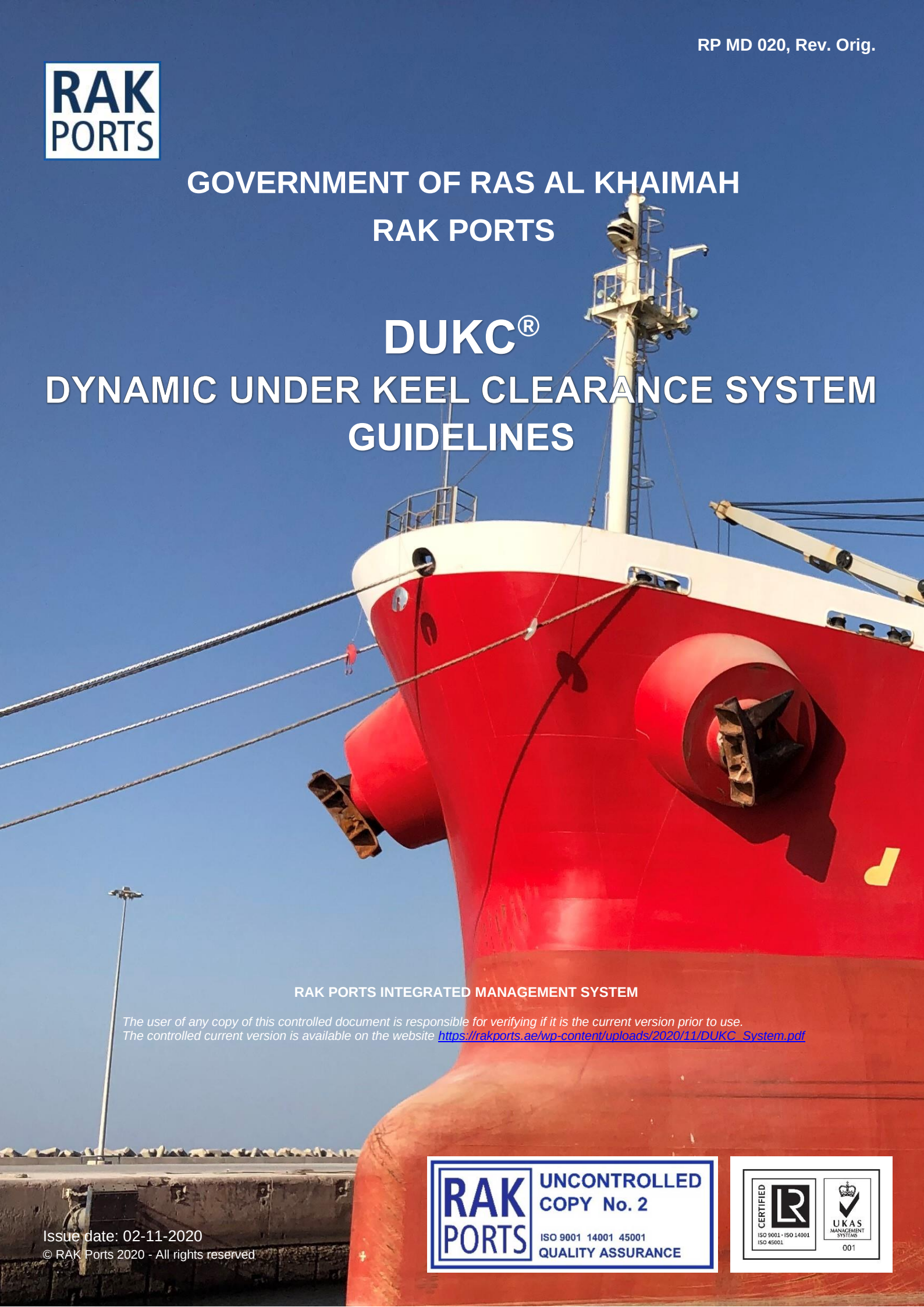
GOVERNMENT OF RAS AL KHAIMAH
RAK PORTS

DUKC®
DYNAMIC UNDER KEEL CLEARANCE SYSTEM
GUIDELINES



RAK PORTS INTEGRATED MANAGEMENT SYSTEM

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CERTIFIED ISO 9001 • ISO 14001 ISO 45001 — UKAS MANAGEMENT SYSTEMS 001

