Advanced Certificate in Tank Storage and Terminal Operations in Oil and Gas (Oman)

Terminal Management Systems

API 650 – Related terms: tank design, code compliance. The American Petroleum Institute standard for the design and construction of welded steel storage tanks. It specifies material selection, welding procedures, testing, and inspection requirements to ensure structural integrity. Example: A 50 000 m^3 crude oil tank built to API 650 must undergo hydrostatic testing before commissioning. Practical application includes using the standard as a baseline for engineering calculations and tender specifications. Challenges arise when local regulations differ, requiring additional documentation or modifications to meet both API 650 and national codes.

API 653 – Related terms: tank inspection, maintenance. The API standard for the inspection, repair, alteration, and reconstruction of above-ground storage tanks. It provides guidelines for routine visual inspection, thickness measurement, and corrosion monitoring. Example: A terminal schedules API 653 inspections every five years, focusing on bottom welds and roof panels. Practical application involves integrating inspection schedules into the Terminal Management System (TMS) to trigger work orders. Challenges include coordinating inspections with operational shutdowns and managing data from non-destructive testing (NDT) reports.

API 660 – Related terms: pressure vessels, over-pressure protection. The API specification for the design and construction of pressure vessels used in oil and gas terminals. It addresses pressure rating, material selection, and safety devices. Example: A vapor recovery unit (VRU) housing a pressure vessel must comply with API 660 to prevent catastrophic failure. In a TMS, pressure vessel data are stored for periodic certification. Challenges include tracking changes in design pressure due to process upgrades and ensuring that software modules reflect the latest code revisions.

API 661 – Related terms: vapor recovery, environmental compliance. The API standard for vapor recovery systems at storage terminals. It outlines requirements for design, installation, testing, and performance monitoring of VRUs. Example: A terminal in Oman implements a VRU to capture hydrocarbon vapors during loading, meeting API 661 standards. The TMS logs VRU operational data, alerts for efficiency drops, and schedules maintenance. Challenges involve handling fluctuating ambient temperatures that affect recovery efficiency and ensuring real-time data integration from multiple sensors.

API 2000 – Related terms: hydrostatic testing, pressure testing. The API recommended practice for tank testing, including hydrostatic, pneumatic, and leak testing methods. It defines test pressures, durations, and acceptance criteria. Example: Before commissioning a new storage tank, a hydrostatic test at 1.5 times the design pressure is performed per API 2000. In TMS, test results are recorded, and the system generates certification documents. Challenges include managing test data for large fleets of tanks and ensuring that test procedures are updated when new technologies (e.g., remote monitoring) are introduced.

API 2023 – Related terms: damage detection, inspection techniques. The API recommended practice for inspection of storage tanks using non-destructive evaluation (NDE) methods. It covers ultrasonic, radiographic, and magnetic particle testing. Example: An ultrasonic thickness gauge is used to detect corrosion under insulation on a terminal's tank bottom. The TMS integrates NDE results, flags areas below minimum thickness, and schedules repairs. Challenges involve standardizing data formats from various NDE equipment and training personnel on interpretation of results.

ASME B31.3 – Related terms: process piping, code compliance. The American Society of Mechanical Engineers code for process piping, governing design, materials, fabrication, examination, and testing of piping systems in oil and gas facilities. Example: A terminal's crude oil transfer line must be designed to ASME B31.3 standards, including stress analysis for thermal expansion. The TMS records pipe line IDs, material grades, and inspection dates. Challenges include reconciling ASME requirements with local Omani standards and maintaining accurate as-built records for future modifications.

ASME B31.4 – Related terms: pipeline design, liquid transport. The ASME code for design of pipelines transporting liquid hydrocarbons, covering material selection, wall thickness, and corrosion control. Example: A 12-inch pipeline connecting a storage tank to a loading berth is designed per ASME B31.4. The TMS tracks the pipeline's cathodic protection status and inspection intervals. Challenges arise from aging pipelines, where the TMS must predict remaining life based on corrosion rate data and schedule replacements without disrupting operations.

ASME B31.8 – Related terms: gas pipelines, high-pressure systems. The ASME code for design and construction of gas transmission and distribution piping systems. Example: A terminal's LPG loading line operates at 150 bar and must comply with ASME B31.8. The TMS includes pressure monitoring, leak detection, and emergency shutdown functionalities. Challenges include integrating gas-specific safety interlocks and ensuring that the TMS can handle rapid pressure fluctuations during loading cycles.

