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1.0 PURPOSE

1.1 This procedure establishes minimum guidelines for the safe entry into inert confined spaces and the requirements for working safely near inert confined spaces. While developed primarily for catalyst removal, this procedure applies to any work involving entry into an inert confined space.

2.0 SCOPE

2.1 This procedure applies to the entry into confined spaces that have been inerted so that catalyst can be replaced, or so that maintenance or modifications can take place.

3.0 STANDARDS/REFERENCES

3.1 API Pub 2217A Guidelines for Work in Inert Confined Spaces

3.2 MPC Refining Confined Space Entry RSW-106-GV

3.3 MPC Refining Safe Entry Into Inert Atmosphere RSW-0143-GV

3.4 OSHA 1910.146 Permit Required Confined Spaces

4.0 DEFINITIONS

4.1 **Acceptable Inert Atmosphere** – For the purposes of this standard, an Acceptable Inert Atmosphere is a maximum of four percent oxygen (≤4% O_2), by volume, Which is considered the maximum acceptable oxygen concentration allowed during inert entry operations for preventing ignition of flammable hydrocarbon vapors or spent catalyst.

4.2 **Back Pressure Test Manifold –** is a device used to determine if inert gas back pressure is present, or has developed, as a result of crusting and possible formation of pockets within the catalyst while inert gas is being fed into a process vessel (Confined Space).

Important: Crusting and pocketing presents a potential engulfment hazard and risk from released energy in the confined space to Inert Confined Space Entrants.

4.3 **Catalyst Replacement Process – Is** the work wherein an operating reactor vessel is shut down, cooled, and opened, so that spent catalyst can be removed, the interior of the vessel inspected, and fresh catalyst placed in the vessel.

Due to the pyrophoric nature of the spent catalyst, the work requires that the process be accomplished under an inert atmosphere and that inert gas be continuously fed into the vessel, with the resultant vapors vented at access openings.

Risk to Workers: The process requires that workers enter the vessel under an inert atmosphere. Workers are potentially at risk form high temperature, inert atmosphere, pyrophoric spent catalyst, Potentially high concentrations of flammable and toxic vapors, and physical hazards of the confined space.

4.4 **Confined Space** – A space that is large enough and so configured that an employee can enter, has limited means for entry and exit and is not designed for continuous employee occupancy.

4.5 **Engulfment** – Is the surrounding and effective capture of a person by a liquid or finely divided (fluidized) solid substance that can cause death by filling or plugging the respiratory system or that can exert enough force on the body to cause death by strangulation, constriction or crushing.

4.6 **Immediately Dangerous to Life or Health (IDLH)** – Any condition that poses an immediate or delayed threat to life or would cause irreversible adverse health effects or interfere with an individual's ability to escape from a confined space.

4.7 **Inert Confined Space** – A confined space where the existing atmosphere is intentionally displaced with an inert gas such as nitrogen. The intent is to reduce the oxygen concentration to low levels (oxygen deficient) to absolutely prevent ignition of residual flammable gases. Such an atmosphere is IDLH.

4.8 **Inert Confined Space Entry Contractor** - a contractor that is utilized to perform work in inert confined spaces. The contractor provides workers trained and qualified in inert entry operations and is able to provide certification upon request. The Inert Confined Space Entry Contractor also possesses and provides the required equipment to safely carry out all inert entry operations.

4.9 **Inert Entry** – Whenever a person passes through an opening into a confined space having an inert atmosphere.

Note: Entry occurs whenever any part of the entrant's body breaks the plane of the confined space opening.

4.10 **Inert Entry Attendant** – The Inert Entry Attendant is the attendant required by OSHA regulations. This person shall wear and utilize PPE equivalent to an Inert Entrant and be immediately available to assist in an emergency.

4.11 **Inert Entry Attendant Back-up –** The Inert Entry Attendant Back-up is as additional person required by Refining in addition to the Inert Entry Attendant, and shall assist the Inert Entry Attendant, and shall be trained in the hazards, equipment, procedures, and safeguards.

Note: The Inert Entry Attendant Back-Up need not be suited up but will have All equipment immediately available to suit up in PPE similar to an Inert Confined Space Entrant.

4.12 Inert Confined Space Entrant – Inert Confined Space Entrants contractor personnel who have been trained and qualified in inert entry. MPC employees shall not enter an inerted confined space. Such personnel must be Inert Entry Trained to include training on this Inert Entrant Standard Practice as well as OSHA's Confined Space Entry standard, have practical experience in actual inert entry, and have been deemed qualified by the Inert Entry Contractor to perform such entry.

4.13 Inert Entry Supervisor - is an individual designated to authorize, supervise and oversee inert entry operations and who has been trained in inert entry. The training must also include the contents of RSW-0143-GV as well as OSHA's Confined Space Standard (1910.146). The Inert Entry Supervisor must be deemed qualified by the supervisor's employer.

