1.0 Policy

Excavation work activities shall be conducted safely with associated exposures eliminated and/or controlled.

2.0 Purpose

To ensure that every employee involved in excavation work is protected against foreseeable associated hazards.

3.0 Scope

Applies to all Sunbelt Controls work sites where construction and service work activities require excavation.

4.0 Definitions

4.1 General Definitions

Approved – for the purpose of this section, authorized by Sunbelt Controls, tested and certified by the manufacturer or any recognized national testing laboratory to possess the strength requirements specified in this section.

Competent Person – is one who is capable of identifying existing and predictable hazards in the surroundings or working conditions which are unsanitary, hazardous, or dangerous to employees, and who has the authorization to take prompt corrective measures to eliminate them.

Construction Work – work for construction, alteration, and/or repair to new underground utilities.

Defect – any characteristic or condition that tends to weaken or reduce the strength of the tool, object, or structure of which it is a part.

Employee – every laborer regardless of title or contractual relationship.

Service Work – work for alteration and/or repair of existing underground utilities.

Work Area – the portion of a walking/working surface where work activities are being performed.

4.2 General Excavation Definitions

Aluminum Hydraulic Shoring – a pre-engineered shoring system comprised of aluminum hydraulic cylinders (cross braces) used in conjunction with vertical rails (uprights) or horizontal rails (wales). Such system is designed specifically to support the sidewalls of an excavation and prevent cave-ins.

Benching (Benching system) – a method of protecting employees from cave-ins by excavating the sides of an excavation to form one or a series of horizontal levels or steps, usually with vertical or near-vertical surfaces between levels.

Cave-In – the separation of a mass of soil or rock material from the side of an excavation, or the loss of soil from under a trench shield or support system, and its sudden movement into

the excavation, either by falling or sliding, in sufficient quantity so that it could entrap, bury, or other wise injure and immobilize a person.

Cross Braces – the horizontal members of a shoring system installed perpendicular to the sides of the excavation, the ends of which bear against either uprights or wales.

Distress –the soil is in a condition where a cave-in is imminent or is likely to occur. Distress is evidenced by such phenomena as the development of fissures in the face of or adjacent to an open excavation; the subsidence of the edge of an excavation; the slumping of material from the face or the bulging or heaving of material from the bottom of an excavation; the spalling of material from the face of an excavation; and *ravelling* (i.e., small amounts of material such as pebbles or little clumps of material suddenly separating from the face of an excavation and trickling or rolling down into the excavation).

Excavation – any man-made cut, cavity, trench, or depression in an earth surface, formed by earth removal.

Faces or Sides – the vertical or inclined earth surfaces formed as a result of excavation work.

Failure – the breakage, displacement, or permanent deformation of a structural member or connection so as to reduce its structural integrity and its supportive capabilities.

Hazardous Atmosphere – an atmosphere which by reason of being explosive, flammable, poisonous, corrosive, oxidizing, irritating, oxygen deficient, toxic, or otherwise harmful, may cause death, illness, or injury.

Kickout – the accidental release or failure of a cross brace.

Maximum Allowable Slope – the steepest incline of an excavation face that is acceptable for the most favorable site conditions as protection against cave-ins, and is expressed as the ratio of horizontal distance to vertical rise (H:V)

Protective System – a method of protecting employees from cave-ins, from material that could fall or roll from an excavation face or into an excavation, or from the collapse of adjacent structures – protective systems include support systems, sloping and benching systems, shield systems, and other systems that provide the necessary protection

Ramp – an inclined walking or working surface that is used to gain access to one point from another, and is constructed from earth or from structural materials such as steel or wood.

Registered Professional Engineer – a person who is registered as a professional engineer in the state where the work is to be performed.

Sheeting – the members of a shoring system that retain the earth in position and in turn are supported by other members of the shoring system.

Shield (Shield System) – a structure that is able to withstand the forces imposed on it by a cave-in and thereby protect employees within the structure.
Shields can be permanent structures or can be designed to be portable and moved along as work progresses. Additionally, shields can be either pre-manufactured or job-built in

accordance with this manual section. Shields used in trenches are usually referred to as "trench boxes" or "trench shields."

