Safe Equipment Preparation Guidelines

Overview

Purpose

The purpose of this reference document is to outline guidance to safely
- **(a)** prepare refining process equipment to be opened to atmosphere for entry or other invasive work, and
- **(b)** return equipment that has been opened to atmosphere back to service.

Scope

This document applies to all equipment in hydrocarbon service or equipment which contains other hazardous materials where there is a risk of personnel exposure or injury.

Examples of these types of materials include:
- **(a)** acids,
- **(b)** caustics,
- **(c)** process chemicals, etc.

Out of Scope

Except for Section 2.0, this document ***does not*** apply to:
- **(a)** Utilities or other non-hydrocarbon, non-hazardous materials, or
- **(b)** Atmospheric storage tanks.

Records Retention

Printed copies of this document should not be retained more than 12 months. Any revision to this document will be retained indefinitely.

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1.0 References

1.1 Refining References

The table below lists the Refining references used with this document.

Number	Description
--	Nickel Carbonyl Best Practice **Link:** http://reweb.cbg.mapllc.com/_GetFile/GetDocFromLibrary.aspx?lib_no=105&doc_no=1340
RRD-1150-010	Utility Connections to Process Lines & Vessels
RRD-1339-000	Unit Decontamination
RSP-1121-010	Blinding and Energy Isolation
RSP-1121-030	Live Flare Header Invasive Work
RSP-1127-000	Confined Space Entry
RSP-1128-000	Work Permit

1.2 Industry References

The table below lists the industry references used with this document.

Number	Description
American Petroleum Institute (API)	
API RP 2003	Protection Against Ignition Arising Out of Static, Lightning, and Stray Currents
National Fire Protection Association (NFPA)	
NFPA 30	Flammable and Combustible Liquids Code

1.3 Terms

For definitions of terms used in this document, see Appendix A: Terms and Definitions.

2.0 Operation of Energy Isolation Devices

2.1 Introduction

2.1.1 In order to control hazardous energy, the owning department needs to:

(a) Assure that the energy isolation devices prevent energy from entering the isolated system, and

(b) Verify that the energy contained within the system at the time of isolation has dissipated.

2.1.2 The following sections describe methods that can be employed to confirm that these two objectives have been met for the different types of stored energy encountered at the refinery. This information should be used as a reference when executing energy isolation in the field.

2.1.3 The guidelines for safe and consistent isolation of refinery equipment and machinery at all refineries to facilitate servicing, maintenance or testing are covered by **RSP-1121-010**.

2.2 Equipment Isolation Overview

2.2.1 Take the equipment off-line and isolate at the **primary isolation points** per refinery specific guidelines and/or procedures.

Note: The Energy Isolation List is a supplemental procedure for isolation of specific equipment and systems.

2.2.2 Although single blocks are acceptable, double block and bleeds or physical disconnects are to be used whenever possible at the primary isolation points. This allows for definitive atmospheric testing of the isolated equipment or piping circuit and blinding without a positive purge and breathing air.

2.3 Valve Operation

Hydrostatic energy is most often controlled by closing valves to isolate the source of pressure from the system. Common methods and techniques for operating a valve into the closed position include:

2.3.1 The resistance on the valve while turning indicates the valve has seated and is closed. For frequently used, small valves (3/4” – 2”), hand tightening is sufficient to achieve a good seal. For large or worn valves, additional leverage applied with the appropriate sized valve wrench can overcome premature resistance. Improper use of a wrench to close a valve can damage the valve seat so a wrench should not be used unless necessary.

Notes:

(1) Wrenches may not be appropriate for certain valve operators (e.g. valves with gear operators) because the excessive force could damage the gear assembly.

(2) “Cheaters” are not to be used to gain additional leverage on a valve. If more leverage is needed, a larger valve wrench should be used, however care should be taken to ensure that the valve is not at risk for damage due to too much leverage. It is possible to force the wedge of a gate valve down past the body seat, causing a catastrophic failure of the valve.

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2.0 Operation of Energy Isolation Devices, Continued

2.3 Valve Operation (continued)

2.3.2 Valve position indicator, if present, should show 100% closed. If the indicator is "mostly closed" or "almost closed" it is likely that the valve is not sealed. Valves with non-standard operators (i.e., chain operators, MOVs, etc.) may be retrofitted with indicator rods to give an indication of valve position when the view of the stem is obscured. In any case, valve position indicators should not be relied upon as the sole indication for valve position due to their propensity to break and/or give false indication on occasion.

2.3.3 For heat traced piping circuits that contain process fluids that solidify at, or slightly above, ambient temperature (e.g., sulfur, heavy oil, benzene, water, etc.), the heat tracing should remain on the system until it is verified that the isolation valves are holding. Otherwise, a valve could have an undetected leak because the process fluid has solidified in the seat and the obstruction may be at risk for "blowing out" if the pressure or temperature of the system changes. After verification of isolation, heat tracing may need to be turned off to mitigate potential hazards to the servicing group – this will depend on the job scope.

2.3.4 Improper backseating of valves can cause premature resistance when having to eventually close the valve. To avoid this situation, a backseated valve that is to be left open should be closed ¼ turn off the backseat position and left in that position to ensure that the packing does not dry out and cause resistance when attempting to close it at a future time. Valves that are backseated to control a packing leak ought to have a work notification to repair them at the next practical opportunity.

2.3.5 For very large, or especially difficult to turn valves, portable pneumatic actuators may be used to assist the operator. These tools can introduce additional hazards and should be well understood and the job SLAMed before use.

Caution: The torque settings on the pneumatic actuator need to be set to prevent damage to the valve. The valve manufacturer or site valve SME should be consulted to ensure the design torque load is not exceeded.

2.3.6 Additional methods exist that are specific to the valve design. These methods are listed in the following Table.

Valve Type	Method(s) Used to Indicate Valve Closure
Rising Stem Gate Valve	**(a)** Generally speaking, no threads should be showing above hand wheel in the closed position. **(b)** If a valve is known to seal with some threads showing above the hand wheel, document this information so that it can be known for future isolation attempts. Examples include, marking the point on the exposed stem where the valve seals, hanging a tag on the valve, making a note in an operating procedure, etc. The stem position at the point of sealing can change over the life of the valve, so marking the stem can only give guidance, not absolute assurance. **(c)** Overseating can occur if the valve is closed too far (see Section 2.5 for additional details).
Quarter turn Ball Valve	**(a)** Valve handle should be perpendicular (at 90°) to the process flow in most cases for the valve to be closed. **(b)** Chemical totes sometimes have the handle offset by 90° to minimize the risk of damaging the valve/tote when it is moved. In these cases, the handle may need to be parallel to the flow to be closed. **(c)** If the valve handle is missing, the valve position can be determined by observing the valve stem or other markings on the valve body. All valve manufacturers do not conform to the same marking system so valve specific literature from the manufacturer should be consulted to determine valve position.

