PARTICULAR SPECIFICATION

APPENDIX P

TEMS SYSTEM AND REQUIREMENTS

TEMS System and Requirements

1. INTRODUCTION

1.1 This document details the codes, protocols, and formats which have to be followed by the Contractor while submitting instrumentation information to the web-based Tunnelling and Excavation Monitoring System (TEMS).

1.2 The format stated below is indicative only. The IM contractor shall liaise with the Authority on the final data format to be adopted.

1.3 IM Contractor shall be required to register with LTA and will be provided with the Username and Password for accessing the TEMS. Authorized users are able to upload geotechnical data to the TEMS.

1.4 IM Contractor shall provide drawings and information on the area of instrumentation as listed below.

2. TEMS OVERVIEW

2.1 Purpose

2.1.1 Tunnelling and Excavation Monitoring System (TEMS) is a web-based application. The purpose of the TEMS is for IM Contractor to upload instrumentation information. The system accepts instrumentation files in a defined format. The files will be validated by TEMS and the system will process the uploaded files.

2.2 List of Codes

2.2.1 The following are the list of codes which should be used while preparing the data for TEMS.

Instrument Type (BCA AGS(SG))	**TEMS Instrument Type Code**	**Description**
SP	GWS	Ground Water (Standpipe)
SPIE	GWC	Ground Water (Casagrande)
EPIE	GWV	Ground Water (Vibrating Wire)
PPIE	GWP	Ground Water (Pneumatic Piezometer)
ETM	MX	Magnetic Extensometer
ETR	RX	Rod Extensometer
HS	HS	Heave Stake
ICM_IS	IS	Inclinometer in Soil
ICM_IW	IW	Inclinometer in Wall
ICM_IE	IE	Inclinometer with Magnetic Extensometer
PC	PC	Soil Pressure Cell
TMU	TM	Portable Tiltmeter
TS	XYZ	3D Precision Survey
ETT	TE	Tape Extensometer
VM	VM	Vibration Monitor
ELB	ELB	Electro-level Beam
TMS	TMS	Tiltmeter (Sensor)
CMA	CMA	Crack Meters (Avongaurd)
CME	CME	Crack Meters (Wire Extensometer)
CMD	CMD	Crack Meters (Demec)
TP	TP	Thermistor
SG	SG	Strain Gauges
LC	LC	Load Cell
MSET_LG	LG	Ground Settlement Markers
MSET_LB	LB	Building Settlement Markers
MSET_LU	LU	Utility Settlement Markers

3. INPUT FILE FORMATS FOR TEMS

3.1 Instrument Setup File

3.1.1 The Instrument setup file is used to define the instrument in TEMS Database. It is derived from “Guidelines for Electronic Transfer of Site Investigation Data (BCA AGS(SG)) and includes user defined Group and Headings which are defined for TEMS System. It is an AGS Excel Format File, including PROJ, ZONE, HOLE and MONP groups.

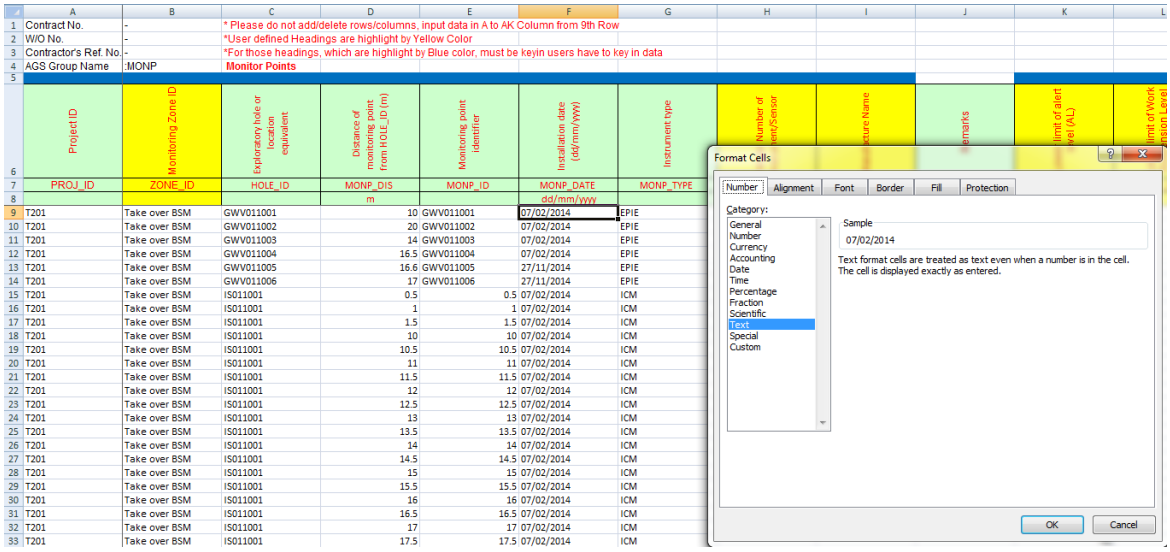
3.1.2 Refer to the attached excel file (ContractNo_SetupData_TEMS.xlsx), it includes 7 sheets:

