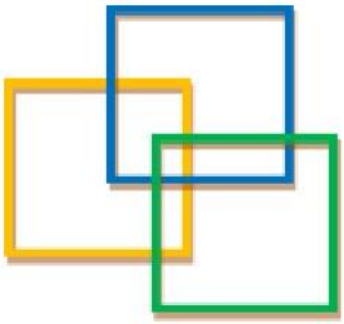
Hong Kong Institute of Utility Specialists
Non – profit Making Organization

Particular Specification For Utility Mapping By non-Destructive Methods



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Foreword

It's been more than ten years now since the disastrous landslip that occurred in Kwun Lung Lau on Hong Kong Island on 23 July, 1994. Since 1995, the Government of HKSAR has awarded tens of millions of dollars in contracts related to detection of leakage from buried water carrying services (BWCS) both on slopes and on the roads throughout the territory. As expected, this sequence of events generated an increasingly large pool of "Utility Specialists (US)", with most working almost independently, devoid of any standardized surveying methods, quality requirements (on survey results) and the "registration" of operation personnel in the market before the establishment of HKIUS in 2002.

In view of the availability of the multitude of method statements, specifications, training manuals, and the contracts documents produced for the vast number of underground utility survey contracts (by government and private projects), the following sections try to provide a comprehensive set of method statement, by addressing the following topics in general and where the abbreviation can be found in the Appendix:

(1) Utility Services Information to be Investigated
(2) Level of Accuracies
(3) Types of Deliverables and Schedules
(4) Requirements for Deliverables

You are welcome to take reference to this particular specification for your contract and in case you need further information, please send an e-mail to info@hkius.org.hk or call Ir Dr. King Wong.

Mr, Zico Kai Yip KWOK
(郭啟業先生)
President, HKIUS (2010-11)
April, 2011

If any error or mistake is found in this particular specification, please kindly contact us.
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Table of Content

C1. Description

The underground utility system of Hong Kong is extremely complicated. Electric cables, water pipes, sewage pipes and gas pipes, telecommunication lines, etc. are buried underground in high density. Construction, repair and maintenance works of the utilities often involve excavation. Careless excavation works may cause damage to underground utilities and social cost of it will be higher. And damage of utilities can paralyze the power and water supply and cut communication channels. Moreover, accidents related to buried pipes and cables can cause injuries and fatalities. Therefore, a responsible business shall locate the buried lines and provide relevant information to minimize the possibility of any accidents.

Non-destructive methods are introduced to estimate the location of the buried utilities. Pipe cable locator (PCL) and the use of ground penetrating radar (GPR) are two common equipment of electromagnetic methods.

The Utility Specialist shall investigate all surface features which relate to underground utilities, such as fire hydrants, valve chambers/pits, manholes, draw pits, inspection covers and gullies, including all street furniture connected to pipes and cables such as lamp posts, illuminated road signs and bollards, telephone booths etc. The footprint of such features at road or pavement level shall be recorded in three dimensions(3D).

There is no requirement to re-investigate kerbs, back of pavement and street furniture which does not have a power supply or associated underground services.

C2. Survey Equipment

C2.1 Electromagnetic type detection equipment (pipe/cable locator)

Electromagnetic type detection equipment comprises a hand-held detector and a matched portable signal generator/ transmitter. For metallic pipes, cables or non-metallic pipes with tracing tapes or wires, the output signal from the signal generator is either directly connected to the buried services using suitable connectors, or induced onto the services by placing the generator on the ground surface directly above the services. The hand-held detector then picks up the signal and at position which signal is the strongest will indicate the position of the buried services. If the pipe is non-metallic, the output signal can be radiated by a small transmitter inserted into and pushed along the pipe from which the signal can be picked up by the detector.

Equipments can be used in electromagnetic detection varies according to the capabilities of the locating set. The two basic components of the locating set are a transmitter and a receiver. Other accessories are available to form a more sophisticated set with more functions. Basic components can locate buried pipes and cables while a sophisticated set can locate faults and solve problems. The following equipment will be used during surveying:

(1) Receiver

(2) Transmitter

(3) Sonde

(4) ID Marker

C2.2 Ground Probing Radar (GPR)

Radar scan type detection equipment or ground probing radar is a technique which employs radio waves to map structures and features buried in the ground. This method may require survey a large area in order that different and congested services can be distinguished.