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2.0 Operation of Energy Isolation Devices, Continued

2.3 Valve Operation (continued)

Valve Type	Method(s) Used to Indicate Valve Closure
Butterfly Valve	**(a)** Most butterfly valves have position indicators and some have mechanical stops when sealed. **(b)** When the mechanical seat in a butterfly valve becomes worn, the valve will overseat and leak through.
Triple Offset Valve	There is a noticeable pop when the valve seals.
Valve with Chain Operator	**(a)** Hammer wheels (knockers) with safety cables provide enough force while turning chain operators to ensure large, elevated valves are fully closed. **(b)** Chain operators can obscure the line of sight to observe the position of a valve. While a visual inspection should be used to identify obvious indications of the valve status, the valve should be attempted to be operated rather than relying solely on visual observation.
Valve with Motor Actuator	**(a)** Valves with motor actuators are generally designed with inherent mechanical advantage that eliminates the need to use a wrench when operating it manually. In these cases, using a wrench will likely break the components of the actuator and/or valve. **(b)** Some motor actuators have a clutch to place the valve in manual mode so that the wheel can be turned by hand. **(c)** If the valve is designed for a motor actuator and the motor actuator is not present (i.e., out for maintenance), the assistance of a valve SME is recommended. Oftentimes machinists are needed in this case to ensure the valve is in the intended position. **(d)** Actuators with torque limiters may need to be manually started before engaging the motor, otherwise the torque limit can be exceeded and prevent it from operating.
Globe Valve	When a globe valve is fully closed, the valve wheel is usually not seated against the bonnet and there are still threads showing between the wheel and the bonnet.
Orbit Valve	Orbit valves are prone to breaking if they are overtightened. Valve wrenches should not be used on these types of valves.
Relief Valve	Relief valves should not generally be used for energy isolation. If it is necessary to use a relief valve as an EID, refer to **RSP-1121-010** (***Section 4.15***) for additional precautions.
Control Valves	Control valves should not be used as EIDs.
FCC Slide Valves	FCC slide valves should not be used as EIDs
Valves Not Covered Above	Consult with the MPC valve subject matter expert and/or valve manufacturer to discuss confirmation methods for specialty valves.

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2.0 Operation of Energy Isolation Devices, Continued

2.4 Assurance of Energy Isolation and Dissipation

Verification that hydrostatic energy has been dissipated from an isolated system is accomplished by ensuring that no residual pressure remains on the system and there is no longer a bulk inventory of hazardous material. Methods to accomplish this include:

2.4.1 Measure the pressure on the isolated system with a gauge suitable for accurately measuring low pressure (e.g., 0 – 20 psi gauge). Installation of temporary pressure gauges is usually necessary. The pressure on an isolated, depressured system should be monitored for a minimum of 15 minutes (longer for large systems) before concluding that there are no valve leaks. In low pressure systems, such as flare headers, the natural pressure difference across an isolation valve may not be sufficient to verify with 100% certainty that the valve(s) are sealed. In these cases, the pressure on the live side of the isolation valve can be raised (with nitrogen, for example) to increase the driving force across the isolation valves to positively confirm that the system is isolated. Care needs to be taken to ensure that the MAWP of the system is not exceeded when conducting the pressure test.

Note: Valves, or other components, internal to the isolated system can create potential hazards by trapping energy in a sub-section of the larger system. When installing pressure gauges to verify dissipation of energy, this hazard should be assessed and multiple pressure gauges used on the system if necessary. In line equipment, like process analyzers, may have internal valves that close and trap pressure – these components of an isolated system should be well understood during the verification process.

2.4.2 After the system is decontaminated, a portable gas meter may be used to verify that there is no LEL, H_2S, benzene or other component that may indicate that process fluid is leaking back into the isolated system.

Note: Portable gas meters are designed for use in specific environments and can give erroneous readings if used outside of the design conditions. Perceived false readings should be thoroughly investigated by other test methods and in consultation with the appropriate SMEs since interferences can be indicative of an unsafe environment. Refer to Section 5.11 and the manufacturer's specifications for additional details.

2.4.3 Before the work permit is issued to the servicing organization, and during the Joint Jobsite Visit, open valve(s) on the system to atmospheric pressure to observe that no energy or product remains in the system.

Notes:

(1) Appropriate safeguards need to be in place to protect workers from hazards that may be present during the verification steps. The safeguards should be defined based on the possibility that residual energy may still exist until the verification process is complete, and may include barricading, engineering controls and/or elevated levels of PPE.

(2) The verification of hydrostatic systems necessitates that the valves used for verification are not plugged. Properly designed bleeder reamers need to be used to open the flow path of valves that are plugged.

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2.0 Operation of Energy Isolation Devices, Continued

2.4 Assurance of Energy Isolation and Dissipation (continued)

2.4.4 In large, low pressure piping systems with limited drain and vent locations (found most often in Tank Farms), it may be necessary to hot tap high and low point bleeder valves in the system to facilitate de-energization and verification. Alternatively, it may be appropriate to drill pilot holes in the piping system to allow for system verification where the flow of any residual material leaving the piping is easily managed according to the environmental requirements at the facility.

Note: Any in-service drilling or welding needs to follow the local procedures that are in place to mitigate potential hazards associated with these activities.

2.4.5 Temperature measurements, taken with an infrared gun on the piping upstream and downstream of a valve can provide an indication of the valve status. For example:

- **(a)** If the piping downstream of the valve is ambient, but the temperature upstream is warm or cold (as expected by the process conditions), this could indicate the valve is sealed.
- **(b)** If the piping temperature upstream and downstream of the valve are the same, it could indicate that the valve is leaking. Piping configuration should be considered in this case as this impacts the temperature readings. For example, if there is a large deadleg upstream of the closed valve the process fluid may be stagnant and reach ambient temperature. In addition, since metal is a good conductor of heat, temperature will be transmitted through the piping even if the valve is holding (this is especially true for insulated or heat traced piping circuits).
- **(c)** If the valve is in LPG service and the downstream piping is significantly cooler than the upstream piping, this indicates the valve is leaking. In some cases, condensation or ice may form on the valve body – this is another indicator that process fluid is leaking through the valve.

2.4.6 A valve that is leaking may have elevated sound/vibration readings when checked with an ultrasonic instrument.

2.4.7 The console operator may be able to monitor the isolated equipment and/or adjacent systems to verify whether a system is positively isolated and de-energized. When system conditions are not within the normal operating range, the measurement limits of the instrumentation should be well understood so that the data can be interpreted correctly.

2.5 Isolation Troubleshooting Techniques

On occasion, an isolated system may respond in unexpected ways to performing the steps outlined in Section 2.3 and Section 2.4. These abnormal responses may be cues that indicate the attempt to isolate the system was unsuccessful. In these cases, additional troubleshooting is warranted before turning the system over to the servicing organization. The proper troubleshooting steps to take depend on the specific circumstances, but some examples that could apply include:

2.5.1 To clear debris from the seat of a valve that is preventing a proper seal, maintain process flow across the valve seat while opening and closing the valve multiple times. This practice often flushes the debris through the valve and allows it to seat properly.

Note: In particularly severe services, like FCC slurry, pinching down on the valve to enable accelerated flow across the valve seat for a period of time (~10 minutes) on the initial valve closure may increase the probability of getting positive seal.

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2.0 Operation of Energy Isolation Devices, Continued

2.5 Isolation Troubleshooting Techniques (continued)

2.5.2 Some valves have a bleeder installed on the valve body or on the piping nearby that can be used to flush the valve seat by introducing a flushing fluid. Before flushing a valve in this manner, the following criteria should be evaluated:

- **(a)** Is the flushing fluid chemically compatible with the process fluid?
- **(b)** Is the flushing fluid available at a higher pressure than the process fluid?
- **(c)** Are the requirements for utility to process connections, outlined in **RRD-1150-010** being followed to ensure backflow does not occur and other hazards are mitigated?
- **(d)** Where will the flushing fluid settle out after it enters into the process? Have other units been warned about potential impacts?