Shoring (Shoring system) – a structure such as a metal hydraulic or mechanical shoring system that supports the sides of an excavation and which is designed to prevent cave-ins.

Short Term Exposure – a period of time less than or equal to 24 hours that an excavation is open – See Table A-1 (Maximum Allowable Slopes for Excavations) of Appendix 18-C1

Sides *See* ***Faces***

Sloping (Sloping System) – a method of protecting employees from cave-ins by excavating to form sides of an excavation that are inclined away from the excavation so as to prevent cave-ins. The angle of incline required to prevent a cave-in varies with differences in such factors as the soil type, environmental conditions of exposure, and application of surcharge loads.

Stable Rock – natural solid mineral material (not soil) that can be excavated with vertical sides and will remain intact while exposed

Structural Ramp – a ramp built of steel or wood, usually used for vehicle access.

Support System – a structure such as underpinning, bracing, or shoring, which provides support to an adjacent structure, underground installation, or the sides of an excavation.

Trench (Trench Excavation) – a narrow excavation (in relation to its length) made below the surface of the ground.

Trench Box or Trench Shield *See* ***Shield***

Uprights – the vertical members of a trench shoring system placed in contact with the earth and usually positioned so that individual members do not contact each other. Uprights placed so that individual members are closely spaced, in contact with or interconnected to each other, are often called “sheeting."

Underground Installations – utility installations, such as sewer, telephone, fuel, electric, water lines, fiber optic, etc

Wales – horizontal members of a shoring system placed parallel to the excavation face whose sides bear against the vertical members of the shoring system or earth.

4.3 Soil Definitions

Cemented Soil – a soil in which the particles are held together by a chemical agent, such as calcium carbonate, such that a hand-size sample cannot be crushed into powder or individual soil particles by finger pressure.

Cohesive Soil – clay (fine grained soil), or soil with a high clay content, which has cohesive strength – cohesive soil does not crumble, can be excavated with vertical side slopes, and is plastic when moist; cohesive soil is hard to break up when dry, and exhibits significant cohesion when submerged; cohesive soils include clayey silt, sandy clay, silty clay, clay and organic clay.

Dry Soil – soil that does not exhibit visible signs of moisture content.

Fissured – a soil material that has a tendency to break along definite planes of fracture with little resistance, or a material that exhibits open cracks, such as tension cracks, in an exposed surface.

Granular Soil – gravel, sand, or silt (coarse grained soil) with little or no clay content. Granular soil has no cohesive strength. Some moist granular soils exhibit apparent cohesion. Granular soil cannot be molded when moist and crumbles easily when dry.

Layered System – two or more distinctly different soil or rock types arranged in layers.

Moist Soil – a condition in which a soil looks and feels damp; moist cohesive soil can easily be shaped into a ball and rolled into small diameter threads before crumbling; moist granular soil that contains some cohesive material will exhibit signs of cohesion between particles.

Plastic – a property of a soil which allows the soil to be deformed or molded without cracking, or appreciable volume change.

Saturated Soil – a soil in which the voids are filled with water. Saturation does not require flow. Saturation, or near saturation, is necessary for the proper use of instruments such as a pocket penetrometer or sheer vane.

Soil Classification System – for the purpose of this subpart, a method of categorizing soil and rock deposits in a hierarchy of Stable Rock, Type A, Type B and Type C, in decreasing order of stability. The categories are determined based on an analysis of the properties and performance characteristics of the deposits and the characteristics of the deposits and the environmental conditions of exposure.

Stable Rock – natural solid mineral matter that can be excavated with vertical sides and remain intact while exposed.

Submerged Soil – soil which is underwater or is free seeping

Type A – cohesive soils with an unconfined, compressive strength of 1.5 ton per square foot (tsf) (144 kPa) or greater. Examples of cohesive soils are: clay, silty clay, sandy clay, clay loam and, in some cases, silty clay loam and sandy clay loam. Cemented soils such as caliche and hardpan are also considered Type A. However, *no soil is Type A if any of the following are noted*:

- The soil is fissured; or
- The soil is subject to vibration from heavy traffic, pile driving, or similar effects; or
- The soil has been previously disturbed; or
- The soil is part of a sloped, layered system where the layers dip into the excavation on a slope of four horizontal to one vertical (4H:1V) or greater; or
- The material is subject to other factors that would require it to be classified as a less stable material.

