

## SECTION E

### TELEMETRY, ETC

#### 1 General

##### 1.1 Introduction

1.1.1 This Section E sets out:

- (a) Transco NTS' requirements for telemetry in relation to NTS/LDZ Offtakes;
- (b) the upstream DNO's requirements for provision of daily reads in relation to LDZ/LDZ Offtakes.

1.1.2 In relation to a Bi-directional LDZ/LDZ Offtake, references in this Section E to the downstream Party and upstream DNO shall be construed in accordance with the relevant Supplemental Agreement.

##### 1.2 Telemetry Facilities

1.2.1 In this Section E:

- (a) **NTS Telemetry Facilities** means, in relation to an Offtake, telecommunications and other equipment to be installed at the Offtake for the purposes of receiving (as telemetry signals) measured data from Measurement Equipment and sending such data to Transco NTS;
- (b) **Telemetry Connection Facilities** means the telemetry connection facilities to be provided by the DNO pursuant to paragraph 2.1; and where the DNO has installed telemetry facilities as provided in paragraph 2.2.2, includes such telemetry facilities;
- (c) **telemetry boundary** means the point up to which the DNO is responsible for providing telemetry signals, being (subject to any contrary provision of the Supplemental Agreement) the boundary of the area on which (as provided in Section B.5) the NTS Telemetry Facilities are located, as further described in Annex E-3 and specified in the Supplemental Agreement;
- (d) **point of telemetry** means the particular feature or characteristic of an Individual Offtake Point, the Connection Facilities at an Offtake and the state, configuration or operation of such Connection Facilities, or the gas flowing or of flow of gas at an Offtake, which is to be subject to telemetry pursuant to this Section E;
- (e) references to an Offtake are to a NTS/LDZ Offtake, except in paragraph 4 where such references are to an LDZ/LDZ Offtake at which Measurement Equipment is installed.

1.2.2 Subject to any contrary provision of the Supplemental Agreement, at each Offtake, the points of telemetry shall be as specified in Annex E-1 (as applicable to such Offtake).

1.2.3 Any variations (from what is provided in Annex E-1) in the points of telemetry in relation to an Offtake are set out in Appendix E to the relevant Supplemental Agreement.

## **2 Telemetry Facilities**

### **2.1 DNO obligation to connect to NTS Telemetry Facilities**

- 2.1.1 The Measurement Equipment installed or to be installed by the DNO pursuant to Section D shall be designed, installed, operated and maintained so as to provide telemetry signals in respect of the points of telemetry in accordance with this paragraph 2.
- 2.1.2 The DNO shall provide (and operate and maintain) such connection facilities (including cables, lines, ducts and other equipment) from the Measurement Equipment to the NTS Telemetry Facilities as are required to connect such facilities so as to enable the continuous and uninterrupted transmission of telemetry signals between them.
- 2.1.3 The DNO shall be responsible for providing such Telemetry Connection Facilities up to the telemetry boundary; and Transco NTS shall be responsible for making the final connection to the NTS Telemetry Facilities.
- 2.1.4 The Telemetry Connection Facilities shall comply with the resilience requirements specified in Annex E-2.
- 2.1.5 The DNO shall provide (by means of the Measurement Equipment and the connection facilities referred to in paragraph 2.1.2 to Transco NTS (at the telemetry boundary) telemetry signals on a continuous and uninterrupted basis in respect of the points of telemetry referred to in paragraph 2.1.2.
- 2.1.6 The Measurement Equipment and the Telemetry Connection Facilities shall be installed, maintained and operated in compliance with (and shall provide telemetry signals conforming to) the protocols, standards and other requirements set out in Annex E-3 in order to ensure their compatibility with the NTS Telemetry Facilities.

### **2.2 DNO entitlement to use telemetry facilities**

- 2.2.1 Without prejudice to the requirements in Section B where the DNO is not the Site Owner, nothing in this Section E shall prevent the DNO from:
- (a) installing measurement equipment at an Offtake for points of telemetry in addition to those required pursuant to this Section E; and
  - (b) arranging and installing telemetry facilities for the transmission or other availability to itself (at its control room or otherwise) or any other person of telemetry signals from the Measurement Equipment;

provided that this does not interfere with the operation (as contemplated by this Section E) of the Measurement Equipment and NTS Telemetry Facilities or the transmission of telemetry signals between such equipment and facilities.