In GPR, almost all buried object or feature can be displayed and shown in 3D. There are some critical and variables difficulties, including the depth of burial, the size of the target object, and the type of materials (soil/ sediment) that surrounds and buries it. For example, very small object is difficult to be located and displayed at shallow depth. At deeper position detection, only fairly large object can be displayed. In either case, successful imaging depends on using the correct radar antenna.

There are the three major component of GPR system:
(1) Control unit

(2) Antenna

(3) Power supply

C3. Survey procedure

C3.1 Electromagnetic detection (pipe/ cable locator)

Calibration, Planning and Preparation

(1) Check Record Plans, Traffic Permit and other information.

(2) Boundary Definition and Visual Inspections for valves, chambers and pits of different utilities.

(3) Safety precautions – PTW, TTA, PPE.

Operation

(1) Traverse the area in grid search

(2) Stop when the receiver indicate the presence of a line

(3) Pinpoint the line and mark the position

(4) Depth measurement

(5) Record

(6) Hand in the data to the record team

Report

(1) Process raw data from site team.

(2) Office Checking of the site records against existing Record Plans.

(3) Use the total station result to edit drawings by IDMS.

(4) Technical Report with site records, photographs, signature and proposed trial pit location (if necessary).

Final verification

(1) Hand-dig trial pit by the contractor to expose cables located.

(2) Checking by clamping method on cables by the **competent person** to locate the alignments and depth of those exposed cables.

(3) Update the utility survey drawing for final reporting.

C3.2 Ground Probing Radar (GPR)

Calibration, Planning and Preparation

(1) Study record drawing and previous survey result/information.

(2) Utility survey by pipe locator.

(3) Planning and Prepare list for unreliable.

(4) Site investigation.

(5) Safety precautions – PTW, TTA, PPE.

(6) Check and charge the GPR.

Operation

(1) Design transverse pattern and mark on site.

(2) Set parameters of GPR, such as gain, range, sample per trace, etc.

(3) Mark the start and end point of each GPR traverse so that topographic survey can be followed to pin-point the coordinate and level of the GPR traverse.

(4) General GPR survey (approximately 4m x 4m) (as find necessary by team leader).

(5) Specific GPR survey (pattern design on site) – according to the prepared list of unreliable and informed on site by Locator Operator.

(6) Record the surface installation, pipe alignment and depth.

(7) Hand in raw data materials to report team.

Report

(1) Process raw data from project team.

(2) Download data and store in assigned folder with site no.

(3) Data analysis.

(4) Report

Detail refer to HKIUS 2011, Work Procedure for Utility Mapping by Non-Destructive Methods.

C4. Services to be located, identified and described

C4.1 Surface water drainage

(1) All drains and drain connections with invert levels.

(2) All manholes which are within are survey area and immediate upstream and downstream manholes outside the survey area.

(3) Type and diameter of pipework.

(4) Connections to storm/foul and combined water sewers.

(5) Depth below ground shall be annotated at each surface feature and at significant changes of depth.

(6) Internal dimensions of manholes and invert levels of manholes and their connection pies.

C4.2 Foul sewerage

(1) All sewers and sewer connections with invert levels.

(2) All manholes within the survey area and also immediate upstream or downstream manholes outside the survey area.

(3) Type and diameter of pipework.

(4) Connections to foul/storm and combined water sewers.

(5) Depth below ground shall be annotated at each surface feature and at significant changes of depth.

(6) Internal dimensions of manholes and invert levels of manholes and their connection pipes

C4.3 Water mains (including cooling water mains)

(1) Pipe routes including fire mains with levels.

(2) Valve and meter pits.

(3) Diameters and material specifications.

(4) Classification (i.e. salt water, fresh water, cooling water, etc)

(5) Owner/operator.

(6) Connections to building.

(7) Depth below ground shall be annotated at each surface feature and at significant changes of depth.

(8) Dimensions and levels of the thrust blocks & concrete surrounds (if available).