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GENERAL INTRODUCTION

The Dynamic Under Keel Clearance (DUKC®) System was introduced in RAK Ports to provide benefits to the shippers, ship owners and charterers through safely maximising the sailing drafts and tidal windows. The DUKC System is a consistent and scientific approach to shipping under keel clearance management. It integrates real-time measurement of tide height and waves with modelled vessel motions in order to determine if a proposed transit for a particular vessel meets pre-determined under keel clearance safety criteria. The system uses specially formulated algorithms to analyse a range of inputs in order to provide a report as to the status of the proposed transit.

This guideline aims to provide basic information regarding DUKC System; it also describes the procedure for the optimal utilisation of the system at RAK Ports, to ensure safe navigation.

SCOPE

The DUKC® has been operational at RAK Ports since January 2020 and is applicable to pilots and all vessels utilising the system at the following ports/terminals:

- **Saqr Port Inner Harbour**
- **Saqr Port Deep-Water Bulk Terminal**
- **RAK Maritime City FZA**

Masters of vessels calling at above ports and utilising the DUKC System are required to provide accurate stability and draft data to Port Control in a timely manner. The DUKC System uses this data to provide the best possible under keel clearance information, updated in real time and assist in the planning and safe conduct of vessel transits.

DISCLAIMER

The details in this procedure are correct at the time of publication but may be subject to variation. The procedure has been produced in good faith, but we cannot guarantee the accuracy and/or completeness of the information which is produced for guidance purpose only and should not be regarded as a comprehensive coverage or a substitute for appropriate use of the DUKC System.

CONTACT INFORMATION

Group Office:

Saqr Port

Telephone: +971 (0)7 205 6000

E-mail: info@rakports.ae

PO Box 5130, Ras Al Khaimah, U.A.E

Harbour Master's Office

The Harbour Master's Office is located in the Marine department at Saqr Port, and co-ordinates the statutory compliance for navigational safety across all RAK Ports. All operational marine matters are dealt with by respective ports.

For general enquiries, please call on: +971 (07)7 205 6164.

Port Control should be contacted for all urgent matters pertaining to marine operations:

- Saqr Port (Control Tower): VHF Ch.16/14 - Tel.: +971 (0)7 205 61 61 – Email: spatower@rakports.ae
- RMC/Stevin Rock (Control Tower): VHF Ch.16/69 - Tel.: +971 (0)7 205 61 62 – Email: rmctower@rakports.ae
- Ras Al Khaimah Port (Control Tower): VHF Ch.16/71 - Tel.: +971 (0)7 202 98 07 – Email: khrtower@rakports.ae
- Al Jazeera Port (Control Tower): VHF Ch.16/68 - Tel.: +971 (0)7 244 66 27– Email: ajzpt@rakports.ae
- Al Jeer Port – Contact Control Tower at Saqr Port & Al Jeer Port Office at: Tel.: +971 (0)7 268 23 33

WEBSITE OF THE PORT
https://rakports.ae

WEBSITE OF THIS DOCUMENT
https://rakports.ae/wp-content/uploads/2020/11/DUKC_System.pdf

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Distribution

The 'Dynamic Under Keel Clearance (DUKC®) System' for RAK Ports will be distributed as follows:

One copy will be posted on the company website and the following will be notified when there are any changes or amendments:

1. Harbour Master
2. Deputy Harbour Master
3. All Ports' Managers
4. Pilots, Tug Masters and Port Controllers
5. Port/Marine Section Supervisors
6. Chief Executive Officer
7. HSEQ Manager

One PDF copy shall be filed in the Integrated Management System as an internal document.

Amendments

Proposed amendments are to be sent to the document owner, Harbour Master, who will maintain a record of changes in accordance with the Control of documents and records Procedure.

