STRICTLY CONFIDENTIAL

PROJECT

Gas Lift

TITLE

Control Room Specification

ISSUE STATUS

ISSUE	AUTHOR	Date	Release Status	Change Request	AMENDMENTS
A	Philip Hockley	30/09/09	Superseded	N/A	Initial release
B	Peter Watson	01/06/10	Superseded	68	Amended to include software GUI operation and installation
C	David Reaves	19/07/10	In-Review	N/A	Implement comments from 18Jun10 & 07Jul10 meetings

TABLE OF CONTENTS

1. PURPOSE 4

2. SYSTEM OVERVIEW 4

2.1. GENERAL SYSTEMS LAYOUT 4
2.2. CONTROL ROOM EQUIPMENT SPECIFICATION 5
2.3. PC/LAPTOP REQUIREMENTS 5
2.4. INTERFACES 5
2.4.1 MODBUS Control Interface 5
2.4.2 SBC Configuration Interface 5

3. SOFTWARE COMPONENTS 6

4. GAS LIFT SOFTWARE (CONTROL ROOM) 6

4.1. CONTROLS AND DISPLAY. 6
4.2. SOFTWARE ENVIRONMENT & DEPLOYMENT 7
4.2.1 SOFTWARE ENVIRONMENT 7
4.2.2 SOFTWARE DEPLOYMENT. 7
4.3. INSTALLATION 8
4.3.1 LANGUAGE SUPPORT 8
4.3.2 INSTALLATION STRUCTURE 8
4.3.3 INSTALLATION APPLICATION 8
4.4. STARTING THE APPLICATION 13
4.5. SYSTEM LOGGING 13
4.5.1 Log creation – On start up. 13
4.5.2 System Log messages 14
4.6. SYSTEM CONFIGURATION 15
4.6.1 System startup. 15
4.6.2 System configuration data. 15
4.6.3 System Configuration file 16
4.6.4 Status Synchronisation 17
4.7. APPLICATION BEHAVIOUR 17
4.7.1 Background Tasks 18
4.7.2 Main application screen 20
4.7.3 Setup screen (Service agent contact details) 22
4.7.4 Setup screen (System setup screen) 23
4.7.5 Application Menu Options 25
4.8. ERROR REPORTING 27
4.8.1 SCS / DHCS Communication Errors 27
4.8.2 No Response to a User-initiated MODBUS Fn5 27

4.8.3 DHCS Communications Error Response to a User-initiated Command..... 27
4.8.4 Periodic MODBUS Fn5..... 28
4.8.5 Periodic MODBUS Fn3..... 28
4.8.6 SCS / DHCS Interface Constraints..... 29

APPENDICES:

Appendix A– System Log Texts.

Appendix B– Sample configuration (CRS_config.cfg) file

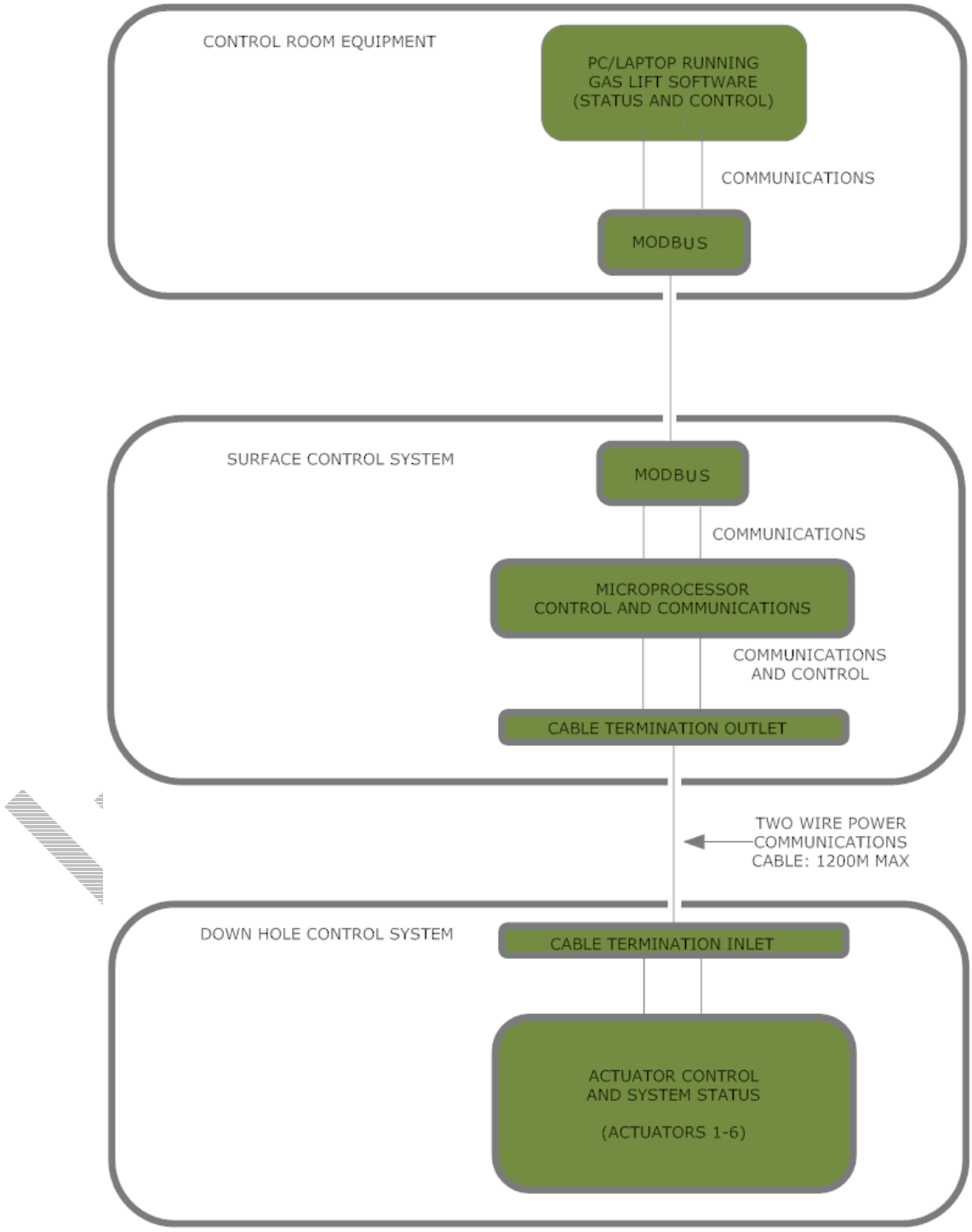
Appendix C– Sample Mandrel.cfg

1. PURPOSE

The purpose of this document is to describe the equipment and software requirements for the control room area for the Artificial Gas lift system.