2.5.3 Tapping a valve on the stem and/or the bottom of the valve body to create vibration may help to break loose debris that may be preventing a positive seal.

Note: Care should be taken not to damage the valve or the tapping tool while employing this method. Permanent damage can be done to the valve, tool or adjacent piping if this is done carelessly.

2.5.4 After flushing the seal, if a valve is still leaking and compromising the system isolation, moving the isolation point so that the leaking valve is now included inside the isolated system is often the most straightforward and sure solution. If this is not possible, more advanced troubleshooting techniques, as outlined below, may be necessary.

2.5.5 If a valve is putting up significant resistance and still does not appear to be closed, grease can be applied at the contact points of the stem to the packing gland and/or bushing while repeatedly exercising it. This often results in an incremental increase in travel distance and allows the valve to fully close. Multiple repetitions are often necessary to get the valve to fully close. Brand new valves normally do not come greased, and should be greased in the field before being put in service.

Caution: Some lubricants have a flash point that may be below the temperature of the valve, piping or nearby equipment. Awareness of the physical properties of the lubricant and the operating temperature of the process equipment is necessary to avoid creating a fire hazard while greasing a valve.

2.5.6 Thermal imaging cameras (e.g., FLIR cameras) are a useful tool for visually observing whether there is flow through a valve.

2.5.7 Change the temperature of the valve by alternating between using steam and a cool water stream on the body of the valve. Once the valve temperature has been changed, attempt to further operate the valve to achieve a seal. More extreme temperature variations may be achieved by using stress relieving blankets or liquid nitrogen. These methods often need 3rd party equipment and a specialty contractor to administer the procedure. Furthermore, an engineering evaluation and Management of Change are necessary before employing these methods to ensure that the design conditions of the valve are not exceeded and the process fluid is not adversely impacted.

2.5.8 X-raying the valve can give evidence that:

- **(a)** it is in the correct position to provide a positive seal,
- **(b)** there is debris in the seat of the valve that is preventing a proper seal, or
- **(c)** there is mechanical damage to the valve.

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2.0 Operation of Energy Isolation Devices, Continued

2.5 Isolation Troubleshooting Techniques (continued)

2.5.9 Valve over-seating can occur if the gate of the valve and valve seat have become worn and the valve is closed so tight that the process fluid leaks over the top of the gate. By monitoring a pressure gauge inside the isolation valves, the operator may be able to determine the optimal position of the closed valve where there is no process leakage and no downstream increase in pressure (i.e., the “sweet spot”). A procedure for detecting the sweet spot includes:

- **(a)** Install a pressure gauge (rated for the correct pressure) on a bleeder within the isolated system.
- **(b)** Vent the system to safe location until a pressure reduction of 25-50 psig is observed.
- **(c)** Adjust the suspected leaking valve by slightly opening it while monitoring the pressure gauge. If the sweet spot is found, the gauge pressure begins to drop.

2.5.10 Pumping valve seats with packing to provide isolation when a valve won’t seat can be used in certain circumstances. This operation should be conducted by a qualified individual (usually a third party contractor) and be managed by the MOC process to ensure that the packing material is compatible with the process, the downstream impacts are known and the correct amount of packing material is used.

2.5.11 Bleeder blinds should be installed in systems where advanced troubleshooting was necessary to isolate the system to prevent further leakage and pressure build up behind the blind while doing work on the system. In addition, a work notification to replace the leaking valve should be entered.

3.0 Initial Decontamination and Blinding

3.1 Step 1: Initial Decontamination

3.1.1 Execute **Initial Decontamination** of equipment to remove the bulk hydrocarbons or contaminants, using one or more of the following methods:

- **(a)** Draining,
- **(b)** purging with water or nitrogen,
- **(c)** steaming ,
- **(d)** water washing, or
- **(e)** chemically neutralizing or cleaning.

Note: In some instances process streams may be utilized in the initial decontamination phase. Examples would include using hydrogen, fuel gas or natural gas to purge equipment in high H_2S service. Similarly, LCO or another aromatic stream may be used in heavy oil circuits to remove residual oil, reduce viscosity and make it easier to de-inventory the system. Refer to **RRD-1339-000** for additional guidance on bulk oil displacement for different refinery streams.

3.1.2 The following guidelines should be applied for temporary piping, tubing, or hose that is needed to support decontamination:

- **(a)** Guidance in **RRD-1150-010** should be utilized when making utility connections to process lines and vessels.
- **(b)** Temporary piping, tubing, or hoses used for decontamination should not be connected to the process piping until it is needed. Temporary connections made well before the decontamination begins should be blinded if possible, to provide energy isolation from the process. Failure to blind the piping or premature connection could lead to potential leaks, especially if a block valve is relied upon for isolation.
- **(c)** The temporary piping, tubing, or hoses should be designed for the conditions of the permanent piping and equipment at the time of decontamination, taking into consideration temperature, pressure, and material compatibility. These conditions are likely to be lower pressure and temperature than normal operation.
- **(d)** The temporary piping, tubing, or hoses are not intended to be used for anything other than decontamination and should be disconnected as soon as possible after decontamination activities have been completed.
- **(e)** Temporary drain headers should be leak checked prior to use. This may involve using a utility to pressure the piping up to a safe and acceptable pressure in order to check all connections, joints, etc. for leaks.
- **(f)** Temporary drain headers should utilize check valves at each tie point to prevent cross contamination of systems.
- **(g)** The design of temporary drain headers should ensure that the header is properly vented to ensure any non-condensables (N_2) are removed from the system.

3.1.3 If blinds ***do not*** need to be installed,

- **(a)** a permit should be issued for the planned work after all the requirements outlined in **RSP-1128-000** have been met, and
- **(b)** the rest of this topic ***DOES NOT*** apply.

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3.0 Initial Decontamination and Blinding, Continued

3.2 Step 2: Initial Blinding

Complete the actions in the following table to install primary isolation point blinds.

Note: For certain systems, such as those present in the HF Alky, the process is to be completely decontaminated or neutralized prior to invasive blinding work.