Documents and records

The definition of documents and records is defined below:

- **Documents:** Documents may be in any form or type of medium such as paper, magnetic, electronic, photos and templates. They are designed to capture information on activities or results.
- **Records:** Records provide evidence that activities have been performed or results have been achieved. They always record the past.

Reference documents

Document Title
International Safety Management Code (ISM)
The UK Port Marine Safety Code (PMSC)
Guide to Good Practice on Port Marine Operations
RAK Ports Marine Safety Management System (MSMS)
OMC International
SOLAS & MARPOL Conventions
RAK Ports Regulations

DEFINTIONS & ACRONYMS

AIS: Automatic Identification System.

Bottom Clearance – BC: The depth of water remaining between ship keel and seabed after subtracting allowances for static draft, Tidal Residual, squat, heel, wave response and safety factors from UKC Gross.

Displacement: Water displaced in tonnes by the vessel hull at the draft at which KG and GMf are provided for wave response modeling.

Draft: Draft is the distance from the waterline to the bottom of the ship's keel.

DUKC: Dynamic Under-Keel Clearance (DUKC) is a method of using multiple prediction and real time factors to determine the draft limitations on ships.

DUKC®: DUKC® is the trademarked product of OMC International to determine dynamic under keel clearances.

DWBT: Saqr Port's Deep-Water Bulk Terminal.

GMf: The distance from the vessel center of gravity (G) to the Transverse Metacentre (M), measured in metres. The period and amplitude of vessel roll in a particular wave environment will be affected by this value. The "f" refers to a correction for free surface. That is, a correction to the GM value to allow for the movement of uncontained fluid as the vessel rolls which will affect the roll period and amplitude.

Heave: Heaving is upward and downward force (acceleration) applied along the ship's vertical axis. This motion always occurs when there is wave action.

Heel: The effect of a ship leaning towards one side, caused by the centripetal force of turning, or the force of wind on the side of the ship.

Hogging: Hogging is the stress a ship's hull or keel experiences that causes the centre or the keel to bend upward.

Hydrographic Survey: "Hydrographic Survey" means surveying coastlines, harbours and of the seabed to determine of sea bed depth by sounding to ensure navigational safety and production of bathymetric and nautical charts.

IMO Regulations: "IMO Regulations" means various shipping regulations, international conventions issued by the International Maritime Organisation (IMO).

Incident: An uncontrolled or unplanned event, or sequence of events that may result in damage, or threat, to the safety of personnel, the vessel, the environment, or property.

ISM Procedures: International Safety Management (ISM) Code provides international standards for the safe management and operation of ships and for pollution prevention.

KG: Vertical distance from the keel to vessel center of gravity in metres.

Manoeuvrability Margin-MM: Describes the depth of water available for the ship to manoeuvre without the assistance of tugs. The depth of water remaining between ship keel and seabed after subtracting allowances for static draft, tidal level

prediction error, squat and safety factors from UKC Gross. Wave response allowances are not a factor in determining MM.

Marine Emergency Response Plan: "Marine Emergency Response Plan" means the contingency plan that details the manner in which any marine emergency or critical incident under RAK Ports are to be managed.

Pitch: Pitching is ship motion where the bow is lifted and stern lowered, and vice-versa. Pitching angles vary with the length of vessel.

Port Control: "Port Control (PC)" means a 'vessel traffic control centre' for shipping in the port limits and the surrounding waterways.

Rolling: Motion of the vessel from side to side, alternately raising and lowering each side of the deck.

Sagging: Sagging is the stress a ship's hull or keel is placed under when a wave is the same length as the ship and the ship is in the trough of two waves.

Squat: A combination of bodily sinkage and change in trim of the vessel while sailing. Primarily affected by vessel speed through the water, and the ratio of ship cross-sectional area to that of the channel in which it is sailing. See https://en.wikipedia.org/wiki/Squat_effect

Swell: Water motions not described as sea waves, usually of longer period than sea waves. Primarily generated by wind forces outside the local area.

Tidal Window: A Tidal Window is a period of time during which a vessel can set sail and safely complete the desired transit in the expected wave climate. It is called a Tidal Window because the opening and closing of windows are usually associated with changing tide heights.

