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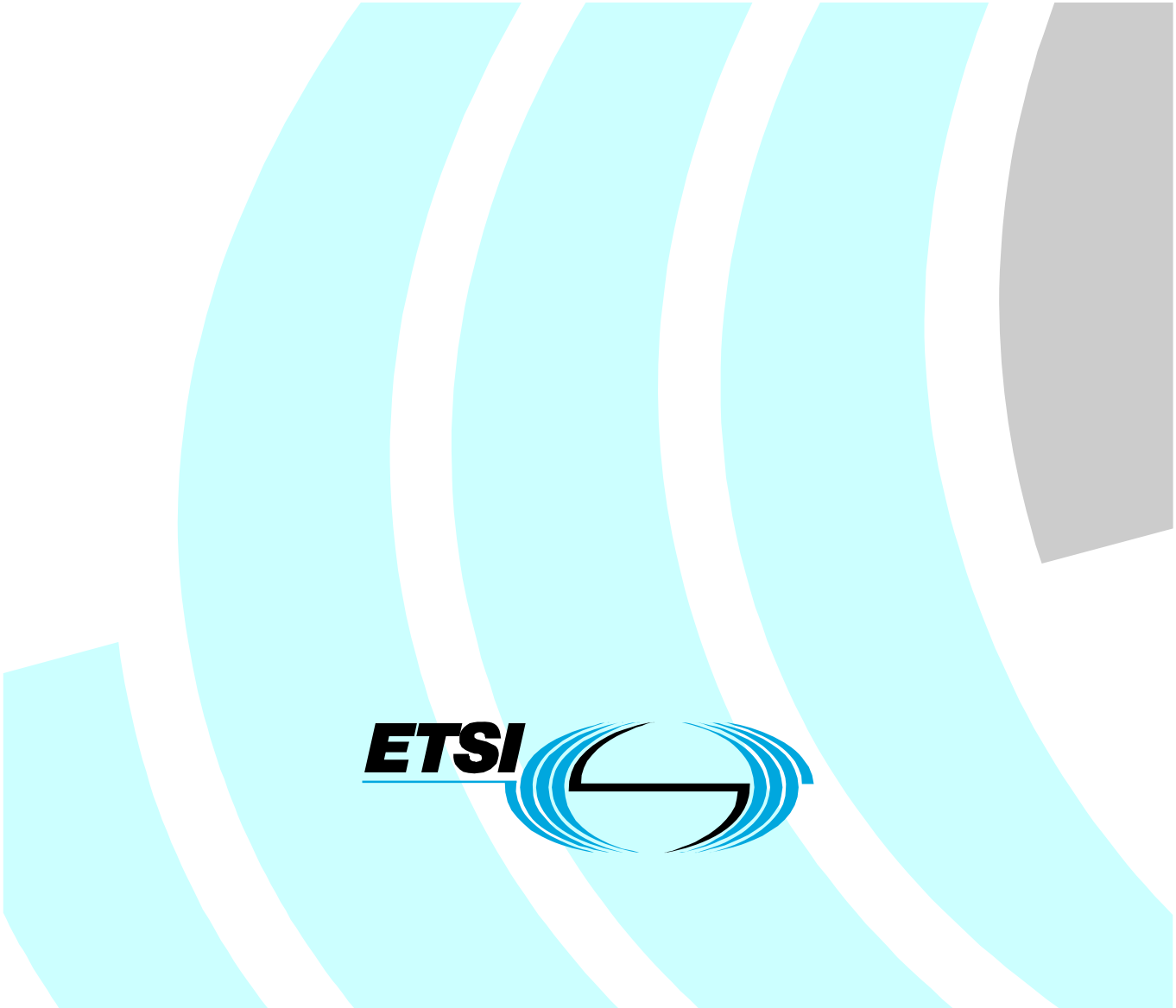
ETSI Standard

Environmental Engineering (EE);
Monitoring and Control Interface for Infrastructure Equipment (Power, Cooling and Building Environment Systems used in Telecommunication Networks);
Part 5: AC diesel back-up generator system control and monitoring information model



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Contents

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Foreword

This ETSI Standard (ES) has been produced by ETSI Technical Committee Environmental Engineering (EE).