(9) Internal dimensions of valve and meter pits.

C4.4 Telecommunications

(1) Cable routes with levels, numbers and sizes of ducts.

(2) Cable draw pits and manholes.

(3) Owner/operator.

(4) Connections to buildings.

(5) Depth below ground shall be annotated at each surface feature and at significant changes of depth.

(6) Number and configuration of cables/ducts.

(7) Dimensions and levels of concrete surrounds (if available).

(8) Internal dimensions of cable draw pits and manholes.

C4.5 Ventilation ducts

(1) Grilles and underground ventilation ducts including duct routes, levels and sizes.

(2) Depth below ground shall be annotated at each surface feature and at significant change of depth

C4.6 Electricity

(1) Cable routes and levels.

(2) Cable draw pits and manholes including those associated with traffic control and street lighting.

(3) Voltages classified as:
   a. Low (0-11kv),
   b. high (over 11kv-66kv) and
   c. transmission (132kv or over)

(4) Connections to buildings.

(5) Depth below ground shall be annotated at each surface feature and at significant changes of depth.

(6) Dimensions and levels of concrete surrounds (if available).

(7) Internal dimensions of cable draw pits and manholes.

C4.7 Cable TV

(1) Cable routes with levels and junction boxes

(2) Connections to buildings

(3) Depth below ground shall be annotated at each surface feature and at significant changes of depth.

(4) Dimensions and levels of concrete surrounds (if available)

(5) Internal dimensions of cable draw pits and junction boxes

C4.8 Combined services ducts

(1) Internal box dimensions of ducts and access points.

(2) All pipes and cables identified and surveyed as for individual services.

(3) Dimensions and levels of concrete surrounds (if available)

C4.9 Gas main

(1) Pipe routes with levels;

(2) Valve and meter pits;

(3) Diameters, material specifications and working pressures;

(4) Depth below ground shall be annotated at each surfaced feature and at significant changes of depth.

(5) Dimensions and levels of concrete surrounds (if available).

(6) Internal dimensions of valve and meter pits

C4.10 Other Services

Other services including abandoned services which are located during the survey shall be recorded with any available information regarding the identity or type of materials or services.

C5. Quality Control and Quality assurance

C5.1 Accuracy of location and survey of underground services

Underground services can be located without excavation, such as cables and connected metal pipes which can be located by surface detection equipment, and drains, manholes, chambers and draw pits shall be located and investigated to the given accuracies.

Underground services shall be located continuously and recorded in three dimensions with intervals not exceeding 5 meters at discrete areas or with intervals not exceeding 10m for survey along the road, and at each surface feature, change of direction and bifurcation.

There are three accuracy levels of survey result which are LOW, MEDIUM and HIGH. The position and level of locatable services, at the recorded points and intervals defined above, shall be related to grid control points and bench marks which should better than ±100 mm root mean square error on the ground and better than 80% of a representative sample of points on locatable services, also within ±165 mm or 0.1d (depth) whichever is bigger to define the accuracy level of survey result.

Table C5.1.1 – Accuracy levels of survey result

	locatable services shall be within			
Percentage of a representative sample of points on locatable services		**±300mm**	**±250mm**	**±200mm**
	80%	L	L	M
	85%	L	M	H
	90%	M	H	H

Remarks: The Confidence Level of Investigation is upto 95% and within ±165mm.

Positions and levels shall be related to the specified grid and datum and shall normally be related to the centre of metallic pipes or cables, crown of ducts and inverts of sewers and drains.

All known underground services or information which cannot be investigated to the accuracies stated above, by excavation, accuracy shall be entered in a unique layers defined as “unreliable”, as approved by the Engineer. The Utility Specialist shall itemise the types of services in his reports, which have been classified as “unreliable” and under other circumstances, such as local areas of interference, where the specified accuracies cannot be achieved. The Utility Specialist shall make his best judgment to provide details of these “unreliable” services or information as requested by the Engineer. The Utility Specialist shall specify in the report the reasons of such services or information cannot be investigated.

Wherever underground services cannot be clearly determined without excavation, these details shall be deduced from the utility undertakers’ record drawings and entered into the drawing in a unique layer defined as ‘records”.

