

Confined Spaces

1.0 Purpose and Scope

- 1.1 This procedure establishes requirements for AECOM employees to participate in entries into, or attendance of, confined space / limited egress (CS/LE) locations.
- 1.2 AECOM's clients may have specific confined space procedures and supporting documentation which shall be followed on their properties or facilities. Provided the client's procedures meet or exceed those of AECOM, approval shall be obtained from the Manager and the SH&E Manager to follow the client's procedures.
- 1.3 This procedure applies to all AECOM Americas-based employees and operations and any other entity and its personnel contractually required to comply with this document's content.

2.0 Terms and Definitions

- 2.1 **Alternate Entry Confined Space** – As permitted by the applicable jurisdiction, a confined space, initially classified as a permit-required confined space that only has an atmospheric hazard that can be completely controlled through ventilation.
- 2.2 **Asphyxiant** – An airborne substance that can cause suffocation. Simple asphyxiants (e.g., carbon dioxide, nitrogen, argon, etc.) physically displace oxygen from the atmosphere; chemical asphyxiants (e.g., carbon monoxide, hydrogen cyanide, etc.) prevent the body from utilizing oxygen in the atmosphere.
- 2.3 **Attendant** – An individual who is stationed outside of a permit-required confined space to monitor authorized entrants and to initiate emergency response if necessary. As per jurisdictional requirements, an attendant may be required to be in the vicinity of a confined space irrespective of a permit requirement.
- 2.4 **Authorized Entrant** – Individual, authorized by the employer, who enters into the CS/LE to perform the task(s) defined in the entry permit and mitigation/control procedures
- 2.5 **Blanking or Blinding** – The absolute closure of a pipe, line, or duct by the fastening of a solid plate (such as a spectacle blind or a skillet blind) that completely covers the bore and that is capable of withstanding the maximum pressure of the pipe, line, or duct with no leakage beyond the plate.
- 2.6 **Competent Person** – The designated individual who evaluates the hazards in the space and confirms the controls and procedures outlined in the plans and permits.
- 2.7 **Confined Space** – Also referred to as Confined Space / Limited Egress (CS/LE). A space that:
- Is large enough and so configured that an employee can physically enter.
 - Has limited or restricted means for entry or exit.
 - Is not designed for continuous human occupancy.
- 2.8 **Controlling Contractor** – the employer that has overall responsibility for construction at the worksite. The controlling contractor may have been contractually issued the responsibility by the property owner or manager, or the controlling contractor may be the property owner or manager.
- 2.9 **Double Block and Bleed** – The closure of a line, duct, or pipe by closing and locking or tagging two in-line valves and by opening and locking or tagging a drain or vent valve in the line between the two closed valves.
- 2.10 **Emergency** – Any failure of hazard control or monitoring equipment, or other event(s) inside or outside a confined space that could endanger entrants within the space.

- 2.11 **Engulfment** – The surrounding and effective capture of a person by a fluid (i.e., liquid or finely-divided particulate) substance that can be aspirated and 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.
- 2.12 **Entry** – The action by which a person passes through an opening into a confined space. Entry includes ensuing work activities in that space and is considered to have occurred as soon as any part of the body breaks the plane of an opening of a confined space.
- 2.13 **Entry Permit** – An employer authorized written or printed document containing the required information as specified in this procedure that controls entry into a permit-required confined space.
- 2.14 **Entry Supervisor** – An employee responsible for determining if acceptable entry conditions are present, for authorizing entry into a permit-required confined space, for overseeing entry operations, and for terminating entry. After the initial entry authorization, the duties of an entry supervisor may be passed from one supervisor to another supervisor during the course of an entry operation. Entry supervisors may serve as attendants, competent persons, or as authorized entrants, so long as they are properly trained and equipped for each role the entry supervisor fills.
- 2.15 **Flammable Atmosphere** – Any atmosphere that contains a concentration of flammable or combustible material in excess of the percentage of the lower explosive limit (LEL) or lower flammable limit (LFL) and below the percentage of the upper explosive limit (UEL) or upper flammable limit (UFL) as specified by the applicable jurisdiction.
- 2.16 **Hazardous Atmosphere** – One or more of the following atmospheres that may expose employees to the risk of death, incapacitation, impairment of ability to self-rescue, injury, or acute illness:
- Oxygen concentrations less than the minimum or in excess of the maximum established by the applicable jurisdiction.
 - Flammable gas, vapor, or mist in excess of the percentage of the lower explosive limit (LEL) or lower flammable limit (LFL) as specified by the applicable jurisdiction (e.g., Ontario, CAN - 10% of LEL/LFL, Alberta, CAN - eliminate an explosive or flammable atmosphere, or inert, United States – 10% of LEL/LFL, British Columbia, CAN – 20% of LEL/LFL, etc.).
 - Toxic environments.
 - Airborne combustible dust in excess of the lower explosive limit (LEL) or lower flammable limit (LFL) as specified by the applicable jurisdiction OR in the absence of LEL/LFL, in a concentration that may be approximated as a condition in which the combustible dust obscures vision at a distance of 5 feet (1.52 meters) or less.
 - Atmospheric concentration of any substance for which a jurisdictionally established concentration, limit or value is exceeded (i.e. threshold limit value, permissible exposure limit, contamination limits, etc.)
 - Any other atmospheric condition that is immediately dangerous to life or health. The material safety data sheet (MSDS/SDS) can provide guidance in establishing acceptable atmospheric conditions when a concentration, limit or value is not given.
- 2.17 **Hot Work** – Any task that may produce a spark or source of ignition (e.g. riveting, welding, cutting, heating, etc.) and requires the employer's written authorization (hot work permit) to perform the operations.
- 2.18 **Immediately Dangerous to Life or Health (IDLH)** – Any condition that:
- Poses an immediate or delayed threat to life; or
 - Could cause irreversible adverse health effects; or
 - Potentially interfere with an individual's ability to escape unaided from a confined space.
- 2.19 **Inerting** – The displacement of the atmosphere in a permit space by a noncombustible gas (such as nitrogen) to such an extent that the resulting atmosphere is noncombustible. This procedure produces an IDLH oxygen-deficient atmosphere.

