TABLE OF CONTENTS

1.0 Purpose

The purpose of this procedure is to ensure proper safeguards are in place for employees who perform work using high velocity water (hydroblasting).

The intent is to provide uniform safety guidelines for all personnel involved in hydroblast activities regarding equipment and safe work practices.

2.0 Scope

Water jetting is using high velocity water (greater than 100 psi) to clean non-porous surfaces. Hydroblasting is a particular type of high pressure water jetting to clean items such as exchanger tubes, remove paint or oxidation from surfaces, and other such non-superficial contaminants. These terms are further defined in section 5.0 Definitions.

This practice applies to all persons who are involved with hydroblast operations at the Texas City Site. The practice also covers PPE requirements for other water jetting activities between 100 and 3,000 psi. In addition to the safeguards discussed within this practice, all hydroblasting activity is subject to the site GBR-HESS-PR-03 Safe Work Permit Procedure.

This practice excludes activities related to hydrocutting (aka cold cutting). For guidance regarding hydroexcavation please refer to GBR-HESS-PR-04 Excavation.

If the pump used for water jetting activities is similar in capacity to a hydroblast pump (i.e., at or above 3000 psi), then the requirements of this practice shall apply to such activity. The Safe Work Permit (SWP) and Job Safety Analysis (JSA) shall be based upon the capacity of the pump.

3.0 Special Considerations

3.1 All electrical equipment that may be impacted by hydroblasting (including overspray) must be covered, de-energized, or otherwise protected. All electrical equipment required to support the hydroblasting operations must be equipped to prevent electrocution (e.g., grounded, GFCI.)

3.2 Never use abrasive jetting in atmospheres above 10% LEL.

3.3 Precautions shall be taken when jetting equipment with pyrophoric iron sulfides to ensure the pyrophoric materials are controlled (wetted) at the exit point.

3.4 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.).

3.5 When using Hydroblast methods to remove lead-based paint, requirements stipulated in the OSHA Lead Standard shall be adhered to.

3.6 Variances from the requirements of this RSP are only acceptable after all other measures have been exhausted and require approval per ADM-6 Safety Exception and Variance Procedure. 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 moleing.

4.0 Procedure

4.1 Roles and Responsibilities

4.1.1 Safety Department

4.1.1.1 Develop, maintain, and update this procedure.

4.1.1.2 Evaluate industry standards and specifications of safe work practices as they

become available or change for inclusion into this procedure.

4.1.2 Permit Writer

4.1.2.1 Manage the Safe Work Permit process per the requirements of GBR-HESS-PR-3.

4.1.2.2 Inspect hydroblasting jobs for compliance per Safe Work Permit RSP (e.g., once per shift).

4.1.2.3 If hydroblasting water is to be sent to the wastewater treatment plant and has the potential to affect the wastewater treatment process, the Permit Writer must notify the Waste Water operator and obtain permission prior to each shift.

4.1.3 Owner of Equipment to be Hydroblasted

4.1.3.1 Ensure communication of any hazardous chemical last contained in the equipment has been communicated to the hydroblasting crew.

4.1.3.1.1 This can generally be achieved by attaching an SDS of the last process chemical/ contaminant to the piece of equipment to be hydroblasted.

4.1.4 MPC Maintenance Coordinator

4.1.4.1 Ensure personnel who fall within his/ her area of responsibility have completed required training.

4.1.4.2 If personnel will be working on equipment that has previously been in HF Acid service, ensure that these personnel are trained on HF Acid containing equipment.

4.1.5 Contractors Conducting Hydroblasting

4.1.5.1 Follow the practices required by the MPC Hydroblasting RSP and this procedure.

4.1.5.2 Conduct daily inspections of all hydroblasting equipment and complete required documentation.

4.1.5.3 Ensure that all contractor personnel operating hydroblasting equipment are trained per Section 4.6 of this procedure and can provide documentation of that training upon request.

4.1.5.4 Ensure that all contractor personnel on the hydroblasting crew are trained per Section 4.6 of this procedure.

4.1.5.5 Monitor and operate the hydroblasting pump per the manufacturer's recommendations.

4.1.5.6 Obtain all required Safe Work Permits.

4.1.5.7 Ensure that all equipment meets the specifications required by this procedure.

4.1.5.8 Hydroblast Crew Leader will complete Attachment A –Hydroblasting Checklist.

4.1.5.9 Turn in Attachment A –Hydroblasting Checklist with permit at end of shift.

4.2 General Requirements

4.2.1 Working Safely

4.2.1.1 For water jetting activities below the hydroblast threshold (e.g. power washing with pump capacity less than 3000 psi) the following minimum personal protective equipment is required:

4.2.1.1.1 Hard Hats

4.2.1.1.2 Safety Glasses with Side Shield

4.2.1.1.3 Face Shield

4.2.1.1.4 Safety Boots

4.2.1.1.5 Leather or PVC Gloves

4.2.1.1.6 Other as required by applicable PPE policy/practices, unit specific requirements, and the Safe Work Permit and Job Safety Analysis.