Wherever access is available from the surface, the contractor shall check the depth to underground services. Positions of exact measurements shall be noted as attributes in the Drawings

C5.2 Grid and Plan Control Accuracies

Plan control shall be calculated on a local Transverse Mercator Grid suitable for use as a plane rectangular grid with Scale factors not exceeding one part in 20,000

Permanent Ground Markers shall be connected by a closed net.

The network shall be adjusted by 'least square' to obtain a best mean fit. Misclosures within the net shall not exceed one part in 20,000. For distances between adjacent Permanent Ground Markers of less than 300 meters, the maximum error shall not exceed ±15mm. Temporary survey stations for mapping shall be in sympathy with the nearest marker in the closed net to better than one part in 12,000.

C5.3 Height Datum and Vertical Accuracies

All heights supplied by the Utility Survey Specialist shall be related to the latest published values of Hong Kong Principal Datum Bench Marks.

Permanent Ground Markers and Permanent Bench Marks shall be connected by a closed leveling net which shall be tied to a minimum of three Hong Kong Principal Datum Bench Marks.

Vertical misclosures within the leveling net and between Bench Marks shall not exceed: $\pm (12\sqrt{K})$ mm where K is the sum of the distance leveled in kilometers.

Principal Datum Bench Marks which exceed these tolerances shall be omitted from the adjustment.

The height difference between adjacent Permanent Ground Markers and Permanent Bench Marks shall not be in error by more than ±5 mm when checked by precise leveling.

C5.4 Errors

Maximum errors

(1) Maximum errors are only used for fieldwork misclosures and plotting of Map grids and control points.

(2) All errors exceeding the maximum allowable tolerance including consequential errors shall be corrected by the Utility Survey Specialist at his own expense.

Root mean Square errors

(1) The root mean square errors (RMSE) are related to checks on representative dimensions or levels.

(2) The following conditions have to be satisfied:

(3) At least 67% of all readings must be correct to or better than RMSE;

(4) At least 90% of all readings must be correct to or better than 1.65 times the RMSE;

(5) All readings must be correct to or better than 3 times the RMSE.

All readings not complying with the above three conditions, including consequential errors, shall be corrected by the Utility Survey Specialist at his own expense.

C5.5 LIC Digital Maps

The Utility Specialist shall provide the basic horizontal and vertical survey control plans and data from the Survey and Mapping Office of the Lands Department relating to the Site Area aiming at checking the given control point values and establish survey control networks based on the survey control obtained from the Survey and Mapping Office.

The Utility Specialist shall check the LIC digital maps provided by the Lands Department and verify and update (at 1/1000 or better standard relevant to the project area) the information contained therein as necessary in relation to the areas indicated on the drawings. The Utility Specialist shall maintain the information in the various layers as provided in the LIC digital data

C6. Deliverable

C6.1 Preliminary Stage

(1) One set of preliminary digital data.

(2) One set of paper copy of drawings.

(3) Control results, including simple description of permanent ground markers.

(4) One copy of brief technical report drafted by MHKIUS (US(PCL)) and checked by RPUS.

(5) One set of photographs.

C6.2 Interim Stage (where necessary)

(1) One set of interim digital data.

(2) One set of paper drawings in 1:100 scale

(3) One copy of interim technical report drafted by MHKIUS (US(PCL)) and checked by RPUS.

C6.3 Final Stage

2 copies of Final Report drafted by MHKIUS (US(PCL)) and checked by RPUS which is a compilation of all deliverables required under interim stage to incorporate all comments provided by the Engineer.

C7. Deliverable Schedule

Utility Specialists shall supply for the Site preliminary digital data and paper check plots including a draft technical report with control results within one week after the programmed completion of the works for the site. The Engineer may direct the Contractor to submit preliminary reports of the Site during the execution of investigation. The Contractor shall submit the reports within 1 week after the Engineer has given such written instruction at no additional costs.

Engineers shall return a copy of preliminary data with comments and correction progressively within one week data. The Utility Specialist shall incorporate the Engineer's comments on the preliminary data within the preparation of his Final Survey report.

The Utility Specialist shall submit a Final Report for the investigation within 4 weeks after the completion date of the Works.