2. SYSTEM OVERVIEW

2.1. GENERAL SYSTEMS LAYOUT



2.2. CONTROL ROOM EQUIPMENT SPECIFICATION

The control room shall consist of the follow components

- Customer supplied PC or Laptop Running Camcon or third party Gas lift Software
- Suitable cable connection

2.3. PC/LAPTOP REQUIREMENTS

The PC or Laptop will run the Camcon Technology Gas lift Software, and be connected via the appropriate cable to the Surface Control System (SCS).

- Operating Systems: - Windows XP and Windows 7
- RAM: - To be advised by software implementer
- Hard Drive: - To be advised by software implementer
- Graphics - 1024 x 768 in 256 Colours (minimum)

The PC will be required to have both an RS232 port and an RS485 port, either internally or via external devices.

2.4. INTERFACES

2.4.1 MODBUS Control Interface

The RS485 interface is used to control and monitor the SCS and hence the Down-hole equipment. This interface uses the MODBUS protocol as specified by:

DL100001 (MODBUS protocol).

The Control Room PC is a MODBUS master. The system design allows for multiple MODBUS masters, multiple slaves and multiple interfaces (eg when using wireless links). A master may not see slave messages to or from another master.

It is assumed that the parameters for each MODBUS RS485 communications port (parity, stop bits etc) would be set up at the PC using standard Windows communications setup facilities. The system setup screen makes provision for there to be multiple MODBUS ports.

2.4.2 SBC Configuration Interface

The RS232 interface is used to configure the Single Board Computer (SBC) that is part of the SCS. The interface is specified by DL100002 (SBC Requirements) and is designed to be controlled by a standard terminal program (e.g. Hyper Terminal), hence no special

software is required at the PC for this interface. Note that the PC would need to be located such that the RS232 cable length limit (15m) is not exceeded whilst controlling the SBC configuration interface, but any suitable PC could be used for this purpose.

3. SOFTWARE COMPONENTS

The control software has two components. One component runs on the SBC within the SCS and is specified by DL100002 (SBC Requirements). The other is the subject of this document and runs on the customer's PC. Both documents need to be read in conjunction with DL100001 (MODBUS protocol specification).

This document specifies the control room system software (CRS) to be written for Camcon Technology Limited and is also intended to guide customers who wish to write their own software to control the SCS.

4. GAS LIFT SOFTWARE (CONTROL ROOM)

4.1. CONTROLS AND DISPLAY.

This software controls and displays the status of the Gas lift system.

The software shall display the following information in an easy to understand format for the Mandrel currently being controlled:

- Mandrel Name — Free text (up to 40 characters)
- Mandrel Slave Address — 1 to 247 (decimal)
- Mandrel Communication Status — Icons (see section 4.8)
- Orifice Diameters: — Free text (up to 6 characters)
- Actuator Status: — Open or Closed
- Annulus Pressure: — 0-10,000PSI or 0 - 670 Bar (user choice)
- Production Pipe Pressure: — 0-10,000PSI or 0 - 690 Bar (user choice)
- Production Pipe Temperature: — 0-125°C or 0 - 255°F (user choice)
- Actuator Health: — Open/Short Circuit, Actuator Stuck
- Capacitor Bank Health: — 0-100%

Details of user controls and displays are specified in DL100004 (Control room software graphical specification)

The following table shows the valid commands that can be sent on the MODBUS interface, all being a Fn5/Fn3 command pair except the last one which is a standalone Fn3 command:

Command	Action
Open Actuator 1	Opens Actuator one, updates Pressure/Temperature and actuator one health
Open Actuator 2	Opens Actuator two, updates Pressure/Temperature and actuator two health
Open Actuator 3	Opens Actuator three, updates Pressure/Temperature and actuator three health
Open Actuator 4	Opens Actuator four, updates Pressure/Temperature and actuator four health
Open Actuator 5	Opens Actuator five, updates Pressure/Temperature and actuator five health
Open Actuator 6	Opens Actuator six , updates Pressure/Temperature and actuator six health
Close Actuator 1	Closes Actuator one, updates Pressure/Temperature and actuator one health
Close Actuator 2	Closes Actuator two, updates Pressure/Temperature and actuator two health
Close Actuator 3	Closes Actuator three, updates Pressure/Temperature and actuator three health
Close Actuator 4	Closes Actuator four, updates Pressures/Temperature and actuator four health
Close Actuator 5	Closes Actuator five, updates Pressures/Temperature and actuator five health
Close Actuator 6	Closes Actuator six , updates Pressures/Temperature and actuator six health
Get Status	Updates Pressures/Temperature and data for a specific actuator
Get Data	Updates all status data to that currently held by the SCS (but not by the DHCS)

All commands update the status of the communications between the SCS and the DHCS for the selected mandrel.

4.2. SOFTWARE ENVIRONMENT & DEPLOYMENT

4.2.1 SOFTWARE ENVIRONMENT

The software shall be written in a C++ environment to run on both a windows XP and a windows 7 platform.

Where the word “parameter” is used, a mechanism shall be provided for the value to be changed within reasonable limits to be defined by the implementer, without rebuilding the software, eg via hyperterminal or a text-based parameter file. It is acceptable that a reboot would be required after any change.

4.2.2 SOFTWARE DEPLOYMENT.

The software shall be made available as a self extracting and installing application.

The un-extracted application prior to installation should be no greater than 50MB to enable swift download in areas of low speed connections.

4.3. INSTALLATION

4.3.1 LANGUAGE SUPPORT

The user interface shall be written in English but will wherever possible use Graphics/Icons to help users of any language to use it.

4.3.2 INSTALLATION STRUCTURE

4.3.2.1 The application shall have a default installation directory of:

c:\program files\Camcon_CRS.

At the point of install the customer can choose an alternative installation directory.

4.3.2.2 The installation directory shall have three sub folders which shall be :

- CRS – Contains all application files
- SETUP – Contains all configuration files (**Mandrel.Cfg & CRS.cfg**)
- LOGS – Contains the system log file (**camcom_syslog.txt**)

4.3.3 INSTALLATION APPLICATION

4.3.3.1 The installation application should be called CCS_Setup.exe with the desktop icon which is shown in .

Figure 1 - Start icon

4.3.3.2 The installation shall follow the procedure shown in Figure 2 after the installation icon is double clicked.

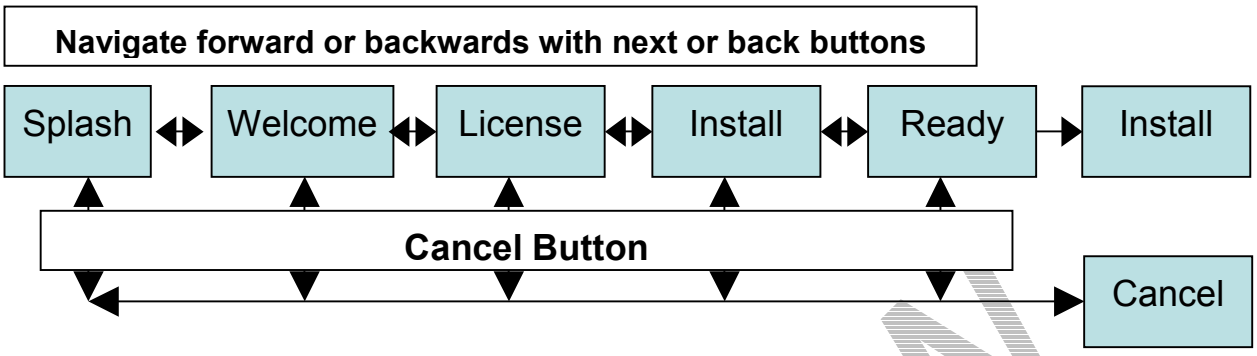


Figure 2 – Software installation Flow

4.3.3.3 Splash Screen

- The splash screen (see Figure 3) shall be displayed for a minimum of 5 seconds whilst the software loads.

Figure 3 - Splash screen (Help, "About" screen)

- During installation and until the application has completely loaded, the OK button shall be labelled "CANCEL" and if pressed will abort the installation and clean up to the pre-installation state. This splash screen is also used as the help about screen which will include the OK button.
- The Support Company information shall be hard coded as follows for the installation splash screen and shall also be used for the splash screen when loading installed software and for the software 'help about' screen if a system configuration file does not exist or does not contain full service agent contact data:-

  Camcon Ltd

  Unit 4A

  Button End Industrial Estate

Harston, Cambs

CB22 7GX

01223 873650

4.3.3.4 Welcome screen

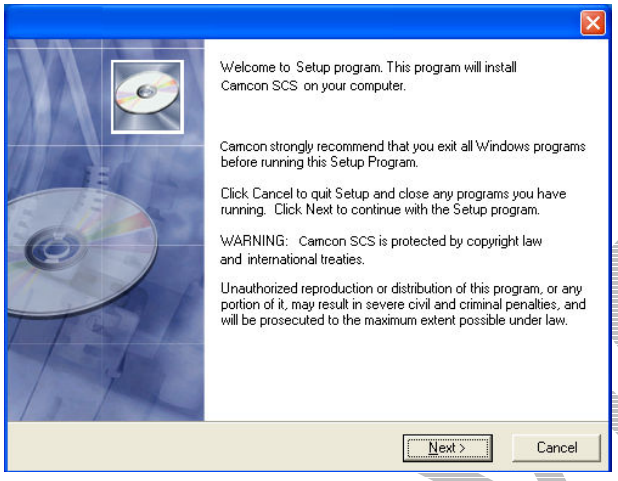


Figure 4 - Welcome screen

4.3.3.5 License screen

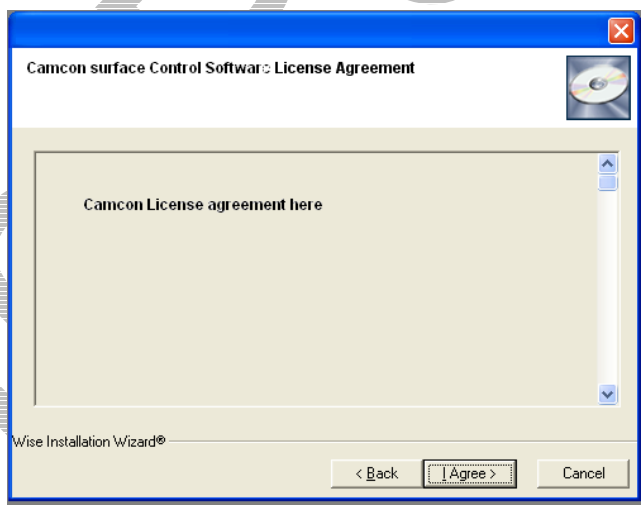


Figure 5 - License screen

4.3.3.6 Install folder screen

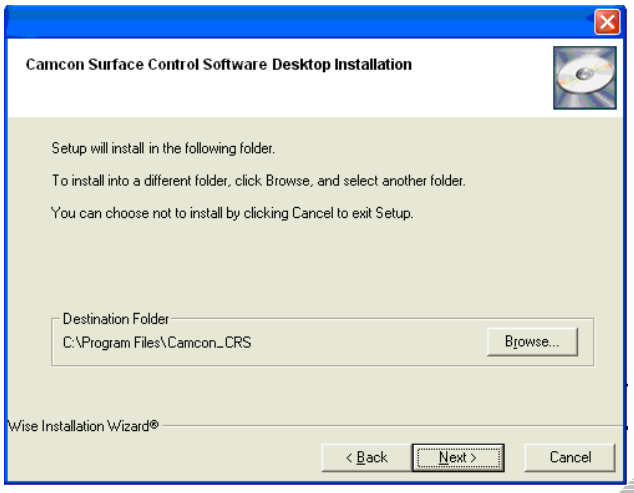


Figure 6 - Install directory screen

4.3.3.7 Ready to install screen

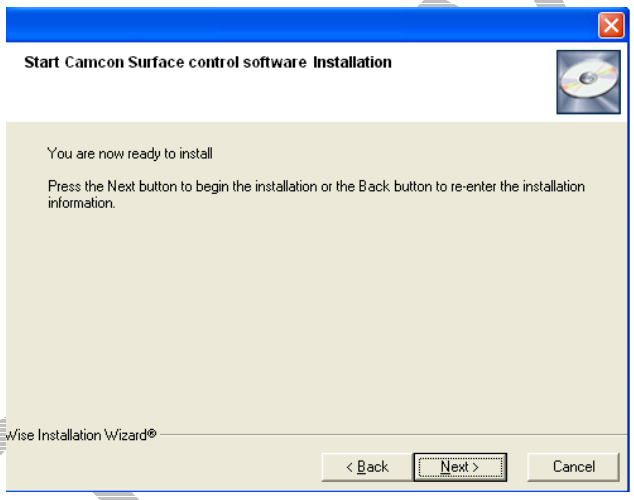


Figure 7- Ready to install

4.3.3.8 Installation complete screen

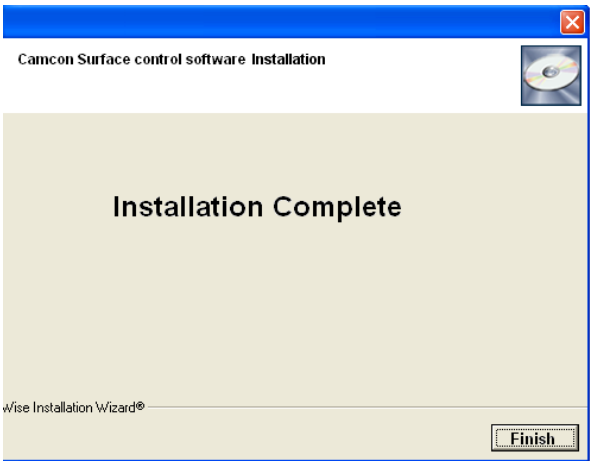


Figure 8 - Installation complete

4.3.3.9 Cancel screen

At any point through the installation process, prior to the installation complete screen, the customer can choose to cancel the installation. If the cancel button is chosen then the application shall show the Cancel screen as shown in Figure 9. On selecting the “Exit setup” option the installation shall be rolled back and the “installation cancelled” screen shall be displayed as shown in Figure 10.

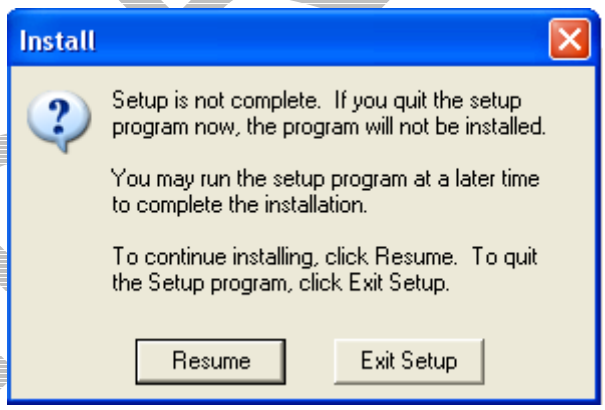


Figure 9 - Cancel screen

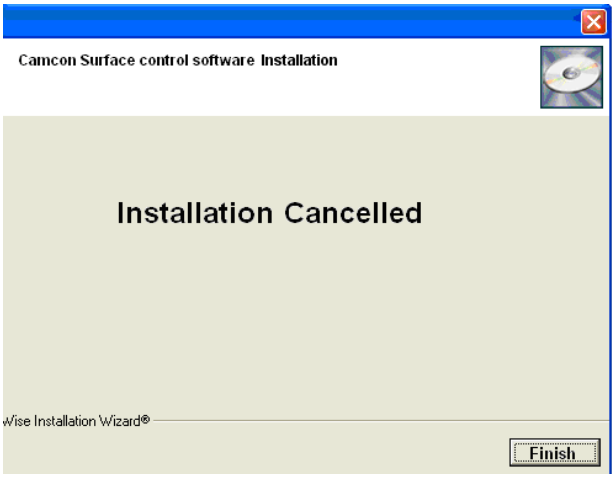


Figure 10 - Installation Cancelled

4.4. STARTING THE APPLICATION

Once the application is loaded it should start either from a desktop icon (see Figure 11) or from a Start Menu item pick (see Figure 12).

Figure 11 - Desktop icon

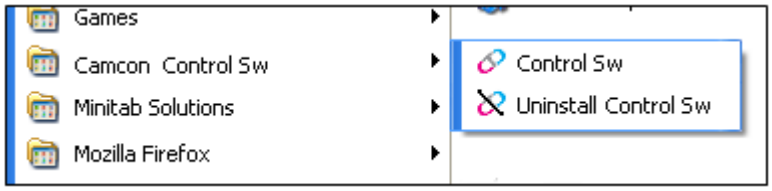


Figure 12 - Menu start selection

4.5. SYSTEM LOGGING

4.5.1 Log creation – On start up.

On startup of the application the system shall check for the presence of a system log **file camcom_syslog.txt** in the <install_directory\logs\>. If one is not present the system shall create one and time stamp the start time. If a file is present the time stamp shall be appended to the file. The message will take the form:-

<CURRENT DATE>,<CURRENT TIME>,Application Started

4.5.2 System Log messages

4.5.2.1 The system shall create a new message on every action performed on the system, whether user-initiated or software-initiated and including any changes in communications status and any changes in data reported back by mandrels. These actions shall be recorded in the logfile as an action followed by the response to the action as shown below:-

<CURRENT DATE>,<CURRENT TIME>, User: Open Actuator 1

<CURRENT DATE>,<CURRENT TIME>, System: Open Actuator 1 OK

4.5.2.2 If an instruction fails to be carried out successfully then the action and response shall be recorded together with additional data taken as appropriate from actuator health or communications status data status (see Figure 1 above), as shown in the example below where the second entry has word-wrapped in the absence of any new line character within the entry:

<CURRENT DATE>,<CURRENT TIME>, User: Open Actuator 1

<CURRENT DATE>,<CURRENT TIME>, System: Open Actuator 1 Failed,
ERROR 1: No Communication to DHCS

4.5.2.3 Each status message received will be examined for any other data that has changed and each such change shall be recorded in the logfile as shown in the example below:

<CURRENT DATE>,<CURRENT TIME>, System: Mandrel Temperature 110°C

4.5.2.4 A status message can be requested from the DHCS by pressing the option button 7 (communications health) and the data received will shall be recorded in the logfile as shown in the example below:

<CURRENT DATE>,<CURRENT TIME>,M1 Status: 100C, 100Bar, 70Bar, 97%, X, O, F, O, O, O

The data comprises the four data readings and the state of the six actuators in the order displayed by the main application screen icons. Actuators are displayed as “O” (open), “X” (closed) or “F” (faulty).

4.5.2.5 On detection of any fault whether indicated via the MODBUS or diagnosed locally, an e-mail shall be queued for sending at the first opportunity by the CRS to the diagnostic e-mail address, with the fault as subject and all system log data that has not been previously sent as the body or as an attachment. Further faults will not initiate an e-mail more often than every 30 minutes.

4.5.2.6 On Exit from the application the log file shall be updated with the following message:-

<CURRENT DATE>,<CURRENT TIME>,Application Exit

A complete list of types of log entry is shown in Appendix A

4.6. SYSTEM CONFIGURATION

4.6.1 System startup.

On starting, the application will check for the existence of a CRS Configuration file, creating a default file if one does not already exist. If a file containing all Service Contact screen fields except TB4, TB5 and TB6 does not exist, the Service Contact Setup screen shall be displayed and all these fields must be completed and saved before the user can proceed to the Setup screen.

Otherwise, if on starting, the file does not contain Setup screen fields TB1, TB2, TB3 and PB1 to PB7 inclusive, the Setup screen shall be displayed and all these fields must be completed and saved before the user can proceed to the main screen.

In each case, the appropriate button(s) and screens in the application window menu (see section 4.7.5.3) will be greyed out and inactive.

If all the above constraints are satisfied, the main screen will be displayed at startup for the most recently selected mandrel.

4.6.2 System configuration data.

4.6.2.1 Service Contact Details Screen

See DL100004

4.6.2.2 Setup Screen

The data required for the setup screen:

Short name	Long name		Description
TB1	Text box 1	Customer entered mandrel name Max length: 40 characters	Free text
TB2	Text Box 2	Customer entered serial number. Max length: 8 Characters	Serial number entered from the mandrel paperwork supplied.
TB3	Text Box 3	Customer selected comms port from available ports	Computer communications port for this mandrel
TB4	Text Box 4	Customer selected child status from available options	Type of mandrel (normal, passive repeater, active repeater) - FUTURE
PB1	Pick box 1	Customer selected from the "Mandrel.cfg" configuration file or a customer entered value via a custom entry selection.	Orifice size for each gas actuator. Individually selected by the customer.
PB2	Pick box 2		
PB3	Pick box 3		
PB4	Pick box 4		
PB5	Pick box 5		
PB6	Pick box 6		
TB5	Text Box 5	Customer entered text. Max length: 1024 Characters	Description of the installation and any other data that the customer wishes to enter.

4.6.3 System Configuration file

The system shall store the information from the system setup screens in the following format. [Note: Software implementer may propose an alternative format if desired]

The first data line shall be a header line starting with 2 hash symbols (##)

Comments written prior to the hash symbols will be ignored.

This will then be followed by the company name and address information, including phone and email address, with each field having a single line. Where no entry has been made in a field an empty line shall be present. This information shall then be closed with a single hash symbol #.

The information regarding individual mandrel configuration shall then be as follows :-

Mandrel Name:- 'TB1'

Mandrel serial number:- 'TB2'

Comms port:- 'PB7' (probably the same for all mandrels of an SCS)

Slave address:- TB3

Child status:- TB4

Orifice sizes:- PB1,PB2,PB3,PB4,PB5,PB6

Installation Notes:- TB5

The end of each Mandrel definition shall be marked by a hash symbol.

If more than one mandrel is configured then all mandrels shall be listed in the format shown above and in the order applicable to user-selection.

The system configuration information shall be saved in a file called CRS_config.cfg.

When a change is made to a system configuration and the file is saved the original file shall become a backup (.bak), overwriting any previous backup.

A sample configuration file is shown in Appendix B

4.6.4 Status Synchronisation

On software startup and initial display of the main application screen, the CRS will request status from the SBC for each mandrel, repeated until status is received. As mandrels may be on different SCSs, the CRS will cycle around all mandrels, omitting each as status is received. This shall not prevent the user from selecting a different mandrel or initiating a command.

Note that this action will not provide up to date status on capacitor health nor on actuator faults. In local and remote control modes, the user can check actuators manually. In remote control mode, the user can also check capacitor health by pressing the Storage Bank Health button.

4.7. APPLICATION BEHAVIOUR

The wording of all popups and logging messages is to be agreed between the implementer and Camcon Technology Ltd.

4.7.1 Background Tasks

At all times whilst the software is running and setup is complete such that the main screen is not inhibited from display, the software shall perform background tasks independently of which screen is currently being displayed.

4.7.1.1 Periodic Status Synchronisation with the SCS

For each mandrel whilst in remote control mode, the CRS shall send a Fn5 Get Status command a parameter 5 minutes after the most recent Fn5 command addressed to the mandrel. This command shall be delayed if necessary to give priority to any user-command and shall be followed after a parameter 2 seconds by a Fn3 command

4.7.1.2 Periodic Status Update from the DHCS

For each mandrel, the CRS shall send a Fn3 command a parameter 5 seconds after the most recent Fn3 command addressed to the mandrel unless a Fn3 response is expected resulting from a previous Fn5 command. [Wingpath: we feel that 5 seconds is adequate. 1 second is short especially if the modbus is shared amongst many mandrels and maybe other equipment]

4.7.1.3 Status Message Processing

Fn3 status response messages shall be used to update data displayed for the currently displayed mandrel and to update data held by the CRS for other mandrels such that it is immediately available when the user switches to another mandrel for display.