- PROJ – AGS
  It records Project Information and includes Project ID (PROJ_ID, for Projects, it is Txxx, Txxx etc. xxx - contract No.), Project title (PROJ_NAME), Location of site (PROJ_LOC), Client name (PROJ_CLNT), Contractors name (PROJ_CONT), and Project engineer (PROJ_ENG) etc.
- ZONE – AGS
  It is user defined group and used to record the monitoring zone information. It includes Project ID (PROJ_ID), Monitoring Zone ID (ZONE_ID) and Location of Monitoring Zone (ZONE_LOC) etc.
- HOLE – AGS
  It records Instrument Information and includes Project ID (PROJ_ID), Monitoring Zone ID (ZONE_ID), Instrument ID (HOLE_ID), Instrument Parent No (HOLE_PRT), Type of exploratory hole (HOLE_TYPE, for instrument, please input INST), Coordinates of Instrument Location (HOLE_NATE: Easting; HOLE_NATN: Northing by Singapore Coordinate System SVY21), Ground Level (HOLE_GL), Orientation of Instrument (HOLE_ORNT, record the direction of the measuring for Inclinometer, Tiltmeter and XYZ Prism etc), Monitoring Frequency (HOLE_FREQ) etc.
- MONP – AGS
  It records Monitoring Point Information and includes Project ID (PROJ_ID), Monitoring Zone ID (ZONE_ID), Instrument ID (HOLE_ID), Distance of monitoring point from HOLE_ID (MONP_DIS), Instrument Installation Date (MONP_DATE), Instrument Type (MONP_TYPE), AL/PDL/WSL Values etc.

- ABBR – AGS
  It defines data abbreviations where these have been used as data entries in the data GROUPs.
- DICT – AGS
  It defines user defined Groups or Headings used for TEMS system, such as ZONE etc.
- UNITS – AGS
  It defines definition of measuring units used for TEMS Database System.

3.1.3 There are other sheets (such as MONR – AGS, ISPT – AGS and GEOL – AGS etc), which are hidden and reserved for future use.

The date format in the excel file is Text (follow AGS rule), refer to the explanation as follows:



	A	B	C	D	E	F	G
1	Contract No.	-	* Please do not add/delete rows/columns, input data in A to AK Column from 9th Row				
2	W/O No.	-	*User defined Headings are highlight by Yellow Color				
3	Contractor's Ref. No.	-	*For those headings, which are highlight by Blue color, must be keyin users have to key in data				
4	AGS Group Name	:MONP	Monitor Points				
5							
6	Project ID	Monitoring Zone ID	Exploratory hole or location equivalent	Distance of monitoring point from HOLE_ID (m)	Monitoring point identifier	Installation date (dd/mm/yyyy)	Instrument type
7	PROJ_ID	ZONE_ID	HOLE_ID	MONP_DIS	MONP_ID	MONP_DATE	MONP_TYPE
8				m		dd/mm/yyyy	
9	T201	Take over BSM	GWV011001	10	GWV011001	07/02/2014	EPIE
10	T201	Take over BSM	GWV011002	20	GWV011002	07/02/2014	EPIE
11	T201	Take over BSM	GWV011003	14	GWV011003	07/02/2014	EPIE
12	T201	Take over BSM	GWV011004	16.5	GWV011004	07/02/2014	EPIE
13	T201	Take over BSM	GWV011005	16.6	GWV011005	27/11/2014	EPIE
14	T201	Take over BSM	GWV011006	17	GWV011006	27/11/2014	EPIE
15	T201	Take over BSM	IS011001	0.5	0.5	07/02/2014	ICM
16	T201	Take over BSM	IS011001	1	1	07/02/2014	ICM
17	T201	Take over BSM	IS011001	1.5	1.5	07/02/2014	ICM
18	T201	Take over BSM	IS011001	10	10	07/02/2014	ICM
19	T201	Take over BSM	IS011001	10.5	10.5	07/02/2014	ICM
20	T201	Take over BSM	IS011001	11	11	07/02/2014	ICM
21	T201	Take over BSM	IS011001	11.5	11.5	07/02/2014	ICM
22	T201	Take over BSM	IS011001	12	12	07/02/2014	ICM
23	T201	Take over BSM	IS011001	12.5	12.5	07/02/2014	ICM
24	T201	Take over BSM	IS011001	13	13	07/02/2014	ICM
25	T201	Take over BSM	IS011001	13.5	13.5	07/02/2014	ICM
26	T201	Take over BSM	IS011001	14	14	07/02/2014	ICM
27	T201	Take over BSM	IS011001	14.5	14.5	07/02/2014	ICM
28	T201	Take over BSM	IS011001	15	15	07/02/2014	ICM
29	T201	Take over BSM	IS011001	15.5	15.5	07/02/2014	ICM
30	T201	Take over BSM	IS011001	16	16	07/02/2014	ICM
31	T201	Take over BSM	IS011001	16.5	16.5	07/02/2014	ICM
32	T201	Take over BSM	IS011001	17	17	07/02/2014	ICM
33	T201	Take over BSM	IS011001	17.5	17.5	07/02/2014	ICM

