Subsurface Utility Engineer Qualification Programme

Trade Skill Evaluation at Competency level – 1

COMPETENCE:	TTOQP 1	SUBSURFACE SURVEY
BASIC COMPETENCE	SUO1.1	SUBSURFACE UTILITY ENGINEER

Background

Subsurface Utility Engineering (SUE) refers to the process that involves managing certain risks associated with utility mapping at appropriate quality levels, utility coordination, utility relocation design and coordination, utility condition assessment, communication of utility data to concerned parties, utility relocation cost estimates, implementation of utility accommodation policies, and utility design.

Subsurface utility engineer therefore should be conversant with various tools required to detect underground utilities, general utility layout practices, land surveying practices and CAD drawing aspects. Present document identifies a set of standards for a qualified professional working as Subsurface Utility Engineer. These sets of vocational qualification standards define the minimum technical qualifications one needs to possess for handling the process of subsurface utility engineering successfully.

PRIOR ACHIEVEMENT EVIDENCE

The geophysical operators should have minimum Diploma level qualification in surveying, civil, electrical, CAD or geoscience and must possess valid training certificate on use of technique from a recognized institute/training partner of IndSTT.

PERFORMANCE STANDARD

Qualified candidate should be able to display competence in the following sections of utility investigation:

- Ability to consider the most important basics of jobsite preparation when planning the complete project.
- Awareness of general safety precautions.
- Awareness of electrical safety precautions and ability to use them at site.
- Ability to understand maps, plans and reports on existing networks.
- Aware of the use of scientific/geophysical equipment.
- Ability for Field Data Acquisition
- Ability to use Computer software in geophysical investigations
- Ability to anticipate problems in equipment.
- Ability to carry out common maintenance and problem-solving measurements independently.

MINIMUM PERFORMANCE STANDARDS

While performing the subsurface investigation the operators need to display the following minimum qualifications:

1. Safety during work

i. General precautions necessary for safety of the operators;
ii. General precautions necessary for safety of equipment;
iii. Necessary Aids for safety are used without fail;

2. Read working drawings / Sketches and proceed with work

i. Given a set of drawings / sketch requirement of the equipment and related tooling worked out and the scope of work understood;
ii. The work is executed as per drawings / sketches;

3. Knowledge and use of equipment and tooling

i. Proper identification of equipment/tools.
ii. Proper storage of equipment and tooling;
iii. Proper use of tools.

4. Knowledge of machine operating procedure and sequence

i. Equipment is properly connected to desired power points and all related accessories are connected properly.
ii. Voltage, frequency, current potential, and polarity are checked.
iii. Instrument is properly calibrated to get accurate reading.

5. Knowledge about defects, their remedy and acceptance limit

i. Identified the defects of equipment.
ii. Remedy to the defects is known.
iii. Acceptance limit as per standard code is known.

PERFORMANCE EVIDENCE

1. Helmet, Hand Shields, Safety Goggles, Gloves etc. are used.
2. Operator's health is fit before he goes to job.
3. The geophysical operator identified the proper tools for work.
4. The geophysical operator knows the use of specific tool.
5. The work is done as per demand of drawings.
6. Operator knows how to make equipment/ instrument ready for use.
7. Proper earthing is provided.
8. Proper polarity is confirmed.
9. Loose connections are checked.
10. All the defects in different type of equipment/ instrument are clearly identified.
11. Possible remedy to the defects identified is given.
12. Variation allowed as per codes are very well known.

SUPPLEMENTARY (KNOWLEDGE) EVIDENCE

In addition to the prior achievement evidence a trainee needs to display the following supplementary knowledge evidence for the course completion and being permitted to operate the geophysical investigation equipment independently:

1. Reading and writing in vernacular language.
2. Ability to conduct area and volume calculations.
3. Understanding about subsurface investigation requirements.
4. Understanding about different types subsurface investigation techniques
5. Possession of knowledge of various basic construction norms;
6. Possession of knowledge of basic electrical hazard prevention methods;
7. Awareness about basic operator's manual for geophysical investigation equipment required for the job.

TEST COVERAGE

In order to verify the above competencies, the test is aimed to evaluate the workers' knowledge in the following fields:

A. Basics of Mathematics / Natural Sciences;

- Units and their conversion
- Calculation of cross-section and volumes (i.e. annuli, pits)
- Basic of technical mechanics (power, torque, tension)
- Work, energy, capacity
- Basics of fluid mechanics (hydrostatic pressure, flow-rate, viscosity, pressure loss in fluids)

B. Project Basics;

- Location plans and terrain profiles;
- Basics of classification of soils and physical characteristics of subsoil;
- Basics of detection techniques like cable locator, GPR.
- Classification of the subsoil;
- Properties of coarse and fine soils;
- Rock Properties, Classification and mode of formation;
- Ground water conditions;
- Line installation plans (overhead lines, lines installed underground);
- Basics of bore path investigation (geo-radar);
- Practical training.
- Pollution hazards of drilling fluids and spoils with remedial measures / precautions;

C. Geophysical Investigation Techniques;

- Application Area of Geophysics;
- Geophysical investigation techniques and basic selection criteria;
- Principle of Geophysical investigation methods;
- Objectives of Geophysical investigation;
- Stages of Geophysical investigation;
- Demonstrations of Geophysical Techniques.

D. Project Realization;

- Job site set-up (mini/midi);
- Documentation of system basics;
- Daily job reports;

E. Reviewing Available Surface and Subsurface Information;

- Topographic Maps;
- Geologic Maps;
- Soils Maps;
- Aerial Photographs;
- Local Experience;
- Individual Site Mapping;
- Seismicity Maps;
- Mine Maps Geological maps and memoirs;
- Site Histories and Details of Adjacent Development.

F. Essential Information Required for a Trenchless Technology Project;

- Standard penetration values;
- Particle size distribution including presence of cobbles and boulders;
- Shear strength;
- Atterberg limits (liquid, plastic and shrinkage limits);
- Moisture content;
- Height and movement of water-table;
- Permeability;
- Presence of contaminated soils (hydrocarbons, etc)
- Identification and location of subsurface structures.

G. Geophysical Investigation Requirements;

- Determination of depth and thickness of geologic strata;
- Determination of perched water zones and depth of groundwater;
- Estimation of soil and rock composition;
- Location of fracture zones, faults, karst, and other hazards;
- Location of clay lenses and sand channels;
- Location of buried objects (metal and non-metal);
- Location of utilities, and backfilled areas;
- Assessment of ground response to changing natural conditions brought about by subsurface excavations;
- Assessment of any special construction problems with respect to the existing structures nearby;
- Presence of contaminated soils (hydrocarbons, etc).

H. Geophysical Tools for Sub Surface Investigations;

- Electrical Tomography:
  - ⇒ Equipments and mode of operation;
  - ⇒ Field of application.
- Seismic Techniques:
  - ⇒ Equipments and mode of operation;
  - ⇒ Field of application.
- Electromagnetic Methods:
  - ⇒ Equipments and mode of operation;
  - ⇒ Field of application.
- Ground Penetrating Radar:
  - ⇒ Components and mode of operation;
  - ⇒ Field of application.

I. Subsurface Survey:

- Electrical Tomography:
  - ⇒ Electrode configurations and spacing;
  - ⇒ Limitations of Electrical Tomography methods;
  - ⇒ Issues to be considered while selecting this method.
- Seismic Techniques:
  - ⇒ Types of Seismic Techniques and their applications;
  - ⇒ Arrangement of the geophone sensors;
  - ⇒ Limitations of the Seismic Techniques.
- Electromagnetic Methods:
  - ⇒ Types of EM methods;
  - ⇒ Spacing of the EM transmitter and receiver;

- ⇒ Configuration requirements of the EM receiver and transmitter coils;
- ⇒ Limitations of EM methods.

- Ground Penetrating Radar:
  - ⇒ Required range of antenna frequency to acquire subsurface information;
  - ⇒ Effect of electrical properties of the subsurface materials on GPR survey;
  - ⇒ Necessity of test surveys to predict the success of GPR;
  - ⇒ Method of traversing, spacing of the traverse lines and traverse rates for GPR survey;
  - ⇒ Influences on GPR survey.

J. Authority regulations / safety at work / environmental protection / work sheets;

- Responsible persons;
- Work safety;
- Water protection;
- Pollutant and noise emission;
- Regulations for handling dangerous materials and agents;
- Basics of working and civil laws for drilling operations (liability, negligence etc.);
- Regulatory guidelines;
- Relevant laws, rules and regulations;
- Work sheet standards.