An actuator icon will be displayed as open or closed, as indicated by the status message except:

a) for a status response to a command for an actuator, if a fault is indicated for that actuator and communications are OK, the fault (open) or fault (closed) icon will be displayed to reflect the reported position.

b) for a status response to a command for an actuator to change, if no fault is indicated for that actuator and communications are OK but the actuator position has not changed, the fault (open) or fault (closed) icon will be displayed to reflect the reported position. However, this situation should not occur.

c) for a status response to a command for an actuator to change, if communications are not OK, the fault (unknown position) icon will be displayed for that actuator.

d) for a status response to a command for an actuator to change, if an additional actuator moves as well as the commanded one, this is likely to be due to a short circuit to actuator casing and a popup will be displayed to suggest this possibility).

e) for any status message for any actuator other than one commanded to change, if a fault is indicated for that actuator, the fault (open) or fault (closed) icon will be displayed to reflect the reported position.

Any pressure or temperature value that has changed by more than parameter 10% shall lead to a warning popup screen, displayed as either stacked or composite messages if more than one value is involved. So that slow changes are detected as well as a step change, the comparison shall be against all values received up to and including the most recent one that was received more than one hour previously.

Whenever the temperature increases to a value greater than 125°C (or the Fahrenheit equivalent), a warning popup screen shall be displayed in preference to one that may indicate a rise of more than 10%, and at a higher priority than any other popup.

A warning popup screen shall be displayed it status messages indicate that the SCS has remained in local mode for a period of 30 minutes and shall be re-displayed if this mode remains 30 minutes after any such popup has been cancelled by the user.

A warning popup screen shall be displayed on any unexpected change of actuator position whilst in remote mode.

Status Message processing shall be maintained and popups displayed even if for a different mandrel to that selected or if a popup is already displayed or if a setup screen is displayed.

4.7.1.4 Health Check Monitoring

For each mandrel, a warning popup will be displayed if every non-faulty actuator has not been toggled within the previous 8 days. The popup will be re-displayed each day until resolved.

For each mandrel, a warning popup will be displayed if a capacitor health check has not been performed within the previous 8 days. The popup will be re-displayed each day until resolved.

4.7.2 Main application screen

4.7.2.1 Graphical user interface

The main screen graphical user interface and its related buttons and icons are described in DL100004 (Control room software graphical specification). The following behavioural requirements supplement those described in DL100004.

4.7.2.2 Screen behaviour (entry)

The main application screen shall not be selectable for display unless the system has a valid configuration file including data for at least one mandrel, see section 4.6. On entry to the screen, the selected mandrel shall be that most recently selected on this or the Setup screen, otherwise mandrel number 1, and the application shall update all graphics accordingly. On initial entry to the screen, the mandrel shall be that selected at the previous program exit or the first mandrel in sequence if none had ever been selected.

4.7.2.3 Screen Behaviour (alternative display units)

Temperature and pressure can be displayed in alternative units as described in DL100004. The appropriate conversions will be applied to the text for display, ignoring any correction for depth below sea level.

4.7.2.4 Screen Behaviour (Communications health button 7)

Operation of the communications health button whilst it indicates system healthy and the SCS is in remote control mode, causes the CRS to send a Fn5/Fn3 command pair to interrogate the DHCS status.

In local mode and for the other button state, this action leads to a warning popup that the data may be stale and the reason (eg because of local mode / lost DHCS communications etc).

4.7.2.5 Screen Behaviour (Capacitor Health Check button 14)

Operation of the Capacitor Health Check button whilst the communications system is healthy and the SCS is in remote control mode, causes the CRS to commence the capacitor health check specified in DL100005. Otherwise operation of the button will lead to an explanatory popup and no action will be taken.

The CRS will first re-check each non-fault valve via a Fn3 command to confirm that communications are still healthy and that the valve is still non-faulty, and then initiate the

process by sending a Fn5 command to set the valve to its current position. If the response to the associated Fn3 command indicates a potentially bad measurement by means of the out-of-range value 0xFF for capacitor health, the CRS will send Fn3 commands at a parameter period of 3 seconds until a valid capacitor health value or a fault status is received. The CRS will repeat the whole process for each non-faulty actuator, displaying a progress popup until complete.

Cancelling the popup will abort the process. Any communications failure during the process will display an explanatory popup and abort the process.

4.7.2.6 Screen behaviour (diagnostics logging window)

The diagnostics logging window displays data as it is added to the CRS log, scrolling up when full such that the most recent data line is at the bottom of the displayed data. The user may scroll to previous data from the CRS log. The addition of new data by the CRS will cause the most recent data to be re-instated to display after a parameter period of 20 seconds since any user scroll action.

The displayed data replicates that in the log except that to save space the date is suppressed from each data line. The top line displayed is always the date applicable to the second line. Any date change within the displayed data is shown by another date line.

The user may add free-text notes to the log. Clicking on the window will place the cursor at the end of the most recent data line, or if notes have been commenced but not entered, at the closest point within the notes to the cursor. Typing the first character will scroll up one line to accumulate the note on the bottom line.

Any further system logging prior to the use of the return key will be displayed prior to the user entry line(s) by scrolling previous data upwards. Whilst any user-text exists, the current time and the text “Note: “ shall precede the user text. Text will line-wrap but use of the return key will complete that entry. Entry of null text will cause the window to discard the time and “Note: “ text.

Note: an acceptable alternative is to use a separate window for text entry, displayed as a popup by clicking on the diagnostics logging window.

4.7.2.7 Button behaviour

Further actions associated with each button are described in DL100004 (Control room software graphical specification).

Pressing any button that requires a response from the DHCS whilst the SCS is in local mode will lead to an explanatory popup message and send a Fn3 command to the SBC to obtain the most recent data held by the SBC, but will cause no further action.

Pressing any button that requires a response from the DHCS whilst the SCS is in remote control mode will display a wait indication to the user until the associated Fn3 response is received, eg an hour–glass instead of the pointer. See also section 4.8.6

On pressing a valve button that is displaying the fault icon, a command will be sent to set the actuator to the same position as that commanded or reported, whichever is the most recent event. If a non-fault status response is received, a popup will be displayed explaining that the fault condition may not have been resolved and should be checked by attempting to change the actuator position twice.

4.7.3 Setup screen (Service agent contact details)

4.7.3.1 Graphical user interface

The Service agent contact details screen graphical user interface and its related buttons and icons are described in DL100004 (Control room software graphical specification). The following behavioural requirements supplement those described in DL100004.

