

# New Black Sea Terminal of Port Kulevi and its Navigating Features

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**ABSTRACT:** In May, 2007 in Georgia the new Black Sea Terminal (including the complex of a railway junction, capacities for storage of oil) was opened in the port Kulevi. Necessity of creation of the named terminal in Georgia was caused by following factors:

1. The necessity of search and the creation new alternative ways of safe transportation of oil to Europe;
2. A favourable geographical position of Georgia - Asia, the Near East and Europe crossroads;
3. Presence of already existed means of communication between Georgia and oil-producing regions - Kazakhstan, Turkmenistan and Azerbaijan.

Choosing the port and terminal place it was necessary to be guided first of all by maintenance of safety navigation and minimum expenses from the point of view of an economic profit. That is why the special attention was paid to search of a natural reservoir with an exit in the sea.

This article deals with the questions of construction of the oil terminal, maintenance of port Kulevi with means of the navigating aids and features of entering and leaving vessels.

## 1 INTRODUCTION

The idea of construction of the oil terminal came into view in 1998. The special attention was paid to search of a natural reservoir with an exit in the sea. After long debate the settlement Kulevi was chosen. By the end of 1998 survey and a preparatory works began. The works lasted for one year and in December 1999 construction works of the oil terminal and port Kulevi began.

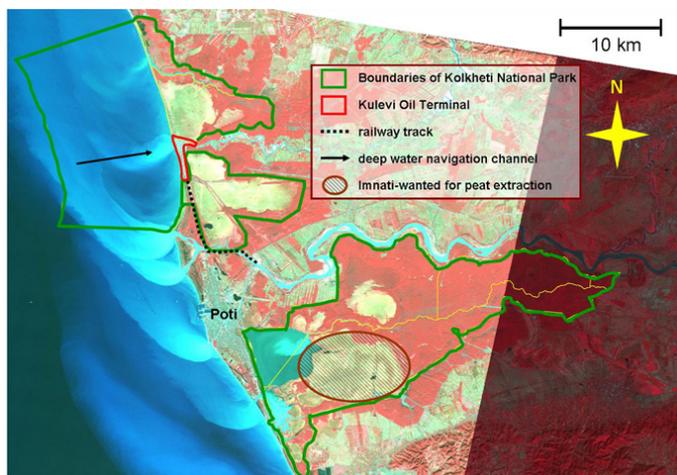


Figure 1. Location of Black Sea Terminal & Port Kulevi

The position of terminal is the river Khobi mouth, settlement Kulevi – Latitude 42.16 N & Longitude - 041. 38 E, flowing into the sea on distance of 17 km from port Poti. The river Khobi flowing into Black sea between the rivers Enguri (15 km to the North) and Rioni (8 km to the South) (see fig. 1). The low coast between the rivers is bordered by shoal which is formed by carrying out of these rivers. The coast in the region of the river Khobi is low and sandy. The choice of the given place was caused by the following reasons:

- 1 Presence of closely located powerful railway junction - Samtredia;
- 2 Presence of the big areas of free territories suitable for construction;
- 3 Presence of the developed infrastructure of a highway motorway;
- 4 Natural big depth of a mouth of the river Khobi - 6-9 meters;
- 5 Depths around the mouth of the river Khobi smoothly increase in process of removing from coast: 10 meters contour line passes in distance of 1.3 km from coast; 20 meters contour line - 2.5 km, and 30 - meters contour line - 3.2km.
- 6 Possibility of an arrangement of moorings on the left bank of the river Khobi which in this area practically is not washed away, and also, possibility of creation of the entrance channel, direction

of which, practically with the minimum expenses, coincides with a direction of a berthing line.

## 2 CONSTRUCTION OF THE OIL TERMINAL AND PORT KULEVI

The basic criteria at construction of the oil terminal and port were: taking into account the natural and climatic conditions for creation protected from excitement and sediments of aquatory with the least volume of dredging operations; preservation of the region's ecosystem; construction of the oil terminal on handling and to storage of oil; construction of new port - Kulevi with a navigation channel; maintenance with the terminal and port processing of tankers given in table 1.