4.2.1.2 Whenever feasible for hydroblast operations, automated equipment shall be used. This allows the operator to be removed from the line of fire. The Safe Work Permit and Job Safety Analysis shall address feasibility. When automated equipment can be used, the minimum personal protective equipment shall be defined by applicable PPE policy/practices, unit specific requirements, and the Safe Work Permit and Job Safety Analysis.

4.2.1.3 When automated hydroblasting equipment cannot be used, the following additional minimum personal protective equipment shall include all of the following:

4.2.1.3.1 Head Protection: All personnel shall wear an approved hard hat.

4.2.1.3.2 Eye/Face Protection: All personnel operating hydroblasting equipment shall wear safety glasses with side shields and face shields. When blasting acidic or caustic containing materials, personnel shall wear goggles and face shields or a full face respirator.

4.2.1.3.3 Body Protection:

4.2.1.3.3.1 At a minimum, all personnel operating hydroblasting equipment that will be exposed to hydroblasting water or mist shall wear a rain suit.

4.2.1.3.3.2 Suitable chemical protective clothing shall be worn when a rain suit will not protect the operators against the chemicals that he/she may come into contact with during the job.

4.2.1.3.3.3 Personnel that are operating remote hydroblasting equipment and are not exposed to hydroblasting water or mist can wear FR Tyvek® over their FR clothing.

4.2.1.3.4 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.

4.2.1.4 PPE for HF Acid Containing Equipment:

4.2.1.4.1 Modified level B HF PPE shall be worn when jetting HF acid-containing equipment, including when it is located on the bundle jetting pad.

4.2.1.4.2 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. Supplied-air respirator is not required. The hood is required to provide splash protection. A Bottle Watch must be in place at the breathing air source and must verify that positive airflow into hood is maintained at all times. No backup personnel in HF PPE are required.

4.2.1.4.3 Foot Protection:

4.2.1.4.3.1 All operators shall wear waterproof boots with safety toes.

4.2.1.4.3.2 Metatarsal protection is required for all shot gunning operations.

4.2.1.4.4 Hearing Protection: Hearing protection shall be worn by all operators of hydroblasting equipment. In some instances double hearing protection may be required.

4.2.1.4.5 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 with any questions.

4.2.1.4.6 Any other equipment required by the Safe Work Permit.

4.2.1.5 To protect against exposure to L. pneumophila (bacteria that can cause Legionnaires' disease), a half-mask air-purifying respirator with a HEPA filter must be worn when working in a non-operating cooling tower.

4.2.1.6 Operators controlling the gun or lance shall have direct control of the water flow. No portion of the body shall ever be placed in front of the water jet. The water jet can easily puncture and tear the skin or penetrate deeper, causing serious internal damage and infection. In the event of an injection injury, supervision shall promptly notify its local medical provider of the potential for infection due to contamination being injected via the high-pressure water system. Pressurized hoses should not be handled within 1 foot of hose connections where most hose failures occur.

4.2.1.7 A pressurized system shall never be left unattended. A pump operator must be within 25 feet of the pump while running.

4.2.1.8 Where practicable the length of the barrel should be such that the nozzle strikes the ground so that the operator cannot inadvertently direct it onto his/her feet or legs. Operators shall also wear foot and metatarsal protection.

4.2.1.9 Before making any modifications to the system, the pump shall be turned off.

4.2.1.10 Small items to be cleaned should be secured before cleaning and never held by one’s hand or foot. Shields shall be used when necessary to protect other workers in the immediate job area from flying projectiles and the water stream.

4.2.1.11 Special emphasis shall be placed on worker fatigue. All equipment operators shall be evaluated for fitness for duty before the job begins.

4.2.1.12 The crew members shall not work for more than 16 hours, regardless of location, in any 24-hour period. The team members should rotate their duties to minimize fatigue. Shotgun operators shall not operate a shotgun for more than twelve (12) hours in any twenty four (24) hour period.

4.2.1.13 When repositioning equipment care should be taken to ensure that proper personal protective equipment is used as determined by the material properties of the material being removed via the water jetting process.

4.2.2 Procedures for Conveying Injury Information

4.2.2.1 In the event that a person is injured by the impact of a water jet, the injury caused may appear insignificant and give little indication of the extent of the injury beneath the skin and the damage to deeper tissues. Larger quantities of water may have punctured the skin, flesh, and organs through a very small hole that may not even bleed. Immediate medical attention is required and medical staff must be informed of the cause of the injury.