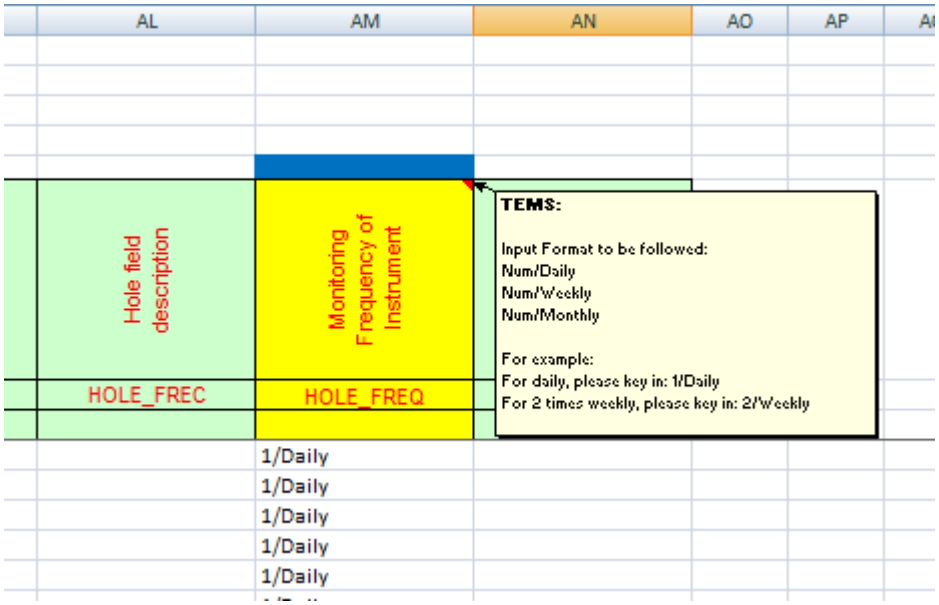
For Monitoring Frequency:

The accepted input is Num/Period

Num: monitoring number within the indicated period

Period: Daily, Weekly or Monthly (case sensitive)

Refer to the sample of input as follows:



AL/PDL/WSL Values for each type of instrument:

Instrument Type (BCA AGS(SG))	Instrument Type Code	Description	AL/PDL/WSL
SP	GWS	Ground Water (Standpipe)	Water Level, mRL
SPIE	GWC	Ground Water (Casagrande)	Water Level, mRL
EPIE	GWV	Ground Water (Vibrating Wire)	Pressure Head Level, mRL
PPIE	GWP	Ground Water (Pneumatic Piezometer)	Pressure Head Level, mRL
ETM	MX	Magnetic Extensometer	Magnet Movement, mm
ETR	RX	Rod Extensometer	Settlement, mm
HS	HS	Heave Stake	Settlement, mm
ICM_IS	IS	Inclinometer in Soil	Movement, mm
ICM_IW	IW	Inclinometer in Wall	Movement, mm
ICM_IE	IE	Inclinometer with Magnetic Extensometer	Movement, mm
PC	PC	Soil Pressure Cell	Soil Pressure, kPa
TMU	TM	Portable Tiltmeter	Change of Tilting, Deg
TS	XYZ	3D Precision Survey	Movement, mm
ETT	TE	Tape Extensometer	Convergency, mm
VM	VM	Vibration Monitor	PVS, mm/s
ELB	ELB	Electro-level Beam	Change of Tilting, Deg
TMS	TMS	Tiltmeter (Sensor)	Change of Tilting, Deg
CMA	CMA	Crack Meters (Avongaurd)	Displacement, mm