Table 1. Types of tankers are processed with the terminal and port

Deadweight (t)	100.000	40.000	28.700	17.100	7.600
Length Overall (m)	250.0	195.0	179.0	151.5	114.6
Breath Mounded (m)	42.2	28.0	25.3	22.4	16.5
Max. Draft Loaded (m)	15.0	12.2	11.0	8.7	6.0

Construction of port and the terminal was simultaneously carried.

Territory of port occupied approximately 10 acre, and the terminal of 173 acre. In this territory the sea level from a chart datum on long-term supervision varies from 0.1 up to 1.0 meters. Because of a wave mode of the sea and prevention of flooding from the mouth of the river Khobi territories of port, the decision to raise safe height construction from a chart datum up to 2.5 meters it was accepted. In the beginning of construction approximately 11000 m<sup>3</sup> of the vegetative layer of a ground (sickness of 0.5 meter), was removed. For formation of the construction areas approximately 70000 m<sup>3</sup> of a sandy ground were covered. Dredging operations at the right coast of a mouth river Khobi and directly in aquatory of the future port were carried out with the help of dredgers and dredges allowing the increasing of the width of aquatory up to 290 meters. The design of a mooring facility of port was constructed in the following sequence: creation of an obverse wall by immersing of piles from metal grooves, marks LX-32, alternation 27 and 25 meter piles; immersing of piles from metal pipes diameter 820 mm on depth up to 25 meters in a unloading wall; immersing of piles from metal pipes diameter 1020 mm on depth up to 27 meters in anchor wall; dredging from pipes, using grab plant; installation channel frames in heads of piles from pipes with concreting; installation of an obverse distributive belt; dredging under

anchor bar; stacking of wooden nozzles under anchor bar; installation anchor bar using the crane with their tension; concreting anchor beams; covering anchor bar a sandy ground with a layer not less than 1 meter; concreting head a mooring; dribble feed bosoms of a mooring up to a bottom of a final covering with level-by-level condensation; arrangement of a mooring after the end of dredging operations at a mooring and in water area of port.

As a result of the made construction the new oil terminal and port Kulevi consists of:

- The oil terminal on handling and to storage of oil distributed in 16 shore tanks, each in volume of 20000 m<sup>3</sup> (see fig. 2);
- A complex of hydraulic engineering constructions providing unloading of oil from railway or road transport to shore tanks, communication with objects of a tank farm, transportation of oil to moorings and their loading on tankers;
- Hydraulic engineering constructions, which consist of: mooring №1 for reception of vessels by deadweight 100000 т., mooring №2 for reception of vessels by deadweight 40000 т. and mooring №3 for vessels of auxiliary fleet (see fig. 3, 4);
- A navigation channel, including: the entrance channel, manoeuvring space – swinging room (swinging pool) and operational space at moorings (see fig. 5).



Figure 2. Shore tanks of oil terminal



Figure 3. Hydraulic engineering constructions



Figure 4. Hydraulic engineering constructions

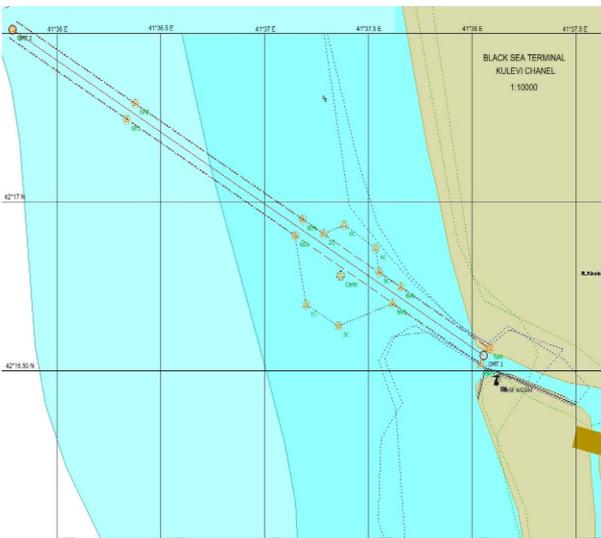


Figure 5. Navigation channel

### 3 NAVIGATING PROVISION OF PORT KULEVI

#### 3.1 ORT KULEVI

*Port Kulevi* (42°16'N, 041°38'E) is located in the mouth of the river Khobi, the settlement Kulevi, running into the sea on distance of 17 km to the North from port Poti.