4.2.2.2 To ensure that this is not overlooked, contract companies shall have procedures in place to convey information to emergency medical personnel regarding the possible nature of injury and treatment considerations in the event of an injury. Text suggested by the Water Jet Technology Association follows.

"This patient may be suffering from a water jet injury. Evaluation and management 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 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 preoperatively if arterial injury is suspected. Bandages with a hygroscopic solution (MgS04) and hyperbaric oxygen treatment have been used as adjunctive therapy to decrease pain, edema and subcutaneous emphysema. Unusual infections with uncommon organisms in immune-competent patients have been seen; the source of the water is important in deciding on initial, empiric antibiotic treatment, and broad-spectrum intravenous antibiotics should be administered. Cultures should be obtained."

Note: for handout, see Attachment B – Water Injection Injury Note

4.2.3 Risk Assessment (Example: JSA)

4.2.3.1 Prior to starting any hydroblasting, the job must be properly risk assessed. The goal of the risk assessment is to remove the operator from as many hazards as is practicable. Any remaining hazards should be minimal and have corresponding personal protective equipment clearly defined.

4.2.3.2 Use of technology which removes the operator from the line of fire shall be the first option for all hydroblast activity.

4.2.4 Site Preparation

4.2.4.1 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.

4.2.4.2 Surrounding electrical equipment should been identified and properly protected.

4.2.4.3 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. . The barricade should clearly warn unauthorized persons that they are approaching a restricted area.

4.2.4.4 Ensure that everyone on the hydroblasting crew understands that hydroblasting operations will be shut down if unauthorized personnel enter the barricaded area.

4.2.4.5 Provisions must be established for the collection and/ or disposal of hazardous waste and runoff.

4.2.4.6 Determine if special personal protective equipment is required due to the chemicals involved in the hydroblasting operation or on the equipment or parts being hydroblasted

4.2.4.7 Determine if there is adequate room for storage of bundles, etc., and consider if additional traffic or specific routes will be required.

4.2.4.8 Consider the accessibility of utilities, such as water or electric. Avoid running hoses, electric cords, etc. across roads and high traffic areas without properly protecting impacted hoses/ cords from traffic.

4.2.4.9 Ensure that good housekeeping is maintained throughout the job.

4.2.4.10 Ensure permission to set-up and attach to utilities.

4.2.4.11 Hazards associated with freezing weather shall be pre-planned to prevent slip hazards, frozen hoses, etc.

4.2.4.12 Requests for fire water system connections shall be made in accordance with GBR-HESS-EPR-07 Fire Water System Management. Ensure that fire hydrants are operated properly if fire hydrants will be utilized as a water utility.

4.2.5 Safety Procedures while Operating Hydroblasting Equipment

Personnel operating hydroblasting equipment must be trained on the proper operation of the equipment and be 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:

4.2.5.1 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.

4.2.5.2 Hose end restraining devices (whip checks) shall be used on all high pressure connections to prevent hose whipping.

4.2.5.3 All fittings used to connect nozzles and hoses must be rated at least to the maximum allowable working pressure (MAWP) of the pump.

4.2.5.4 All hydroblasting units are to be equipped with a water filter adequately sized to not allow particles larger than the nozzle jets to pass through.

4.2.5.5 Verify proper operation of the fail safe dump valve.

4.2.5.6 At least one tire on a hydroblasting pump unit must be double chocked against accidental movement when parked on location.

4.2.5.7 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.

4.2.5.8 Personnel must never place hoses under arms, near neck or face, or between the legs.

4.2.5.9 Hoses must be protected from traffic damage. Hose bridges or other means must be in place so a vehicle never runs over a high pressure hydroblasting hose.

4.2.5.10 Barricading of the pump(s) and job site hazards is required on every hydroblasting job and should be a minimum of 10 feet to a maximum of 25 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.

4.2.5.11 Personnel should never step on high pressure hoses.

4.2.5.12 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 flow 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 an alternative safe means of clearing the hose and lance or shotgun can be used. The alternative safe procedures must be approved by MPC Safety and the Maintenance Coordinator.

4.2.5.13 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.

4.2.5.14 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.

4.2.5.15 Personnel must never tie down, lock, or bypass a fail-safe system. Note: Anyone caught tampering with, locking or otherwise bypassing a hydroblasting fail safe system will be disciplined up to and including removal from an MPC refinery.

4.2.5.16 Personnel must never stand on top of or directly behind the pump while it is operating.

4.2.5.17 Anyone approaching the operator must have their presence acknowledged and approach only after the high-pressure cleaning tool has been stopped.