Barrel (bbl) – Related terms: volume unit, oil measurement. A standard unit of volume for crude oil and petroleum products, equal to 42 U.S. gallons (≈ 159 liters). Example: A terminal's daily throughput is reported as 120 000 bbl. The TMS converts barrel measurements to cubic meters for inventory reconciliation. Challenges involve handling different barrel definitions (e.g., oil barrel vs. beer barrel) and ensuring consistent conversion factors across modules.

Bulk Terminal – Related terms: storage facility, commodity handling. A facility designed to receive, store, and dispatch bulk liquid hydrocarbons such as crude oil, refined products, or LPG. Example: The Sohar Bulk Terminal in Oman can accommodate 2 million bbl of crude. The TMS manages berth allocation, inventory control, and loading schedules. Challenges include coordinating multiple product streams, preventing cross-contamination, and optimizing turnaround time while adhering to safety and environmental regulations.

Cathodic Protection (CP) – Related terms: corrosion control, electrochemical protection. A technique to mitigate corrosion of metal structures by applying a sacrificial anode or impressed current system. Example: A terminal's underground storage tank (UST) is protected by a CP system monitored through the TMS. The system records CP potentials, alerts when values fall outside acceptable ranges, and schedules anode replacement. Challenges involve maintaining CP effectiveness in high-salinity environments and integrating CP data from remote sensors into the central database.

Coastal Storage Terminal – Related terms: marine interface, environmental exposure. A storage facility located near or on a coastline, often requiring additional safeguards against wave action, salt spray, and storm surge. Example: The Duqm terminal incorporates seawall reinforcement and corrosion-resistant coatings. The TMS includes weather monitoring, tide predictions, and emergency response plans. Challenges include predicting extreme weather events, managing sea-water intrusion into tanks, and ensuring continuity of operations during coastal emergencies.

Crude Oil Blend – Related terms: product specification, mixing strategy. The process of combining different crude grades to achieve a desired quality or price point. Example: A terminal blends light Arabian Medium with heavy Arabian Heavy to meet a refinery's API gravity target. The TMS tracks each grade's inventory, blending ratios, and resulting specifications. Challenges involve real-time quality analysis, maintaining accurate blend records for regulatory reporting, and preventing inadvertent contamination.

Daily Tank Balancing (DTB) – Related terms: inventory reconciliation, mass balance. A routine procedure to compare measured tank levels with recorded transactions to identify discrepancies. Example: The TMS automatically generates DTB reports, highlighting tanks with variance exceeding 0.5 %. Practical application includes investigating causes such as temperature-induced volume changes or unrecorded transfers. Challenges include accounting for vapor losses, temperature gradients, and ensuring measurement accuracy of level sensors.

Dead-Freight – Related terms: unloaded vessel, berthing cost. The cost incurred when a ship occupies a berth without cargo, often due to delays or scheduling mismatches. Example: A vessel awaiting discharge at a terminal may incur dead-freight charges if loading windows are missed. The TMS can forecast berth availability, reduce idle time, and calculate potential dead-freight penalties. Challenges involve aligning ship arrival estimates with terminal capacity and handling unforeseen disruptions such as weather or labor strikes.

Discharge Rate – Related terms: flow control, pump capacity. The speed at which liquid hydrocarbons are transferred from a storage tank to a vessel, typically expressed in barrels per minute (bbl/min) or cubic meters per hour (m^3/h). Example: A loading arm equipped with a 5 000 bbl/min pump must meet a chartered vessel's loading window. The TMS monitors discharge rates, adjusts pump settings, and ensures compliance with contractual specifications. Challenges include managing pump wear, avoiding cavitation, and maintaining consistent flow despite viscosity variations.

Dynamic Positioning (DP) – Related terms: vessel maneuvering, off-loading. A computer-controlled system that automatically maintains a vessel's position and heading using thrusters, crucial for offshore loading operations. Example: An FPSO off-loads crude to a floating hose using DP to keep station-keeping within a 10-meter radius. The TMS integrates DP status to synchronize loading sequences and trigger safety interlocks. Challenges involve handling DP system failures, ensuring redundancy, and accounting for sea state impacts on loading rates.

