

STATEMENT OF WORK

Development of a data collect software for FMBS system

1. Scope

This Statement of Work (SOW) describes the requirements for a data collect software for the new electronics, hereinafter referred to as “Software” which will be used in UMS Flow Monitor Based Systems.

2. Applicable Documents

The following documents shall be applicable for the work to the extent specified hereinafter:

- ISO 8601 standard for timestamp

In the event of conflict between the documents listed above and the content of this Specification, the content of this Specification shall take precedence to the extent of the conflict.

3. Definitions, Acronyms, and Abbreviations

The following definitions, acronyms, and abbreviations shall apply throughout this SOW unless defined otherwise hereinafter:

UMS: Unattended Monitoring System

FMBS: Flow Monitor Based System

FLUM: Flow Unattended Monitor

ATPM: Advanced Thermo-Hydraulic Power Monitor

4. Requirements

4.1. Functional and Performance Requirements

The Software shall meet the following functional and performance requirements:

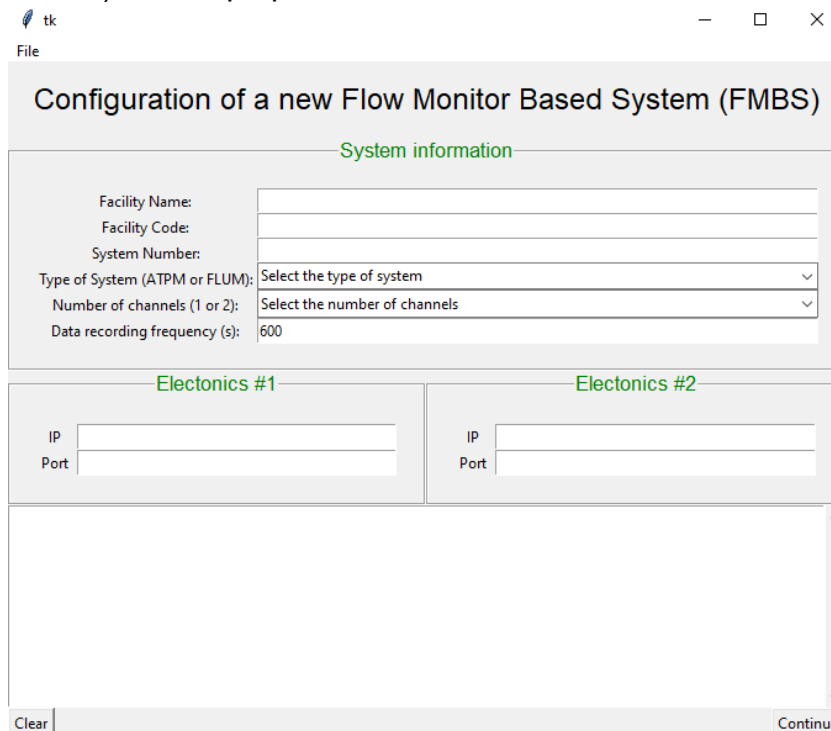
- 4.1.1. Be in English;
- 4.1.2. work on Windows 10;
- 4.1.3. Be reliable and work 24 hours a day and 7 days a week;
- 4.1.4. Be easy to maintain;
- 4.1.5. The software source code shall be well organized, commented and documented;
- 4.1.6. Be developed using standard development code;
- 4.1.7. Propose an easy way for the configuration of a new system;
- 4.1.8. Establish Modbus communication with the two Electronics;

- 4.1.9. Propose an ergonomic GUI with a display of all relevant information;
- 4.1.10. Propose a visual indicator of the state of health of the electronics;
- 4.1.11. Collect data and diagnostic values from the electronics by using Modbus communication protocol;
- 4.1.12. Create daily data files;
- 4.1.13. Write timestamped data in the data files (frequency of writing data in the data files shall be settable);
- 4.1.14. Create daily log files;
- 4.1.15. Write timestamped logs in log files;
- 4.1.16. Detect connection errors with electronics;
- 4.1.17. Detect temperature probes errors (by using Modbus communication protocol);
- 4.1.18. Detect Ultrasonic transducers errors (by using Modbus communication protocol); and
- 4.1.19. Propose a log viewer with the possibility to view over a customizable time frame.