UKC: The Under-Keel Clearance, or UKC, is the vertical distance between the lowest part of the ship's hull and the seabed. UKC ensures a ship's keel is kept clear of the seabed and minimises the chance of the vessel grounding.

Wave Response: The motion resulting from the action of waves on the ship. Only the vertical component of this motion affects under-keel clearance.

Weather Forecast: "Weather Forecast" means prevailing and future weather conditions, and the wind is driving force of sea state, as wind generates local wind waves and long ocean swells. The Weather Forecast promulgated by RAK Ports includes local sunrise and sunset timings, synoptic situations, warning, visibility, dust risk, winds speed and directions and sea swell conditions.

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SECTION ONE

INTRODUCTION

OVERVIEW

RAK Ports has implemented Dynamic Under Keel Clearance (DUKC®) System as both a risk-mitigation tool and a way of allowing vessels to arrive/depart with a deeper deep-draft thereby facilitating increased cargo throughput.

The System became live on 1st January 2020, with the successful installation of DUKC® programme in the Control Tower at Saqr Port and considered to be consistent and compatible and used currently for the following ports and terminals at RAK Ports:

- Saqr Port Inner Harbour
- Saqr Port Deep-Water Bulk Terminal
- RAK Maritime City FZA

PURPOSE OF DUKC SYSTEM

The purpose of a DUKC System is to provide an aid in the safe transit of vessels to and from port. The System is used to accurately predict a particular vessel's Under Keel Clearance (UKC) based on the vessel's dimensions and stability, the prevailing environmental conditions, predicted vessel speeds and a detailed profile of the Harbour and the approach channel.

The DUKC calculation provides the window of opportunity for a given draft during which the vessel may sail, together with the manoeuvrability margin and bottom clearance in the port and the channel. The DUKC programme is used to determine the tidal window for vessels to depart or to determine the maximum draft that a vessel may sail at for a particular tide.

FUNCTIONALITY OF DUKC SYSTEM

The core functionality of the DUKC is to provide the port and shippers with dynamic passage planning advice regarding maximum sailing drafts for known or fixed arrival or departure times. For information on DUKC®, visit http://bit.ly/SaqrDUKC

DUKC SYSTEM COMPONENTS

Manual and automated inputs include all or some of the following: annual tide predictions produced by RAK Ports Hydrographic department; live tidal data and its residual variations; wave and swell conditions from the Wave Detector buoy installed in the vicinity of DWBT; AIS live data feed; real-time weather monitoring data from Port Control; weather forecast detailing wind speed, direction, sea conditions/swell and visibility for the port region; hydrographic survey data; latest high-density bathymetric chart; and, individual vessel information which is obtained from the "Application to Use the DUKC System".

BENEFITS OF DUKC

Given the right circumstances deep-draft vessels, utilising DUKC System, could safely increase draft by up to 1.2m or more, compared with the previously calculated standard static draft. The resulting increased volumes will have a benefit to the port, shippers, and environmentally with less CO_2 emissions.

SECTION TWO

DUKC OPERATING PROCDURE

INTRODUCTION

The following section is intended to outline the requirements and procedures for the optimal utilisation of DUKC in order to ensure minimum UKC to provide safe navigation through the harbour and channel, thus enhancing the safety of navigation and protection of the marine environment.

Based on the annual tidal predications for the port, OMC International's DUKC system analysis's various data to provide timings and maximum drafts for shippers and ship operators to help facilitate:

- Optimising the vessel selection or chartering decisions or freight contracts.
- Planning the sailing drafts and cargo availability.
- Increasing the import/export cargo quantities.

PROCEDURE

Initial enquiry

- The Agent or Tenant/Operator of Vessel intending to utilise DUKC system at RAK Ports is required to obtain approval from Harbour Master/Deputy Harbour Master by sending the following information along with the vessel's particulars:
  - estimated date and transit draft.