- 2.2.2 In particular (subject to the above proviso) the connection (to be provided by the DNO pursuant to paragraph 2.1) from the Measurement Equipment to the NTS Telemetry Facilities may be provided via telemetry facilities installed by the DNO.

### **2.3 Installation of NTS Telemetry Facilities**

- 2.3.1 Transco NTS shall be entitled, at its expense, to install, operate and maintain at the Offtake the NTS Telemetry Facilities and to connect such facilities (via the Telemetry Connection Facilities) to the Measurement Equipment.

- 2.3.2 The DNO shall cooperate with Transco NTS in the commissioning and testing of the NTS Telemetry Facilities and the connection to the Telemetry Connection Facilities, and shall meet and discuss in good faith with Transco NTS and use [all] reasonable endeavours to agree matters pertaining to such installation and commissioning as Transco NTS may reasonably request.
- 2.3.3 Transco NTS shall be entitled to operate and use the NTS Telemetry Facilities for the purposes of transmitting telemetry signals between the Measurement Equipment and Transco NTS at its control room or otherwise.
- 2.3.4 Nothing in this Section E prevents Transco NTS from using facilities comprised in the NTS Telemetry Facilities for the purpose of telemetry (including monitoring and control) in relation to Transco NTS' Connection Facilities (or other plant and equipment comprised in the NTS).
- 2.3.5 It is the responsibility of Transco NTS to arrange satellite or other telecommunications services to enable the transmission of telemetry signals from the NTS Telemetry Facilities.

## **2.4 Modifications of Telemetry Facilities**

- 2.4.1 For the avoidance of doubt, Section [B2.2] applies in relation to Telemetry Connection Facilities and NTS Telemetry Facilities.
- 2.4.2 The purposes referred to in Section [B4.1.3] are the continued operation of the Telemetry Connection Facilities and NTS Telemetry Facilities in compliance with paragraphs 2.1.5 and 2.1.6.

## **2.5 Failure of Telemetry Facilities**

- 2.5.1 Where the DNO or Transco NTS believes or becomes aware that any of the Telemetry Connection Facilities or NTS Telemetry Facilities has failed or is failing to function properly, that Party shall immediately notify the other Party, and the further provisions of this paragraph 2.5 shall apply.
- 2.5.2 The DNO shall:
- (a) promptly on (and in any event within 10 minutes of) despatch by the DNO or receipt from Transco NTS (as the case may be) of the notice in paragraph 2.5.1 above, inspect (by means of remote interrogation or testing from its control centre or by such other method as the Parties shall agree) the Telemetry Connection Facilities to ascertain whether these are functioning properly;
  - (b) promptly following such inspection, inform Transco NTS whether the Telemetry Connection Facilities are functioning properly;
  - (c) where a failure or error in the functioning of the Telemetry Connection Facilities has been identified pursuant to paragraph (a) above, within 24 hours of such failure or error having been identified:
    - (i) rectify such failure or error; or
    - (ii) where rectification pursuant to paragraph (i) above is not practicable by the DNO, acting as a Reasonable and Prudent Operator, submit to Transco NTS proposals for initiating the rectification of such failure or error, and ensure that such rectification is effected as soon as reasonably practicable.

- 2.5.3 For so long as (notwithstanding paragraph 2.5.2(c)) any failure or error continues in the functioning of the Telemetry Connection Facilities or the NTS Telemetry Facilities:
- (a) the Parties shall consult as to and keep under review the situation; and
  - (b) the DNO shall take such steps as are reasonably practicable and as Transco NTS may reasonably require for the purposes of the provision (in operational timescales, and without prejudice to paragraph 2.6) of the relevant measured data to Transco NTS.

## **2.6 Arrangements for data provision in case of failure**

- 2.6.1 In the case of any failure of the Telemetry Connection Facilities, measured data will be provided to Transco NTS by the means and at the times provided in or pursuant to Section [M].