C8. Electronic Data File for Utility Services

C8.1 Requirement of Data format

The results of the investigation shall be supplied in DWG/DGN/GIS/IDMS format. All surface and underground features shall be located as described in Clauses C4 in this specification. Non graphic information shall included in the DWG/DGN/GIS/IDMS file database as block attributes or similar. All data shall be separated by type into a logical system of DWG/DGN/GIS/IDMS layers as approved by the Engineer.

The Contractor shall submit a schedule of DWG/DGN/GIS/IDMS standards to the Engineer for approval, which contain proposed division of investigation data into separate DWG/DGN/GIS/IDMS files and layers; naming conventions; symbol definitions and annotation.

Utility services shall be recorded as continuous features between junctions, surface access points (e.g. stop valve or manhole) or changes in characteristic (e.g. pipe diameter/voltage). Completed lines and line strings the approval from the Engineer.

Data files shall be labeled with the filename, number, extent, size, date of investigation, or revision, to be agreed with the Engineer.

C8.2 Surface features

All surface features defined Clause C1 in this Particular Specification shall be shown in the correct 3D position in the file. Annotations shall be placed at the same z-value as the feature using the correct abbreviation. All surface features should be shown proportionally.

C8.3 Underground services

Underground services shall be recorded in three dimensions below each surface feature, at change of director and bifurcations, and with intervals not exceeding 10 metres. Other than at surface features, the location of the services run shall be marked as a cross at the 3D position at maximum 10 meter intervals. Depth below ground shall be annotated at each surface feature and at changes of depth. Annotation shall be placed at the same z-value as the recorded point. For example:

0.68d
…..X……

Where space permits at 1:100 scale, each service run shall be annotated with the type of utility, diameter of pipe or voltage or number of lines etc, at appropriate intervals.

C9. Presentation and Drawing

The investigation results shall be plotted in 1:100 scale A1 drawings on the specified grid and datum approved by the Engineer. The layout, border and title block shall be approved by the Engineer.

The drawings includes building lines, roads with road names and traffic lane road markings, pavement and kerbs, and other significant physical features within the investigated area.

Cross-sections (minimum of 2) shall be provided as instructed by the Engineer to scale and shown at regular intervals, more frequently at points of change and congestion. Cross-sections shall show surface feature, underground utilities (size, depth and type), sub-surface anomalies (GPR Survey results analysed by MHKIUS (GPR)), pavement and kerbs, and other significant physical features.

A key plan of 1:1000 scale on each drawing to show the following:

(1) The location of the site

(2) The 1:1000 topographical map index in which the site is located

C10. Preliminary and Final Report

Report shall consist of the followings:

(1) Introduction
   a. Project name and Location
   b. Site appreciation

(2) Details of Investigation
   a. Date of Investigation
   b. Detailed description of the investigation procedure adopted
   c. All equipment used for the investigation
   d. Identification of supervisor and equipment operators carrying out the investigation

(3) Investigation results
   a. Summary of buried utilities
   b. Report on examination, analysis and interpretation of the investigation results
   c. Identification of utilities, chambers, manholes and relevant surface installations
   d. Records of on-site verification of data handled by qualified person responsible for the report

(4) Appendix
   a. Floppy diskettes or CDR for the digital data files of qualitative and numeric data about the underground assets found;
   b. Engineering Drawings (updated) showing the types and location of various underground assets;
   c. Survey Photographs - 3R colored photographs (prints and negatives/digital copy in JPEG format)

The drawings and textual report will be certified and stamped by the approved qualified person who responsible for the preparation of the report

The Utility Specialist shall supply the Survey Report as described fully as in the above. This report shall include all results with a detailed discussion and accompanying plans. It shall be prepared and signed by an qualified person who shall hold one of the following qualifications:

(1) RPUS or MHKIUS (US(PCL)) with two years local post qualification experience ;
or the followings

(2) MICE, or MHKIE or MHKIS with 10 years experiences, each year 35 hours CPD training, and 14hours refreshment training every 3 years.

C11. Personnel Requirement

In order to maintain the Utility Profession's requirements for the consistency, reliability and accuracy of reports, inspection shall be performed by a properly trained and accredited personnel, for example, OMHKIUS or MHKIUS.