Step	Action
1	Verify with assigned personnel that the equipment or piping is properly prepared and ready for blinding. This includes verifying the isolation requirements outlined in **RSP-1121-010**.
2	Verify that equipment and/or piping is completely de-energized and depressured. This verification should include: **(a)** Opening a bleeder or valve in close proximity to the work location. For large/complex systems multiple bleeders and valves should be opened to ensure that the entire system is de-energized. **Note:** All bleeders and valves that remain open during the maintenance work are to be tagged and listed on the energy isolation list. **(b)** Pushing any start buttons on pumps, compressors, fans, etc. **(c)** Taking any other physical actions necessary or any actions outlined in Owning Department procedures. **Note:** Refer to ***Section 3.1*** of **RSP-1121-010** for listing of requirements.
3	Verify the primary isolation point isolations are holding: **(a)** If the points are holding, execute atmospheric testing to ensure the environment of the equipment or piping circuit is ready to be exposed to oxygen and blinded without a positive purge or breathing air. **(b)** If they are not holding or if their condition cannot be determined, utilize line breaking procedures with additional precautions implemented to protect workers. This may include: – Using additional/specialized PPE as dictated by the Invasive Work Risk Assessment Score or some other form of hazard assessment, – Having fire protection onsite and attended, – Utilizing a qualified electrician to test electrical equipment, or – Maintain equipment under a slight positive pressure with the use of an inert gas (nitrogen) or steam purge while completing blinding activities (This prevents air from entering the equipment). **Note:** Refer to ***Section 3.1*** of **RSP-1121-010** for listing of requirements regarding verification of energy isolation.
4	Issue permit to install blinds. **(a)** If using an inert gas, take caution to ensure asphyxiation hazard is mitigated. Depending on the size of the line break and location, fresh air may need to be utilized. If using steam, take caution to prevent employee exposure to hot steam vapor and the potential to pull a vacuum on the equipment. A vacuum can be pulled if the steam purge is reduced for blinding and the equipment cools. **(b)** Complete gas testing at the blinding location to verify ***no*** exposures are above the PEL. **(c)** Complete Joint Job Site visit as outlined in **RSP-1128-000**. During the visit, Operations should direct the maintenance representative to the exact blind location in the field. In addition, a final inspection should occur at the blinding location to verify that the line has been de-pressured, tested, and is safe to open. **(d)** For situations in which the equipment or piping cannot be completely de-pressured or verified to be de-pressured, additional/specialized PPE should also be utilized as dictated by the Invasive Work Risk Assessment Score or some other form of hazard assessment. This additional/specialized PPE should be listed on the Safe Work Permit.
5	Install primary isolation point blinds.

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3.0 Initial Decontamination and Blinding, Continued

3.3 Important Blinding Notes

The following items should be considered when installing primary isolation point blinds:

3.3.1 For fired equipment, such as heaters or boilers, the main fuel gas should be blinded as soon as possible after shutdown to prevent the possibility of fuel gas leaking into the firebox, creating an explosive atmosphere. Leaving the pilots lit and operating the forced draft/induced draft (FD/ID) fans, where available, are precautions which should be taken to prevent the build-up of gas prior to blinding.

3.3.2 When installing isolation blinds ***ALWAYS*** think about how the air free and blind removal procedure is going to be executed. If a bleeder is not present to properly air free the system or a bleeder is not present on the "dirty side" of the blind to verify that the system is de-pressured, the use of a bleeder blind is recommended. Refer to **RSP-1121-010** for further guidance on the use of bleeder blinds.

3.3.3 New gaskets should always be installed on the "dirty side" of the blind.

- **(a)** When installing spacers in blinds, ensure that materials used ***do not*** damage the gasket surface.
- **(b)** Example of materials that could lead to damage are brass wedges, aluminum or brass rods, cut out gaskets, and tubing.

3.4 Flare Header Blinding

The following items should be considered when installing blinds in the flare header:

3.4.1 Install blinds in a manner to minimize the amount of air that can migrate into the header.

3.4.2 Utilize a positive purge and fresh air respiratory protection for ***all*** blinding activities on the flare line, unless the header is already shut down and gas-free.

3.4.3 The installation of flare blinds should ***always*** use the "last in-first out" method, so that relief protection is maintained at ***all*** times during shutdown, decontamination and return to service.

3.4.4 Blinding of a "live" flare header is to be done in accordance with the refinery's safety and operating procedures and **RSP-1121-030**. This type of work poses inherent risks, and it should be reserved for situations where failure to complete the work is deemed to present greater risks than opening a live flare header.

4.0 Equipment Decontamination Following Initial Blinding

4.1 Introduction

The following section provides the steps to be followed for equipment decontamination following the initial blinding.

4.2 Step 1: Final Decontamination

To execute **Final Decontamination**, the equipment/piping is now purged, steamed, water washed, chemically treated, etc., as necessary to properly free the vessel of hydrocarbon and contaminants to the level necessary for the maintenance scope.

4.2.1 When selecting a decontamination technique, special attention and preparation is given to understanding:

- **(a)** the preferred method of decontamination (liquid phase or vapor phase) for equipment/piping in a certain services,
- **(b)** removal of liquid product, sludge and residue,
- **(c)** controlling escaping gas and vapors in the surrounding area,
- **(d)** controlling all sources of ignition in the area, and
- **(e)** flaring and other environmental limits.

4.2.2 The final decontamination continues until an acceptable atmospheric reading is obtained based on the type of work that is being done.

Notes:

1. (1) Specific LEL Requirements for Hot Work and Cold Work are presented in ***Appendix B*** of **RSP-1128-000**.
2. (2) LEL Requirements for confined space entry (non-inerted) are presented in **RSP-1127-000**.
3. (3) Specific LEL levels may need to be met before certain equipment can be purged to the atmosphere. Refer to local environmental representatives for guidance on the limits and equipment this regulation applies to at each site.

4.2.3 If a confined space entry is not necessary, the equipment may be turned over for maintenance after achieving acceptable atmospheric readings.

4.3 Step 2: Confined Space Blinding

If a confined space entry is necessary, each piece of equipment to be entered is to be properly blinded in accordance with **RSP-1121-010**.

4.4 Equipment that Can be Isolated with Common Blinds

4.4.1 There are occasions where separate pieces of equipment may be blinded together as one "confined space". Common examples of this include a reboiler/tower or two piggyback exchanger shells.

4.4.2 Additional precautions required for this situation are outlined in **RSP-1127-000** in the section discussing "*Multiple Compartment or Coupled Vessels*."

5.0 Decontamination Methods

5.1 Introduction

The following section provides recommended methods for equipment decontamination.

Note: For further guidance on final decontamination techniques, refer to **RRD-1339-000**. Sections within this document provide guidance for determining if vapor phase or liquid phase decontamination is preferred for certain services, and it also discusses the preferred chemical treatment options for certain contaminants/services.

5.2 Steam to Hydrocarbon-Free Equipment

Steaming is one of the most popular methods to remove hydrocarbon from process equipment. When steaming, the following guidelines should be used:

5.2.1 Steam should be injected in a manner that allows for the proper draining of condensate, which is why it should not be injected into low points.

5.2.2 Ensure condensate is being adequately drained from all deadlegs and all low points during the steaming process. An IR gun is a useful tool in determining whether or not a section of pipe is getting good steam flow or is water logged with condensate. Typically, maintaining temperatures > 180^{o}F ensures proper decontamination.

5.2.3 Positive pressure should be maintained on the equipment or system while steaming to ensure steam is hot enough for proper decontamination.

5.2.4 Always monitor system pressure and ensure that the system operates below its maximum allowable working pressure (MAWP). Depending on isolations, relief protection may or may not be in place.

5.2.5 Steam out equipment until system is gas free by approved field analysis or lab analysis.

5.2.6 If the equipment is being purged for confine space entry, test the equipment per **RSP-1127-000**. Equipment should be de-pressured to a pressure slightly greater than the flare system before steaming to atmosphere. At this point, all connections to the flare should be closed and/or disconnected to avoid contaminating the equipment with flare gas while purging to atmosphere. Consult the Refinery Environmental Group to determine the acceptable pressure and LEL level at which equipment can be opened and purge to atmosphere, as this is often controlled by the state environmental regulations.

5.2.7 As long as there is light hydrocarbon present in a piece of equipment (especially a tower or drum) it is impossible to reach a good outlet vent temperature from steaming. As a rule of thumb you should continue to steam until the outlet vent temperature is ***above 180°F***.

5.2.8 Steaming to the flare can create a vacuum on flare system; so a nitrogen purge or other appropriate measures should be used in conjunction with the steam to avoid pulling a vacuum on the flare header.