4.2.5.18 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.

4.2.5.19 High-pressure hoses must never be kinked or intentionally damaged or mishandled.

4.2.5.20 After the pump, hose, and gun (or lance) have been assembled, water must be pumped through the system at low pressure to flush any debris out of the line before the nozzle is attached.

4.2.5.21 Prior to starting 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.

4.2.5.22 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 someone might slip on the walking.

4.2.5.23 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.

4.2.5.24 One control valve or switch shall control only one high-pressure nozzle.

4.2.5.25 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.

4.2.5.26 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 frequently if recommended by the manufacturer.

4.2.5.27 During long jobs, worker fatigue should be considered and appropriate steps taken to mitigate worker fatigue.

4.3 Equipment

4.3.1 Anti-Withdrawal Device (AWD) Requirement

4.3.1.1 As with other types of flexible lances, an AWD must be used at the point of entry into the equipment being cleaned.

4.3.1.2 Hand held AWDs are not permitted. If c-clamps must be used to secure the AWD then the application must be risk assessed.

4.3.1.3 An AWD attached to the equipment being cleaned is to be used on all flex lancing and line moleing jobs.

4.3.1.4 Prior to being placed into service, the AWD shall be tested to ensure that it can withstand the maximum force pressure generated by the hose in use.

4.3.2 Anti-Reversal Device (ARD) Requirement

4.3.2.1 ARDs are required on all flexible lance and line mole jobs. The ARD length must be at least 1.5 to 2 times the pipe diameter.

4.3.2.2 When a ‘T’ is present the ARD shall be no less than 3 times the pipe diameter. This is required to prevent the mole from turning around inside the

pipe and coming back out under pressure.

4.3.2.3 Engineering studies show the maximum length ARD that can clear a 90 degree turn is two times (2x) the pipe diameter.

4.3.3 Circumvention

At no time shall safety equipment be bypassed or circumvented. All hoses, fittings, and relief devices shall be engineered for their specific purpose.

4.3.4 Fittings

Fittings, collars and connectors, as with hoses, must have a burst rating of at least 2.5 times the working pressure and shall be marked according to working pressure.

4.3.5 High Pressure Hose Requirements

4.3.5.1 Hoses must have maximum allowable working pressure (MAWP) of 1.5 times the working pressure of the pump and a burst rating of 2.5 times the working pressure of the pump. Hose failure while under high pressure can cause serious injury. All fittings shall have a mark indicating their respective MAWP.

4.3.5.2 Hose inspections — all high pressure hoses shall be inspected and hydrotested to the maximum allowable working pressure by the company using the hose at least once every three months. High pressure hose shall be visually inspected daily and prior to each use.

4.3.5.3 Removal from service — Hoses with broken or frayed wire braid shall be removed from service. Any hose with kinks, flat spots, or stripped or damaged threads at the connectors should be taken out of service immediately.

4.3.5.4 Whip checks — High pressure hose connections and couplings shall have whip checks bridging across the entire connection from hose to hose, and at every connection point to protect against injury due to a coupling or hose end failure. Whenever possible, nylon whip checks should be used, otherwise, metallic whip checks may be used.

4.3.5.5 All hose rated 20,000 psi or higher requires an additional protective cover to protect the user from water cut injury due to hose failure. The cover must be used to prevent direct body contact while the hose is pressurized.

4.3.6 Hydroblast Gun (Shot Gun) - The use of a hand held hydroblasting gun (aka: shot gunning) 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 shot gunning operations:

4.3.6.1 At no time shall pressurized high pressure hose, which does not have a protective shroud, be held in contact with the body other than the hands nor be placed between the feet.

4.3.6.2 Shotgun shall be activated by a dual trigger mechanism (double dump). All trigger mechanisms must be guarded.

4.3.6.3 Inspect the gun and test the dumping mechanism daily and before each use.

4.3.6.4 All fittings must be designed for hydroblasting use.

4.3.6.5 Trigger guards must be in place at all times.

4.3.6.6 The high pressure hose connected to the hydroblast gun shall have a shroud

of at least ~~10~~ 6 feet.

4.3.6.7 The barrel shall be at least 48 inches in length. If the geometry of the work site prevents use of a 48 inch barrel the length of the barrel can be shortened to 36 inches with approval per ADM-6 Safety Exception and Variance Procedure.

4.3.6.8 Overall length shall be at least 66 inches. If the geometry of the work site prevents use of a 66 inch shotgun the length of the shotgun can be shortened to 60 inches with approval per ADM-6 Safety Exception and Variance Procedure.