4.2. Design Requirements

The Software shall meet the following design requirements

- 4.2.1. The software shall propose a configuration window (example in the picture below) It shall propose to the user:



- 4.2.1.1. Enter a facility name (text value);
- 4.2.1.2. Enter a facility code (text value with special characters);
- 4.2.1.3. System number/IAEA inventory number (text value with special characters);
- 4.2.1.4. Type of system: list with 2 choices (ATPM or FLUM) ;



- 4.2.1.5. Number of channels: list with 2 choices (1 or 2);
- 4.2.1.6. Data recording frequency (seconds): to define the time for which data are written in the data files;
- 4.2.1.7. IP and port for each electronics;
- 4.2.1.8. A blank zone in which user errors or system errors must be written in such as "Enter a Facility name" if the field is not filled etc... and if the Modbus communication between the computer and the electronics shows an error (means that a connection test to the electronics must be performed here);
- 4.2.1.9. A clear button to remove everything filled by the user;
- 4.2.1.10. A continue button which launch the connection test to the electronics and the creation of a configuration file if everything is fully filled and worked. The configuration file shall be named "FMBS_Config_File.FMBS" and contains the following information:

```

1 Software Name:FMBS Collect Software
2 Software Version:0.1
3 Facility Name:IAEA HQ
4 Facility Code:G-376
5 System Number:ATPM/010
6 System Type:ATPM
7 Data Location Path:c:\Data\G-376\ATPM\ATPM
8 SOH Location Path:c:\Data\G-376\ATPM\SOH
9 Number of Channels:1
10 Data Recording Frequency:600
11 Electronics 1 IP Adress:192.168.0.71
12 Electronics 1 Mask Adress:502
13 Electronics 2 IP Adress:192.168.0.70
14 Electronics 2 Mask Adress:502

```

The data location path and SOH location Path must be automatically build based on the user information filled in the configuration GUI.

"C:\Data\Facility Code"\System Type\FM1" for electronics 1

"C:\Data\Facility Code"\System Type\FM2" for electronics 2

"C:\Data\Facility Code"\System Type\SOH" for State of Health files

- 4.2.2. After depending on the values filled by the user the following GUIs should appear full screen (Escape touch shortcut to reduce).

- 4.2.2.1. If ATPM and one channel are selected



File
Plasma F721 Log

Facility Name: **IAEA HQ** Facility Code: **G-376** System Number: **ATPM/010**

Electronics #1		Electronics #2	
IP Address: 192.168.0.71 Status: ●		IP Address: 192.168.0.70 Status: ●	
<p>Measurement</p> <p>Power - MW</p> <p>Temperature Inlet - Temperature Outlet - Flow rate</p>		<p>Measurement</p> <p>Power - MW</p> <p>Temperature Inlet - Temperature Outlet - Flow rate</p>	
<p>Diagnostics</p> <p>SNR SCNR</p>		<p>Diagnostics</p> <p>SNR SCNR</p>	

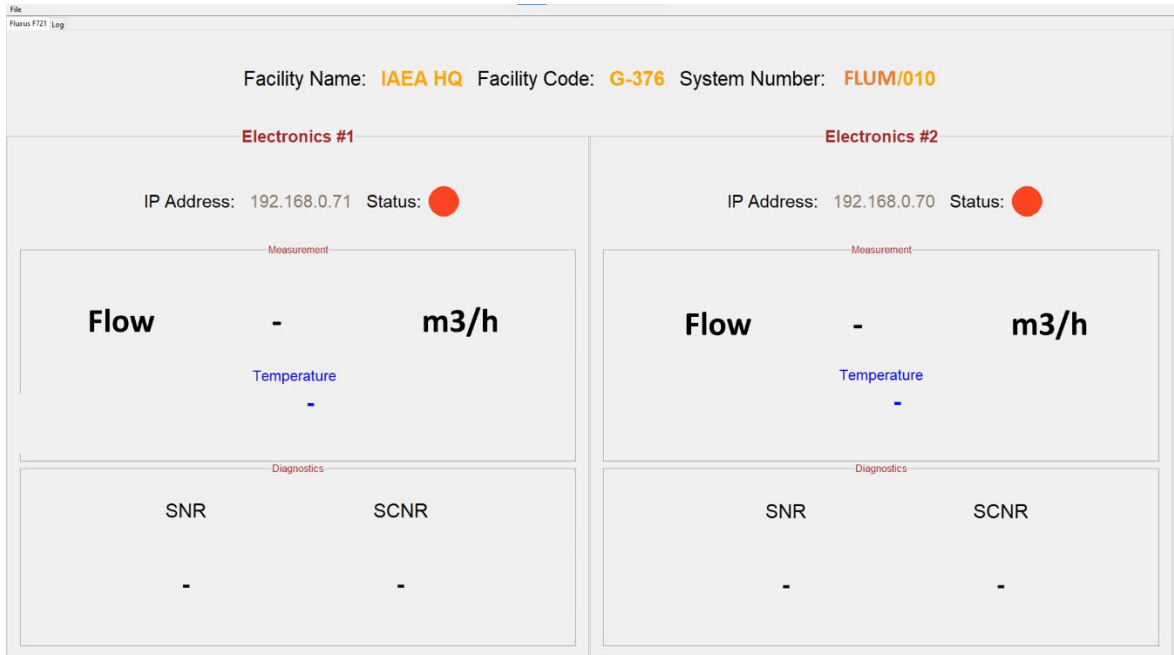
4.2.2.2. If ATPM and two channels are selected:

