CAMBRIDGE
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Wednesday 13 January 2027 – Afternoon

Level 3 Cambridge Technical in Applied Science

05874 Unit 22: Global scientific information

PRE-RELEASE

INSTRUCTIONS

- Do **not** take this copy of the pre-release material into the exam.
- Do **not** take any notes into the exam.

INFORMATION

- A clean copy of this pre-release will be given to you with the question paper.
- This document has **8** pages.

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Pre-release research brief

You should carry out your own research on the themes given in this research brief. Your research will help you to prepare for your exam.

Your research is only for your own use. You must not bring your notes into the exam.

A clean copy of this research brief will be provided in the exam.

In your research you should consider the following themes:

- categories of information holder
- locations of scientific information
- characteristics of good quality scientific information
- consequences of poor quality scientific information
- classification of scientific information.

The questions in **Section A** of the exam will require you to draw on the knowledge and understanding which you have gained while researching these themes.

Instructions:

Read the following three pages of information.

Carry out your own research on the themes given above.

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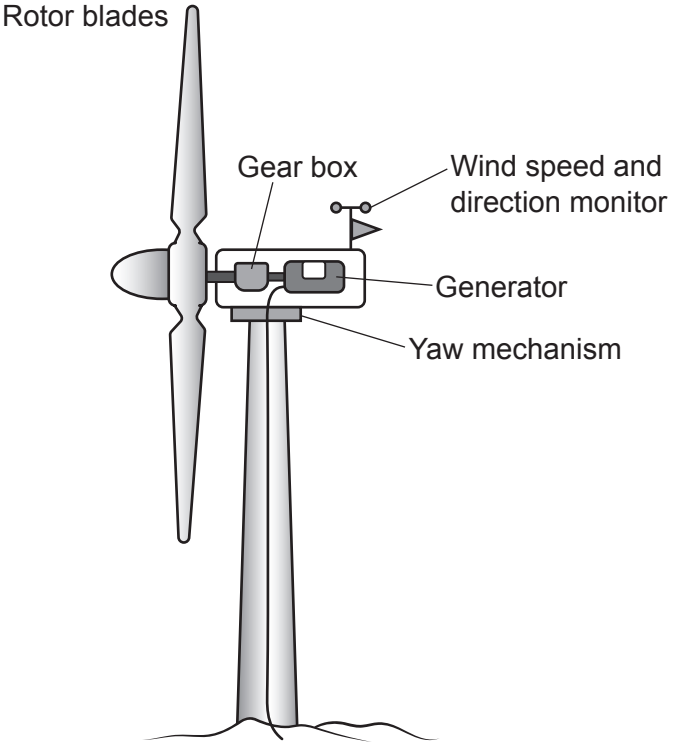
Source A

Adapted from: Supervisory Control and Data Acquisition (SCADA) systems. [1] [2]

The turbine

SCADA systems are vital for monitoring wind turbine performance, predicting maintenance needs and optimising energy output.

The diagram shows a typical wind turbine.



Sensors on the turbine measure the wind speed (to optimise the pitch of the rotor blades) and the wind direction (to ensure that the turbine is facing the wind). This data is sent to the wind farm's centrally located computer systems. The SCADA software processes the data and returns a signal carrying instructions to the turbine's electrical control system. This activates the mechanism to rotate the turbine towards the wind and adjust the pitch of the blades.

SCADA systems also monitor other factors that affect the performance of the wind turbine (air pressure and density, power output, temperature, vibration) and indicate faults that require maintenance.

Regulation and compliance

Wind farms need to comply with energy regulations and data governance policies.

- ISO 27001 – guidance for establishing, implementing, maintaining and continually improving an information security management system, to avoid unauthorised access to data.
- ISO 50001 – provides a practical way to improve energy use, through the development of an energy management system (EnMS).
- IEC 61400 – wind turbine design, testing and safety standards.

A wind farm in the UK must regularly report accurate, auditable energy production data to Ofgem (Office of Gas and Electricity Markets).

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Validation

- Computer System Validation (CSV) – ensures that software and hardware controlling wind turbines meet requirements for performance and reliability. For example, a wind farm operator validates its SCADA system to ensure that the wind turbine power output data is accurately recorded and transmitted to the national grid operator (Ofgem).

- 21 CFR Part 11 – defines standards for electronic records (e.g. logbooks), electronic signatures, ensuring data is secure and auditable. For example, a wind farm using data from sensors to monitor turbine power output and efficiency must comply with regulations to ensure that the data cannot be intentionally tampered with or altered.

- GAMP 5 – provides a risk based approach to validating automated systems. For example, a wind farm operator needs to predict when maintenance is required to ensure that sensors are correctly calibrated and control systems (e.g. pitch, yaw and braking controls) work as intended.

[1] https://www.youtube.com/watch?v=rmDdK38w-uw – Wind Farm SCADA and PLC systems

[2] https://www.youtube.com/watch?v=X0U8-4ZPcro – SCADA Tutorial (DPS)

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Source B

Adapted from: Ovation™ Green Asset Management and SCADA Software [3] [4] [5]

Renewables can be a mix of energy generating assets such as wind farms, solar farms or hydro plants and energy storage assets, including hydro pump storage, green hydrogen or lithium battery facilities.