Personnel responsible for surveying and report preparation shall hold a certified qualification issued by a Registered Training Organization (RTO), such as Utility Training Institute (UTI) or The Hong Kong Polytechnic University or equivalent approved by HKIUS.

A certified qualification shall be:

Either Degree, Professional Diploma, Professional Certificate or equivalent approved by HKIUS in Utility Surveying and Management or related subject awarded by a RTO such as Utility Training Institute or The Hong Kong Polytechnic University.

Further information can be referred to the Appendix A2 in this PS.

References

(1) 16/WSD/97, Leakage Detection of Buried Watermains Affecting Slopes - Stage I, Water Supplies Department

(2) 3M Cable Locator User Manual

(3) Code of Practice on Monitoring & Maintenance of Water Carrying Services Affecting Slopes, ETWB (2006), Hong Kong SAR Government.

(4) Constitution, Hong Kong Institute of Utility Specialists, (2011).

(5) Course Note, Advanced Utility Survey for Operators, Engineer/surveyors and managers, UTI, 2005-07

(6) DC96/19, Investigation of Sewers and Drains Behind and Adjacent Fill Slopes and Retaining Walls, Drainage Services Department.

(7) King Wong(2009), Hong Kong Conduit Condition Evaluation Codes(HKCCEC) ,The Code of Practice on Conduit Condition Evaluation using CCTV in Hong Kong, 4th Edition,UTI

(8) HKHA161/95, Detection of Leakage from buried water carrying services in the vicinity of slopes 'and retaining walls within the lands 'maintained by Housing Authority.

(9) King Wong (2000), The design of Water Leakage Detection Methods for Hong Kong. An unpublished Master Degree Thesis at The University of Hong Kong.

(10) Method Statement for Utility Survey, HKIUS, 2011.

(11) Sample report for Utility Survey, HKIUS, 2011

(12) W. Lai, S. Tsang & K. Wong, Applications of Ground Penetrating Radar in Civil Engineering Works, 2004

(13) Work procedures for Utility Survey, HKIUS, 2011

Appendix

A1 Abbreviations

Company/ Organization	
Code	Description
BD	Buildings Department, HKSARG
CEDD	Civil Engineering and Development, HKSARG
DSD	Drainage Services Department, HKSARG
EMSD	Electrical and Mechanical Services Department, HKSARG
EPD	Environmental Protection Department, HKSARG
HA	Hong Kong Housing Authority, HKSARG
HKIUS	Hong Kong Institute of Utility Specialists, HKSARG
HKURC	Hong Kong Utility Research Centre
HyD	Highways Department, HKSARG
LandsD	Lands Department, HKSARG
LD	Labour Department, HKSARG
PolyU	The Hong Kong Polytechnic University
UTI	Utility Training Institute
WRc	Water Research Centre
WSAA	Water Services Association Australia
WSD	Water Supplies Department, HKSARG
WTI	Water Training Institute
Others	
Code	Description
%	Percentage
BMP	Bitmap (Picture Format)
BWCS	Buried Water Carrying Service
CCE	Conduit Condition Evaluation

Company/ Organization	
CCE(CCTV & ME)	Conduit Condition Evaluation(Closed Circuit Television & Man- Entry)
CCES	Conduit Condition Evaluation Specialists
CCTV	Closed Circuit Television
CD	Compact Disc
CL	Cover Level
COP	Code of practice
CP	Competent Person
DN	Nominal Diameter
DP	Design Pressure
DVD	Digital Versatile Disc
e.g.	Exempli Gratia
GIS	Geo-Information System
EPR	Environmental Protection Requirements
etc.	et cetera
GL	Ground Level
H	Height
HKCCEC	Hong Kong Conduit Condition Evaluation Codes
HPWJ	High Pressure Water Jetting
hr	Hour
Hz	Hertz
ICG	Internal Condition Grade
ID	Internal Diameter
IDMS	Integrated Data Management System
IL	Invert Level
ISO	International Standards Organization
JPEG	Joint Photographic Experts Group (Picture Format)