4.7.3.2 Screen behaviour (entry)

On first entry to the screen the system will check for a valid configuration file and if present will populate the display with all available field data. Fields for which no data exists should be displayed blank.

4.7.3.3 Screen behaviour (exit)

If the system configuration file does not contain all service contact fields except TB4, TB5 and TB6, the user cannot proceed to any other screen. The appropriate button(s) and screens in the application window menu (see section 4.8.4) will be greyed out and inactive.

If the system configuration file does not contain setup screen fields TB1, TB2, TB3 and PB1 to PB7 inclusive, the user cannot proceed to the main screen. The main screen button and screen in the application window menu (see section 4.8.4) will be greyed out and inactive.

On selection of the setup or main screen whilst there are unsaved changes on the service contact screen, the system shall prompt with a separate Yes/No dialog box “Do you wish to save your changes for this screen?”. Choosing “Yes” shall save the changes in the

system configuration file and then display the setup screen. Choosing "No" shall close the dialog and the user will be able to continue working.

4.7.4 Setup screen (System setup screen)

4.7.4.1 Graphical user interface

The System setup screen graphical user interface and its related buttons and icons are described in DL100004 (Control room software graphical specification). The following behavioural requirements supplement those described in DL100004.

4.7.4.2 Screen behaviour (entry)

On first entry to the screen the system will populate all available field data for the most recent mandrel selected on this or the Main screen, otherwise mandrel number 1.

A Fn43 Read Device Identification command will be addressed to the mandrel and the data response will be displayed at the top of the Notes area of the Setup screen, preceding any existing notes. On selecting a different mandrel, the command will be addressed to the new mandrel and the data on the screen will be updated accordingly although if the mandrel is connected to the same SCS, the vendor name data will be the same.

4.7.4.3 Screen Behaviour (add mandrel)

A new mandrel will be added to the order stored in the configuration file in a position immediately following the currently displayed mandrel.

4.7.4.4 Screen Behaviour (child mandrel)

The following two paragraphs describe future functionality with the intent that the initial implementation architecture is such as to support their future implementation. The initial software requirement is for standalone mandrels only.

The child mandrel function allows a mandrel to be situated more than 1200m from the SCS by fitting one or more intermediate mandrels that act as repeaters for the communications link. The following selections exist:

- *"Standalone mandrel" - the default that is implemented.*
- *"Bottom mandrel of set" - the deepest in the well, supported by shallower repeaters*

- *"Repeater for next, active" - this mandrel is a repeater for the next one in sequence, and it has active actuators.*
- *"Repeater for next, hidden" - this mandrel is a repeater for the next one in sequence but it is hidden in the main screen because its actuators remain closed and are not controllable.*

A set of linked mandrels in a single hole can comprise up to 3 mandrels. The last in sequence of a set is intended to be at the deepest level in the pipe and to be active. Any of the others in the set may be active or hidden in any order.

Note that there can be up to three standalone mandrels in a pipe but in this case the deepest cannot be more than 1200m from the SCS and they have individual links to the SCS instead of being daisy–chained on to a single link when using repeaters.

4.7.4.5 Screen Behaviour (comms port)

Comms Port is intended to link the MODBUS port to the software and to specify the interface speed and any other necessary parameters if these are not configured by standard comms setup software. [Note: software implementer to advise and this screen function to be removed or extended as appropriate]

4.7.4.6 Screen Behaviour (valve orifice sizes)

The list of values for actuator orifice size are obtained from the mandrel configuration file which is provided at the time of sale. A facility shall be provided to enable the user to select from these values or to enter custom values.

4.7.4.7 Screen behaviour (exit)

If the system configuration file does not contain setup screen fields TB1, TB2, TB3 and PB1 to PB7 inclusive, the user cannot proceed to the main screen. The main screen button and screen in the application window menu (see section 4.8.4) will be greyed out and inactive.

On selection of the service contact or main screen whilst there are unsaved changes on the service contact screen, the system shall prompt with a separate Yes/No dialog box "Do you wish to save your changes for this screen?". Choosing "Yes" shall save the changes in the system configuration file and then display the selected screen. Choosing "No" shall close the dialog and the user shall be able to continue working.

4.7.5 Application Menu Options

Normal Microsoft Office keyboard short cuts will be available where appropriate (eg cut/copy/paste/exit etc)

4.7.5.1 File Menu Options.

4.7.5.1.1 Save Log option

The “save log” option is available on any screen and allows the user to save the standard system log file to any location. When selected the system shall present a dialog box allowing the user to set the location where the file should be saved and also allow the user the change the file name.

4.7.5.1.2 Properties option

As Microsoft Office standard

4.7.5.1.3 Close & Exit options

The close and exit options allow users to exit the application at any time except when another dialog window is already open. When the user selects this option whilst displaying a setup screen with unsaved changes, the system shall prompt with a separate Yes/No/Cancel dialog box “Do you wish to save your changes for this screen before closing?”. Choosing “Yes” shall save the changes and then close the application. Choosing “No” shall close the application. Choosing “Cancel” shall close the dialog and the user shall be able to continue working.

Otherwise, the system shall prompt with a separate Yes/No dialog box “Do you really wish to exit?”. Choosing “Yes” shall close the application. Choosing “No” shall close the dialog and the user shall be able to continue working.

4.7.5.2 Edit Menu Options

4.7.5.2.1 Undo/Repeat Options

As Microsoft Office standard multi-level but only for text input fields and not beyond a save action or a screen type change.

4.7.5.2.2 Cut/Copy/Paste/Clear/Select_All Options

As Microsoft Office standard including interaction with other applications but only for text input fields.

4.7.5.3 Window Menu Option

4.7.5.3.1 Main screen option

Selecting the “main screen” option shall allow you to navigate to the Main screen from the current screen. The rules for exiting from the current screen shall be enforced when performing this function.

4.7.5.3.2 System setup option

Selecting the “System setup” option shall allow you to navigate to the System setup screen from the current screen. The rules for exiting from the current screen shall be enforced when performing this function.

4.7.5.3.3 Service agent contact option

Selecting the “Service agent contact” option shall allow you to navigate to the Service agent contact screen from the current screen. The rules for exiting from the current screen shall be enforced when performing this function.

4.7.5.4 Help menu Option

4.7.5.4.1 “Help” option

The “Help” menu option shall link to a Camcon Technology web page TBD using the system default internet brower.

4.7.5.4.2 “About” option

The “About Menu” shall display the Splash screen shown in Figure 3 except that if a system configuration file exists and contains full service agent contact data, that data shall be displayed instead of the Camcon data.

4.8. ERROR REPORTING

4.8.1 SCS / DHCS Communication Errors

In addition to sending commands and the display of status, any communication errors between the SCS and DHCS will also need to be displayed. The table below gives the possible communication errors.

Error Code	Meaning	Icon
None	DHCS is communicating	
ERR1	No communication to DHCS	

Figure 13 - Communication error codes

Note: this status reflects the validity of the display to the user of mandrel parameters reported from the hole and as such will indicate ERR1 when the fault is between the SBC and the SCS or between the CRS and the SBC. The CRS Diagnostics Logging Screen will provide extended data where available, including whether the detected fault is of the MODBUS or of the SBC/SCS/DHCS communications.

4.8.2 No Response to a User-initiated MODBUS Fn5

If no response has been received to a user-initiated MODBUS Fn5 (Write Single Coil) command within a parameter 1 second, this shall be logged as a failure to acknowledge a Fn5 command, but a Read Holding Registers command will be sent in the normal way after a parameter 2 seconds and any response will update the status display and raise any popup as normal. If no response to the latter command is received within a parameter 1 second, this shall be logged as a failure to respond to a Fn3 command and an explanatory popup shall be raised, inviting the user to try again. Similar processing will apply to a user-initiated standalone Fn3 command (if such a command is used).

4.8.3 DHCS Communications Error Response to a User-initiated Command

If two successive user-initiated commands for a mandrel result in Fn3 status responses that indicate a DHCS communication error, a parameter 60-second countdown timer pop-up window with a cancel button shall be displayed to advise “Please wait. Mandrel n is being reset.” where ‘n’ is the number of the subject mandrel. This will cause the mandrel capacitor to lose all power such that the mandrel processor will be reset. Upon expiry, a Fn5 Get Status command shall be sent, followed after a parameter 2-second interval by a

Fn3 command. If the response indicates no error, the pop-up will be cleared, otherwise the Fn5 / Fn3 pair will be repeated and the popup cleared on no error. If the error persists, the popup will be replaced by one indicating that the mandrel has a persistent fault. The PC display will show the current status and the user is responsible for repeating the command if desired.

A pop-up can be cancelled by the user who may then action another command. If a command is requested for the same mandrel whilst its communication error persists, it will be processed as normal including the processing applicable if a recent Fn5 command has not completed its associated Fn3 command.

If more than one mandrel is active, the pop-up message shall include "Press CANCEL to work on another mandrel"

4.8.4 Periodic MODBUS Fn5

If no response has been received to a software-initiated periodic MODBUS Fn5 (Write Single Coil) command within a parameter 1 second, this shall be logged, but a Fn3 (Read Holding Registers) command will be sent in the normal way after a parameter 2 seconds and any response will update the status display.

If no response to the Fn3 command is received within a parameter 1 second, this shall be logged and the Fn5 / Fn3 commands shall be repeated. On no response to this second Fn3 command, a popup shall be displayed indicating that MODBUS communications to the subject mandrel have been lost and the communications icon for that mandrel shall be set to "no communication".

If a response to a Fn5 / Fn3 command pair indicates DHCS communications failure, the Fn5 / Fn3 commands shall be repeated. If the Fn3 response still indicates failure, the communications icon for that mandrel shall be set to "no communication" and a popup shall be displayed indicating that MODBUS communications to the subject mandrel have been lost.

4.8.5 Periodic MODBUS Fn3

If a software-initiated periodic Fn3 command has been sent (whether standalone or following a periodic Fn5 command) and no response has been received within the Fn3 parameter time above, this shall be logged. As the frequency of these commands is high, subsequent sequential multiple failures shall be logged once against the time of the most recent unsuccessful message as an aggregate failure with a count of failed attempts. The diagnostics logging screen shall display this message once with time and count updated at each failure, hence the log will contain the first and last occasion and the count.

Note that no popup will be displayed because a periodic standalone Fn3 command is most unlikely to lead to a status display update except in local mode.

4.8.6 SCS / DHCS Interface Constraints

The software will control the data flow over the MODBUS to ensure that SCS/DHCS interface constraints are met, displaying an error message if a user action would breach these constraints.

Any user action that would otherwise cause a command to be sent:

a) after a Fn5 but before a response or timeout to the associated Fn3 command

b) before a response or timeout to a Fn3 command

shall cause an explanatory popup to be displayed. If an error condition is being processed, the popup shall indicate the issue and that the user-action will be aborted. Otherwise, the popup shall indicate “please wait” and the user-action will follow as soon as permitted. Note that there is no cancel available for the popup so any further user action will be ignored whilst the popup is displayed, preventing more than a single command from being queued. The popup shall be displayed for at least parameter 2 seconds to avoid confusing the user with a very brief appearance.

Appendix A. – System Log Texts.

Command	Response	
	Success	Fail
Open Actuator <n>	Open Actuator <n> OK	Open Actuator <n> Failed
Close Actuator <n>	Close Actuator <n> OK	Close Actuator <n> Failed
	Remainder TBD	

Appendix B. – Sample configuration (CRS_config.cfg) file

The following file describes a setup of 2 Mandrels supported by oil installations.

##

Oil installation engineering

Unit7

Any street

Oil town

UK

ZZ7 8ZA

01234 456789

info@Oil-installations.com

logging@ Oil-installations.com

#

Description:- Well 7 600m mandrel

Serial number:- 08051001

Comms port:- 9

Orfice sizes:- 3,3,3,4,3,3

Installation Notes:- Mandrel at 576m in well 7 has 1 unloading actuator (actuator 4). Gives maximum production rate at 12 Bar differential pressure

#

Description:- Well 7 1200m mandrel

Serial number:- 08051002

Comms port:- 6

Orfice sizes:- 3,3,3,3,3,3

Installation Notes:- Mandrel at 1156m in well 7 with balanced actuators. Gives maximum production rate at 26 Bar differential pressure.

#

Appendix C. – Sample Mandrel.cfg

Camcon Mandrel config file (Actuator sizes)

##

1.0

2.0

3.0

4.0

5.0

6.0

#