Environmental Impact Assessment (EIA) – Related terms: regulatory compliance, sustainability study. A systematic process to evaluate the potential environmental effects of a terminal's construction or operation. Example: Before expanding storage capacity, a terminal conducts an EIA to assess impacts on marine life, air quality, and groundwater. The TMS stores baseline data, monitors ongoing emissions, and generates reports for regulatory authorities. Challenges include gathering accurate baseline data, addressing stakeholder concerns, and adapting operational practices to meet mitigation commitments.

Flow Assurance – Related terms: pipeline integrity, hydrocarbon transport. The practice of ensuring that hydrocarbons flow smoothly from source to destination without blockages, hydrate formation, or wax deposition. Example: A terminal's export line utilizes chemical injection, heating, and insulation to maintain flow assurance for heavy crude. The TMS tracks inhibitor dosing, temperature profiles, and pressure drops. Challenges involve predicting wax deposition rates, managing inhibitor inventory, and responding to unexpected temperature drops that could trigger flow interruptions.

Gasoline Blendstock – Related terms: refined product, octane rating. A component of gasoline produced by blending various refinery streams to achieve desired performance characteristics. Example: A terminal stores blendstock A (high-octane) and blendstock B (low-octane) to formulate final gasoline blends for local distributors. The TMS records each blendstock's inventory, octane contribution, and blending ratios. Challenges include maintaining accurate octane calculations, preventing cross-contamination, and complying with fuel quality standards.

General Storage Tank (GST) – Related terms: above-ground tank, capacity. A term used for standard above-ground steel tanks that store liquid hydrocarbons, as opposed to specialized tanks like LNG or LPG vessels. Example: A 100 000 bbl GST built to API 650 holds diesel fuel. The TMS monitors level, temperature, and product density to calculate inventory. Challenges involve managing corrosion in the tank shell, ensuring proper ventilation, and integrating tank data with loading/unloading operations.

Geotechnical Survey – Related terms: soil investigation, foundation design. An assessment of subsurface conditions to determine bearing capacity, settlement, and seismic considerations for terminal infrastructure. Example: Before constructing a new tank farm, a geotechnical survey identifies a soft clay layer requiring pile foundations. The TMS stores survey results, links them to design modules, and flags any changes that may affect structural integrity. Challenges include updating geotechnical data when ground conditions change due to nearby construction or natural events.

Gross Tank Capacity – Related terms: storage volume, design capacity. The total internal volume of a storage tank, measured at a specified temperature, before accounting for unusable space such as ullage or freeboard. Example: A 200 000 bbl tank has a gross capacity of 220 000 bbl at 15 °C, but operational capacity is limited to 200 000 bbl to maintain safety margins. The TMS calculates usable volume based on temperature corrections and product density. Challenges include handling thermal expansion, ensuring accurate calibration of level sensors, and preventing over-filling.

H2S Monitoring – Related terms: sulphur detection, hazardous gases. Continuous measurement of hydrogen sulfide concentrations in tank atmospheres, pipelines, and vent stacks due to its toxic and corrosive nature. Example: A terminal employs fixed H2S detectors linked to the TMS, which triggers alarms and initiates evacuation procedures if concentrations exceed 10 ppm. Practical application includes automatic venting and crew training. Challenges involve sensor drift, maintenance in high-humidity environments, and integrating alarm thresholds with international safety standards.

Heat-Integrated Loading (HIL) – Related terms: energy recovery, process optimisation. A technique that recovers heat from product discharge to pre-heat incoming cargo, reducing energy consumption. Example: During crude oil off-load, the warm product exiting the tank transfers heat to the incoming product via a heat exchanger, managed by the TMS. Benefits include lower pump power and reduced emissions. Challenges include designing exchangers that handle variable flow rates, preventing product contamination, and controlling temperature differentials to avoid thermal stress on equipment.

Inert Gas System (IGS) – Related terms: safety blanket, tank purging. A system that supplies inert gas (usually nitrogen) to storage tanks to reduce oxygen concentration, preventing fire or explosion hazards. Example: A terminal uses an IGS to maintain tank headspace oxygen below 5 % during loading of volatile liquids. The TMS monitors inert gas flow, pressure, and oxygen levels, issuing alerts if parameters deviate. Challenges include ensuring adequate gas supply during power outages, managing nitrogen generation costs, and integrating IGS data with tank pressure control loops.

Jacketed Tank – Related terms: thermal control, heat exchange. A storage tank equipped with an external jacket through which a heating or cooling medium circulates to regulate product temperature. Example: A 150 000 bbl jacketed tank stores heavy crude that requires heating to 60 °C for efficient off-loading. The TMS controls jacket flow, temperature set points, and monitors energy consumption. Challenges involve balancing heating demand with fuel costs, preventing thermal stratification, and maintaining jacket integrity against corrosion.

