VALERO	**2.2.1- Inert Entry**	**Effective Date: January 1, 2007** **Revision Date: Under Revision**

Standard Owner : Corporate Safety Director

1.0 Purpose

This standard defines the minimum requirements that must be in place at each site to protect employees and contract personnel from the hazards associated with entering and/or working near vessels purged with nitrogen or other inert gases (e.g. argon, carbon dioxide, etc.). This is applicable to all refining operations and supplements applicable regulatory requirements.

In addition to performance based requirements, this standard contains design requirements; therefore, the applicable requirements will be reviewed and applied during the design phases associated with new construction or modifications.

2.0 Scope

This standard applies to all employees and contractors working at Valero Refineries and Terminals (The Company).

3.0 Requirements

Each facility's local Inert Entry Safety Requirements and/or Operating and Maintenance Procedures will address the following issues:

3.1 Restrictions / Limitations

3.1.1 Valero employees are prohibited from entering inert spaces for any reason, including rescue operations.

3.1.2 Inert entry will only be allowed by a "specialty contractor" when all other less hazardous options have been fully evaluated and after adequate procedures have been developed to manage the risks.

3.1.3 Inert entry and/or opening vessels under inert purge for the purpose of entry will only be performed by specialty contractors specifically trained and equipped for this type of work.

3.1.3.1 Hot bolting (exercising the bolts) or preparing the equipment can be completed by other parties trained to do so (Example: boiler makers, pipe fitters) as specified in the site procedure.

3.1.3.2 The specialty contractor will be required to perform the work when the possibility for complete engulfment is a risk. (Example: Removing the last bolts and removing the manway off of an reactor under inert purge)

3.1.3.3 Opening vessels under inert purge for purposes other than entry (troubleshooting, taking a sample or skimming of catalyst, etc.) is permissible and may be accomplished by other than a specialty contractor. This type of work is subject to controls such as:

3.1.3.3.1 Written JSA.

3.1.3.3.2 Refinery leadership team and refinery manager approval.

3.1.3.3.3 Other practices specified in the Nitrogen Handling/Use standard.

3.2 Contractor Selection

3.2.1 Each site must have a formal contractor review and approval process for inert entry contractors. The contractor must demonstrate a clear commitment to safety as a core value and an ongoing cycle of continuous improvement.

3.2.1.1 All contractors that perform Inert Entry work must have their Safety Program reviewed, including Inert Entry and Rescue Procedures, against the key requirements of this document.

3.2.1.2 The review must include an evaluation of fit test records to ensure that personnel working in breathing air are routinely examined for medical fitness as required by regulatory requirements or the equivalent local standard.

3.2.1.3 The review must examine inspection and test records for all BA equipment, Life Support System(s), emergency rescue equipment, and gas testing equipment to ensure it is routinely inspected, tested and meets the relevant standards.

3.2.2 The Management of speciality contractors who perform Inert Entry work must make a presentation to Company site management prior to award of a contract and annually thereafter. Company management participation will be specified by the individual site. The presentation shall include, at a minimum:

- Demonstration of Management's Commitment to Safety
- Senior Management Site Visits for the purpose of HSE review
- Contractor's Organization Chart Review and Changes Since Last Year
- Organizational Roles & Responsibilities for HSE
- Safety, Health and Environmental Program review to include;
  - Equipment Integrity Program (Inspection, Replacement/Upgrade)
  - Personnel Review (Training, Experience, Crew Size)
  - Contractor's work History (Experience in Type and Scope of job)
  - Auditing (Pre-Job, Execution, Follow-up Actions)
  - Job Observation Program
  - Hazard Recognition Program
  - Incident Investigation and Follow-up (Review of Company & Industry Incidents w/ Changes Implemented & Corrective Action Closure Times)
  - Three year history of near miss incidents and Safety Statistics, or the history of the company (if doing business less than three years)

If the company name has changed then the history of the company under the different business name must be provided.

3.3 Pre-job planning

3.3.1 Pre-planning every aspect of the job is required in order to complete the job successfully. Sample checklists have been provided in Appendix A to cover most phases of inert entry work.

