
UNIVERSITY OF RIJEKA
FACULTY OF MARITIME STUDIES



**AMENDMENT TO THE MARITIME STUDY
LNG FSRU KRK**



Uncertified translation from Croatian language

Rijeka, October 2020



Title: **Amendment to the Maritime Study – LNG FSRU Krk**

Client: POMGRAD inženjering d.o.o.
Stinice 26b,
210000 Split
Croatia

Contractor: FACULTY OF MARITIME STUDIES
University of Rijeka
Studentska 2,
51000 Rijeka
Croatia

Authors: Damir Zec, PhD.
Lovro Maglić, PhD.



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1 INTRODUCTION

This study was prepared pursuant to the agreement entered into between POMGRAD Inženjering, d.o.o., as the client, and the Faculty of Maritime Studies of the University of Rijeka, as the contractor.

The scope of the agreement is Amendment to the Maritime Study for LNG FSRU¹ Krk (hereinafter referred to as the Maritime Study) that the Faculty of Maritime Studies has prepared pursuant to the agreement entered into with EKONERG d.o.o. within the scope of the Public Tender for preparing “Services of preparation of the design and permitting documentation for the construction of the Krk LNG terminal and consulting services relating to obtaining of all necessary permits and approvals: FEED preparation and main design preparation for Krk LNG FSRU and obtaining of construction permit and LNG FSRU power supply system documentation” from 2017.

The said Maritime Study was delivered to the client and subsequently accepted by the authorised representatives of the Ministry of the Sea, Transport and Infrastructure of the Republic of Croatia.

The purpose of amending the study was to prepare the proposal for efficient navigation, as well as maritime safety measures, in compliance with the as-built state, i.e. such state on 1 January 2021.

This Amendment to the study assumes all essential preconditions, restrictions, instructions, recommendations and conclusions determined in the original study, and it neither plans any additional conditions or restrictions nor does it derogate any restrictions, instructions, recommendations or conclusions. Exceptionally, this Amendment introduces temporary restrictions concerning approach and berthing manoeuvring, which shall apply until the works have been completed, and the conditions have been met as determined in the Maritime Study.



Figure 1 Area of FSRU with the dredging area

¹ *Floating Storage and Regasification Unit - FSRU*. In the remaining text, the standard English abbreviation for a unit used in importing LNG and its re-gasification, will be used. The term *terminal*, in this study, only applies to land facilities, their infrastructure and equipment. The term *floating terminal* is deemed as technically and legally inaccurate and will therefore not be used

2 CURRENT SITUATION

According to the Maritime Study, the following trajectories of an LNG carrier are planned, depending on the prevailing meteorological and oceanographic conditions:

- by sailing along the Ert peninsula, and turning starboard in the vicinity of the terminal aiming to stop the LNG carrier when it reaches the position parallel to the FSRU, or
- by sailing directly from the passage of Vela Vrata to the FSRU, stopping and turning around, so the LNG carrier comes into the position parallel to the FSRU, or
- by sailing from the SW, stopping the carrier to the southeast of the FSRU, with or without turning around, until the carrier is in the position parallel to the FSRU.

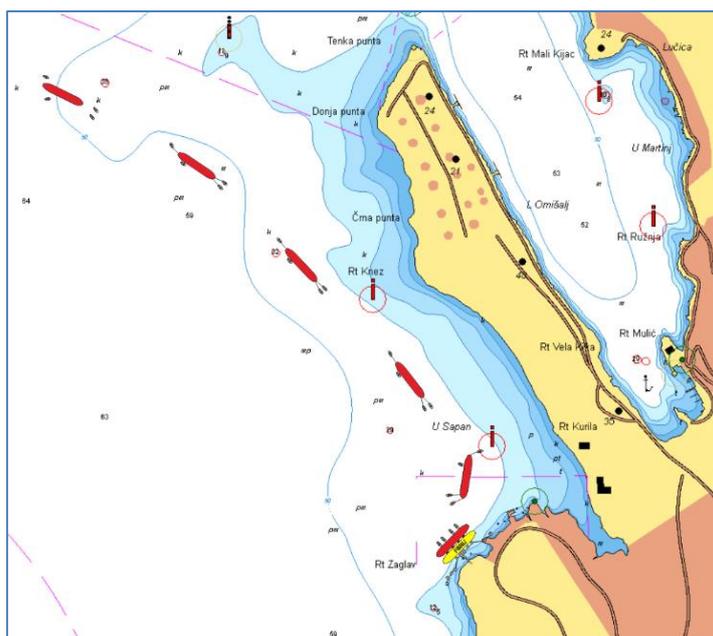


Figure 2 Basic portside berthing manoeuvring – the approach along the shore of Ert peninsula