4.14 Inert Entry Trained Person – MPC employees trained on this standard. Such personnel will also have been trained on the MPC Confined Space Entry Standard. Such personnel are not qualified as Inert Entrants.

4.15 Oxygen Deficient Atmosphere - Any atmosphere containing less than 19.5% oxygen by volume.

4.16 Restricted Area – The area outside an opening of an inerted confined space where vapors from the confined space are being vented. This area has the potential to be oxygen deficient and / or contain elevated concentrations of flammable or toxic vapors vented from the confined space.

4.17 Void – A void in the catalyst bed is an open cavity in the catalyst bed where there is no catalyst remaining and solid catalyst is still present around it, and above it, thereby creating a collapse/engulfment hazard.

5.0 INERT ENTRY GUIDELINES

Note: These "Inert Entry" guidelines are to be followed in addition to all requirements in the MPC Refining Confined Space Entry Standard RSW-0106-GV and the LRD confined space procedures. Inert Entry Trained Personnel must perform all inert entry work.

5.1 Process Overview - The Catalyst Replacement Process is the work wherein an operating reactor vessel is shut down, cooled, and opened, so that

a) Spent catalyst can be removed
b) The interior of the vessel inspected, and
c) Fresh catalyst placed in the vessel.

5.1.2 Due to the pyrophoric nature of the spent catalyst, the work requires that:

a) The process be accomplished under an inert atmosphere, and
b) Inert gas be continuously fed into the vessel, with the resultant vapors vented at access openings.

5.2 Hazards – A vessel under inert gas purge containing an oxygen deficient atmosphere constitutes an Immediately Dangerous to life and Health environment.

Important: This task shall be performed by specialized Inert Entry Contractors who have the training, expertise, and equipment necessary for work of this nature.

5.2.1 The process requires that workers enter the vessel under an inert atmosphere. Workers are potentially at risk form hazards including:

a) High temperature,
b) Inert gas/oxygen deficient/IDLH atmosphere,
c) Pyrophoric spent catalyst,
d) Potentially high concentrations of flammable and toxic vapors,
e) Physical hazards of the confined space,
f) Crusting and pocketing of catalyst presents a potential engulfment and sudden pressure release hazard to the confined space entrants and attendants
g) Potential for arsenic containing spent catalyst

Note: A Back Pressure Test is completed to determine if a sudden pressure release hazard exists.

5.3 Personnel to Perform Work: - Inert Confined Space Entrants must be trained and qualified to perform all inert entry work per the requirements of this procedure. *See Definitions* (**Inert Confined Space Entrant**).

Important: Pre-Job planning shall involve personnel responsible for the overall inert entry work including inert entry field leadership. The pre-job planning shall include a meeting with all involved parties prior to the start date of the inert entry work and address items noted in **RSW-0143-FORM02**. The training records for all personnel involved in the inert entry must be verified as current by MPC personnel before work begins.

Pre-Entry Evaluation - A pre-entry evaluation shall be conducted prior to entry to ensure that all requirements are in place and the training of all personnel involved in the inert entry has been verified. The Pre-Entry Checklist (or similar) in **RSW-0143-GV-FORM01** must be completed to document the evaluation. The evaluation team should include representatives from operations, tech services, the nitrogen vendor, maintenance, safety and the inert entry contractor. All discrepancies are to be corrected prior to issuing the safe work permit for entry.

6.0 Acceptable Inert Atmosphere

6.1 Maintain Oxygen Concertation - For purposes of this standard, the oxygen concentration (by volume) shall be 2% or less for initial entry into an inert vessel and maintained at 4% or less during inert entry activities.

Reason: This is to

a) ensure a safely inert atmosphere in the vessel and

b) absolutely prevent

- any ignition of the catalyst or
- ignition of flammable vapors in the vessel, or
- potential adverse effect on vessel metallurgy.

6.2 Monitor Oxygen Concentration: The oxygen concentration must be continuously monitored.

Important: If the oxygen concentration exceeds 4% by volume during inert entry activities, all Inert Confined Space, entrants shall immediately exit the inert vessel until the oxygen concentration is reduced to 4% or less.

7.0 Inert Gas Source

7.1 Gas Purity – Apply the following gas purity requirements and guidelines:

7.1.1 The inert gas will typically be nitrogen, although carbon dioxide and argon my be used.

7.1.2 Whenever inert gas is used, its composition shall be maximum 0.5% oxygen and verified prior to it being discharged into the confined space. The nitrogen composition must be >99.9% and this shall be verified in writing by either the supplier or laboratory.

7.1.3 Plant nitrogen may be used for inert operations provided the supply is adequate to achieve 2% oxygen or less for initial entry and maintain 4% oxygen or less during inert entry activities.

Notes:

(1) If the inert gas is supplied by a vendor's truck, the vendor should supply verification. For plant nitrogen, the refinery must have a means/method to ensure the purity requirements are met.