3.3.2 Company employees must be involved in the operation to provide the contractor with the proper facility knowledge, task expectations, and accountability to complete the job safely. Site documents shall incorporate thorough preplanning procedures to include:

3.3.2.1 Company's Process, Mechanical, and HSE representatives will review the contractor's written site safety and emergency/rescue plan prior to arrival or start of work.

3.3.2.2 Prior to inert entry, Mechanical Execution First Line Supervisor (FLS) will coordinate a meeting to discuss the contractor's written plan for performing work under inert conditions and their emergency procedures. Meeting attendees shall include:

- Process Front Line Supervisor
- Mechanical Planning
- Contractor Safety Coordinator
- HSE Representatives (e.g. Safety, Industrial Hygiene, Emergency Response)
- Contractor Representative(s)

3.3.3 Results of this meeting shall be documented and action items must be completed prior to start of the inert entry job.

3.3.4 Contractor must provide to the company representative written documentation prior to commencement of work supporting qualifications for working in an inert environment. The minimum documentation required shall include:

- Employee service and current training records for all crew members
- Certification of emergency/rescue training (Regulator standards or equivalent local standard)
- Documentation of Confined Space Entry training consistent with regulatory standards, or equivalent local standard
- A written procedure for performing work, including Job Safety Analyses (JSA) for work as defined below.

3.3.5 The contractor shall prepare a JSA, specific to the vessel being entered and the work being performed. The JSA should address all recognized risks associated with the work such as:

- Setting up the inert entry / catalyst handling equipment at the work site
- Access to and egress from the equipment
- Provision for adequate lighting
- Control of access around the work site and around any open manways or nitrogen vent points
- Lifting and rigging activities
- Manual handling activities
- Catalyst handling
- Removal of vessel internals (scale traps, internal manways, trays)
- Installation and operation of catalyst dump valve
- Catalyst loading
- Installation of warning signs utilizing recognized caution/danger symbols.

3.3.6 The JSA will be reviewed by the Valero Rep. responsible for the work activity and must be communicated by the contractor to those doing the work.

3.3.7 The inert entry contractor shall have a documented heat stress plan, including a work/rest regimen, based on the ACGIH Threshold Limit Values. See Appendix C for further details. (non-mandatory appendix)

3.4 Equipment and Life Support System Requirements

3.4.1 Inert entry requires specialized equipment that must be inspected and in good working order. Contractors must supply all equipment necessary for completing the job.

3.4.1.1 Contractors must maintain a communications system for use by their employees working inside the inert atmosphere and those monitoring the work from the outside. This system must be capable of simultaneous communication with all connected personnel. The system shall include a redundant system in the event the primary system fails. If for any reason the primary communication link fails, the persons working inside must be evacuated.

3.4.1.2 Technicians entering the inert space must wear a helmet which is sufficiently secured to prevent inadvertent removal. (Some contractors use a special 'clamshell type' helmet with integral BA, which can not be accidentally removed or dislodged).

3.4.1.3 Technicians must be equipped with a form of video monitoring systems for use inside of the inert vessel.

3.4.1.4 Two independent sources of air must be provided to a helmet. The second air supply shall cut-in automatically on loss of the primary air supply pressure.

3.4.1.4.1 Air supply must be Certified Grade D quality breathing air or better. Each facility procedure will address quality control checks of the breathing air supplied for the inert entry contractor. Only bottled air is permitted and must be supplied from vendors who use compressed breathing air and routinely sample lots to ensure that oxygen concentrations are within acceptable limits.

WARNING!
Blended or synthetic air
shall NOT be used for supplied breathing air.

3.4.1.5 The technician must wear an auxiliary escape air bottle.

3.4.1.6 An Emergency Egress Line (EEL) shall be supplied for each entrant. Air for these EEL lines shall be supplied from an independent source.

3.4.1.7 The umbilical cord containing the air hoses must be adequately sheathed to protect the hoses and be designed such that the hoses can not be detached (e.g. internal wire hooked to the harness and anchored to a secure point outside the vessel).

3.4.1.8 A trained person, located outside the confined space, must continuously monitor the air supply. An alarm, audible or visible, must be provided to warn of low air pressure.