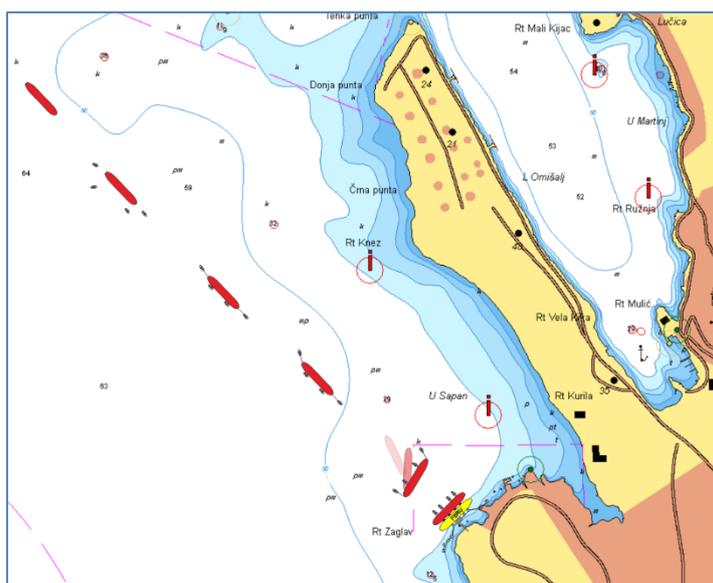


Figure 3 Portside berthing manoeuvre by direct arrival at the terminal

In all three cases, the plan is to tie up tugs to the carrier, and then push the carrier towards the terminal with proper speed, no exceeding the speed limit.

The Maritime Study does not force a mandatory approaching pathway of the LNG carrier concerning the direction of the FSRU. That is left to be agreed by the masters on the FSRU and the tugs towing the LNG carrier. It is expected that in most cases, especially with LNG carriers of approximately the same size as the FSRU, shipmasters would choose the same berthing orientation as that of the FSRU, since in that case, the mooring lines between the carrier and the FSRU are approximately at the same height, providing uniform distribution of mooring forces. Also, such an orientation of the carrier and the FSRU enables simple manifold alignment of the LNG carrier with the FSRU manifold.

A carrier manoeuvring was mainly obstructed by the shallow spot (13.7 m) located 318 m from the coast in the northwest direction. Two green navigational marks mark the shallow spot.

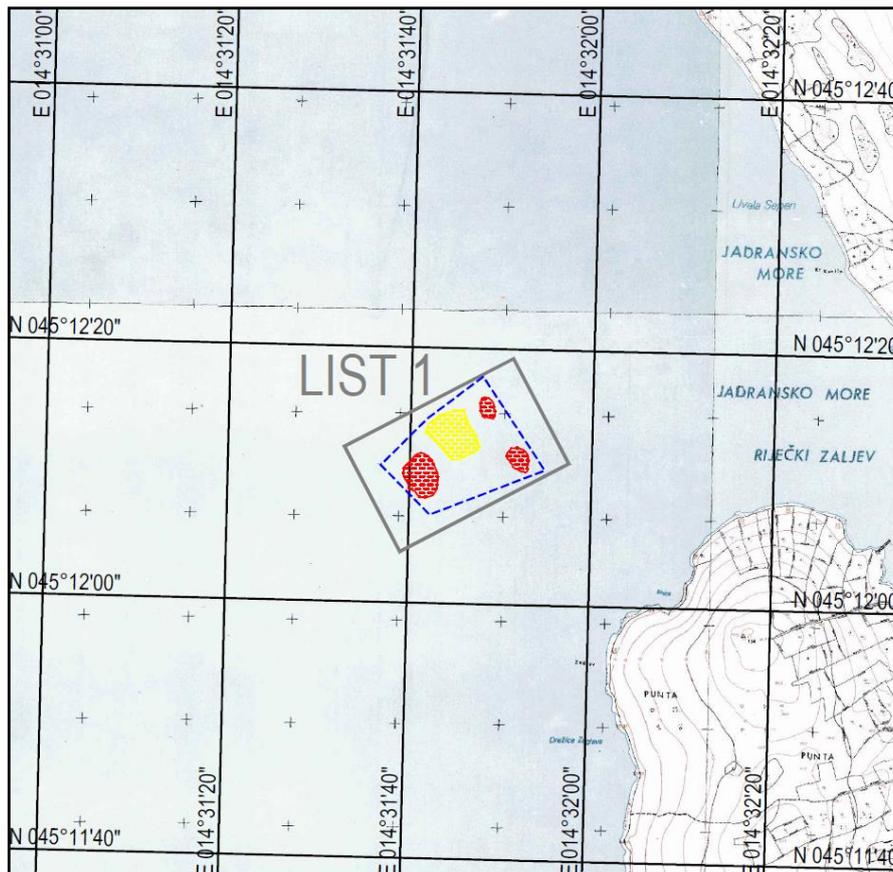


Figure 4 Location of shallow spots (red) and the area of placing the dredged material (yellow)

For safe manoeuvring from any direction and the accommodation of the largest LNG carriers, the Maritime Study planned to dredge the shallow spot (13.7 m) in front of the planned terminal to the depth of at least -15 m .² According to the estimate performed before the commencement of the works, it was necessary to dredge approximately $11,000\text{ m}^3$.

Dredging of the said shallow spot guarantees safe berthing, i.e. departure of carriers of the planned size in all types of conditions concerning tides, waves and barometric pressure.

² Pursuant to the Environmental Impact *Import terminal for liquefied natural gas on the island of Krk*, Oikon d.o.o. Institute of Applied Ecology, 2013, Zagreb.