- 2.20 **Isolation** – The process by which a permit space is removed from service and completely protected against the release of energy and material into the space by such means as: blanking or blinding; misaligning or removing sections of lines, pipes, or ducts; a double block and bleed system; lockout or tag out of all sources of energy; or blocking or disconnecting all mechanical linkages.
- 2.21 **Limited or Restricted Means of Entry or Exit** – A condition that has the potential to impede an employee's movement into or out of a confined space such as trip hazards, poor illumination, slippery floors, steep inclining floors and ladders.
- 2.22 **Line Breaking** – The intentional opening of a pipe, line, or duct that is or has been carrying flammable, corrosive, or toxic material, an inert gas, or any fluid at a volume, pressure, or temperature capable of causing injury.
- 2.23 **Lockout Tag Out** – The use of a locking device to confirm that an energy-isolating device and the equipment or system it controls cannot be operated or energized until the lockout device is removed. A disconnect switch, circuit breaker, valve or other energy-isolating mechanism is put in the safe or off position, a lock applied and a written warning is attached to it. Tag out is always to be used in conjunction with lockout.
- 2.24 **Lower Explosive Limit (LEL)** – Also referred to as Lower Flammable Limit (LFL). The lowest concentration of a flammable gas / vapor in air which will ignite.
- 2.25 **Non-Permit Required Confined Spaces (NPRCS)** – As permitted by the applicable jurisdiction, spaces that do not contain existing or potential hazards, nor will the work performed or natural environment therein create a hazardous condition. Alternate terms may be used to refer to these spaces, depending upon the jurisdiction (e.g. Restricted Space, Confined Space – Low Hazard Atmosphere, etc.). These spaces do not require a confined space entry permit.
- 2.26 **Oxygen-deficient** – An atmosphere with an oxygen concentration less than the minimum established by the applicable jurisdiction that should not be entered without wearing an approved SCBA, or approved supplied air, full face respirator.
- 2.27 **Oxygen-enriched** – An atmosphere with an oxygen concentration in excess of the maximum established by the applicable jurisdiction. Oxygen enriched atmospheres will cause flammable materials to burn violently when ignited
- 2.28 **Permit-Required Confined Space (PRCS)** – Also called **Permit Space**. A confined space that exhibits one or more of the following properties:
- Contains or has a potential to contain a hazardous atmosphere.
 - Contains a material that has the potential for engulfing an entrant.
 - Has an internal configuration that could potentially cause an entrant could be trapped or asphyxiated by inwardly converging walls or by a floor that slopes downward and tapers to a smaller cross-section.
 - Contains any other recognized safety or health hazard.
- NOTE: Permitting of a confined space may be required in certain jurisdictions irrespective of the presence or absence of hazards.*
- 2.29 **Physical Hazard** – A nonchemical hazard that may cause cuts, abrasions, suffocation, crushing, trauma, hearing loss, burns, or radiant energy effects (e.g., welding).
- 2.30 **Prohibited Condition** – Any condition in a PRCS that is not allowed by the permit during the period in which entry is authorized. A hazardous atmosphere is a prohibited condition unless it is demonstrated that personal protective equipment (PPE) will provide effective protection for each entrant in the permit space and provides the appropriate PPE to each entrant.
- 2.31 **Rescue Service** – The individual and/or organization that is properly trained and equipped to carry out a confined space rescue operation.

- 2.32 **Retrieval System** –Includes equipment such as retrieval lines, harnesses, wristlets (if appropriate), lifting devices and anchors used for non-entry rescue of persons from permit spaces. Note that a retrieval line differs from a lifeline, which is a type of fall-arrest system.
- 2.33 **Self-Rescue** – The act of escaping unaided from a hazardous atmosphere or IDLH situation in a permit space.
- 2.34 **Upper Explosive Limit (UEL)** – The highest concentration of a flammable gas / vapor in air that will ignite.

3.0 References

- 3.1 S3AM-003-PR1 SH&E Training
- 3.2 S3AM-208-PR1 Personal Protective Equipment
- 3.3 S3AM-209-PR1 Risk Assessment & Management
- 3.4 S3AM-218-PR1 Permit to Work
- 3.5 S3AM-302-PR1 Electrical Safety
- 3.6 S3AM-312-PR1 Ladders
- 3.7 S3AM-325-PR1 Lockout Tagout
- 3.8 S3AM-332-PR1 Hot Work

4.0 Procedure

4.1 Roles and Responsibilities

4.1.1 Managers

- Make available confined space training to employees engaged in projects covered by this procedure. This training shall be completed and documented prior to initial assignment, prior to a change in assigned duties, if a new hazard has been created and/or if special deviations have occurred. Training shall be refreshed as appropriate. Refer to *S3AM-003-PR1 SH&E Training*.
- Determine alternative procedures that eliminate the need for entering confined spaces.
- Consult with the Safety, Health and Environment (SH&E) Department regarding project-specific requirements for confined space entries.
- As applicable, contact the employer that owns or is the contractual manager of the property to obtain information on:
 - The location of each known permit space,
 - The hazards in each space or the reason it is a permit space, and
 - Any precautions that the host employer implemented for protection of employees in the permit space
- As applicable, if AECOM is the controlling contractor of the construction site:
 - Confirm the information received from the property owner or manager is communicated to other contractors who will be entering the permit space.
 - Coordinate permit space activities for other contractors on the site.
- As applicable, if AECOM is not the controlling contractor of the construction site, inform the controlling contractor of the permit space program to be used and identify any hazards that could be confronted or created while working in the permit space.

- Inform the workers involved or affected by the confined space work about the client's, controlling contractor's or facility's requirements for confined space entries.
- Verify that only trained, authorized employees work in or near confined spaces.
- Confirm equipment any required entry equipment is provided at no cost to the employees, and the equipment is properly used and maintained.
- Confirm that written Confined Space Entry Procedures and permits are prepared for each entry.
- Assign an Entry Supervisor to be in control of all activities associated with the confined space.
- Confirm completed confined space entry documentation (*S3AM-301-FM2 Confined Space Entry Classification / Permit*) is reviewed within one year of the entry, or annually, for compliance to this procedure and to confirm entrants are adequately protected. This review should be verified by notation and date on the reviewed documentation.
- Confirm an assessment / evaluation and any necessary revision of this program, *S3AM-301-PR1 Confined Spaces* and supporting documentation, is conducted whenever procedures prove inadequate through reviews of confined space entry documentation, and annually as a minimum.