4.3.6.9 Barrels and parts must not have deep grooves from pipe wrenches or vices. The support stock should never be raised above shoulder level.

4.3.6.10 The force generated by the shot gun should be less than 1/3 of the operator's weight. The formula below can be used to calculate the back thrust of the shotgun.

0.0526 X gpm X (psi) x 1/2 = Back Thrust Force

4.3.7 Piping

Ensure that any piping used is designed for high pressure use (Schedule 80 or greater) and that it has the proper pressure rating for the operation being performed. Never use galvanized, brass, cast iron, or seamed piping or fittings for high pressure service. Most commonly available pipe has rupture rating far too low for the pressures used in hydroblasting.

4.3.8 Relief Devices

4.3.8.1 Hydroblast pumps must have a minimum of two (2) over pressure relief devices: a relief valve (or bypass valve) and a rupture disc. Relief devices must be capable of reducing water flow pressure to approximately 200 psi or less with the pump running at full capacity.

4.3.8.2 It is strictly prohibited to use a coin or other disc substitute that is not designed as a rupture device.

4.4 Lancing and Line Moleing

CAUTION: Water is being projected at high pressure and high velocity in a concentrated area. It is capable of causing death or serious injury to any and all personnel in the work area.

4.4.1 Line Moleing

4.4.1.1 Cleaning shall be preceded by shot gunning to a distance of at least 2 feet. This eliminates trying to clean the first few inches with a line mole where it is possible for the mole to jump out and injure the operator.

4.4.1.2 Before pressuring up the system, the line mole must be secured in an anti-withdrawal device.

4.4.1.3 Periodically check the nozzle tip for tightness as well as the AWD, line mole, and hose assembly connections.

4.4.1.4 In addition to the use of anti-withdrawal devices, when line moleing, a stinger rod must 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.

4.4.1.5 Line moles shall be equipped with back thrust nozzles that pull the hose/line forward.

4.4.1.6 Apply pressure only after the lance or mole is inserted into the tube.

4.4.1.7 The barricaded area shall include the exit end of the piping to prevent access at that location.

4.4.1.8 In order to clean the portion of the piping off a “T”, an ARD in conjunction with a flange adapter anti-withdrawal plate must be used. When using this assembly, the nozzle/stinger combination must be a minimum of three times the larger diameter of pipe.

4.4.1.9 Do not use quick connect couplings in high-pressure hoses used for line moleing between the discharge side of the foot pedal and the nozzle.

4.4.2 Flexible Lancing

4.4.2.1 All flex lancing requires a fixed AWD. Fixed AWDs require that the combined length of the AWD and tip allow the tip to rest inside the focus tube when the flex lance is completely withdrawn from the tube being cleaned.

4.4.2.2 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).

4.4.3 Horizontal Lancing (with stiff or flexible lances)

4.4.3.1 A fixed anti-withdrawal device must be used in all flexible lancing or line mole jobs. Removal or insertion of the lance must be done by the same person operating the control device. The line must be depressured prior to initiating the extraction process. The control device must be a foot operated device so that both of the operator’s hands are free to manipulate the lance and the lance tip.

4.4.3.2 The lance shall have an identifiable marking no less the 36 inches from the lance tip. This mark acts as a warning that the lance tip is approaching the tube exit point and shall be installed such that normal operation does not dislodge it.

4.4.3.3 The path of the person walking must be clear and free of obstructions at all times. During job setup the person walking the lance must mark the point of return in order to prevent walking back too far. Walking back too far may cause the lance to exit the tube too far which will place additional stress on the anti-withdrawal device.

4.4.3.4 The work area must be barricaded to prevent entry by unauthorized personnel. Additionally, a shield shall be placed at the exhaust end of the equipment to contain the spray.

4.4.4 Vertical Lancing (with stiff or flexible lances)

4.4.4.1 When using rigid lances, a method for lifting and lowering the lance, such as a pulley, must be rigged.

4.4.4.2 All the safety requirements listed for horizontal lancing also apply to vertical

lancing with the exception of those related to the walking path as no walking path is required for vertical lancing.

4.4.4.3 The operator's feet must be protected by rubber boot with metatarsal protection and a vertical metal shield to prevent dragging a "live" tip across the operator's feet and as a protective measure against hydraulic reversal of the lance.

4.4.4.4 The AWD affixed to the foot pedal may be secured by the weight of the employee's foot provided it is protected as described above.

4.4.5 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:

4.4.5.1 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.

4.4.5.2 The water jetting pump operator shall remain by 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.

4.4.5.3 A single crew member must be assigned the duties of monitoring the entire vessel while it is being cleaned and have a means of immediate communication with the water jetting pump operator.