Key Performance Indicator (KPI) – Related terms: performance metric, benchmarking. Quantitative measures used to evaluate the efficiency, safety, and profitability of terminal operations. Example: Loading turnaround time, inventory accuracy, and incident frequency are KPIs tracked in the TMS dashboard. Practical application includes setting targets, generating trend analysis, and rewarding high-performing crews. Challenges include selecting relevant KPIs, ensuring data quality, and avoiding metric overload that can obscure critical insights.

Liquid Cargo Transfer (LCT) – Related terms: off-loading, loading operations. The movement of liquid hydrocarbons between storage tanks and vessels using pipelines, hoses, or loading arms. Example: An LCT operation may involve a 12 inch loading arm delivering 4 000 bbl/min of diesel to a tanker. The TMS coordinates pump start-up, flow monitoring, and safety interlocks. Challenges include managing hose wear, preventing spillage, and synchronizing multiple simultaneous transfers while adhering to contractual load windows.

Load-On-Board (LOB) System – Related terms: vessel monitoring, cargo accounting. A technology that measures cargo mass on a vessel in real time using strain gauges or draft sensors, providing accurate loading data. Example: A terminal integrates LOB data with its TMS to verify that the amount loaded matches the quantity pumped from the tank. Practical application reduces disputes and improves inventory reconciliation. Challenges involve calibrating sensors for different vessel designs, accounting for ballast water, and ensuring data transmission reliability in harsh marine environments.

Load-Port – Related terms: berth facility, discharge point. The physical location on a terminal where a vessel is moored for cargo loading or unloading. Example: The Sohar terminal has three load-ports equipped with dual-arm loading systems. The TMS schedules berth allocation, tracks berth occupancy, and optimizes load-port utilization to minimize vessel waiting time. Challenges include coordinating multiple vessels with varying draft requirements, handling adverse weather conditions, and maintaining equipment availability.

Logistics Management System (LMS) – Related terms: supply chain, inventory control. Software that oversees the movement of goods, equipment, and personnel within and around the terminal. Example: The LMS interfaces with the TMS to plan the delivery of cleaning chemicals, spare parts, and crew rotations. It generates work orders, tracks asset location, and ensures compliance with Omani customs regulations. Challenges include integrating disparate data sources, handling real-time updates, and maintaining cybersecurity across interconnected platforms.

Lubrication Oil (LO) Management – Related terms: equipment maintenance, oil analysis. The process of storing, dispensing, and tracking lubricating oils used in pumps, compressors, and gearboxes. Example: A terminal maintains a dedicated LO inventory, with the TMS logging each draw, batch number, and analysis results. Practical application includes predictive maintenance based on oil condition monitoring. Challenges revolve around contamination control, ensuring proper oil grades for different equipment, and preventing stockouts that could lead to equipment failure.

Marine Loading Arm (MLA) – Related terms: off-loading equipment, articulated arm. A hinged device mounted on a terminal's load-port that transfers liquid cargo between storage tanks and vessels. Example: An MLA with a 12 meter reach can service vessels up to 30 meter beam. The TMS monitors arm position, flow rate, and interlock status to prevent over-pressurization. Challenges include managing mechanical fatigue, aligning the arm with varying vessel heights, and ensuring emergency release mechanisms function under all conditions.

Mass Balance – Related terms: inventory reconciliation, conservation of mass. The principle that the total mass entering a system must equal the mass leaving plus any accumulation. Example: A terminal calculates mass balance by accounting for inbound deliveries, outbound shipments, and inventory changes recorded in the TMS. Practical application helps detect leaks, measurement errors, or unrecorded transfers. Challenges involve correcting for temperature-induced volume changes, vapor losses, and ensuring high-precision measurement devices.

Metering System – Related terms: flow measurement, accuracy. Devices such as turbine, Coriolis, or ultrasonic meters that quantify the volume or mass of liquid hydrocarbons transferred. Example: A Coriolis meter installed on a loading line provides mass flow data directly to the TMS, improving billing accuracy. Challenges include maintaining meter calibration, handling high-viscosity fluids, and mitigating fouling that can affect measurement integrity.