5.2.9 Once you have hydrocarbon freed the equipment or system, take the appropriate measures to address pyrophoric material prior to opening any vessels.

5.2.10 Use steam or nitrogen as needed to avoid pulling a vacuum, which could cause damage or failure of equipment not rated to vacuum.

5.2.11 Steaming could cause damage to certain coatings used to line vessels or exchangers. If a lining is present, ensure its temperature rating allows it to be steamed.

5.2.12 The use of steam is not recommended in some services. Consult technical services and/or the unit metallurgist for further guidance.

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5.0 Decontamination Methods, Continued

5.3 Pulling an Evacuation

5.3.1 In many hydrogen and hydroprocessing units, the process equipment is rated for full vacuum. In these types of units, evacuating the process equipment is often the appropriate method used to hydrocarbon-free equipment.

Caution: If sealing surfaces have been compromised, pulling an evacuation has the potential to draw oxygen into a hydrocarbon environment creating an explosive mixture. Ensure proper blinding and bolting is in place prior to pulling evacuations.

5.3.2 When utilizing eduction, the following guidelines should be used:

- **(a)** Prior to pulling any vacuums, ensure that the system is cleared of as much liquid hydrocarbon as possible.
- **(b)** It is recommended to have the system that is to be evacuated isolated by blinds. For instances where the system to be evacuated is only isolated by block valves, precautions should be put in place to ensure that the valves are holding.
- **(c)** Pull a minimum of ***3 vacuums*** to at least ***25 inches*** Hg with hold points of ***15 minutes*** each.
  - Break each vacuum with nitrogen injected into the system as far from the eductor as practical.
  - Drain liquid hydrocarbon from all low points after each evacuation.
- **(d)** With minimal N_2 pressure on the system, test various points throughout the system to determine the personal protective equipment (PPE) to be utilized for maintenance activity.

5.4 Pressure / De-Pressure

The pressure/de-pressure method is another means to hydrocarbon-free equipment in hydroprocessing units. This method is also used in systems and piping circuits where purging and/or evacuations may not be practical. When utilizing pressure/de-pressure the following guidelines should be used:

5.4.1 Pressurize the system using nitrogen and drain as much liquid hydrocarbon as possible from all low points.

Note: Precaution should be taken to not exceed the MAWP of the equipment.

5.4.2 De-pressure the system as much as possible to the flare.

Note: Care should be taken to not de-pressure the system all the way to flare header pressure. Doing this may result in backing in flare gas to the system.

5.4.3 Repeat the pressure/de-pressure steps listed above as necessary to hydrocarbon free the equipment or system.

Note: Technical Services can aid in determining how many pressure/de-pressure steps are needed to hydrocarbon free the system.

5.4.4 With minimal N_2 pressure on the system, test various points throughout the system to determine the personal protective equipment (PPE) to be utilized for maintenance activity.

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5.0 Decontamination Methods, Continued

5.5 Water Flooding

In many process units, it may be possible to water flood the equipment with water and "float out" the hydrocarbon, leaving only the water to drain. When water flooding, the following guidelines should be used:

5.5.1 When the water is drained, use nitrogen or steam to break the vacuum. ***Do not*** allow air to be pulled into the system until you have tested and verified to be hydrocarbon free.

5.5.2 Ensure the piece of equipment and/or piping run is structurally designed to contain the weight of liquid water needed to execute the water flood procedure.

5.5.3 Make sure that equipment internal components are considered when water flooding; on some types of equipment, as the hydrocarbon floats to the top of the water. For some types of equipment, water flooding is ineffective.

5.5.4 When water flooding towers or vessels, cycles of filling/dumping should be executed in order to purge the hydrocarbon from the system. The hydrocarbon should remain floating above the water level if water is introduced and dumped continuously.

5.5.5 The waste water from water flooding may contain benzene or other contaminants that could create environmental concerns when drained to the WWTP. Ensure these concerns are addressed during the planning phase of the procedure.

5.6 Chemical Cleaning

In many process units, chemical decontamination is the best method to ensure the system is cleaned adequately for the invasive work in a time-efficient manner. When chemically cleaning a process, the following guidelines should be followed:

5.6.1 Involve the Tech Services Engineer when selecting a chemical decontamination method to ensure that it is effective for the given process.

5.6.2 When chemically cleaning for hydrocarbon removal, ensure that as much hydrocarbon as possible is removed from the system prior to introduction of the chemical cleaning agent. Bulk hydrocarbon increases the amount of chemical and time needed for the cleaning. This is generally accomplished by a water flood/flush or an initial steaming step prior to the cleaning.

5.6.3 Often, chemical cleaning procedures create large amounts of waste which needs to be treated prior to being drained or managed through offsite disposal. Ensure Wastewater Treatment Plant and Environmental Reps are involved during the planning phases of the decontamination procedure.

5.6.4 Consider utilizing a vapor phase cleaning instead of liquid circulation, if possible. The amount of waste created is much less, and the cleaning does not entail Operations maintaining a liquid circulation path through the unit.

Note: For further guidance on chemical cleaning of equipment, refer to **RRD-1339-000**. Sections within this document provide information on the preferred chemical treatment options for certain contaminants/services.

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5.0 Decontamination Methods, Continued

5.7 Decontaminating in Pyrophoric Services

Many of the corrosion products present in hydrocarbon services are pyrophoric. Pyrophoric materials spontaneously ignite when contacted with air. When pyrophoric materials are present in the process, the following guidelines should be followed:

5.7.1 Pyrophoric materials may be chemically oxidized during the decontamination process.

Notes:
(1) This is typically done with potassium permanganate.
(2) If a chemical oxidizer is used, take precautions to ensure the system is rinsed per vendor recommendations if a confined space entry is to occur.

5.7.2 Pyrophoric materials are non-reactive if they are "wetted" and not allowed to dry out. Thus, pyrophoric materials can be managed by having a plan to continually spraying the material with water.

5.7.3 Pyrophoric materials are also non-reactive if they remain inerted and not allowed to contact air. This is done through the use of nitrogen or dry ice.

5.7.4 Packed vessels are particularly susceptible to fire from pyrophoric materials due to channeling issues, which prevent the materials from being neutralized or wetted during the decontamination process. Special procedures should be written for opening these vessels to atmosphere to mitigate the risk of fire through additional monitoring and control of the amount of air the packing is exposed.

5.8 LPG Equipment Preparation

When preparing LPG equipment (especially towers and exchangers) for maintenance, the following guidelines should be followed:

5.8.1 Use fuel gas, natural gas, nitrogen, or heavy hydrocarbons such as alkylate to displace the LPG to storage or flare before trying to steam or nitrogen sweep.

5.8.2 If water is being used to float LPG, care should be taken to prevent hydrates (freezing water) from forming in the flare header or temporary drain headers.

5.8.3 LPG equipment typically needs to be dried completely prior to startup, as water results in freeze-up and product quality issues which delays startup.

5.8.4 The measured % LEL can vary day-to-night with ambient temperature in LPG equipment, due to vaporization and re-condensing of hydrocarbon.