Company/ Organization	
kHz	Kilo- Hertz
kPa	Kilopascal
m	Meter(s)
ME	Man Entry
MHICS	Manhole Internal Condition Survey
mm	Millimetre(s)
Mpa	Megapascal
MPEG	Motion Picture Experts Group (Video Format)
MS	Method Statement
MSCC	Manual of Sewer Condition Classification, UK
OHSAS	Occupational Health and Safety Assessment Series
PPE	Personal Protective Equipment
ppm	Parts per million
PS	Particular Specification
PSI	Pound Per Square Inch
QA/ QC	Quality Assurance/ Quality Control
Ref.	Reference
RMSE	Root Mean Square Error
RPUS	Recognized Professional Utility Specialist
RTO	Recognized Training Organization
SCG	Service Condition Grades
SOPs	Safe Operator Procedures
SPF	Sun Protection Factor
SPG	Structural Performance Grade
SRM	Sewer Rehabilitation Manual
STP	System Test Pressure
TTA	Temporary Traffic Arrangement

Company/ Organization	
US	Utility Specialist
VHS	Video High Speed
W	Width
WLD	Water Leakage Detection
WO	Works Order
WP	Work Procedure

A2 Requirements for Personnel Carrying Out Inspection

Training and Experience Requirements for Personnel Carrying Out Inspection (HKIUS standard, 2011)

Title	Role	Minimum Training Requirement	Minimum Years of Practical Experience	Qualification
Project Leader	Responsible for contract administration and preparation, checking and certifying of reports for compliance with the technical specification.	➢ At least 35 hours of CPD every year ➢ At least 14 hours for refreshment training in every three years ➢ Relevant training in RTO (e.g. PolyU, UTI) for surveys and data collection ➢ Has attended training courses for relevant survey/detection methods, and Possesses a valid training certificate for relevant survey/detection methods used	10 years in contract administration, preferably in works related to the inspection, survey and in data management.	Either: M/FHKIUS, RPUS plus CP, CW or MHKIE/ R.P.E. plus CP, CW and relevant training in RTO (e.g. PolyU, UTI) for surveys and data management
Deputy Project Leader	Responsible for assisting project leader and acting the post of project leader when project leader temporary not with the team	➢ At least 35 hours of CPD every year ➢ At least 14 hours for refreshment training in every three years ➢ Relevant training in RTO (e.g. PolyU, UTI) for surveys and data collection ➢ Has attended training courses for relevant survey/detection methods, and Possesses a valid training certificate for relevant survey/detection methods used	10 years in contract administration, preferably in works related to the inspection, survey and in data management.	Either: M/FHKIUS, RPUS plus CP, CW or MHKIE/ R.P.E. plus CP, CW and relevant training in RTO (e.g. PolyU, UTI) for surveys and data management
Team Leader	Responsible for works arrangement and data processing including checking of raw data for quality and consistency.	➢ At least 35 hours of CPD every year ➢ At least 14 hours for refreshment training in every three years ➢ Relevant training in RTO (e.g. PolyU, UTI) for surveys and data collection ➢ Has attended training courses for relevant survey/detection methods, and Possesses a valid training certificate for relevant survey/detection methods used	5 years in works related to the inspection, survey and in data management.	M/FHKIUS, RPUS, CP, CW
Crew Leader	Responsible for supervising the field works and site safety.	➢ At least 35 hours of CPD every year ➢ At least 14 hours for refreshment training in every three years ➢ Relevant training in RTO (e.g. PolyU, UTI) for surveys and data collection ➢ Has attended training courses for relevant survey/detection methods, and Possesses a valid training certificate for relevant survey/detection methods used	3 years in works related to the inspection, survey and in data collection	O/MHKIUS, CP, CW
Operators	Responsible for operating equipment and carrying out inspection and survey.	➢ At least 35 hours of CPD every year ➢ At least 14 hours for refreshment training in every three years ➢ Relevant training in RTO (e.g. PolyU, UTI) for surveys and data collection ➢ Has attended training courses for relevant survey/detection methods, and Possesses a valid training certificate for relevant survey/detection methods used	2 years in works related to the inspection, survey and in data collection.	AMHKIUS, CP, CW