Minimum Operating Pressure (MOP) – Related terms: system safety, pump performance. The lowest pressure at which equipment can operate safely without cavitation, vapor formation, or loss of control. Example: A terminal's pump set has an MOP of 2 bar; operating below this triggers an alarm in the TMS. Practical application ensures pumps are not starved during low-load conditions. Challenges arise when product density changes, requiring dynamic adjustment of MOP thresholds within the TMS.

Mobile Offshore Production Unit (MOPU) – Related terms: floating facility, production platform. A vessel equipped to process and store hydrocarbons offshore, often connected to shore via pipelines or shuttle tankers. Example: A MOPU off-loads stabilized crude to a shore-based terminal using a flexible hose. The TMS tracks receipt volumes, quality parameters, and scheduling. Challenges include handling vessel motion, ensuring hose integrity, and coordinating with on-shore safety procedures.

Modular Terminal Design – Related terms: scalable infrastructure, prefabricated units. An approach where terminal components such as tanks, loading arms, and control rooms are built as interchangeable modules. Example: A terminal expands capacity by adding a pre-engineered tank module, reducing construction time. The TMS automatically incorporates new module data, updates inventory capacity, and revises operating procedures. Challenges involve standardizing interfaces, ensuring compatibility with existing systems, and managing regulatory approvals for each added module.

Molten Sulphur Handling – Related terms: high-temperature processing, corrosion management. Procedures for storing and transferring sulphur in its liquid state, typically above 115 °C. Example: A terminal receives molten sulphur via insulated pipelines, storing it in heated tanks equipped with temperature control. The TMS monitors tank temperature, level, and safety interlocks to prevent solidification. Challenges include maintaining uniform temperature, preventing sulphur oxidation, and handling the aggressive corrosive environment on equipment surfaces.

Multi-Product Terminal (MPT) – Related terms: product segregation, cross-contamination. A facility that simultaneously stores and handles several petroleum products, each requiring dedicated tank farms or separation equipment. Example: An MPT may store diesel, aviation kerosene, and LPG, using dedicated loading arms for each. The TMS tracks product-specific inventories, schedules transfers, and enforces segregation rules. Challenges include preventing product mixing, managing different safety distances, and coordinating loading sequences to avoid bottlenecks.

Net Capacity – Related terms: usable volume, operational limit. The portion of a tank's total volume that can be safely utilized for product storage after accounting for ullage, freeboard, and safety margins. Example: A 250 000 bbl tank may have a net capacity of 230 000 bbl, reserving 20 000 bbl for vapor space and safety. The TMS calculates net capacity based on temperature, product density, and regulatory limits. Challenges involve dynamic adjustments for temperature variations and ensuring that over-filling alarms trigger before reaching net capacity.

Non-Destructive Testing (NDT) – Related terms: inspection technique, integrity assessment. Methods such as ultrasonic testing, radiography, and magnetic particle inspection used to evaluate material condition without causing damage. Example: Ultrasonic thickness measurements on a tank shell reveal 2 mm of remaining corrosion allowance. The TMS records NDT results, flags critical areas, and schedules repairs. Challenges include standardizing reporting formats, training inspectors, and integrating NDT data with asset management modules.

Off-loading – Related terms: cargo discharge, transfer operation. The process of removing liquid hydrocarbons from a vessel and storing them in terminal tanks. Example: A VLCC off-loads 2 million bbl of crude over 48 hours using multiple loading arms. The TMS coordinates pump sequencing, flow monitoring, and safety interlocks. Challenges involve managing high flow rates, preventing spillage, and aligning off-loading schedules with berth availability.

On-shore Storage Facility (OSF) – Related terms: land-based terminal, fixed infrastructure. A terminal located on land, typically comprising tank farms, pipelines, and loading equipment. Example: The Salalah OSF handles both imports and exports of refined products. The TMS integrates inventory, pipeline monitoring, and loading operations for the OSF. Challenges include land acquisition constraints, environmental permitting, and ensuring resilience against seismic activity.

Operational Excellence (OpEx) – Related terms: process improvement, continuous improvement. A management philosophy focused on maximizing efficiency, safety, and reliability while minimizing waste. Example: A terminal implements OpEx initiatives such as lean workflow redesign for loading cycles, monitored through the TMS performance dashboards. Practical application includes root-cause analysis of incidents and systematic implementation of corrective actions. Challenges include cultural resistance, aligning cross-functional teams, and maintaining momentum over long-term projects.