5.9 Purging Hydrocarbon w/ Compressed Air

Purging hydrocarbon from pipelines with compressed air is not a recommended practice and its use should be avoided when practical. If no other options are available and this method is used:

5.9.1 Conduct a hazard review/risk assessment on all applications where air is used to purge hydrocarbon from equipment/piping. The hazard review/risk assessment should focus on operating tanks per design with good engineering practices

5.9.2 Consideration should be given to compliance with:
(a) NFPA 30, Flammable and Combustible Liquids Code,
(b) API RP 2003, Protection Against Ignition Arising Out of Static, Lightning, and Stray Currents, and
(c) Other applicable practices.

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5.0 Decontamination Methods, Continued

5.10 Executing Decon after Equipment is Opened

5.10.1 Despite every effort to ensure equipment is adequately prepared for invasive work, occasionally hydrocarbon or other contaminants are discovered after the equipment is open to atmosphere. In these situations, work needs to be discontinued and the equipment re-cleaned. This unplanned type of decontamination offers many unique hazards.

5.10.2 When faced with this situation, the following guidelines should be followed:

(a) When steaming or purging equipment, always ensure that an adequate relief path is present. Ensure that the flare system is available and the relief valve protection is in place.

Notes:

(1) If the flare header is not available the relief valve protecting the equipment/piping may be turned to atmosphere.

(2) If the equipment/piping does not have relief protection, monitor the system pressure closely to ensure its maximum allowable working pressure (MAWP) is not exceeded.

(b) ***Do not*** purge the shell side of exchangers if the channel head has been removed without first securing the tube bundle. The pressure from purging can cause the bundle to be ejected from the shell.

(c) Beware of open-ended lines in the circuit. When steaming or purging the circuit, these locations could be hazardous to nearby employees.

(d) Involve the environmental group when putting together the decon plan. The emissions may need to be quantified and reported.

5.10.3 When cleaning out sludge from vessels it should be assumed the material has not been completely decontaminated. In these instances, additional PPE should be utilized, including respiratory protection. The PPE should be based on the contaminants and concentration levels normally present in the process.

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5.0 Decontamination Methods, Continued

5.11 Testing Equipment for Contaminants

The table below describes appropriate testing methods to determine equipment cleanliness.

Method	Description
Multi-Gas Meter	The most common method to measure oxygen, LEL and toxic gas levels inside equipment is the use of a calibrated Multi-Gas Meter. **(a)** Avoid exposing the Multi-Gas Meter directly to steam (water vapor), as this could damage the instrument and interfere with the accuracy of the measurement. **(b)** Using a Condensing Coil is a method of testing that runs the steam vapors from the vent through a cooling coil to condense the steam, which allows for testing the vapor directly above the condensate. **(c)** A dilution tube is generally used along with the Multi Gas Meter in order to accurately measure combustibles (% LEL) in an inert atmosphere where nitrogen has replaced O_2. **(d)** Some common toxic gases that may be encountered include hydrogen sulfide (H_2S) and carbon monoxide (CO). These common toxics can also be measured on most Multi-Gas Meters. **(e)** Another option for measuring combustibles (% LEL) in a low O_2 atmosphere is an infrared LEL sensor. These sensors have the ability to measure % LEL in the absence of O_2. Use extra care when using this technology because infrared LEL sensors have specific limitations, such as the inability to detect hydrogen gas. **(f)** There are a few known interferences that can result when using a multi-gas meter. When these situations arise, an alternate method should be used to analyze the environment of the equipment. – Equipment cleaned using Refined Technologies Inc. (RTI) QuickTurn chemistry, can falsely test high in benzene levels. – The presence of hydrogen has also resulted in detecting false CO levels in equipment.
Laboratory Analysis of Purge or Release Gas from Equipment	Taken while purging, the gas sample can be analyzed by gas chromatography for a wide range of analysis.
Evacuated Bomb	This method can be used as a very good method of determining the non-condensable hydrocarbon content of equipment. **(a)** Prepare a sample bomb (vapor) by installing a vacuum gauge. **(b)** While steaming equipment to flare, connect evacuated bomb to a bleeder and steam through the bomb for 15 minutes. **(c)** Disconnect bomb and place in bucket of water. **(d)** Monitor the vacuum pressure gauge. The gauge read a vacuum of 26 inches Hg or greater. If the vacuum is not achieved, this indicates the presence of non-condensable hydrocarbon in the bomb and further decontamination is needed.

Continued on next page

5.0 Decontamination Methods, Continued

5.11 Testing Equipment for Contaminants (continued)

Method	Description
VOC Monitor with Benzene Specific Measurement	**(a)** An UltraRAE PID can be used to directly measure the concentration of benzene in a vessel's atmosphere. **(b)** There have been documented situations where inaccurate readings were obtained when using an UltraRAE to measure high benzene levels or in atmospheres that have other hydrocarbons present. In these situations, Dräger tubes or another sampling method should be utilized.
Dräger Tubes	**(a)** Dräger tubes can be used to measure the concentration of a variety of contaminants when determining equipment cleanliness. Specific types of tubes commonly used include H_2S, Benzene, and CO. **(b)** A H_2S and Benzene Dräger tube directly measure the concentration of these toxic compounds in a vessel's atmosphere. **(c)** A CO Dräger tube is often used to test recycle gas streams in hydroprocessing units for carbon monoxide. This is done to prevent the formation of Nickel-Carbonyl which can be a deadly poison in the reactor circuits. Tech Service has issued a best practice that outlines guidelines to be followed to prevent the formation of Nickel-Carbonyl in reactor circuits and also provides a recommended method for measuring CO in the recycle gas streams (see Nickel Carbonyl Best Practice).

6.0 Returning Equipment to Service

6.1 Introduction

6.1.1 The following section provides the steps to follow when returning a piece of equipment to hydrocarbon service that was opened to the atmosphere.

6.1.2 The following general precautions should always be followed when executing an air free procedure to return equipment to service:

- **(a)** ***NEVER*** purge air into a flare system.
- **(b)** ***NEVER*** remove primary isolation point (PIP) blinds until the equipment or piping circuit is air free.
- **(c)** ***Do not*** remove any test blinds or confined space entry blinds that are dual purpose blinds and also serve as primary isolation point blinds.

6.2 Step 1: Remove Interior Blinds

Remove all blinds within the primary isolation points (confined space and hydrotest/hotwork blinds).

6.3 Step 2: Equipment Punch Out

Prior to beginning the air free procedure, ***all*** blinding locations, flanges, and manways should be checked for loose bolts and that gaskets have been installed properly in all necessary locations. This is done to ensure there are no locations where air can migrate into the system.

6.4 Step 3: Complete Leak Test

6.4.1 Per **RSP-1121-010**, either a leak test or a P&ID walk down is necessary prior to returning equipment to service. Refer to the RSP for specific directives for completing each task.

6.4.2 The pressure leak test and/or P&ID walkdown is completed to ensure that the equipment is fit for service following maintenance activity.

6.5 Step 4: Air Free Equipment

Air free the equipment or piping circuit by an approved method, before removing any primary isolation blinds. Approved methods of air-freeing equipment are presented in Section 7.0.

6.6 Step 5: Test Atmosphere

Test the atmosphere inside of the equipment for oxygen. It is important to maintain a slight positive pressure on the equipment during testing.

6.7 Step 6: Actions Depending on Test Results

Based on the results of the above testing:

- **(a)** If oxygen tests over ***2.0%*** the air freeing steps are continued.
- **(b)** If oxygen tests under ***2.0%,*** proceed with ***Step 8*** (see Section 6.9).

Note: If the equipment was ***not*** blinded, the equipment may now be put back in service, and ***rest of this topic DOES NOT apply***.