3 PROPOSAL FOR ADDITIONAL MARITIME RESTRICTIONS

According to the existing dynamics of the works on completion of the FSRU, it is expected that the FSRU shall be functional within the planned deadline (until the end of 2020) and that it will be ready to receive LNG carriers at the beginning of 2021.

The status of the dredging works is displayed in the figures below.

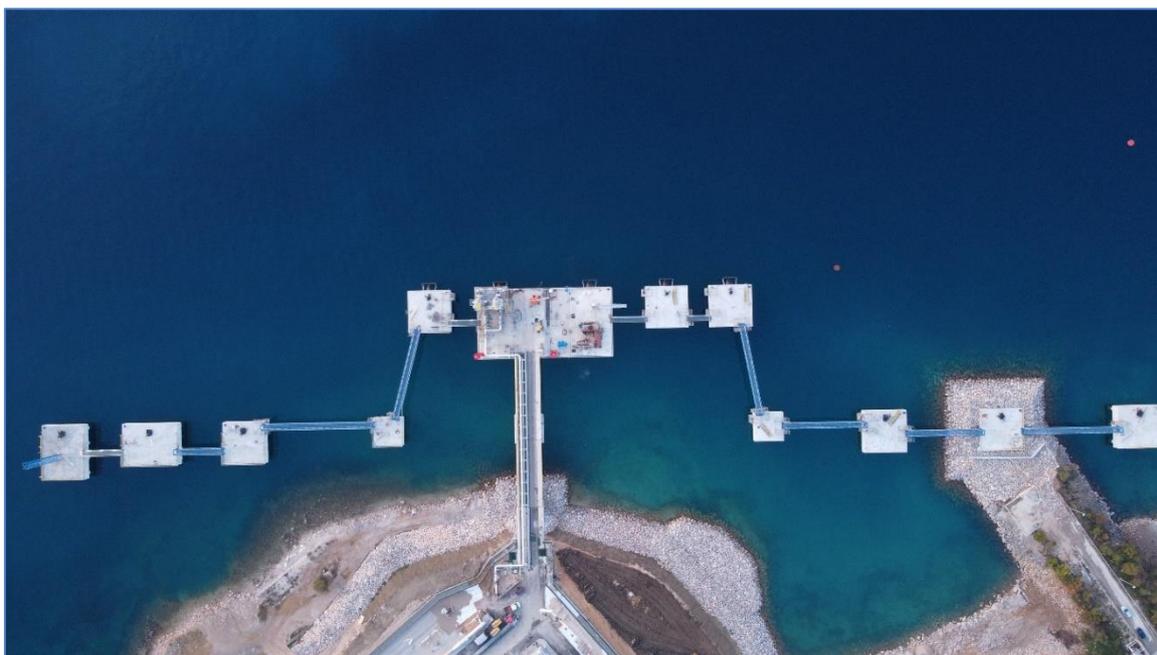


Figure 5 Current state of construction (October 2020)

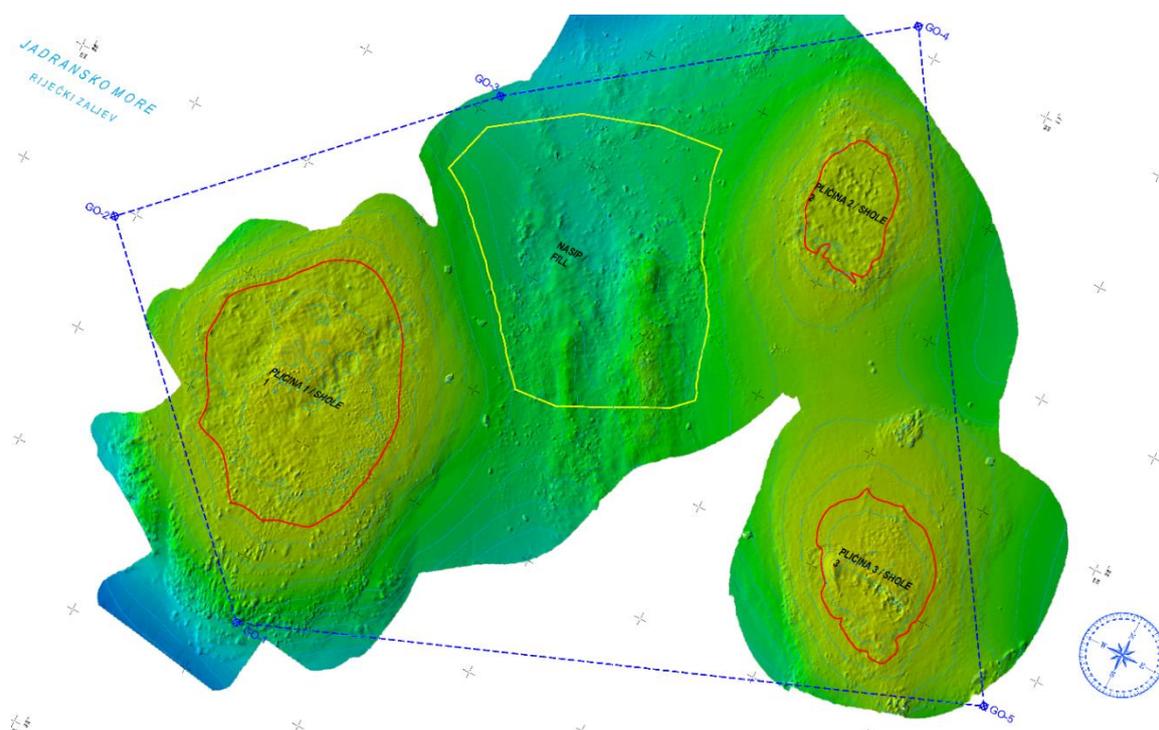


Figure 6 Current state of dredging (on 13 October 2020)