File
Plasma F721 Log

Facility Name: **IAEA HQ** Facility Code: **G-376** System Number: **ATPM/010**

Electronics #1		Electronics #2	
IP Address: 192.168.0.71 Status: ●		IP Address: 192.168.0.70 Status: ●	
<p>Channel A</p> <p>Power - MW</p> <p>Temperature Inlet - Temperature Outlet - Flow rate</p> <p>Diagnostics</p> <p>SNR SCNR</p>		<p>Channel A</p> <p>Power - MW</p> <p>Temperature Inlet - Temperature Outlet - Flow rate</p> <p>Diagnostics</p> <p>SNR SCNR</p>	
<p>Channel B</p> <p>Power - MW</p> <p>Temperature Inlet - Temperature Outlet - Flow rate</p> <p>Diagnostics</p> <p>SNR SCNR</p>		<p>Channel B</p> <p>Power - MW</p> <p>Temperature Inlet - Temperature Outlet - Flow rate</p> <p>Diagnostics</p> <p>SNR SCNR</p>	

4.2.2.3. If FLUM and one channel are selected



Facility Name: **IAEA HQ** Facility Code: **G-376** System Number: **FLUM/010**

Electronics #1

IP Address: 192.168.0.71 Status: ●

Measurement

Flow - **m3/h**

Temperature -

Diagnostics

SNR SCNR

- -

Electronics #2

IP Address: 192.168.0.70 Status: ●

Measurement

Flow - **m3/h**

Temperature -

Diagnostics

SNR SCNR

- -

- 4.2.3. The window should appear if a configuration file already exists and accordingly to the configuration file;
- 4.2.4. The GUI main window shall be ergonomic;
- 4.2.5. The GUI main window shall propose: a main window in which are displayed all relevant information (Power MW, Flow m3/h, Temperatures °C collected via Modbus communication protocol), and a log window in which all the logs are displayed;
- 4.2.6. The display should display in real time the relevant values;
- 4.2.7. A “status LED” shall reflect the state of health of the electronics with a relevant color code (blue if not pingable, green if everything is ok, red if in a critical state, etc...);
- 4.2.8. Displaying of diagnostics value shall reflect the supplier recommendation:
A black font with a coloured background (green, orange or red) is preferred (in case of the user wants to modify it these threshold shall be settable in the configuration file);

good measurement	measurement at limit	measurement not possible
SCNR > 30 dB (> 50 %)	20 dB ≤ SCNR ≤ 30 dB (0 % < SCNR ≤ 50 %)	SCNR < 20 dB (= 0 %)
SNR > 15 dB	0 dB ≤ SNR ≤ 15 dB	SNR < 0 dB

- 4.2.9. A log viewer shall be implemented, the log viewer shall show all messages over a time frame, customizable by the user. Sorting options shall be proposed such as shown in the picture below (electronics 1 or 2, channel A or B, etc...). Every log shall be timestamped;



