Purging of Flammable Gas Equipment and/or Piping (Explosion Hazard)

APPLICABILITY:

This EH&S Instruction applies to UTAS sites worldwide, including contractors working at UTAS facilities. The document describes minimum safeguards that must be implemented by an UTAS site that is considering purging any equipment, piping or piping system containing a flammable gas or fuel gas (e.g. propane, natural gas, etc.) or purging the equipment or piping system with the intended flammable or fuel gas by displacing the air or inert gas in the system.

This procedure applies to the purging of systems with pressures less than 40 psig (2.8 kg./cm^2; 2.7 atm.), pipe size of 2 inches (5 cm.) or less in diameter **and** where the purge volume is less than 200 ft^3 (5.7 m^3). Effective Immediately - all sites must adhere to this instruction when conducting purging activities of this type. UTAS sites must also comply with any applicable local regulatory requirements that are more stringent than this EH&S Instruction.

The use of compressed flammable gas or fuel gas to blow out debris is specifically prohibited at UTAS.

When a system purge requires pressure that exceeds 40 psig (2.8 kg./cm^2; 2.7 atm.), **or** the pipe size exceeds 2 inches (5 cm.) in diameter **or** the total gas purge volume exceeds 200 ft^3 (5.7 m^3), UTAS Sites must obtain prior approval from the Vice President – EH&S and Vice President – Operations. Appendix B describes specific requirements for these situations.

SUMMARY:

Any UTAS site considering the performance of a new installation, maintenance, replacement or other service to equipment or facility piping systems that uses or transports flammable gases or fuel gas shall ensure that adequate controls are in place to eliminate the possibility of explosion created during the purging of the flammable gas from the equipment or piping systems or by filling the equipment or piping system with the intended flammable or fuel gas after servicing where the system pressure is less than 40 psig (2.8 kg./cm^2; 2.7 atm.), the pipe size is less than 2 inches (5 cm.) in diameter and purge volume is less than 200 ft^3 (5.7 m^3). Prior review and written approval of responsible UTAS personnel (or assigned delegates) is required for maintenance, installation, service, replacement or any other activity that would require the purging of piping containing a flammable gas or fuel gas or filling equipment or piping system with the intended flammable or fuel gas as described under Key Elements and the Approval to Purge Flammable Gas Permit form (see Appendix A.)

BACKGROUND:

When new flammable gas or fuel gas piping is put into service, or when existing piping is returned to service after interruptions, "it is typically necessary to purge the lines of air. U.S. fuel gas safety codes require that new piping installations be pressure-tested with air or an inert gas prior to initial operation, when this activity requires purging during the introduction of natural gas. Purging is commonly done by one of two methods: (a) fuel gas is used to directly displace the air, or (b) inert gas is used to displace the air and then fuel gas is used to displace the inert gas"[1]. The U.S. Chemical Safety Board (CSB) has released a Safety Bulletin (**No. 2009-12-I-NC)** that draws attention to serious dangers that can arise during flammable gas or fuel gas purging operations and that highlights five (5) key lessons the agency recommends for improving safety in the workplace. Based on the attached CBS Safety Bulletin, failure to implement all of these lessons has previously led to fatalities and substantial property loss for other companies. A similar risk exists during the purging of systems to remove the flammable gas or fuel gas prior to servicing. A copy of the CSB Safety Bulletin is imbedded below for reference.

1 – Excerpt from U.S. Chemical Safety Board (CSB) Safety Bulletin No. 2009-12-I-NC

KEY ELEMENTS: Any UTAS site planning a new installation, maintenance, replacement or other service to equipment or facility piping systems that uses or transports flammable gases or fuel gas that will involve the purging of a flammable gas or fuel gas from the equipment or piping systems, or filling the equipment or piping system with the intended flammable or fuel gas by displacing the air or inert gas in the system with the flammable gas or fuel gas, must comply with the following key elements:

1) The UTAS Project Manager (the UTAS individual responsible for the installation, maintenance, replacement or other service to equipment or facility piping systems that use or transport flammable gases or fuel gas that will require purging) shall complete Appendix A prior to the start of the project. Appendix A requires the review and approval of the site EH&S Department, the site Operations Manager (or assigned delegate) and the site Emergency Services Manager (if applicable).
2) The UTAS Project Manager shall specify methods to be used to directly vent purged gases to a safe location outdoors, away from people and ignition sources, and away from building air intakes whenever practicable. This can be done using a temporary hose or piping or permanently installed vent pipes, depending on the facility design. Venting purged gases to a safe location outdoors, away from people and ignition sources, and away from building air intakes sources is the preferred method for controlling the hazard.
3) If venting gases to a safe location outdoors, away from people and ignition sources, and away from building air intakes is not practicable, the UTAS Project Manager must document on the Approval to Purge Flammable Gas Permit form (see Appendix A) how the following minimum safeguards will be implemented:
    a) The evacuation of nonessential personnel from the work area and securing the work area from entry of non-essential personnel;
    b) Control or elimination of all potential ignition sources in the area into which the gas purge discharge will be vented;
    c) Provide adequate ventilation to maintain flammable gas concentrations well below the explosive limit at all times;
    d) Perform continuous monitoring during the purging event, using direct read combustible gas monitors (either portable or fixed) capable of emitting both audible and visible alarms, located in the area into which the gas purge discharge will be vented;
4) "Never rely on odor alone to detect releases of fuel gases. An odorant is typically added to fuel gases, such as natural gas and propane, to warn workers and consumers of releases. However, the perception of odor is highly subjective and varies from one person to another. People also become desensitized to odor during prolonged exposures. Additionally, new gas pipes and containers can react with or otherwise remove the odorant, an effect known as 'odor fade.'"[1]
5) While the gas is being purged, only employees and contractors directly involved with the activity and the combustible gas monitor observer shall be present in the immediate vicinity of the purge process.
6) The combustible gas monitor shall be in current calibration in accordance with the manufacturer's specification.
7) The combustible gas monitor shall be continuously observed by a qualified individual who has no other responsibilities during the purge process. If the monitor at any time indicates a reading > 25% of the Lower Explosive Limit (LEL), the purging process must immediately be shut down, all employees/contractors must leave the area, and the area must be ventilated. Work can not resume until the combustible gas monitor reads 0% LEL.
8) All UTAS employees, contractors or other personnel who will participate in the gas purge process shall receive training each time a permit is requested. At a minimum the training shall include a review of this EH&S Instruction, instruction on the use of the specific combustible gas monitor to be used (if applicable),

a review of the permit conditions, and a review of the U.S. Chemical Safety Board (CSB) Safety Bulletin (**No. 2009-12-I-NC).**

COMPLIANCE DATES: The requirements of this EH&S Instruction are effective immediately.

For further information, contact:

Jim Rost Telephone: 815-226-6352

Document Changes

Revision No.	Date	Description of Change
1	November 2010	Clarify requirements for high pressure/high volume systems.
2	December 2011	Clarify requirement for V.P. approval (e.g. pipe size greater than 2").
3	6/7/2012	Change HS to UTAS

Appendix A: Approval to Purge Flammable Gas Permit

SECTION I: PROJECT DESCRIPTION AND APPLICABILITY DETERMINATION

United Technologies Aerospace Systems Project Manager: Name / Telephone and Pager #:

_____

Alternate United Technologies Aerospace Systems Contact: Name / Telephone and Pager #:

_____

Date(s) Permit is Valid (5 Days Max.): Start: _____ End: _____

Time(s) Permit is Valid: Start: _____ End: _____

Is Weekend/Off-Shift/Holiday Work Required? Yes ☐ No ☐

If Yes, UTAS contact who will monitor work during this time:

_____

Describe the equipment or process piping and the flammable gas or fuel gas involved in the purge process: (Pressure must be less than 40 psig (2.8 kg/cm^2; 2.7 atm.), pipe size less than or equal to 2 inches (5 cm.) in diameter and purge volume less than 200 ft^3 (5.7 m^3))

Does the purge process directly vent purged gases to a safe location outdoors, away from people and ignition sources and away from any building air intake?

☐ **YES:** Sections II and IV are not applicable; perform training and obtain signatures in Section III prior to beginning the project.

☐ **NO:** Explain below why it is not practicable to directly vent purged gases to a safe location outdoors, away from people and ignition sources, and away from building intakes.

SECTION II: REQUIRED CONTROLS

Describe the specific methods to be used to evacuate nonessential personnel from the work area and to secure the work area from entry of non-essential personnel during the purge process:

Describe how all potential ignition sources in the area into which the gas purge discharge will be vented will be controlled or eliminated. Consideration must be given to ALL potential ignition sources (e.g. electrical disconnects and switches, portable equipment, lighting fixtures, cell phones, etc.):

Describe how ventilation will be established to maintain flammable gas concentrations below the explosive limit at all times:

A combustible gas monitor with visual and audible alarms, capable of measuring a minimum of 25% of the Lower Explosive Limit (LEL), shall be continuously observed by an individual with no other responsibilities.

Indicate gas monitor Manufacturer Name: _____

Indicate gas monitor Model Number: _____

Who will observe the gas monitor during the project? _____

Monitors must be within calibration per manufacturer's specifications.

Record Calibration Due Date or Calibration Interval Remaining _____

SECTION III: ADVANCE PROJECT APPROVAL

Verify that the minimum training requirements have been completed:

Training Date(s): _____

List Employees Trained: _____

Minimum Training Requirements Checklist:

☐ Employees have received instruction on the requirements of this Work Instruction and permit.

☐ Employees have received instruction on the use of the specific combustible gas meter to be used. **(Not required if gas is vented to a safe location outdoors, away from people and ignition sources and away from any building air intake - See Section I))**

☐ Employees have reviewed the U.S. Chemical Safety Board (CSB) Safety Bulletin (**No. 2009-12-I-NC).**

Signature of Person Performing the Training: _____

1. UTAS Project Manager:_____ Date: _____

2. Operations Manager (or Delegate): _____ Date: _____

3. EH&S Department: _____ Date: _____

4. Emergency Services (If present on Site): _____ Date: _____

OTHER SIGNATURES AS NECESSARY

5. Area UTAS Supervisor/Foreman: _____ Date: - _____

6. Other: _____ Date: _____

7. Other:_____ Date: _____

SECTION IV: APPROVAL TO PROCEED

	DATE:				
Area has be evacuated and secured from unauthorized entry:	☐	☐	☐	☐	☐
Verify that gas monitor is calibrated and monitor observer is present:	☐	☐	☐	☐	☐
Verify that individuals have received minimum awareness training:	☐	☐	☐	☐	☐
UTAS Project Manager's Initials:					

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If an atmospheric concentration of 25% Lower Explosive Limit (LEL) is reached, immediately shut down the purge process, evacuate the work area, and contact the UTAS Project Manager and EH&S Department.

"Never rely on odor alone to detect releases of fuel gases. An odorant is typically added to fuel gases, such as natural gas and propane, to warn workers and consumers of releases. However, the perception of odor is highly subjective and varies from one person to another. People also become desensitized to odor during prolonged exposures. Additionally, new gas pipes and containers can react with or otherwise remove the odorant, an effect known as 'odor fade.'"[1]

Appendix B: Purging High Pressure/High Volume Systems

When a system purge requires pressure that exceeds 40 psig (2.8 kg./cm^2; 2.7 atm.), the pipe size exceeds 2 inches (5 cm.) in diameter **OR** the total gas purge volume exceeds 200 ft^3 (5.7 m^3), UTAS Sites must develop a process-specific procedure to complete the purge event. These process-specific procedures shall follow the latest and most stringent regulatory requirements, and shall contain, as a minimum.

- Notification of all affected persons.
- Isolation of the process line work area.
- The sequential order (e.g. a checklist) to isolate the gas line from the gas supply.
- References to specific valve numbers in accordance with the Process and Instrumentation Drawing.
- The location and attachment of the purge supply line.
- The location of the discharge point.
- Specific ventilation criteria.
- Specific monitoring criteria.
- Specific pressure and purge duration requirements.
- The sequential order (e.g. a checklist) for re-connection and re-charging.

The checklists used to isolate the gas line and to reconnect the gas line shall be independently reviewed by at least two qualified individuals as each step is completed.

Specific requirements to be included in the process-specific procedures shall also include:

- Lines or line sections that are not part of the test must be isolated, blanked, and/or blinded.
- The point of discharge shall be continuously monitored during purging.
- Purged gases must be discharged at least 500 feet (152 meters) from potential ignition sources. In no case will purged gases be purged into a building.
- A seclusion zone will be set up for the gases to be purged and only authorized personnel will be permitted in the seclusion zone. Barricade procedures will be strictly followed in the setup and maintenance of the seclusion zone. An accountability system will be utilized for all individuals permitted in the seclusion zone.
- Continuous air quality monitoring will be performed in the immediate area of the purging operation and at specified points inside the seclusion zone. The selection of monitoring points will include consideration of the purge location, characteristics of the gas (heavier or lighter than air), stratification or mixing of the gas, and existing ventilation. Air monitoring will be performed using a gas meter set at 10% of the Lower Explosive Limit (LEL).
- As soon as gas is detected above 10% of the LEL, all purging shall stop. Purging may only resume after the gas meter detects no gas in the area.
- Purging with an inert gas shall be performed at the lowest acceptable pressure to achieve a complete purge.