Type B – cohesive soil with an unconfined compressive strength greater than 0.5 tsf (48 kPa) but less than 1.5 tsf (144 kPa); or

- Granular cohesion-less soils including: angular gravel (similar to crushed rock), silt, silt loam, sandy loam and, in some cases, silty clay loam and sandy clay loam.
- Previously disturbed soils except those which would otherwise be classed as Type C soil
- Soil that meets the unconfined compressive strength or cementation requirements for Type A, but is fissured or subject to vibration; or
- Dry rock that is not stable; or
- Material that is part of a sloped, layered system where the layers dip into the excavation on a slope less steep than four horizontal to one vertical (4H:1V), but only if the material would otherwise be classified as Type B.

Type C – cohesive soil with an unconfined compressive strength of 0.5 tsf (48kPa) or less; or

- Granular soils including gravel, sand, and loamy sand; or
- Submerged soil or soil from which water is freely seeping; or
- Submerged rock that is not stable, or
- Material in a sloped, layered system where the layers dip into the excavation or a slope of four horizontal to one vertical (4H:1V) or steeper.

Unconfined Compressive Strength – the load per unit area at which a soil will fail in compression. It can be determined by laboratory testing, or estimated in the field using a pocket penetrometer, by thumb penetration tests, and other methods.

Wet Soil – soil that contains significantly more moisture than moist soil, but in such a range of values that cohesive material will slump or begin to flow when vibrated; granular material that would exhibit cohesive properties when moist will lose those cohesive properties when wet.

5.0 Requirements

5.1 Risk Assessment (JSA)

A Competent Person shall conduct a JSA prior to excavation work activities beginning (reference JSAs under Safety Systems section nine [9] sub-section [5.2] of this manual) to assess the identifiable hazards associated with work areas, occupations, and tasks.

5.2 Written Work Plan (> 5 Ft. in depth)

A Competent Person shall develop a written work plan for every excavation exceeding five feet in depth based on the JSA and the other requirements of this section.

The written Excavation Work Safety Plan shall include:

- Identification of all hazards in the work area related to excavation equipment
- Describe the excavation protection system(s) to be provided
- Describe the soil type and the correct procedures for the selection, fit, use and maintenance of the excavation protection system
- Describe procedures for excavation

- Describe the method for prompt, safe removal of injured workers
- Be available on the job site
- Signature of the Competent Person

5.3 Training

Initial training of employees shall occur during orientation for employees who may possibly be engaged in excavation work. Hazard recognition and excavation protection systems shall be included in the training.

Site specific training shall occur before the start of excavation work activities, including hazards and controls noted in the JSA and the other provisions of the written plan.

5.4 Inspections

When employee exposure in an excavation is reasonably anticipated, an inspection shall be conducted by a Competent Person:

- prior to the start of work each day
- as needed throughout the shift
- after every rainstorm
- when an unusual occurrence affects the integrity of the excavation

Note: Where the Competent Person finds evidence of a situation that could result in a possible cave-in, indications of failure of protective systems, hazardous atmospheres, or other hazardous conditions, exposed employees shall be removed from the hazardous area until the necessary precautions have been taken to ensure their safety.

5.5 Personal Protective Equipment

Minimum Personal Protective Equipment shall consist of:

- Approved Hardhats
- Approved Safety Glasses
- Approved Safety-Toe Boots
- If exposed to vehicular traffic, employees shall be provided with and shall wear warning vests or other suitable garments marked with or made of high-visibility, reflective material if working in dim light or at night

5.6 Specific Engineering Control Options

5.6.1 Requiring Registered Professional Engineer

Excavation protection system configurations requiring development by a Registered Professional Engineer:

- excavations greater than twenty (20) feet in depth
- any excavation below the level of the base or footing of any foundation or retaining wall that could be reasonably expected to pose a hazard to employees
- where the stability of adjoining buildings, walls, or other structures is endangered by excavation operations

Designs shall be in written form and will include at least the following:

- The protective system configurations that were determined to be safe for the particular project
- The identity and stamped seal of the Registered Professional Engineer approving the design

At least one copy of the design shall be maintained at the jobsite.