The present document is part 5 of a multi-part deliverable covering Monitoring and Control Interface for Infrastructure Equipment (Power, Cooling and Building Environment Systems used in Telecommunication Networks), as identified below:

Part 1: "Generic Interface";

Part 2: "DC power system control and monitoring information model";

Part 3: "AC UPS power system control and monitoring information model";

Part 4: "AC distribution power system control and monitoring information model";

Part 5: "AC diesel back-up generator system control and monitoring information model";

Part 6: "Air conditioning system control and monitoring information model";

Part 7: "Other utilities system control and monitoring information model";

Part 8: "Remote Power Feeding System control and monitoring information model".

1 Scope

The present document applies to monitoring and control of AC diesel back-up generator system for telecommunication equipment.

The document defines:

- The monitored and controlled back-up generator system architectures.
- The minimum set of exchanged information required at the interface, described in "natural language" in text tables.
- The XML tags and variables corresponding to the data in the tables.

2 References

References are either specific (identified by date of publication and/or edition number or version number) or non-specific.

- For a specific reference, subsequent revisions do not apply.
- Non-specific reference may be made only to a complete document or a part thereof and only in the following cases:
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2.1 Normative references

The following referenced documents are indispensable for the application of the present document. For dated references, only the edition cited applies. For non-specific references, the latest edition of the referenced document (including any amendments) applies.

[1] ETSI ES 202 336-1: "Environmental Engineering (EE); Monitoring and Control Interface for Infrastructure Equipment (Power, Cooling and Building Environment Systems used in Telecommunication Networks) Part 1: Generic Interface".

[2] ETSI ES 202 336-2: "Environmental Engineering (EE); Monitoring and control interface for infrastructure equipment (Power, Cooling and environment systems used in telecommunication networks); Part 2: DC power system control and monitoring information model".

[3] ETSI EN 300 132-2: "Environmental Engineering (EE); Power supply interface at the input to telecommunications equipment; Part 2: Operated by direct current (dc)".

[4] ETSI EN 300 132-3: "Environmental Engineering (EE); Power supply interface at the input to telecommunications equipment; Part 3: Operated by rectified current source, alternating current source or direct current source up to 400 V".

[5] ISO/IEC 10164: "Information technology -- Open Systems Interconnection -- Systems Management".

[6] ISO/IEC 8879: "Information processing -- Text and office systems -- Standard Generalized Markup Language (SGML)".

2.2 Informative references

The following referenced documents are not essential to the use of the present document but they assist the user with regard to a particular subject area. For non-specific references, the latest version of the referenced document (including any amendments) applies.

[i.1] ETSI TR 102 336: "Environmental Engineering (EE); Power and cooling system control and monitoring guidance".

[i.2] ETSI TR 102 121: "Environmental Engineering (EE); Guidance for power distribution to telecommunication and datacom equipment".

[i.3] IEEE 802.1 to 11: "LAN/MAN Standards".

[i.4] ETSI ES 202 336-4: "Environmental Engineering (EE); Monitoring and Control Interface for Infrastructure Equipment (Power, Cooling and Building Environment Systems used in Telecommunication Networks); Part 4: AC distribution power system control and monitoring information model".

3 Definitions and abbreviations

3.1 Definitions

For the purposes of the present document, the following terms and definitions apply:

NOTE: Terms referring to energy interface, equipment and distribution are described in power distribution standards EN 300 132-2 [3] for 48 Vdc and EN 300 132-3 [4] for ac and dc lower than 400 V.

alarm: any information signalling abnormal state, i.e. different to specified normal state of hardware, software, environment condition (temperature, humidity, etc.)