(2) For hydro processing units (hydrotreaters, hydrocrackers, etc.) and Tail Gas Reactors (SCOT Catalyst), membrane technology shall not be used as the source of inert gas. Membrane generating units may be used for inert Claus sections of sulfur unit trains as long as 99.5% purity is confirmed and maintained.

7.2 Inert Gas Supply and Backup Supply – Apply the following inert gas supply and backup supply requirements and guidelines:

7.2.1 There must be an adequate supply of inert gas to achieve 2% oxygen or less for initial entry and , maintain the inert atmosphere in the confined space during inert entry activities to 4% Oxygen or less for the duration of the work.

Note: The inert gas flow must be controlled to prevent ice formation within the inert vessel and ensure proper purging. The formation of ice within the vessel may be determined via cameras or indicated by the buildup of pressure in the vessel.

7.2.2 In addition, there must be an immediately available independent backup supply of inert gas sufficient to maintain flow to the vessel for the duration of the proposed work.

Note: This supply shall be immediately available and be connected to a manifold attached to the primary inert gas supply.

7.2.3 A qualified person shall
a) monitor the inert gas supply, and
b) be immediately available to shift to the backup supply.

8.0 Monitoring Near Restricted Areas

8.1 Respiratory Protection Requirement when Monitoring Inert Confined Space Openings - Using supplied breathing air respiratory protection, initial air monitoring shall be conducted by MPC or designated representative at the inert confined space openings.

Reason: This is to determine the level of respiratory protection required, for personnel working in those areas.

8.2 Managing Vapors: During the inert process, vapors are being vented from access openings.

Note: These vapors contain inert gas and vapors already present in the confined space and thus, a hazardous atmosphere may exist outside the inert confined space near the access openings.

9.0 Inert Entry Attendant Back Up

9.1 Introduction - In addition to the "Inert Entry Attendant" required for a confined space entry, a "Inert Entry Attendant Back Up" is always required, regardless of the atmospheric conditions when any personnel are working or sampling near the inert confined space opening.

9.2 Attendant Back-Up Requirements - The **"Back Up Attendant"**

- **a)** shall be responsible for controlling worker access to the restricted/inert areas (e.g. manway platform)
- **b)** have the workers sign in and out of the restricted area,
- **c)** visually observe and monitor all personnel working in a restricted area, including the Inert Entry Attendant, and
- **d)** have PPE similar to an Inert Confined Space Entrant immediately available to don and assist in an emergency.

Important: These procedures shall be followed until the potential for an oxygen-deficient, flammable, or immediately dangerous to life or health (IDLH) atmosphere has been eliminated.

10.0 Warning Signs at Access Openings

10.1 Signs Around Restricted Areas - In addition to signage normally required for confined space entry, the area around the restricted area shall be marked with signs.

Reason: This is to warn personnel of the hazardous condition around openings and any respiratory protection requirements.

10.2 Where to Post Signs – These signs around restricted areas and access points must be posted

- a) in the immediate area of the restricted area openings, and
- b) at ladders and stairways leading to the restricted areas.

10.3 Example: Sign Wording - The signs should contain wording similar to the examples provided below.

Restricted Area Opening at Top of Reactor
Danger – Inert Confined Space <u>Restricted Area</u> **Immediately Dangerous to Life & Health** **Continuous Monitoring and Supplied Breathing Air Required** **Due to Vented Vapors, Areas Immediately Outside Access Opening May Contain Hazardous Vapors Requiring Respiratory Protection**

Ladder and Stairways Leading to Restricted Area
Danger – Reactor Under Inert Atmosphere **Low Oxygen Content – Immediately Dangerous to Life & Health** **Check-in Required with Catalyst Contractor Supervision** **before Accessing Vessel Top**

11.0 Air Monitoring Requirements

11.1 Monitoring Internal Atmosphere - The Inert Entry Contractor shall monitor the internal atmosphere of the inert confined space and the effluent gases immediately outside the confined space openings in the restricted area for

- **a)** oxygen content,
- **b)** flammable levels, and
- **c)** all applicable toxic atmospheric contaminants.

Important: In addition, the confined space must be monitored for temperature and inert gas back-pressure(a back-pressure test is done prior to entry to verify there is no back-pressure build-up of nitrogen due to catalyst crusting.)

Note: The Inert Entry Contractor has primary responsibility for this requirement. In addition, MPC personnel shall conduct initial and mid-shift (at a minimum) independent atmospheric monitoring of the inert confined space and the effluent gases. After all spent catalyst is unloaded and the internal atmosphere is returned to normal oxygen levels, atmospheric monitoring can resume to normal CSE procedures.

11.2 Atmospheric Conditions to Meet: Before entry, at a minimum, the atmospheric conditions in the table below

- a) must be met, and
- b) maintained throughout the entry and verified through continuous monitoring.