4.4.5.4 The crew member assigned to monitor the vessel shall ensure the following:

4.4.5.4.1 The vessel, vessel openings, and barricaded areas are clear of all personnel each time the pressure is engaged and while the nozzle is running.

4.4.5.4.2 Vessel openings that are not required to be open must either be bolted shut or securely covered with a warning tag attached.

4.4.5.4.3 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.

4.4.5.4.4 Adequate 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.

4.4.5.5 Confined space entry shall not be permitted concurrently when orbital jetting in the space is in operation. The orbital jetting machine shall be locked/ tagged out when entry is required and the machine is in the space.

4.5 Inspection of Equipment

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 (See Appendix C for an example checklist):

4.5.1 Hose Inspection and Testing:

4.5.1.1 All High pressure hose must be marked with manufacturer's name or symbol, serial number, and Maximum Allowable Working Pressure (MAWP).

4.5.1.2 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.

4.5.1.3 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.

4.5.1.4 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

4.5.2 Nozzle and Tip Inspection:

4.5.2.1 Check the nozzle to be sure it is free from any debris prior to installing the nozzle.

4.5.2.2 Periodic checks should be made to ensure tip is secure during the job.

4.5.3 Relief System Inspection:

4.5.3.1 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.

4.5.3.2 Personnel must never bypass or otherwise disable the pump rupture disc assembly.

4.5.3.3 Only rupture disks of the same type and rating as supplied and recommended by the manufacturer may be used.

4.5.3.4 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.

4.5.3.5 Personnel must never work on or change any elements of the pressure relief system while pumps are operating.

Note: After pressurization, hoses and equipment shall be inspected for leaks, bulges, etc. before use.

4.5.4 Start Up

4.5.4.1 Slowly pressurize the system.

4.5.4.2 Check for leaks. Leaks must be repaired immediately.

4.5.4.3 Ensure the trigger and dump mechanisms are working properly.

4.5.4.4 Flush the hose and gun with fresh water before installing a tip.

4.5.4.5 Verify that the hydroblast unit is properly grounded before the engine is started.

4.5.4.6 Complete the Attachment A –Hydroblasting Checklist or equivalent.

4.6 Training and Certification

4.6.1 Training

4.6.1.1 Hydroblasting personnel must have documented training in the use of hydroblasting equipment and use including, but not limited to:

4.6.1.1.1 Energy isolation of the hydroblasting equipment

4.6.1.1.2 Confined Space Entry

4.6.1.1.3 Correct body positioning for hydroblasting operations

4.6.1.1.4 Inspection and proper use of hydroblasting shotguns

4.6.1.1.5 Inspection and proper use of flex lancing equipment

4.6.1.1.6 Inspection and proper use of rigid lancing equipment

4.6.1.1.7 Inspection and proper use of line moleing equipment, and

4.6.1.1.8 Install and use of anti-withdrawal devices

4.6.1.2 Every employee on the hydroblasting crew must know how to properly shutdown a pump and disconnect its energy source in the event an adjustment or maintenance to the cleaning system needs to be performed.

4.6.1.3 Training may be provided by the Hydroblast Company, equipment manufacturer, reciprocal area safety council, or as approved by the MPC HESS Contractor Safety Coordinator.

4.6.2 Operator Certification

4.6.2.1 Each hydroblast crew member shall carry documentation of hydroblast training and certification.

4.6.2.2 The document shall be carried at all times while preparing for or executing hydroblast activity.

4.6.2.3 The document shall detail role and type of hydroblast activity for which the crew member is certified.

4.6.2.3.1

4.7 Assurance

4.7.1 Verification

4.7.1.1 Before hydroblasting work commences, the Owning Department Representative shall verify that all personnel in the hydroblast team possess an active operator certification card.

4.7.1.2 The Servicing Group Supervisor shall verify that the Job Safety Analysis addresses verification of training of hydroblast personnel.

4.7.2 Audit

4.7.2.1 A HESS Safety Team Leader shall conduct audits of hydroblast companies every two years against the following criteria.

4.7.2.1.1 Equipment meets manufacturer and MPC specifications.

4.7.2.1.2 All hydroblast operators training is current at all times

4.7.2.1.3 Required personal protective equipment readily available.

4.7.2.1.4 Process to communicate diagnosis and treatment of water jet injury to medical professionals.

5.0 Definitions

5.1 ***Abrasive Cutting and Cleaning*** – Abrasive Cutting and Cleaning is a water-directing device with or without abrasive cutting material for the purpose of cutting or cleaning materials or equipment.