4.1.2 Competent Person:

- Meet the CS/LE requirements that are defined by applicable jurisdictional regulations, have documented CS/LE work experience and practical skills, and is capable of identifying workplace hazards relating to CS/LE entries. Refer to *S3AM-003-PR1 SH&E Training*.
- Evaluate the work site and identify confined spaces, including PRCS.
- Perform a hazard evaluation of the confined space using *S3AM-301-FM2 Confined Space Entry Classification / Permit*.
- Assess whether those hazards that create a permit-required confined space can be eliminated without necessitating employee entry into the space.
- Take appropriate actions and commit resources to identify and mitigate safety and health issues associated with CS/LE entries.

4.1.3 Rescue Services

- Confirm location of the confined space and the potential hazards associated with the proposed entry.
- Confirm adequate personnel and rescue equipment (type, quantity) are available to provide appropriate response.
- Confirm lifting devices, hardware, and retrieval lines meet applicable standards for personnel use.
- Confirm rescue procedures are appropriate to the given confined space and the potential hazards.
- Shall be within the proximity of the confined space specified by the applicable jurisdiction. In addition to and in the absence of specifications, proximity shall be appropriate to the potential hazards associated with the confined space in order to confirm a timely rescue.
- A rescuer shall be immediately outside the confined space for IDLH conditions, including when a retrieval line is used, while the work is being performed.
- Additional rescuers may be required to be in the immediate vicinity depending upon the hazards identified and jurisdictional requirements.

4.1.4 Entry Supervisor

- Shall be a Competent Person.
- Assess the risks prior to entry and establish the work plan accordingly, which includes identifying and obtaining all necessary equipment, and verifying functionality.
- Notify the location's SH&E representative prior to entry into a confined space.
- Coordinate confined space entry activities with the employer who has overall responsibility for construction at the worksite (known in various jurisdictions as Controlling Contractor or Prime Contractor). Confirm communication with other contractors who may affect the entry or who may be affected by the entry.
- Provide the controlling contractor and, as necessary, any other relevant contractors with a copy of this written program.
- Verify what conditions exist related to the confined space.
- Confirm barricades and posting of signage at the entrance of the space stating "Danger Confined Space Do Not Enter" or equivalent wording.
- Arrange for Authorized Entrants, Attendants, and Rescue Service personnel, as required.
- Verify all participants (Authorized Entrants and Attendants) are adequately trained for the work that is to be performed.
- Conduct a tailgate training session at the location of the confined space, reviewing all entries in the Permit with all Authorized Entrants and Attendants. Confirm the planned program shall include procedures for coordinating entry operations for multi-employers so that employees of one employer do not endanger the employees of any other employer.
- Confirm the confined space is emptied, purged, flushed, ventilated with air, or otherwise made free of hazardous substances.
- Confirm that the air within the confined space is tested with an appropriate air monitoring instrument.
- Confirm that all air test results are documented on *S3AM-301-FM2 Confined Space Entry Classification / Permit*.
- Verify the Rescue Service is equipped with retrieval equipment and trained in confined space entry rescue is available. A Rescue Service may be the local Fire Department or a client's Emergency Rescue Squad or the construction project's emergency response team. Emergency rescue capability and response time shall be established in the permit process and shall include emergency contact numbers.
- Confirm alternate procedures are developed for protection of entrants for any lines that may not be controlled (e.g., lines through storm water or sewer vaults). An advanced warning system will be provided for any potential sources of non-isolated engulfment as part of the entry program.
- Prior to the entry taking place, notify the emergency rescue service of the time, location, and duration of work in the confined space.
- Confirm appropriate means of communication are confirmed (in place and operable) for the entry team. Communication can be verbal, hand signals, radio, or telephone.
- Verify the proper isolation and lockout / tag out of any equipment, process lines, pipes, electrical systems or any other hazardous energy that can affect the safety or health of entrants in a confined space (e.g. line breaking, blanking or blinding, etc.).
- Remain in proximity of the confined space during all entries.
- Verify fresh air ports, manways, and access-ways are opened during the entire operation.

- When forcing air into a confined space to facilitate the proper entry condition, confirm that fresh air is continuously forced into the confined space prior to and during work within a permit-required confined space. Air will not be exhausted from a space. The objective is that the forced air will be sufficient to maintain a space safe for entry.
- Make sure that appropriate safety equipment is selected and used by all entrants based on the physical and health hazards that may exist.
- Confirm any unauthorized people are removed from a confined space.
- The Entry Supervisor on each shift shall determine, at appropriate intervals dictated by the hazards and operations performed within the space, whether entry operations remain consistent with the terms of the entry permit and that acceptable entry conditions are maintained.
- Cancel the entry permit at any time based on a change in monitored conditions or perceived hazards.
- Whenever responsibility for a permit space entry operation is transferred, the outgoing entry supervisor determines that entry operations are still consistent with the terms of the permit and that acceptable entry conditions are present, before turning operations over to the incoming entry supervisor.
- Terminate the entry and cancel the entry permit when the work authorized by the permit is complete. This includes taking necessary measures for concluding the entry operation and closing off the permit space.
- Review the Confined Space Entry Permit after completion of the work to evaluate the process.
- Confirm an assessment / evaluation of this program, *S3AM-301-PR1 Confined Spaces* and supporting documentation, is conducted whenever procedures prove inadequate through reviews of confined space entry documentation, and annually as a minimum.

4.1.5 Attendant

- Complete required training applicable to performing the roles and responsibilities of attending a confined space. Refer to *S3AM-003-PR1 SH&E Training*.
- Know the hazards of the permit space and the signs of exposure (including behavioural signs).
- Attendants shall not enter a confined space. Attendants may only enter a confined space if trained and competent in entry rescue procedures, the appropriate emergency equipment is available AND the original Attendant is replaced by another Attendant.
- As specified by the applicable jurisdiction, shall be stationed at or near to the entrance.
- The Attendant shall not leave the post unattended at any time or perform conflicting duties. If the attendant needs to leave his / her position, Authorized Entrants shall be called out of the confined space or another qualified Attendant shall take the position and responsibility.
- A single Attendant shall not monitor more than one confined space at any given time.
- Confirm that correct names of all Authorized Entrants are listed on the permit. Keep a current count and be able to identify all entrants.
- Confirm that all applicable parts of the permit are completed before allowing any Authorized Entrant to enter the space.
- Confirm that all equipment going into the confined space (e.g., tools and protective equipment) is in safe operating condition. It is prohibited for compressed gas bottles (e.g., burning and welding) to be brought into a confined space. All gas lines brought into access-ways shall be protected from sharp edges.
- Confirm that all Authorized Entrants have received any special instructions for the work to be performed before entering into the space.