At a minimum the following conditions must be maintained:

Inside Confined Space	Outside Confined Space
Oxygen*: Less than or equal to 2% by volume or less for initial entry 4% by volume or less during inert entry activities	**Oxygen: N/A**
Toxics: N/A	**Toxics <IDLH*** **H_2S & CO--Continuous monitoring required** **Benzene—Periodic monitoring to confirm respiratory protection**
Flammables*: 10% LEL for hot work, <20% LEL for cold work	**Flammables: <10 LEL***
Carbon Monoxide: 10 PPM limit inside vessel (See Note below)	**Carbon monoxide: 25 PPM**
Temperature*: Shall not exceed 100° F nor rise more than 5^0F in any 15 minute period. Shall not be less than 40°F (See Notes below)	**Temperature: N/A**
Verify no back pressure buildup prior to entry Inert Gas Back Pressure (prior to Catalyst removal Only*) – No buildup during entry (Also, see Note below)	**N/A**

<u>NOTE:</u>

This monitoring is to be continuously conducted by both the contractor performing the inert entry and LRD Safety/IH and is intended to continuously confirm that the atmosphere inside the inert confined space remains at acceptable levels. This monitoring is also performed to continuously confirm that the level of respiratory protection being worn by the outside attendant(s) is appropriate for the hazards and would alert them of potential IDLH conditions and prevent exposure above the PEL for any of the toxics which may be present.

11.3 Calibrate Equipment for measuring - Equipment used to analyze the confined space and effluent atmospheres must be

a) properly calibrated for oxygen deficient atmospheres, and

b) capable of accurately measuring low levels of oxygen and flammables in an oxygen deficient atmosphere.

11.4 Potential Formation of Nickel Carbonyl – There is a potential formation of nickel carbonyl, a highly toxic material, when carbon monoxide in the purge gas reacts with a nickel – containing catalyst.

Note:

1. This would present a hazard to unprotected personnel outside the confined space.
2. Carbon monoxide should be kept to a minimum (< 10 PPM) in the inert gas used.
3. A direct reading instrument may be used to monitor for carbon monoxide; however, if levels >10 ppm are detected, detector tubes (with required pre-tubes) must be utilized to verify the reading.

11.5 Monitoring Carbon Monoxide Levels: Monitoring must be conducted to determine if carbon monoxide levels are exceeding

a) 10 ppm inside the vessel, or
b) 25 ppm outside the vessel.

Important:

1. The inert vessel shall not be cooled below 400 degrees Fahrenheit if more than 10 ppm CO is present.
2. If carbon monoxide levels greater than 10 ppm inside the inert vessel must be purged further.
3. If carbon monoxide levels exceed 10 ppm inside the vessel, personnel must exit the vessel until the source of carbon monoxide is determined and the levels return to below 10 ppm.

11.6 Monitoring Inert Vessel Temperature: The ambient temperature of the inert vessel must be continuously monitored, by the Inert Entry Contractor conducting the inert entry, to ensure the ambient atmospheric temperature limit of 100 degrees F is ***not*** exceeded.

Reason: This is to prevent undue heat stress on Inert Confined Space Entrants.

Important: If the ambient temperature rises more than 5° in a 15-minute period, personnel must be immediately removed, and the cause of the temperature rise must be determined.

Note: The catalyst bed temperature can be monitored in the control room using internal temperature sensors in the confined space, if the sensors are installed.

11.7 Monitoring Inert Gas Flow Pressure: Before entry, the inert gas flow pressure must be monitored using a Back pressure Test Manifold or equivalent.

Reason: This test is to ensure that the inert gas flow into the vessel is not obstructed by crusted catalyst which would cause back pressure to build and accumulate. The Back Pressure test blocks in pressure against the catalyst in the reactor and confirms that the pressure dissipates over a short period of time, thus demonstrating that the inert gas moves freely through the catalyst.

12.0 Evacuation, Ventilation and Protection

12.1 Evacuation - The Inert entry confined space attendant shall continuously monitor the atmospheric conditions of the confined space and must direct all entrants to evacuate the space immediately if

- **a)** the conditions change from established and permitted requirements outlined in 6.1 or
- **b)** in the event any other hazardous condition becomes apparent.

12.2 Adequate Ventilation - If an enclosure or partial enclosure (e.g. shelter, tent) is built over the point of entrance (e.g. manways) , it must be

- **a)** designed to ensure adequate ventilation and
- **b)** continuously monitored so that inert gases do not accumulate.

Important: Enclosures must always have the bottom and at least two sides open.

12.3 Protection of Restricted Area - When the inert vessel is left unattended (e.g. lunch breaks, shift changes), the open manways must

- a) Be covered with a physical barrier(e.g., nylon rope lockout device, plywood bolted to manway), and
- b) Have a sign warning of the inert atmosphere hazards.

13.0 Inert Entry Personnel

13.1 Inert entry contractor and Inert Confined space entrants: Any inert confined space entrant shall be trained and qualified as an Inert Entrant. See definitions.
References: For details on qualifying as an inert confined space entrant, see *definition Inert Confined Space Entrants*.