Due to unforeseen circumstances, dredging of the shallow spots, the FSRU shall not be completed within the planned deadline. Following the abovesaid, the approach of LNG carriers to the terminal shall not be possible using trajectories as stipulated by the approved Maritime Study.

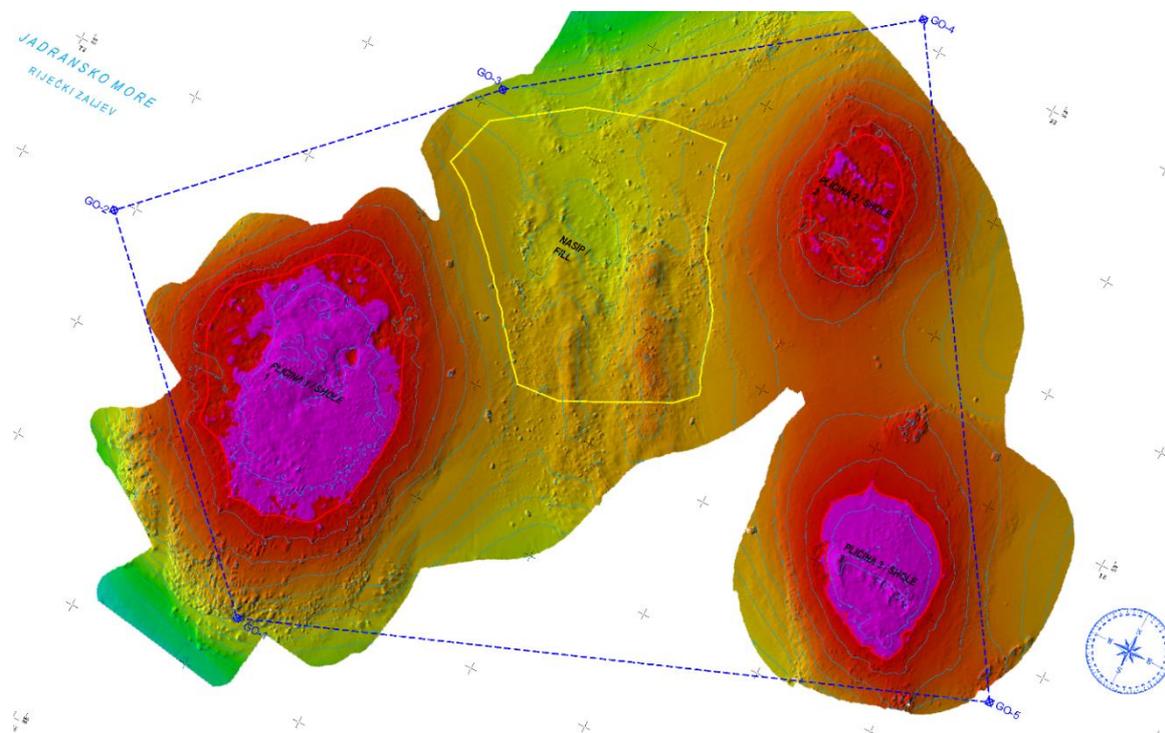


Figure 7 Current state of dredging (on 13 October 2020)

Especially in the given circumstances, berthing of the carrier must be performed bearing in mind the restricted width of the area of sufficient depth. Taking into consideration the state of affairs at the time this Amendment to the Maritime Study is prepared, the width of the free area (the area between the external edge of FSRU and the shallow spot 3) is estimated at approximately 250 m.³

The approach of an LNG carrier to the FSRU by arriving directly from W-WNW

The approach to the berth when arriving from W-WNW presumes turning around, i.e. rotating the carrier above the shallow spot where, depending on the prevailing weather conditions and dynamic properties of the LNG carrier, it may touch the bottom of the sea. Therefore, an approach to the FSRU using this pathway in the given circumstances is unacceptable.

The approach of an LNG carrier to the FSRU by sailing along the Ert peninsula

The approach to the berth by sailing along the Ert peninsula means sailing with a constant change of course and stopping directly before the FSRU. Such manoeuvring requires the following:

- sailing the LNG carrier with sufficient speed so the carrier may maintain, i.e. change course,
- astern movement with sufficient power to stop the carrier in the confined space,

³ The distance from the shallow spot is 318 m, however, the dredging works require additional space (for anchoring i.e. a safety area) and therefore, the clearance is estimated to approximately 250 m.



- stopping parallel to the FSRU, after which the tugs push the boat into the berthing position, i.e. towards the FSRU.