Continued on next page

6.0 Returning Equipment to Service, Continued

6.8 Step 7: Preparing to Remove Primary Isolation Point Blinds

Prior to pulling Primary Isolation point blinds, check the piping "live side" of each blind for accumulation of pressure and potential contaminants and take the following actions based on what is found:

6.8.1 **"IF"** there are contaminants above their PEL or the levels ***cannot*** be determined, utilize appropriate PPE when pulling the blinds. Requirements are outlined in ***Section 3.1*** of **RSP-1121-010**.

6.8.2 **"IF"** pressure is confirmed upstream of the blinds, it should be relieved prior to pulling the blinds.

6.8.3 **"IF"** the piping on the "live side" of the blind cannot be completely de-pressured or verified to be de-pressured, special precautions should be taken. These precautions are outlined in ***Section 3.1*** of **RSP-1121-010**.

6.8.4 **"IF"** the hazard ***cannot*** be mitigated through the use of PPE and other safeguards or the pressure is such that the blinds ***cannot*** be pulled, the isolation points upstream of the blinds should be checked and/or modified, and the "live side" piping decontaminated, if needed.

6.8.5 **"IF"** contaminants and pressure at the blinds have been addressed, issue a permit to remove the blinds.

6.9 Step 8: Removing Primary Isolation Point Blinds

Remove primary isolation point blinds.

(a) Blind removal should be directed so as ***not*** to pull blinds in such a fashion that a "chimney" effect is created on any vessel allowing air to be drafted the length of the equipment (particularly on vessels and towers).

(b) A chimney effect can be created by pulling blinds at a "high" and "low" point simultaneously.

(c) Slight positive pressure should be maintained on the equipment or system to avoid air ingress when blinds are being pulled.

6.10 Step 9: Return to Service

Return equipment to service per local guidelines or procedures.

7.0 Methods for Air Freeing Equipment

7.1 Introduction

The following section provides recommended methods for air freeing equipment.

7.2 Steam to Air Free Equipment

Steaming may be used as a method to air free the process. Its largest advantage over Nitrogen is that steam is visible and thus does not present an asphyxiation hazard. When steaming, the following guidelines should be used:

7.2.1 Steam should be injected in a manner such that it is pushed to high point vents and low point bleeders. It should not be connected to low point bleeders, as this may prevent proper draining of condensate.

7.2.2 When steaming is utilized, it may be difficult to measure % O_2 utilizing a multi-gas meter. A hard steam plume blowing from a bleeder constitutes “air free” at that vent point.

7.2.3 When utilizing steam to air free, condensate accumulates in the unit. Some of this may be drained during the startup procedure. For LPG services, where condensate could freeze or product quality issues could result, steam ***should not*** be utilized.

7.2.4 Caution should be used when air freeing with steam during freezing weather. If possible, nitrogen should be used instead of steam.

7.2.5 When pulling blinds, enough steam flow should be maintained to prevent pulling a vacuum on the process equipment. To control this hazard, consideration should be given to introducing nitrogen prior to pulling blinds.

7.2.6 Always monitor system pressure and ensure that the system operates below its MAWP. Depending on isolations, relief protection may or may not be in place.

7.3 Nitrogen to Air Free Equipment

Nitrogen is the most common utility used to air-free equipment in today’s refining industry. Nitrogen’s biggest advantages over steam are that no condensate accumulates in the process piping. When using nitrogen to air-free, the following guidelines should be used:

7.3.1 Nitrogen should be connected at low points and air free to high point vents.

7.3.2 Take precautions to minimize the asphyxiation hazard from open plugs, leaking flanges, and vents. A strict procedure to control access to the unit should be enforced, and all personnel should be aware of the potential hazards that may be encountered.

7.3.3 Verify the system is air free by using a multi-gas meter to measuring the oxygen levels at various locations throughout the system.

7.3.4 Always monitor system pressure and ensure that the system operates below its MAWP. Depending on isolations, relief protection may or may not be in place.

