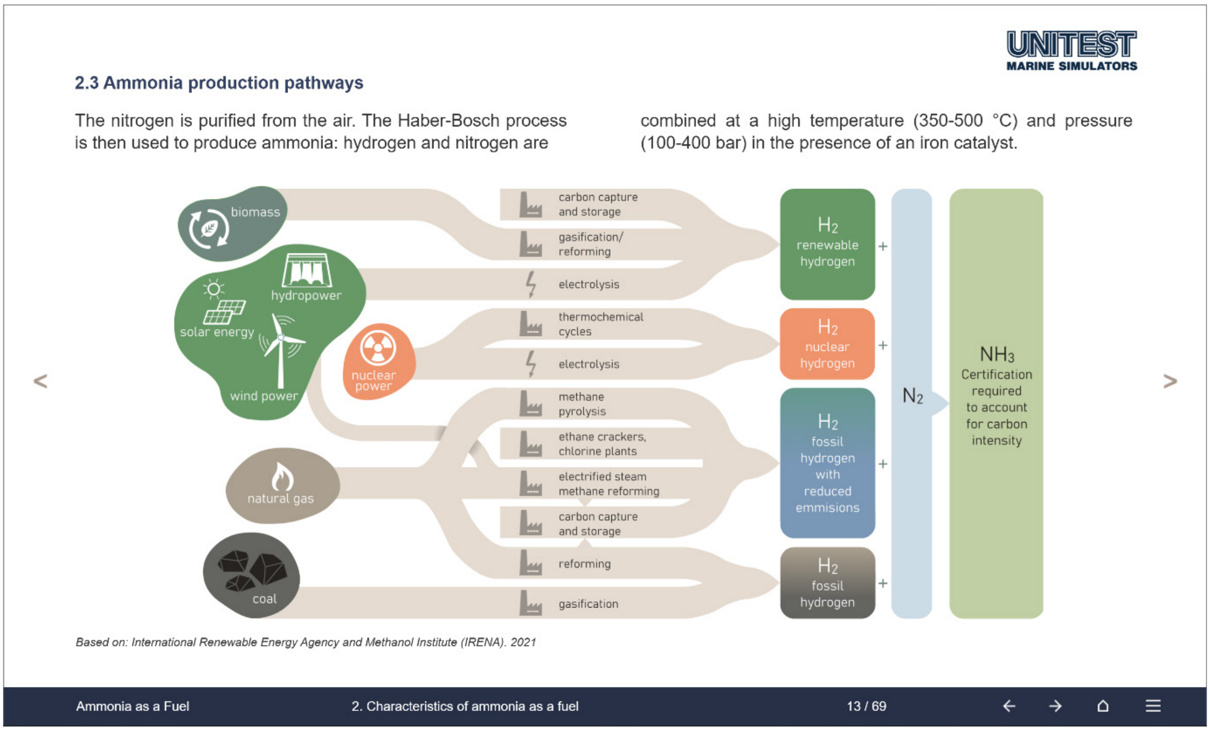
CBT 13 includes the following modules:

1. Ammonia as a fuel for marine 2-stroke DF engines - Introduction
2. Methanol as a fuel for marine 2-stroke DF engines - Introduction course
3. Electronically controlled low speed diesel engines

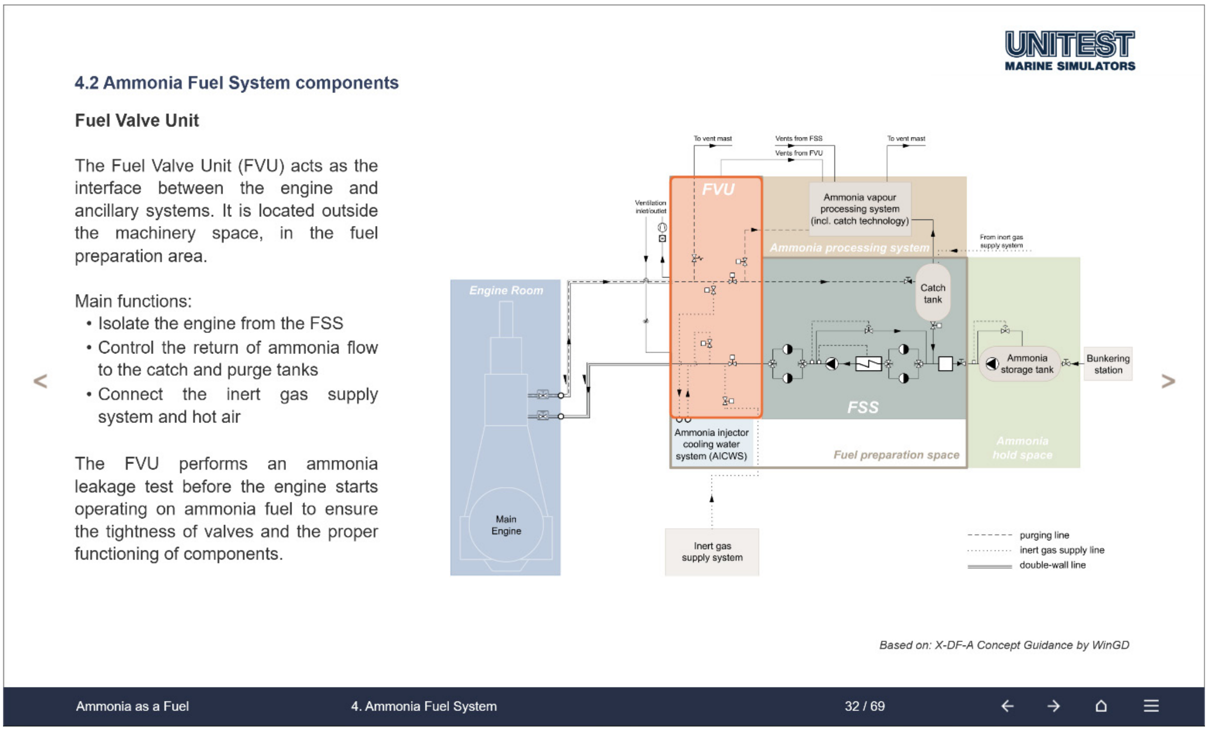
1. Ammonia as a fuel for marine 2-stroke DF engines

This e-learning module discusses in detail the role of ammonia (NH_3) as a key, carbon-free alternative fuel in maritime transport, introduced to meet the International Maritime Organization's (IMO) 2050 decarbonization goals.

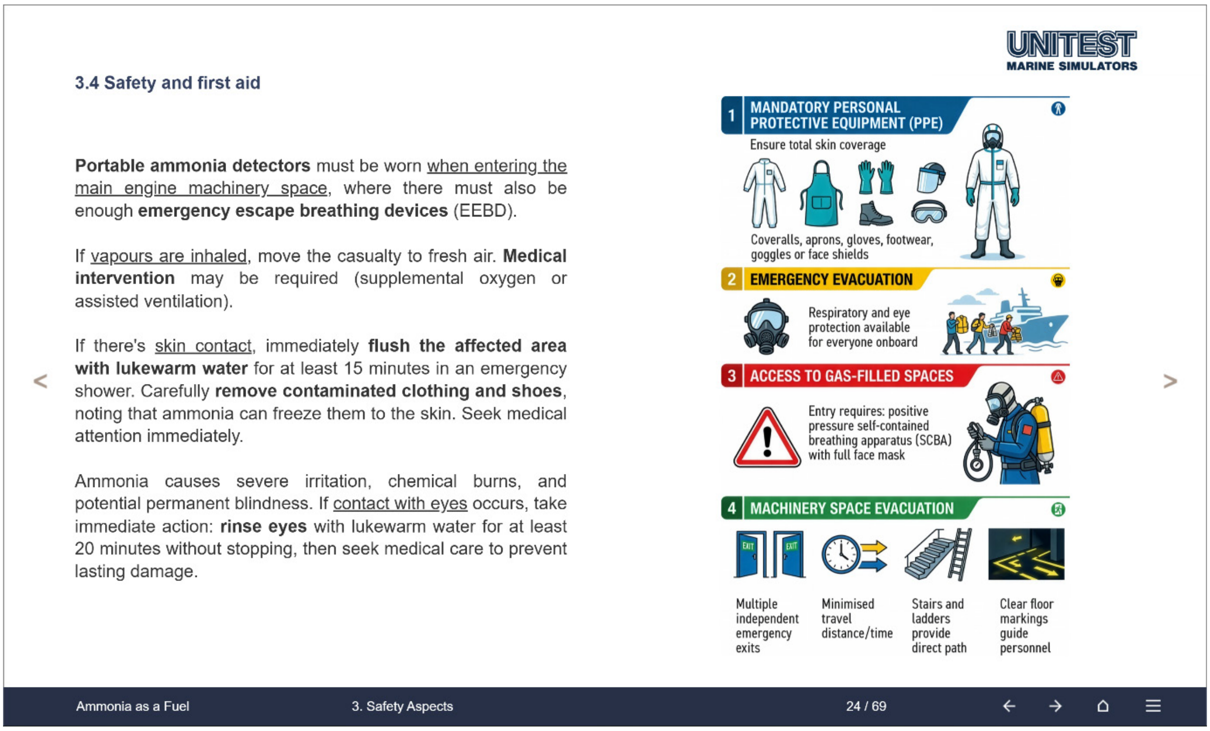
It presents the physicochemical characteristics of ammonia, its production pathways (grey, blue, green), and global market forecasts up to 2050.



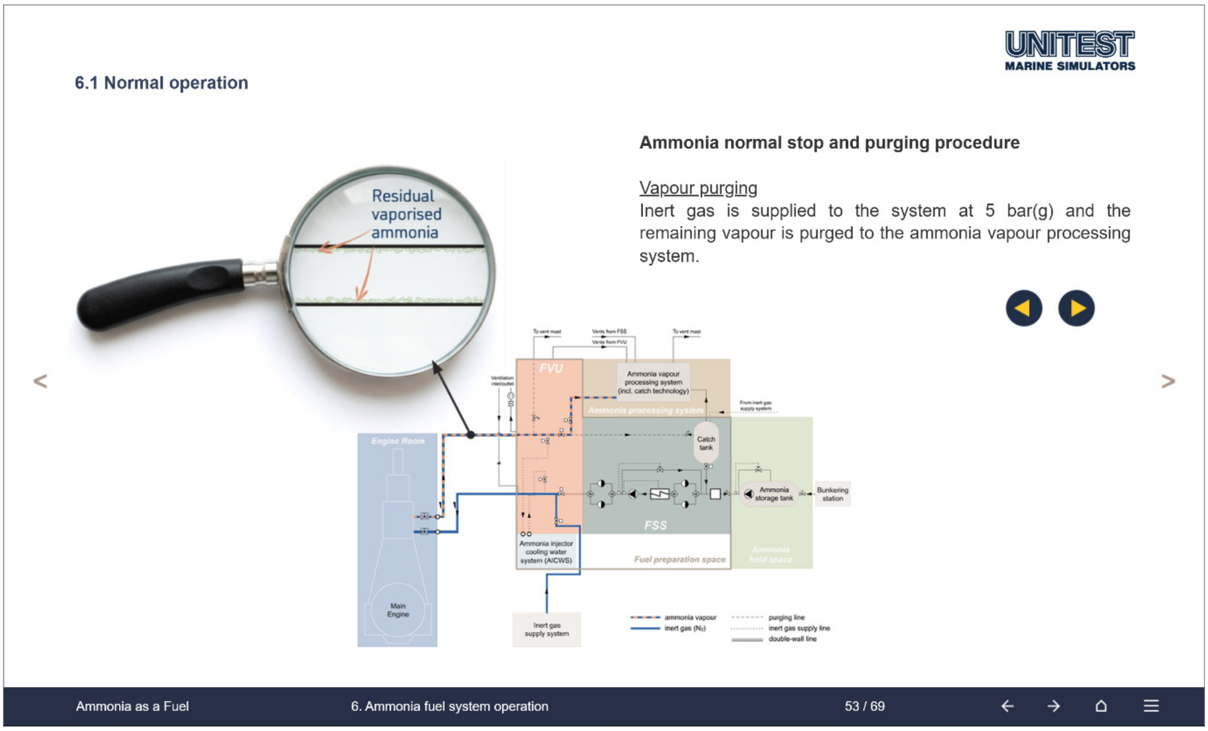
It describes the architecture and components of the marine fuel system (e.g., bunkering stations, Fuel Valve Units (FVU), ventilation, and venting systems) and the design criteria for dual-fuel engines (e.g., WinGD X-DF-A) operating in diesel and ammonia modes.



It focuses heavily on safety aspects, analyzing ammonia's toxicity, fire and explosion hazards, hazardous area zoning, leak detection systems, emergency response protocols, first aid, and firefighting techniques.



It provides precise instructions regarding normal system operation (fuel mode transitions, normal stop, and purging procedures) as well as maintenance workflows, including gas-freeing procedures and pressure testing.

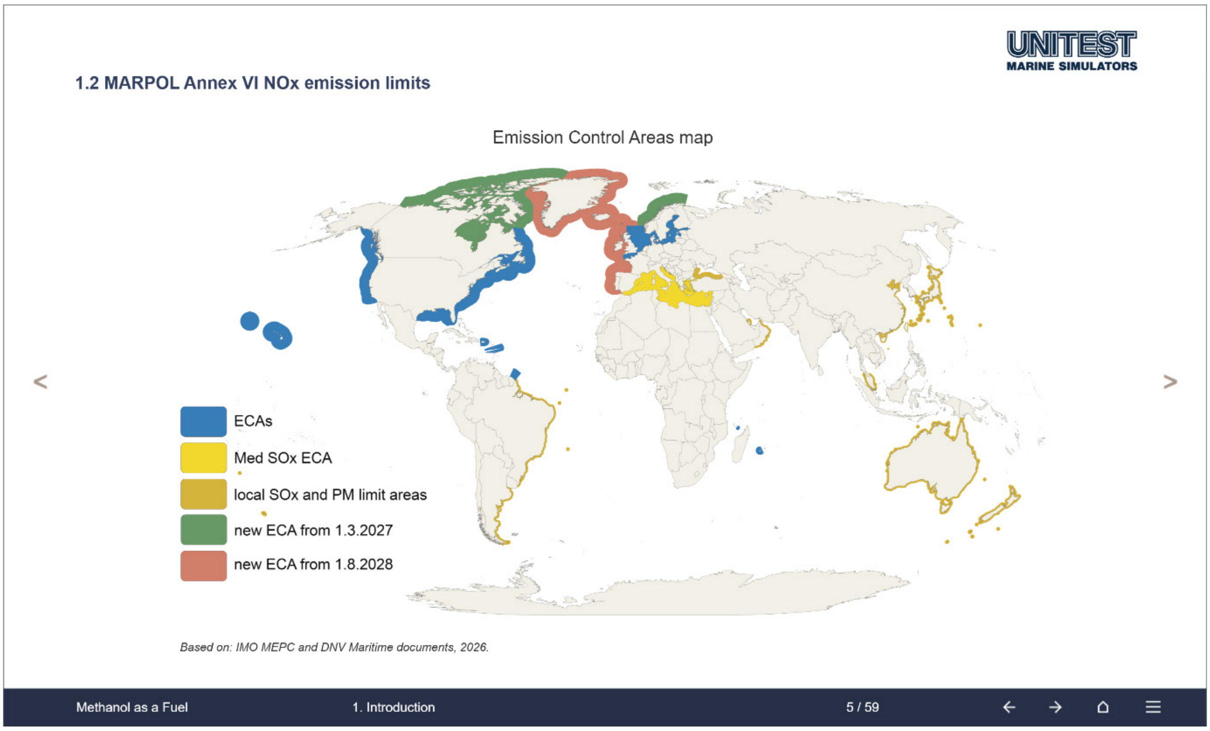


Educational objectives:

- Understanding the environmental and regulatory context: familiarizing the reader with greenhouse gas reduction targets and MARPOL Annex VI NO_x emission limits in Emission Control Areas (ECAs).
- Learning the design and operation of modern marine machinery: developing technical knowledge regarding the management of ammonia fuel supply systems, injection mechanisms, and ancillary equipment like the Ammonia Vapour Processing System (AVPS).
- Mastering safety and risk management protocols: preparing crew members and engineers to work safely with a highly toxic substance by training them to interpret sensor data, handle minor and major leaks, administer first aid, and safely isolate and purge piping systems before maintenance.

2. Methanol as a fuel for marine 2-stroke DF engines

The e-learning module 'Methanol as a Fuel for Marine 2-Stroke DF Engines: Introduction Course' is a technical training guide detailing the maritime industry's transition to alternative energy sources in order to comply with global emission regulations.

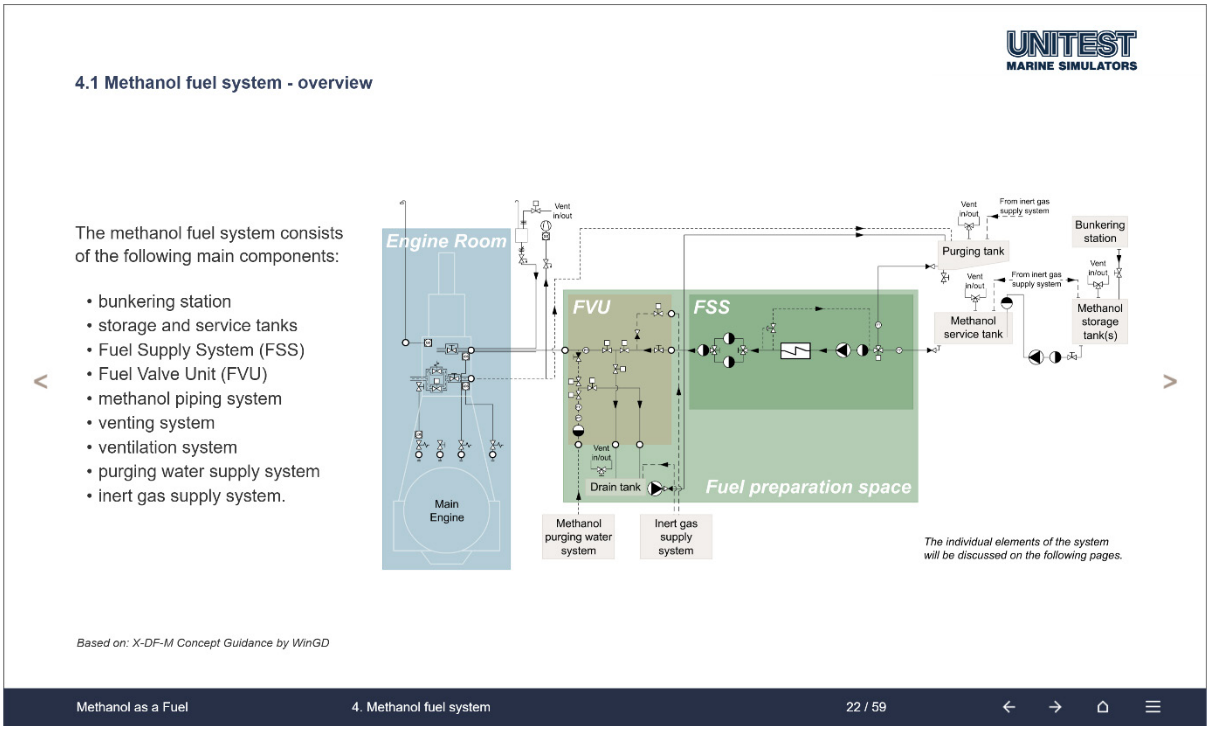


The text highlights the global demand for low-carbon fuels in order to meet the IMO's greenhouse gas reduction targets by 2050, as well as ensuring compliance with the strict air pollution limits set out in MARPOL Annex VI within designated Emission Control Areas (ECAs).

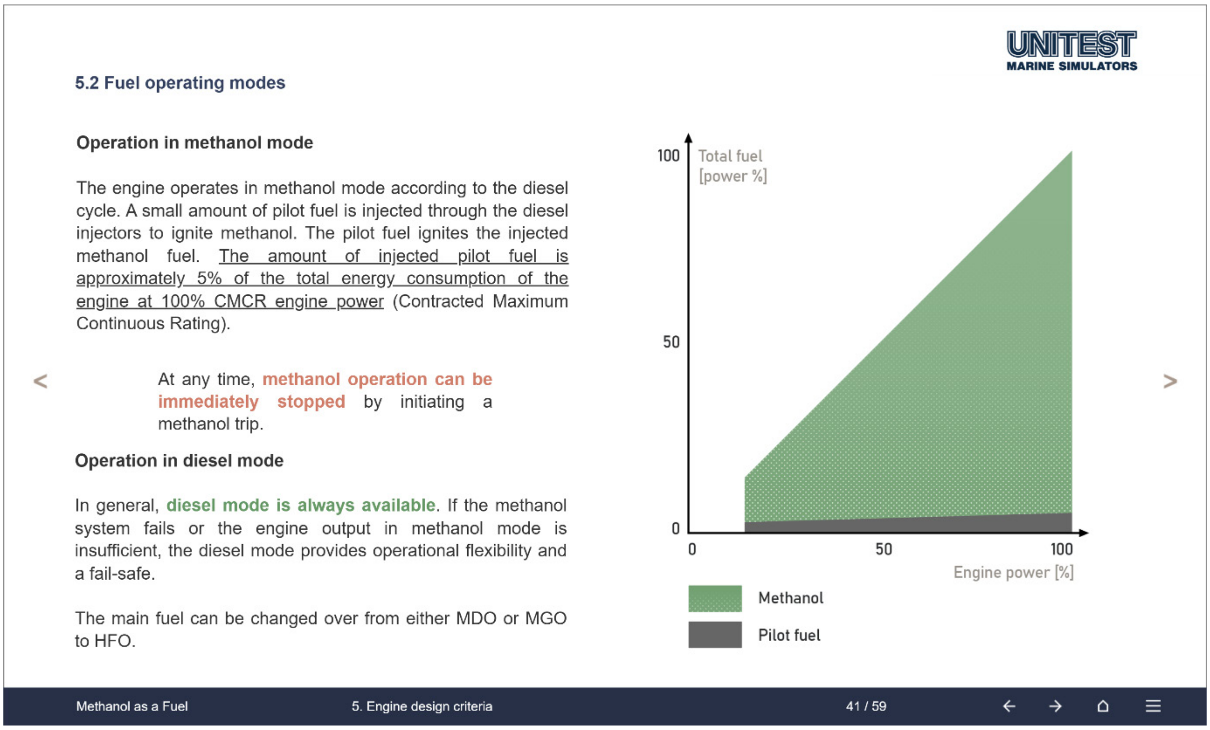
It highlights methanol's physical advantages - e.g. easy ambient-temperature storage and engine compatibility - while clarifying that its true sustainability depends on its production pathway.

The text details the operational safety protocols for methanol, including mandates for explosion-proof equipment, nitrogen tank blanketing, first aid and alcohol-resistant foam for firefighting.

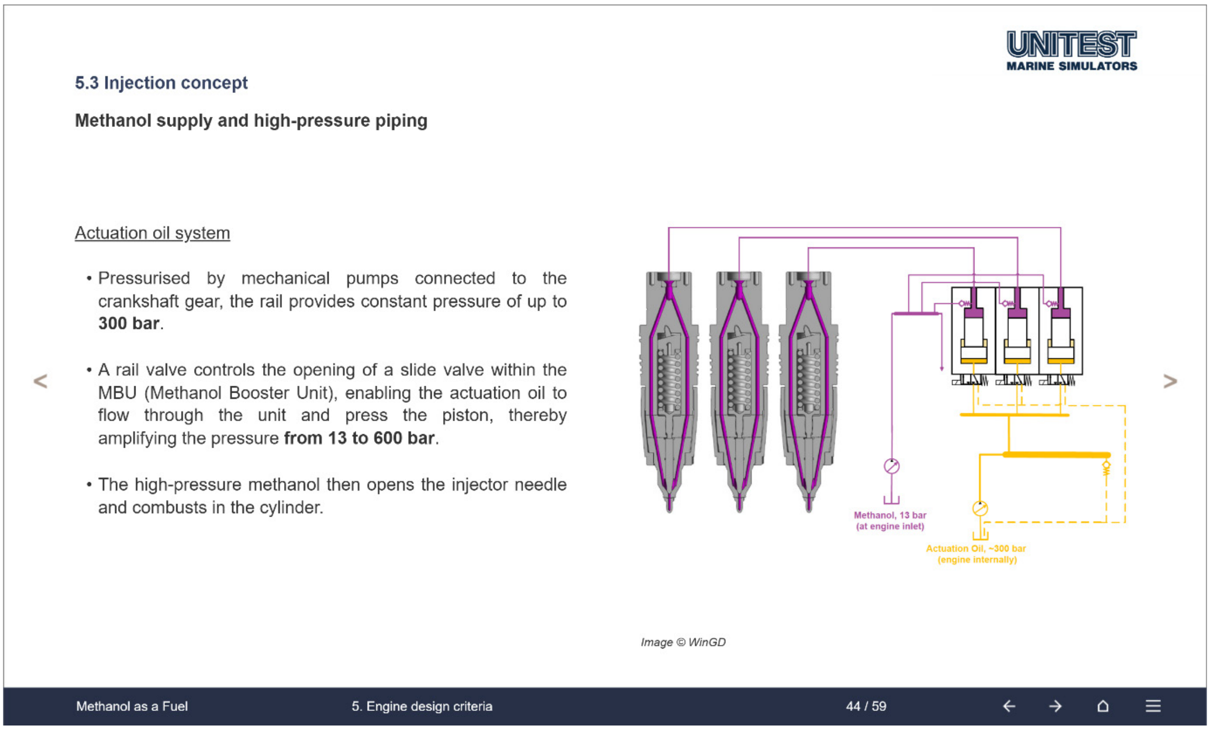
It outlines the essential mechanical layout required on board a ship to safely handle fuel. Key components that are highlighted include the fuel supply system (FSS), fuel valve unit (FVU) engine interface, double-wall piping and the purging water supply system (PWSS), which is used to flush lines safely before maintenance.



The course focuses on the WinGD X-DF-M engine model and explains how dual-fuel engines can seamlessly switch between conventional diesel mode and methanol mode, which uses a 5% pilot fuel ignition.



It provides details of the automated safety fail-safes, known as 'Methanol Trips', and the role of the cylinder-specific Methanol Booster Units (MBUs), which hydraulically amplify the fuel pressure to up to 600 bar to ensure optimal combustion.



Educational objectives:

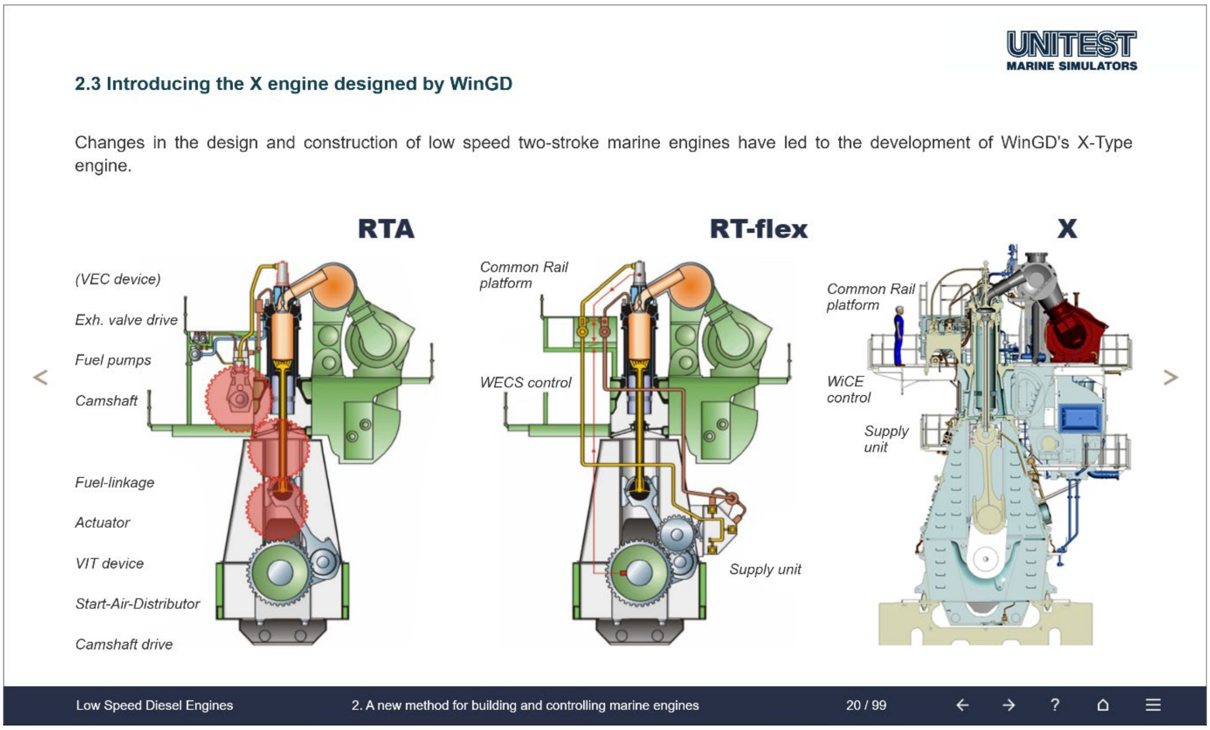
- The material takes a top-down approach to education. First, it covers the global environmental 'why' (e.g. International Maritime Organization (IMO) goals and MARPOL regulations), and then the technical 'how' (e.g. engine design and fuel properties). This helps learners understand the real-world necessity of engineering modifications.
- Safety is not treated as an afterthought, but is woven directly into every technical description. By linking specific chemical hazards (e.g. invisible flames or toxicity) with engineering solutions (e.g. double-walled pipes, AR foam or N_2 padding), the text encourages readers to consider risk management in advance.
- Marine machinery is broken down into sub-systems (bunkering, FSS, FVU and MBU). This helps learners understand individual components and how they interact.
- Diesel engines are used for reference. New technology is presented as an extension of a 'proven diesel design' to facilitate understanding of the dual-fuel systems.
- Procedural, rule-based training provides learners with explicit, actionable parameters (e.g. exposure limits of 200ppm, purging recommendations of 10 minutes, and deck vent heights of 3m). This approach fosters a disciplined compliance mindset, which is paramount in high-risk seafaring environments.