*Depths* in mouth sites of the rivers Enguri, Khobi and Rioni are changeable because of moving sediments and constant sea stream directed from the South on the North up to 0.4 - 0.6 knots.

*Grounds* in a coastal zone up to contour line 10 m - silt with fine sand, in sea zone - dense silt with fine sand, clay, a broken shell.

*Fogs* in area of a mouth of the river Khobi - 29 days with fogs on the average per year.

*Visibility* is mainly good. Visibility range more than 5 miles is observed in 90 % of cases. In 65 % of

cases visibility range about 10 miles – transmissivity of atmosphere  $T = 0.74$ .

*The entering channel* begins on natural depths and proceeds up to a mooring №1. Length of the channel - 2.3 miles, width in a bottom - 210 m, estimated depth - 18,2 m.

*The manoeuvring space* is used for a swinging. Diameter swinging room (swinging pool) - 500 m, which is settled on the distance of 800 m from a mooring №1.

*Operational space* meets the conditions of safe manoeuvring of vessels in narrow pools with a one-way location of moorings. The width of operational space is - 230 m.

*Moorings* - №1 for reception of vessels by deadweight 100000 т., №2 for reception of vessels by deadweight 40000 т. and №3 for vessels of auxiliary.

*Anchorage* - the area №200 is located on outer roads of port Poti, in distance of 5 miles on the South from a mouth of the river Khobi.

The western part of this area with depths from 20 up to 90 m is suitable for anchorage tankers with draft up to 15 m.

*Pilot* - Compulsory. Vessels expect pilotage in area of №200. With the help of VTS operator the pilot meets a vessel at receiving buoy (OMT2) in 2.3 miles to NW from an extremity of a mooring №1. Communication with operator VTS and the pilot is carried out on VHF, the channel 73.

*Aids of navigation* provide navigation of vessels on the entering channel in the daytime. Navigating orientation is carried out with the help of complex use of coastal and floating aids of navigation. The entering channel is equipped with sector light beacon - PEL-6-10D, fixed on an axis of the channel and a floating protecting buoy, exposed on outer limit of fairway on Lateral System (IALA) - Region A « red to port side ». Swinging pool and the deep space of port are protected special buoys.

*Navigation regime* in the zone of responsibility of Georgia is performed in accordance with recommended routes, which are indicated on the charts and pilot books. Recommended track from the port of Kulevi to the port of Poti navigation should be carried out in accordance with two-way recommended track, the separate line of which is laid through the recommended two-way track №02 (see table 2).

Table 2. Recommended two-way track from the port of Kulevi to the port of Poti

Name of the point	Coordinates of the points		Direction of the way between the points	Nautical miles
	Latitude N	Longitude E		
K01	$\varphi=42^{\circ} 18.78'N$	$\lambda=041^{\circ} 32.97'E$	186-06	4,2
P01	$\varphi=42^{\circ} 14.63'N$	$\lambda=041^{\circ} 32.36'E$		