5.2 ***Anti-Reversal Device (ARD)*** – The combination of nozzle, stinger and hose collar that is used to prevent a flex lance or mole from turning around inside a pipe Also referred to as stinger/nozzle assembly

5.3 ***Anti-Withdrawal Device (AWD)*** – A mechanically attached device which prevents accidental withdrawal of the hose and nozzle outside of a guarded environment.

5.4 ***Barrel*** – The metal tube, no less than 48 inches in length, which is affixed to the hydroblast gun (shotgun) through which high velocity water is controlled and directed. If the geometry of the work site prevents use of a 48-inch barrel, the length of the barrel can be shortened to 36 inches with higher level approval per ADM-6 Safety Exception and Variance Procedure.

5.5 ***Dump System*** – An operator controlled manual pressure relief device (i.e. foot pedal) or system that rapidly reduces the pressure to a level that yields a pressure flow at the nozzle that is considerably below the risk threshold.

5.6 ***Flex Lance*** – Flex lances are flexible sections of high pressure hose commonly used to clean exchanger tubes but also sometimes used to clean small diameter pipes or lines. Flex lances are usually 1/8" and 3/8" in diameter.

5.7 ***High Pressure*** – Working pressure equal to or greater than 750 psi.

CAUTION: Although a pressure less than 750 psi is not considered to be high pressure, severe injury is still possible.

5.8 ***Hydroblasting*** – Water jetting with pressurized water exceeding 3000 psi. Examples are line moleing, shot gunning, lancing.

5.9 ***Hydroblast Gun (Shot Gun)*** – A portable combination of operator's control valve, barrel and nozzle, normally resembling a gun in arrangement.

5.10 ***Lance*** – A rigid metal tube used to extend and retract the nozzle.

5.11 ***Lancing*** – An application whereby a lance (flexible or rigid) and a nozzle combination is inserted into and retracted from the interior tubes of an exchanger bundle, fin fan, or other multiple-tubed device.

5.12 ***Line Mole*** – The combination of flex lance and ARD and is manufactured in various shapes, sizes, and combinations of forward and backward directed jets.

5.13 ***Line Moleing*** – Special type of lancing whereby a flexible, high pressure hose fitted with an ARD is inserted into, and retracted from, the interior of a pipe for the purpose of cleaning the internal surfaces of pipes, tubes, or drains. It can be self-propelled by its backward directed jets.

Caution: Most dangerous type of hydroblasting

5.14 ***Nozzle*** – The device attaching to the tip of the hose and/or ARD which contains some combination of forward, backward, and rotating angled jets which direct high pressure water to

the surface to be cleaned. Used in moleing and lancing operations.

5.15 ***Operator*** – The hands on individual that is working the gun, lance or line mole.

5.16 ***Orbital Jetting (2-D and 3-D jetting)*** – A water-jetting operation that utilizes a rotating nozzle.

Note: This operation is utilized for internal vessel cleaning without requiring confined space entry.

5.17 ***Rigid Lance*** – Non-flexible sections of high pressure pipe commonly used to clean exchanger tubes.

5.18 ***Safety Dump Valve*** – A foot or hand operated contact-type switch which when released by the operator, interrupts pressure at the nozzle.

5.19 ***Shot gunning*** – An activity where a jetting gun is used to blast deposits out of the end of a pipe or tube. The gun is commonly fitted with a shrouded nozzle, which is pushed firmly against the open end of the pipe or tube while the jet is operated in short bursts.

5.20 ***Shroud*** – An approved, double braided, high pressure enclosure surrounding high pressure hose for the purpose of preventing operator injury due to hose failure by diffusing the high velocity water. The minimum length shall be 10 feet and should cover the point where the gun and high pressure hose connect.

5.21 ***Stinger*** – Rigid pipe installed between the hose end and nozzle to prevent the line mole from turning around inside a pipe. ARD component

5.22 ***Ultra High Pressure (UHP)*** – Hydroblasting operations greater than 30,000 psig.

5.23 ***Water Jetting*** – All pressurized high velocity water cleaning operations at pressures above 100.5 psig (0.69 MPa).

6.0 References

6.1 ASTM E-1575-08 - Standard Practice for Pressure Water Cleaning and Cutting

6.2 Water Jet Technology Association - Recommended Practices for the Use of High Pressure Water-jetting Equipment, Fourth Edition Third Printing October 2012

6.3 RSP-1708-000 Hydroblasting, Marathon Petroleum Company February 2016

7.0 Attachments

7.1 Attachment A: Hydroblasting Checklist

7.2 Attachment B: Water Injection Injury Note

8.0 Revision History

Revision Number	Description of Change	Written by	Approved by	Revision Date	Effective Date
0	Original Issue. New site procedure replaces GBR-HESS-PR-38 and updated to align with RSP-1708-000 under MOC 51587.	J. D. Bergeron, Jr.	D. C. Staats	9/7/2018	9/28/2018