13.2 Refining Personnel Overseeing Entry Procedure: Any Refining personnel overseeing the contractor inert entry procedure shall be qualified as an Inert Entry Trained Personnel as defined in see definitions.

References:

1. For details on qualifying as an Inert Entry Trained Personnel, see definitions (*Inert Entry Trained Person*).
2. For details of reactor workflow and MPC oversight into the process of safe entry into inert atmospheres, see RSW-0143-GV-FORM01.

14.0 Personnel Protective Equipment

14.1 Respirator Use Requirements: During inert entry operations, a positive pressure (helmet style), full facepiece, airline supplied respirator with an auxiliary self-contained escape unit shall be utilized by all entrants and attendants.

NOTE: In sub-freezing temperatures, measures must be taken to ensure the proper operation of supplied air equipment (e.g., equipment warmers or heaters).

14.2 Emergency Escape: The escape unit shall have adequate supply to allow emergency escape.

14.3 Air Supply Sources: The air supply shall have a primary and backup source.

14.4 The **backup source** shall be connected and be immediately available to pressurize the system and shall be independent of the primary air supply.

Important: The primary and Back-up supply shall have sufficient capacity to supply the work for the duration.

14.5 Air Helmet: The supplied air helmet shall be secured to prevent inadvertent removal.

14.5.1 All breathing air shall be Grade D or better and
14.5.2 supplied from cylinders, *not* compressors.

14.6 Monitoring Breathing Air Supply: A trained person must

14.6.1 continually monitor the breathing air supply of all workers in supplied breathing air equipment and
14.6.2 be available to switch to the back-up supply (if the Inert Confined Space Entrants breathing air system is not designed to activate automatically upon dropping below a low-pressure set-point).

14.7 Evacuation of Personnel: All personnel in or near the inerted confined space shall be evacuated immediately if the primary or back-up air supply is compromised or interrupted in any way.

14.8 General PPE: Appropriate clothing (e.g., Disposable FR coveralls) must be worn to provide protection from identified hazards.

15.0 Communication Equipment

15.1 Communication Equipment : A hardwire or radio form of communication between and among the following must be assured for at least the following personnel:

- **a)** workers in the vessel,
- **b)** personnel stationed on platforms or at manways, and
- **c)** personnel in the command module.

Important: The communication system shall be installed in the helmet worn by the Inert Confined Space entrant and Inert Entry attendants.

15.2 Refinery Radios: The Inert Entry Supervisor and the Nitrogen Truck Operator shall be issued a MPC radio.

Reason: This is to maintain communications with MPC Operations in order that they can take immediate action as necessary, such as switching to the backup nitrogen supply.

15.3 Evacuation of Personnel: All personnel are to be evacuated from the confined space if the communication system is interrupted. Personnel shall not re-enter the inerted confined space until a reliable communication system meeting the requirements in Section 15.0 is assured.

16.0 Rescue and Emergency Services

16.1 Rescuing Personnel: Provisions for rescue of personnel from an inert confined space will primarily be the responsibility of the contractor .

Important: The Inert Entry contractor's rescue service shall be evaluated by MPC to ensure they have the capability to reach the victim within an appropriate time frame and they are equipped and proficient in performing the needed rescue services. Proficiency is typically determined by reviewing training records and proof of rescue exercises.

16.2 Facility's Rescue Team: The facility's Rescue Team will be available on site to

- **a)** supplement (non-entry rescue) the Inert Entry contractor's rescue team and
- **b)** provide medical assistance.

16.3 Emergency Rescue Equipment: At a minimum, the following Emergency Rescue Equipment shall be immediately available at the inerted vessel and provided by the contractor:

1. Hoisting device to extricate personnel from the confined space.
2. Extra and independent supplied air respirators as required by the scope of the work and rescue pre-plan.

3. Harnesses, ropes, tools, etc. needed to extricate personnel

4. Medical response equipment (e.g. trauma kit, first aid kit, Bag Valve mask oxygen, , AED)

5. Stretcher and means to lower injured personnel to ground

6. Provisions for summoning assistance
7. Personal Protective Equipment required for entry

16.4 Rescue Pre-Plan: A written Rescue Pre-Plan shall

a) be developed by the Inert Entry Contractor performing inert entry operations and
b) include as a minimum,

- Emergency Rescue of an Injured Person from within the Vessel,
- Rescue Equipment Placement,
- Lowering an injured person to grade,
- Medical treatment,
- Emergency Management Responsibilities,
- Contact numbers for emergency services,
- Rescue Personnel Assignments.

Important: The completed Rescue Pre-Plan shall be attached to the inerted confined space entry permit.

16.5 CPR Trained Personnel: The Inert Entry Contractor shall have CPR trained personnel, AEDs and resuscitators available for immediate use.

16.6 Full Body Harnesses: All inert confined space entrants shall wear a full body harness with a life line attached to a retrieval device outside of the vessel.