5.6.2 Sloping and Benching Systems (excavation depth > five ft., < twenty ft.)

Note: *Suitable sloping or benching shall occur at >4 feet in depth for unstable soil (Type C).*

5.6.2.1 Classifying Soil

Soil and rock deposits shall be classified in accordance with the Classifying Soil guidelines under sub-section (5.8.1).

5.6.2.2 Maximum Allowable Slope

The maximum allowable slope for a soil or rock deposit shall be determined from **Table A** of Appendix 18-C of this section.

When additional weight loads to the system are present from stored material or equipment, operating equipment, or traffic, a Competent Person shall determine the degree to which the slope must be reduced below the maximum allowable slope, and will assure that such reduction is achieved.

5.6.2.3 Prohibition

Employees shall not be permitted to work on the faces of sloped or benched excavations at levels above other employees except when employees at the lower levels are adequately protected from the hazard of falling, rolling, or sliding material or equipment.

5.6.3 Shielding Systems (excavation depth > five ft., < twenty ft.)

5.6.3.1 General

Installation of a support system shall be closely coordinated with the excavation of trenches.

Shield systems shall not be subjected to loads exceeding those which the system was designed to withstand.

Employees shall not be allowed in shield systems when shields are being installed, removed, or moved vertically.

Employees shall be protected from the hazard of cave-ins when entering or exiting the areas protected by shields. This means that the access and egress methods shall be included from within the protection of the shielding system.

Excavation of material to a level no greater than 2 feet (.61 m) below the bottom of the members of a shield system shall be permitted.

5.6.3.2 Materials and Equipment

Materials and equipment used for protective systems shall be free from damage or defects that might impair their proper function.

Manufactured materials and equipment used for protective systems shall be used and maintained in a manner that is consistent with the recommendations of the manufacturer.

When material or equipment that is used for protective systems is damaged, a Competent Person shall examine the material or equipment and evaluate its suitability for continued use. If the Competent Person cannot assure the material or equipment is able to support the intended loads or is otherwise suitable for safe use, then such material or equipment shall be removed from service.
Manufactured material or equipment, in this case, shall be evaluated and approved by the manufacturer or a Registered Professional Engineer before being returned to service.

Designs for shoring in trenches shall be determined in accordance with the conditions and requirements set forth in Classifying Soil under sub-section (5.8.1) and with the Aluminum Hydraulic Shoring for Trenches Table (B-1) of Appendix 18-C of this section. Other manufactured shoring systems that meet or exceed these tables are permitted.

Note: Aluminum Hydraulic Shoring is preferred to Timber Shoring.
However, if Timber Shoring is more feasible or practical, it shall be utilized in accordance with OSHA CFR 29 1926 Subpart P, Appendix C.

5.6.4 Combination Systems (excavation depth > five ft., < twenty ft.)
If the excavation is of a depth whereby the shielding system is not of sufficient height, sloping/benching shall be utilized in combination.

5.6.5 Installation and Removal of Support
Members of support systems shall be securely connected together to prevent sliding, falling, kickouts, or other predictable failure. Support systems shall be installed and removed in a manner that protects employees from cave-ins, structural collapses, or from being struck by members of the support system. Individual members of support systems shall not be subjected to loads exceeding that which they were designed to hold or withstand.

Before temporary removal of individual members begins, additional precautions shall be taken to ensure the safety of employees, such as installing other structural members to carry the loads imposed on the support system. Removal shall begin at, and progress from, the bottom of the excavation.

Members shall be released slowly so as to note any indication of possible failure of the remaining members of the structure or possible cave-in of the sides of the excavation. Backfilling shall progress together with the removal of support systems from excavations.

5.7 Specific Excavation Hazard Controls

5.7.1 Access and Egress

Structural ramps that are used solely by employees as a means of access or egress from excavations shall be designed by a Competent Person (see sub-section 4.1).

Ramps and runways constructed of two or more structural members shall have the structural members connected together to prevent displacement.

Structural members used for ramps and runways shall be of uniform thickness.

Cleats or other appropriate means used to connect runway structural members shall be attached to the bottom of the runway or shall be attached in a manner to prevent tripping.

Structural ramps used in lieu of steps shall be provided with cleats or other surface treatment on the top surface to prevent slipping.

A means of egress from trench excavations shall always be maintained. A stairway, ladder, ramp or other safe means of egress shall be located in trench excavations that are 4 feet or more in depth so as to require no more than 25 feet of lateral travel for employees.

Employees shall not utilize mechanical equipment to access or egress from trench excavations.

5.7.2 Exposure to Falling Loads

Employees shall be protected from excavated or other materials or equipment that could pose a hazard by falling or rolling into excavations.

Protection shall be provided by placing and keeping such materials or equipment at least 2 feet (.61 m) from the edge of excavations, or by the use of retaining devices that are sufficient to prevent materials or equipment from falling or rolling into excavations, or by a combination of both if necessary.

Whether inside or outside of an excavation, no employee, shall be a permitted underneath loads handled by lifting or digging equipment.

Employees shall stand away from any vehicle being loaded or unloaded to avoid being struck by any spillage or falling materials.

Operators of such vehicles being loaded or unloaded are required to remain out of the cabs of vehicles during loading or unloading.

5.7.3 Hazardous Atmospheres

Where oxygen deficiency (atmospheres containing less than 19.5 percent oxygen) or a hazardous atmosphere exists or could reasonably be expected to exist, such as in excavations in landfill areas or excavations in areas where hazardous substances are stored nearby, the atmospheres in the excavation shall be tested before employees enter excavations greater than 4 feet (1.22 m) in depth.

Reference the Confined Space guidelines under section twelve [12] of this manual.

5.7.4 Mobile Equipment

When mobile equipment is operated adjacent to an excavation, or when such equipment is required to approach the edge of an excavation, and the operator does not have a clear and direct view of the edge of the excavation, a warning system shall be utilized such as barricades, hand or mechanical signals, or stop logs.

5.7.5 Underground Installations

Utility companies or owners shall be contacted within established or customary local response times, advised of the proposed work, and asked to establish the location of the utility underground installations prior to the start of actual excavation. When utility companies or owners cannot respond to a request to locate underground utility installations within 24 hours (unless a longer period is required by state or local law), or cannot establish the exact location of these installations, the work may proceed, provided the employees do so with caution, and provided detection equipment or other acceptable means to locate utility installations are used.

When excavation operations approach the estimated location of underground installations, the exact location of the installations shall be determined by safe and acceptable means.

While the excavation is open, underground installations shall be protected, supported or removed as necessary to safeguard employees.

5.7.6 Water Accumulation

Employees shall not work in excavations in which there is accumulated water, or in excavations in which water is accumulating, unless adequate precautions have been taken to protect employees against the hazards posed by water accumulation. The precautions necessary to protect employees include special support or shield systems to protect from cave-ins and/or water removal to control the level of accumulating water.

If water is controlled or prevented from accumulating by the use of water removal equipment, the water removal equipment and operations shall be monitored by a Competent Person to ensure proper operation. If excavation work interrupts the natural drainage of surface water (such as streams), diversion ditches, dikes, or other suitable means shall be used to prevent surface water from entering the excavation and to provide adequate drainage of the area adjacent to the excavation.

5.7.7 Protection of Employees from Loose Rock, Soil, Equipment and Materials

Adequate protection shall be provided to protect employees from loose rock or soil that could pose a hazard by falling or rolling from an excavation face. Such protection can consist of:

- scaling to remove loose material
- installation of protective barricades at intervals as necessary on the face to stop and contain falling material
- or other means that provides equivalent protection

Such rock, soil and materials and equipment shall additionally be kept at least 2 feet (.61 m) from the edge of excavations.

5.7.8 Fall Protection

Reference the Fall Protection guidelines under section nineteen [19] of this policy manual.

5.8 Classifying Soils

5.8.1 Classification of Soil and Rock Deposits

Each soil and rock deposit shall be classified by a Competent Person as Stable Rock, Type A, Type B, or Type C in accordance with the definitions within this section.

The classification of the deposits shall be made based on the results of at least one visual and at least one manual analysis. Such analyses shall be conducted by a Competent Person using tests described within this section.