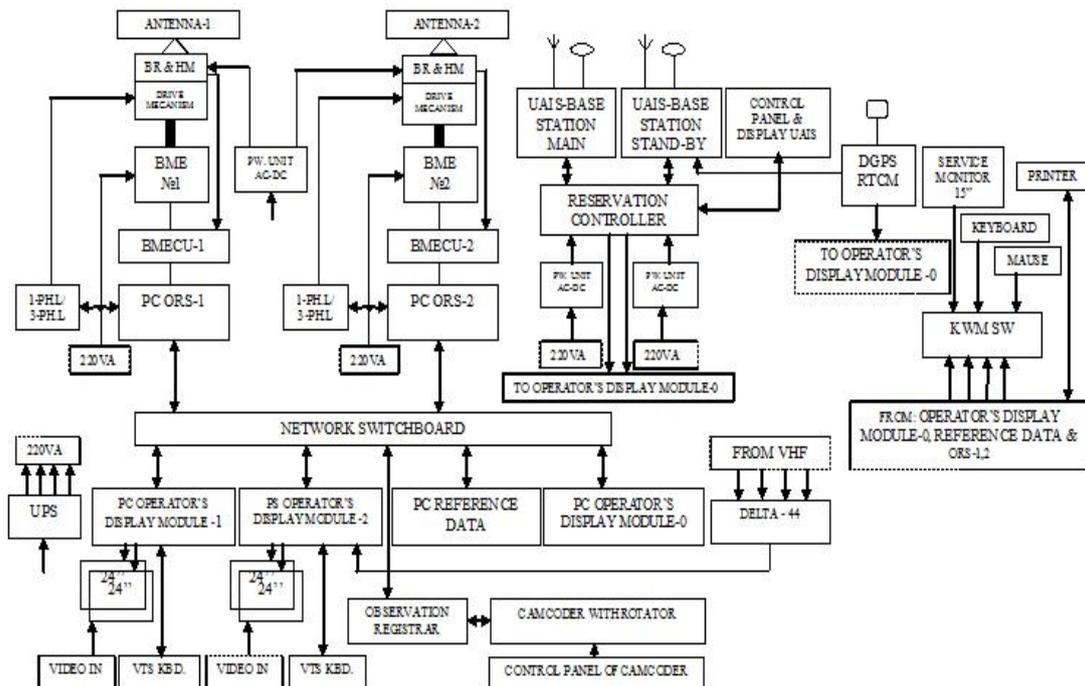


Figure 6. The bloc scheme VTS-Navi Harbour Port Kulevi

### 3.2 VTS - NAVI HARBOUR OF PORT KULEVI

For provision of complex system of safety of navigation of tankers on the channel and to moorings of the terminal, VTS - NAVI HARBOUR of port Kulevi was created, including the following equipment and elements (see fig. 6):

- Radar station - Bridge Master-E with the radar processor;
- The registrar VHF VTS Audio;
- Server reference data VTS (VTS Information System);
- Server VTS;
- The equipment of operator VTS - Monitor TFT 24 ", the PC of the workstation, the specialized keyboard of operator VTS, Software operators display module Navi Harbour (see fig. 7);
- System of TV observation VTS consisting of - CCTV camcorder VTS of 120 mm, with rotator and control panel, TV monitor TFT 20 ", observation registrar (CCTV) (see fig. 8);
- Base station DGPS Trimble DCM232;
- Base station Transas Redundant UAIS;
- VHF VTS - ICOM-M602 and ICOM-A110 for communication with aircrafts;

- Coastal station GMDSS A1- 16/70 channel -2x RT4160, DSC modem T500.



Figure 7. Workstation of operator VTS



Figure 8. System of TV observation VTS

Recommended tracks pass in distance 8-10 miles from coast and there are no navigating dangers near them. According to Resolution IMO A.529 the area of navigation is related to a voyage stage - «approaches to ports». Under the calculations and the analysis of the received indicators carried out for, the following conclusion was made for recommended entering tracks: the visual navigation aids do not provide necessary accuracy of position fixing during navigation on the channel. Necessary accuracy of position fixing is possible only by using sector leading light, floating navigating protections and VTS - NAVI HARBOUR.

### 3.3 ANALYSIS OF HUDRO METEOROLOGICAL CONDITIONS

The analysis of hydrometeorological characteristics showed, that the limiting factor, influencing on the safety of navigation and effective operation of hydraulic engineering constructions of port Kulevi, is the excitement arising mainly at action of winds of the westerly.

Thus, at an initial stage wind conditions of the given area were carefully analyzed.

The analysis of wind conditions showed, that the basic wave creating winds are winds of the westerly. The winds of easterly are coastal and do not render essential influence on a wave situation (see fig.9).

The most dangerous, from the point of view of safety of navigation, are winds of the western and southwest directions due to the big dispersal of waves (see table 3). At moderate and rough sea on approaches to a mouth of the river Khobi the tied rip is formed. At rough sea in a mouth of the river it is observed tyagun.