This manoeuvre is challenging, and the carrier may get in an unfavourable position (sailing in the shallow waters) due to:

- misjudgement of the influence of wind, currents and waves to the rotation of the carrier while approaching,
- unknown level of thrust force when stopping the carrier,
- limited width of free space immediately before the FSRU.

Due to the said reasons, approach by sailing along the Ert peninsula is not acceptable.

The approach of an LNG carrier to the FSRU by sailing from SW

The approach of an LNG carrier to the FSRU by sailing from SW presupposes:

- sailing of an LNG carrier from the passage of Vela Vrata towards the area south of the FSRU (approximately 10 M, bearing 95°),
- tying up the tugs (approximately 2.0 M from the FSRU),
- stopping the carrier (at the distance of approximately 0.3-0.5 M from the loading arms), and turning around the carrier to the direction parallel to the FSRU (the course being approximately 224°),
- towing the carrier astern, bearing of approximately 44°, until the carrier is in the position parallel to the FSRU,
- after stopping the LNG carrier parallel to the FSRU, the tugs change the position and push the carrier towards the FSRU,
- mooring the LNG carrier along the FSRU.

In case of the LNG carrier approaching from SW, as shown above, including turning around and stern mooring (parallel to the FSRU), the standard requirements of the maritime safety of both the LNG carrier and the FSRU are met.

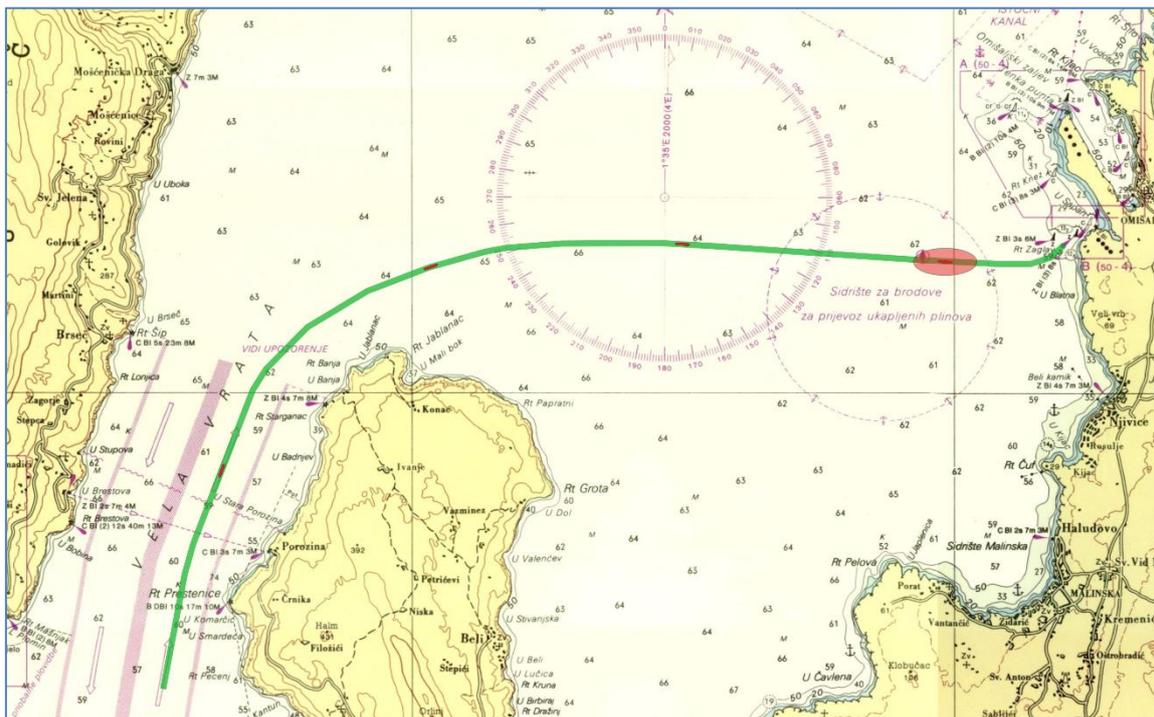


Figure 8 Sailing of LNG carrier from the passage of Vela Vrata until the FSRU, with the marked area where tugs are tied up (red)

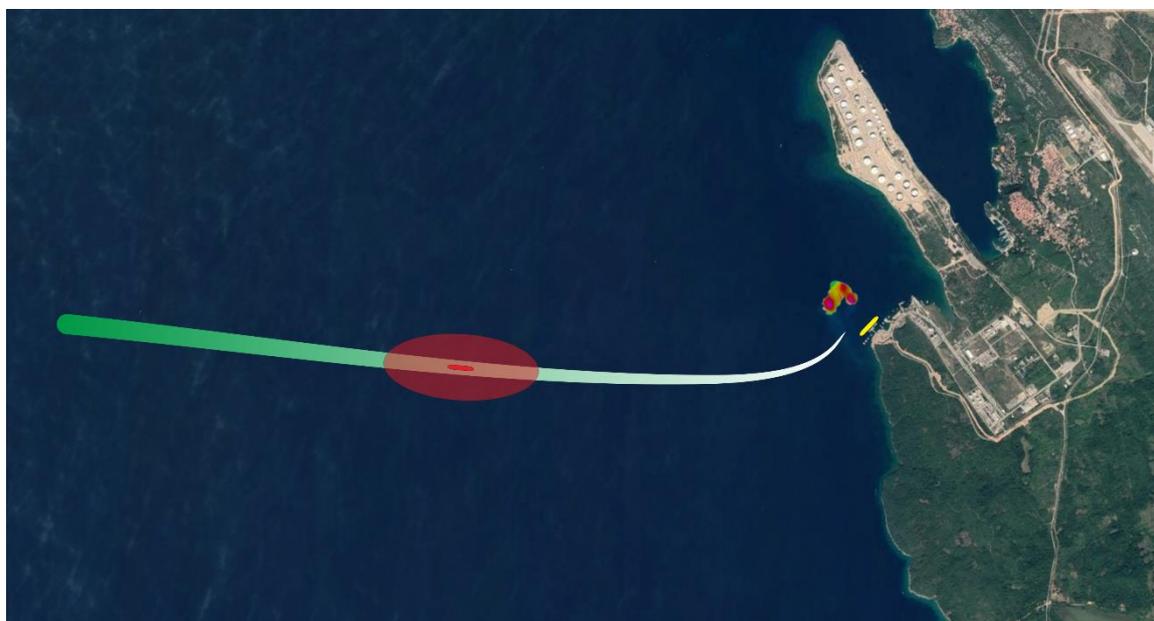


Figure 9 Direct approach of an LNG carrier to the FSRU, with the marked area where tugs are tied up (red)

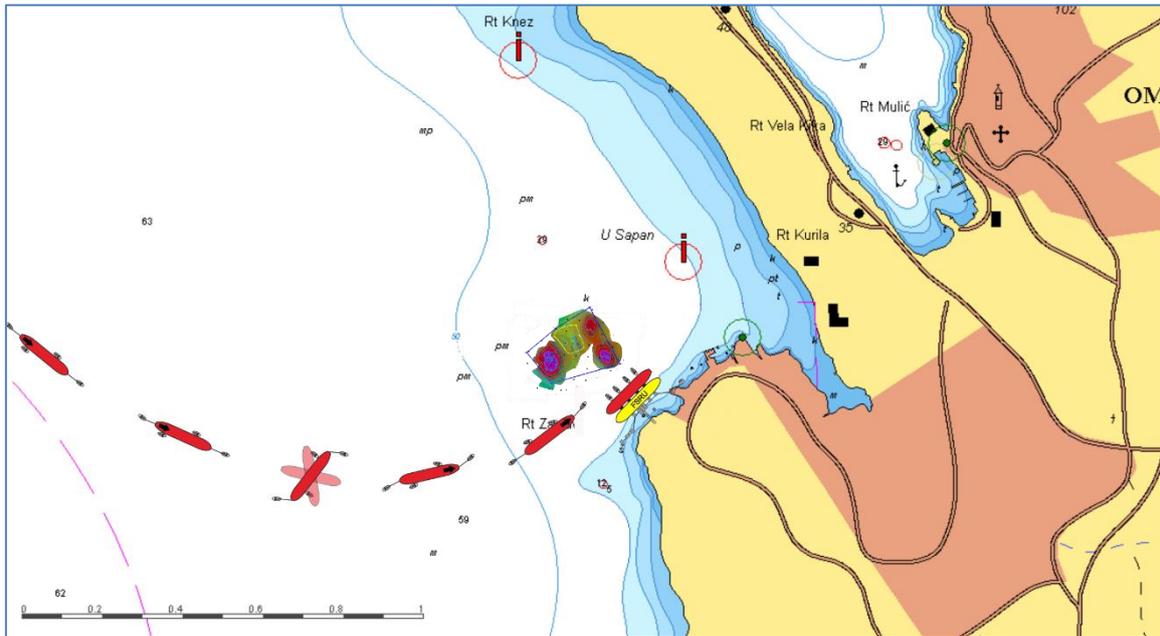


Figure 10 Approach and portside mooring of an LNG carrier to the FSRU

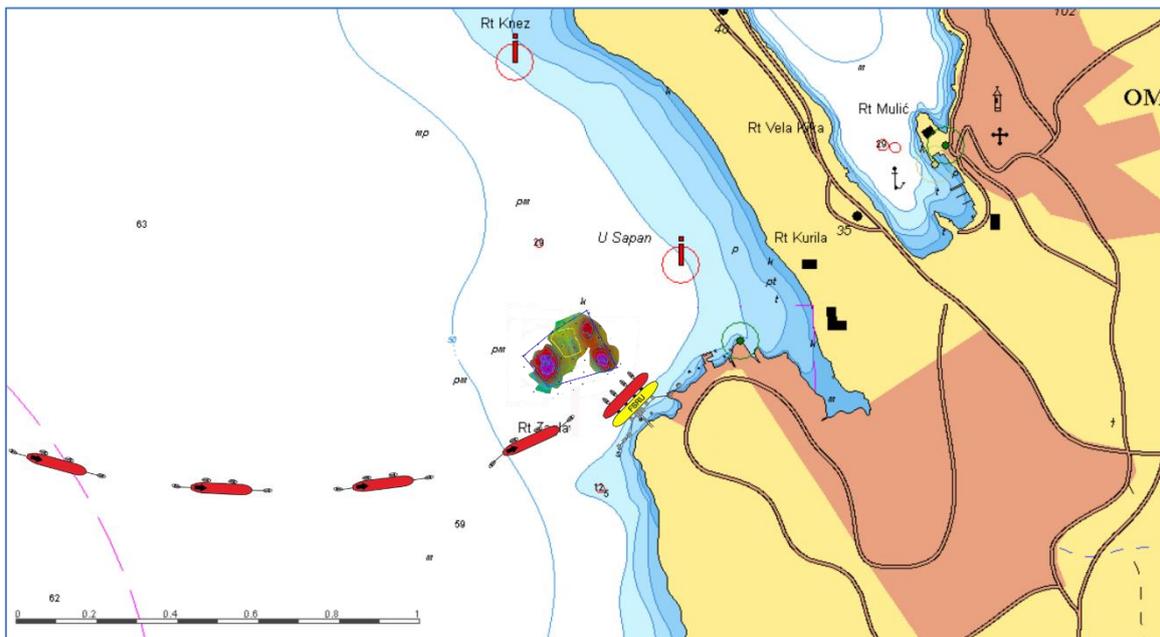


Figure 11 Approach and starboard mooring of an LNG carrier to the FSRU

Departure manoeuvre

The departure manoeuvre of the starboard moored carrier includes the following:

- tying tugs and releasing the mooring lines,
- distancing the LNG carrier from the terminal by tugs attached to the stern and bow and/or bow thrusters,
- using the carrier engines at the distance of at least 50 m (but no more than 100 m), for moving away from the FSRU, with a gradual change of heading to the right (ROT 1-2°/min),

- releasing the tugs at a distance from the FSRU of at least two lengths of the carrier, and sailing towards the passage of Vela Vrata.

The departure of the LNG carrier in the manner described above meets the maritime safety conditions of both the LNG carrier and the FSRU.

