26	32	36	41	45	48	51	58	63	69	73
8	29	36	42	47	51	55	59	66	72	79	83
9	33	41	47	52	57	62	66	74	81	89	94
10	37	45	52	58	64	69	74	82	90	99	104
11	40	50	57	64	70	76	81	90			
12	44	54	62	70	76	83	88	99			
13	48	59	68	76	83	89	96	107			
14	51	63	73	81	89	96	103	115			
15	55	68	78	87	96	103	110	123			
16	59	72	83	93	102	110	118	132			
17	63	77	88	99	108	117	125	140			
18	66	81	94	105	115	124	132	148			
19	70	86	99	110	121	131	140	156			
20	74	90	104	116	127	138	147	164			
21	77	95	109	122	134	144	154	173			
22	81	99	114	128	140	151	162	181			
23	85	104	120	134	146	158	169	189			
24	88	108	125	140	153	165	176	197			
25	92	113	130	145	159	172	184	206			

Marathon Petroleum Company LP	Garyville Refining Safe Practice			
Hydroblasting	Doc Number: RSW-0169-GV	Rev No: 8		

## 9.0 REVISION HISTORY

Revision Number	Description of Change	Written by	Approved by	Revision Date	Effective Date
0	Original Approval	ES&S Dept.	ES&S Dept. Refining Management		4/30/2012
1	Changed language in 6.3.4.2	Safety	Safety	11/9/2013	11/9/2013
2	Added 6.2.3.2 added lancing equipment	Safety	Safety	1/3/2014	1/3/2013
3	Three year review	Safety	Safety	4/22/15	4/30/15
4	Routine triennial review, no changes	Safety	Safety	4/26/18	4/26/18
5	Routine triennial review, no changes	Nick Martin	Safety	4/26/2021	4/5/2021
6	Updated policy to match RSP updates. This includes rupture disc being required and inspected. PPE for previously contained acidic/caustic containing materials and when double hearing protection required.	Cam Koepp	VPP / RLT	01/27/2022	01/27/2022
7	Three Year Review Removed checklist redundancy in 6.2.3 Added 6.2.3.2 Note Removed Snapshots of checklist; added checklist reference in appendices.	Travis Gregory	VVP/RLT	9/22/2022	9/22/2022
8	Updated policy to RSP requirements, definitions, Manual lancing, PPE requirements, and Thrust back Calculations. Medical information card	Shawn Scott	VPP / RLT	11/11/2024	1/6/2025