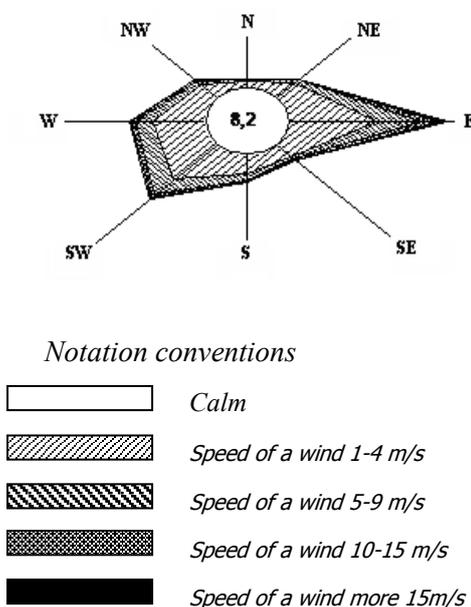


Figure 9. Annual wind rose

### 4 FEATURES OF ENTRANCE AND EXIT OF VESSELS TO PORT KULEVI

In-coming channel of port Kulevi has the following data: length - 2.3 miles;

Distance from receiving buoy up to swinging pool - 1.2 miles; diameter swinging pool - 500 meters; distance from the centre swinging pool up to an entrance to port - 5.7 cables.

For a safe entrance and exit of vessels at least 3 tugs are used.

The entrance is carried out on a technological card of enter and mooring (see fig. 10):

- Entering vessel accepts the pilot at receiving buoy (OMT2) and under supervision of operator VTS begins to move on an axis of the channel with maximum critical speed of 4-5 knots.
- For fast repayment of headway of a vessel, during its move to swinging pool to pass stern towing line on a tug.
- On arrival of a vessel to the swinging pool its inertia decreases, and turn of a vessel begins through the starboard (position 1,2) with the help of two tugs and bow thruster (if those are at entering vessel).
- A vessel is swinging 180° (position 3, 4), then the stern tug starts to tighten a vessel to stern in a direction to a mooring (a position 5).

The exit of a vessel is carried out without any difficulties as a vessel stands bow outward at a mooring. It is necessary to make small efforts from the bow and stern to withdraw a vessel using tugs from a mooring and it immediately appears on a channel axis and in its own power exits outward moving on the channel to receiving buoy under the direction of the pilot and operator VTS.



Figure 10. Technological card of enter and mooring tankers of Kulevi port

Table 3. Wind directions & speed in harbourage of Kulevi port

Speed of a wind m/s	Direction										Total
	-	N	NE	E	SE	S	SW	W	NW		
Calm	8.2	-	-	-	-	-	-	-	-	-	8.2
1-4	-	1.7	5.0	17.3	4.2	4.6	12.2	10.4	4.5	59.9	
5-9	-	0.3	1.1	8.7	0.9	1.8	5.3	3.4	1.3	22.8	
10-15	-	-	0.1	3.4	0.1	0.5	1.1	0.9	0.3	6.4	
More 15	-	-	0.1	1.9	-	0.1	0.2	0.3	0.1	2.7	
Total	8.2	2.0	6.3	31.3	5.2	7.0	18.8	15.0	6.2	100	

## 5 CONCLUSIONS

It is possible conclude, that prospect of development of port Kulevi from the point of view of safety navigation, its economic feasibility and also effective operation of hydraulic engineering:

- In connection with that buoys, bordering width of the channel are established on depths of 8-12 meters, and their anchor cables length is 30 meters. They drift under the influence of current, the width of the channel varies and a basis of safe movement of a vessel in the channel is orientation with help VTS - NAVI HARBOUR.
- In area of port Kulevi dynamics of the sediments is caused, basically, a firm drains of the river
- Khobi. The basic sedimentation of deposits occurs on internal water area, and also on a site entering channel in 0-700 meters, that is why it is necessary to carry out measurements of depths per 2 weeks and after each storm.
- The most dangerous, from the point of view of safety of navigation, are a wind of the western and southwest directions. It is expedient to carry out the complex analysis of hydrometeorological characteristics in area of port Kulevi with the purpose of development of an optimum variant of the protective constructions, allowing to increase

a degree of navigating safety at navigation on water area, and also to increase efficiency of its operation.

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