Attachment A – Hydroblasting Checklist

PR-38 ATTACHMENT A – HYDROBLASTING CHECKLIST	
Date:	*This checklist is to be completed by the Hydroblasting Crew Leader.
Refinery:	**Work Location:**
Task/ Equipment Description:	
Crew Leader:	**Pump Operator:**

Equipment Information

Hydroblast Unit #: _____ Maximum Allowable Working Pressure: ☐ >3K ☐ 5K ☐ 10K ☐ 15K ☐ 20K ☐ 40K

Check all that apply: ☐ Shotgun ☐ **2-D Nozzle** ☐ Line Mole ☐ **3-D Nozzle** ☐ Lance ☐ Automated ☐ Pressure Wash (over 750psi) ☐ Vertical ☐ Horizontal

Personal Protective Equipment (PPE)

☐ Hard Hat ☐ Safety Glasses ☐ Hearing Protection ☐ Face Shield ☐ Slicker Suit ☐ Rubber Gloves
☐ Rubber Boots *Other PPE:* ☐ Metatarsal Protection ☐ *Goggles* ☐ *Shin Guards* ☐ *Respirator*

Operational Protective Equipment – GENERAL HYDROBLASTING OPERATIONS

Number of High Pressure Hoses from Pump to Shotgun or Lance: [_____] Hose Maximum Working Pressure: _____K

☐ Whip Check at Every Connection Hose to Hose; Pump to Hose ☐ All Fittings Rated for max. Pressure ☐ Filter on Pump inspected and clean ☐ Rupture Disc in Place and properly rated
☐ Adequate Barricade ☐ Two (2) Pressure Relief Devices ☐ Flush Water Source & Hoses
☐ Hydroblast Unit Grounded ☐ Fire Extinguisher Present ☐ Wheel Chocks in Place
☐ Hoses Kept Out of Walkways ☐ Hoses are Free of Doors/Equipment That Could Damage the Integrity of the Hose
☐ Hose Protected from Mobile Equipment (e.g., Road Ramp in Place) ☐ All Hydroblast Equipment / Fittings / Hoses Visually Inspected
☐ Electrical Equipment Shielded from Water ☐ Hydroblasting PPE Available to All Personnel Entering Barricade
☐ All Camlock Fittings/Caps are Pinned, Wired, or Taped Closed.

Note: A high pressure hose fails inspection if: the PVC outer covering has a hole, if any metal braids are exposed; if the PVC outer covering has moved from the crimp; if any defects are found that questions the integrity of the hose.

Operational Protective Equipment – SHOTGUN OPERATIONS

Shroud Information:

Manufacturer: _____ Shroud Rating: _____K ≥ 1 ½ times MAWP

☐ 6 Feet or Greater ☐ Shroud Covers Whip Hose and Crimp-to-Gun Connection

Shotgun Information:

☐ 48" Barrel or Greater ☐ Trigger Safety Latch ☐ Trigger Guard in Place ☐ Tip / Nozzle Free of Debris
☐ Barrel <48" ** If checked the following additional requirements must be in place, at a minimum: Safety Supervisor and Maintenance Manager Approval, Shotgun operator must wear shin guards. **

Operational Protective Equipment – FLEX LANCE / RIGID LANCE / LINE MOLE OPERATIONS

☐ Pedal In-Line and In Position to be Controlled by the Lanceman ☐ Pipe Exit Properly Guarded

Anti-Withdrawal Device (AWD) Information:

Type of AWD: _____ ☐ AWD is Mechanically Attached ☐ Die is Correct ☐ Die is Secure

☐ Less than 1" gap between snorkel and tube sheet ☐ Lanceman Trained on AWD Use

Lance / Tip / Nozzle / Stinger Information:

Size of Lance (inches): _____ ☐ Tip / Nozzle Free of Debris

Inside Diameter (ID): _____ Stinger Length (For Line Moling stinger rod must be 1.5x ID): _____

_____ HYDROBLASTING TEAM LEADER SIGNATURE

_____ DATE / TIME

Attachment B – Water Injection Injury Note

"This patient may be suffering from a water jet injury. Evaluation and management 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 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 preoperatively if arterial injury is suspected. Bandages with a hygroscopic solution (MgS04) and hyperbaric oxygen treatment have been used as adjunctive therapy to decrease pain, edema and subcutaneous emphysema. Unusual infections with uncommon organisms in immune-competent patients have been seen; the source of the water is important in deciding on initial, empiric antibiotic treatment, and broad-spectrum intravenous antibiotics should be administered. Cultures should be obtained."