NOTE: The alarm signal should be understood by itself by an operator and should always have at least one severity qualification or codification (colour, level, etc.).

EXAMPLE: Rectifier failure, battery low voltage, etc.

alarm loop: electrical loop which open or closed state correspond to alarm start (set) or end (clear) state

alarm message: text parts of the alarm structure

alarm structure: organized set of information fields in an alarm data frame (time stamp, set/clear, text, etc.)

client post: any device (laptop, PDA, console, etc.) connected to servers via the operation system networks to perform maintenance or supervision operations

Control form Style Sheet (CSS): simple mechanism for adding style (e.g. fonts, colours, spacing) to Web documents

NOTE: Tutorials, books, mailing lists for users, etc.

Control Unit (CU): integrated unit in an equipment to monitor and control this equipment through sensors and actuators

Data Gathering Unit (DGU): functional unit used for several functions:

- collect serial, digital, and analog data from several equipment;
- option to send (output) serial or digital commands;
- forward/receive information to/from the Local/Remote Management Application via agreed protocols;

- mediation between interfaces and protocols.

NOTE: This function may be integrated as part of specific equipment.

Dynamic Host Control Protocol (DHCP): protocol used for self configuration of TCP/IP parameters of a workstation assigning IP address and a subnetwork mask

NOTE: DHCP may also configure DNS.

Dynamic Name Server (DNS): associates a single domain name to an IP address

dynamic synoptic: dynamic display of geographical maps, networks, installations and equipment

ethernet: LAN protocol

NOTE: Equivalent to IEEE 802.1 to 11 [i.3].

event: any information signalling a change of state which is not an alarm: e.g. battery test, change of state of battery charge

NOTE: The event signal should be understood by itself by an operator and should always have at least one severity qualification or codification (colour, level, etc.). It should be transmitted in a formatted structure with text message and other fields like for alarm, e.g. an event can be coded as an alarm with severity "0".

infrastructure equipment: power, cooling and building environment systems used in telecommunications centres and Access Networks locations

EXAMPLE: Cabinets, shelters, underground locations, etc.

intranet: internal company network generally using Ethernet protocol and extended IP addresses

logbook: chronological file that contains alarm and event messages may be paper or electronic

Management Information Base (MIB): dynamic data base that gathers all objects and should evolve to include automatic and manual configuration tools with self coherence tests

menu: list of possible input command choices that may be presented in different ways on a display

NOTE: Selection is normally made by a keyboard, a pointing device, a mouse or directly by finger on a sensitive screen.

object: class description of items that accept a set of properties or functions

NOTE: Generic objects can include more specific items and inherit from their properties. If correctly structured, object programming can allow the system to evolve, i.e. be more future-proof. The code should intrinsically be open and structured.

PHP: powerful tool for making dynamic and interactive Web pages

pop-up: information or command screen that appears when a menu choice is selected

EXAMPLE: This may be a pop-up menu when the pointer is on a title button.

REpresentational State Transfer (REST): way to build an application for distributed system as www

Simple Object Access Protocol (SOAP): way to communicate between applications running on different operating systems, with different technologies and programming languages

NOTE: SOAP communicates over HTTP, because HTTP is supported by all Internet browsers and servers, SOAP traffic is not blocked by firewalls and proxy servers (see W3C).

Systems Management Function (SMF): object properties or classes with projection on CMIS application context communication

NOTE: Set of ISO system management functions according to ISO/IEC 10164 [5].

warning: low severity alarm

Web: common name for the Internet or Intranet

Windows: virtual area on the display that corresponds to a specific application

World Wide Web Consortium (W3C): consortium founded in October 1994 to develop common interoperable protocols and promote World Wide Web

NOTE: See http://www.w3c.org.