They typically operate with equipment from a number of manufacturers and are managed by a variety of control and monitoring systems. Often, these systems do not easily integrate and limit data access necessary for providing a broad view of operations, which can hinder timely and effective decision-making. Maintaining multiple systems can also be time-consuming and costly.

Emerson's Ovation™ Green SCADA software helps manage and monitor renewable energy systems. It works with all kinds of equipment, no matter who made it or how old it is, making it easier to control one or many sites at once. The system gives secure, real-time access to detailed data from anywhere, helping users better understand how their equipment is performing and how to improve it. It allows operators to spot maintenance needs early and make fast, informed decisions to avoid expensive breakdowns.

Manage all assets from one platform

- Protect assets and data with comprehensive cybersecurity systems that protect against threats at several levels, not just one.
- Simplify portfolio management with renewable-specific functions.
  - KPI (Key Performance Indicator) dashboards, alarms, diagnostics and trends.
  - Generation, GADS (Generating Availability Data System) and reporting.
- Promote operational continuity and faster response by automating tasks through a modern, efficient and user-friendly HTML-based interface.
- High-resolution data via direct communication with asset controls.
- Connectivity to third-party systems.
- Historical data analysis.
- Remote condition monitoring services by Level 3 vibration analysts.
- Cybersecurity services that support NERC CIP compliance and best practices.

Emerson's Ovation™ Green asset management and SCADA software is available by download in two versions:

Cloud-based Ovation™ Green SCADA software automatically connects to renewable energy generation and storage systems to continuously monitor production, availability, impending issues and more. Full access to operating data from a common web browser enables more informed decision-making for instant reaction to alarms and shifts in weather conditions.

Ovation™ Green **Enterprise** SCADA software provides the same value as the cloud-hosted version, with a focus on serving the demands from renewable asset operators and service companies for a comprehensive view of operations. Enterprise SCADA software is designed for medium to large renewable energy projects that need to collect and manage a lot of data in one place.

Today's market demands software that is readily available, easy to maintain and integrates with other systems. Emerson's Ovation™ Green SCADA system helps manage renewable energy assets with easy-to-use software, flexible tools, and open connections to other systems. It works on either Windows or Linux and connects a number of different devices to collect, display and share data with other renewable energy systems.

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The system includes:

- A SCADA server and SQL database for storing setup info.
- A Cassandra database for fast logging and quick access to high-speed data, which helps with reporting, performance analysis and troubleshooting.

It also comes with standard and customisable dashboards so users can create views that match their specific needs. The software can be used on its own or as part of a larger system upgrade.

[3] https://www.emerson.com/is/content/emerson/en/corporate/shared-assets/documents/pws_010851-renewable-energy-scada.pdf

[4] https://videos.emerson.com/detail/videos/ovation/video/6319928744112/a-unified-view-of-renewable-operations-with-ovation-green?autoStart=true

[5] https://videos.emerson.com/detail/videos/scada-systems/video/5521986728001/wind-turbine-control-solutions?autoStart=true

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Source C

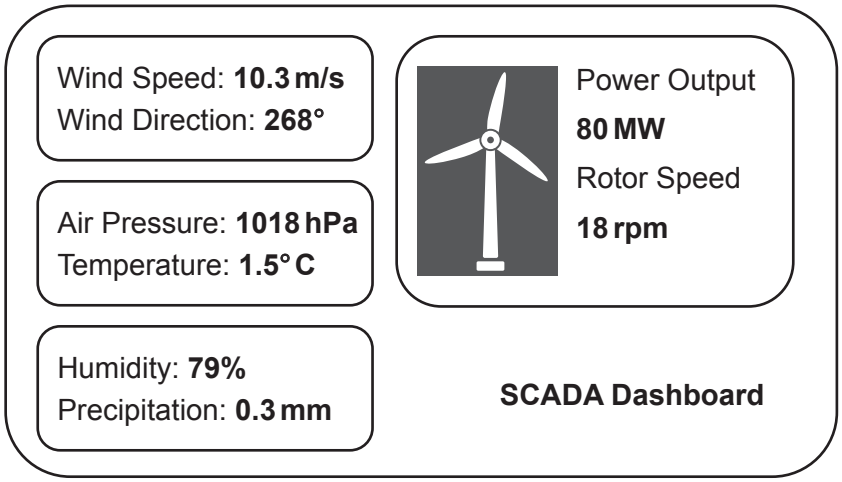
A theoretical case study

SCADA detects an unusual increase in vibration from one turbine. At the same time, high humidity and low air temperature are recorded overnight.

SCADA response:

The dashboard shows:

- wind speed and wind direction are within the optimal range
- temperature reading is low
- humidity reading is higher than expected when compared with the temperature reading
- rotor speed shows rapid changes (spikes) during gusts of higher wind speed.



Action taken:

The SCADA system detects the issue, triggering:

- An automated alert to maintenance staff.
- A brief turbine slowdown to reduce stress to mechanical components.
- A scheduled inspection on 25th April 2025.

Investigation reveals:

- Early-stage significant wear in the gear teeth and bearings of the gear box causing the vibration.
- Condensation inside a turbine sensor which caused inaccurate readings and potentially allowed the issue with the bearings to go undetected for too long.

Outcome:

- The sensor is resealed and the gearbox replaced, preventing more serious issues.
- The engineers and operators update the maintenance logbook.

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