File					
Fluor F721 Log					
Filters					
Electronics to display: <input checked="" type="checkbox"/> Electronics #1 <input checked="" type="checkbox"/> Electronics #2					
Type of message to display: <input checked="" type="checkbox"/> INFO Messages <input checked="" type="checkbox"/> WARNING Messages <input checked="" type="checkbox"/> ALARM Messages					
Reset Delete					
Upload From:					
Id	Date	Type	Electronics Number	Comments	
148	2021-01-28 11:12:01	ALARM	N01	Unable to connect to the Electronics at the following address: 192.168.0.71 : 502 : 1	
147	2021-01-28 11:12:01	ALARM	N02	Unable to connect to the Electronics at the following address: 192.168.0.70 : 502 : 1	
146	2021-01-28 11:12:00	ALARM	N01	Unable to connect to the Electronics at the following address: 192.168.0.71 : 502 : 1	
145	2021-01-28 11:12:00	ALARM	N02	Unable to connect to the Electronics at the following address: 192.168.0.70 : 502 : 1	
144	2021-01-28 11:11:59	ALARM	N01	Unable to connect to the Electronics at the following address: 192.168.0.71 : 502 : 1	
143	2021-01-28 11:11:59	ALARM	N02	Unable to connect to the Electronics at the following address: 192.168.0.70 : 502 : 1	
142	2021-01-28 11:11:58	ALARM	N01	Unable to connect to the Electronics at the following address: 192.168.0.71 : 502 : 1	
141	2021-01-28 11:11:58	ALARM	N02	Unable to connect to the Electronics at the following address: 192.168.0.70 : 502 : 1	
140	2021-01-28 11:11:57	ALARM	N01	Unable to connect to the Electronics at the following address: 192.168.0.71 : 502 : 1	
139	2021-01-28 11:11:57	ALARM	N02	Unable to connect to the Electronics at the following address: 192.168.0.70 : 502 : 1	
138	2021-01-28 11:11:56	ALARM	N01	Unable to connect to the Electronics at the following address: 192.168.0.71 : 502 : 1	
137	2021-01-28 11:11:56	ALARM	N02	Unable to connect to the Electronics at the following address: 192.168.0.70 : 502 : 1	
136	2021-01-28 11:11:26	ALARM	N02	Unable to connect to the Electronics at the following address: 192.168.0.70 : 502 : 1	
135	2021-01-28 11:11:26	ALARM	N01	Unable to connect to the Electronics at the following address: 192.168.0.71 : 502 : 1	
134	2021-01-28 11:11:25	ALARM	N01	Unable to connect to the Electronics at the following address: 192.168.0.71 : 502 : 1	
133	2021-01-28 11:11:25	ALARM	N02	Unable to connect to the Electronics at the following address: 192.168.0.70 : 502 : 1	
132	2021-01-28 11:11:24	ALARM	N01	Unable to connect to the Electronics at the following address: 192.168.0.71 : 502 : 1	
131	2021-01-28 11:11:24	ALARM	N02	Unable to connect to the Electronics at the following address: 192.168.0.70 : 502 : 1	
130	2021-01-28 11:11:23	ALARM	N01	Unable to connect to the Electronics at the following address: 192.168.0.71 : 502 : 1	
129	2021-01-28 11:11:23	ALARM	N02	Unable to connect to the Electronics at the following address: 192.168.0.70 : 502 : 1	
128	2021-01-28 11:11:22	ALARM	N01	Unable to connect to the Electronics at the following address: 192.168.0.71 : 502 : 1	
127	2021-01-28 11:11:22	ALARM	N02	Unable to connect to the Electronics at the following address: 192.168.0.70 : 502 : 1	
126	2021-01-28 11:11:21	ALARM	N01	Unable to connect to the Electronics at the following address: 192.168.0.71 : 502 : 1	
125	2021-01-28 11:11:21	ALARM	N02	Unable to connect to the Electronics at the following address: 192.168.0.70 : 502 : 1	
124	2021-01-28 11:11:20	ALARM	N01	Unable to connect to the Electronics at the following address: 192.168.0.71 : 502 : 1	
123	2021-01-28 11:11:20	ALARM	N02	Unable to connect to the Electronics at the following address: 192.168.0.70 : 502 : 1	
122	2021-01-28 11:11:19	ALARM	N01	Unable to connect to the Electronics at the following address: 192.168.0.71 : 502 : 1	
121	2021-01-28 11:11:19	ALARM	N02	Unable to connect to the Electronics at the following address: 192.168.0.70 : 502 : 1	
120	2021-01-28 11:11:18	ALARM	N01	Unable to connect to the Electronics at the following address: 192.168.0.71 : 502 : 1	
119	2021-01-28 11:11:18	ALARM	N02	Unable to connect to the Electronics at the following address: 192.168.0.70 : 502 : 1	
118	2021-01-28 11:11:17	ALARM	N02	Unable to connect to the Electronics at the following address: 192.168.0.70 : 502 : 1	
117	2021-01-28 11:11:17	ALARM	N01	Unable to connect to the Electronics at the following address: 192.168.0.71 : 502 : 1	
116	2021-01-28 11:11:15	ALARM	N02	Unable to connect to the Electronics at the following address: 192.168.0.70 : 502 : 1	
115	2021-01-28 11:11:15	ALARM	N01	Unable to connect to the Electronics at the following address: 192.168.0.71 : 502 : 1	
114	2021-01-28 11:11:14	ALARM	N02	Unable to connect to the Electronics at the following address: 192.168.0.70 : 502 : 1	
113	2021-01-28 11:11:14	ALARM	N01	Unable to connect to the Electronics at the following address: 192.168.0.71 : 502 : 1	
112	2021-01-28 11:11:13	ALARM	N02	Unable to connect to the Electronics at the following address: 192.168.0.70 : 502 : 1	
111	2021-01-28 11:11:13	ALARM	N01	Unable to connect to the Electronics at the following address: 192.168.0.71 : 502 : 1	
110	2021-01-28 11:10:51	ALARM	N01	Unable to connect to the Electronics at the following address: 192.168.0.71 : 502 : 1	
109	2021-01-28 11:10:51	ALARM	N02	Unable to connect to the Electronics at the following address: 192.168.0.70 : 502 : 1	
108	2021-01-28 11:10:50	ALARM	N02	Unable to connect to the Electronics at the following address: 192.168.0.70 : 502 : 1	
107	2021-01-28 11:10:50	ALARM	N01	Unable to connect to the Electronics at the following address: 192.168.0.71 : 502 : 1	
106	2021-01-28 11:10:49	ALARM	N02	Unable to connect to the Electronics at the following address: 192.168.0.70 : 502 : 1	