    Please note: should there be any specific UKC requirements other than the standard RAK Ports UKC should be notified to the port at this stage, see "*Ruling Depth & Under Keel Clearances" - Link: https://rakports.ae/wp-content/uploads/2020/05/RDUKC.pdf*
- Subsequent to submitting the above information, the Port authority will assess the feasibility for the vessel to arrive or depart at an anticipated tidal window.

Specific transit time

- If required, an Agent or Tenant/Operator may request a specific transit time (or transit window).
- If the specified transit time does not fall within the calculated tidal window, the Port Authority will advise the Agent or Tenant/Operator so that an alternative time can be established.

Obligation

- The Agent or Tenant/Operator of the Vessel is obliged to provide accurate information at the time of seeking to utilise the DUKC System for their vessel; if any alteration or changes are necessary the Port Authority must be consulted promptly.

DUKC application

- Once positive confirmation is obtained and the voyage is scheduled, the vessel Master should submit "***Application to Use the DUKC System"*** (see Annex 2 to this guideline). This form is available in the '*Marine Forms'* Marine section of the RAK Ports website.
- Once complete, the Agent is required to email the form to Port Control no later than 24 hours prior to vessel's transit.
- Updates must be notified to Port Control no later than 6 hours prior to the vessel commencing its transit. This notification may be done by email to Port Control by updating the Application.

Berth allocation & scheduling

- Once voyage is fixed and confirmation to utilise DUKC system is notified, the Port Authority will:
  - Allocate berth for cargo operations (at Saqr Port) at appropriate time which will be done and notified by Operations department via ***Berthing Schedule***.
  - Schedule the vessel's arrival or departure which will be undertaken by the Marine department.

Special Note:

1. *The "vessel transit window" allocation and scheduling of arrival or departure of laden vessels utilising DUKC will be subject to the approval of Harbour Master/ Deputy Harbour Master.*
2. *Berth allocation for RAK Maritime City tenants' berths will be subject to their approval.*
3. *Scheduling of vessels determined by DUKC System and calling tenant's berth will be subject to the discretion of the Harbour Master/Deputy Harbour Master.*

Port Control duties

- Once the vessel is scheduled, Port Control will enter the vessel data to DUKC system and calculate the sailing window and maximum permissible draft alongside during low water.
- Maximum permissible draft alongside will be calculated according to the available depth in each berth pocket at each port/terminal.
- The time of resuming cargo operation and allowable increase in draft at each hour will be calculated and included in the DUKC chart.
- Further, Port Control will circulate the "Vessel DUKC Calculation Chart" to all concerned (Marine Pilot, Operations Dept. Vessel Agent/Master).
- Vessel Master shall ensure the vessel draft does not exceed the maximum permissible draft in each low tide or the rising tide.

Arrival & Departure

- The "Vessel DUKC Calculation Chart" will determine the required water level for a given tide. Accordingly, the vessel's arrival or departure will be scheduled, ensuring a safe transit.
- See Emergency Procedure – Annex 1.

Vessel Master's responsibilities

General:

- Master in coordination with loading supervisor shall ensure the trimming, completion of cargo operation, draft surveys and documentation is undertaken in a timely manner and prepare the vessel ready for departure on time, i.e. within the prescribed sailing window.

Vessel loading:

- Master shall pay attention to vessel's loading condition and all other variable factors affecting the UKC, including vessel's trim, list and the paired conditions of hogging and sagging.
- Master shall take utmost care to avoid any delays in the unloading or loading of cargo which might adversely impact the vessel alongside or during the sailing/berthing manoeuvre, resulting in breach of UKC requirements.

Vessel discharging:

- Arriving vessels utilising DUKC will need to commence discharging as soon as possible.
- Agents must ensure all clearances and formalities are completed, preferably in advance, and Operations department will allocate cranes to ensure sufficient cargo is discharged to prevent a breach of UKC requirements, especially at the following low water.

Vessel's motion and stability:

- Master shall pay attention to vessel's motion and stability whilst alongside and during harbour transit, paying particular attention to heave, pitch and roll.