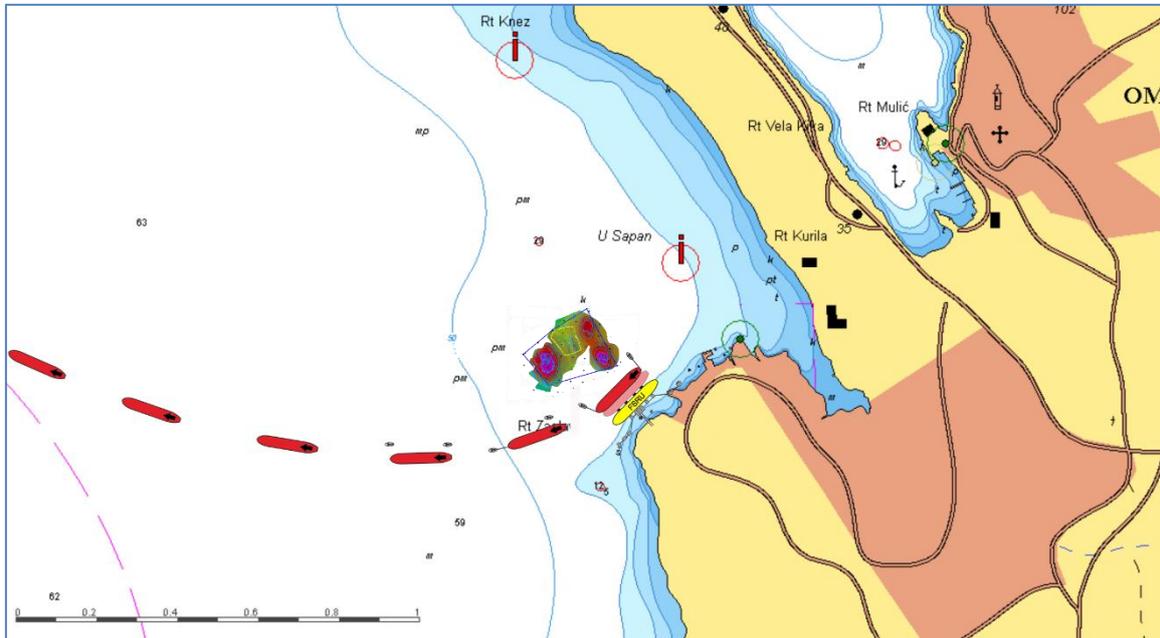


Figure 12 Unmooring and departure of LNG carrier moored portside to the FSRU

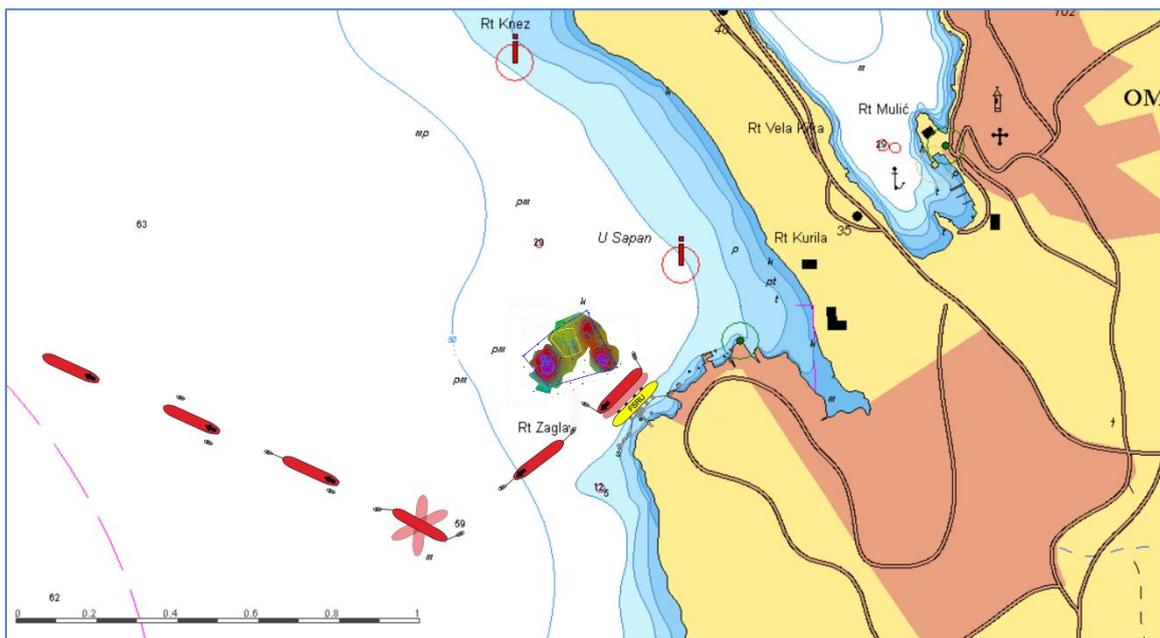


Figure 13 Unmooring and departure of LNG carrier moored starboard side to the FSRU

Taking into consideration restricted manoeuvring area, until the shallow spots have been removed in the vicinity, the arrival manoeuvre must be performed in daylight and the conditions of good visibility. Good visibility means visibility exceeding 3 M.



The Rijeka Harbour Master's Office may approve departure manoeuvring at night as well, but only after some experience has been gained. Sufficient experience means that at least ten departure manoeuvrings have been performed.



4 CONCLUSION

Conclusions of this Amendment to the Maritime Study are as follows:

1. Until completing the dredging of shallow spots, located approximately 250 m to the W-WNW from the FSRU, the acceptance of an LNG carrier may be performed only in daylight, by approaching from SW, with previous turning and portside berthing.
2. All other restrictions listed in the Maritime Study, especially restrictions concerning arrival and departure in daylight, remain in force.
3. In case of dredging of shallow spots not being completed within six months, the concession holder shall inform the Rijeka Harbour Master's Office on the status of the works, and will request additional time to complete the works, stating the reason thereof. If the additional time is approved, the restrictions listed in this Amendment to the Maritime Study shall remain in force.



REPUBLIKA HRVATSKA
Ministarstvo mora, prometa
i infrastrukture
Uprava sigurnosti plovidbe
Lučka kapetanija Rijeka
Senjsko pristanište 3



KLASA: UP/I-350-05/18-01/31
URBROJ: 530-04-5-2-20-4
Rijeka, 23. studenog 2020. godine

LUČKA KAPETANIJA RIJEKA nadležna temeljem članka 1. Zakona o lučkim kapetanijama (NN br. 118/18), temeljem članka 96. Zakona o općem upravnom postupku (NN br. 47/09), povodom zahtjeva Lučke uprave Rijeka u predmetu prihvaćanja i potvrđivanja maritimne studije, donosi

RJEŠENJE

Prihvaća se i potvrđuje dopuna maritimne studije 'Maritimna studija - LNG FSRU Krk', izrađene u Rijeci, listopada 2018. godine od Pomorskog fakulteta u Rijeci, Studentska 2, Rijeka za potrebe naručitelja LNG Hrvatska d.o.o, Radnička cesta 80, 10000 Zagreb.

Obrazloženje

LNG Hrvatska d.o.o, obratila se dana 20. studenog 2020. ovom tijelu sa zahtjevom da se prihvati i potvrdi dopuna 'Maritimne studije - LNG FSRU Krk', izrađena od Pomorskog fakulteta u Rijeci za potrebe naručitelja LNG Hrvatska d.o.o.

Uvidom u navedenu dopunu Maritimne studije utvrđeno je da ista, u cjelini s Maritimnom studijom – LNG FSRU Krk, formalno udovoljava uvjetima propisanim člankom 54a. stavkama 4, 5. i 6. Pomorskog zakonika (NN 181/04, 76/07, 146/08, 61/11, 56/13, 26/15 i 17/19), odnosno da sadržajno udovoljava osnovnim mjerama maritimne sigurnosti u predmetnoj luci posebne namjene.

Slijedom iznesenog riješeno je kao u izreci. Upravna pristojba u iznosu od 35,00 kuna naplaćena je po Tar. br. 1. i 2. Tarife Zakona o upravnim pristojbama (NN br. 8/96 s izmjenama) u korist Državnog proračuna RH.



LUČKI KAPETAN

dr. sc. Darko Glažar dipl. inž. kap.