Log message shall be sort into 3 categories (info, alarm and warning)

- Info messages:
 - o Creation of daily data files;
 - o Creation of daily log files;
- Warning messages:
 - o The software restarts;
 - o Electronics restarts;
 - o SNR or SCNR in measurement at limit state;
- Alarm messages:
 - o Impossible to connect to electronics;
 - o No data received;
 - o Data not written in the file;
 - o Malfunction of an ultrasonic transducer (state readable via Modbus protocol);
 - o Malfunction of a temperature probe (state readable via Modbus protocol);
 - o SNR or SCNR in measurement not possible state;

4.2.10. Tree structure and files organization

The tree structure shall be the following, files shall be created in the following folder:

“c:\Data\Facility Code\System Type (ATPM or FLUM)”

- o Sub folder “FM1” (data folder of the electronics #1);
 - Sub Sub folder “Year – Month”;
 - Daily data files;
- o Sub folder “FM2” (data folder of the electronics #2);
 - Sub Sub folder “Year – Month”
 - Daily data files;



- Sub folder “SOH”
 - Year – Month
 - Daily log files

These folders paths shall be settable in the configuration file.

4.2.11. Data files:

4.2.11.1. Data files must be created on a daily basis, one per electronics;

4.2.11.2. The name of data files must be built as following: “Facility Name” + “_” + “Type of system” + “_” + “Electronics number” + “_” + Date + “.FM2FData.txt”;

4.2.11.3. Data must be written in the data files as following (case of one channel ATPM system);

Timestamp	A-T-In1 (C)	A-T-Out (C)	A-Flow (m3/h)	A-Pow (MW)	A-SNR (dB)	A-SCNR (dB)
2021-01-27T11:42:35	21.8	22.0	0.0	0.0	35.0	5.0
2021-01-27T11:42:50	21.8	22.0	0.0	0.0	36.0	4.8
2021-01-27T11:43:08	21.8	22.0	0.0	0.0	36.0	4.8
2021-01-27T11:43:23	21.8	22.0	0.0	0.0	36.0	4.9
2021-01-27T11:43:41	21.8	22.0	0.0	0.0	37.0	4.8
2021-01-27T11:43:56	21.8	22.0	0.0	0.0	37.0	4.9
2021-01-27T11:44:12	21.8	22.0	0.0	0.0	37.0	4.8
2021-01-27T11:44:27	21.8	22.0	0.0	0.0	36.0	4.8
2021-01-27T11:44:45	21.8	22.0	0.0	0.0	37.0	4.8
2021-01-27T11:45:00	21.8	22.0	0.0	0.0	37.0	5.1
2021-01-27T11:45:15	21.8	22.0	0.0	0.0	37.0	4.8
2021-01-27T11:45:30	21.8	22.0	0.0	0.0	36.0	4.9
2021-01-27T11:45:45	21.8	22.0	0.0	0.0	36.0	4.9
2021-01-27T11:46:00	21.8	22.0	0.0	0.0	36.0	4.8