CME	CME	Crack Meters (Wire Extensometer)	Displacement, mm
CMD	CMD	Crack Meters (Demec)	Displacement, mm
TP	T	Temperature	Temperature, DegC
SG	SG	Strain Gauges	Force, kN
LC	LC	Load Cell	Force, kN
MSET_LG	LG	Ground Settlement Markers	Settlement, mm
MSET_LB	LB	Building Settlement Markers	Settlement, mm
MSET_LU	LU	Utility Settlement Markers	Settlement, mm

3.2 Instrument Data File

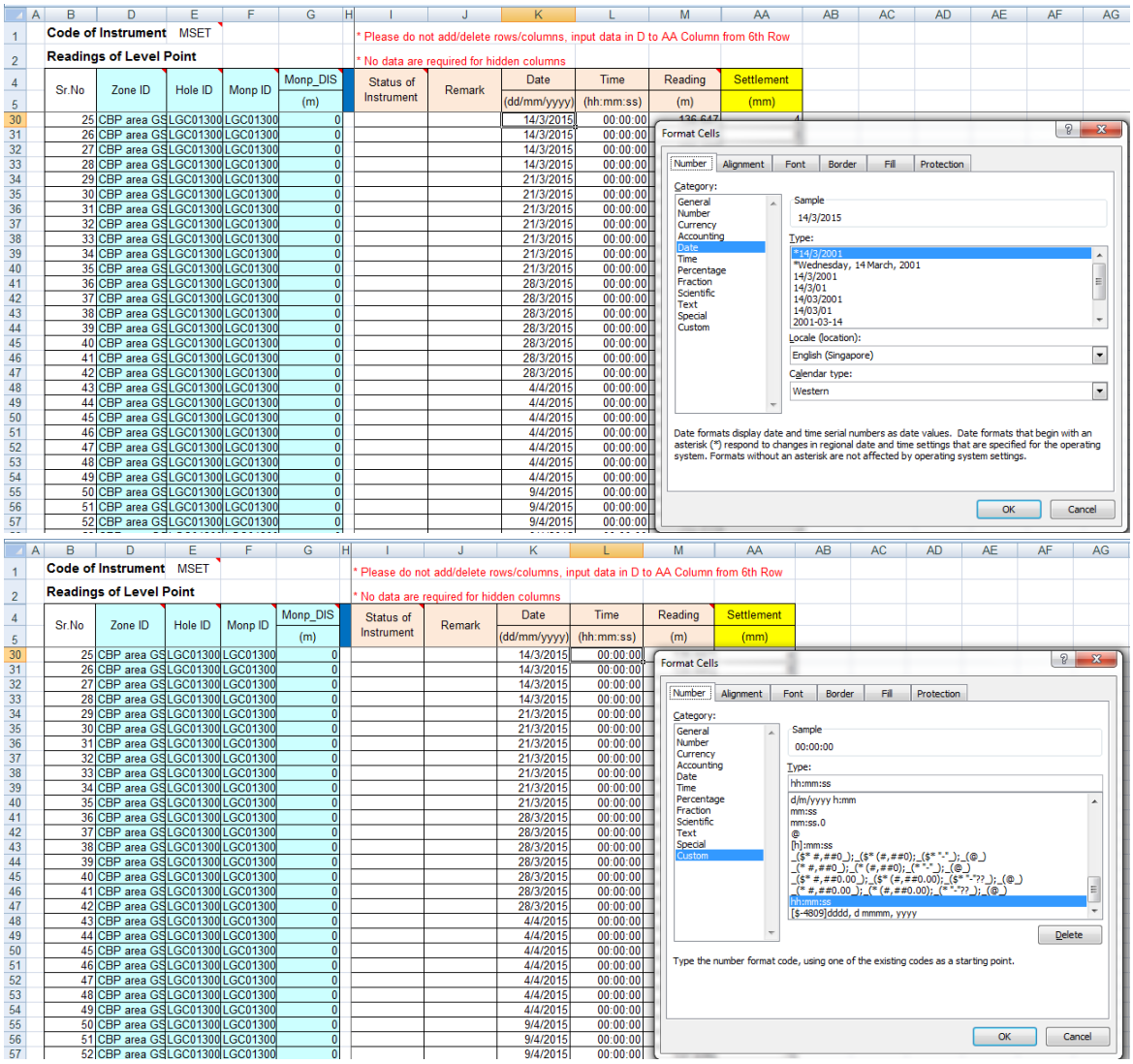
3.2.1 It is an Excel Format File and used for input the monitoring readings and results for each type of instrument (it replace MONR group for user easy to input the monitoring data).