- Maintain communication with Authorized Entrants visually, verbally, or through the use of hand signals or radio.
- Monitor retrieval lines or other equipment to prevent entanglement.
- Monitor the permit space itself, as well as the immediate areas around the space, to detect potential hazards.
- Interrupt work and evacuate any/all Authorized Entrants in the event of a newly developed dangerous condition, when signs of entrant stress or fatigue are noticed, or when the Attendant needs to leave the post and cannot be replaced by another attendant.
- Summon Rescue Services and other services during an emergency.
- Warn any unauthorized persons not to enter a Confined Space.
- Inform the Authorized Entrants and the Entry Supervisor if unauthorized persons have entered the permit space.

4.1.6 Authorized Entrants

- Maintain appropriate training for the Confined Space entry and the applicable tasks, and competency in the associated procedures (e.g. communication, rescue, etc.) and use of the necessary personal protective equipment (PPE) for entry and rescue. Refer to *S3AM-003-PR1 SH&E Training*.
- Responsible to know the Emergency Response Plan and be able to recognize the potential for real hazards associated with the Confined Space. Refer to the Permit and ask the Entry Supervisor or SH&E Manager if a question arises
- Know any modification of normal work practices that are necessary for permit-required confined space work.
- Know, recognize and communicate the warning signs or symptoms of exposure to the hazards that may be encountered in the confined space (e.g. toxic or hazardous materials, noise, fatigue, heat, etc.).
- Relay an alarm to the outside attendant and attempt self-rescue immediately upon becoming aware of hazardous conditions.
- Exit the confined space as rapidly as possible without help whenever:
 - The Attendant orders an evacuation.
 - Any alarm from a continuous monitor/detector sounds.
 - The Authorized Entrant(s) recognizes the warning signs of exposure to hazardous substances or conditions that could be found in that confined space.
- Maintain communication with the Attendant.

4.1.7 Employees

- Refrain from making any attempt to enter a confined space without first meeting the requirements of this procedure and the applicable entry permit, and receiving authorization for entry from the entry supervisor.
- Employees or their representatives are entitled to observe testing and request additional monitoring at any time.
- Avoid areas where other employees are working in confined spaces.

4.2 Requirements

- 4.2.1 All confined spaces will be considered permit-required by default in the absence of a previous classification by the owner or AECOM competent person.

4.2.2 All confined spaces under the control of AECOM will be identified, evaluated, and classified on *S3AM-301-FM1 Confined Space Identification Log* (or equivalent). The identification log shall be updated as required, at a minimum annually. An identification log shall be prepared for each project site containing confined spaces to which AECOM employees are exposed.

4.2.3 Labelling / Signage

- Access points of confined spaces shall be identified by a sign or other effective means, indicating the hazard and prohibiting unauthorized entry.
- Confirm labelling and signage meets requirements established by the jurisdiction and, as applicable, the client (e.g. Oil Sands Safety Association specific requirements). Examples:
 - 'Danger: Permit Required Confined Space'.
 - 'Danger, Do Not Enter'.
 - 'Confined Space Monitor and Permit Required for Entry'.
 - 'Confined Space Permit Required for Entry'.
- All confined spaces that are to be entered under AECOM control will be labeled so that employees are adequately warned of the potential for hazardous conditions and unauthorized entry is restricted.
- When non-permit-required confined spaces (if permitted by the applicable jurisdiction) require the implementation of confined space entry procedures because of specific work operations (e.g., painting, welding), all entry points will be labeled or identified by signs to alert all employees of the existence of the hazardous conditions. These labels or signs will be removed only when the hazard no longer exists (e.g., complete curing of the paint).

4.3 Classification of Confined Spaces

4.3.1 For each identified confined space, an evaluation to determine the nature and extent of all possible hazards to entrants shall be conducted. A thorough inspection of a confined space shall be performed to verify acceptable entry conditions and to implement appropriate control measures prior to entry. This frequently includes a physical inspection not only of the space to be entered, but also of adjacent and connected spaces that might pose a threat to entrants. Consideration will be given to the following types of hazards:

- The presence of possible airborne contaminants at concentrations exceeding established occupational exposure limits (OELs / PELs).
 - Toxic atmospheres in confined spaces can cause serious health problems and even death. Poisonous physical effects may be immediate, delayed, or a combination of both.
 - Toxic contaminants can be gases, vapors, fumes, or airborne dusts. The most common gases encountered in confined spaces are carbon monoxide and hydrogen sulfide. Other sources of toxic atmospheres in confined spaces include fuel vapors, protective tank coatings, inerting media, fumigants, and residues from previous tank contents.
- Oxygen deficiency (less than the minimum O₂ concentration established by the applicable jurisdiction). Breathing oxygen deficient air can cause poor judgment, loss of coordination, fatigue, vomiting, unconsciousness, and may ultimately lead to death. Asphyxiation from insufficient oxygen frequently occurs when victims, unaware of the problem, reach the point where they cannot save themselves or call for help. Oxygen deficiency can be caused when oxygen is:
 - Absorbed by other substances, such as activated charcoal.
 - Consumed by chemical reactions, such as rusting and burning, or biological processes, such as bacterial decomposition.

- Displaced by another gas, such as when a confined space is intentionally inerted by a nitrogen blanket or other non-reactive atmosphere, such as fire control agents, that contain no oxygen.
- Oxygen enriched atmosphere:
 - Can be a serious fire hazard, since oxygen-enriched air can cause combustible materials to burn violently.
 - Consult applicable jurisdictional specifications for established maximum O₂ concentrations.
- The presence of any physical hazards (e.g. noise, electrical shock, mechanical injury, etc.).
 - Work performed inside a confined space can be deafening. Scaling, chipping, grinding, hammering, riveting, power scrubbing, the use of power and pneumatic tools, and airline leaks create hazardous noise levels. When work is done inside a vessel, tank, or other space with non-absorbing surfaces, noise increases as it reflects off the walls and floors.
 - Ventilation may produce sound and noises outside the space, which can sound louder inside a confined space.
 - A tank or vessel can become a health hazard to the entrant if the heat inside is allowed to climb too high. The sun on a metal tank or lack of air circulation and hot work can contribute to an entrant being overcome by heat stress. If pre-entry hazard identification indicates heat stress can become a problem, it is a safe practice to plan periodic temperature testing and rest breaks.
 - A confined space become a health hazard to the entrant if the temperature inside is allowed to drop too low. If pre-entry hazard identification indicates cold stress can become a problem, it is a safe practice to plan periodic temperature testing and rest breaks.
 - The effect of electrical energy is a frequent contributor to confined space accidents. It is difficult in confined spaces to avoid contact with electrical components. An effective lockout / tag out program can prevent nearly all-electrical hazards.
 - The effects of mechanical energy are an also frequent contributor to confined space accidents. An effective lockout / tag out program can prevent nearly all-mechanical hazards.
- The presence of flammable or explosive conditions.
 - Flammable and explosive atmospheres contain gases, vapors, or airborne dusts at concentrations great enough to burn rapidly upon contact with ignition sources such as heat, open flames or electrical sparks. The LEL / LFL is the lower limit at which a flammable substance will ignite into sustained combustion.
 - Changes in oxygen concentrations shall also be monitored. While it is not flammable itself, oxygen is necessary for all combustion to take place. Materials that are normally nonflammable, such as clothing, can burst into flames at the smallest spark in a confined space containing a high volume of oxygen.
- The presence of any potential for rapid flooding or engulfment.
 - Engulfment in a confined space occurs when the victim is immersed in liquid or trapped and enveloped by finely-divided dry bulk materials, such as grain or sawdust.
 - Engulfment hazards include asphyxiation from aspirating (inhaling) the engulfing material, which causes death by filling or plugging the respiratory system. Another asphyxiating effect of engulfment is compression of the torso by the weight of the engulfing material, preventing the victim's lungs from moving.

- Configurations / positioning that may cause an Authorized Entrant to become trapped, including, but not limited to, chutes, piping and slippery surfaces.
- 4.3.2 Document the initial classification:
- As PRCS, Alternate Procedure PRCS or NPRCS, or
 - In accordance with the classification method of the given jurisdiction (e.g. hazardous confined space vs. confined space; restricted space vs. confined space; low hazard atmosphere, moderate hazard atmosphere, high atmosphere; etc.).
 - Note: certain jurisdictions consider all confined spaces as PRCS.
- 4.3.3 The evaluation will be documented using *S3AM-301-FM2 Confined Space Entry Classification / Permit*. A copy of this documentation will be maintained in the project files.
- 4.3.4 Wherever the confined space is controlled by a property owner or manager (also known as host employer), this controlling entity shall be available to provide the information necessary to complete the evaluation (e.g. known hazards, precautions, previous entry operations, etc.).
- Coordinate with the employer who has overall responsibility for construction at the worksite (Controlling Contractor or Prime Contractor) to obtain any information provided by the property owner or manager and
 - Provide AECOM's applicable confined entry documentation to the employer who has overall responsibility for construction at the worksite (Controlling Contractor or Prime Contractor).
 - If AECOM personnel are requested to enter a confined space owned or controlled by others, the final evaluation will be with the AECOM employee.
- 4.3.5 If NPRCS is permissible in the applicable jurisdiction, NPRCS shall be designated only by a Competent Person (may include Certified Industrial Hygienist / Registered Occupational Hygienist, Certified Safety Professional, Certified Registered Safety Professional, SH&E Manager, or Professional Engineer) after review of the space(s), historical monitoring data, and other factors (e.g., injuries that have occurred). Therefore, all confined spaces will be considered permit-required (PRCS) unless specifically designated as a NPRCS in writing, on the approved confined space inventory listing.
- 4.4 PRCS Pre-Entry Planning
- 4.4.1 Refer to *S3AM-218-PR1 Permit to Work* for additional guidance related to Safe Work Permits.
- 4.4.2 PRCS Pre-Entry Procedure – To protect employees during PRCS entries, AECOM-specific PRCS entry procedures will be developed for each PRCS to be entered. Each entry procedure will specify:
- The identity of the PRCS(s) to which the procedure applies.
 - The potential hazards associated with the entry operation/PRCS.
 - Necessary communication equipment.
 - Required air monitoring equipment and procedures.
 - Required ventilation equipment and procedures (as applicable).
 - Required lockout / tag out procedures (as applicable).
 - Refer to *S3AM-325-PR1 Lockout Tagout*.
 - Verify that the confined space is emptied, purged, flushed, ventilated with air, or otherwise made free of hazardous substances.
 - Isolate the confined space as described on the permit. Isolation procedures typically include disconnection or blocking of lines, pipes, or other material conveyances to or through the confined space that may be carrying fuels, liquids, or gases.

- Isolate and lockout / tag out all forms of potential energy inside the confined space, including, but not limited to the following:
 - Electrical.
 - Mechanical.
 - Thermal.
 - Pneumatic.
 - Hydraulic.
 - Chemical.
 - Residual.
 - Gravitational.
- Develop alternate procedures for protection of entrants for lines that may not be controlled (e.g. lines through storm water or sewer vaults).
- Required equipment and tools to completed the proposed task(s).
 - Provide adequate lighting.
 - Provide non-sparking tools where flammable or explosive atmospheres may be encountered.
 - Provide electrical equipment that meets the electrical classification of the area (e.g. intrinsically safe, low voltage, battery tools, etc.). Refer to *S3AM-302-PR1 Electrical Safety*.
 - Route all line powered portable electrical equipment through ground fault circuit interruption (GFCI) devices.
- Required emergency response/extraction equipment meeting applicable standards for personnel use;
- Establish Rescue Services notification requirements (as applicable);
- Required pre-entry testing procedures and applicable at-entry re-classification criteria;
- Establish PPE requirements during entry;
- Provide necessary barricades, fall protection and shields to protect entrants from external and internal hazards.
- Provide posting for the entrance of the space (a sign stating "Danger Confined Space Do Not Enter" or equivalent wording) to prevent unauthorized entry.
- Any other equipment required for safe entry and exit from the confined space.

4.4.3 Additional requirements for Pre-Entry Planning include the following:

- Select the appropriate equipment to measure the potential hazards. Select a multi-gas meter capable of measuring oxygen, combustible gas (% LEL / LFL), and other hazardous gases.
- Determine the acceptable values for the hazardous conditions being measured, based on the equipment in use and the field calibration method. The acceptable working levels are determined by the applicable jurisdictional requirements.
 - Oxygen
 - LEL / LFL
 - Hydrogen sulfide
 - Carbon monoxide

- Other toxic chemicals: contact the SH&E Department.
- Confirm that all the equipment selected is calibrated and that calibration is still valid.
- Personnel trained in accordance with this procedure and with manufacturer's procedures for the given equipment shall perform field verification of equipment as follows:
 - Calibrate combustible gas meters using appropriate span gas for the detectors to be used. (This span gas calibration shall be performed at frequencies determined by the manufacturer).
 - Conduct alarm checks (bump checks) using the appropriate span gas for the detectors to be used each time the instrument is turned on.
 - Check detector tube pumps for leakage using the manufacturer's procedures.
 - Calibrate photo ionization detectors (PID) using isobutylene or other material in accordance with the manufacturer's directions.
 - Calibrate any other instrumentation to be used in accordance with manufacturer's directions.
- Set up barricades and signage around the space being entered as required.
- Set up required fall arrest, retrieval, or rescue systems.
- Institute required lockout / tag out procedures (i.e. electrical, steam, liquid flow-pipe blanking or blinding).
- Confirm that a second person (trained as entry Attendant) is available to assist in the set up procedures.
- Agree upon a means of communication between the Authorized Entrant(s) and the Attendant. (The Attendant is not authorized to perform rescue involving entry into the space unless he/she is trained for rescue and another entry Attendant replaces him/her prior to the attempt to rescue).
- Verify Rescue Service requirements (e.g. immediately available or summoned and necessary response time frame) and a means to contact emergency Rescue Services for further assistance.
- Prior to the start of the entry operation, the Entry Supervisor will assign individuals on the entry team to the following jobs:
 - Authorized Entrant – The person entering the PRCS.
 - Primary Attendant – The person dedicated only to assisting the entrant, observing the entry operation, and maintaining communications with the entrant throughout the entry procedure.
 - Secondary Attendant for Rescue Procedures – An additional employee who is assigned either to specific support of the entry operation or to working nearby, as specified by the applicable jurisdiction, and can assist with rescue operations in the event of an incident. This person can perform other duties unrelated to observing the entry providing they are not attending a retrieval line.
- The Entry Supervisor is responsible for ensuring that the individuals assigned to each job fully understand their duties and responsibilities prior to initiating the entry operation. The Entry Supervisor will review the complete entry procedure and confined entry permit with all team members prior to the work commencing. The Entry Supervisor will also verify the availability of locally accessible rescue services.
- The Entry Supervisor shall also:
 - Have the Attendant verify the completion of the required actions.

- Personally verify the completion of the required actions.
- Sign the permit upon verification of completed actions.
- Confirm completed entry permits are readily available to all authorized entrants or their authorized representatives by posting at all authorized entry sites, as specified by the applicable jurisdiction, until completion of the entry.

4.5 Confined Space Entry Permit

4.5.1 A Confined Space Entry Permit is required to be completed for each individual PRCS entry operation. Refer to *S3AM-301-FM2 Confined Space Entry Classification / Permit*. The Permit provides the means for documenting:

- The identities and roles of all individuals involved in the entry operation.
- Equipment used for performance of the entry (monitoring instruments, extraction equipment, etc.).
- Pre-entry testing and operational monitoring results.
- Communications protocols between Authorized Entrants, Attendants, and Rescue Services.
- Lockout / tag out procedures.
- PPE for specific tasks (refer to the Task Hazard Analysis for the task).
- Other relevant workplace conditions or events related to the entry operation (e.g., vault isolation procedures).
- Authorized Entrants and Attendant(s) are required to review the permit and print and sign their names on the permit.
- Each Permit will be signed and authorized by the Entry Supervisor. If the confined space entry operation is transferred to another Entry Supervisor, the outgoing Entry Supervisor determines that entry operations are still consistent with the terms of the permit and that acceptable entry conditions are present, before turning operations over to the incoming Entry Supervisor. The incoming Entry Supervisor shall sign and authorize the existing permit.
- At the completion of the entry operation, the permit will be filed as part of the project records.

4.6 PRCS Entry Procedure

4.6.1 Confirm all Authorized Entrants and Attendants are briefed on the contents of the Confined Space Entry Permit and the conditions of the confined space.

4.6.2 Don any required PPE.

- Attach a body harness, if required, to a retrieval line. Attach the other end of the retrieval line to a fixed point or to a mechanical lifting device outside the space at all times the Authorized Entrant(s) is in the space.
- Wristlets will not be used for non-entry rescue procedures unless it can be demonstrated that the use of a chest or full-body harness is not feasible or unsafe and that the use of wristlets is the most effective alternative.

4.6.3 Attendant(s) shall be stationed at or near the entrance of the confined space, as specified by the applicable jurisdiction, whenever an Authorized Entrant is inside the confined space.

- Attendant(s) may only enter a confined space if trained and competent in entry rescue procedures, the appropriate emergency equipment is available AND the original Attendant is replaced by another Attendant.
- The Attendant shall not leave the post unattended at any time or perform conflicting duties. If the Attendant needs to leave his / her position, Authorized Entrants shall be called out of the confined space or another qualified Attendant shall take the position and responsibility.

- A single Attendant shall not monitor more than one confined space at any given time.
 - The Attendant will order Authorized Entrant(s) out of the space whenever:
 - A prohibited condition on the entry permit develops;
 - The surrounding work area becomes unsafe;
 - An early warning of an engulfment hazard occurs;
 - Any monitoring instrumentation, rescue equipment, ventilation, etc. becomes compromised;
 - Possible symptoms of exposure are noted in entrant(s); or
 - Authorized Entrant(s) expresses any type of concern regarding the safety of entry.
- 4.6.4 Entry of a confined space is limited to Authorized Entrants listed on the permit and only for the purpose stated on the permit. Authorized Entrants shall follow all requirements listed on the permit.
- 4.6.5 Test the atmosphere around the confined space access point, door or cover for oxygen, LEL / LFL, and other hazardous gases (e.g. Methane, hydrogen sulfide, and carbon monoxide), in the same order, prior to entry into the space.
- Always check for oxygen levels first if the meter does not measure simultaneously. Low oxygen levels can cause LEL / LFL readings to be incorrect.
 - Upon removal of the access cover/door, test the immediate atmosphere using remote testing procedures to confirm that the immediate atmosphere is safe. If any of the parameters being tested are outside the acceptable working level, do not enter.
 - Make initial atmospheric tests of the space with the ventilation OFF.
- 4.6.6 If unacceptable entry conditions are indicated, correct the limiting condition:
- If necessary, use ventilation equipment to either remove the contaminant(s) or to correct the oxygen-deficient atmosphere.
 - Mechanical ventilation used to maintain a safe atmosphere during entry shall be equipped with an alarm or equivalent to alert entrants of malfunction OR monitored by a worker who is in continuous communication with entrant(s).
 - Open as many openings as possible in the space to aid in cross ventilation.
 - Never ventilate confined spaces with pure oxygen. Always ventilate with a clean source of air.
 - Confirm that air supply for the ventilation equipment originates from a clean source.
 - Ventilation shall provide adequate air changes to confirm a safe atmosphere.
 - If a generator is used to provide power, be sure that the exhaust does not enter the space. Carbon monoxide monitoring may be required.
 - Place blower ductwork such that it does not create a hazard by impairing the line of vision of Attendants observing space Authorized Entrants or by blowing contaminants to other workers.
 - When exhaust ventilation is required and possible, confirm the system moves sufficient volume to maintain a safe atmosphere.
 - Use fire/explosive proof ventilating equipment that is in compliance with National Fire Protection Association (NFPA 91) and ANSI/AIHA Z9.2, as applicable when exhausting flammable gases, vapors, and dusts from confined spaces.

- When an explosive or flammable atmosphere cannot be eliminated within a confined space through other means, an established method of inerting shall be used. If inerting is used, the Entry Supervisor shall confirm that:
 - All Authorized Entrants entering the confined space are equipped with supplied air respiratory protection equipment;
 - All ignition sources are controlled; and
 - The atmosphere within the confined space stays inerted while Authorized Entrants are inside.
- 4.6.7 If the initial test(s) are within acceptable working levels or ventilation has provided acceptable working levels, continue to test the rest of the confined space. Confirm the Authorized Entrant conducting the testing, or the instrument's extension probes slowly enter the space, continually testing the atmosphere in front and to the sides.
- 4.6.8 In stratified atmospheres (i.e., vertical entries), test 4 feet (1.2m) in advance of the direction of travel. The Authorized Entrant's or probe's travel speed shall allow for adequate sampling and instrument response time (consult instrument's operating manual to determine response times).
- 4.6.9 If using extension probes, confirm lengths are attached that are adequate to reach the complete extent of the confined space. For horizontal spaces, the probe may need to be attached to a pole.
- 4.6.10 Test the entire area where work is to be performed (bottom, middle, top, corners and additional protrusions or depressions such as sumps) prior to performance of any work.
- 4.6.11 While performing the work, place the direct read instruments in a location that will not interfere with the work, will allow for required monitoring (interval or continuous), and will enable the entrant to detect alarms that may be activated.
- 4.6.12 Continuously monitor atmospheric conditions unless it can be demonstrated that commercially available monitoring equipment for the hazard is not available or that periodic monitoring at a sufficient frequency will confirm that the specific atmospheric hazard is being controlled at safe levels.
- 4.6.13 Monitor continuously for oxygen and LEL / LFL if hot work will be performed in the space. Refer to *S3AM-332-PR1 Hot Work*.
- 4.6.14 If acceptable entry conditions cannot be maintained, or any condition not allowed by this permit (prohibited condition) is present or developing, all entrants shall exit the confined space and this permit subsequently cancelled. The confined space shall be re-evaluated, acceptable entry conditions re-established and a Confined Space Entry Permit issued reflecting the required conditions and procedures prior to re-entry.
- 4.7 **Alternate Entry of PRCS**
- 4.7.1 If permitted by the applicable jurisdiction, alternate procedures for entering a PRCS containing atmospheric hazards can be used provided it can be demonstrated that continuous forced air ventilation alone will control all hazards in the space. Alternate Entry is subject to the following criteria:
- Persons entering this type of space shall complete the appropriate sections of *S3AM-301-FM2 Confined Space Entry Classification / Permit*.
 - There may be no hazardous atmosphere within the space whenever any Authorized Entrant is inside the space.
 - Continuous forced air ventilation will be used, as follows:
 - An Authorized Entrant may not enter the space until the forced air ventilation has eliminated any hazardous atmosphere.

- The forced air ventilation will be so directed as to ventilate the immediate areas where an Authorized Entrant is or will be present within the space and will continue until all Authorized Entrants have left the space.
- The air supply for the forced air ventilation will be from a clean source and may not increase the hazards in the space.
- The atmosphere within the space will be periodically tested as necessary to confirm that the continuous forced air ventilation is preventing the accumulation of a hazardous atmosphere.
- If a hazardous atmosphere is detected or conditions change during entry:
 - Each Authorized Entrant will leave the confined space immediately.
 - The confined space classification will be cancelled and documented on *S3AM-301-FM2 Confined Space Entry Classification / Permit*.
 - The space will be evaluated to determine and implement appropriate measures to protect Authorized Entrants from the hazardous atmosphere or hazards presented by the changed condition.
 - The confined space shall be re-evaluated and reclassified before entry can commence in accordance with the required procedures.

4.8 PRCs Exit Procedure

- 4.8.1 Remove all equipment.
- 4.8.2 Verify all personnel (Authorized Entrants, Rescuers) have exited the confined space.
- 4.8.3 Replace all access covers.
- 4.8.4 Confirm that all signs are visible and legible.
- 4.8.5 Remove all lockout / tag out equipment.
- 4.8.6 Note on the permit any problems encountered while in the space.
- 4.8.7 Finish the permit and turn it in to the Entry Supervisor.
- 4.8.8 The Entry Supervisor will inspect the Permit for completion and will investigate any noted problems. Actions taken to correct noted problems will be discussed with all Authorized Entrants and Attendants for future implementation.
- 4.8.9 Inform the employer who has overall responsibility for construction at the worksite (Controlling Contractor or Prime Contractor) of the completion of confined space entry work, or of a cancelled confined space entry.
 - Communicate all hazards encountered or created during entry operations.
 - The employer who has overall responsibility for construction at the worksite (Controlling Contractor or Prime Contractor) shall communicate obtained information to the property owner or manager (also known as host employer).
- 4.8.10 The completed permit will be maintained on file as required in this section.

4.9 NPRCS Entry Procedure

- 4.9.1 If applicable to the given jurisdiction, a permit may not be required to enter confined spaces that do not contain existing or potential hazards, and the work performed or natural environment therein does not create a hazardous condition.
- 4.9.2 Confined spaces with actual or potential atmospheric hazards that can be controlled but not eliminated by ventilation cannot be downgraded to non-permit spaces. The control of atmospheric hazards using forced air ventilation does not constitute elimination of those hazards.

- 4.9.3 The use of air purifying or supplied air respirators for atmospheric hazards is not considered a control and cannot be used to justify a non-permit space.
- 4.9.4 NPRCS entry is subject to the following criteria:
- Persons entering this type of space shall complete the appropriate sections of *S3AM-301-FM2 Confined Space Entry Classification / Permit*.
 - If it is necessary to enter a confined space in order to eliminate its hazards, the entry shall occur in accordance with the written permit-required confined space program and requires *S3AM-301-FM2 Confined Space Entry Classification / Permit* to be completed in entirety.
 - Remain vigilant about conditions in the space, to remember that if any condition changes or if hazards are introduced into the space (e.g. welding/cutting operations) the classification and entry procedures in the space may change.
 - When entrance covers are removed, guard the opening to prevent an accidental fall through the opening and to protect each employee working in the space from foreign objects entering the space.
 - Check the atmosphere with the gas detector for oxygen, LEL, and other hazardous gases (e.g. Methane, hydrogen sulfide, and carbon monoxide) in the same order prior to entry into the space.
 - Record the measured conditions on the permit and do not allow entry if detected levels are above safe working levels.
 - Proceed with entry and work with caution.
 - If hazards arise within a space that had been classified as NPRCS:
 - Each Authorized Entrant will leave the confined space immediately.
 - The confined space classification will be cancelled and documented on *S3AM-301-FM2 Confined Space Entry Classification / Permit*.
 - The space will be evaluated to determine and implement appropriate measures to protect Authorized Entrants from the hazardous atmosphere or hazards presented by the changed condition.
 - The confined space shall be re-evaluated and reclassified before entry can commence in accordance with the required procedures.

4.10 NPRCS Post Entry Procedures

- 4.10.1 If NPRCS is permissible in the applicable jurisdiction, the following post-entry procedures shall be followed after the completion of an NPRCS entry:
- Remove all equipment.
 - Verify all personnel (Authorized Entrants, Rescuers) have exited the confined space.
 - Replace all access covers.
 - Confirm all signs are visible and legible.
 - Remove all lockout / tag out equipment, if applicable.
 - Inform the employer who has overall responsibility for construction at the worksite (Controlling Contractor or Prime Contractor) of the completion of confined space entry work, or of a cancelled confined space entry.
 - Communicate all hazards encountered or created during entry operations.
 - The employer who has overall responsibility for construction at the worksite (Controlling Contractor or Prime Contractor) shall communicate obtained information to the property owner or manager (also known as host employer).

4.11 Rescue Services

- 4.11.1 Employees designated to provide rescue and /or emergency response shall have current basic first aid/CPR training as a minimum.
- 4.11.2 External rescue services should practice conducting rescue operations at least every 12 months.
- 4.11.3 A contract for qualified entry Rescue Services may be with local emergency services personnel, contract rescue teams, or response teams provided by the host facility. If response teams are provided by the host facility, this shall be noted in the health and safety plan and agreed to by both parties.
- 4.11.4 Entry rescue equipment shall be staged on-site adjacent to the space for the duration of the entry.
- 4.11.5 Rescue Services shall be within the proximity of the confined space specified by the applicable jurisdiction for the duration of the entry. In addition to and in the absence of specifications, proximity shall be appropriate to the potential hazards associated with the confined space in order to confirm a timely rescue.
- 4.11.6 Rescue Services personnel shall be staged at the entry to the confined space any time conditions within the confined space are or could become immediately dangerous to life or health (IDLH).
- 4.11.7 AECOM will not place staff at risk by allowing confined space entry when qualified Rescue Services cannot be identified.
- 4.11.8 If the Authorized Entrant is injured, rendered unconscious and / or needs assistance to exit the space:
 - Appropriately trained Attendant or Rescue Services will operate entrant retrieval system to evacuate personnel within the confined space. If this system fails, they will call for emergency assistance (additional Rescue Services).
 - Once Rescue Services arrive, they will assume the duties of the Attendant. A trained member(s) of Rescue Services will enter the space to extricate the downed entrant and perform first aid services as required.
 - The Attendant will remain at the confined space and provide assistance to the Rescue Services, if requested.
- 4.11.9 Facilitating Non-Entry Rescue
 - Non-entry retrieval systems or methods designed for rescue operations shall be used for every entry, where feasible and provided the retrieval equipment would not increase the overall risk of entry.
 - Retrieval systems shall meet the following requirements:
 - Each Authorized Entrant shall use the proper class of full body harness with a retrieval line attached.
 - The retrieval line shall be attached to a mechanical extraction device, usually consisting of a tripod and winch (mandatory for more than 5 feet deep rescue), or fixed point outside the permit space.
 - The mechanical extraction device should be designed for extractive rescue of personnel from a permit space.

5.0 Records

- 5.1 Training Records – All employee training records shall be maintained in accordance with *S3AM-003-PR1 SH&E Training*.
- 5.2 *S3AM-301-FM2 Confined Space Entry Classification / Permit* – Will be signed by the entry supervisor and maintained onsite during the confined space entry activity. Once the entry activity is officially closed the

entry document (including cancelled permits) shall be maintained in the project files for a minimum of one year.

6.0 Attachments

- 6.1 S3AM-301-FM1 [Confined Space Identification Log](#)
- 6.2 S3AM-301-FM2 [Confined Space Entry Classification / Permit](#)
- 6.3 S3AM-301-ATT1 [Type of Confined Space Decision Flow Chart](#)