In a case of two channels ATPM system:

Timestamp	A-T-In1 (C)	A-T-Out (C)	A-Flow (m3/h)	A-Pow (MW)	A-SNR (dB)	A-SCNR (dB)	B-T-In1 (C)	B-T-Out (C)	B-Flow (m3/h)	B-Pow (MW)	B-SNR (dB)	B-SCNR (dB)
2021-01-27T11:42:35	21.8	22.0	0.0	0.0	35.0	5.0	21.8	22.0	0.0	0.0	35.0	5.0
2021-01-27T11:42:50	21.8	22.0	0.0	0.0	36.0	4.8	21.8	22.0	0.0	0.0	36.0	4.8
2021-01-27T11:43:08	21.8	22.0	0.0	0.0	36.0	4.8	21.8	22.0	0.0	0.0	36.0	4.8
2021-01-27T11:43:23	21.8	22.0	0.0	0.0	36.0	4.9	21.8	22.0	0.0	0.0	36.0	4.9
2021-01-27T11:43:41	21.8	22.0	0.0	0.0	37.0	4.8	21.8	22.0	0.0	0.0	37.0	4.8
2021-01-27T11:43:56	21.8	22.0	0.0	0.0	37.0	4.9	21.8	22.0	0.0	0.0	37.0	4.9
2021-01-27T11:44:12	21.8	22.0	0.0	0.0	37.0	4.8	21.8	22.0	0.0	0.0	37.0	4.8
2021-01-27T11:44:27	21.8	22.0	0.0	0.0	36.0	4.8	21.8	22.0	0.0	0.0	36.0	4.8
2021-01-27T11:44:45	21.8	22.0	0.0	0.0	37.0	4.8	21.8	22.0	0.0	0.0	37.0	4.8
2021-01-27T11:45:00	21.8	22.0	0.0	0.0	37.0	5.1	21.8	22.0	0.0	0.0	37.0	5.1
2021-01-27T11:45:15	21.8	22.0	0.0	0.0	37.0	4.8	21.8	22.0	0.0	0.0	37.0	4.8

In a case of a one channel FLUM system:

Timestamp	A-T-In1 (C)	A-T-Out (C)	A-Flow (m3/h)	A-SNR (dB)	A-SCNR (dB)
2021-01-27T11:42:35	21.8	22.0	0.0	35.0	5.0
2021-01-27T11:42:50	21.8	22.0	0.0	36.0	4.8
2021-01-27T11:43:08	21.8	22.0	0.0	36.0	4.8
2021-01-27T11:43:23	21.8	22.0	0.0	36.0	4.9
2021-01-27T11:43:41	21.8	22.0	0.0	37.0	4.8
2021-01-27T11:43:56	21.8	22.0	0.0	37.0	4.9
2021-01-27T11:44:12	21.8	22.0	0.0	37.0	4.8
2021-01-27T11:44:27	21.8	22.0	0.0	36.0	4.8
2021-01-27T11:44:45	21.8	22.0	0.0	37.0	4.8
2021-01-27T11:45:00	21.8	22.0	0.0	37.0	5.1

4.2.12. Log files

4.2.12.1. Log files must be created on a daily basis;

4.2.12.2. The name of data files must be built as following: “Facility Name” + “_” + “Type of system” + “_” + Date + “.FM2FSOH.txt”;

4.2.12.3. Every log file must start by the following data

```

2021-01-28T00:00:01      INFO      Creation of the SOH file
2021-01-28T00:00:01      INFO      FM2F Data Collect Software version 0.1
2021-01-28T00:00:01      INFO      Facility Name:      IAEA HQ
2021-01-28T00:00:01      INFO      Facility Code:      G-376
2021-01-28T00:00:01      INFO      System Number:     ATPM/010
  
```



5. Deliverable Data Items

The Contractor shall deliver the following data items:

- Software source code,
 - Software design document.
-