Prevailing weather conditions:

- Master shall ensure the prevailing weather conditions and parameters shall not affect the vessel's stay alongside.
- In the event Port Control informs vessels impending inclement weather conditions, vessel Masters shall implement his own safety procedures.
- The port may direct a DUKC vessel to vacate a berth and sail to anchorage, if, in the opinion of the port authority (Harbour Master), there is a risk to port infrastructure and safety of navigation.

- If there is a likelihood a vessel may exceed UKC limits while alongside the berth, the Master will be required to take the precautionary measures which may include:
  - Cease cargo operations and maintain safe UKC;
  - Discharge cargo to maintain safe UKC;
  - Move to anchorage immediately if possible, weather permitting;
  - Move off the berth to a deeper pocket and drop anchor.

Port Operations duties

- In order to achieve the required pace for cargo loading and discharging by vessels utilising DUKC System, the Port Operations department will:
  - Liaise with shippers/cargo agents to ensure sufficient cargo availability at the quayside.
  - Ensure prompt allocation of equipment and resources including cranes and shovels to expedite cargo operations and optimise productivity within the required time-frame;
  - Ensure required loading/discharging rates are achieved;
  - Liaise with relevant vessel staff to ensure loading plan takes requirements of DUKC into account.
  - Liaise with Port Control and Marine Agents as required.

Note:

1. *LOADING - Failure to have an enduring loading pattern of all cargo accumulated at berth may require the vessel to depart before achieving the required DUKC draft or cause delays waiting for the next tide if there is sufficient depth to lay over at the following low water.*
2. *DISCHARGING - Failure to achieve required discharging rate of the cargo being discharged from the vessel, may result in breach of UKC requirements.*

Multiple DUKC Vessels

- Entry or departure of multiple DUKC vessels simultaneously requires careful coordination, to be monitored by the Control Tower.
- In the case that more than one vessel is scheduled to complete transit on the same tide, Port Control will refer such situation to duty pilot and arrange the vessel's departure or arrival timings accordingly.
- Such movements will be prioritised, coordinated and arranged taking in to account vessel draft, quayside operations, marine operational requirements and weather conditions. Safety of navigation always takes precedence.

ANNEX - 1

EMERGENCY PROCEDURE

This guideline shall never preclude the Master from performing his duties to ensure safety of his vessel during the manoeuvre or while alongside the berth. As such, the Master and crew of vessels with timings determined by DUKC shall remain responsible and exert themselves by avoiding bridge team failure, engine and navigational equipment malfunctions and operational delays.

The pilotage passage should have adequate and appropriate support from both from the Master and bridge team as well as assisting tugs and port control to ensure safe transit. It is imperative that the Master exercise due diligence and act to avert circumstances which may result in the breach of required UKC.

If the Master deems the achieved or achievable draft may result in a lesser UKC than the required, he should take appropriate action immediately and notify the Port Authority without delay. In such case, the berthing/unberthing manoeuvre should be re-assessed with potential to terminate arrival or ceasing of cargo operations.

Environmental factors may alter the predicted tidal level. If the preceding tide has shown an appreciable difference between predicted and actual the following tides, both high and low, are to be closely monitored by Port Control and vessel.

If, for whatever reason, a vessel may breach under-keel clearance requirements the following measures are to be considered:

- Offload cargo if tide, sailing window or weather constrains, allow;
- In case of engine/equipment failure - tow the vessel clear of the port;
- If weather, tide, sailing window & time constrain:
  - Saqr Port Inner Harbour - tow the vessel off berth and drop anchor in the harbour basin where the depth is sufficient for the draft.
  - Deep-Water Bulk Terminal - tow the vessel west of buoys C1 and C2 to deeper water.
  - RAK Maritime City - tow the vessel to where depth is sufficient for the draft.
- Deploy adequate tugs/stand-by;
- Dynamic risk assessment by Master/Pilot.