XCU: CU enabled to communicate using XML interface as defined in the present document

XHTML: stricter and cleaner version of HTML. XHTML consists of all the elements in HTML 4.01 combined with the syntax of XML. It can be read by all XML browser (see W3C)

eXtensible Mark-up Language (XML): application profile or restricted form of SGML

NOTE: By construction, XML documents are conforming SGML the Standard Generalized Markup Language (ISO/IEC 8879 [6]). documents.XML is designed to describe data and focus on what data is. XML must be discerned from the well known Hypertext Transfer Mark-up Language (HTML) which was designed to display data and to focus on how data looks.

XML Schema Definition (XSD): new more detailed XML description compared to the previous one, the DTD

Extensible Style sheet Language (XSL): language for expressing style sheets

NOTE: It consists of two parts, a language for transforming XML documents, and an XML vocabulary for specifying formatting semantics. An XSL style sheet specifies the presentation of a class of XML documents by describing how an instance of the class is transformed into an XML document that uses the formatting vocabulary.

3.2 Abbreviations

For the purposes of the present document, the following abbreviations apply:

AC	Alternating Current
CU	Control Unit of an equipment
DGU	Data Gathering Unit
HTML	Hypertex Transfer Make-up Language
HTTP	Hypertex Transfer Protocol
IP	Internet Protocol
LAN	Local Array Network
MTTR	Mean Time To Repair
PLC	Programmable Logic Controller
RMA	Remote Management Application
TCP	Transmission Control Protocol for IP
XCU	XML enabled CU
XML	eXtensible Markup Language (see W3C)

4 Back-up generator system control and monitoring presentation

Some telecom or datacom site (datacenters) are powered by the public AC mains and are often backed-up by one or several generators when the mains voltage is either interrupted or out of predefined ranges of voltage, frequency or distortion.

The starting order may also come from the permanent power subsystem when a persistent battery discharge is observed.

The back-up generator described in ES 202 036-1 [1] is generally of diesel type and with AC interface output as defined in EN 300 132-3 [4].

The back-up generator is generally connected to the AC distribution power system that is monitored by interface ES 202 336-4 [i.4]. More information is given on the place of these back-up generators in the power system inside a telecom or data center in TR 102 121 [i.2].

It is possible that XCU be the same for back-up generator and AC distribution.

The back-up generator is composed of several well defined functions or circuits:

- engine (speed, temperature, speed, safety circuitry, etc.);
- alternator and power circuit (voltage, frequency, current);
- fuel tank and supply to the engine;
- water and air cooling circuit (fluid temperature, levels, circulation pumps, air, louvers, fans control, etc.);
- oil circuit (pressure, levels, preheating, etc.);
- starting devices system (battery voltage, starting speed, battery charger, etc.);
- electrical auxiliary circuit (auxiliary protection devices, power contactors, etc);
- a system monitoring and control unit (XCU) to monitor the back-up generator, extend alarms and provide system control functionality.

NOTE 1: AC mains may be monitored by the diesel generator control unit and/or by the AC distribution CU.

NOTE 2: A diesel generator system may comprise several XCU. An XCU can monitor and control each diesel generator, and be interfaced to the AC distribution XCU that monitors the public AC mains and transfer starting signal to diesel generator XCU in case of AC mains failure. Another option is that each equipment transfers information (alarm, measurement, etc.) to a DGU that may be associated with one of the equipment e.g. the diesel generator.

A permanent monitoring is performed even when engine is stopped to reduce the MTTR.

In addition, automatic starting/running test procedures and reports are very important for engine training and health check-up.

The Diesel AC back-up generator systems addressed by the present document are depicted in figure 1.