In a layered system, the system shall be classified in accordance with its weakest layer. However, each layer may be classified individually where a more stable layer lies under a less stable layer.

If, after classifying a deposit, the properties, factors, or conditions affecting its classification change in any way, the changes shall be evaluated by a Competent Person. The deposit shall be reclassified as necessary to reflect the changed circumstances.

5.8.2 Acceptable Visual and Manual Tests

5.8.2.1 Visual Tests

Observe samples of soil that are excavated and soil in the sides of the excavation. Estimate the range of particle sizes and the relative amounts of the particle sizes. Soil that is primarily composed of fine-grained material is cohesive material. Soil composed primarily of coarse-grained sand or gravel is granular material.

Observe soil as it is excavated. Soil that remains in clumps when excavated is cohesive. Soil that breaks up easily and does not stay in clumps is granular.

Observe the side of the opened excavation and the surface area adjacent to the excavation. Crack-like openings such as tension cracks could indicate fissured material. If chunks of soil fall off a vertical side, the soil could be fissured. Small falls are evidence of moving ground and are indications of potentially hazardous situations.

Observe the area adjacent to the excavation and the excavation itself for evidence of existing utility and other underground structures, and to identify previously disturbed soil.

Observe the opened side of the excavation to identify layered systems.

Observe the area adjacent to the excavation and the sides of the opened excavation for evidence of surface water, water seeping from the sides of the excavation, or the location of the level of the water table.

Observe the area adjacent to the excavation and the area within the excavation for sources of vibration that may affect the stability of the excavation face.

5.8.2.2 Manual tests

5.8.2.2.1 Plasticity

Mold a moist or wet sample of soil into a ball and attempt to roll it into threads as thin as 1/8-inch in diameter for a length of at least 2 inches. Cohesive material can be successfully rolled into threads without crumbling.

5.8.2.2.2 Dry Strength

If the soil is dry and crumbles on its own or with moderate pressure into individual grains or fine powder, it is granular (any combination of gravel, sand, or silt). If the soil is dry and falls into clumps that break up into smaller clumps, but the smaller clumps can only be broken up with difficulty, it may be clay in any combination with gravel, sand or silt. If the dry soil breaks into clumps which do not break up into small clumps and which can only be broken with difficulty, and there is no visual indication the soil is fissured, the soil may be considered un-fissured.

5.8.2.2.3 Thumb Penetration

The thumb penetration test can be used to estimate the unconfined compressive strength of cohesive soils. Type A soils with an unconfined compressive strength of 1.5 tsf can be readily indented by the thumb with very great effort. Type C soils with an unconfined compressive strength of 0.5 tsf can be easily penetrated several inches by the thumb, and can be molded by light finger pressure.

This test should be conducted on an undisturbed soil sample, such as a large clump of spoil, as soon as practicable after excavation to keep to a minimum the effects of exposure to drying influences.

If the excavation is later exposed to wetting influences (such as rain or flooding), the classification of the soil must be changed accordingly.

5.8.2.2.4 Other Strength Tests

Estimates of unconfined compressive strength of soils can also be obtained by use of a pocket penetrometer or by using a hand-operated shear vane.

5.8.2.2.5 Drying Test

The basic purpose of the drying test is to differentiate between cohesive material with fissures, un-fissured cohesive material, and granular material. The procedure for the drying test involves drying a sample of soil that is approximately one inch thick (2.54 cm) and six inches (15.24 cm) in diameter until it is thoroughly dry, then:

- If the sample develops cracks as it dries, significant fissures are indicated
- Samples that dry without cracking are to be broken by hand. If considerable force is necessary to break a sample, the soil has significant cohesive material content. The soil can be classified as an un-fissured cohesive material and the unconfined compressive strength should be determined
- If a sample breaks easily by hand, it is either a fissured cohesive material or a granular material. To distinguish between the two, pulverize the dried clumps of the sample by hand or by stepping on them. If the clumps do not pulverize easily, the material is cohesive with fissures. If they pulverize easily into very small fragments, the material is granular

6.0 References

OSHA 29 CFR 1926 Subpart P (Excavations)