3. Electronically controlled low speed diesel engines

This e-learning module introduces the fundamental concepts, control systems and key components of electronically controlled, low-speed, two-stroke marine diesel engines developed by Winterthur Gas & Diesel (WinGD). It also provides introductory context for the X-92B Marine Engine Room Simulator.

Key themes covered:

- The material discusses how to ensure merchant vessels meet international environmental legislation and maintain high propulsion efficiency and reliability. This includes meeting the Energy Efficiency Design Index (EEDI) and adhering to MARPOL Annex VI NOx and SO_x emission tiers within designated ECAs.
- It outlines the shift from traditional mechanical propulsion (like the Sulzer RTA) to advanced common rail platforms (RT-flex and WinGD X-Type). Key modifications include eliminating the fuel camshaft and introducing electronic control over fuel injection and exhaust valve operations via ICU and VCU.



- The text provides a detailed overview of the WinGD Integrated Control Electronics (WiCE) system, including its interaction with external shipboard networks such as the Propulsion Control System (PCS) and the Alarm and Monitoring System (AMS). It also defines the specific roles of the system's redundant hardware modules, including Cylinder Control Units (CCUs), Main Control Units (MCUs) and Firewalled Gateway Units (GTUs).

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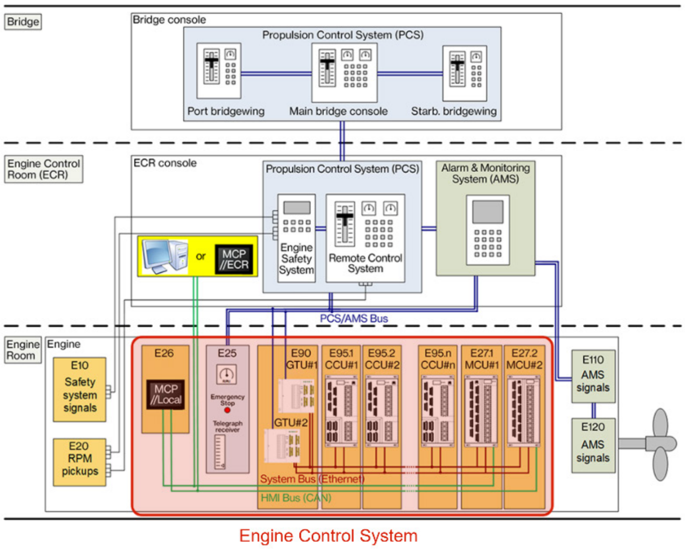
3.3 Engine Control System (ECS) - functional diagram

The diagram shows the functional operation of the ECS system and the associated external control systems.



- Features like Intelligent Combustion Control (ICC) are explained, detailing how the system automatically balances and fires the cylinders to optimize engine load and reduce emissions. The text also covers the WinGD Integrated Digital Expert (WiDE) for continuous diagnostics.

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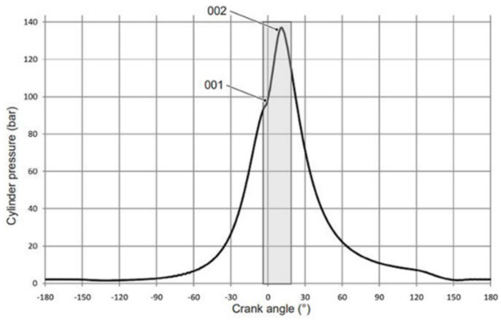
3.8 Engine Control System (ECS) - included functionality

Intelligent Combustion Control (ICC)

A pressure transducer is installed on each cylinder cover to monitor the cylinder pressure. The pressure data from each cylinder is transmitted to the Engine Control System (ECS) as an analogue input signal. The ECS filters these signals from the sensors and sends them to a controller. The measured value is adjusted to match the correct setpoint, which is determined based on engine load. This real-time correction and comparison process is performed for every engine cycle.

The ICC Engine Control System allows the ship's main engine to be optimally controlled to improve efficiency, manage load and reduce emissions. Engineers can also compare specific combustion process parameters with shop test results and perform appropriate engine maintenance.



Legend

001 Pressure at start of ignition (p_i) 002 Maximum firing pressure (p_F)

- The text outlines the physical sub-systems (e.g. fuel and servo oil pumps), high-pressure rail components (including the pressure control valve) and cylinder pressure sensors. Finally, it explains the alphanumeric naming system used to identify engine signals and components.