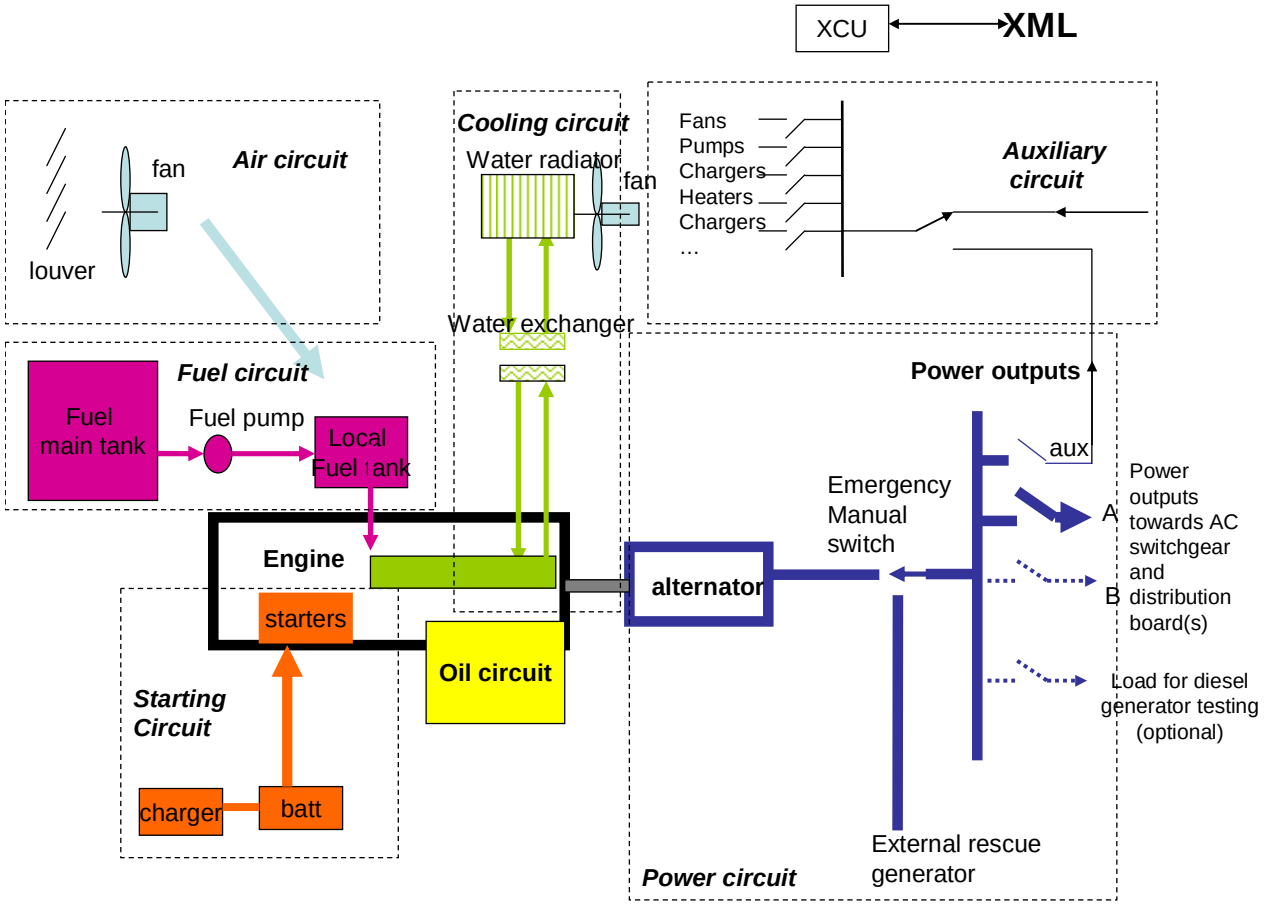

Figure 1: Example of water cooled Diesel Engine backup generator architecture under XML control-monitoring

The back-up generator XCU may use permanent power with DC interface as defined in EN 300 132-2 [3] or EN 300 132-3 [4].

There can be periodical or on demand test in addition to permanent monitoring to reduce the failure detection time and the MTTR. The dynamic test can be off load starting or on site load running.

More details on monitoring and information are given in TR 102 336 [i.1].

NOTE 3: Other generator such as gas turbine or stirling engine or fuel cell may also be used and the control-monitoring should be defined, based on the present document in other ES 202 336 parts.

The power circuit monitoring should help to discriminate the distribution and sub-equipment faults.

Several measurements are possible: operation states, voltage, frequency, speed, air and fluid temperature, user load currents, etc.

Several controls may be possible to adjust parameters for energy saving and higher reliability, to start test procedure of the whole generator or on some subsystem (fans, pumps, etc.).

Mandatory monitoring/ supervision information and functions are given in annex A.

Non-mandatory (optional) monitoring/ supervision information and functions are given in annex B.

Table TP1 (Table Power in annex A) corresponds to mandatory data that shall be provided for a diesel engine back-up generator, and TP1x (annex B) includes data that should be provided in addition to mandatory one.

Common XML coding structures for the table TP1 and TP1x data should be based on annex C of ES 202 336-2 [2].

Annex A (normative): Summary of mandatory monitoring / supervision information and functions

This annex gathers the information needed on the Remote Monitoring Application for different types of power supplies. It specifies the mandatory requirements that must be provided in all cases.

NOTE 1: These tables do not specify the power equipment by itself. These tables refer to subsets or devices that are not necessarily present in each equipment configuration. As a matter of fact, one alarm and its class apply only in case of the presence of this subset or device.

When an optional alarm that requires a parameter set is present, the corresponding parameter set is mandatory in the control section in order to allow remote adjustment under appropriate login procedure.

According to their element type (Description, Alarm, Data, etc.), as defined in ES 202 336-1 [1] the information shall be provided by the Control Unit (XCU).

NOTE 2: If there is no XCU this data should be provided by the Data Gathering Unit (DGU).

When a CU has a field data bus connected to the DGU, at least, the DGU shall store data (record measurements, log files). The XCU which has the XML interface over Ethernet TCP/IP, shall store these data.

NOTE 3: The "Explanation" column provided in the following data tables has been used where necessary to further explain the statements in the "Monitored information" column. The "Element type" column gives the assigned name used in XML coding and the "Monitored information" column provides details of the condition or state being monitored. The identifiers used in the Type column of the following tables are described in ES 202 336-1 [1].

NOTE 4: Partial communication network failures e.g. XCU link fault should be detected by an upper element of the network e.g. the RMA (refer to figure 1 of ES 202 336-1 [1]).

NOTE 5: Clause 9.4.4 of ES 202 336-1 [1] details the parameters associated with XML elements e.g. time delay, severity of alarm element. The tables below do not include the application of these parameters.

Table A.1: TP1 minimum set of monitored information

Type	Monitored information	Explanation
Description	Device description	
Alarm	Main fuel tank low level	This is the site main fuel tank. This is the only one in small site. This tank can supply several diesel generators, and heatings in big sites.
	Auxiliary fuel tank low level	For big diesel engine architecture only, for fuel better supply regulation and to limit fuel volume closes to the engine and fire hazard in accordance to safety standards or laws (e.g. It may be a daily fuel tank of less than 500 liters).
	Lubricant oil low level	
	Main coolant tank low level	Not for air cooled engine.
	Auxiliary coolant tank low level	Not for air cooled engine.
	Lubricant oil very high level	
	Main coolant tank very high level	Not for air cooled engine.
	Start failure	
	Safety stop	This information is provided by the ultimate safety circuitry. In general it includes at minimum oil over pressure default, very low oil abnormal levels, coolant overheating, emergency stop activated.
	Undetermined stop	This indicates that the engines stopped without any identified reason or failure.