Refer to the attached excel file (ContractNo_InstData_TEMS.xlsx), it includes sheets as follows:

- Info sheet
  It records Contract No (PROJ_ID) and Contract Name. The Contract No will be used to identify the Contract when user is uploading the monitoring data to TEMS system.
- Other sheets are for input monitoring data and results for each type of instrument, For example, GWS sheet will be used for user to input the monitoring readings and results for Water Standpipe.

3.2.2 Each Monitoring data sheet includes Zone ID (ZONE_ID), Hole ID (HOLE_ID), Monp ID (MONP_ID) and Monp_DIS (MONP_DIS). These values will be used to identify the each instrument t monitoring point in TEMS Database and must be same with the Instrument Setup File.

3.2.3 The date format in the excel file is Date (dd/mm/yyyy), and Time format is hh:mm:ss. Refer to the explanation as follows:



4. DATA SUBMISSION PROTOCOL

4.1 General

4.1.1 The data submission protocol is in the following sequence which the Contractor has to comply:

(a) Setup file

(b) Data file

The process for data submission to TEMS shall comply with the following:-

(a) Contractor shall use the TEMS application for verification and uploading of instrument setup files and data files.

(b) Error files generated by TEMS, if any, will be displayed in the upload file history and the Contractor will be notified for correction to comply with the error messages.

(c) Contractor shall upload real-time data to TEMS using the templates provided by the Authority via Secure File Transfer Protocol (SFTP). SFTP access account and password will be provided to the Contractor

4.2 Calibration, Installation and Initialization Records

4.2.1 The Contractor is responsible for maintaining a permanent paper record of each instrument's installation, calibration and initialization, including:-

(a) Instrument Manufacturer, Model Number, Serial Number and Calibration Certificate (where applicable.) Post-installation value (initial reading.)

(b) Graphical time-series plot demonstrating stability of readings following instrument installation. For piezometers, these readings will take place over a 2 to 4 week period. For other instruments, readings shall take place during the first several days following instrument installation. For instruments which may be influenced by daily temperature fluctuations (strain gauges, load cells, etc.) readings shall be taken at several points during the thermal cycle to enable identification of the effect (if any) on the instrument readings, so that appropriate compensation can be attempted using the TEMS.

(c) Inclinometer casings shall include a deviation and “spiral” test, and probe calibration shall be maintained and documented as necessary by contractor.

4.3 General Notes

4.3.1. Data transmissions shall comply with the following file naming convention:

(a) Instrument Setup File
ContractCode_InstSetup_TYEMS_xxxx_yyyymmdd.xlsx

Where: ContractCode is the code of civil contact, for example T3072;
xxxx is sequence number of the file uploaded, for example 0001;
yyyymmdd is latest date of the instrument installation when you create this setup file

(b) Instrument Data File
ContractCode_InstData_TEMS_xxxx_yyyymmdd.xlsx

Where: ContractCode is the code of civil contact, for example T201;
xxxx is sequence number of the file uploaded, for example 0001;
yyyymmdd is latest date of the monitoring when you create this setup file

(d) Example:
T201_InstSetup_TEMS_0001_20150618.xlsx
T201_InstData_TEMS_0001_20150710.xlsx

The latest installation date in the file is 20150618, 18 June 2015
The latest monitoring date in the file is 20150710, 10 July 2015

4.3.2 When re-submitting the ERROR files, the file names shall not be changed.

4.4 Drawings and Information Required for Contract Set-up in TEMS

4.4.1 In order to create the contract (civil) map in TEMS, the Contractor shall provide the following drawings in softcopy to the TEMS Administrator:

Description	**Layer**
• Topographic Survey	Topo
• Alignment	Align
• Propose structure/s (outline only)	Struct

4.4.2 The coverage for the above layers shall be more than the extent of the instrumentation monitoring.

4.4.3 In addition, the IM Contractor shall provide the following information:

- Contract
- Civil Contractor
- Instrumentation Start Date
- Min Northing
- Max Northing
- Min Easting
- Max Easting
- Min Elevation
- Max Elevation