Note: In some cases, a retrieval line may not be practical, such as when a reactor contains multiple trays. In these cases, the rescue pre-plan must address this issue.

17.0 Catalyst Removal – Vertical Reactors / Vessels

17.1 Differential Pressure Measurement: Prior to entry a Back Pressure test, must be used to

a) measure back-pressure, and
b) determine whether catalyst crusting is a potential problem.

17.2 An **MPC employee** (Operations/Coordinator/Safety) shall witness the results of the test.

Important: If the Back pressure test has determined the back-pressure or crusting is a potential problem, personnel cannot enter the confined space until the hazard is eliminated or mitigated(alternatively placing nitrogen hoses into the top of the reactor vessel to maintain an inert atmosphere).

17.3 Inert Confined space Entrant engulfment: Due to the potential for crusting and inert confined space entrant engulfment in the catalyst bed, at ***no*** time during the inert entry process shall work be performed that puts the Inert Confined Space Entrant in a position where they are supported solely by the catalyst. The entrant must be supported by either; standing on a ladder platform (with a vertical lifeline attached to their harness D-ring), or **a taut lifeline** attached to their harness D-ring when removal activities necessitate standing on the catalyst. Catalyst removal activities conducted with Inert Confined Space Entrants standing on the catalyst bed should be minimized when dumping catalyst bed. A Plant variance is required before being permitted to stand on catalyst bed. Inert Confined Space Entrants shall not stand on the catalyst when a void is present in the catalyst bed beneath their location.

Important: A void in the catalyst bed must be eliminated by methods that do not involve Inert Confined Space Entrants standing on the catalyst bed, such as use of an auger, vibrator, lance, raking or chipping catalyst from a ladder platform, or other means to physically separate fused catalyst.

NOTE: Initially, entry will *only* be allowed on the top distributor tray, if so equipped to remove the internal manway.

17.4 Removing Catalyst from Vessels: As much catalyst as possible shall then be removed from vessels utilizing non-entry methods such as gravity flow or vacuum.

17.4.1 Before an entry can be made below the level of the distribution tray, an MPC Inert Entry Trained Person is required to confirm via video, in consensus with the Inert Entry Contractor Supervisor, that catalyst will not pose an engulfment or falling object hazard to the entrant.

17.4.2 When the catalyst level has been confirmed at the bottom of the vessel, Inert Confined Space Entrants may walk on the bottom of the vessel to remove the last catalyst at the bottom of the vessel.

Important:

1. In vertical reactors with multiple beds and tray levels, as much catalyst as possible shall be removed utilizing non-entry methods (bottom dumping) before allowing entry to remove residual catalyst and open the next manway.
2. An Additional attendant shall be positioned on the tray section

above the inert confined space entrants to ensure their safety is maintained In multi-bed vessels.

Reference: For details of reactor workflow and MPC oversight into the process of safe entry into inert atmospheres, see RSW-0143-GV-FORM01

NOTE: Other means (flushing with neutralized water, vibrator, lance, etc) may be necessary to remove non-flowing catalyst.

17.5 Accumulation of Catalyst: Catalyst must never accumulate to the point where there is a possibility of a cave in.

Important:

1. Any bridging or catalyst sticking together or catalyst buildup attached to the walls must be removed progressively to avoid exposing inert entrants to the hazard of collapsing catalyst or falling crusted/chunks of catalyst.

2. No one is allowed on a bed of catalyst that is being bottom dumped.

NOTE: If catalyst is found to be sticking together and/or stuck to the walls the inert entrant shall work from a position where they are protected from the hazard of collapsing or falling catalyst.

17.6 Entering Inerted Vessels: Inert Confined Space Entrants may enter the inerted vessel to dislodge stuck catalyst or to vacuum catalyst from vessels that are not equipped with bottom dump nozzles, ***as long as*** the Inert Confined Space Entrant is supported by a ladder platform or **a taut lifeline** attached to their harness D-ring when removal activities necessitate standing on the catalyst. Catalyst removal activities conducted with Inert Confined Space Entrants standing on the catalyst bed should be minimized.

Important: This requirement may be eliminated once *only* residual catalyst remains and the engulfment hazard no longer exists.

Reference: For details of reactor workflow and MPC oversight into the process of safe entry into inert atmospheres, See **RSW-0143-GV-FORM01**

18.0 Catalyst Removal – Horizontal Reactors / Vessels

18.1 Removing Catalyst from Vessel: Prior to entry into an inerted horizontal vessel, as much catalyst as possible must be removed from outside the manway.

18.2 As much catalyst as possible shall then be removed from vessels utilizing non-entry methods such as gravity flow or vacuum.

18.3 Before an entry can be made below the level of the distribution tray, MPC Inert Entry Trained Personnel are required to confirm via video, in consensus with the Inert Entry Contractor Supervisor, that catalyst will not pose an engulfment or falling object hazard to the entrant.