3.4.1.9 Contractors can be lowered into the vessel using a winch/hoist specifically designed for carrying people. Contractors shall provide appropriate documentation on these winch/hoists prior to start of work. Alternatively, a ladder can be used for access. In both cases an independent means of fall arrest must be provided (e.g.-. using an inertia reel or a 'Rollgliss' type device).

3.4.1.10 Lighting systems must be explosion proof and supplied by a GFCI power source. Transformers must be located outside the vessel.

3.4.1.11 A risk assessment shall be conducted to determine the additional PPE required to protect the persons working inside the equipment from catalyst dust, residual oil and other physical hazards.

3.4.1.12 Nitrogen shall be used to power any pneumatic equipment being used inside the space during inert conditions.

3.4.1.13 Any tents/enclosures built in the regulated area must designed to prevent nitrogen accumulation and oxygen deficient atmospheres.

3.5 Emergency Preparedness (Rescue/Evacuation)

3.5.1 The contractor is responsible for developing a written emergency plan which includes, but is not limited to:

- Loss of N_2 Supply (low pressure)
- High N_2 pressure (potential catalyst crust)
- High reactor O_2
- High/increasing reactor temperature
- Loss of BA air supply
- Emergency inside the reactor
- Plant emergency outside the reactor
- Communication between company and contractor personnel
- Means of summoning emergency services

3.5.2 Adequate emergency rescue facilities must be immediately available at the vessel manway and the contractors must be trained in its use. This will include:

- Hoisting device and lifeline to extract person from inside confined space.
- Persons working inside the reactor will wear a harness, which enables the person to be lifted out of the reactor in a vertical position (e.g. 6 point harness, parachute type harness).
- A pre-planned means of lowering the person to the ground (e.g.- stokes, backboard, lowering system).
- A radio or other means of summoning for assistance.
- The safety stand-by (holewatch) at the vessel manway must wear standard inert entry equipment. A spare set of standard inert entry equipment must be available at the vessel manway so that the inert assistant can replace the safety stand-by in the event he must assist the workers inside.

- The Standby by cannot leave his post until relieved

3.5.3 Trained personnel to provide emergency first aid and cardiopulmonary resuscitation (CPR)shall be available to respond in a timely manner.

3.5.4 The person working inside the vessel must maintain visual contact with the safety stand-by. An additional stand-by inside the reactor may be necessary (or other visual means established such as CCTV).

3.5.5 A rescue procedure will be developed for multi-bed reactors with staggered tray manways or horizontal vessels, where the person inside the reactor cannot be lifted out directly using the hoisting device.

3.5.5.1 It is preferable to enter an inert vessel with multiple beds from the lowest manway where work is performed to avoid tunneling through reactor trays. In addition, consideration must be given to air supplies for entrants during rescue for multi-bed operations. It is anticipated that these rescue operations are more complicated and longer in duration. Rescue teams must have demonstrated capabilities for performing entry rescues specific to the hazards and obstacles that may be encountered.

3.5.6 Evacuation of the vessel must occur under the following circumstances:

- Loss of primary communications system
- Vessel temperature rise greater than 15^{o}F
- Loss or problems with primary breathing air
- Loss or problems with nitrogen purge
- Loss of power and/or lighting
- Low/high nitrogen pressure alarm
- O_2 concentration greater than 4% or the elevation above any other atmospheric conditions listed in 3.6.6

3.5.7 Anytime a vessel is evacuated, a thorough investigation must be performed to identify the cause(s) that led to the evacuation. Re-entry shall not be allowed until corrective actions have been implemented to address the cause(s). The inert entry permitting process shall be repeated and a new entry permit issued.

3.6 Entry Conditions & On-going Monitoring

3.6.1 A primary and secondary nitrogen supply will be established to ensure no loss of purge (see Appendix B for example). Means will be available to monitor the nitrogen supply and warn of any problems (e.g. pressure gauges and/or alarms).

3.6.1.1 If the site cannot produce a secondary nitrogen supply then they have to assure that they have a reliable supply of nitrogen.

3.6.2 Procedures need to include provisions for sampling of nitrogen sources to ensure purity is sufficient to meet limits on inert atmospheric conditions.