Type	Monitored information	Explanation
	Voltage or frequency out of range	Speed engine regulation failure or alternator voltage regulation failure.
	Fuel leakage	It may be detected in the double envelope of the fuel tank. It's generally mandatory to respect national safety and environment laws.
	Battery starter charger failure	This is generally integrated in the charger.
	Protections trip (output power, fans, pumps, auxiliary)	
	Manual/maintenance mode	This indicates a change of state of the engine between automatic and manual start/stop control.
	Engine start inhibited	This indicates that the engine is no longer able to start in order to make safe maintenance.
	Engine fuel feeding circuit manually shut off	This indicates that the fuel circuit has been locked off. In general, this is used to stop the engine, the fans and fuel provision when a fire occurs in the site.
	Link failure between AC distribution boards or DC power system	This permanent monitoring detects a fault in the link between the equipment control system circuit (e.g. PLC) used to start, load, and stop the engine.
	Starting battery failure	It can be detected by an abnormal voltage drop during the starting phase and by a low open circuit voltage between charges.
Measurement	None	
Calculated value	None	
Event	Generator, fans, pumps status changes (running/stop)	
	Starting reason (mains outage, mains quality drop, manual mode, test, undetermined)	
	Running/Stop generator status	
Config	Date and Time	
	Default values resetting (safe value for engine)	
Control	XCU program download with default to previous release	
	Default values resetting (safe value for XCU)	
	Parameters set: oil change time counter	
	Parameters set: air filter replacement time counter	
	Parameters set: engine running time counter	

Annex B (normative): Mandatory XML structure and elements

B.1 Structure of a XML document related to a diesel back-up generator system

In the site DGU XML data structure as described in ES 202 036-1 [1], a diesel back-up generator system equipment is always a child of a site energy system.

The XML structure shall be as follows:

NOTE: Indicate precisely the generic mandatory XML structure and where to put the information if it exists (where it starts and stops). Every equipment and element, should be considered as a folder in the XML structure.

```
<site id="23" status ="normal">
        ....
   <energy_system id="1" status="normal">
      <description_table>
      …
      </description_table>
      …
      < diesel_backup_generator_system id="1" status="normal">

      Here is the XCU file embedded (see next §)  ….

      </diesel_backup_generator_system >

      < diesel_backup_generator_system id="2,3, ...n" status="normal">

      Here is the XCU file embedded (see next §)  ….

      </diesel_backup_generator_system >
```

```
</energy_system>
   …
</site>
```

A diesel engine backup generator system XCU will only generate the XML document "diesel_backup_generator_ system.xml". This file can be downloaded by the DGU of the site and embedded in the "site.xml" document. In this case, the structure of the document is as follows:

```
< diesel_backup_generator_system id="1" status="normal">
   <description_table>
   …
   </description_table>
   <alarm_table>
   …
   </alarm_table>
   <event_table>
   …
   </event_table>
   <data_table>
   …
   </data_table>
   <data_record_table>
   …
   </data_record_table>
   <config_table>
   …
   </config_table>
   <control_table>
   …
   </control_table>
   < general id="10" status="normal">
   …
   </ general >

   < starting_circuit id="1" status="normal">
   …
   </ starting_circuit >

   < fuel_circuit_id="2" status="normal">
   …
   </ fuel_circuit >

   < oil_circuit_id="3" status="normal">
   …
   </ oil_circuit >

   < cooling_circuit_id="4" status="normal">
   …
   </ cooling_circuit >

   < air_circuit_id="5" status="normal">
   …
   </ air_circuit >

   < power_circuit_id="6" status="normal">
   …
   </ power_circuit >

   < auxiliary_power_id="7" status="normal">
   …
   </ auxiliary_circuit >
   …
</ diesel_backup_generator_system >
```

B.2 The specific elements of a diesel back-up generator system

Table B.1

Child Element	Description	Datatype
<starting_circuit> <fuel_circuit> <oil_circuit> <air_circuit> <cooling_circuit> <power_circuit> <auxiliary power_circuit>	For detailed information about each diesel generator circuit	xs:complexType
NOTE: In the following, xml examples have been given in a flat description only using the parameter group = "xxx circuit", but it is possible to define circuit as child element in a more hierarchized description.		

Annex C (informative): Summary of non-mandatory monitoring / supervision information and functions

According to their types (Description, Alarm, Data, etc.), as defined in ES 202 336-1 [1] the information should be provided by the Control Unit (XCU) or by the Data Gathering Unit (DGU).