18.4 When the catalyst level has been confirmed at the bottom of the vessel, Inert Confined Space Entrants may walk on the bottom of the vessel to remove the last remaining catalyst.

Reference: For details of reactor workflow and MPC oversight into the process of safe entry into inert atmospheres, see RSW-0143-GV-FORM01.

Notes:

18.4.1 Other means (flushing with neutralized water, auger, vibrator, lance, etc.) may be necessary to remove non-flowing catalyst.

18.4.2 This will typically be accomplished by vacuuming.

18.5 **Entering Inerted Vessels:** Inert Confined Space Entrants may enter the inerted horizontal vessel to remove (e.g. vacuum) residual catalyst whenever the possibility of engulfment *no* longer exists.

19.0 Catalyst Loading

19.1 **Vessels Inerted during Catalyst Loading**: If the confined space vessel is inerted during catalyst loading**, all** previously stated requirements must be adhered to.

19.2 **Standing and Walking on the Catalyst:** When loading operations require entry, the inert confined space entrant may stand / walk on the catalyst as long as

a) there is ***no*** slack in the lifeline and
b) it remains taut.

19.3 The **loading hopper** must be offset from the top manway so as not to block the only egress from the reactor.

20.0 Miscellaneous

20.1 **Tools:** Pneumatic tools used inside the confined space shall be powered with nitrogen to prevent the introduction of air into the inert atmosphere.

Important: All tools shall be equipped with nitrogen service fittings.

20.2 Electrical Devices: All electrical devices

a) must be appropriately classified and
b) generally shall be

- "intrinsically safe" or
- explosion proof.

Exception: One exception is when using cameras to examine the reactor, noting that most cameras are not explosion proof or intrinsically safe.

Important: When using non-explosion proof or non-intrinsically safety equipment, the oxygen concentration must be less than or equal to 4% by volume and flammable vapors less than 10% LEL.

20.3 Lighting: Adequate lighting shall be provided inside the inerted vessel to insure that work can be performed in a safe manner.

20.4 Adequate lighting is defined to be enough lighting for the workers inside the vessel to see vessel walls and *all* parts of the catalyst bed.

20.5 Exposure to Atmospheric Contaminants: Inert confined space Entrants and others associated with the unloading process may be exposed to atmospheric contaminants above the permissible exposure limits.

20.5.1 The Inert Entry Contractor must comply with all requirements of the appropriate OSHA regulations such as

a) atmospheric monitoring,
b) biological monitoring,
c) warning signs, and
d) wash facilities.

20.6 Inert Camera: Video and audio recordings of all unloading and loading operations shall occur in their entirety. If the camera is not functioning the Inert Entrants shall be removed from the vessel. Video and audio recordings of unloading and loading operations must be submitted to an MPC Representative if requested.

Appendices

RSW Safe Entry into Inert Atmosphere Pre-Entry Checklist-FORM01
RSW Reactor Alignment Meeting Discussion Points-FORM02
GVL Reactor Worksheet-FORM03
Appendix C

REVISION HISTORY

Revision Number	Description of Change	Written by	Approved by	Revision Date	Effective Date

0	**Change procedural format**	**Safety**	**Refinery Management Team (RMT)**		
1	**Revised to include Refining Safe Entry into Inert Atmosphere Standard Practice revisions**	**Safety**	**Refinery Management Team (RMT)**	**12/03/2010**	**12/03/2010**
2	**Added contractor requirement of portable TIs during unloading and entry of inert confined spaces. Added requirement to set the fixed TI alarm set points to 110° F and to contact the confined space entry supervisor if set points are exceeded.**	**Safety**	**RLT**	**8/13/2013**	**8/13/2013**
3	**Added statement in 5.4.5 Note #2 concerning readings of CO greater than 10 ppm to be checked with detector tube. This has been updated for the three year review.**	**Safety**	**Safety**	**11/26/2013**	**11/26/2013**
4	**Fixed the formatting of the document.**	**Amanda Hall**	**Safety**	**7/10/2014**	**7/10/2014**
5	**Added Section 5.4.14**	**Amanda Hall**	**VPP 10/22/2015** **RLT 10/29/2015**	**11/13/2015**	**11/13/2015**
6	• **Added Sections 3.5, 4.9, 4.13** • **Changed Acceptable O2 to ≤ 4% throughout procedure** • **Changed Temperature to 100°F throughout procedure** **All changes were part of Audit Findings to comply with Corporate RSP and API Standard** **3 Year Review**	**Al Morales**	**VPP – 8/18/2016** **RLT – 9/1/2016**	**9/6/2016**	**9/6/2016**
7	• **Added section 5.4.15 to allow permit and entry log to be kept in the life support trailer for reactor inert entries.**	**Al Morales**	**VPP – 2/21/2018** **RLT – 3/1/2018**	**3/1/2018**	**3/1/2018**
Revision Number	**Description of Change**	**Written by**	**Approved by**	**Revision Date**	**Effective Date**

8	• **Replaced references to Basic Practices and Updated to Refining Standards** • **Format corrections** **3 Year review**	**Safety**	**Safety**	**9/11/2019**	**9/11/2019**
9	• **3 Year Review** • **Added requirement for Safety verification for Grubbs Test, Falling, and Dropped Object.** • **Added Safety/IH monitoring of atmosphere & Temp. of inerted space.** • **Added requirements around egress of space and video monitoring.** • **Updated Reactor Workbook** • **Replaced Pre-Entry Checklist and TAR Planning with RSP Forms 01 & 02.**	**T. Gregory**	**VPP/RLT**	**9/22/2022**	**9/22/2022**
10	• **Added pre-job planning requirements. Updated atmospheric and temperature limit and monitoring requirements. Added continuous video monitoring and video verification requirements for entry operations. Updated support requirements for inert entrants. Updated Appendix B and added Appendix C. Other general clarifications throughout document.**	Allen Morton	VPP/RLT	**3/31/2023**	**10/3/2023**
11	• **Made clarifications to Section 11.6 and removed section 11.7 which was monitoring inerted vessel (Catalyst) temperature. This is a minor change to match the RSP.**	**Allen Morton**	**Safety**	**3/5/2025**	**3/15/2025**

Appendix C: Loading of Ex-Situ Sulfided Catalyst

C.1 Hazards

Ex-situ sulfided catalyst is similar to spent catalyst in that it is self-heating. It spontaneously reacts with air/oxygen. This reaction is exothermic, resulting in a rapid generation of heat, and it also forms sulfur dioxide (SO_2), a respiratory irritant.

C.2 Special Precautions

Keep ex-situ sulfided catalyst from contacting air/oxygen. Ex-situ catalysts are shipped in nitrogen-blanketed bins and must be loaded in an inert atmosphere. All containment mechanisms (hopper, chute, vessel) must be inerted to prevent air/oxygen from contacting the ex-situ sulfided catalyst. Frequent monitoring should be conducted to ensure oxygen levels inside the hoppers, chute and catalyst bins are maintained at the lowest achievable level to prevent an exothermic reaction with the catalyst (0.5% oxygen is a suggested target).

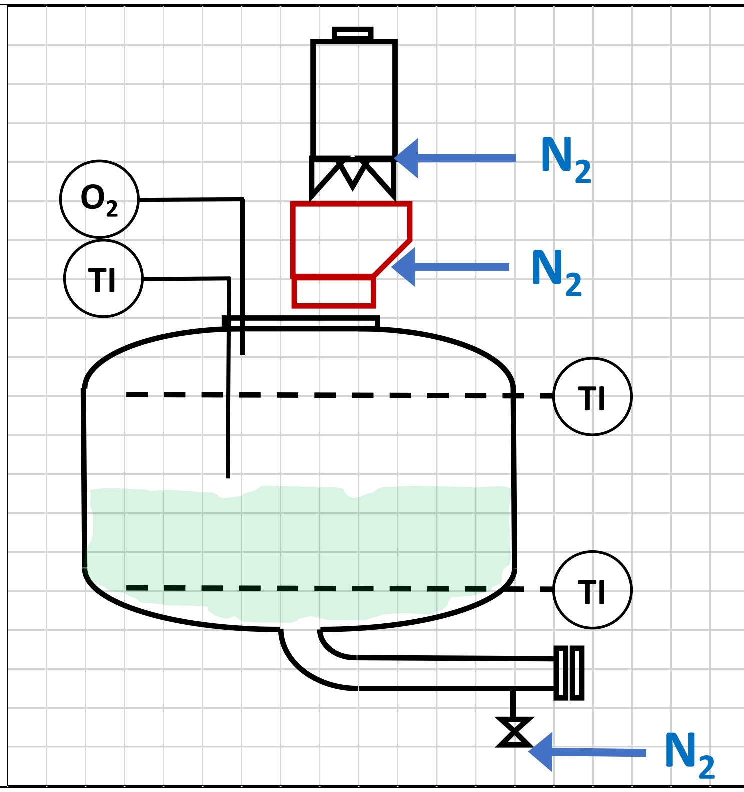
C.3 Loading of Ex-Situ Sulfided Catalyst

The reactor vessel must be aggressively purged with nitrogen to prevent catalyst contact with air. The catalyst bin and loading hopper must also be nitrogen purged. The catalyst hopper must be tarped when changing bins in order to prevent catalyst contact with air/oxygen.

C.4 Temperature Monitoring

Monitor catalyst temperature using bed Temperature Indicators (TIs). Only TIs near the catalyst surface are effective since that is the catalyst with the potential for contact with air/oxygen. Temperature must be steady, not rising – rising temperature indicates air in the system.

Reactor Vessel, TIs, Catalyst Hopper, Chute, Monitoring Points and Nitrogen Connections



N_2
O_2
TI
N_2
TI
TI
N_2