3.6.3 Due to the potential for some catalysts to develop a crust, planning the introduction of nitrogen supply must address methods to eliminate the potential for build-up of pressure below this crust (e.g. Grigg's manifold, N_2 Hoses through top manway, relief valve below the bed). ??????????????????????

3.6.4 The site shall establish a means of identifying if the catalyst has been crusted over, or provide a means to measure pressure levels above and below each catalyst bed.

3.6.5 All valves in the nitrogen supply system shall be tagged or locked as available to prevent unauthorized opening/closing.

3.6.6 Vessel atmosphere requirements for inert entry with life support system breathing apparatus are outlined in the following table. If these levels are exceeded while an entry is in progress, the vessel must be evacuated until these levels are restored.

Substance	Max Value	Comment
Oxygen	<4 vol%	The max limit set by API 2217A is 5%. However, sites may set lower limits. The maximum limit for vacuum operations is 4%.
Hydrocarbons, Hydrogen	<10% LEL	Standard combustible gas meters may not be able to measure %LEL in a low oxygen environment. Special devices (diffusers/venturi's) are required and are to be used only by trained technicians.
H2S	<100 ppm	Limit based on avoiding H2S levels>10 ppm in the vicinity of the reactor manway platform, and avoiding odor complaints.
Benzene	<10 ppm	Limit based on avoiding Bz levels >1 ppm in the vicinity of the reactor manway platform.
CO	<50 ppm*	Will be tested when catalyst contains Nickel or Cobalt. This is to prevent the potential formation of highly toxic metal carbonyls.

* Continuous monitoring of CO is required since an increase could be indicative that a combustion reaction is taking place.

3.6.7 The contractor shall maintain a periodic log or checklist of continuous monitoring. Site procedures will include routine checks of the log by the FLS assigned to the job with appropriate documentation of this check (see below). The contractor's checklist or log must include:

- Vessel temperature
- LEL
- Oxygen Concentration
- Air Supply (Primary & Secondary & EEL) Checks
- Communication Checks
- Regulated Area Checks

3.7 Access Control

3.7.1 The area around the Inert Entry Operation must be barricaded to limit personnel in the area. The perimeter of this regulated area will be a minimum of 4-feet from the vessel opening or manway. Atmospheric testing shall be utilized to determine if the size of the regulated area needs to be increased to insure a safe working environment for those not working within the regulated area.

3.7.2 A qualified attendant is required to be at the entry point, but outside the regulated area (defined by gas tests) throughout the inert entry portion of the job or any time the vessel manway is not barricaded.

3.7.2.1 The attendant is assigned this position to coordinate between the Inert Entry Supervisor and Company during any emergencies and to facilitate response to changing job conditions that could impact the overall safety of the work.

3.7.2.2 The attendant is responsible for insuring no unauthorized personnel are allowed to enter the regulated area. The attendant will maintain a log of all personnel entering and leaving the restricted area.

3.7.2.3 The attendant will not be assigned any other duties until inert conditions are complete.

3.7.3 An Inert Entry sign will be posted at the point of access to the area (ladder, cage, elevator, etc.), at the entry point to the regulated and at the entry point into the vessel. The sign will indicate "Danger – Nitrogen in use - Authorized personnel only".

3.7.4 Any time the regulated area is left unattended (job completion or work breaks), the manway and other openings must be physically secured using a manway locking device or 4 bolting the entry way to prevent unauthorized entry. Blanks or other devices used to secure the manway shall be constructed such that they allow atmospheric testing of the vessel without removal.

3.7.5 Anyone entering the regulated area must wear supplied breathing air and a harness.

3.7.6 Access to the equipment platform will be limited to essential personnel.

3.8 Vacuum Operations

3.8.1 Vacuum risks must be addressed from the approval process through execution. The following additional precautions need to be taken:

- All components including the ducting, the cyclone, and vacuum equipment must be properly bonded and grounded to prevent build-up of an electrostatic charge.
- Hoses must be visually examined prior to each use. (catalyst erosion)
- Vacuum equipment must be purged with nitrogen prior to use and a nitrogen supply will remain connected at all times.
- A vacuum system removes large amounts of nitrogen from the vessel. Nitrogen levels in the vessel must be regulated to maintain the proper concentration during vacuum operations.
- Exhaust shall be discharged to a safe location.
- A barricade shall be used to establish a safe zone around the vacuum truck.
- A method shall be established to verify positive pressure in the vessel during vacuum operations.
- Vacuum operations must be stopped if the vessel O_2 level rises above 4% and LEL rises above 10%.
- The location of the vacuum hose needs to be considered in the emergency evacuation procedures.
- Spent catalyst containers must be inerted (e.g. use of dry ice chunks).

3.8.2 At the end of the vacuuming operation, the internal components of the vacuum system shall be thoroughly washed/cleaned to remove pyrophoric dust/residues. Filters shall be routinely cleaned to prevent build-up of pyrophoric waste.

3.9 Pre-Job Checks/Work Permitting

3.9.1 Prior to beginning inert entry tasks, a Pre-job Safety Audit Checklist (Appendix A or equivalent) must be completed.

3.9.2 All personnel working in or near an inert purged vessel are required to obtain a safe work permit before beginning any work activities.

3.9.3 A field review between the permit issuer and the permit recipients is required to ensure complete understanding of the scope of work, the hazards present, and the safeguards required.

3.9.4 Initial confined space entry permits into vessels under inert purge require authorization by a company safety department representative and the FLS responsible for the work being performed. Re-issuance of the permit at the start of each shift also requires authorization by the FLS responsible for the work being performed.

3.10 Post-job Critique

3.10.1 At the conclusion of each inert entry job, there shall be a documented critique facilitated by the Company employee supervising the job and the contractor manager over the job. The agenda for the critique shall include:

- Contractor review of Highlights & Opportunities

- Company review of Highlights & Opportunities
- Review the effectiveness of communications system performance
- Review of any evacuations and corrective actions
- Review of any near misses and associated corrective actions
- Lessons learned for policy and procedure revisions
- Overall safety performance

3.11 Training Requirements

Each facility's local nitrogen safety training will meet the following criteria, at a minimum:

3.11.1 All employees and contractors will be trained on a annual basis to maintain a heightened awareness of the potential dangers of nitrogen to include:

- The hazard characteristics and properties of nitrogen.
- Sources of nitrogen
- Symptoms and effects of nitrogen exposure
- Workplace practices and relevant procedures that have been established to protect personnel from the hazards of nitrogen asphyxiation.
- Confined space and enclosed facility entry procedures.
- Reporting requirements
- Locations and use of safety equipment
- Locations of emergency assembly areas

3.11.2 Additionally, supervisory personnel, employees and contractors involved in inert entry work will receive training prior to the start of the inert entry work that meets the following criteria, at a minimum:

- Special precautions and procedures associated with inert vessel entry.
- Proper use and maintenance of breathing equipment for working in nitrogen areas (theory and hands-on practice, with demonstrated proficiency).
- Emergency response procedures that have been established for the facility.
- Rescue techniques and first aid for victims of nitrogen exposure

3.12 Facility variance process

3.12.1 Any deviation must be reviewed and approved through a process that has been expressly approved, with regards to inert entry by the facility vice president / general manager.

4.0 Performance Management

4.1 Site self-audits

4.1.1 Annually verify implementation of the Refinery Inert Entry Standard Program.

.

4.1.2 Prior to each inert entry job, the site will assess corporate and local procedures and practices including:

- Incident reviews
- Audit reviews and findings
- Post-job critiques from previous work
- Contractor selection
- Pre-job planning
- Emergency Preparedness
- Entry Conditions & ongoing monitoring
- Access Control
- Work permitting

4.2 Corporate compliance audits

4.2.1 Will be conducted based upon audit schedules.

5.0 Definitions

5.1 **Specialty Contractor** - A specialty contractor is one who can comply or complete (which ever is applicable) with all of the following sections of this procedure:
3.3.4 Pre-Job planning
3.3.5 Pre-Job planning
3.4 Equipment and life support system requirements
3.5 Emergency Preparedness
3.6.1 Entry conditions and on-going monitoring
3.8.1 Vacuum operations

5.2 **Inert Confined Space** –A confined space where the existing atmosphere is intentionally displaced with a non-flammable gas, such as nitrogen, creating an inert atmosphere in the confined space. As used in this standard, an inert atmosphere is oxygen deficient (typically below 5% O2) and is an immediate asphyxiation hazard (typically below 12.5% by volume).

6.0 Roles And Responsibilities

6.1 **Site**
6.1.1 Assure compliance with this standard.
6.1.2 Develop site requirements which incorporate the CTEMS Standard.
6.1.3 Conduct self and contractor audits & track corrections.

6.2 **Corporate**
6.2.1 Review these requirements every 3 years
6.2.2 Ensure these requirements are integrated into the audit criteria
6.2.3 Assist sites with implementation
6.2.4 Corporate compliance audits will be conducted based upon audit schedules

7.0 Management Review

7.1 Corporate Health and Safety will review every three years the results of the performance measures. Based on this review corrective/ preventive action shall be implemented to address deficiencies or non-conformances in the design or implementation of this Standard. The results of the management review should also be used as appropriate to revise and improve this CTEMS Standard to confirm it is achieving the desired business results.

8.0 References

8.1 API Standard 2217A
8.2 29CFR 1910.146
8.3 Cal-OSHA Title 8; Subchapter 7; Article 108

9.0. Appendices

Appendix A

Safety Planning Checklist

Check	Y	N	Comment
1. Is it essential that the work be carried out under inert entry conditions and has the work been authorized by turnaround/project manager or equivalent?			
2. Has inert entry duration been minimized (e.g.- can the vessel be loaded under normal air conditions)?			
3. Is the contractor on the ACL?			
4. Does the catalyst contain cobalt or nickel - is a check for CO required?			
5. Do the persons carrying out the inert entry work have adequate training and experience? Are they fit tested and routinely examined for medical fitness?			
6. Does the contractor's BA equipment, Life Support System and emergency rescue facilities comply with site requirements?			
7. Has a Company person been assigned who will be responsible for the inert entry activity?			
8. Has the Pre-job Planning Meeting been held with the contractor and are all action items complete?			
9. Have tasks requiring PPE been clearly identified (e.g.- blinding of vessel, removal of manway doors, other work in close proximity of open manway)?			
10. Is a manway locking device available if needed to prevent unauthorized entry?			
11. Has a Task Risk Assessment or Job Safety Analysis been conducted?			
12. Have plans for an independent back-up of N_2 been provided for in the event of loss of the primary N_2 supply?			
13. Has an emergency response plan been developed for this vessel and the scenarios defined by this document?			
14. If vacuum systems are being utilized have plans been developed for their safe use?			

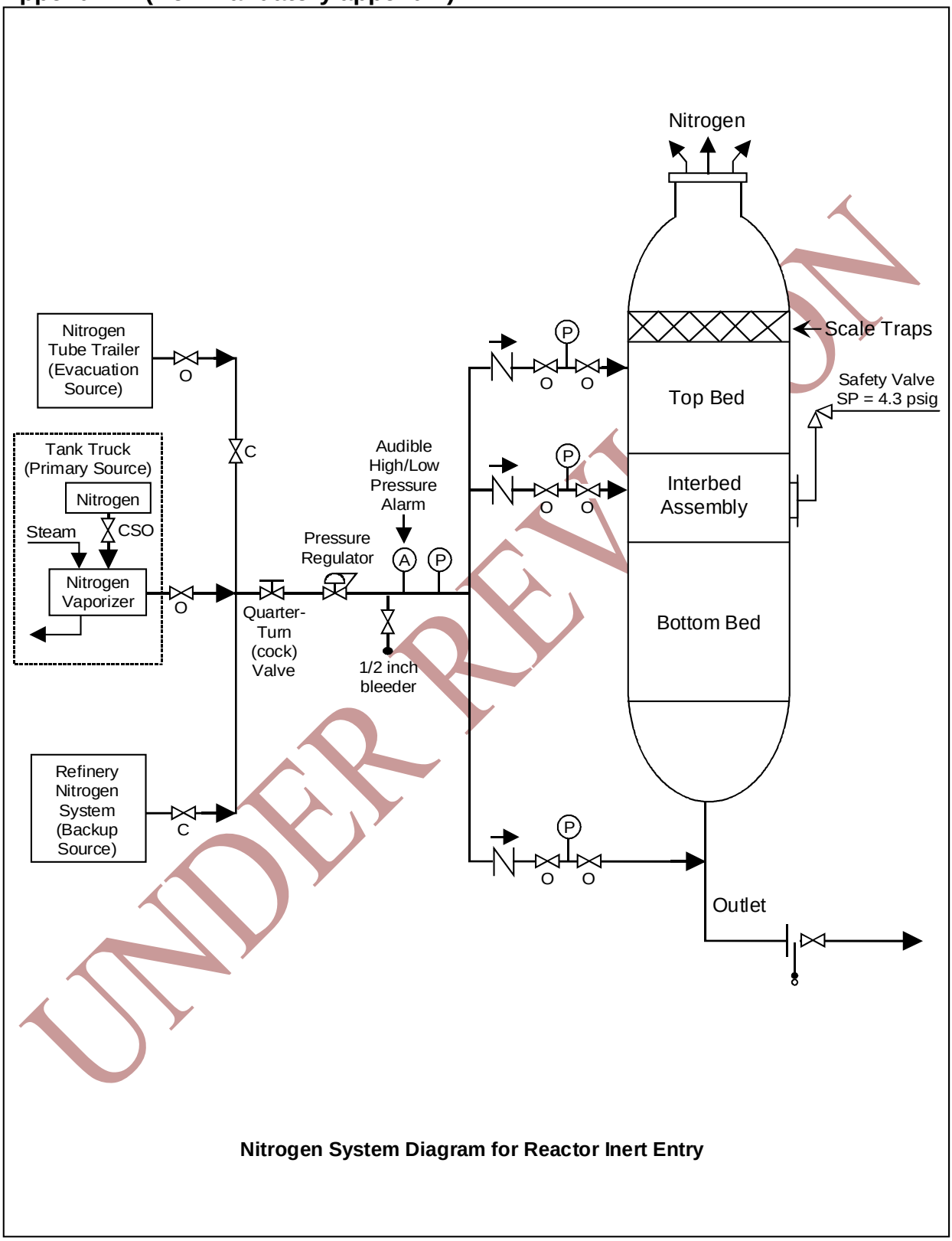
Pre-Job Safety Audit Checklist

Note: Checklist to be completed by FLS responsible for Inert Entry.

Check	Y	N	Comment
Procedures			
1. Have procedures been developed, approved, and communicated?			
2. Is Confined Space - Inert Entry sign readily visible at point of access and entry point?			
3. Is the vessel blinded from all process and utility connections (excluding the N_2 purge)?			
4. Has the general work site been barricaded and signs put up to warn of Inert Entry Job in progress?			
5. Are regulated areas appropriately barricaded and identified?			
6. Is the Entry Supervisor, Safety Stand-by, Attendant, and Technician (Entrant) identified? Verify they understand their responsibilities prior to initial entry.			
7. Have JSA's been completed and communicated to all affected personnel?			
Vessel Atmosphere			
1. Is necessary equipment available/on-site to conduct atmosphere tests at low O_2 levels?			
2. Has the atmosphere been tested by Company personnel to confirm that it meets the Inert Entry conditions (O_2 < 4%, LEL < 10%, Bz < 10 PPM, CO < 50 PPM, and H_2S < 100 PPM)?			
3. Has the primary N_2 supply has been secured open and is a secondary N_2 supply is available?			
4. Has the vessel manway been protected against loss of N_2 supply?			
5. Is there a potential for heat stress and has the temperature been measured? Has an appropriate work-rest regimen been developed?			
6. Has a work permit been authorized for entry into the vessel?			
7. Do the contractors know what actions to take if the specified atmospheric monitoring limits are exceeded?			
8. Are the atmospheric monitoring and alarm systems functioning properly?			
Equipment			
1. Has the contractor checked all his equipment to confirm that it is working correctly? – BA equipment, air supplies and escape bottles – Life support system & alarms – Communications equipment – Gas detection – Emergency rescue equipment – Harnesses			
2. Have fire extinguishers/charged water hose been provided to deal with any minor spill of pyrophoric catalyst?			
3. Are there radio interferences?			

Check	Y	N	Comment
Emergency Response			
1. Has a radio or other means of communication been provided in the event of an emergency?			
2. Verify Contractor's rescue team is on-site and all equipment is in place.			
3. Site Emergency Response Coordinator notified of Inert Entry work in progress.			
4. Have facilities been provided to quickly retrieve an injured person from the confined space, and to lower him from the vessel platform to ground level?			
5. Is the safety stand-by wearing full inert entry BA equipment?			
Entry and Communications			
1. For multi-bed or horizontal vessels, are adequate provisions in place for monitoring work in the vessel (e.g.- TV camera, second person inside reactor)?			
2. Have precautions been taken to avoid the potential blow out of a catalyst crust?			
3. Has the pressure drop across the bed(s) been checked?			
4. Has safe access to the vessel been provided?			
5. Has adequate lighting been provided?			
6. Are pneumatic tools being supplied with N_2 and not air?			
Vacuum System Operations (If applicable)			
1. Has the vacuum equipment been purged with N_2 prior to use? Are all components suitably bonded and grounded?			
2. Are hoses located in a safe location, protected and clear of evacuation routes?			
3. Is the pressure differential between the space and the outside atmosphere being monitored?			
4. Do the employees know when to order an evacuation of the space?			
5. Is the vacuum system being exhausted in a safe location and manner?			
6. Are the persons working inside the confined space continuously monitored and in communication with a person outside the space (typically at the Life Support Control Module)?			
7. Has the atmosphere been tested at the start of each shift by Company personnel to confirm that it meets the inert entry conditions?			

Appendix B (Non mandatory appendix)



Nitrogen System Diagram for Reactor Inert Entry

Appendix C

Heat Stress Guidelines

The advised limit of 86 deg F (normal dry bulb temperature) for moderate work in normal overalls provides a simple guide as to when a more detailed assessment of heat stress needs to be undertaken. This limit is based on an estimate of the Globe Bulb and Natural Wet Bulb temperatures for a reactor purged with dry nitrogen where the Relative Humidity (%RH) is close to zero. It does not apply to reactors or other vessels, which are purged with air. For work in an impervious/impermeable suit (e.g.- Disposable Tyvek suit) a lower temperature limit of 77 deg F is recommended.

The following table shall be used to provide minimum guidelines for controlling heat stress:

Category	**Ambient Temp (°F) wearing regular clothing[1]**	**Ambient Temp (°F) wearing PPE[2]**	**Action Steps**
I	<90	<70	• No specific heat stress action steps.
II	90-100	70-90	• Ready access to fluids, consumption will be 1 cup every 20 minutes[3]. • Periodic breaks. • Monitor employees for symptoms by supervision.
III	100-110	90-100	• All Category II, plus a communicated work/rest regimen and at least one of: - Use shading - Use temporary insulation - Use spot cooling (fan or A/C) - Use personal cooling devices (cooling vests, vortex tubes, etc.) - Supplied air respiratory protection. - Reflective barriers for radiant heat.
IV	110-120	100-110	• All Category II, plus a documented work/rest regimen; at least one of Category III, plus: - No work[4] without approval from next level of supervision.

Notes:

1 - Regular clothes- FRC, Nomex, cotton coveralls, etc.

2 - PPE- slicker suits (e.g.- for acids or caustics, impervious/impermeable coveralls (e.g.- for asbestos, lead), disposable coveralls, welding leathers, etc.

3 - For certain activities involving decontamination (asbestos, lead) where access to water may be infeasible, a special work/rest regimen must be developed.

4 - Work means continuous presence in the environment for greater than 15 minutes.

The above limits do not apply where persons are wearing specially designed air- cooled suits. If the temperature is greater than the *Threshold Limit Values* a more detailed assessment will be required involving the local Occupational Health/Industrial Hygiene specialist in order to establish the appropriate work-rest regimen and to identify whether any additional monitoring of the workers is required. The assessment shall take into account the following:

- The ambient temperature of the work environment
- The internal temperature of the vessel
- The job tasks being performed
- The length of the job tasks
- Crew size/rotation of tasks
- Acclimatization
- PPE
- Work/rest regimens established by the contractor

Revision Log

Revision Date	Revision No.	Revision Summary
		Initial Version