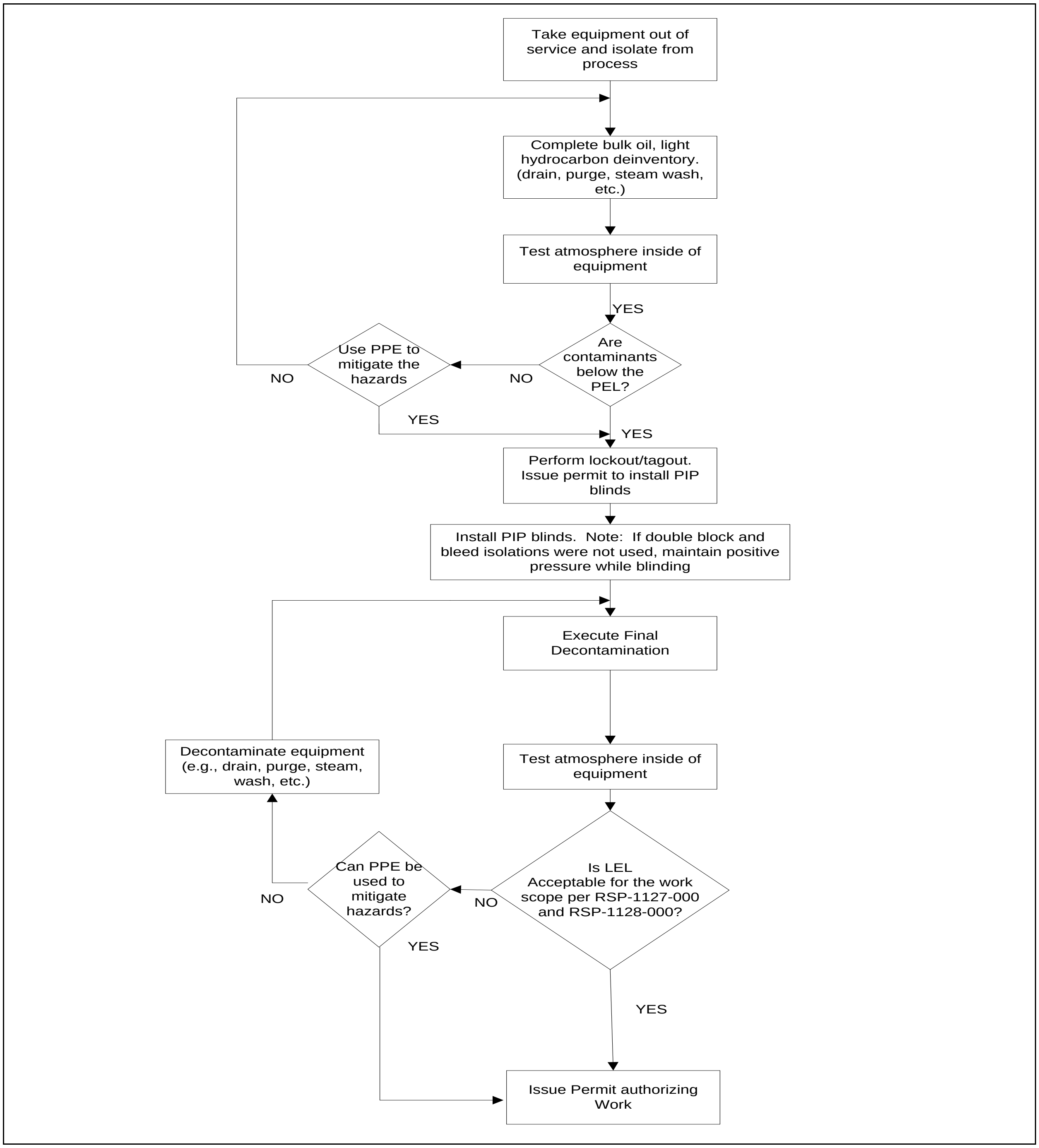
Appendix A: Terms and Definitions

A.1 Air Free	***Air Free*** is the process of removing oxygen from equipment to less than 2% prior to placing it back in hydrocarbon service.
A.2 Contaminants	***Contaminants*** are materials with the potential for causing injury or illness to exposed personnel. **Example:** H_2S, HF, FeS_2
A.3 Final Decontamination	***Final Decontamination*** is the removal of any remaining hydrocarbons or contaminants after primary isolation point blinds have been installed in preparation for turnover to maintenance.
A.4 IDLH	Immediately Dangerous to Life and Health
A.5 Initial Decontamination	***Initial Decontamination*** is the removal of bulk oil and hydrocarbons prior to initial blinding.
A.6 Invasive Work	***Invasive Work*** is work that may involve exposure to the internals of a(n) **(a)** vessel, **(b)** pump, **(c)** piping, **(d)** exchanger, or **(e)** other piece of equipment (especially equipment in hydrocarbon service).
A.7 Lower Exposure Limit (LEL)	***Lower Exposure Limit (LEL)*** is the lower limit of the flammable range of a particular substance.
A.8 PEL	Permissible Exposure Limit
A.9 PPE	Personal Protective Equipment
A.10 Primary Isolation Point	A ***Primary Isolation Point*** is the valve, flange, union, or other isolation point where hazardous energy is isolated from a piece of equipment or unit. The Primary Isolation Points are part of the Energy Isolation List, or other refinery specific procedure.

Appendix B: Flowcharts

B.1 Preparing Equipment

The figure below is a flowchart for preparing equipment in service for invasive work.



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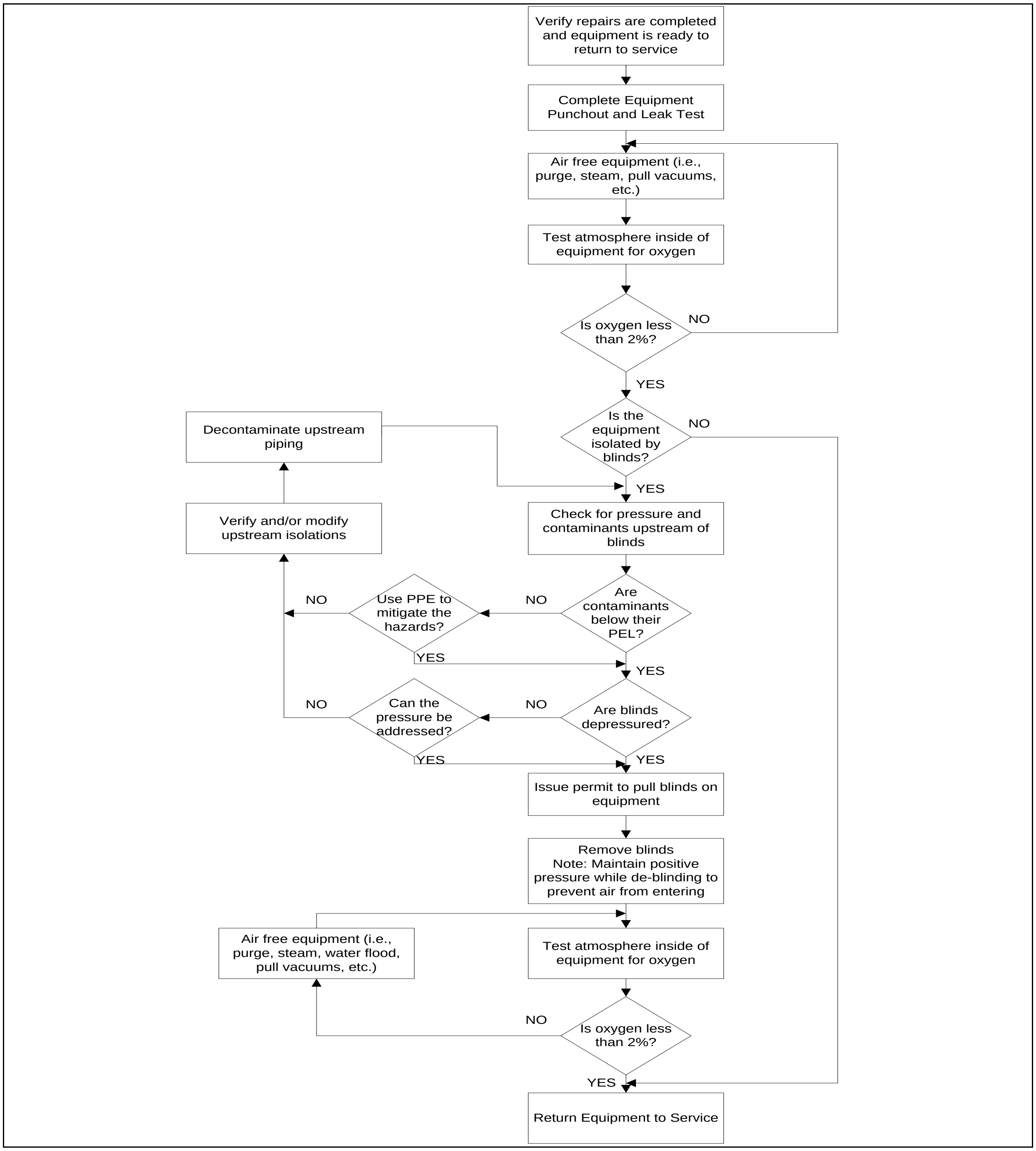
Appendix B: Flowcharts, Continued

B.2 Return Equipment to Service

The figure below is a flowchart for preparing equipment out of service to return to hydrocarbon service.



Revision History

Document Revision History Complete the following table for each document revision.

Rev. No.	Description of Change	Author	Approved By	Rev. Date
0	***No Record***			
1	Updated	--	--	10/30/03
2	Conversion of document to new format.	M.I. Etter	K.D. Bogard	3/24/10
3	Significant Document Update; reformatted and added new information.	J.R. Mueller	K.D. Bogard	11/24/10
4	Added Section 4.8 from IG-17.	J.R. Mueller	R.A. Hernandez, Jr.	9/19/11
5	Updated Section 2.3.	B.M. Hamari	D.T. Roland	2/28/14
6	Removed GBR conformance date.	M.I. Etter	T.M. Hearn	5/16/14
7	Reviewed, updated and approved for 5 years. See Communication Tool No. 16-059 for summary of updates.	J.T. Zuech	D.K. McCord	12/15/16
8	Updated definition of Primary Isolation Point and referenced Energy Isolation List in Section 2.2.1. Removed language suggesting enforceable requirements per HQ Tier III Audit findings.	J.T. Zuech	J.M. Richert	8/31/17
9	Added Section 2.0.	J.T. Zuech	J.M. Richert	2/20/18
10	Updated Section 5.3 to include caution while pulling evacuations, per PSA 19-03.	J.M. Zalewski	J.F. Marra	1/24/20