Emergency Response in accordance with: “RAK PORTS MARINE EMEGENCY RESPONSE PLAN”

Note: *The Ship’s contingency Plan must include “UKC Breach”*

ANNEX - 2

RAK PORTS
APPLICATION TO USE THE DUKC SYSTEM

(Please download the original from RAK Ports website, at: https://rakports.ae/marine/)

RAK PORTS
Doc. No. RP MD 020-01
Rev. Orig., Issue Date: xx-xx-2020

PORT/TERMINAL NAME	☐ SAQR PORT INNER HARBOUR	☐ SAQR PORT DWBT	☐ RAK MARITIME CITY FZA

NOTE TO THE MASTER / AGENT

- The form to be submitted 24 hours before the estimated transit time.
- All fields are compulsory and must be completed.
- Vessel Master/Agent should: Email the completed form to spatower@rakports.ae

VESSEL DETAILS

Vessel Name		IMO No.	
Vessel Type		LOA (m)	
Type of Cargo		Summer draft (m)	
Cargo Quantity		TPC	

TRANSIT DETAILS

Expected to: Choose an item.	Specify Port & Berth ►	☐ Saqr Port Inner Harbour	Berth Number	Choose an item.
		☐ Saqr Port DW Bulk Terminal	Berth Number	Choose an item.
		☐ RAK Maritime City FZA	Berth/Quay No.	Choose an item.
Date of Transit (dd/mm/yyyy)	Click or tap to enter a date.		Estimated Transit Time (hh:mm)	Enter TIME here

Draft (m)	Enter FORWARD draft here	Enter MIDSHIP draft here		Enter AFT draft here	
Displacement (tons)	Click here to enter text	*GMf (m)	Enter GMf (m) here	**KG (m)	Enter KG (m) here
Does the vessel owner require a specific UKC other than RAK Ports standard requirements, while the vessel is alongside?	☐ No	☐ Yes (specify):	Click here to enter text		

MASTER'S UNDERTAKING STATEMENT

1. I hereby declare that my vessel shall comply with RAK Ports laid down procedure during vessel's loading/discharging, to enable the utilisation of DUKC System.
2. I undertake that:
   - the vessel draft will not exceed the max draft specified in the transit details on the application form.
   - during low tide the vessel draft will not exceed the specified draft (as per DUKC table provided by the Port).
   - shall maintain the statutory UKC as per port standard while the vessel is alongside the berth.
   - I agree to move the vessel from the berth as a dead-ship, in case of necessity.
   - On behalf of the Owners/Agent, I agree to accept all liabilities in connection with non-compliance relating to the utilisation of DUKC System.
3. I also confirm that I do hereby accept the conditions and limitations stipulated under.

The Master and Agent agree to the following conditions and limitations, in relation to the use of DUKC information

1. The user acknowledges that, for the DUKC System to function properly, it is dependent on the:
   - performance of third parties under support agreements with RAK Ports.
   - continuous supply of relevant wave and tide data.
   - DUKC infrastructure being working condition.
2. The user acknowledges that, in order to use and obtain accurate predictions from the DUKC system:
   - accurate drafts and hydrostatic data must be supplied to RAK Ports.
   - any change to anticipated condition to be conveyed to RAK Ports (Port Control) as soon as possible.
3. RAK Ports and the user agree that nothing will oblige RAK Ports to provide any component of the DUKC service to the user in circumstances where RAK Ports is unable to operate the DUKC System, or provide any component of the DUKC services as a result of:
   - termination or discontinuance of any of the third-party agreements with RAK Ports.
   - any reasonable DUKC System downtime due to repairs or maintenance.
   - any failure of or any damage to any component of the DUKC infrastructure.
4. If due to non-availability of data or invalid data, the DUKC System is unable to run for any reason, transiting vessels will be handled in accordance with the static UKC criteria for the management of under keel clearance.

Master's Name: Stamp (Master)	Agent: Stamp (Agent)	**FOR PORT CONTROL USE**	
Date:	Date:	Data entered into DUKC System	☐
		Completed	☐
		Cancelled	☐
		DUKC calculation emailed	☐

* ***GM(f)*** *– Centre of Gravity to Metacentre corrected for Free Surface Allowance*
** ***KG*** *- Keel to centre of Gravity uncorrected for Free Surface Allowance*

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