Optimisation Algorithm – Related terms: mathematical model, schedule planning. A computational method used to determine the most efficient allocation of resources such as berths, pumps, and personnel. Example: The TMS employs a linear programming optimiser to minimize vessel turnaround time while respecting safety constraints. Practical application reduces idle time and fuel consumption. Challenges include data accuracy, handling stochastic events (e.g., weather), and ensuring the algorithm’s outputs are interpretable by operators.

Orifice Plate Meter – Related terms: flow measurement, pressure differential. A simple flow meter that measures the pressure drop across a calibrated plate to infer flow rate. Example: An orifice plate installed on a low-pressure LPG line provides flow data to the TMS for billing purposes. Challenges include pressure loss, fouling, and the need for frequent recalibration to maintain accuracy.

Over-fill Alarm – Related terms: safety interlock, level monitoring. A warning system that activates when a tank’s liquid level exceeds a predefined threshold, preventing spills and structural overload. Example: The TMS triggers an audible and visual alarm when a tank reaches 98 % of its net capacity, automatically shutting off pumps. Practical application enhances safety and protects product. Challenges involve sensor drift, false alarms due to temperature expansion, and ensuring rapid operator response.

Pipeline Integrity Management (PIM) – Related terms: risk assessment, corrosion monitoring. A systematic approach to ensure the safe operation of pipelines throughout their lifecycle, including inspection, risk analysis, and corrective actions. Example: A terminal’s export pipeline undergoes inline inspection (ILI) every five years, with results fed into the TMS to update risk matrices. Practical application prioritizes maintenance based on defect severity. Challenges include scheduling inspections without disrupting flow, interpreting ILI data, and complying with both international standards and Omani regulations.

Process Safety Management (PSM) – Related terms: hazard analysis, risk mitigation. A regulatory framework that requires identification, evaluation, and control of hazards associated with highly hazardous processes. Example: The terminal conducts a Process Hazard Analysis (PHA) for its crude off-loading system, documenting findings in the TMS. Practical application includes tracking corrective actions and verifying compliance during audits. Challenges involve maintaining up-to-date documentation, integrating PSM with day-to-day operations, and fostering a safety culture.

Product Density – Related terms: specific gravity, mass-volume conversion. The mass per unit volume of a liquid hydrocarbon, typically expressed in kg/m^3 or API gravity. Example: Diesel with a density of 820 kg/m^3 at 15 °C is stored in a terminal; the TMS uses this value to convert volume readings to mass for accounting. Practical application improves inventory accuracy. Challenges include temperature correction, handling blended products with variable densities, and ensuring sensor calibration.

Product Segregation – Related terms: tank allocation, contamination control. The practice of keeping different petroleum products physically separated to prevent mixing. Example: A terminal assigns dedicated tanks for gasoline and jet fuel, with dedicated loading arms to maintain segregation. The TMS enforces segregation rules, flags any cross-contamination, and generates cleaning work orders. Challenges include managing limited tank space, handling product swaps, and ensuring cleaning effectiveness after each transfer.

Quality Assurance (QA) – Related terms: quality control, standard compliance. Systematic activities that ensure products and processes meet defined specifications and regulatory requirements. Example: QA sampling of diesel at the terminal verifies compliance with ASTM D975; results are logged in the TMS. Practical application supports customer confidence and regulatory reporting. Challenges involve timely sampling, maintaining chain-of-custody, and integrating QA data with operational dashboards.

Quench System – Related terms: fire suppression, emergency cooling. A system that rapidly cools a fire or hot surface using water or foam to prevent escalation. Example: A fire on a loading arm activates a quench spray, controlled by the TMS safety module. Practical application reduces fire damage and protects personnel. Challenges include ensuring adequate water supply, preventing water damage to electrical equipment, and coordinating quench activation with other emergency systems.

Racking System – Related terms: storage layout, space optimisation. The arrangement of multiple storage tanks or containers in a systematic pattern to maximise land use and facilitate access. Example: A terminal employs a double-row racking layout for 30 m diameter tanks, allowing efficient pipe routing. The TMS incorporates racking maps for asset location tracking. Challenges involve accommodating future expansion, ensuring safe clearances, and integrating racking data with GIS for navigation.