## **3 Transitional Provisions**

### **3.1 SOMSA**

- 3.1.1 The provisions of this paragraph 3 shall apply where and for so long as a System Operation Managed Service Agreement (**SOMSA**) is in force between Transco plc (as manager) and a DNO in relation to an LDZ.
- 3.1.2 The Parties acknowledge that, by virtue of the SOMSA, Transco NTS will have access to and the use of telemetry (including telemetry facilities) in relation to each Offtake, which will meet its requirements as reflected in this Section E.
- 3.1.3 The DNO agrees that (notwithstanding the provisions of the SOMSA) Transco NTS may access and use the telemetry pursuant to the SOMSA in its capacity as Transco NTS under this Document and for the purposes for which Transco NTS would use telemetry under this Document, as well as in its capacity of manager under the SOMSA.
- 3.1.4 The DNO undertakes to Transco NTS, for the purposes of this Document, to comply with the provisions of the SOMSA in relation to telemetry.
- 3.1.5 For so long as the SOMSA remains in force, subject to paragraphs 3.1.6 and 3.2, the provisions of paragraph 2 shall not apply either to the DNO or to Transco NTS in relation to any NTS/LDZ Offtake to that LDZ.
- 3.1.6 Notwithstanding paragraph 3.1.5:
- (a) paragraph [2.4] shall apply to all NTS Telemetry Facilities installed on or after the [relevant Supplemental Agreement Date]; and
  - (b) paragraph [2.5] shall apply as if references to the Telemetry Connection Facilities were to the telemetry facilities to be provided by the DNO pursuant to the SOMSA.

### **3.2 Expiry or termination of SOMSA**

- 3.2.1 The DNO shall at its cost, in good time before the expiry or (pursuant to any provision thereof) termination of the SOMSA (and in any event in accordance with any reasonable request to that effect from Transco NTS), in relation to each Offtake serving the relevant LDZ:
- (a) consult with Transco NTS so as to establish an agreed process and timetable for the works in paragraphs 3.2.1(b) to (d) [or such alternative works or arrangements as may

be agreed by the Parties to ensure that Transco NTS' requirements for telemetry are satisfied];

- (b) ensure that the Offtake Telemetry Facilities (including connection facilities as provided in paragraph 2.3) are installed or modified;
- (c) allow Transco NTS to install, commission and test the NTS Telemetry Facilities; and
- (d) cooperate with Transco NTS in the commissioning and testing of the Offtake Telemetry Facilities and the NTS Telemetry Facilities so as to ensure their mutual compatibility and operability

so as to enable the DNO to be fully in compliance with its obligations under this Section E by not later than the effective date of expiry or termination of the SOMSA.

3.2.2 [In accordance with the provisions of the SOMSA] the DNO shall bear or reimburse to Transco NTS the costs of the [procurement,] installation, commissioning and testing of the NTS Telemetry Facilities.

## **4 Daily Read Requirement**

### **4.1 General**

4.1.1 **Daily Read Facilities** means facilities by means of which measured data from Measurement Equipment can be captured and recorded and periodically transmitted to or retrieved by a Party.

4.1.2 At a LDZ/LDZ Offtake at which Measurement Equipment is installed, the downstream Party shall:

- (a) provide, install (in connection with its Measurement Equipment), maintain and operate Daily Read Facilities, complying with the requirements in Annex E-4, for the purposes of sending to the upstream Party measured data as provided in Annex E-4;
- (b) obtain by means of the Daily Read Facilities measured data at the times and intervals specified in Annex E-4.

4.1.3 The upstream Party shall be entitled at its cost to install and maintain (as Connection Facilities) separate Daily Read Facilities enabling it directly to obtain measured data from the Measurement Equipment, provided that the installation and operation of such Daily Read Facilities dose not interfere with the operation of the Measurement Equipment or the downstream Party's Daily Read Facilities.

4.1.4 The Parties shall cooperate to the extent necessary in the installation, maintenance and operation of the Daily Read Facilities to be installed under this paragraph 4.1.

4.1.5 In relation to any LDZ/LDZ Offtake, where the Supplemental Agreement provides for telemetry facilities to be installed at an LDZ/LDZ Offtake, and such telemetry facilities are installed:

- (a) the requirements of this paragraph 4 shall not apply;
- (b) instead, paragraph 2 (and paragraph 1, mutatis mutandis, but not Annex E-1) shall apply as if references to Transco NTS were to the upstream Party, the DNO were to the downstream Party, and an NTS/LDZ Offtake were to the LDZ/LDZ Offtake;

- (c) the downstream Party shall be entitled, after giving notice to and consulting with the upstream Party, to replace such telemetry facilities with Daily Read Facilities (in which case paragraphs (a) and (b) shall cease to apply).

#### **4.2 Sending measured data**

- 4.2.1 The downstream Party shall provide to the upstream Party measured data at the times and intervals specified in Annex E-4 by the means provided in or pursuant to Section M.

#### **4.3 Failure of Daily Read Facilities**

- 4.3.1 If the downstream Party believes or becomes aware that any part of the Daily Read Facilities has failed or is failing to function properly:

- (a) the downstream Party shall inspect the Daily Read Facilities to ascertain whether they are functioning properly;
- (b) where it identifies any failure or error in the functioning of the Daily Read Facilities, the downstream Party shall:
  - (i) rectify such failure or error as soon as reasonably practicable, and
  - (ii) if the failure or error prevents or is likely to prevent the downstream Party from providing measured data to the upstream Party at times and otherwise in accordance with paragraph 4.2, inform the upstream Party of such failure or error and keep the upstream Party informed as to the progress in rectifying such failure or error.

- 4.3.2 In the case of any failure of the Daily Read Facilities, measured data will be provided to the upstream Party as provided in or pursuant to Section M.

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**ANNEX E-1****Points of Telemetry**  
(Paragraph 1.2.2)**Part 1 – General Analogues**

<b>Point</b>	<b>Minimum Requirement?</b>	<b>Site Specific Options</b>	<b>Comments</b>
Feeder Pressure(s)	Yes		
Outlet Pressure(s)	Yes		
Interstage pressure(s)	-	Yes	If fitted.
Outlet Temperature(s)		Yes	If pre-heating on Site.
Orifice DP(s)	Yes		High head and standby.
Filter DP		Yes	Where analogue reading provided.
FCV position(s)		Yes	If fitted.
Flow Setpoint(s)		Yes	If fitted.
Low Pressure Override Setpoints		Yes	If remote volumetric control fitted.
High Pressure Override Setpoints		Yes	If remote volumetric control fitted.
Outlet pressure set point		Yes	If remote pressure control fitted.
Compressibility		Yes	If fitted.
Flow meter temperature		Yes	If fitted.

**Part 2A – FWACV Analogues (Sites with a flow greater than 1 million m<sup>3</sup>/day)**

Point	Minimum Requirement?	Site Specific Options	Comments
Calorific Value	Yes		
Relative Density	Yes		
Nitrogen	Yes		
Carbon Dioxide	Yes		
Wobbe	Yes		
24 Hour Average CV	Yes		
24 Hour Average RD	Yes		
Inst. Volume Flow(s)	Yes		Corrected to STP.
Inst. Energy Flow(s)	Yes		Corrected to STP.

**Part 2B – FWACV Analogues (Sites with a flow less than [or equal to] 1 million m<sup>3</sup>/day)**

Point	Minimum Requirement?	Site Specific Options	Comments
CV Tracker	Yes		
RD Tracker	Yes		
Calorific Value		Yes	
Relative Density		Yes	
Nitrogen		Yes	
Carbon Dioxide		Yes	
24 Hour Average CV	Yes		
24 Hour Average RD	Yes		
Instantaneous Volume Flow(s)	Yes		Corrected to STP.
Instantaneous Energy Flow(s)	Yes		Corrected to STP.
CV Tracker	Yes		

**Part 3 – States (All Sites)**

Point	Minimum Requirement?	Site Specific Options	Comments
Filter	Yes		Common or individual alarm as fitted.
Slam Shut	Yes		Common or individual alarm as fitted.
Maintenance key	Yes		
Inlet pressure alarm		Yes	If fitted.
Outlet pressure alarm	Yes		
Heater/boiler status alarms			
Instrument fault		Yes	If fitted (may include RTU communications faults, barrier faults etc).
Intruder alarm	Yes		
System alarm(s)	Yes		CV or tracker monitoring alarms.
Instrument Gas Fail		Yes	If fitted.
Override		Yes	If remote volumetric control fitted.
Site mains supply	Yes		
Site charger alarm	Yes		
Generator running/locked out		Yes	If fitted.
Metering alarm	Yes		
Remotely operable meter valves		Yes	If fitted.
CV or tracker UPS alarm	Yes		CV or tracker UPS supply.
CV Not Valid		Yes	Flow > 1 Million m <sup>3</sup> /Day.
CV Not Attributable		Yes	Flow > 1 Million m <sup>3</sup> /Day.
FWACV Remote Access alarm	Yes		Flow > 1 Million m <sup>3</sup> /Day.
Status Local/Remote		Yes	If remote control fitted.
FCV Selected		Yes	If more than one control valve.
FCV Parallel		Yes	If more than one control valve.
Mode SPC/DVC		Yes	If remote control fitted.
Override in DVC		Yes	If remote control fitted.
Local Valve indications	Yes		
Pump A common alarm	Yes		Local Gas treatment.
Pump B common alarm	Yes		Local Gas treatment.
Tank low level	Yes		Local Gas treatment.
Power Supply	Yes		Local Gas treatment.

**Part 4 – Controls**

Point	Minimum Requirement?	Site Specific Options	Comments
Remote Flow Control Valves	Yes		
Remotely operable meter valves		Yes	If multiple meter streams selectable.
FCV Select		Yes	If more than one control valve.
SPC/DVC Select		Yes	If remote control fitted.
Override in DVC		Yes	If remote control fitted.
FCV Parallel		Yes	If remote control fitted.
Flow Setpoint		Yes	If remote control fitted.
DVC Control		Yes	If remote control fitted.
Low Press override		Yes	If remote control fitted.
High Press override		Yes	If remote control fitted.

**Part 5 – Counters**

Point	Minimum Requirement?	Site Specific Options	Comments
Volume integrators	Yes		
Boiler volume integrators		Yes	If fitted.
Boiler energy integrators		Yes	If fitted.
Energy integrators		Yes	Flow > 1 Million m <sup>3</sup> /Day
Pump A flow integrator	Yes		Local Gas treatment.
Pump B flow integrator	Yes		Local Gas treatment.

## ANNEX E-2

### Resilience of Telemetry Connection Facilities

(Paragraph 2.1.4)

#### 1 Design and Operation

- 1.1 The Telemetry Connection Facilities shall be designed, operated and maintained following the lifecycle detailed within BS IEC 61511.
- 1.2 The DNO acknowledges that the Telemetry Connection Facilities form part of a safety instrumented system, therefore a risk assessment must be carried out to determine the required risk reduction for the Telemetry Connection Facilities to meet the appropriate Safety Integrity Level (SIL). A minimum SIL of ONE should be used unless the risk assessment dictates a more onerous SIL.

#### 2 Availability and Reliability

- 2.1 The Telemetry Connection Facilities shall:
  - (a) have high availability as is agreed by the parties, which shall be greater than 99.95% for [strategically important sites] and greater than 99.5% for [all other sites]; and
  - (b) have a fallback which uses either the ISDN or PSTN.
- 2.2 The Telemetry Connection Facilities shall be designed to meet the requirements in paragraph 2.1. An availability model shall be produced detailing the availability of the design. The manufacturer's availability data, presented in terms of MTBF (Mean Time Between Failure) information, shall be used in producing the availability model.
- 2.3 The level of reliability for the overall RTU configuration shall have a MTBF in excess of 13,000 hours.

#### 3 Resilience

- 3.1 The [Telemetry Connection Facilities comprise a remote telemetry unit (RTU)] which shall incorporate a watchdog timer capable of detecting a catastrophic failure of a downloaded RTU programme and automatically reverting to a previous proven version of that programme, a catastrophic failure of the RTU to scan the I/O, service the communication ports or run the kernel software.
- 3.2 In the event of a PSU failure (owing to a mains failure or otherwise), the DNO shall ensure that there is a back-up battery to provide on-site power to the Telemetry Connection Facilities for at least 8 hours, so as to enable RTU, I/O and communications to continue to operate normally.
- 3.3 In the case of a mains failure, this should be registered within the RTU and can be used, if so configured, to raise a corresponding alarm at the [Data Centre]. At [strategically important sites], a PSU management facility should be used to monitor the charger and batteries to enable the Data Centre to remotely monitor the estimated battery state throughout the failure (where so configured).
- 3.4 The DNO shall ensure that:
  - (a) Transco NTS is notified in good time where back-up battery failure (in which battery power is eventually lost following a mains power failure greater than 8 hours) is anticipated;

- (b) the I/O and Site should be put into a known safe state; and
- (c) any important volatile historical data from the RTU is recovered.

3.5 This paragraph 3.5 sets out a non-exhaustive list of RTU failure scenarios and the DNO response required:

#### 3.5.1 Watchdog Timeout Failure

The RTU platform shall have a watchdog circuit comprising a re-triggerable hardware timer with direct access to the hardware reset line of the CPU (such that if the watchdog timer is timed out, the CPU will automatically be reset and start into its boot sequence). Any CPU reset caused by a watchdog timeout shall be registered, so as to enable the booting CPU to determine that a watchdog timeout has just occurred.

Any application software running on the CPU shall periodically reset the watchdog timer. In the event the RTU software crashes due to an unusual event (perhaps a power glitch), the watchdog should timeout and fire (typically within a fraction of a second), causing the RTU to reboot and hence automatically recover.

The RTU kernel shall reset watchdog at a predetermined interval and will register the occurrence of any watchdog timeout. On rebooting after a reset, the RTU shall set an internal status bit to indicate that it has undergone a reset due to a watchdog timeout.

#### 3.5.2 Profibus DP Master Failure

The RTU shall be capable of detecting a Profibus DP master failure and set an error flag to indicate such failure. This error flag shall be accessible by the ISaGRAF application and by the toolset. The Profibus DP slave gateway shall also be capable of detecting such failure, unless it is a partial failure (where the Profibus DP master continues to poll the Profibus DP Slave(s) but indicated a failure to operate properly to the RTU).

The DNO shall ensure that it is possible either to freeze the outputs or set them to a safe value, depending on the user configuration.

#### 3.5.3 Profibus DP Slave Gateway Failure

The Profibus DP master shall be capable of detecting a Profibus DP slave gateway failure and set an error status per Slave. This error status must be accessible to the ISaGRAF application.

In the event of loss of the Profibus DP gateway, the outputs of the I/O modules shall be set to the de-energised state.

#### 3.5.4 I/O Module Failure

An I/O module failure means [all][any] of the following:

- (a) short-circuit of individual connection;
- (b) open-circuit of individual connection;
- (c) I/O Module breakdown; and
- (d) I/O Module removal.

The Profibus DP slave gateway shall be capable of detecting I/O module failures and of reporting such failures to the Profibus DP master and the RTU, in order to ensure the setting of an error status per I/O module. The error status shall be accessible to the ISaGRAF

application and by the toolset. In addition, all module failures on an RTU are [OR'ed] together to create a single alarm state which is set if any failure is detected.

Transco NTS shall be entitled to implement ISaGRAF applications to set analogue and digital input values to specified states in the event of the detection of a failure.

An updated version of the RTU software shall include, in addition to the above error detection functionality:

- (a) the setting of any analogue input to zero in the event of the failure of the relevant analogue input module being detected by the Profibus DP slave gateway; and
- (b) the setting of any digital input to the GTMS alarm state in the event of the failure of the relevant digital input module being detected by the Profibus DP slave gateway.

The setting of all analogue inputs to zero and all digital inputs to the GTMS alarm state in the event of the failure of the relevant I/O station being detected by the Profibus DP slave gateway.

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**ANNEX E-3**

**Compatibility Requirements**  
(Paragraph 2.1.6)

**1 Introduction**

- 1.1 The GTMS system uses an intermediate layer of Front End Processor devices (called FEPs) to poll all of its outstation equipment. Each of these FEPs has many independent RS232 asynchronous serial interfaces, called FEP channels, each one effectively acting as a local network master using the modbus protocol to communicate with a number of connected modbus slaves (ie the outstations).
- 1.2 The FEP equipment determines the variant of modbus (based on a published modbus standard [MODBUS]) required for the purposes of the OAD (the **Modbus Variant**). The Telemetry Connection Facilities shall only be required to support Modbus Variant, as opposed to full modbus.
- 1.3 The Telemetry Connection Facilities shall be capable of supporting the modbus-based protocol, and that the protocol itself shall be encapsulated for transmission over IP.
- 1.4 This Annex E-3 specifies the modbus-based protocol used by the Modbus Variant and the method used to encapsulate the Modbus Variant into an IP form suitable for transmission by the Telemetry Connection Facilities. It also specifies how to map the protocol to the internal data structures of the Telemetry Connection Facilities.
- 1.5 Unless otherwise stated, all values in this Annex E-3 are decimal values. Where a hexadecimal value is used, this is denoted by a 0x prefix.

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**2 Modbus Variant**

- 2.1 The following modbus function codes are supported in accordance with [MODBUS]:

Code	Function	Sub Function
0x02	Read Input Status	-
0x04	Read Input Registers	-
0x05	Force Single Coil	-
0x06	Pre Set Single Register	-
0x07	Read Exception Status	-
0x08	Diagnostics	0x02, Return diagnostic register

- 2.2 Function codes (0x07 and 0x08) are not used by GTMS, but are required to support testing activities.
- 2.3 Modbus has two serial transmission modes, called ASCII and RTU. Modbus Variant shall use the RTU transmission mode.

**3 Encapsulation for IP**

The modbus polls from the FEP channels are in an asynchronous serial form (multiple RS232 interfaces). For transmission over the Telemetry Connection Facilities these polls must first be encapsulated as equivalent IP-based polls by adding the appropriate IP and Transport Layer information. This will be done by straightforward encapsulation of the conventional serial modbus polls into a suitable TCP packet.

**4 Integration of Modbus with MM4T**

- 4.1 [The Telemetry Connection Facilities comprise] MM4T, which has internal Medina points (ie AI23, which correspond to analogue input point no. 23) whereas GTMS understands the coils and registers of modbus. It follows that it is necessary to specify the mapping between internal MM4T outstation data and the data being transferred using modbus.
- 4.2 The following table shows how a range of Medina points will be mapped onto a range of modbus registers within the [Telemetry Connection Facilities]:

<b>Modbus Function Code</b>	<b>Medina Point type</b>	<b>Medina Point No</b>	<b>Modbus Register</b>
0x02	Digital Input	DI:0-2047	0x10001 upwards
	Derived Digital	DID:0-2047	
0x04	Analogue Input	AI:0-511	0x30001 upwards
	Derived Analogue	AID:0-511	
	Pulse Counter	PI:0-511	
	Derived Pulse Counter	PID:0-511	
0x05	Digital Output	DO:0-2047	0x00001 upwards
	Derived Digital	DID:0-2047	
0x06	Analogue Output	AO:0-511	0x40001 upwards
	Derived Analogue	AID:0-511	

- 4.3 The Medina Point no. indicated above is a point identifier only and the ranges shown for these does not in any way indicate the total number of available Medina points on the outstation. In practice the actual number of available Medina points is governed by the available outstation memory. For example, a Medina point number of DI2012 would still be valid even for an outstation with 1024 digital inputs.
- 4.4 An error response (0x02) will be returned if the request refers to a register number not supported by that function.
- 4.5 A request with a function code that is not supported by the outstation will cause exception response 01 (Illegal Function) to be returned.
- 4.6 An invalid modbus register address (ie not addressing a valid point number as the start point) will cause the exception response 02 (Illegal Data Address) to be returned.
- 4.7 If the number of points specified causes the IO fit to be exceeded then exception response 02 will be returned.
- 4.8 The actual mapping between Medina and modbus is completely flexible and is defined using a configuration file.
- 4.9 Note that Pulse Counters can only be inputs, derived Medina point types can be either input or output, hence the mnemonic for derived point type is generic (ie AID refers to a derived analogue point type, either input or output).
- 4.10 As integrated points (PI and PID) have 32-bit values, when one is mapped to a modbus register, its lower 16 bits are mapped to that register, and its higher 16 bits are mapped to the next register.

- 4.11 Analogue values (AI, AID and AO) in transferred as modbus messages are raw sensor values in the range -32768 to 32767. Negative values are returned as zero. Where so configured, AI values are adjusted for zero-threshold, under and over-range limiting.
- 4.12 AO values are forwarded to the output hardware stage as received (ie as raw values).

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**Annex E-4**  
**Daily Read Facilities**  
(Paragraphs 4.1.2 and 4.2.1)

**Part 1 - Specifications**

The Daily Read Facilities shall:

- (a) be compatible with the Measurement Equipment installed at the Offtake;
- (b) capture the prescribed information; and
- (c) capture the information on Site at least every 4 minutes for transmission every 24 hours in an electronic format with at least 1-month's information archived on Site.

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**Part 2A – Data Transfer from Metered Connections with Daily Read Equipment Installed**

<b>Point</b>	<b>Minimum Requirement?</b>	<b>Comments</b>
Daily Calorific Value	Yes	Where measured.
	No	Where DCV from alternative place is used.
24 hour relative density	Yes	
24 hr integrated volume	Yes	

**Part 2B – Data to be provided every 24 hours by the Downstream Party**

<b>Point</b>	<b>Minimum Requirement?</b>	<b>Comments</b>
Daily Calorific Value	Yes	From measurement equipment of alternative place.
24 hour integrated volume	Yes	From measurement equipment.

DRAFT