The non-mandatory information of a table TPnx (n being the N° of the table) are provided in addition to the mandatory information defined in annex A in table TPn.

NOTE: The "Explanation" column provided in the following data tables has been used where necessary to further explain the statements in the "Monitored information" column. The "Element type" column gives the assigned name used in XML coding and the "Monitored information" column provides details of the condition or state being monitored. The identifiers used in the Type column of the following tables are described in ES 202 336-1 [1].

Table C.1: TP1x

Type	Monitored information	Explanation
Description	Device description	
Alarm	Starting test failure	The starting test is a short test. It can be a starter speed test without fuel feeding. In that case the compression is maximum, and the current is very high.
	Running test failure	The engine running test is longer. It switches the load on the generator even if the main is present. It is useful to make a full dynamic checking of the whole energy chain (AC switching, rectifiers and DC battery short discharge). It allows temperature rise and so cooling circuit testing.
	Any circuit test failure	Short test can be executed on auxiliary circuits (fans tests, cooling fluid pump tests, oil pumping, louver open/close tests, etc.) to check control/command, electrical circuits, electromechanical equipment, etc.
	Oil change	This indicates that oil has to be replaced. The reasons can be running hours, time period (e.g. 2 years).
	Air filter replacement	This indicates that the air filters have to be replaced. The reason is based on time counters or other specific conditions (e.g. pressure differential).
Measurement	Fuel gauge (±5 %)	
	Oil gauge (±10 %)	1 or 2 depending on the auxiliary fuel tank presence on the site.
	ac voltage (±1 %)	
	ac current (±1 %)	
	ac frequency (±1 %)	
	coolant temperature (±2 %)	Not for air cooled engine.
	air temperature (±2 %)	Generally the air temperature of the diesel room. This is useful to detect air circuit failure (e.g. loover, filter, air input/output problems, broken fans, etc.).
	oil temperature (±2 %)	Generally associated with motor failure.

Type	Monitored information	Explanation
Calculated value	Engine starter battery age since date of installation	This information is useful for preventive battery replacement.
	Remaining autonomy (running time) of generator	This assessment is based on fuel consumption and fuel reserve.
	Running times (since date of installation, since last maintenance, since starting)	This information is useful for preventive maintenance and statistics.
	Oil and water preheating operation duration per day	This information is useful for energy saving and heater circuit failure detection (of sensor or resistance).
	Power capacity management (ratio) = Used power /Installed power	This indication is very useful to avoid overcharge of the diesel and a possible full interruption of the site.
Event	Auxiliaries status change	This is for example the status of a pump, a fan, a preheating resistance, etc.
	Generator starting test	Battery voltage minimum, engine speed maximum are recorded during the test.
	Generator running test execution report	Speed, power, temperature are recorded at least at beginning and end of the test.
	Individual device (pumps, fans) tests execution report	This indication is generally used after a maintenance to detect if reparation is correct.
Control	Generator start / stop	This control can be done from local or remote place under appropriate security login and depending on operator safety rules. A short engine running without load can be used after a maintenance to test if all is ok.
	Starting test	This control test is periodical or done on site after a battery replacement for checking purpose. Starting test may be a starter speed test without fuel feeding.
	Any test of individual circuit (fuel, oil, cooling, starting, electric power, electric auxiliaries, etc.)	These control tests are generally done on site after a maintenance for checking purpose.
	Full system running test	This test is done for example after an heavy maintenance to check if all the energy chain is working good. The running test switches the load on the generator with the mains being present.
	Measurement records	Temperature, speed, voltage, fuel consumption, oil consumption can be recorded to detect parameters deratings and for energy optimization.
	On line help	This is especially useful for the diesel backup engine which is a complex machine.
	Back-up of customized parameters (e.g. can be used for system recovery)	

History

Document history		
V1.1.1	January 2010	Membership Approval Procedure MV 20100329: 2010-01-28 to 2010-03-29
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