Refrigerated Loading Arm (RLA) – Related terms: cryogenic transfer, LPG handling. A loading arm equipped with insulation and cooling systems to handle low-temperature liquids such as LPG or LNG. Example: An RLA maintains product temperature at –42 °C during LPG loading, with temperature sensors feeding data to the TMS. Practical application prevents product boil-off and maintains safety. Challenges include insulation degradation, managing thermal stresses, and ensuring the TMS can handle rapid temperature data streams.

Regasification Facility – Related terms: LNG terminal, vaporisation. Equipment that converts liquefied natural gas (LNG) back to gaseous form for distribution. Example: A regasification unit vaporises 5 million Nm^3/day of LNG, with flow rates monitored by the TMS. Practical application includes managing boil-off gas, controlling vaporisation temperature, and synchronising with pipeline dispatch. Challenges involve high-energy consumption, maintaining cryogenic safety, and integrating real-time data for demand-driven operation.

Remote Monitoring Unit (RMU) – Related terms: telemetry, SCADA integration. A device that collects and transmits operational data from field equipment to a central control system. Example: An RMU on a loading arm sends pressure, temperature, and valve status to the TMS via wireless link. Practical application enables off-site supervision and rapid fault detection. Challenges include ensuring communication reliability in harsh marine environments, cybersecurity protection, and managing data latency.

Risk-Based Inspection (RBI) – Related terms: inspection planning, probabilistic assessment. An approach that prioritises inspection activities based on the probability and consequence of failure. Example: A terminal uses RBI to schedule ultrasonic inspections on high-stress tank shells more frequently than low-risk ancillary piping. The TMS contains RBI matrices, generating inspection work orders aligned with risk scores. Challenges include acquiring accurate failure data, updating risk models as operating conditions change, and balancing inspection cost against risk reduction.

Safety Instrumented System (SIS) – Related terms: functional safety, IEC 61511. A control system that monitors process parameters and automatically initiates safe shutdown actions when unsafe conditions are detected. Example: An SIS monitors tank pressure; if pressure exceeds the set point, it triggers valve closure and initiates venting. The TMS logs SIS events for audit. Challenges include maintaining SIS integrity, periodic functional testing, and ensuring that SIS logic aligns with process changes.

SCADA (Supervisory Control and Data Acquisition) – Related terms: process control, real-time monitoring. A software platform that collects data from sensors and devices, allowing operators to monitor and control terminal processes. Example: The terminal's SCADA system displays tank levels, pump status, and alarm conditions on a graphical interface, integrated with the TMS for reporting. Practical application improves situational awareness and decision making. Challenges involve data integration from legacy equipment, cyber-security threats, and ensuring system redundancy.

Seawater Ingress – Related terms: contamination, corrosion. The unwanted entry of seawater into product lines or storage tanks, typically caused by hose damage or valve failure. Example: A terminal detects seawater contamination in a diesel line via conductivity sensors, prompting an alarm in the TMS. Practical response includes isolating the affected line, draining, and cleaning. Challenges include rapid detection, preventing product loss, and managing environmental disposal of contaminated water.

Shore Power (Cold Ironing) – Related terms: energy efficiency, emission reduction. Supplying electricity from the shore to a moored vessel, allowing the vessel to shut down its auxiliary diesel generators. Example: A terminal provides 11 kV shore power to a tanker, reducing onboard emissions. The TMS monitors power usage, synchronises with vessel schedules, and records fuel savings. Challenges involve compatibility of vessel electrical systems, ensuring power quality, and coordinating with national grid regulations.

Side-Stream Injection (SSI) – Related terms: chemical dosing, flow modification. The introduction of chemicals (e.g., corrosion inhibitors, demulsifiers) into a flowing stream via a side-stream line. Example: An

SSI system injects a corrosion inhibitor into the crude export line, with dosing rates logged in the TMS. Practical application maintains pipeline integrity and extends service life. Challenges include accurate flow measurement for dosing calculations, preventing injector fouling, and integrating SSI control with overall process control.

Single-Point Mooring (SPM) – Related terms: off-loading buoy, anchored system. A floating mooring system that allows a vessel to load or unload without docking at a fixed berth. Example: An SPM located 2 km offshore handles LPG loading for VLCCs. The TMS tracks SPM position, hose tension, and flow rates. Practical benefits include reduced shoreline footprint and flexibility for large vessels. Challenges involve weather-related motion, hose fatigue, and ensuring reliable communication between SPM sensors and on-shore control.

Spill Containment Barrier – Related terms: environmental protection, oil spill response. Physical structures designed to prevent the spread of spilled liquids, such as berms or floating booms. Example: